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Practical Wireless

JUNE 1982

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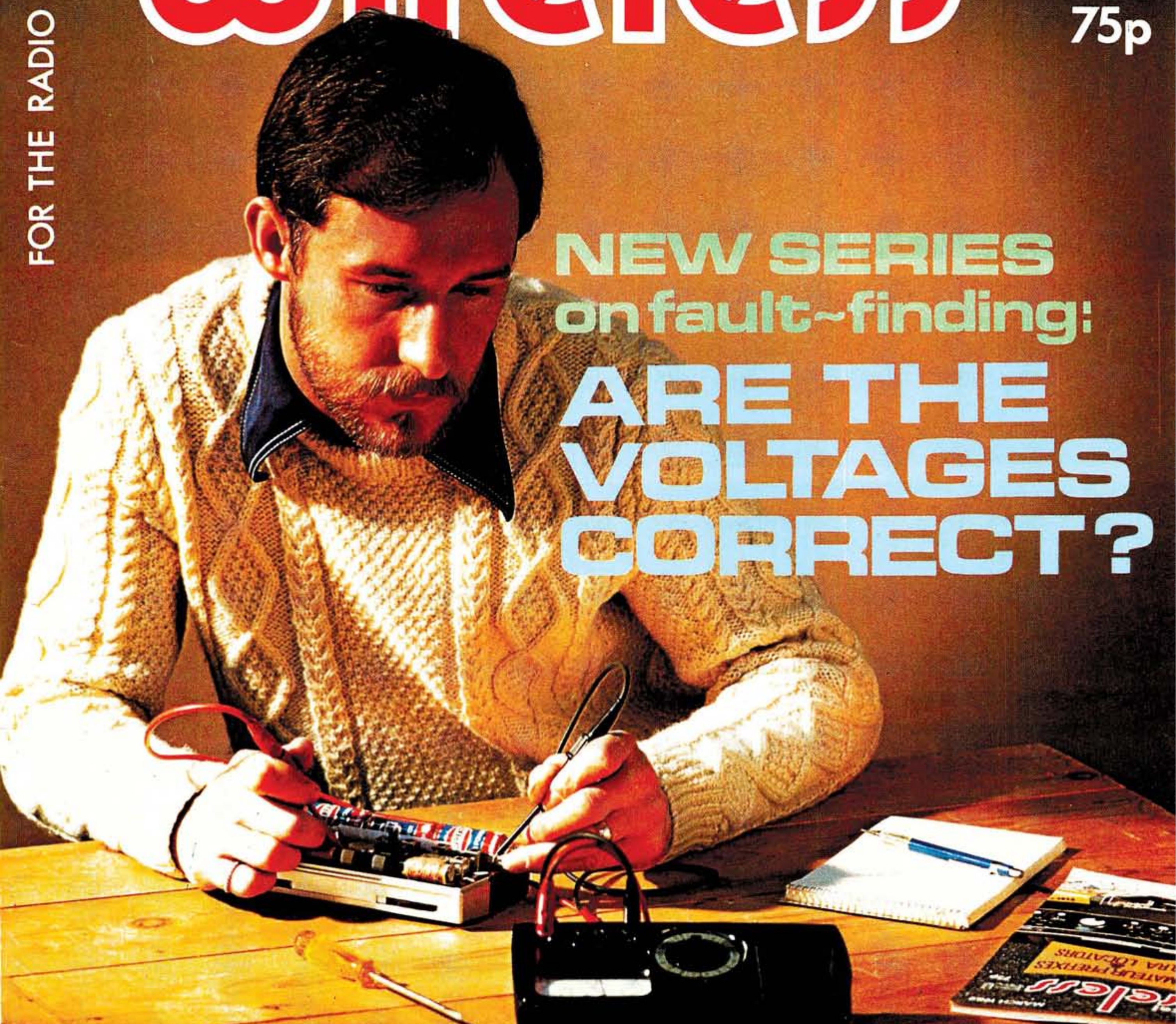

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Practical Wireless

JUNE 1982 VOL. 58 NO. 6 ISSUE 903

contents

pacesetter in amateur radio **NEW HF**

the TS 930S

With the advent of amateur band transceivers/general coverage receivers in one package, the question all the inquiring Trio owners asked was "when will Trio produce their answer/equivalent to the FT-one?". We are delighted to say that it's here right now and, if previous experience is anything to go by, Trio have got it right first time (as always).

The basic package is apparently straightforward. The TS930S is all solid state, gives 120W out from transistors run from a 28V supply for "better than the rest" linearity; covers all amateur bands and general coverage from 150 KHz to 30 MHz; uses a built in power supply; has digital readout; has twin VFO and multi channel memory facilities and so on and so on.

What makes the TS930S stand out from the rest is, once again, the Trio attention to detail. I have always said, Trio design their equipment to be used by the average amateur, whereas some rigs look like the control panels for the space shuttle. The acid test is to sit down in front of the TS930S and compare it *in use* to anything else. Notice how the RF and AF gain controls are together, as are the mic gain and carrier level controls.

Need the variable bandwidth? Trio have come up with the most versatile system ever, with completely independent adjustments for the upper and lower sides of the filter passband, so you can have any bandwidth you like anywhere around the signal you want – think about it.

Now switch on and operate on 14 MHz. So simple, just touch the button marked 14. Need to go to 21? Just push the button marked 21. Compare that to some rigs which need four hands and a degree in computing science to even get switched on!

What about general coverage? Equally simple using the 1 MHz step buttons. If you are on 14 MHz and you need to listen to the 15 MHz broadcast band just touch the 1 MHz UP button and there you are. Keep going and you step right through the spectrum in 1 MHz bands.

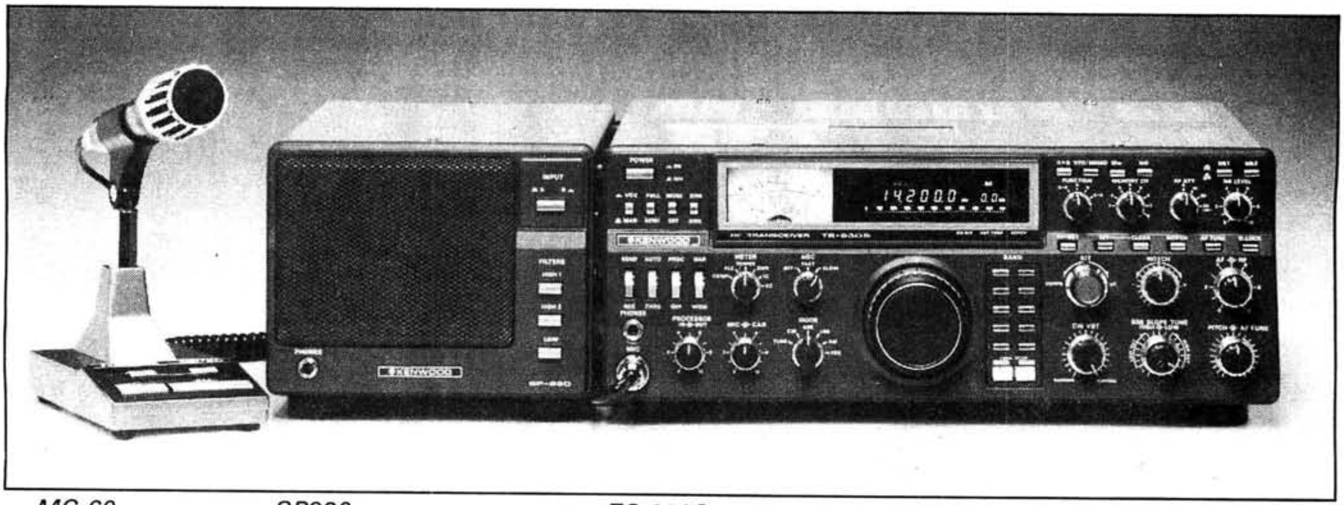
Now just mention some of the other features, look at the display which is bright white on a black background. Frequency readout is to 100 Hz whilst the synthesiser tunes in 10 Hz steps for true "VFO feel". Also included in the display are an analogue dial and the R.I.T. offset in KHz away from dial frequency.

The memory facilities not only remember frequency but also mode in use, and because of the operating simplicity of the TS930S, you don't have to fill the memories with the amateur bands. RF speech processing is fitted together with tunable audio filtering and full break in keying for the real CW operator. The noise blanker system has switchable gate times to cope with not only impulse noise but also the infamous "woodpecker". *And it works.*

Finally, there is provision for fitting *internally* a fully automatic aerial tuner for the amateur bands.

Alan, just back from Tokyo where he tried out the 930, is walking about in a daze muttering, "I've got to have the first one." Judging by his impressions of the rig, it's simply fabulous and we can't wait. By the time you read this, we should have them on show (and in use), so come, see, try out the *new leader in HF* rigs. The family is now completed from TS130S/V through TS530S, TS830S to the amazing TS930S. There is now a rig to suit everyone in the Trio range.

TS 930S £1078.00 inc VAT
AT 930 £125.00 inc VAT
carriage £5.00



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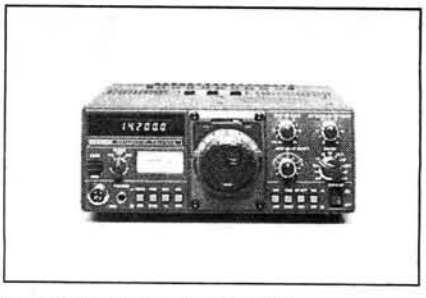

TS 130S
£529.09 inc VAT carr £5.00

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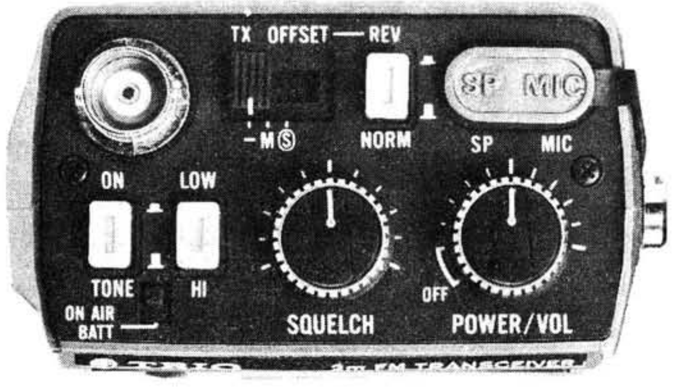
NEW VHF

TRIO

The TR-2500 is a compact 2 meter FM handheld transceiver featuring an LCD readout, 10 channel memory, lithium battery memory back-up, memory scan, programmable automatic band-scan and Hi/Lo power switch.



TR-2500 FEATURES:

● Extremely compact size and light weight 66 W × 168 H × 40 D, mm, 540 g, with Ni-Cd pack. ● LCD digital frequency readout, with memory channel and function indication. ● Ten channel memory, includes "MO" memory, for non-standard split frequencies. ● Lithium battery memory back-up, built-in, saves memory when Ni-Cd pack discharged. ● Memory scan, stops on busy channels, skips channels in which no data is stored. ● UP/DOWN manual scan in 5 KHz steps. ● 2.5 W or 300mW RF output. (HI/LOW power switch.) ● Programmable automatic band scan allows upper and lower frequency limits and scan steps of 5 KHz and larger (5, 10, 15, 20, 25, 30 Khz . . . etc) to be programmed. ● Repeater reverse operation. ● Optional power source, MS-1 mobile or ST-2 AC charger/power supply allows operation while charging. (Automatic drop-in connections.) ● Battery condition indicator. ● Two lock switches for keyboard and transmit. ● Flexible rubberized antenna with BNC connector. ● 400 mAH heavy-duty Ni-Cd battery pack. ● AC charger.

OPTIONAL ACCESSORIES:

● ST-2 Base station power supply and quick charger (approx. 1 hr.) ● MS-1 13.8 VDC mobile stand/charger/power supply. ● SMC-25 Speaker microphone. ● PB-25 Extra Ni-Cd battery pack, 400 mAH, heavy-duty.

the TR2500

£207.00 inc VAT Securicor Carriage £5.00

NEW UHF VHF

With the arrival of the TS780, the dual bander rig has come of age, giving the two band multimode facilities of the original concept, plus a wealth of additional operating facilities. Taking a trip across the front panel of the rig we have the repeater facilities, a non-locking tone switch, ideal now that most repeaters are tone accessed and carrier maintained. The tone, of course, only works whilst the rig is in the FM mode. Below the tone switch is the TX offset switch giving plus or minus 600 KHz or 1.6 MHz, depending on whether 2 metres or 70 cm is selected and last, but certainly not least, reverse repeater – to my way of thinking proof that the TS780 was designed for amateurs by amateurs.

The meter functions on receive as S. meter, ALC meter or as a centre meter, the functions being controlled from a panel switch. On transmit the meter reads relative RF output. Immediately above the digital frequency and memory/VFO indicator are indicating leds: a "busy" led indicating in FM mode whether the squelch is open thereby, assuming the squelch level is correctly set, that the other station is transmitting. A "frequency lock" led tells that the F lock switch is pressed and the VFO knob inoperative. The "on air" led indicates the rig is transmitting and the "offset" led reminds you that the TX offset switch is set to repeater.

The memory operation has been updated: instead of having to progressively move through the memory content in sequence, by means of a rotary switch any of the ten memories (two more than the TS770's) can be selected at will. Entering frequencies into the memory is easier, as anyone who has a TS770 series will explain. Two priority frequencies are included: 9 and 10. Push buttons to the left of the VFO knob allow either of the two programmed frequencies to be quickly selected, immediately cancelling the previous instructions given to the rig. Just the thing for local net frequencies. SSB mic gain needs no explanation, as does the AF/RF gain control.

On the same control knob as the squelch level is a switch enabling the frequency width of scan to be determined. Briefly, when the rig is set to scan either in FM, FM step or SSB mode you can determine the amount of band to be covered.

The ranges are 0.5, 1, 3, 5 and 10 MHz, thus you can limit the rig to scan just the section of the band used by the mode you have selected. Example: scan width 0.5 MHz, VFO set at 144.000, coverage – 144.000 to144.5, mode side band – result: free scanning of the SSB portion of the band. On FM the scan locks if a signal is present. On SSB the scan does not stop but you are made aware that there is activity on the band.

Another new control on the TS780 is the IF shift. Available for some time on HF equipment to cope with crowded band conditions, obviously the Trio design engineers have recognised that the 2 metre SSB end of the band can become crowded during contests or when there is "a bit of a lift on". At these times a rig that has the "IF shift" facility will certainly "score points".

The send/receive Vox/Man, meter function, NB, low/high power switches are all well known and have been found on previous generations of Trio base station equipment and again require no explanation. I could say the same thing about the mode switch but here you will notice alongside the standard FM position another marked FM CH. Put the mode switch in this position and instead of a free-running VFO you have a mechanical "click" step feel, the frequency now moving in either 12.5 KHz or 5 KHz steps. Of course the rig will also scan in these steps, controlled either by the scan switch or the up/down shift microphone. Again the Trio amateurs who design the equipment have here a major triumph.

By now you may be seeing why I am so enthusiastic about the TS780 but there is still more to come. How about a memory scan system that will scan either the 2 metre frequencies stored in the memory or the 70 cm ones or, if you wish, both. Well that's another feature of the TS780. Add to this list variable VFO steps of either 20 Hz or 200 Hz, a selectable braked feel to the VFO knob, rapid up and down MHz switching and you have the most comprehensive rig ever seen.

Too complicated some may say. Rubbish say I. Trio thrive on rigs designed to be simple to operate. Do you remember what John wrote in Radcom about the TR7500 and its competitors? And, finally, how about a rig that without resorting to a MHz switch will, by use of the VFO knob, tune from 144 to 146 MHz and from 430 to 440 MHz – only one rig –

the TS780

£748 inc VAT carr £5.00

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ICOM's answer to your HF mobile problems – the IC-730. This new 80m-10m, 8 band transceiver offers 100W output on SSB, AM and CW. Outstanding receiver performance is achieved by an up-conversion system using a high IF of 39MHz offering excellent image and IF interference rejection, high sensitivity and above all, wide dynamic range. Built in Pass Band Shift allows you to continuously adjust the centre frequency of the IF pass band virtually eliminating close channel interference. Dual VFO's with 10Hz and 1KHz steps allows effortless tuning and what's more a memory is provided for one channel per band. Further convenience circuits are provided such as Noise Blanker, Vox, CW Monitor, APC and SWR Detector to name a few. A built in Speech Processor boosts talk power on transmit and a switchable RF Pre-Amp is a boon on todays crowded bands. Full metering WWV reception and connections for transverter and linear control almost completes the IC-730's impressive facilities.

ICOM produce a perfect trio in the UHF base station range, ranging from 6 Meters through 2 Meters to 70 cms. Unfortunately you are not able to benefit from the 6m product in this country, but you CAN own the IC-251E for your 2 Meter station and the 451E for 70 cms.

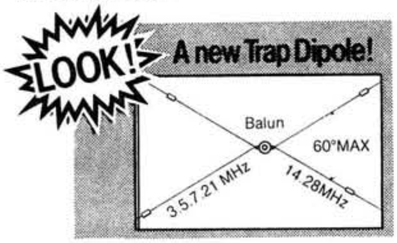
Both are really well designed and engineered multi-mode transceivers capable of being operated from either the mains or a 12 volt supply. Both contain such exciting features as scan facilities, automatic selection of the correct repeater shift for the band concerned, full normal and reverse repeater operation, tuning rate selection according to the mode in use. VOX on SSB continuous power adjustment capability on FM and 3 memory channels. Of course they are both fitted with a crystal controlled tone burst and have twin VFO's as have most of ICOM's fully synthesized transceivers.

The famous IC-240 has been improved, given a face lift and renamed the IC-24G. Many thousands of 240's are in use, and its popularity is due in part to simplicity of operation, high receiver sensitivity and superb audio on TX and RX. The new IC-24G has these and other features. Full 80 channels (at 25kHz spacing) are available and readout is by channel number – selected by easy to operate press button thumbwheel switches. This readout can clearly be seen in the brightest of sunlight. Duplex and reverse duplex is provided along with a 12½ KHz upshift, should the new channel spacing be necessary.

Amazingly small, yet very sensitive. Two VFO's, five memories, priority channel, full duplex and reverse. LED S-meter, 25KHz or 5KHz step tuning. Same multi-scanning functions as the 290 from mic or front panel. All in all the best 2M FM mobile ICOM have ever made.

The TONO range of communication computers take a lot of beating when it comes to trying to read RTTY and CW in the noise. Others don't always quite make it!

Check the many facilities offered before you buy – especially look at the 9000E which also throws in a Word Processor. Previous ads have told you quite a lot about these products – but why not call us for further information and a brochure?



The MT-240X Multi-band trap dipole antenna (80m – 10m) is a superbly constructed antenna with its own Balun incorporated in the centre insulator with an SO239 connector. Separate elements of multi-stranded heavy duty copper wire are used for 80-40-15 and 20-10 Metres. Really one up on its competitors. £49.50 inc. VAT

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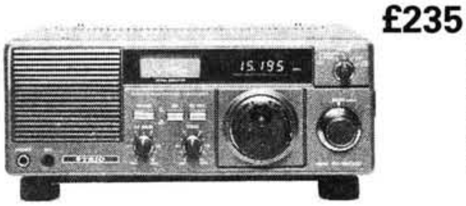

£235 If you're a beginner just starting out in radio you'll be delighted with the performance that the R600 offers you. Considering the electronics that are packed into this receiver, the price is remarkably low. A few years ago this performance would have cost you twice as much. Full digital readout and really simple tuning in of SSB signals makes this one of the few top receivers that the beginner should consider. With all the gloom and doom one hears about in the news these days, why not put a pair of headphones on your head, plug them into the R600 and whisk yourself away into the wonderful world of wireless. Signals from the Australian outback or the flying doctor, radio amateur expeditions on some remote Pacific island, signals from Russian amateurs or young American novices, the latest World news even before the BBC reports it, aircraft over the Atlantic, shipping distress frequencies; all this and much more is possible on this little receiver. So don't delay any further, send today for full details and introduce yourself to an exciting new hobby.

Sony are well known for the innovations and the new ICF2001 is no exception. This receiver covers the full spectrum from 200kHz to 30mHz plus the FM broadcast band. The clear LCD display gives precise frequency readout to 1kHz and the set has six memories for storing popular frequencies. Its diminutive size and complete portability means you can take it anywhere. Powered from internal dry cells it is just as happy on an executive desk as it is in the radio shack. The telescopic aerial gives very creditable performance together with built in aerial tuner. Plug in the external aerial and the World is at your finger tips. It handles both SSB and AM signals and with excellent FM reception can equally double as a domestic receiver. The dual speed electronic tuning and fine tune vernier control make this set a remarkable package at a price that is quite amazing. As the only officially appointed amateur radio Sony dealer in the UK we can give you the kind of after sales service that has made us second to none. **£149**

£319 The FRG7700 is for the advanced listener or for the enthusiast who demands the best in short wave reception. The receiver covers the complete spectrum 200kHz to 30mHz with a highly accurate digital display. The receiver offers excellent sensitivity and selectivity and has separate detectors for AM, FM and SSB, plus switched bandwidth on AM. Other controls include automatic gain control, noise blanker, attenuator, squelch, rf gain control and clock with timer. There is also facilities for fitting an optional 12 channel memory unit. The receiver runs from 230v AC mains or 12v DC and there is an optional aerial tuner to go with it. And if you are interested in VHF, there is a complete range of specially designed converters to go with the receiver that covers the amateur, aircraft and marine bands, etc. Why not send today for our coloured brochure and get to know more about what the FRG7700 has to offer.

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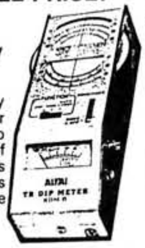

Here's a brand new Dip meter at a very competitive price. You won't find better value anywhere. Covering 1.8mHz to 250mHz it performs a host of measurements and will also function as a wavemeter which of course is required by the amateur radio licence regulations.

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Yours sincerely,
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R1	4.0284	8.0569	12.0854	14.9916	18.1281	44.9750
R2	4.0291	8.0583	12.0875	14.9944	18.1312	44.9833
R3	4.0298	8.0597	12.0895	14.9972	18.1343	44.9916
R4	4.0305	8.0611	12.0916	15.0000	18.1375	45.0000
R5	4.0312	8.0625	12.0937	15.0027	18.1406	45.0083
R6	4.0319	8.0638	12.0958	15.0055	18.1437	45.0166
R7	4.0326	8.0652	12.0979	15.0083	18.1468	45.0250
S8	—	—	12.1000	14.9444	18.1500	44.8333*
S9	—	—	12.1020	14.9472	18.1531	44.8416*
S10	—	—	12.1041	14.9500	18.1562	44.8500*
S11	—	—	12.1062	14.9572	18.1593	44.8583*
S12	—	—	12.1083	14.9555	18.1625	44.8666*
S13	—	—	12.1104	14.9583	18.1656	44.8750*
S14	—	—	12.1125	14.9611	18.1687	44.8833*
S15	—	—	12.1145	14.9638	18.1718	44.8916*
S16	—	—	12.1167	14.9667	18.1750	44.9000*
S17	—	—	12.1187	14.9694	18.1781	44.9083*
S18	—	—	12.1208	14.9722	18.1812	44.9166*
S19	—	—	12.1229	14.9750	18.1843	44.9250*
S20	4.0416	8.0833	12.1250	14.9777	18.1875	44.9333
S21	4.0423	8.0847	12.1270	14.9805	18.1906	44.9416
S22	4.0430	8.0861	12.1291	14.9833	18.1937	44.9500
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SR = Series Resonance
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	5	50	1.00 to 1.499 MHz		£6.00
	6	10	1.50 to 1.999 MHz	£4.75	£4.40
	7	10	2.00 to 2.599 MHz	£4.75	£4.40
	8	10	2.60 to 3.999 MHz	£4.55	£4.10
	9	10	4.00 to 20.999 MHz	£4.55	£4.00
	10	10	21.00 to 24.000 MHz	£6.00	£4.00
3rd OVT	11	10	21.00 to 59.999 MHz	£4.55	£4.50
5th OVT	12	10	60.00 to 99.999 MHz	£5.00	£5.50
	13	10	100.00 to 124.999 MHz	£6.15	£5.20
5th, 7th &	14	20	125.00 to 149.999 MHz	—	£6.00
9th OVT	15	20	150.00 to 225.00 MHz	—	£7.50

Unless otherwise requested fundamentals will be supplied with 30pF load capacity and overtones for series resonance operation.

HOLDERS – Please specify when ordering – 10 to 200kHz HC13/U, 170kHz to 170MHz HC6 or HC33/U, 4 to 225MHz, HC18 and HC25.

Where holders are not specified crystals above 4 MHz will be supplied in HC25/U.

DELIVERY. Column A 3 to 4 weeks, Column B 6 to 8 weeks.

DISCOUNTS. 5% mixed frequency discount for 5 or more crystals at B delivery. Price on application for 10 or more crystals to same frequency specification. Special rates for bulk purchase schemes including **FREE** supply of crystals used in UK repeaters.

The above prices apply to small quantities of crystals for amateur use. We would be pleased to quote for larger quantities or crystals for professional use.

EMERGENCY SERVICE SURCHARGES (To be added to A delivery prices) 4 working days £12, 6 working days £7, 8 working days £5, 13 working days £3. Surcharges apply to each crystal not each order and are subject to VAT.

CRYSTAL SOCKETS HC6/U and HC25/U **20p**. MINIMUM ORDER CHARGE **£1.50**.

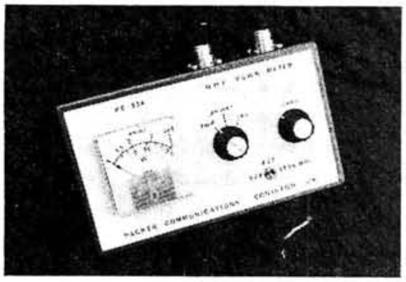
TERMS. Cash with order, cheques and postal orders payable to QSL Ltd. All prices include postage to UK and Irish addresses. Please note Southern Irish cheques and postal orders are no longer acceptable. Please send bank draft in pounds Sterling.

PRICES ARE EX VAT. PLEASE ADD 15%

QSL QuartSLab MARKETING LTD. P.O. BOX 19, ERITH, KENT, DA8 1LH
Telephone: 01-690 4889 (9-5) 24hr Ansafone: Erith (03224) 30830
Telex: 8813271 GECOMS G (Attention Quartslab).

NEW! THE PC-934A UHF VSWR/POWER METER

Developed for the 934MHz business/Citizens Band the PC-934A is the only BRITISH UHF VSWR meter that covers both the 70cm and 23cm amateur bands.



Technical Data:
Usable on 2m, 70cm, 23cm AND 13cm
Max VSWR 3:1
Max Power 25W (100W on VSWR)
BNC for N connectors

Special offer PC-934A **£44.25** inc VAT p&p

Other Packer Products:–

Just pass your RAE? You need a wavemeter

WM-2 130-300 MHz for 2m **£22.45**
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Match that Antenna! Get the most from your rig.

AT-145 2m ATU hundreds now in use SO239 sockets **£19.95**
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Access Visa American Express **YAESU Dealer, ring us for quote.**

Allow 14 days for delivery.

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Telephone: 096 64 678.

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ALL COMPONENTS ARE FULL SPECIFICATION AND CARRY A 10 DAY MONEY BACK GUARANTEE

INTEGRATED CIRCUITS

TAA661B	**0.60**
TBA820	**0.50**
TDA1083	**0.75**
DS8871	**0.25**
DS8874	**0.27**
CD4007	**0.10**

DISPLAYS

TIL313P	**0.50**
8 DIGIT L.E.D. 0·1"	**0.35**
9 DIGIT L.E.D. 0·1"	**0.40**
8 DIGIT L.E.D. NSA1582	**0.40**
9 DIGIT L.E.D. NSA1298	**0.45**
9 DIGIT FLUORESCENT FG95A	**0.50**

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BFR79	**0.16**
PN2222	**0.06**

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AEG DS-100W 2" C.R.T.	**7.20**
P4 PHOSPHOR, 35mW HEATER BASE FOR C.R.T.	**0.25**

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CAR CIGARETTE ADAPTOR

FUSED WITH LEAD AND PLUG	**0.45**

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SIEMENS Q15 CUBE CORE T26, AL400	**0.47**
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BATTERY HOLDER

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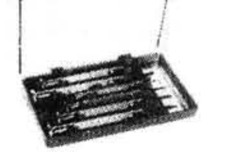
BI-PAK BARGAINS



5T21 SCREWDRIVER SET
6 precision screwdrivers in hinged plastic case. Sizes – 0.8, 1.4, 2, 2.4, 2.9 and 3.8mm **£1.75**

5T31 NUT DRIVER SET
5 precision nut drivers in hinged plastic case With turning rod. Sizes – 3, 3.5, 4, 4.5 and 5mm **£1.75**

5T41 TOOL SET
5 precision instruments in hinged plastic case Crosspoint (Phillips) screwdrivers – H 0 and H 1 Hex key wrenches – 1.5, 2 and 2.5mm **£1.75**

5T51 WRENCH SET
5 precision wrenches in hinged plastic case Sizes – 4, 4.5, 5, 5.5 and 6mm **£1.75**

BUY ALL FOUR SETS 5T21-5T51 and get HEX KEY SET **FREE**
HEX KEY SET ON RING
Sizes 1.5, 2, 2.5, 3, 4, 5, 5.5 and 6mm
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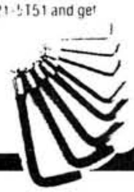
HX/1 **£1.25**



BRAND NEW LCD DISPLAY MULTITESTER.

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LCD 10 MEGOHM INPUT IMPEDANCE
*3½ digit *16 ranges plus hFE test facility for PNP and NPN transistors *Auto zero, auto polarity *Single-handed, pushbutton operation *Over range indication *12.5mm (½-inch) large LCD readout *Diode check *Fuse circuit protection *Test leads, battery and instructions included

Max indication	1999 or – 1999
Polarity indication	Negative only Positive readings appear without + sign
Input impedance	10 Megohms
Zero adjust	Automatic
Sampling time	250 milliseconds
Temperature range	– 5°C to 50°C
Power Supply	1 x PP3 or equivalent 9V battery
Consumption	20mW
Size	155 x 88 x 31mm

RANGES
DC Voltage 0-200mV
0-2-20-200-1000V. Acc 0.8%
AC Voltage 0-200-1000V
Acc 1.2% DC Current 0-200uA
0-2-20-200mA 0-10 A Acc 1.2%
Resistance 0-2-20-200K ohms
0-2 Megohms Acc 1%
BI-PAK VERY LOWEST POSS PRICE
£35.00 each

"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty.*	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
SX11	400	Pre-formed ¼-½ watt Carbon Resistors	£1
SX12	200	⅛ watt Carbon Resistors	£1
SX13	200	¼ watt Carbon Resistors	£1
SX14	150	½ watt Resistors 22 ohm-2m2 Mixed	£1
SX15	100	1 and 2 watt Resistors 22 ohm-2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to cover your projects.
*Quantities approximate, count by weight

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty.*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 1pf-56pf	£1
SX19	100	Mixed Ceramics 68pf-0.5mf	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics 50-1000mf	£1
SX24	20	Tantalum Beads, mixed	£1

*Quantities approximate, count by weight.

AUDIO PLUGS, SOCKETS AND ACCESSORIES

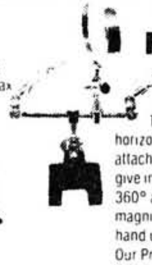
25 pieces of Audio Plugs, Sockets and Connectors to include DIN 180°-240°, Inline 3-6 Pin, Speakers, Phono, Jack, Stereo and Mono, etc. etc. Valued at well over £3 normal. Order No. SX25 Our Price £1.50 per pak. Guaranteed to save you money

SX26	3 Prs. of 6 pin 240° DIN Plugs and Chassis Sockets	50p
SX27	1 x Right Angle Stereo Jack Plug 6.3mm plus matching metal chassis mounting socket	30p
SX28	4 Phono plugs and 2 dual phono connectors	30p
SX29	1 x 2.5mm Plug to 3.5mm Socket adaptor	20p
SX30	1 x 3.5mm Plug to 2.5mm Socket adaptor	20p
SX31	1 x 3.5mm Plug to Phono Socket adaptor	20p

BARGAINS

SX91	20 x Large .2" RED LED	£1
SX42	20 small .125 Red LED's	£1
SX43	10 Rectangular Green LED's .2	£1
SX46	30 Assorted Zener Diodes 250mw-2 watt mixed voltages, all coded. New	£1
SX47	4 Black Instrument Knobs—winged with pointer ¼" Standard screw. Fit size 29 x 20mm.	50p
SX49	20 Assorted Slider Knobs Black/Chrome, etc.	£1
SX80	12 Neons and Filament Lamps. Low voltage and mains — various types and colours — some panel mounting	£1

MINI VICE
This small cast iron quality made vice will clamp on to any bench or table having a max thickness of 1⅛". The 2½" jaws open to max of 1⅝". Approx size 80 x 120 x 66mm. Bi-Pak's Mini Vice at a Mini Price only
£2.50
ORDER NO. SX82



The Third and Fourth Hand...

.... you always need but have never got until now. This helpful unit with Rod mounted horizontally on Heavy Base. Crocodile clips attached to rod ends. Six ball & socket joints give infinite variation and positions through 360° also available attached to Rod a 2½ diam magnifier giving 2.5 x magnification. Helping hand unit available with or without magnifier. Our Price with magnifier as illustrated ORDER NO. T402 **£5.50**
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MONO PRE-AMPLIFIERS

MM100 suitable for disco mixer. MM100G suitable for guitar pre-amp mixer.
The MM100 and MM100G mono pre-amplifiers are compatible with the AL60, AL80, AL120 and AL250 power amplifiers and their associated power supplies.
MM100 Supply voltage 40-65v inputs. Tape Mag P.U. Microphone Max output 500mv ~~£12.43~~ MM100G Supply voltage 40-65v inputs: 2 Guitars, Microphones Max output 500mv

each ~~£12.43~~ **£10**

SINGLE SIDED FIBREGLASS BOARD

Order No.	Pieces	Size	Sq.Ins.	Price
FB1	4	9 x 2¾"	100	£1.50
FB2	3	11 x 3"	100	£1.50
FB3	4	13 x 3"	156	£2.00

DOUBLE SIDED FIBREGLASS BOARD

Order No.	Pieces	Size	Sq.Ins.	Price
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NPN like 2N3055 — but not full spec
100 watts 50V min.
10 for £1.50 — Very Good Value
100s of uses — no duds
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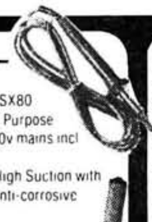

BI-PAK SOLDER – DESOLDER KIT

Kit comprises. ORDER NO. SX80
1 High Quality 40 watt General Purpose Lightweight Soldering Iron 240v mains incl 3/16" (4.7mm) bit
1 Quality Desoldering pump. High Suction with automatic ejection. Knurled, anti-corrosive casing and teflon nozzle.
1.5 metres of De-soldering braid on plastic dispenser
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1 Heat Shunt tool tweezer Type
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OUR SPECIAL KIT PRICE **£8.95**

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Complete PCB Kit comprises
1 Expo Mini Drill 10,000RPM 12v DC incl 3 collets & 1 x 1mm Twist bit
1 Sheet PCB Transfers 210mm x 150mm
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1 ½lb pack FERRIC CHLORIDE crystals
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Full instructions for making your own PCB boards
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OUR BI-PAK SPECIAL KIT PRICE **£9.75**
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Universal Ni-Cad battery charger. All plastic case with lift up lid. Charge/Test switch. LED indicators at each of the five charging points.

Charges –	Power –
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U12 (1.5V penlite)	Dims –
U11 (1.5V 'C')	210 x 100 x 50mm
U2 (1.5V 'D')	**£6.95**

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Power supply fits directly into 13 amp socket. Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug. Input – 240V AC 50HZ. Output – 3, 4.5, 6, 7.5, 9 & 12V DC. Rating – 300 ma. MW88

5 watt (RMS) Audio Amp

High Quality audio amplifier Module. Ideal for use in record players, tape recorders, stereo amps and cassette players, etc. Full data and back-up diagrams with each module.

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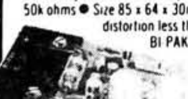
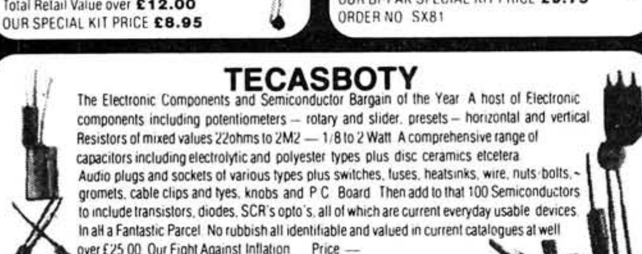
● Power Output 5 watts RMS ● Load Impedance 8-16 ohms ● Frequency response 50Hz to 25 KHz–3db ● Sensitivity 70 mv for full output ● Input Impedance 50k ohms ● Size 85 x 64 x 30mm ● Total Harmonic distortion less than 5%



BI PAK'S give away price
£2.25
You could not Build one for this price.



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The Electronic Components and Semiconductor Bargain of the Year. A host of Electronic components including potentiometers — rotary and slider, presets — horizontal and vertical. Resistors of mixed values 22ohms to 2M2 — 1/8 to 2 Watt. A comprehensive range of capacitors including electrolytic and polyester types plus disc ceramics etcetera. Audio plugs and sockets of various types plus switches, fuses, heatsinks, wire, nuts-bolts, gromets, cable clips and tyes, knobs and P.C. Board. Then add to that 100 Semiconductors to include transistors, diodes, SCR's opto's, all of which are current everyday usable devices. In all a Fantastic Parcel. No rubbish all identifiable and valued in current catalogues at well over £25.00. Our Fight Against Inflation
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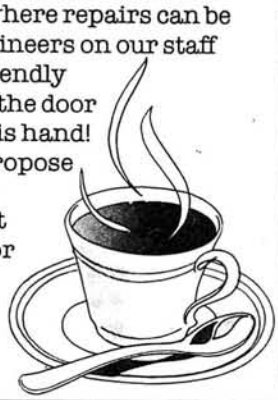
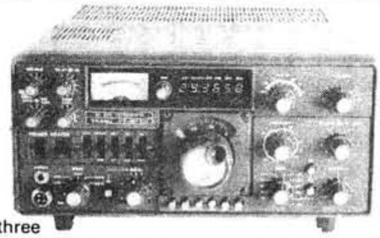
What's more, we now propose to go on giving Guarantee service not just for one but for **two years** on all major items of equipment.

Where else can you get that and a cup of Brenda's coffee too?



FT-101



Are you about to upgrade to an 'A' licence, or are you taking your G4 straight away? Either way, why not start listening right now on a **YAESU FT-101** transceiver? It's at least three ways better than the average general coverage receiver... better for selectivity, better for sensitivity, better for stability...

YAESU FT-290R TUNE-UP

- 3SK88 FET front end
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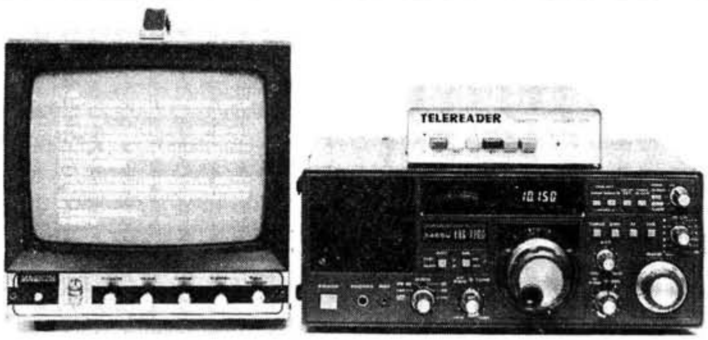
Yaesu's newest 2m FM mobile featuring special LCD illumination for clear readability under **all** lighting conditions from total darkness to direct sunlight.

Phone for price and full specification details, but other points to note are • 25W out • 10 memories, with select or scan facility

- Memory Recall and Priority Recall command switch
- 2 independent VFOs for working odd repeater splits etc.



Ever wanted to decipher all those funny morse code (CW) and radio teletype (RTTY) noises you hear on your communications receiver? Well, now you can – with the new TASCO telereader CWR-680.

Simply connect the input side of the Telereader to your receiver or transceiver, and the output either to a domestic TV (UHF) or to a proper VDU which we can also supply. RTTY and CW will be automatically demodulated and displayed on the screen, CW at speeds of up to 250 characters per minute, RTTY at between 45.5 and 110 Bauds.

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PB 203

Includes 5VDC, 1 amp power supply, available at binding posts, two binding posts (V1, V2) remain uncommitted. The perfect board for TTL and other 5 volt logic designs.

PB 203A

Every development engineer should have one of these, includes 5VDC, 1 amp power supply. Also includes separate + 5.5 to 18 VDC and − 5.5 to 18 VDC power supplies, each capable of supplying 500 mA at 15 VDC. Power supplies are factory preset to + − 15 VDC but can be independently adjusted.

PB 203AK

Identical to PB-203A but in kit form.

PB 6

A kit form breadboard with 4 binding posts, 630 contact points and includes non slip rubber feet.

PB 100

Another kit form breadboard with 760 contact points.

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PB 102

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PB102	1240	12	24.95	30.41	
PB103	2250	24	39.00	46.57	
PB104	3060	32	49.00	58.07	
PB105	4560	48	71.00	83.95	
PB203	2250	24	61.00	72.95	
PB203K	2250	24	89.00	104.65	
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FT ONE £1295 (inc. VAT)

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RX; 150 KHz-30 MHz. Continuous general coverage. TX; 160-10m (9 bands). 1.5-30 MHz commercial version is available.

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All modes: AM, CW, FM*, FSK, LSB, USB.
Tx and Rx on opposite sidebands possible.

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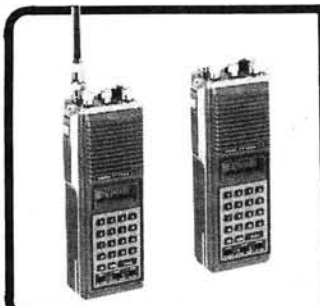

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Waiting

WE HAD HOPED that, by now (end of March), a revised schedule for the UK Amateur Licence would have been published. The latest information we have is that the schedule will appear in the *Gazettes* by mid-April, so it should be in operation before this issue of *PW* reaches the book-stalls.

Since our last issue, a few more anomalies have been noticed in the February 12 Schedule Revision announcement. The most obvious one, though I'm ashamed to say we didn't spot it, is that the announcement was addressed "To All Holders of Amateur (Sound) Licence A, etc.". In fact the UK Amateur Licence hasn't been called that for several years—not since the incorporation of TV operation into the main Licence and the suspension of the old G6 TV licences. Incidentally, in our Analysis on page 33 of the May issue, the reference under "15" to F1B should read F2B. Sorry about that. We've shot the gremlin!

The other anomalies concern the interpretations given under Section E in the Schedule, which do not correspond exactly with the internationally agreed versions in the *Radio Regulations.* (That's where e.i.r.p. originates from, by the way.) Whereas the Schedule talks in terms of "power supplied to the antenna", the *Radio Regulations* quote "power supplied to the antenna transmission line". These two differ in practical terms by the loss in the transmission line, which can be considerable.

When the February 12 Schedule was published, we took it as intending to allow for the loss in the coaxial feeder or whatever, which would be a help to those of us with less than ideal relative positions for antennas and transmitters. It has since been rumoured, though, that the intention was to specify the power level at the point where the feeder leaves the transmitter, on the principle that the feeder was part of the antenna (or antenna system).

Obviously it's desirable to keep feeder losses to a minimum, because specifying transmit power levels at the junction of the feeder and the antenna itself is no help at all when you are also looking for best sensitivity on receive.

Incidentally, for many new amateurs, and Class B Licence-holders who have passed their Morse test and applied for a Class A, the confusion over the new Schedule has meant months of delay in receiving the vital piece of paper.

Worse, for those in the latter category whose Class B licences have expired in the interim, is the fact that through no fault of their own, they have either had to pay twice (to renew their Class B whilst waiting for their Class A) or been put in the position of being effectively pirates. I think that it is quite immoral for the Home Office to collect more money as a result of its own inefficiency.

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.

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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.

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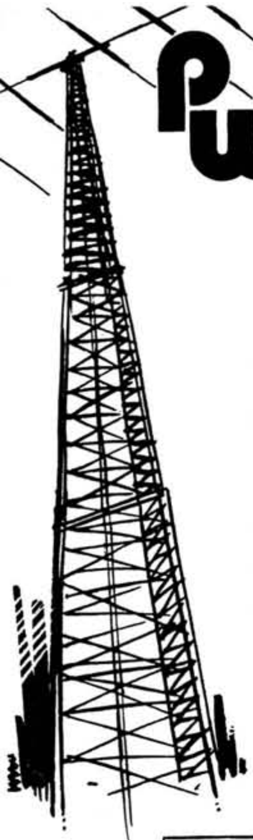

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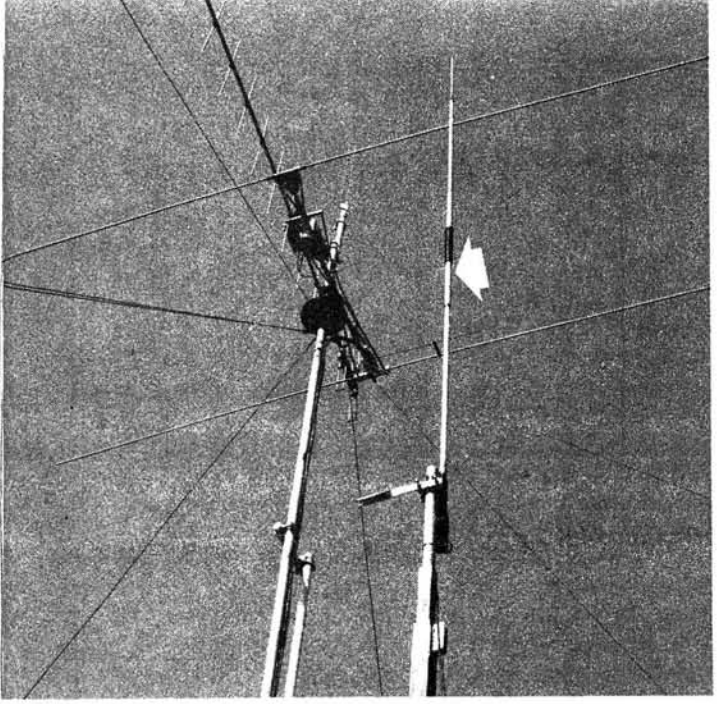


The 27MHz CB Radio Antenna ①

F.C. JUDD G2BCX

Although this article deals with antennas for 27MHz CB use, the technical aspects apply to all mobile h.f. antennas. It is not our intention to condone the use of any illegal antenna for CB and readers should take note of the fact that many of the designs shown here are illegal for CB use under the present legislation. Of course they can be easily scaled for other h.f. bands especially the 28MHz amateur band.

According to the CB Radio Licence (Schedule 3e) the only antenna that may be used for 27MHz f.m. operation **must** consist of a single rod or wire element not exceeding 1·5 metres long, inductively loaded at the base. The base-loading coil is necessary to obtain resonance and the requisite 50 ohm match to the transmitter output. *The loading coil otherwise plays no part whatsoever in radiation from the antenna itself.*

The original draft and later official publication, MPT1320, which deals with the Home Office requirements for 27MHz CB radio, mentioned only a 1·5 metre long rod or wire antenna and no information was given as to how this should be made resonant—or indeed made to function at all. However, the clause in the CB licence makes this clear and also imposes a height restriction on the antenna of 7 metres unless the transmitter power output is attenuated by 10dB.

Although 4 watts of power is allowed from the transmitter the licence states that only 2 watts may be radiated, i.e., the effective radiated power (e.r.p.) from the antenna must not exceed 2 watts with the antenna at a height of not more than 7 metres. There is no doubt that these restrictions have been imposed to limit the range over which 27MHz CB operators can establish contact.

It may not be generally realised that the "specified" antenna will not function without a ground-plane, be this a metal-bodied vehicle for mobile operation, or a system of radials of conducting elements to form a ground-plane where the application is for fixed or base station operation.

Although otherwise omni-directional, an antenna of this nature has an angle of maximum radiation that is high with respect to ground, another factor that puts some limitation on the working range over a ground path. In fact the high vertical angle of radiation assists very effectively in the reception of signals arriving under short-skip skywave conditions, particularly those from high-powered continental (notably Italian) CB stations using sideband transmission. This is making the now legal 27MHz f.m. CB band (27·6 to 27·9MHz) virtually useless during daylight hours because of the high level of interference it causes.

The Ground-plane Antenna

A true ground-plane antenna is one that has a highly conductive ground-plane of infinite dimension, a configuration otherwise impossible as a practical application, even at very high frequencies. The optimum omni-directional antenna for 27MHz would be a vertical half-wave dipole (or a vertical co-linear system) which being a "free space" antenna requires no ground-plane. If well constructed and accurately matched, this will have a radiation efficiency approaching 100 per cent, i.e. virtually all the power supplied to it would be radiated.

The perfect ground-plane antenna consisting of a quarter-wave radiator of full physical length and having an infinite ground-plane (Fig. 3 (a)), would also have a radiation efficiency approaching that of a half-wave dipole. Radiation would be similar, i.e. omni-directional, and the angle of maximum radiation would be about 5 degrees or almost parallel to ground. Unfortunately, a half-wave dipole, co-linear system, or full quarter-wave ground-plane is not allowed for CB operation in the UK.

If the ground-plane for a quarter-wave vertical antenna is made smaller, the vertical angle of the radiation pattern begins to tilt upward. The angle of maximum radiation is in the region of 25 degrees with a ground-plane system of radials each in the region of a half-wave in physical length (Fig. 3 (b)). Again, not a very practical proposition. When each radial is reduced to a quarter-wavelength, we do at least have a more practical condition from the constructional point of view, but the angle of maximum radiation is increased to around 35 degrees (Fig. 4 (a)) and radiation is further reduced along the all-important path parallel to ground. When the ground-plane is smaller still with reference to the wavelength and the radiating element itself is also made smaller (Fig. 4 (b)), matching and resonance become more critical, the angle of maximum radiation is even higher and at the same time radiation as a whole is reduced in amplitude. We are now approaching the configuration allowed by the Home Office for antennas intended for 27MHz operation.

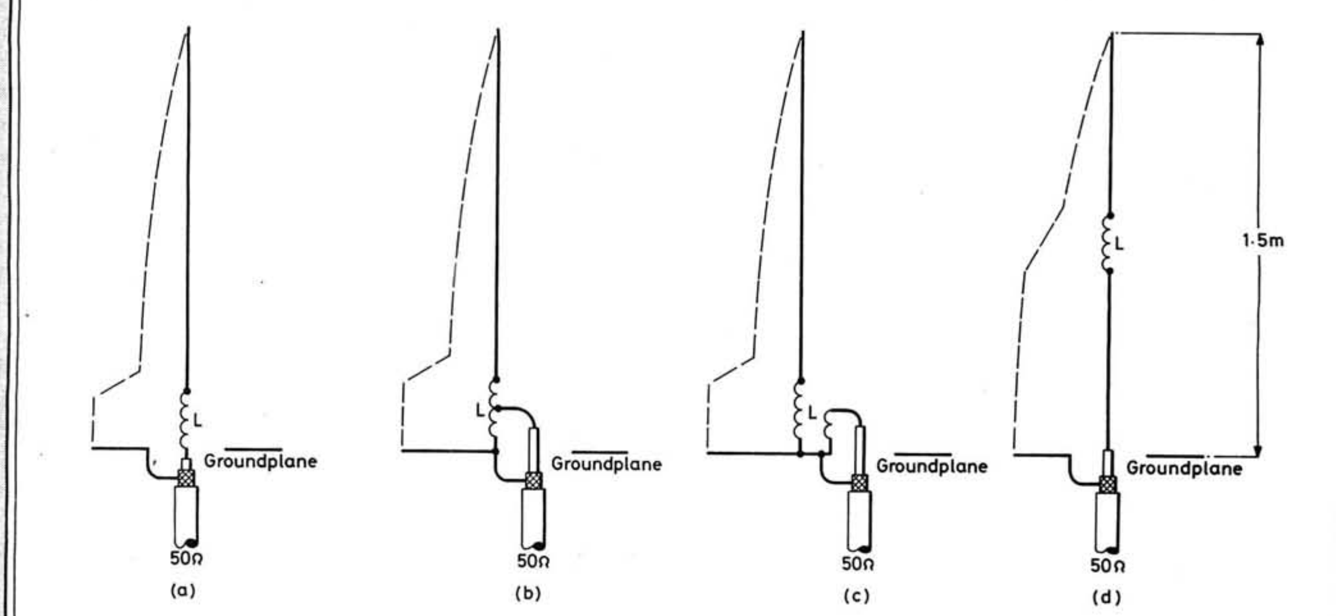


Fig. 1: (a) Series-fed antenna with inductive loading at the base. (b) Shunt-fed by tapping into the loading coil at the base. (c) Link coupled shunt-fed base coil. (d) Centre loaded series-fed (see text). N.B. only (a), (b) and (c) meet the Home Office requirements for CB antennas

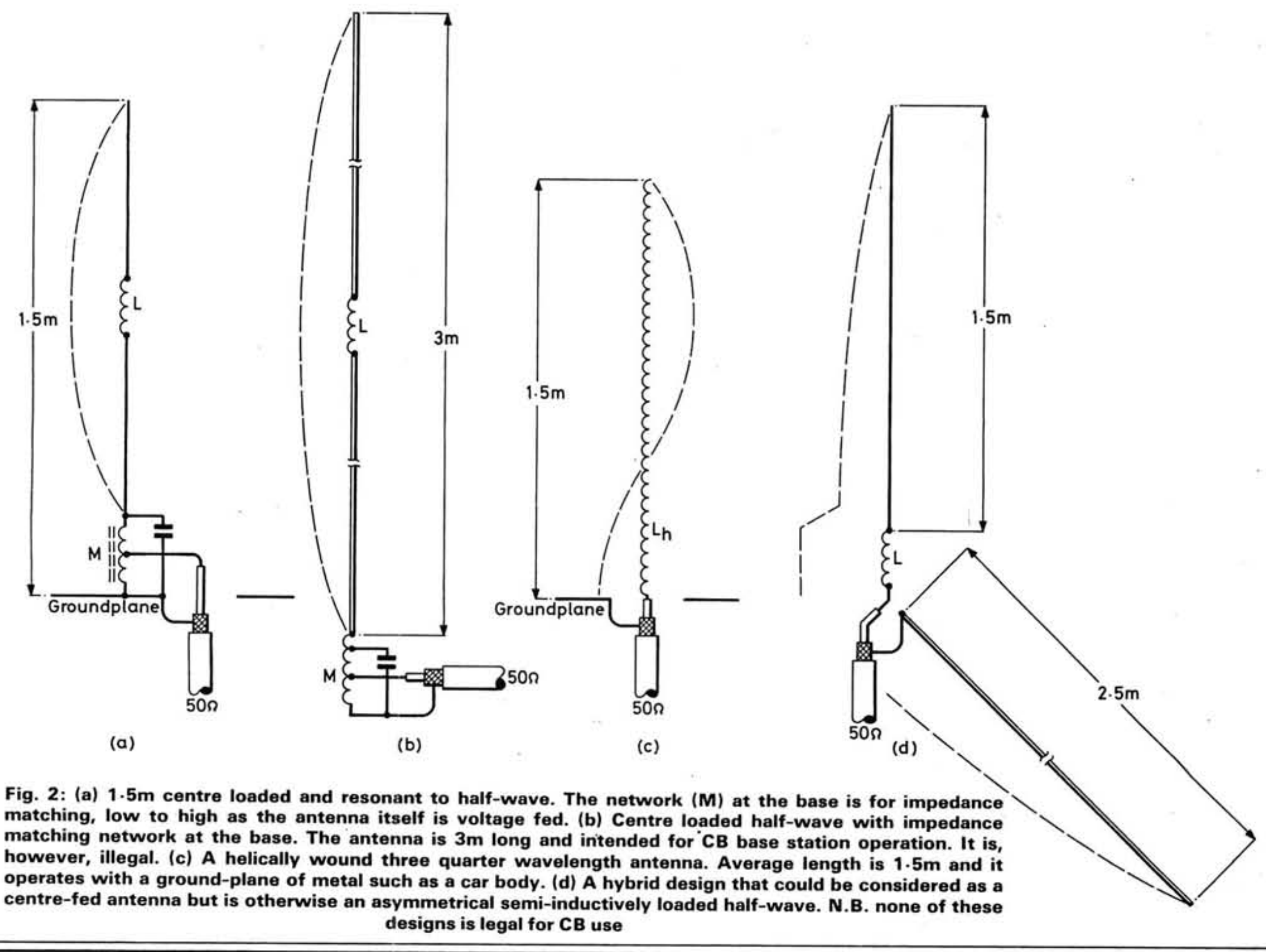


Fig. 2: (a) 1·5m centre loaded and resonant to half-wave. The network (M) at the base is for impedance matching, low to high as the antenna itself is voltage fed. (b) Centre loaded half-wave with impedance matching network at the base. The antenna is 3m long and intended for CB base station operation. It is, however, illegal. (c) A helically wound three quarter wavelength antenna. Average length is 1·5m and it operates with a ground-plane of metal such as a car body. (d) A hybrid design that could be considered as a centre-fed antenna but is otherwise an asymmetrical semi-inductively loaded half-wave. N.B. none of these designs is legal for CB use

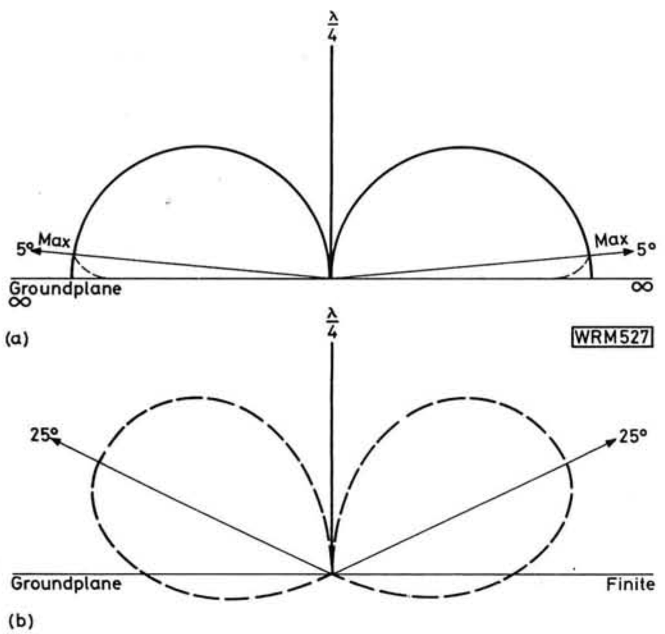


Fig. 3: (a) Vertical angle radiation pattern of a quarter-wave vertical antenna over a perfectly conducting ground-plane of infinite dimension. (b) When the ground-plane is of some infinite dimension, e.g. one wavelength and consists of a number of radials, the vertical angle of maximum radiation is tilted to about 25 degrees

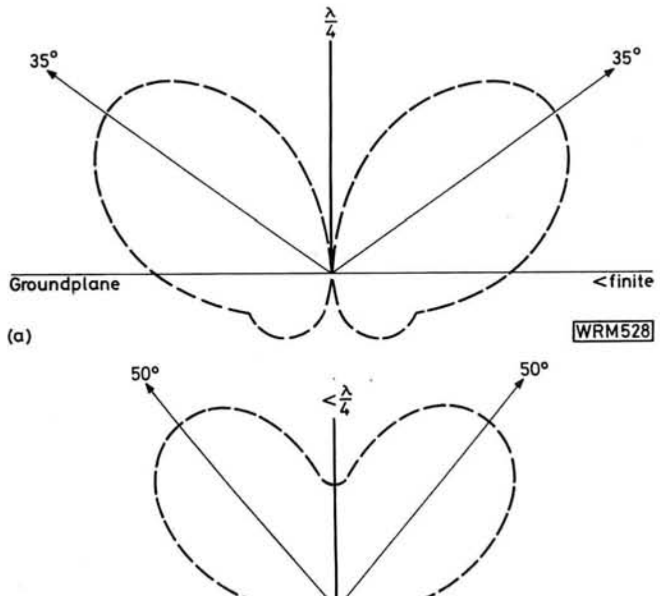


Fig. 4: (a) When the ground-plane is less than finite, e.g. a half-wavelength across, then the angle of maximum radiation becomes even higher—usually in the region of 35 degrees. (b) When both the ground-plane and the radiator are small with respect to wavelength, radiation as a whole is reduced and the angle of maximum radiation becomes even higher. This is more or less the radiation pattern that will be obtained from the HO "specified" 27MHz CB antenna mounted above a ground-plane with four λ/4 radials

Inductive Loading

A grounded, or ground-plane antenna with a radiating element that is physically smaller than a quarter-wavelength must be tuned to resonance by inductive loading otherwise it will not function properly or match with a transmitter having a 50 ohm output impedance. Two features must therefore be considered—resonance and matching.

For mobile operation, fairly short antennas are really essential in the interest of safety, so here a compromise is necessary anyway. However, it must be fully understood that as the radiating portion of the antenna is made smaller so more inductance must be included to maintain resonance and the efficiency of the antenna begins to deteriorate.

Let us now examine the possibilities of inductively loaded antennas and remember, that as well as mobile applications, a base-loaded 1·5 metre radiator must also be employed for any CB radio base-station antenna.

Practical Designs

The most common designs being used at present to meet the CB Licence Schedule 3e requirements are those shown as (a), (b) and (c) in Fig. 1. The inductive component in each contributes nothing to actual radiation and serves only to effect resonance and matching. Design 1 (a) is series fed with sufficient inductance to balance the capacitive reactance of the vertical radiator in order to obtain resonance. Designs 1 (b) and 1 (c) employ a shunt-fed arrangement making it a little easier to achieve the requisite input impedance of approximately 50 ohms whilst the remainder of the inductance serves only to obtain resonance.

These are ground-plane antennas as indicated on the diagram and will generally operate with either the metal body of a vehicle, or four quarter-wave radials functioning as a suitable ground-plane.

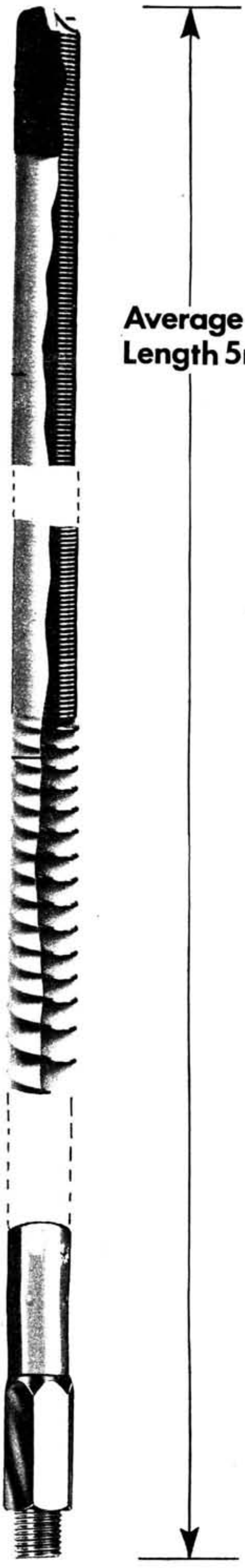
The remaining design 1 (d) is a series-fed arrangement but in this case *centre-loaded* to obtain quarter-wave resonance. This design is a little more efficient because most of the current in the system is flowing in the lower straight portion of the radiator. This antenna is, however, considered by the Home Office as **not legal** as it has more than one element even though it may be only 1·5 metres long.

N.B. The dotted lines in all the diagrams in Figs. 1 and 2 show the current distribution along the antenna.

Loaded Antennas with Higher Efficiency

We will now deal with the designs shown in Fig. 2 as (a), (b), (c) and (d) which are also omni-directional and although inductively loaded to achieve resonance are considerably more efficient and have a far better performance than those illustrated in Fig. 1. **Note, however, that none of these is considered by the Home Office as legal.**

The first design 2 (a), is intended for mobile operation and although only 1·5 metres long is resonant to a half-wave. The matching system (M) at the base provides a voltage drive to the resonant centre-loaded section. Design 2 (b) is also a resonant centre-loaded half-wave and is voltage driven from a low to high matching unit at the base. This is a highly efficient antenna intended for base station operation and requires no ground-plane. Design 2 (c) has been popular in the USA and other countries for mobile operation and employs a helically wound radiating system that is normally series-fed from a 50 ohm source. The lower portion, being resonant to a quarter-wave, provides the low impedance base feed whilst the upper portion assumes resonance to a half-wavelength. This antenna is therefore a ground-plane type but otherwise reasonably efficient. The remaining design 2 (d) is a hybrid system comprised of a vertical radiating section 1·5



A mag-mounted series-fed mobile CB antenna that meets the HO requirements. The design is similar to 1 (a) but the inductance is Ferrox cored

Fig. 5: (Left) Helically wound CB antenna similar to design 2 (c). N.B. this is illegal

metres long and loaded at the base to produce quarter-wave resonance but having a full quarter-wave section attached beneath so that the whole antenna behaves as a semi-loaded half-wave fed at the centre.

The physical appearance of some of the antennas described may be of interest although the method of feeding the base loading coil may not always be apparent in commercially available versions. A typical series-fed and magnetically mounted mobile antenna for 27MHz is shown in the photograph. The base coil has a Ferrox core to reduce the d.c. resistance of the inductance. The whip section, which forms the radiator, is adjustable in length to achieve resonance and the requisite v.s.w.r. **This antenna complies with the CB licence requirements.** Similar antennas are now readily available from CB radio dealers.

The single vertical antenna shown in the leading photograph is to the design of 2 (b). It is centre-loaded to half-wave resonance for 27MHz, is about 3 metres in physical length and has an efficiency nearly equal to that of a full half-wave. **It is, of course, not considered a legal antenna by the HO.** The other antennas that appear in the photo are for amateur radio operation for the 144MHz and 28MHz bands.

The construction of a helically wound CB mobile antenna is shown in Fig. 5 and this is more or less to the design shown as Fig. 2 (c).

Part 2

The second part of this article will deal with the radiation efficiency of the so-called legal antenna for 27MHz CB radio, and the results of field trials showing the performance of such when compared with antennas of higher efficiency.

NEWS NEWS NEWS

Rallies and Events

Swindon and District Amateur Radio Club inform us that their 1982 Radio and Electronics Rally will take place on Sunday 16 May at Park School, Marlowe Avenue, Swindon, Wilts., starting at 1000 hrs.

There will be all the usual attractions for the electronics enthusiast, plus many general interest exhibits. Admission will be 50p.

Further details from: *K. A. Saunders G8SFM, QTHR. Tel: (066 68) 307.*

Lincoln Short Wave Club, G5FZ G6COL, are holding a "Hamfest" on Sunday 9 May, 1982, at the Lincolnshire Showground.

Further details from: *J. R. Hunt G3PVU, QTHR.*

Otley Radio Society have organised their Northern Mobile Rally to be held on Sunday 23 May, 1982 between 1000 and 1800 hrs. Due to the Rally's popularity and success plus the limited space available at their usual site in Keighley, the Society are pleased to announce that their new venue for 1982 will be at the Great Yorkshire Showground, Harrogate.

Further information from: *Pat Horne G8KRU, 14 Fieldhead Road, Guiseley, Leeds LS20 8DT. Tel: (0943) 74986 after 1730 hrs.*

Hull and District Amateur Radio Society will be holding their Mobile Rally on Sunday 30 May, 1982 at the Hull University.

Further details from: *H. V. Cunliffe G6DUL, 142 Hall Road, Hull. Tel: (0482) 447355.*

Lakeland '82 Jamboree

1982 is "The Year of the Scout", and to celebrate the 75th anniversary of the Scout movement scouts in Northern Ireland will be holding a Jamboree at Castle Archdale, County Fermanagh, between 28 July and 6 August 1982.

It is anticipated that 2000 scouts from many parts of the world will take part in the Jamboree, one item of the programme will be an Amateur Radio Station with the special callsign GB2NIS.

The station will be run by a team of eight scout radio amateurs and will be active throughout the Jamboree. It is hoped the station will be operating on SSTV, RTTY and via the amateur satellites. A special QSL card will be available to any amateur station either contacting or hearing GB2NIS.

Further information and arrangements for skeds may be obtained by writing to: *Dr David Hutchinson, 8 Oakglen, Antrim BT41 1JR. Please send s.a.e.*

Satellite News

Information supplied by Ron Broadbent G3AAJ, Hon Secretary of AMSAT-UK, confirms the launch date for AMSAT-Phase III B to be on or about 6 July 1982.

The following information supplied by AMSAT-DL, the West German coordinators of the project, indicate that frequencies employed by the satellite will be:—

B. Transponder: Uplink 435·025–415·175MHz: Downlink 145·975–.45·825MHz: General Beacon .45·81 MHz: Engineering Beacon 145·990MHz.

L. Transponder: Uplink 1269·050–1269·850MHz: Downlink 436·950–416·150MHz: General Beacon 436·04MHz: Engineering Beacon 416·02MHz.

Modes of emission will be identical to previous OSCAR satellites and it is anticipated that with the successful launch of AMSAT-Phase III B, satellite operation will be available for a total of approximately 17 hours per day.

For further information contact: *G3AAJ, AMSAT-UK, 94 Herongate Road, London E12.*

PM Components Limited

Recent advertisements for this company in *Practical Wireless* have stated that a 14-day delivery is offered. In fact we understand that normally a return-of-post despatch is offered.

RSGB HF Convention 1982

The HF Convention will be held at the Belfry Hotel and Conference Centre, Milton Common, Oxford on Saturday June 19.

The programme includes film shows, lectures and home-constructed QRP equipment display. The equipment display and demonstration station will be presented by the G-QRP Club.

A limited number of snack lunches will be available. The hotel's licensed restaurant will be open if more substantial meals are required.

The venue is located about nine miles south-east of Oxford and very close to exit 7 of the M40. Adequate car-parking facilities are available and there is a bus service to and from Oxford.

Admission is £1, payable at the door.

Gemini Communications

Gemini Communications (late of Blackburn) have now moved to 41 Sutton Road, Bolton. Nearest motorway exit is Junction 5 of the M61. Unfortunately just after opening the new shop Ray Hall was burgled and many items of equipment were stolen. Next month we hope to have a list of serial numbers for you to look for.

Stolen Equipment

I have recently received a letter from David Webster, G8MYV, once again drawing attention to the current increase in radio equipment theft from vehicles.

Unfortunately for David he has himself become a victim and he has appealed for your help in retrieving his amateur equipment which comprised a Trio TR-2300, 144MHz f.m. portable serial number 2010076, complete with case, strap, NiCad pack and "rubber duck" antenna. Also missing, a Wood & Douglas 10W p.a. mounted in a home-brew light grey die cast box.

Anyone offered this equipment is requested to contact the Wealdstone Police (01-900 7476) or David QTHR.

QQ QUADMETER

C.L.RICHARDS ACGI BSc CEng MIEE

I have long wanted another meter as I seemed for ever probing around circuits with the one and only 2000 ohms per volt multimeter I possessed, trying to guess the effect of the meter loading on the circuit. So I decided to make one of those attractive high impedance op.amp. voltmeters. A CA3130 and a nice 50µA meter with a big scale were acquired and at a suitable moment I sat down to decide exactly what to build.

The first idea was to have separate range switches for current and voltage, so that two measurements could be made just by switching the meter. The second idea was to have more than one of each, after all one can only read one meter at a time, so instead of switching the eye about from meter to meter, keep it on one meter and switch around a number of measuring points. It ought to save bench space and precious money as well. AC voltages, R, C and dB facilities can also be omitted as these can be made with the multimeter.

Ranges

One range each of volts and current seemed hardly worthwhile, but would I ever need three of each? I settled for two of each.

The instrument would not be much use if a range switch had to be operated every time the test point was changed, so each test point would have to have its own range switch. A quick sum showed that the cost of four range switches each with a handful of 2 per cent resistors, plus a 4-way selector switch, roughly balanced the cost of the meter, the op.amp. and their common circuit components, an answer which I am told is the economic optimum.

CONSTRUCTION RATING **Intermediate**

BUYING GUIDE

Constructors should have no problems in obtaining the components for the Quadmeter from advertisers in *PW*. The push-button bank can be any suitable type that is to hand. The meter can also be any convenient 50µA f.s.d. type (the one used in the prototype was Maplin's Large Meter).

APPROXIMATE COST **£20**

Each t.p. would have to be completely isolated by the 4-way selector switch, so that they could be scattered anywhere around a circuit, and be at different potentials.

The next idea was to make use of the gain of the op.amp., which can be set accurately with close tolerance feedback resistances, to extend the sensitivity beyond the maximum of my multimeter. It could also be used to reduce the magnitude of the current shunt resistances, which have to be inserted into the circuit under test, causing undesirable voltage changes. The latter could be nearly as valuable a feature as the op.amp.'s gift of very high impedance, when measuring voltage.

Considering these factors when deciding what ranges to have, and wishing to keep costs down by having no more than single wafer range switches, a nice compromise came out, covering frequently used values, with 2p.6w. switches.

Voltmeters (10MΩ input impedance)

Full Scale Reading	50V	5V	500mV	50mV	5mV
Op. Amp. Gain	×1	×1	×1	×1	×10

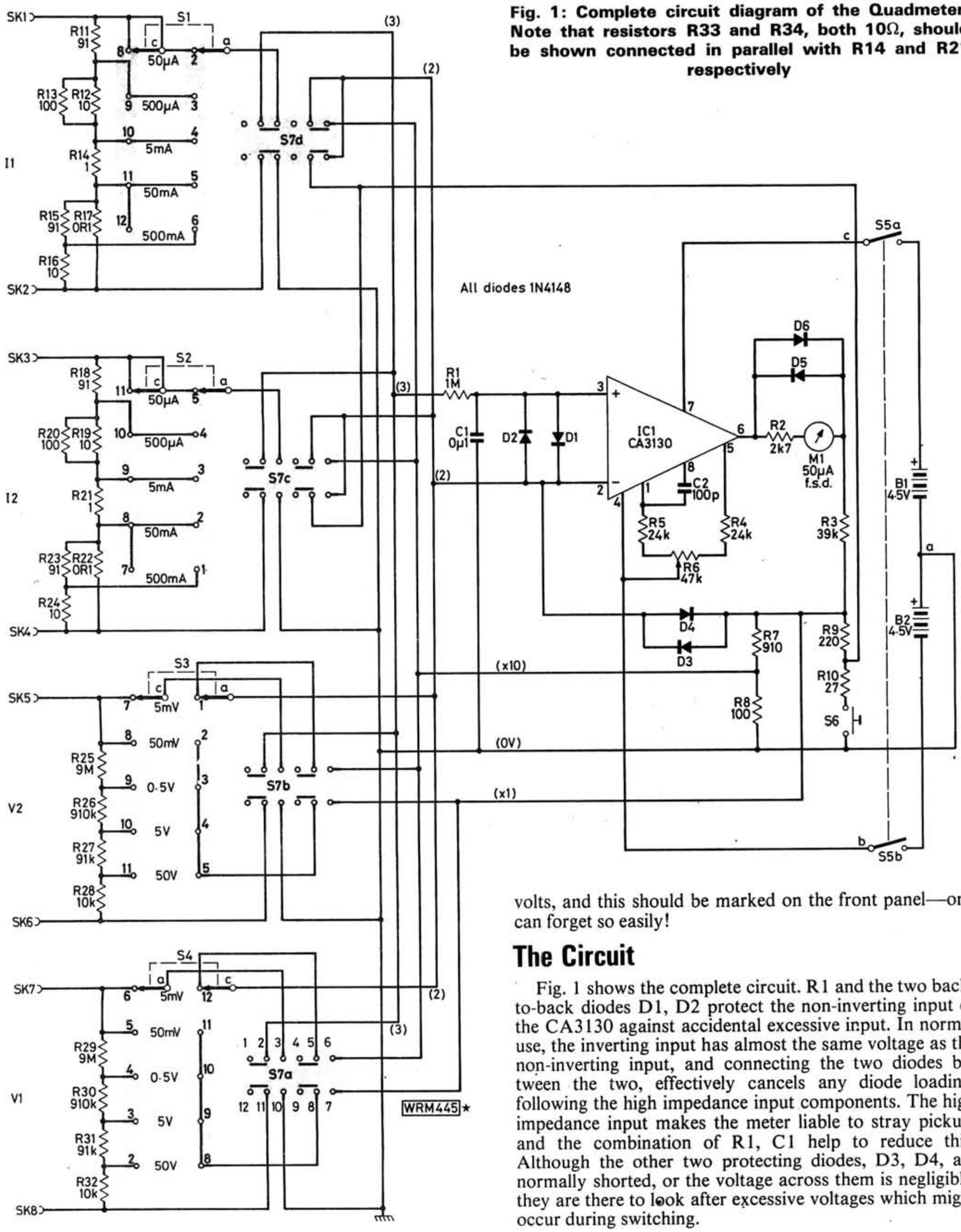
Milliammeters

Full Scale Reading	500mA	50mA	5mA	500µA	50µA
Op. Amp. Gain	×1	×10	×10	×10	×10
Shunt Resistance	0·1Ω	0·1Ω	1Ω	10Ω	100Ω

As a bonus, there would be a pushbutton, effective on all ten ranges, extending the sensitivity by a factor of 5 times.

The well-known Avometers, in use since before the last war, have the very useful feature of a ÷2 button, and this was liked so much, I just had to have something like it. To avoid making mistakes when reading, the scale must be as

Fig. 1: Complete circuit diagram of the Quadmeter. Note that resistors R33 and R34, both 10Ω, should be shown connected in parallel with R14 and R21 respectively



simple as possible, which means the factor is either 2 or 5. Going to "5" gives just that extra little bit of sensitivity, the minimum voltage which can now be read being 1 division (20µV), and the smallest current (1 division) 0·2µA.

Set by component ratings, the maximum permissible potential difference between any two test points is 250 volts, and this should be marked on the front panel—one can forget so easily!

The Circuit

Fig. 1 shows the complete circuit. R1 and the two back-to-back diodes D1, D2 protect the non-inverting input of the CA3130 against accidental excessive input. In normal use, the inverting input has almost the same voltage as the non-inverting input, and connecting the two diodes between the two, effectively cancels any diode loading, following the high impedance input components. The high impedance input makes the meter liable to stray pickup, and the combination of R1, C1 help to reduce this. Although the other two protecting diodes, D3, D4, are normally shorted, or the voltage across them is negligible, they are there to look after excessive voltages which might occur during switching.

Overload Protection

The meter itself is protected against overload by two circuits. The diode pair D5, D6 have negligible conduction until the voltage across them exceeds some 0·25V, and the value of R2 should be such that the voltage across R2 plus the meter resistance is no more than this at full scale current. The combination of R2, plus meter resistance, plus R3 should be some 40kΩ to 50kΩ, so as to limit the total CA3130 output current to about 100μA when the batteries are new, whilst still allowing operation when the battery voltage has fallen. It is worthwhile checking, whilst wiring up the meter panel, that neither R2 nor R3 have been made too high, causing error at full scale.

When there has been an overload, it can take some seconds to discharge C1, via R1 and the voltage attenuator.

The gain is accurately set by the 1 per cent feedback resistors R7, R8, being unity when the inverting input is connected to point 1 and ten when at point 10. In either case, the gain is increased five times when pushbutton S6 puts R9, R10 in parallel. These gain-setting resistances, being part of the meter circuit, are common to all 4 test points, so that their errors, small though they are, are at least the same on all 4 test points.

The 4-way t.p. selector switch cannot be reduced to less than a 4p.4w., which necessitates either a wafer type or a pushbutton unit. The difference in cost is trivial and a pushbutton unit has been chosen for reasons of panel layout and because it avoids having to go through intermediate positions, but there is a serious catch. Never press two buttons at the same time, or you will connect two points with a considerable potential difference, with disastrous results! Some years ago, p.b. units with single button interlocks were available, but no longer seem to be on the home-constructor market.

Current Range Switches

The current range switches may look unnecessarily complicated. These single bank switches are often break-before-make and so must be wired to short the unwanted shunts, instead of tapping-on, in order to avoid nasty bumps when switching. Secondly, all switches have a contact resistance which, in a simple circuit, appears as part of the shunt resistance, as "r" in Fig. 2(a) shows. A good switch will have an "r" of some 5 milliohms at least. With continued use and dirt, some 25 milliohms can be expected, and we have gone to the trouble of making the shunt resistance ten times lower than usual! Even 5 milliohms is quite unacceptable in series with the lowest shunt of 0·1 ohms, a 5 per cent error. So the circuit of Fig. 2(b) is used, "r" of the first bank no longer being part of the shunt and a similar "r" in the second bank having the high impedance of the CA3130 to feed into.

The CA3130, when lightly loaded as in our case, has the ability to swing its output within a few millivolts of the rail voltages, and this permits the use of a single battery, but only so long as the gain is no more than unity. When the gain is ten, the full scale input to the CA3130 is only 5mV and the smaller inputs at the lower end of the scale are too much for the CA3130. The simplicity of the single battery was very attractive, but not worth foregoing all the advantages we get with our gains of 5, 10 and 50.

The current drain is substantially constant at 3mA per battery, so six HP7 cells, which will operate the meter down to about 3 volts, should have a long life.

Construction

Construction is straightforward. The CA3130 and its components are mounted on a 31 hole × 18 strip piece of Veroboard, which is mounted on the meter terminals. Take care that these terminals contact no more than the 3 strips shown in Fig. 3. It is better not to tin these, and check that the meter connects only to R2 and R3, and to nothing else. Use insulated wire for the interconnections, and before connecting the batteries, make sure there is no possibility of one t.p. coming into contact with another by measuring its insulation resistance to each of the other three, operating the pushbutton switch.

The off-set null needs front access. It and its two associated resistors are mounted on a 7 by 7 hole piece of Veroboard. The two lower corner Veropins are soldered behind the board to a U-piece of tin-plate, which has a 6mm clearance hole to allow it to be clamped under the pushbutton S6, Fig. 4. The adjustment hole through the panel should be lined with a short piece of 4mm sleeve, as it is sometimes advisable to earth the front panel.

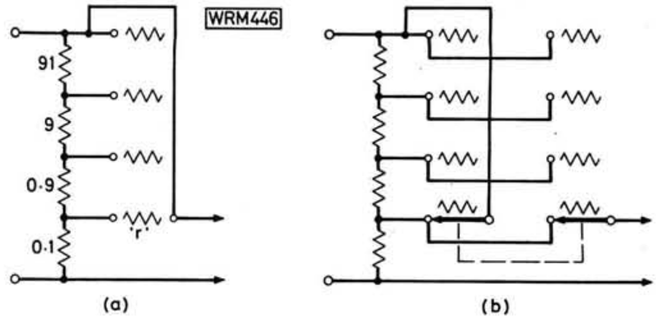


Fig. 2: Overcoming problems due to switch contact resistance on the current ranges

Accuracy

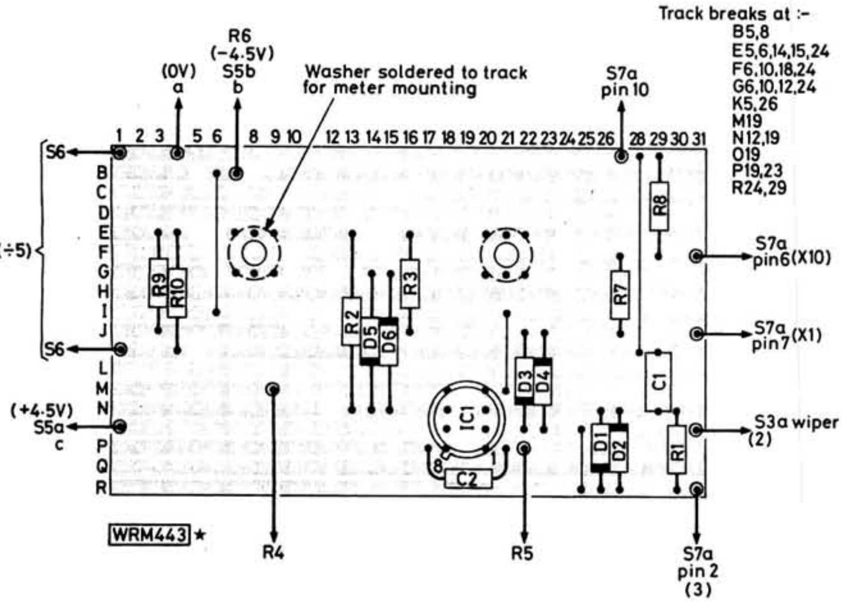
The accuracy of voltmeters is fixed by the errors in the 2 per cent attenuator resistors and the calibration of the meter scale. Unless you have access to a sub-standard meter, there is little you can do except use a string of 1 per cent resistors, as in Fig. 5, to make a relative error graph of the scale markings. If these vary up to their tolerance, the voltage on one can be as much as 2 per cent out, and it is worth while repeating the check, several times if necessary, after changing the positions of the resistors in the string. Use the 50mV range, as this has a straight through connection to the CA3130, and so avoids any tolerance errors in the attenuator.

Testing the prototype in this way showed differences in the error curve, but the points of maximum and minimum fell at the same part of the scale. Averaging the results from 4 or 5 "string mixes" yielded a credible correction curve. The maximum errors so found were 3 per cent high reading at 5 on the scale, 0·6 per cent low at 30 and 2 per cent high at 50.

Shunts

The 0·1 ohm shunt is made up from a length of 38 s.w.g. enamelled copper wire and adjusted to value, using the meter and a 100 ohm 1 per cent resistance. Ideally, the 500mA shunt should be 0·01 ohm, but things get a bit tricky with such a low resistance, and it is preferable to sacrifice some voltage drop at the shunt by using a one tenth tap across the 0·1Ω shunt.

Taking a 120mm length of wire (calculated length plus 10 per cent), clean the ends and solder a 25mm length of



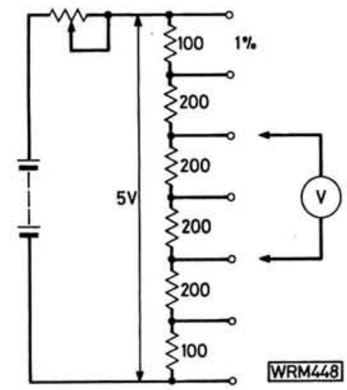
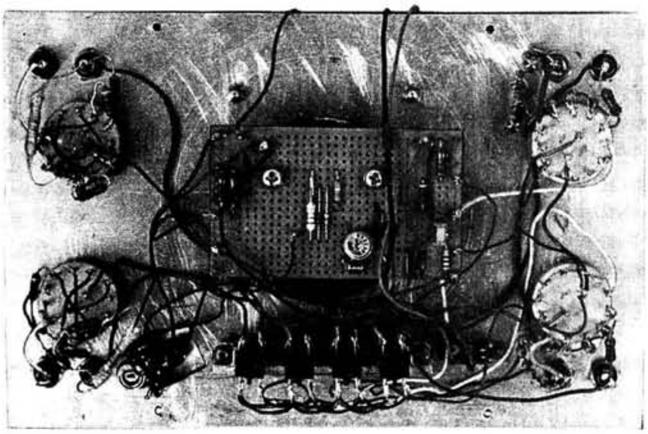
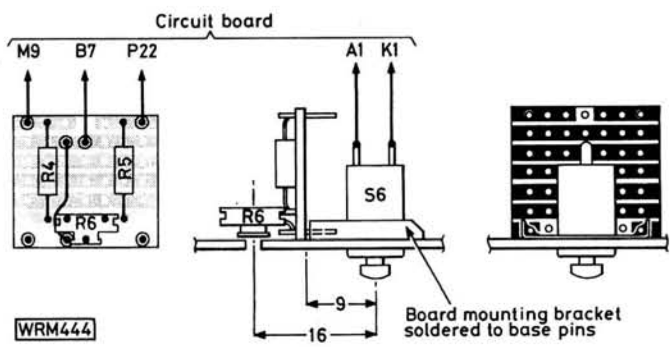


Fig. 5 (above): The calibration string

Fig. 3 (left): The main Veroboard layout

Fig. 4 (below): The offset-null board and method of mounting on the pushbutton switch S6





★ components

Resistors

½W 5% carbon film

2·7kΩ	1	R2 (see text)
24kΩ	2	R4,5
39kΩ	1	R3 (see text)
1MΩ	1	R1

½W 2% metal oxide

10Ω	6	R12,16,19,24,33,34
91Ω	4	R11,15,18,23
100Ω	2	R13,20
10kΩ	2	R28,32
91kΩ	2	R27,31
910kΩ	2	R26,30
1MΩ	18	R25,29 (each 9 in series)

½W 1%

27Ω	1	R10
100Ω	5	R8 and Cal
200Ω	4	Cal
220Ω	1	R9
910Ω	1	R7

Submin. vert. preset

47kΩ	1	R6

Capacitors

Polystyrene

100pF	1	C2

Polycarbonate

0·1µF	1	C1

Semiconductors

Diodes

1N4148	6	D1,2,3,4,5,6

Integrated circuits

CA3130	1	IC1

Switches

Rotary

2p.5w.	4	S1,2,3,4

Pushbutton

4 p.c.o. 4 bank interlocked	1	S7
Push to make	1	S6

Submin. toggle or slide

d.p.d.t.	1	S5

Miscellaneous

Meter, 50µA f.s.d. 110 × 82 × 46mm 1·4kΩ; 4mm sockets 4 red, 4 black; Veroboard 0·1in. matrix; Collet wing knobs (4); Battery holder for 6 × HP7; Aluminium sheet 18 s.w.g. 210 × 138mm; Materials for case.

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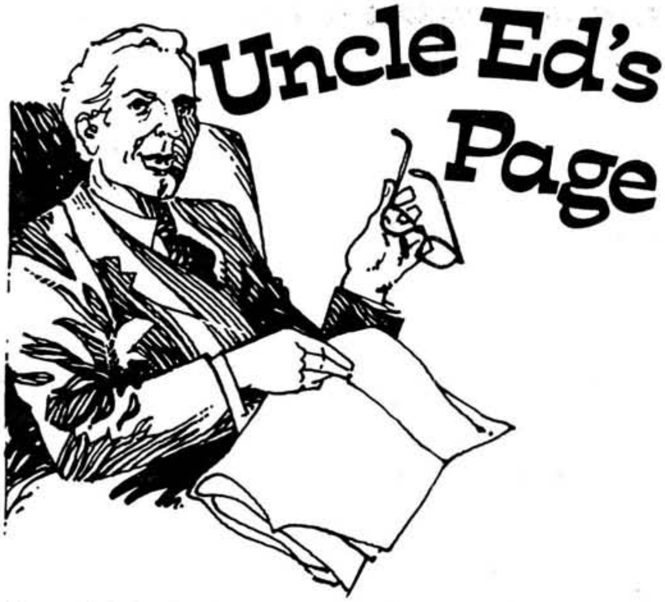


A monthly look at some aspect of the radio/electronics hobby that seems to bug the beginner, or occasionally a more advanced topic seen from an unusual angle.

METERS—3

As I mentioned back in METERS—1, finding the internal resistance of a meter movement is not always straightforward. You'd expect (as I did when a young lad) to connect it to your multimeter on the OHMS range and read the value straight off. Unfortunately, if you did so, chances are you'd hear a substantial "clunk" as the needle of your movement hit the end-stop, doing it no good at all.

The problem is that most multimeters pass quite a bit more current on their resistance ranges than they do on the voltage ranges, because of their internal circuit arrangement, and this could well exceed the full-scale deflection of the movement you're testing. It is becoming less likely as multimeters generally (even quite inexpensive ones) have lower f.s.d.s nowadays, but it's as well to know about the problem.

The solution is to use the test set-up shown in Fig. 7, where M is the meter you're checking. Resistor R1 is there just to limit the maximum circuit current to a safe value, in case you turn variable resistor R2 down to zero, which would probably burn out the meter. Make R1 a 1kΩ (assuming the movement f.s.d. is not greater than 1mA), and R2 also 1kΩ for a 1mA movement, or 50kΩ for a 50μA movement. Adjust R2 until the needle indicates exactly full scale.

Fig 7

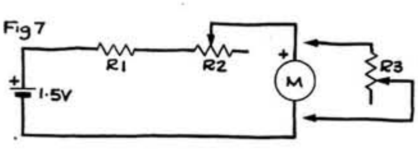


Fig 8

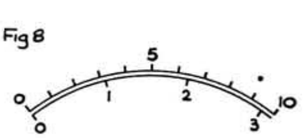
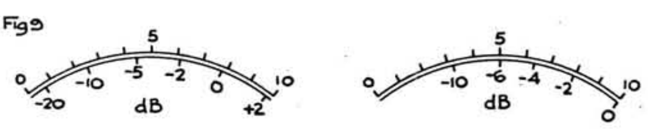


Fig 9



Now connect variable resistor R3 across the meter terminals and adjust it until the meter reading drops to half-scale. Use a 2·5kΩ potentiometer for R3.

Disconnect R3 from across the meter and connect it instead to your multimeter on the OHMS range. Its resistance will be the same as that of the meter. R3 was, of course, acting as a shunt so that half the current went through the meter movement and half through R3. If they both pass the same current, they must have the same resistance!

Finally, to round off this short series on meters, let's look again at the accuracy of measurements which you take. I've already talked about the way that circuit conditions are changed by connecting the test meter, and I know Roger Lancaster will be investigating that further in his articles *Are the Voltages Correct?*

Within the meter itself there are several sources of error: variation of the field strength of the magnet at various deflections of the needle, friction in the pivots, the accuracy of the resistance values of the movement and any shunts or multipliers, and their change with temperature, etc. Most of these are related to the f.s.d. value, which makes their effect worse at readings less than f.s.d. For example, suppose we have a voltmeter with a full-scale deflection of 100V and an accuracy of 3 per cent **of f.s.d.** This means that any reading can be up to 3V above or below the true voltage. If we connect the meter into circuit and get an indication of 20V, then the true reading could be anywhere between 17V and 23V, an error of up to ± (meaning "plus or minus") 15 per cent **of reading.** Not very good, is it?

Of course, if you had a 25V range on the meter, you could switch to that, and an indication of 20V then would mean a true reading between 19·25V and 20·75V (± 3 per cent of 25V) which means a maximum error of only ± 3·75 per cent of reading, a much more respectable figure.

So, to minimise the error, you should choose a range on your multimeter which puts the needle as far up the scale as possible. It is good practice not to use readings below about one-third f.s.d. You will find that some multimeter ranges go 1–2·5–10–25–100–250, and others go 1–3–10–30–100–300. This latter system, known as the 1–3–10 sequence for short, is generally favoured nowadays, because it makes life easier for multimeters with a decibel scale.

If you read my piece on decibels a few months back you will remember (I hope) that a voltage change of ten times equals 20dB. So, if you take two successive readings, and the first reads 2dB on the decibel scale with the range switch set to 1V, and the second reads 3dB on the decibel scale with the range switch set to 10V, the difference between the two readings is 21dB (20dB from the range switch +1dB from the scale).

It would be useful to be able to use the decibel scale on the intermediate ranges too (the 2·5 of the 1–2·5–10 sequence, or the 3 of the 1–3–10 sequence) and this is where the 1–3–10 sequence scores, or almost! In fact, an increase from 1V to 3V represents a change of +9·542dB, close to the useful round number of 10, but not quite right. To get exactly 10dB difference, the scale sequence has to be 1–3·162–10–31·62, etc.

Now you might think that's awkward, but there's a very simple way round it. You can't easily use the same set of scale graduations for ranges 0–3 and 1–10, so the meter manufacturer has to put two sets on anyway. If he puts the "10" graduation on the 0–10 scale opposite where 3·162 would come on the 0–3 scale, the problem is solved. See Fig. 8 for a typical scale arrangement.

Just where the manufacturer puts his 0dB mark is really up to him, but favourites are opposite 0·775V on the 0–1V scale, so that it is direct reading in decibels relative to a milliwatt in 600Ω (dBm (600Ω)), or else at f.s.d. in which case all decibel readings on the scale are negative (Fig. 9).

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New Portable Rig

I have recently received details of the latest Azden 144MHz hand-held f.m. transceiver, shown in the accompanying photograph.

The PCS-300 in its European form, provides coverage over the range 142 to 145·9875MHz, in 5kHz increments. Frequency control and scanning is controlled by a microprocessor based system with the availability of nine memory channels and priority frequency override. Any in-band frequency offset may be programmed into the rig via the front panel keypad arrangement. An l.c.d. display indicates operating frequency, offset, memory address, signal strength, relative output, memory mode status and non-standard offset status.

The output level may be switch selected to give 3W (high) or 1W (low) with current consumptions from the internal 500mAh NiCad pack of 800mA (3W) and 400mA (1W).

A double superheterodyne receiver system is used, featuring the usual 10·7MHz first and 455kHz second i.f.s. Receiver sensitivity is quoted as less than 0·2µV for 12dB SINAD over the complete bandwidth, with an audio output level of 200mW from the combined built-in speaker microphone.

The PCS-300 is supplied complete for £179 which includes earphone, flexible rubber antenna, belt clip, NiCad pack, together with mains charger and desk stand and is available from: *Waters & Stanton Electronics, 18/20 Main Road, Hockley, Essex. Tel: (0702) 206835.*

State-of-the-Art

Very recently introduced onto the video camera market is the VKC 600 colour video camera from Hitachi.

The VKC 600 is very compact, weighs only 1·9kg and has an automatic exposure control which adjusts the iris to achieve perfect recordings and a sensitivity control range covering light intensity from 75 to 10 000 lux. A wide colour temperature band enables filming to be made in most light conditions.

Other major features of the camera are: 6:1 lens spanning 14-48mm with manual and power zoom control plus a macro facility which enables shots to be taken at a range of only 1cm; electronic viewfinder which can also be used as a monitor to play back recorded tapes (the sound track can also be monitored at the same time); back light switch to compensate for indirect lighting conditions and a high/normal sensitivity switch to make allowance for low light conditions; built-in omni-directional boom microphone and socket provided for an external microphone; magnifying lens on the viewfinder for accurate focusing and a detachable pistol grip with on/off motor run switch. All these features should enable even the newcomer to video filming to produce both picture and sound recordings of excellent quality.

The VKC 600 is likely to be on sale, at most good video retailers, for around £525.

New Low-cost d.m.m.

Black Star inform me that they now have in stock the latest hand-held digital multimeter from Sabtronics.

Called the Model 2033, its major features include 0·5 per cent basic d.c. accuracy, large $3\frac{1}{2}$ digit liquid crystal display, rugged new case design with push-button function and range switches, easily accessible battery compartment and tilt stand.

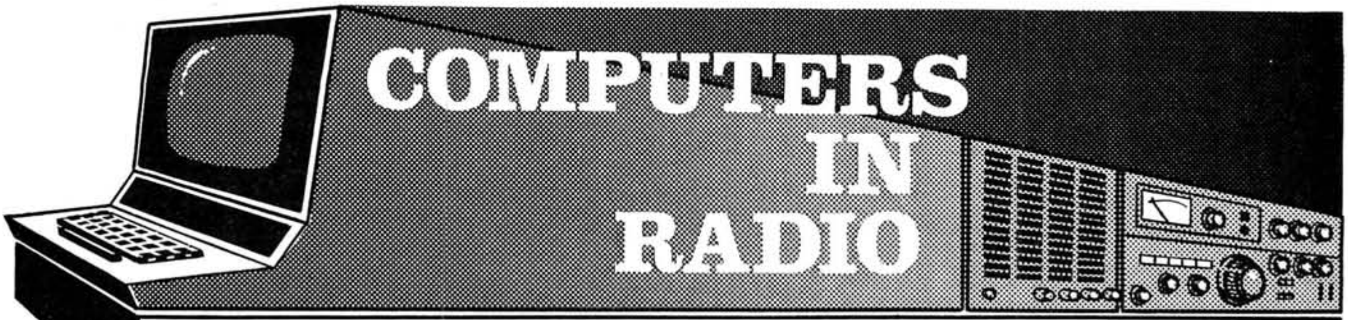
Measurement capabilities of the unit are a.c. or d.c. voltage from 100µV to 1000V over 5 ranges, resistance from 1Ω to 20MΩ over 5 ranges, a.c. and d.c. current from 10µA to 2A over 3 ranges. It is powered by a single PP3 battery. Optional extras include a.c. mains adaptor and a high voltage probe.

The Model 2033 is supplied fully assembled, complete with test leads, and costs only £36.75 plus VAT.

Further details are available from: *Black Star Ltd., 9A Crown Street, St. Ives, Huntingdon, Cambs. PE17 4EB. Tel: (0480) 62440.*

Info Please

We shall be reviewing the Yaesu FT ONE later this year, and would like to hear from anyone owning this new rig, what their experiences are. Please write to the Editor at the Poole address (see page 1).



COMPUTER ASSISTED CONTESTS

by E. A. Parr

In an amateur radio contest, where competitors endeavour to log the maximum number of callsigns in a given time, the greatest time waster is the continual need to check if the current callsign has already been logged. In a typical competition, the leaders will log around 400 callsigns, and towards the end the search can take several minutes. I was asked by some local amateurs if this storage and searching could be done by a computer, and the result is the simple BASIC program described below.

The program will run in any computer with at least 8K of store and a BASIC interpreter capable of handling string variables. It was written for a NASCOM but will transfer to common machines such as PET, TRS-80, etc., with only minimal dialect changes.

Prompts

The operator sits at the computer terminal, and is prompted at each step. He types in the current callsign. The computer extracts any spaces so that G3 GSR and G3GSR are recognised as being the same, and displays the callsign again. The operator confirms it (overcoming typing errors), and the computer searches through all the callsigns already logged. If the new callsign is not found, the computer adds it to its list and informs the operator. If the callsign has been logged before, the operator is told to ignore it. In the worst case, with 500 callsigns, the computer operation itself takes 3 seconds to search and display: a vast improvement on manual methods!

Program Listing

```
100 REM ARKABLE RADIO LOG PROGRAM
110 REM ARKABLY WRITTEN BY E.A. PARR OCT 1980
115 !
120 REM INITIALISE
130 REM SOME BASICS REQUIRE: 130 CLEAR 5000
140 DIM C$(500)
150 N=1
160 C$(1)=" "
200 REM MAIN PROGRAM
210 INPUT " NEXT CALL SIGN",A$
220 IF A$="ALPHA" THEN GOTO 500
230 IF A$="LIST" THEN GOTO 700
240 GOSUB 800
250 PRINT " CONFIRM ";D$
251 INPUT B$
260 IF B$<>"YES" THEN GOTO 210
270 REM SEARCH
280 FOR I=1 TO N
290 IF D$=C$(I) THEN GOTO 400
300 NEXT I
310 REM NEW CALL SIGN
320 N=N+1
325 C$(N)=D$
330 PRINT D$;" IS NEW CALL SIGN"
340 PRINT N-1;"CALLS LOGGED"
350 PRINT
360 GOTO 200
400 REM CALL SIGN FOUND IN LIST
410 PRINT D$;" ALREADY LOGGED"
420 GOTO 340
500 REM ALPHA SORT
510 PRINT " SORTING"
520 FOR I=1 TO N
530 D$=C$(I)
540 PRINT "*";
550 FOR J=I TO N
560 IF D$<=C$(J) THEN GOTO 580
570 B$=C$(J)
572 C$(J)=D$
574 D$=B$
580 NEXT J
590 C$(I)=D$
600 NEXT I
610 PRINT " SORT COMPLETE"
620 INPUT " PRINTOUT",A$
630 IF A$="NO" THEN GOTO 900
700 PRINT
702 PRINT " CALL SIGNS LOGGED"
710 FOR I=1 TO N
720 IF 5*INT(I/5)<>I THEN GOTO 750
730 INPUT " CONTINUE",A$
731 REM ON VDU SCREEN PRINTS OUT IN BLOCKS OF 5
732 REM OMIT LINES 720 TO 740 IF PRINTER IS USED
740 IF A$="NO" THEN GOTO 900
750 PRINT C$(I)
760 NEXT I
770 PRINT
772 PRINT
780 GOTO 900
800 REM SPACE STRIPPER THIS REMOVES SPACES FROM
802 REM CALL SIGN E.G. G2 A BC BECOMES G2ABC
810 D$=" "
820 FOR I=1 TO LEN(A$)
830 IF A$[I;1]=" " THEN GOTO 850
832 REM ON MOST BASICS LINE 830 WILL BE
834 REM ;830 IF MID$(A$,I,1)=" " GOTO850
840 D$=D$&A$[I;1]
842 REM ON MOST BASICS LINE 840 WILL BE
844 REM ;840 D$=D$+MID$(A$,I,1)
850 NEXT I
860 RETURN
900 REM QUIT LOGGING
910 INPUT " DO YOU REALLY WANT TO QUIT NOW",A$
920 IF A$="YES" THEN GOTO 940
930 GOTO 200
940 PRINT " BYE  ZZZZZzzzzzz......"
950 END
```

```
 NEXT CALL SIGN? P29KK
 CONFIRM  P29KK
YES
 P29KK IS NEW CALL SIGN
 1 CALLS LOGGED

 NEXT CALL SIGN? G3GSR
 CONFIRM  G3GSR
YES
 G3GSR IS NEW CALL SIGN
 2 CALLS LOGGED

 NEXT CALL SIGN? G8VFF
 CONFIRM  G8VFF
NO
 NEXT CALL SIGN? G8VFH
 CONFIRM  G8VFH
YES
 G8VFH IS NEW CALL SIGN
 3 CALLS LOGGED

 NEXT CALL SIGN? G8 MCP
 CONFIRM  G8MCP
YES
 G8MCP IS NEW CALL SIGN
 4 CALLS LOGGED

 NEXT CALL SIGN? G8 ZPW
 CONFIRM  G8ZPW
YES
 G8ZPW IS NEW CALL SIGN
 5 CALLS LOGGED

 NEXT CALL SIGN? G3GSR
 CONFIRM  G3GSR
YES
 G3GSR ALREADY LOGGED
 5 CALLS LOGGED

 NEXT CALL SIGN? G8TNT
 CONFIRM  G8TNT
YES
 G8TNT IS NEW CALL SIGN
 6 CALLS LOGGED

 NEXT CALL SIGN? G4 AR
 CONFIRM  G4AR
YES
 G4AR IS NEW CALL SIGN
 7 CALLS LOGGED

 NEXT CALL SIGN? G8 BUS
 CONFIRM  G8BUS
YES
 G8BUS IS NEW CALL SIGN
 8 CALLS LOGGED

 NEXT CALL SIGN? P2 9 KK
 CONFIRM  P29KK
YES
 P29KK ALREADY LOGGED
 8 CALLS LOGGED

 NEXT CALL SIGN? LIST

 CALL SIGNS LOGGED

 P29KK
 G3GSR
 G8VFH
 CONTINUE? YES
 G8MCP
 G8ZPW
 G8TNT
 G4AR
 G8BUS
 CONTINUE? YES
```

```
 DO YOU REALLY WANT TO QUIT NOW? NO
 NEXT CALL SIGN? G4CFY
 CONFIRM  G4CFY
YES
 G4CFY IS NEW CALL SIGN
 10 CALLS LOGGED

 NEXT CALL SIGN? G3AYA
 CONFIRM  G3AYA
YES
 G3AYA IS NEW CALL SIGN
 11 CALLS LOGGED

 NEXT CALL SIGN? G2 FKS
 CONFIRM  G2FKS
YES
 G2FKS IS NEW CALL SIGN
 12 CALLS LOGGED

 NEXT CALL SIGN? G8 MCP
 CONFIRM  G8MCP
YES
 G8MCP ALREADY LOGGED
 12 CALLS LOGGED

 NEXT CALL SIGN? YD 21S
 CONFIRM  YD21S
NO
 NEXT CALL SIGN? YO21S
 CONFIRM  YO21S
YES
 YO21S IS NEW CALL SIGN
 13 CALLS LOGGED

 NEXT CALL SIGN? 4X4MR
 CONFIRM  4X4MR
YES
 4X4MR IS NEW CALL SIGN
 14 CALLS LOGGED

 NEXT CALL SIGN? 3B9RS
 CONFIRM  3B9RS
YES
 3B9RS IS NEW CALL SIGN
 15 CALLS LOGGED

 NEXT CALL SIGN? ALPHA
 SORTING
****************** SORT COMPLETE
 PRINTOUT? YES

 CALL SIGNS LOGGED


 3B9RS
 4X4MR
 G2FKS
 CONTINUE? YES
 G3AYA
 G3GSR
 G4AR
 G4CFY
 CONTINUE? YES
 G8BUS
 G8MCP
 G8TNT
 G8VFH
 G8ZPW
 CONTINUE? YES
 P29KK
 YO21S


 DO YOU REALLY WANT TO QUIT NOW? YES
 BYE  ZZZZZzzzzzz......
```

continued on page 36▶▶▶

swap spot

Have newish mains-powered electric arc welder. Would exchange for anything useful for a radio amateur beginner. S. Vickers, 2 Sandywell Close, Hr. Openshaw, Manchester M11 1EF. *N.330*

Have new unused Astral 400 telescope: 60mm object lens, 100mm focal length, 233X magnification. With accessories: diagonal prism, 2X Barlow lens, 1·5X image erector lens, solar and lunar filters, 6mm & 20mm eyepieces, sighting scope, accessory tray, 5ft adjustable tripod. Would exchange for h.f. receiver or v.h.f./u.h.f. scanner. J. Blain, 19A Birley Street, Stapleford, Notts NG9 7GE. *N.347*

Have Cavendish 2000 Electronic Organ: 2 keyboards, 13-note pedalboard, auto rhythm/cords, built-in 2-speed Leslie. Would exchange for h.f. TX/RX: Trio 520SE or Yaesu FT101Z or w.h.y. G3JPJ QTHR, or 01-958 6887 evenings and weekends. *N.346*

Have Hilger & Watts builders' site square and tripod complete. New condition. Would exchange for any h.f. equipment to get me started listening. W. J. Marles, September Place, Station Road, Upper Broughton, Melton Mowbray, Leics. *N.365*

Have Rollei Model T, mint. Tessar, case, several extra accessories. Would exchange for v.h.f./u.h.f. gear or w.h.y. Taylor, 5 Stanhope Ave, Audenshaw, Manchester M34 5AZ. *N.363*

For that eyeball QSO! Opthalmoscope, prism type, with rotating disc carrying 24 lenses behind prism. Battery handle takes two U2s. Would exchange for good s.w.r./power meter or w.h.y. in 2m gear. Tel: 055 42 3712 evenings (Llanelli, Dyfed). *N.350*

Have tripod Slik 500g, extends to 4ft, v.g.c., plus Mirage 200 lead-type camera flash. Would exchange for 14–18ft × 2in aluminium mast or scaffold and pair of 21in wall stand-off brackets. Tel: Bournemouth 426387. *N.351*

New amateur, awaiting callsign, has Abu Pacific 8 boat fishing rod and matching reel complete with line, ready to use. Both mint condition. What have you for 2m please? Milford Haven 3991 evenings and weekends. *N.382*

Have Chinon CA-4 SLR camera, 50mm and 135mm lens, flash gun, Cokin filter system, all v.g.c. Would exchange for any good general coverage receiver. D. S. Kerr, 1 Argyll Avenue, Stirling, Scotland FK8 1UL *N.402*

Have 6in Mono TV, 12V d.c., good working order. Would exchange for a working 2m receiver. Cpl. P. Hopper, 10 Simeon Close, RAF Hospital, Ely, Cambs. CB6 1DN *N.405*

Have transformer 220V in, 2270V out at approx. $1\frac{1}{2}$–2kW, weight 75lb. Would exchange for usable oscilloscope. A. Keys, Mill Lane Farm, South Somercotes, Louth, Lincs. *N.421*

PW "SWAP SPOT"

Got a camera, want a receiver? Got a v.h.f. rig, want some h.f. gear to go with your new G4? In fact, have you got anything to trade?

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QUADMETER

▶▶▶ *continued from page 29*

tinned copper wire to each with a dab of solder. One tenth of the distance in from one end, clean a small patch and wind a turn or two round a third leadout and solder securely. The two resistances will be adjusted to their final values by moving the end taps.

Set up a current of about 40mA from a battery (don't use a powerpack unless the smoothing is exceptionally good) in the 100 ohm 1 per cent resistor in series with the two outer taps of the fine wire and an adjustable resistor of around 200 ohms. The current is set exactly to 40mA by reading the voltage across the 100 ohm resistance with one of the voltmeters. ($40mA \times 100\Omega = 4{\cdot}00$.) Now with the voltmeter across the shorter length of fine wire, adjust the position of its outer tap inwards, by dabbing the solder joint, until the voltage reads 4mV. ($40mA \times 0{\cdot}1\Omega = 4mV$.) Solder securely and recheck.

Put a 100 ohm resistance across the two outer taps (a 5 per cent one is good enough) and with the voltmeter across these, adjust the other outer tap until the voltage across the whole 1·0 ohm reads 40mV. Solder securely and check. The fine wire can be coiled up and inserted into a length of 4mm sleeving, using coloured sleeving to identify the leadouts, and sealed with epoxy resin.

Using a 100 ohms 1 per cent resistor to set up the current causes all the voltages, 4·0V, 40mV, and 4mV, to fall at the same point on the scale, thereby eliminating meter scale errors. The string of 1 per cent resistors shown in Fig. 5 can be used to check the next range down, but there can still be a 2 per cent error in the string. ●

COMPUTER ASSISTED CONTESTS

▶▶▶ *continued from page 35*

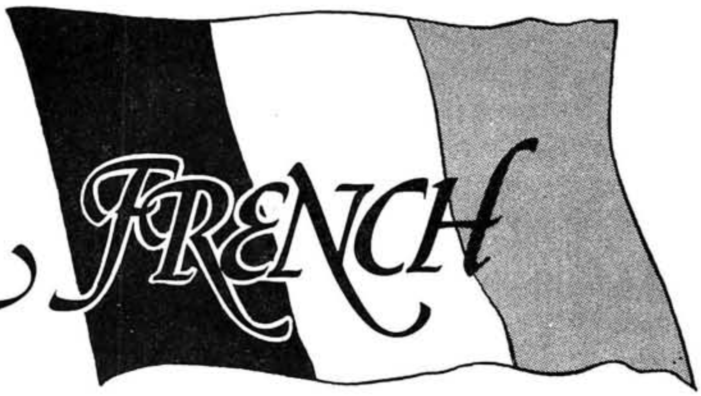
The Program

This is not really the place to discuss the subtleties of BASIC programming, and the listing is fairly straightforward. Lines 100 to 150 set up the machine to store the callsigns and over half the store is allocated to this function. The new callsign is entered at Line 210, and spaces stripped out by the subroutine at Line 800. The callsigns are stored in an array C$, which is searched at Line 270 for the new callsign. If it is not found Line 320 inserts the new callsign into the array. If a match is found, then Line 410 informs the operator.

If the operator types LIST as a callsign, the computer displays all callsigns logged to date. If the operator types ALPHA as a callsign, the computer arranges the callsigns into alphabetical order, and displays them. This last option should only be used at the end of a session, as this routine takes about 15 minutes to sort 500 callsigns.

It is advisable to keep a separate paper record of all callsigns as the computer informs you that a callsign is new. Apart from the mind-boggling task of copying around 500 callsigns from a screen at the end of a session there is the possibility of a computer crash due to the whims of the SSEB and CEGB. On an open air site this risk is increased with the length of temporary cables. Remember a half second supply interruption is eternity to a computer! Those lucky computer owners with a printer should re-arrange the program to print out each new callsign, obviating the need to protect against a crash. ●

BASIC QSOs in FRENCH



PART 1

G. W. Roberts GW4 JXN

The British pride themselves on a general lack of ability to speak foreign languages, and we are very fortunate that English is one of the most useful world languages. Luckily for us very many foreign amateurs have learnt enough English for at least a simple QSO. Some, of course, speak English very well. Most people, however, appreciate being able to speak in their own language and a call in French to a French speaking station is more likely to be replied to.

The greatest advantage for radio amateurs is that the vast majority of contacts follow a very similar pattern and the matters discussed can be very closely predicted. Thus the following article is not meant to make you fluent in French but to help you with a basic QSO.

The French in this article is for the use of foreigners speaking to French amateurs rather than two French friends talking to each other. There is no need to be self-conscious because your contact cannot see you and the narrow speech band transmitted, although making comprehension more difficult, has the virtue of going a long way in eliminating a "foreign" accent; also foreigners' mistakes are usually freely forgiven.

Two further factors can help the English speaking amateur. The seasoned listener will have noticed that some French amateurs tend to use English technical words. This reflects the influence of English on contemporary French. Examples are "le call"—callsign, le log (no prizes for guessing this), le "call-book". Often French amateurs sign by saying "bye-bye" to each other. The other tradition is the influence of the Q-code, as for example le QTH (cu-tay-ash) or QRM (cu-er-em). Thus it is nice to know that you can probably get away with an English technical word or "hamism" if you do not know or remember the French word. Basically, however, the French are purists at heart and appreciate "good" French especially from a foreigner.

Suffering a lot of local interference here

As a language teacher the author knows that well-meaning people will always try to correct or improve the use of their language by foreigners and this can have a disheartening effect on the learner. It should, however, be seen for what it is—a sign of encouragement. Thus the author would appreciate any suggestions or corrections to the article.

The only other problem likely to be encountered by the person using this article is that the French contact will think you have a greater knowledge of French than you have and will suddenly forget that he is speaking to a foreigner and start talking too quickly.

If this is so, then slow him down by saying, "parlez plus lentement, s'il vous plait, n'oubliez pas que je suis etranger (speak more slowly, please, do not forget that I am a foreigner). Keep repeating this politely until the message goes home!

Because the written text is, at best, only a approximation of the pronunciation the author will probably arrange for the production of a C60 teaching cassette with notes for any person interested, who should contact the author directly at Ffrydlas, 4 Frondeg Crescent, Llanfairpwll, Gwynedd LL61 5AX. The cost is likely to be £3 including post and packing. Please do not send any money as the cassettes will be made individually to order, provided there is sufficient demand.

It would be wrong to assume that a strong signal in French on say 14MHz (20m) is coming from mainland France. The author has heard a very strong Canadian station talking in French to France and Switzerland and also European stations when in contact with many former colonies. It is spoken widely as a second language in parts of Africa, Asia and Oceania, including some of the rarer islands and colonies. Some French, therefore, has a practical value in gaining new countries for you—see the *RSGB Operating Manual* for some possibilities. Around 14·120MHz seems a favourite French speaking frequency so you can practise listening.

The following is a list of useful sentences and phrases divided into sections with the English side by side with the French written form. As French spelling and pronunciation is as difficult as that of English, the third column contains an approximate phonetic pronunciation. There then follows an appendix of useful tables, including the alphabet—used for spelling without using the phonetic alphabet and for giving the callsign quickly. Remember you might not understand everything—the important thing is to follow. Bonne chance — good luck.

Making a Call		
CQ France, Switzerland, Belgium, Canada or a French speaking country. This is (own callsign) calling CQ and standing by.	Appel general à la France, la Suisse, la Belgique, au Canada ou à un pays francophone. Ici (own callsign) qui appelle CQ et qui reste à l'écoute de la frequence.	Appell zheneral a la Frons, la Swis, la Belzhik, oh Canada oo a yng pay francophone. Isi (own callsign) ki appell si key ay key rest a laycoot de la fraykons.
Replying to a Call		
(Other callsign phonetically) this is the British/English/Welsh/Scottish/Irish/Australian/Canadian/New Zealand/South African station (own callsign) calling you/returning your call.	(Other callsign phonetically) Ici la station Britannique/Anglaise / Galloise / Écossaise / Irlandaise / Australienne / Américaine/Canadienne/Neozéalandaise/Sud-Africaine (own callsign) qui vous appelle/qui répond à votre appel.	(Other callsign phonetically) Isi la stasion britanik/onglaze/galwaz / aykosayse / irlondayze / awstralien / americayn / canadiayn/nayozayolandayze/sudafrikayn (own callsign) ki vooz appell/ki raypon a votr appell.
The French speaking station, this is . . .	La station francophone, ici . . .	La stasion francophone, isi . . .
After Someone has Replied to Your Call		
I heard more than one station replying. Go ahead (XYZ). Try again (XYZ) please wait. This is (own callsign). Good morning/afternoon-evening old man. Thank you for returning my call.	J'ai entendu plus d'une station qui a répondu. Allez-y (XYZ). Une fois de plus (XYZ) attendex s'il vous plaît. Ici (own callsign). Bonjour — bonsoir mon vieux. Merci d'avoir répondu à mon appel.	Zhay ontondoo ploo doon stasion ki a raypondoo. Alez e (XYZ). Une fwa de ploo (XYZ) atonday sil voo play. Isi (own callsign). Bonzhore—bonswar mon vyeu mersi davwar reypondoo a mon appell.
I think this is the first time we have worked each other.	Je crois que c'est la première fois qu'on s'est contacté.	Zhe krwa ke say la premier fwa kon say kontaktay.
I think we have worked before.	Je crois qu'on s'est déjà contacté.	Zhe krwa kon say dayzha kontaktay.
The name is . . .	Le prenom de l'opérateur, c'est.	Le praynom de loporateur, say . . .
I'll spell it for you phonetically.	Je vous l'épelle phonétiquement.	Zhe voo laypell phonetikemon.
I repeat.	Je répète.	Zhe raypet.
Location		
The location is . . . I'll spell it for you, in the county/state of . . . in North/South/West/East England/Wales/Scotland/Ireland/Canada/USA, etc.	La situation est . . . je vous l'épelle, dans le comté/l'état de . . . au Nord/Sud/Ouest/Est de l'Angleterre/du Pays/de Galles/de l'Ecosse/l'Irlande/du Canada/des Etats Unis.	La sitooasion ay . . . zhe voo laypell, don le komtay/ayta de . . . oh Nor/Sood/West/Est de longleter/do pay/de gal/de laycos/de irlon/doo Canada/day aytas uni.
The location is in the centre of . . .	La situation est au centre de	La sitooasion ay oh sontr de . . .
On the island of . . .	Sur l'ile de	Sir lil de . . .
In the small/big town/city of . . .	Dans la petite/grande ville de	don la petit/grond vil de . . .
In the village of . . .	Dans le village de	don le viladz de . . .
In the seaside town of . . .	Dans la station balnéaire de	don la stasion bolnayr de . . .
About . . . kilometres from . . .	À peu pres à . . . kilometres de . . .	a pu pray a . . . kilometr de . . .
The longitude and the latitude is . . . degrees—minutes North/South, degrees—minutes East/West.	La longitude et la latitude sont . . . degrès — minutes Nord/Sud, degrès — minutes Est/Ouest.	La longitood ay la latitood son . . . degray—minutes Nor/Sood, degray—minutes Est/West.
The QTH locator is . . .	La situation selon la carte de répérage, c'est . . .	La sitooasion selong la kart de raypayraj say . . .
Signal Report		
You are five and nine in . . .	Vous êtes cinq et neuf à . . .	Vooz ets sank ay nerf a . . .
Your signal is variable/very weak/weak/strong/very strong/excellent.	Votre signal est variable/très faible/faible/fort/très fort/excellent.	votr sinal ay variabl/tray faybl/faybl/four/tray four/exselong.
There is no interference.	Il n'y a pas d'interférence.	Il ni ah pa dantifayrons.
There is a lot of local interference.	Il y a beaucoup d'interférence locale.	Il e a bowcoo dantifayrons lokal.
Your signals are fading.	Vos signaux s'affaiblissent.	Vos sinaw safayblis.
Your modulation is good/bad.	Votre modulation est bonne/mauvaise.	Votr modulasion ay bon/mawvayz.
I can understand you very easily.	Je vous comprends très facilement.	Zhe voo komprong tray fasilmong.
I can understand you only with great difficulty.	Je ne vous comprends qu'avec beaucoup de difficulté.	Zhe ne voo komprongkavek bowcoo de difikultay.
Asking for Information and Commands		
Please state your name/your location/your callsign.	Veuillez dire votre nom/votre location/votre indicatif.	Vayay deer votr nom/votr lokasion/votr andikatif.

What is your country?	Quel est votre pays?	Kel ay votr pay?
Please spell your name/location/callsign phonetically.	Epelez votre nom/location/indicatif phonétiquement.	Epelay votr nom/lokasion/andikatif phonayteakmong.
Please can you give me a report?	Pouvez-vous me faire un rapport?	Poovay voo me fair yng rapor?
Please repeat.	Répétez s'il vous plaît/veuillez répéter?	raypaytay sil voo play/vayay raypaytay.
Please speak more slowly.	Parlez plus lentement s'il vous plaît?	Parlay ploo lontement sil voo play.
Do you have a lot of interference?	Avez vous beaucoup d'interférence?	Avay voo bowcoo dantiferons?
Are my signals fading?	Est-ce que mes signaux s'affaiblissent?	Es se ku may sinow safaiblis?
Have we worked each other before—on this band/on 10, 15, 20, 40, 80, 160 metres?	Est-ce qu'on s'est déjà parlé-sur cette bande/sur dix, quinze vingt, quarante, quatre vingt, cent soixante mètres?	Es se kon say dayzha parlay sir set bond/sir di/kanz/van/karont/katrvan/son swasont metr.
I'm sorry I do not understand you.	Je regrette, je ne vous comprends pas.	Zhe regret zhe ne voo comprong pas.
I do not understand/speak French very well.	Je ne comprends pas/parle pas très bien le francais.	Zhe ne comprong pa/parl pa tray biang le fronsay.
Please stand by.	Restez à l'écoute s'il vous plaît?	Restay a laycoot sil voo play.
Please go again.	Essayez encore une fois?	Essayay onkor une fwa.
Do you copy?	Me copiez-vous?	Me copyay voo?
How do you copy?	Comment me copiez-vous?	Comon me copyay voo?
Is this frequency free/occupied?	Est-ce que cette fréquence est libre/occupée?	Es se ku set fraykons ay libr/okupay?
This frequency is in use old man, I'm sorry.	Cette fréquence est déjà ocupée mon vieux, je regrette.	Set fraykons ay dayzha okupay mon vyeu, zhe regret.
I have a sked.	J'ai une conversation au programme.	Zhai un conversasion oh program.
Can we change frequency? How about 10kHz up/down if the frequency is free?	Si on changeait de fréquence? Si on descendait/ montait de dix kilohertz si la fréquence est libre?	Si on shonzhay fe fraykons? So on desonday/montay de di kiloherts si la fraykons ay libr?
How about S19?	Si on allait à la dix-neuf?	Si on allay a la dis nerf?
Can we go simplex?	Est-ce qu'on peut se contacter en direct?	Es ce kon pu se kontaktay en direct?
I shall see you on the . . . repeater.	Je vous verrai sur le relais de . . .	Zhe voos verray sir le relay de . . .
Shall we try sideband?	Si on essayait la bande latérale?	Si on essayay la bond lateral?
How about Morse?	Si on essayait de se contacter en Morse?	Si on essayay de se kontaktay en Morse?
I'll give you a report on the next over.	Je vous ferai un rapport pendant votre prochain échange.	Zhe voo ferray un rapor pondon notr proshain exchonzhe.

Net Working

I think it is (XYZ's) turn.	Je crois que c'est à (XYZ's) de parler.	Zhe krwa ke say a (XYZ's) de parlay.
I've forgotten whose turn it is.	J'ai oublié à qui est le tour.	Zhai oobliay a ki ay le toor.
Over to . . . with the group.	À . . . de parler avec le groupe.	A . . . de parlay aveck ke group.
Break.	Break.	Break.
Over.	À vous.	A voo.

Rig and Antenna

The rig here is . . .	L'équipement ici est un . . .	Laykipemon isi ay un . . .
I'm using a . . . transceiver.	Je me sers d'un émetteur-récepteur . . .	Zhe me ser d'un aymayteur-rayseptor . . .
I have here a . . . receiver and . . . transmitter with a transverter/with a linear amplifier.	J'ai ici un récepteur . . . et un émetteur . . . avec transverteur/avec un amplificateur linéaire.	Zhay isi un rayseptor . . . ay un aymayteur . . . aveck transverteur/avack un amplificateur linayair.
I am putting out 10, 20, 50, 100, 150 watts.	J'émets dix, vingt, cinquante, cent, cent cinquante watts.	Zhemey di, van, sankont, son, son sankont watt.
The rig is home brew with modifications.	L'équipment est de fabrication de fortune avec des modifications.	Laykipemon ay de fabricasion de fortyn aveck day mofficasions.
My antenna is a dipole/is a trapped dipole/a beam with three elements.	Mon antenne est une dipole/une dipole à trap/un faisceau avec trois éléments.	Mon anten ay une daypol/une daypol a trap/un faskow aveck trwa elaymon.
A Yagi with 10 elements.	Un Yagi à dix éléments.	Un Yagi a di elaymon.
with horizontal/vertical/circular polarisation.	avec polarisation horizontale/verticale/circulaire.	aveck polarizasion orizontal/vertical/sirkulair.
with a gain of . . .	avec une avance de . . .	aveck un avons de . . .
A quad/a long wire/an end fed Zeppelin.	Un quadrangulaire/un long fil/un Zeppelin alimenté au bout.	Un kwadrangoolair/un long fil/un Zepelain alimontay oh boo.
A centre fed Zeppelin.	Un Zeppelin alimenté au centre.	Un Zepelain alomontay oh sentr.
The antenna is about . . . metres above ground level.	L'antenna est à peu près à . . . mètres au dessus du niveau du sol.	Lanten ay a pu pray a . . . metr oh dessey do nivoh do sol.
The QTH is . . . metres above sea level/at sea level/below sea level.	Le QTH est à . . . mètres au dessus du niveau de la mer/au niveau de la mer/ au dessous du niveau de la mer.	Le coo tay ash ay . . . metr oh dessey do nivoh de la mare/oh nivoh de la mare/oh desoo do nivoh de la mare.

The antenna has a rotator. I'll turn the antenna on you during the next over.	L'antenne a un rotateur. Je tournerai l'antenne vers vous pendant notre prochain échange.	Lanten a un rotateur. Zhe tourneray lanten ver voo pondon notr proshain ex-shonge.
I rotate the antenna by hand. The antenna is in the garden/attic/on a . . . metre high mast.	Je tourne l'antenne à la main. L'antenne est au jardin/à la mansarde/sur un mât haut de . . . mètres.	Zhe tourn lanten a la man. Lanten ay oh zhardan/a la monsard/sir un ma oh de . . . metr.
I am testing the rig. I am glad of your report. I like my . . . I want to change my . . . How do you like your . . .	Je teste l'équipment. Je suis content de votre rapport. J'aime bien mon . . . je veux changer mon . . . Est-ce que votre . . . vous plaît?	Zhe test laykipemon. Zhe swi conton de votr rapor. Zhaim byan mon . . . zhe voe shonzhe mon . . . Es ce ke votr . . . voo play?

Weather and Radio Conditions

Today the weather is fine/sunny/(very) cold/hot/misty/windy. It is raining. It is snowing. The snow is 300mm thick. The weather has been fine. Today/yesterday/during the weekend it has been raining. It has been snowing.	Aujourd'hui il fait beau/du soleil/(très) froid/chaud/du brouillard/du vent. Il pleut. Il neigé. La neigé est à trente centimetres d'épaisseur. Il a fait beau. Aujourd'hui/hier/pendant le weekend il a plu. Il a neigé.	Ohzhordwe il fay boh/do solay/(tray) frwa/sho/do brooiar/do von. Il plu. Il nezh. La nezh ay a tront sentimetr daypaysor. Il a fay boh. Ohzhordwe/ee-air/pondon le weekend il a plu. Il a nezh.
Winter/spring/summer/autumn has come. The wind has been strong. There has been thunder and lightning.	L'hiver/le printemps/l'été/l'automne est arrivé. Il a fait un orage. Il a fait du tonnerre et des éclairs.	Leevair/le prontom/laytay/lohtum ay arreevay. Il a fay un orazhe. Il a fait du tonair ay daze ayclair.
Working conditions are poor/bad/moderate/good/very good/excellent. All the bands are open. The 10, 15, 20, 40, 80 metre band is closed/open to North/Central/South America. Eastern/Northern/Southern/Western Europe, Asia, Australasia, Africa, the Far East, Japan.	Les conditions de travail sont pauvres/mauvaises/moderées/bonnes/très bonnes/excellentes. Tout les bandes sont ouvertes. La bande de dix, quinze, vingt, quarante, quatre vingt, cent soixante mètres est fermée/ouverte sur L'Amérique du Nord/Central/du Sud. L'Europe d'Est/du Nord/du Sud/de l'Ouest, l'Asie, l'Australasie, l'Afrique, l'extrême Orient, le Japon.	Lay condision de travai son povr/mohvase/modayray/bon/tray bon/ecselongt. Toot lay bond son oovairt. La bond de di, kanz, van, karont, katrvan, son swasont metr ay fairmay/oovairt sir lamayrik do nor/sentral/du sud. Loorop dest/do nord/do sud/de lwest/lasi/lawstralasi/Lafrik/lestrem oriong/le zhepong.
I have just heard a . . . I can hear but cannot work a . . . There is an opening on 2 metres, 70cm.	Je viens d'entendre un . . . J'entends mais je ne peux pas contacter un . . . Il y a une éclaircie sur deux mètres, soixante dix centimètres.	Zhe vee-an dontondr un . . . Zhonton may zhe nay pu pa contactay un . . . Il e a une eklairsee sir duh metr, swasont di sentimetr.
This lift is getting better/getting worse. Hope it lasts. Nice to speak to you under lift conditions.	Le temps se lève/empire. Espérons que cela va durer. Enchanté de pouvoir vous parler dans de meilleures conditions.	Le temp se se laiv/ompir. Ayspayron ke sela va diray. Onshantay de poovwar voo parlay don lay mayor condisions.
It is . . . o'clock approx, local time/GMT. What time is it in . . .	Il est à peu près . . . heures, heure locale/GMT. Quelle heure est-il à . . .	Il ay a pu pray . . . oers, oer local/Zhe m tay. Kel oer ayt il a . . .

Arranging a Sked

May I speak to you again? Are you free tomorrow/this time next week/at . . . hrs GMT?	Puis je vous contacter de nouveau? Est-ce que vous serez libre demain/à cette heure la semaine prochaine/à . . . heures GMT?	Pwi zhe voo kontactay de noovoh? Es se ke voo seray libr deman/a set oeur la semayn proshain/a . . . oeur Zhay m tay?
How about this frequency or alternatively . . . Let's try the 10, 15, 20, 40, 80 metre band. No I'm sorry, I am not free at that time. I am usually on 20 metres at . . . GMT on (days of week) except . . . I have to go to bed/to work now.	Essayons cette fréquence ou bien . . . Essayons la bande de dix, quinze, vingt etc., mètres. Non, je regrette, je ne serai pas libre à cette heure. Je suis généralment sur vingt mètres à . . . GMT (days of week) sauf le . . . Je dois me coucher maintenant/je dois aller au travail.	Esayon set frekons oo biang . . . Esayon la bond de di, kanz, van, karont, etc metr. Non, zhe regret, zhe ne seray pa libr a set oeur. Zhe swi zhenynayralemon sir van metr a . . . zhay m tay (days of the week) sof le . . . Zhe dwa me kooshay mantenon/zhe dwa allay oh travai.

The second part of this article will appear next month

air test

USER REPORTS ON SETS AND SUNDRIES

TELEREADER CWR-685 CW–RTTY–ASCII Communications Computer

The advent of the microprocessor has revolutionised the RTTY side of amateur radio and there are now several dedicated micros designed specifically for this purpose. The subject of this Air Test is the Telereader — a self-contained c.w., RTTY and ASCII terminal complete with video monitor screen.

The Telereader will inevitably be compared with the Tono Theta communications computer which we reviewed in *PW* May 1981. Although they are both aimed at similar markets they differ greatly in approach. The Tono Theta uses a separate video display (television) but is more sophisticated than the Telereader. The Telereader, however, is much easier to drive and is complete with built-in screen. It is more expensive than the Tono but leaves your domestic TV free.

Construction

The main unit is housed in a neat metal case with the main controls grouped sensibly on the left of the front panel and the video screen occupying the right-hand third of the panel. The controls are mostly push-buttons clearly labelled as to their purpose. There are four vertically operating slider controls at the left of the panel which are used to "tune" the Telereader for correct decoding of the signal. Above these four controls are four l.e.d.s which are not connected in any way with the controls. The l.e.d.s indicate power on, c.w. and mark and space. The latter two light up to show a mark or space and make tuning very easy when using the unit as an RTTY terminal.

The keyboard is a stand-alone unit and can be placed in the most convenient position on the operating desk. The key layout is conventional QWERTY and the action light and positive, making its use pleasant and easy. The video screen is clear and, although small compared to a normal portable domestic TV set, is easily read, the characters being clearly formed and well focused.

A handbook is supplied with the unit and takes quite a bit of understanding. No pictures of the front or rear panels are shown but as the controls and connections are clearly marked on the unit itself, and are fairly straightforward to use, the handbook did not prove to be too much of a drawback.

The review unit was used on the *PW* station at Breadboard '81 exhibition last November in conjunction with a Drake TR-7 h.f. transceiver. So pleasant was the Telereader to use that for most of the show GB2PW was on RTTY and contact was made with numerous stations as widely spaced as Japan, Israel, America and most of Europe.

The Telereader was also used with a Standard C58 to try some RTTY on 144MHz. The unit was easily connected to the mic socket to use a.f.s.k. and worked very well with this rig. The only problem arose from the low output power.

Memories

The memory was easily loaded with a selection of useful phrases and this made putting out a CQ call as simple as pushing the appropriate buttons on the keyboard. As the storage capacity of each of the six memories was limited to 32 characters more than one memory was needed to store a CQ call and station ident phrase. However, this did not prove to be a problem and storage was adequate.

Morse

The Telereader can be used to decode, and send, Morse and it was tried in this mode. The problem with the receiving mode is the usual one of setting the unit up to cope with the variations in amateur manual Morse. Whilst being easier to set up than some other machines the Telereader still lost sync occasionally.

The unit can operate at 3 w.p.m. to 50 w.p.m. with automatic speed tracking for c.w. The machine is equipped with a p.l.l. filter which has the effect of having a pass-band of ±80Hz with vertical sides to the filter characteristic. In other words signals within the pass-band are handled only when the p.l.l. is in lock. The p.l.l. filter can be switched out.

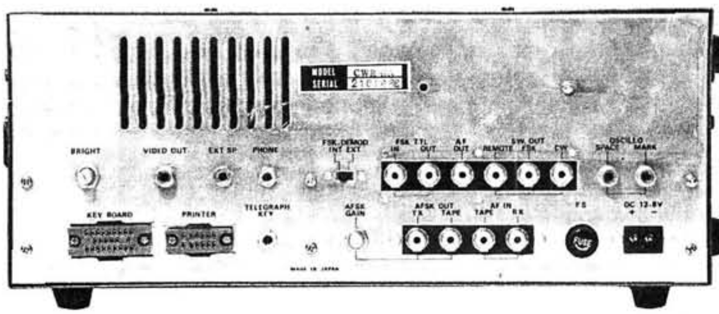
The Telereader is claimed to be able to interprete code with dashes ranging from 2 to 4 dots long. Over 4 dots long the dash may be correctly interpreted but the next code will probably be mis-coded. As the unit is computing using the previous eight characters it should only mis-code the occasional character.

When used as an RTTY terminal the MARK and SPACE l.e.d.s made tuning into a signal very easy and, coupled with the complete lack of mechanical clatter, made RTTY a pleasure. During operation the internal oscillator provides a pleasant sound which also helps with tuning and to some extent simulates the sound of a mechanical RTTY terminal without the mechanical clatter. This oscillator also gives audible Morse when decoding, or sending, this type of transmission.

In RTTY and ASCII modes the Telereader will operate at speeds of 45·45, 50·00, 56·88, 74·2, 110 and 300 bauds, with the highest speed only usable with an external modem or the TTL option input.

The rear panel carries all the input and output plugs, sockets and terminals including the connections for the nominal 12V d.c. supply at 1·6A. The handbook describes how to connect these to the receiver or transmitter and between each other for different operating modes. Frequency shift keying (f.s.k.) is the normal mode for input and output from the Telereader but f.s.k. TTL signals are also available at the back panel for use with an external modulator and demodulator. RTTY and ASCII can be transmitted using the AFSK OUT TX terminal (audio frequency shift keying) when using a transceiver not equipped for f.s.k. inputs. In this case connection is made to the transceiver's MIC terminals.

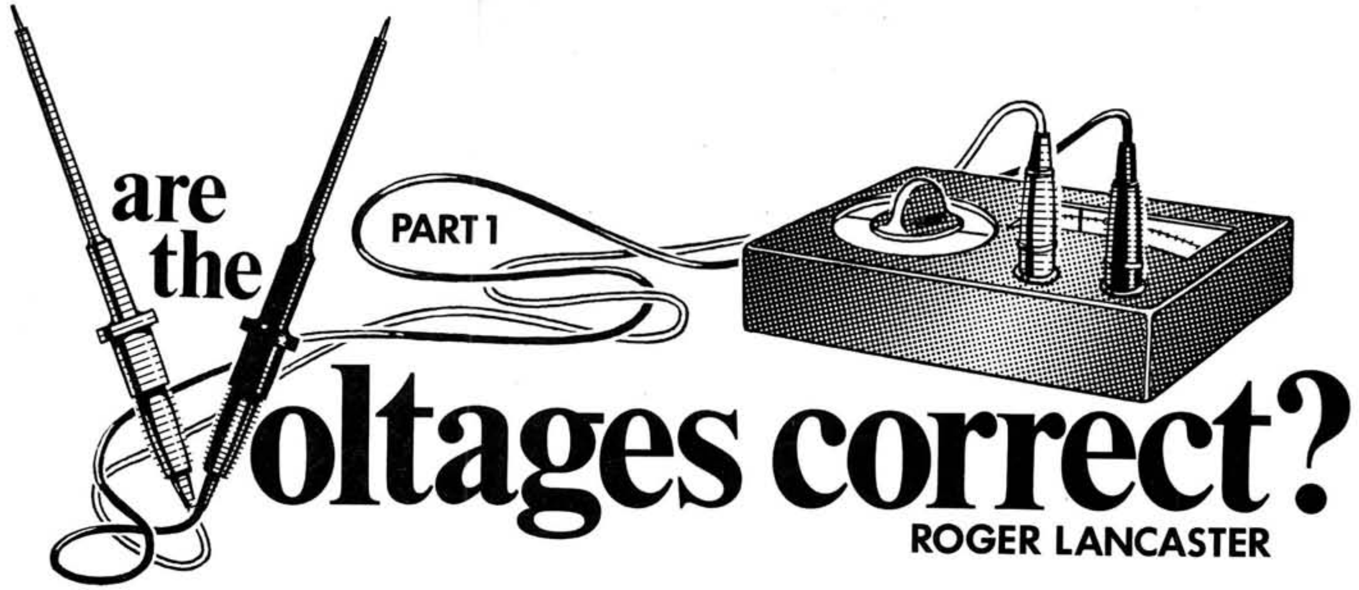
Connections are provided for a tape recorder and a printer (Centronics Compatible Parallel Interface) for hard copy output. ASCII codes are outputed to the printer. An oscilloscope can also be connected, in X-Y mode, to make tuning even easier than it is using just the l.e.d.s and oscillator output.



Handbook

The handbook, whilst adequate in terms of describing the operation of the Telereader, lacks several important features. There are no pictures of the controls or back panel connections and no circuit diagram of the complete unit. These omissions make understanding the fractured English a trifle difficult. The occasional mistake, such as *receiving* instead of *transmitting* in the description of the AFSK OUT TX function, does not help in working out the connections needed for your installation.

Our thanks to **Thanet Electronics, 143 Reculver Road, Beltinge, Herne Bay, Kent. Tel: 02273 63859** for the loan of the review model. The CWR 685 Telereader costs £699 inc. VAT.



are the Voltages correct?

PART 1

ROGER LANCASTER

There are three basic requirements for successful trouble-shooting in radio and electronics:

(i) a multi-range meter
(ii) a good understanding of how the circuit works; and
(iii) the ability to take voltage readings at any point in the circuit **and to recognise whether the readings are acceptable or not.**

This series of articles will concentrate on (iii). It is assumed the enthusiast will possess (i)—it does not have to be an expensive meter. (Other test equipment can be useful but is not normally essential).

The writer has deliberately specified **voltage** readings since far more useful information can be obtained from voltage readings than from other tests—say, ohmic readings with the circuit switched off. In fact, faults can normally be found by making voltage tests even without the benefit of (ii), although the time taken may be longer.

Voltage readings of power supplies are, of course, easy because invariably it will be known what the supply voltage should be; but readings taken at points within the depths of a complex circuit are a very different matter. What should the voltage be? Test data is seldom provided. Does the fact that the meter needle moves across the scale indicate that all is well? Certainly not! The potential at the test point must be **estimated** fairly accurately so that an intelligent assessment can be made after the measurement has been taken.

For example, looking at the circuit in Fig. 1. Suppose the potential at "A" is accurately quoted as being +2·7V with respect to earth, yet the meter reads +1·3V. Is this near enough to be acceptable? It doesn't appear to be very close to the quoted figure, yet in certain circumstances a reading of +1·3V could be **exactly correct.** Take the circuit in Fig. 2. Suppose the meter reads +19·5V. Is this correct? Since the transistor is non-conducting it seems to be near enough, yet if the supply is indeed +20V, this reading could indicate a faulty component! We shall return to these problems in a later article.

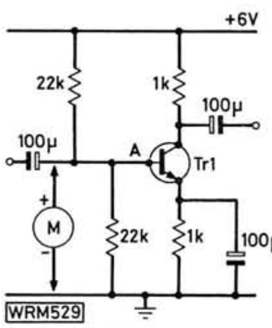


Fig. 1

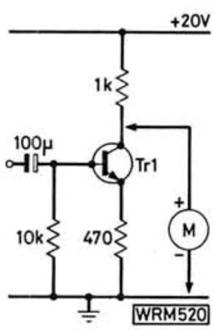


Fig. 2

This series is therefore designed to enable the beginner to acquire the art of estimating voltages in complex circuits so that trouble-shooting can be mastered quickly. It may also help older hands to improve upon their skills in this direction.

We shall start with the simplest of circuits and gradually build up a technique which will be invaluable even when applied to the most complex of circuits.

Points of Reference

To take a voltage reading, both leads of the meter must be connected to the circuit. One of these will be connected to the point whose potential we wish to determine and the other lead will be connected to a **reference point** in the circuit, usually a line considered to be at "zero volts", which may be earthed or may simply be one line of the power supply.

In Fig. 3 the potential difference between points "A" and "C" is 6V, the 6V of the battery. Since R1 and R2 are in series and equal in value, by Ohm's Law there will be equal potential differences across them, therefore a potential difference of 3V between points "A" and "B" and another p.d. of 3V between points "B" and "C". But what are the **potentials** at points "A", "B" and "C"? Well, it depends on which of these points we take as a **reference.** Note that we cannot say that "A" is at +6V and "C" is at −6V since this would imply a potential difference between "A" and "C" of 12V, which in turn would mean a 12V battery.

If "C" is to be our reference, then "B" will be at +3V **with respect to "C"** and "A" will be +6V with **respect to "C".** If we earth "C", or simply call it "0V", then "B" will have a **potential** of +3V and "A" will have a **potential** of +6V.

If "A" is the reference, "B" will be −3V with respect to "A" and "C" will be −6V with respect to "A". If we earth "A", then the potential at "B" will be −3V and the potential at "C" will be −6V.

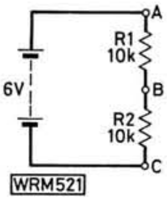


Fig. 3

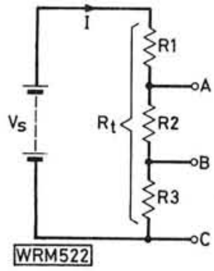


Fig. 4▶

Similarly, if "B" is our "0V" point, "A" will have a potential of +3V and "C" will have a potential of −3V.

If using a moving-coil meter, the polarity of the leads must be correct, otherwise a reverse reading will be obtained—this is not good for the meter since the pointer will hit the left-hand back-stop and could become bent. If your meter is of the digital electronic type, reverse readings will simply be shown with the minus sign illuminated and no harm should befall the instrument.

Resistors in Series

The voltage across any resistor in a series chain can be calculated by Ohm's Law provided the applied voltage and the resistance values are known, this being the usual situation in practice.

In Fig. 4, the voltage across R1 could be found by first calculating the current I from the formula:

$I = Vs/Rt$ (where $Rt = R1 + R2 + R3$),

then by using:

$V_{R1} = IR1$

However, there is no need to calculate I—all good fault-finders are lazy individuals, they always try to take the shortest route to the fault. Since the resistors are in a purely series circuit, the current is common to them all. The voltages across the individual resistors are therefore in direct proportion to their resistance values. We can then use the general formula:

$$V_{R1} = \frac{R1}{Rt} \times Vs$$

to find the voltage across R1. Similarly, $V_{R2} = (R2/Rt) \times Vs$ gives the voltage across R2 and $V_{R3} = (R3/Rt) \times Vs$ is the voltage across R3. The same general formula can be used for voltages across combinations of resistors in series. For example, the voltage between points "A" and "C" would be given by

$\frac{(R2 + R3)}{Rt} \times Vs$. This general formula is easy to use even with the simplest of pocket calculators.

The voltages calculated do not give us the **potential** at any point directly, however. We must use the voltages calculated in conjunction with our reference point in order to estimate potentials.

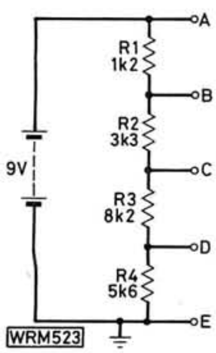


Fig. 5

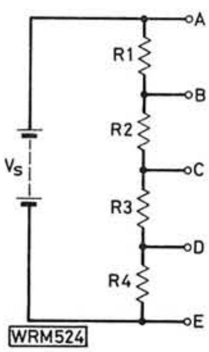


Fig. 6

Take the numerical example in Fig. 5. The total resistance is $(1{\cdot}2 + 3{\cdot}3 + 8{\cdot}2 + 5{\cdot}6) = 18{\cdot}3\text{k}\Omega$

$V_{R1} = (1{\cdot}2 / 18{\cdot}3) \times 9 = 0{\cdot}59\text{V}$
$V_{R2} = (3{\cdot}3 / 18{\cdot}3) \times 9 = 1{\cdot}623\text{V}$
$V_{R3} = (8{\cdot}2 / 18{\cdot}3) \times 9 = 4{\cdot}033\text{V}$
$V_{R4} = (5{\cdot}6 / 18{\cdot}3) \times 9 = 2{\cdot}754\text{V}$

Now "E" is our reference point since it is earthed (0V). From the above results:

Potential at "A" = +**9V** (supply voltage)
Potential at "B" = 0·59V **less positive** than potential at "A" and = 9 − 0·59 = **+8·41V**
Potential at "C" = (0·59 + 1·623)V **less positive** than at "A" and = 9 − 2·213 = **+6·787V**
Or = (2·754 + 4·033)V **more positive** than "E" and = + **6·787V**
Potential at "D" = 2·754V **more positive** than "E" and = **+2·754V**

If "A" was earthed instead of "E", the potentials would be:

"A" = 0V
"B" = −0·59V
"C" = −2·213V
"D" = −6·246V
"E" = −9V

If "B" were 0V instead of E, then

"A" = +0·59V
"B" = 0V
"C" = −1·623V
"D" = −5·656V
"E" = −8·41V

If "C" were the earthed point, then

"A" = +2·213V
"B" = +1·623V
"C" = 0V
"D" = −4·033V
"E" = −6·787V

You should now be able to list the potentials if D were the earthed point.

Now try an experiment for yourself. Wire up the circuit of Fig. 6 using a battery of 6 or 9V and any resistors you have available between the values of 100Ω and 5kΩ. Estimate the potentials at "A", "B", "C", "D" and "E", calling each of the points "0V" in turn. Verify your estimations by meter readings. However, do not worry if your readings are not exactly the same as you have estimated—there are perfectly sound reasons why they may be slightly different and we shall be looking into this in next month's issue.

3V audio amplifier

R.A.PENFOLD

At one time most small battery operated radio and electronic equipment was powered by a 9V battery such as the 6-F22 (PP3) or 6-F50–2 (PP6) types. Rising battery costs have since led to a search for alternative power sources such as rechargeable NiCad batteries, and the use of low voltage torch cells.

In theory a couple of small 1·5V torch cells, like the R6 (HP7), can provide sufficient energy for items of low power equipment such as portable radios, giving many hours of operation at a relatively low cost. The practical problem is that although such a power source can provide quite high currents for long periods, the nominal output potential of the series connected cells is only 3V, and it is difficult to produce an audio output stage that will operate efficiently at such a low voltage. The actual output voltage when the cells are nearing exhaustion, but are still quite useable, is only likely to be about 2·2 to 2·5V, which makes things even more difficult!

Despite these technical restraints, it is possible to produce an audio amplifier that will give adequate volume from a 3V battery supply, using the KB4433 i.c. designed specifically for this purpose. This device actually contains two audio amplifiers, and could be used for example in a portable stereo radio. However, it is more likely to be used as a simple mono amplifier with one section left unused, or with the two sections used in a bridge circuit configuration to give increased output.

Both these methods of operation are considered in this article.

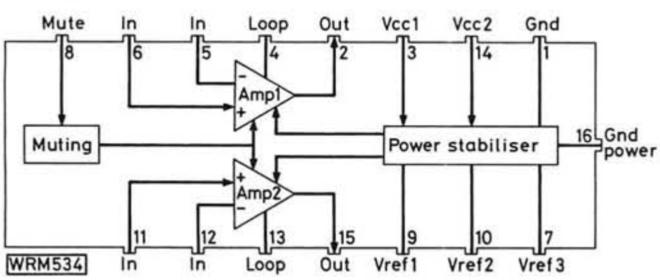


Fig. 1: Block diagram of the KB4433

Simple Amplifier

When using just one section of the KB4433 an output power of typically 150mW r.m.s. can be achieved using a 3V supply and a 4Ω loudspeaker. The output power is reduced to typically 70mW r.m.s. with a 2·2V supply and 4Ω speaker. The output powers are slightly higher than half these figures when an 8Ω speaker is used. Whilst these output powers are admittedly not very high, in practice the volume obtained is surprisingly good even when using an 8Ω speaker. The output stage of the KB4433 is a class B type having a typical quiescent current consumption of 15mA, but this does of course increase considerably at high volume levels.

The circuit diagram, Fig. 2, shows the practical realisation of a simple audio amplifier stage incorporating a KB4433 device. The input signal is coupled to the non-inverting input of the device by way of volume control R1

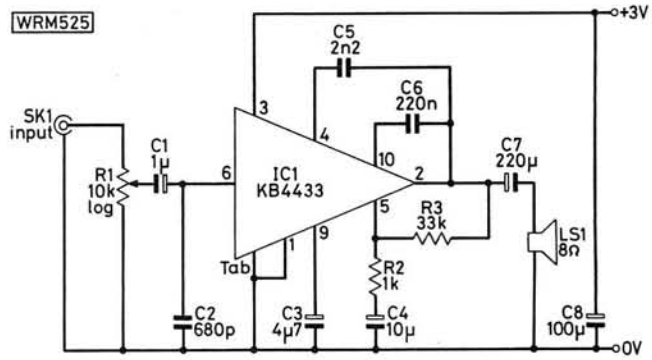


Fig. 2: A simple amplifier circuit using the KB4433 device

and d.c. blocking capacitor C1. This input is biased by an internal biasing circuit. Resistors R2, R3 and capacitor C4 provide negative feedback from the output of the amplifier to the inverting input, and the voltage gain of the circuit is approximately equal to R3 divided by R2. This gives a voltage gain of 33 times with the specified values, but the voltage gain can be altered to other levels, within reason, by changing the value of R3. This requires a value in kΩ equal to the required voltage gain. Electrolytic capacitor C7 couples the output signal to the loudspeaker LS1, and the remaining components are required to aid the stability of the circuit.

CONSTRUCTION RATING **Beginner**

BUYING GUIDE

Constructors of this project should have no difficulty in obtaining the components. The KB4433 is available from Ambit International

APPROXIMATE COST **£6**

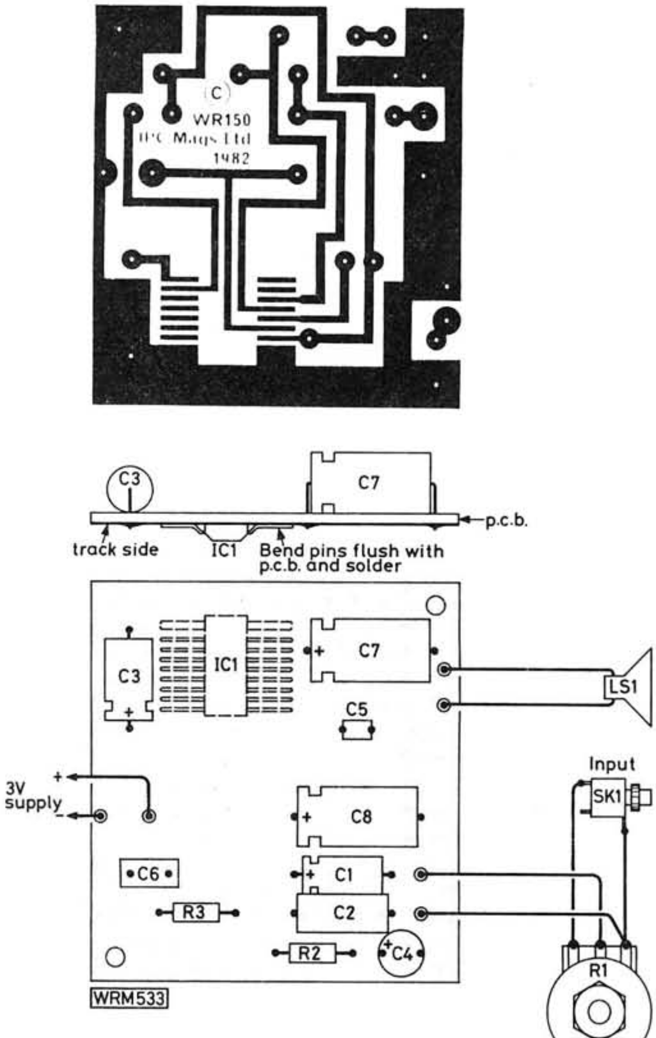
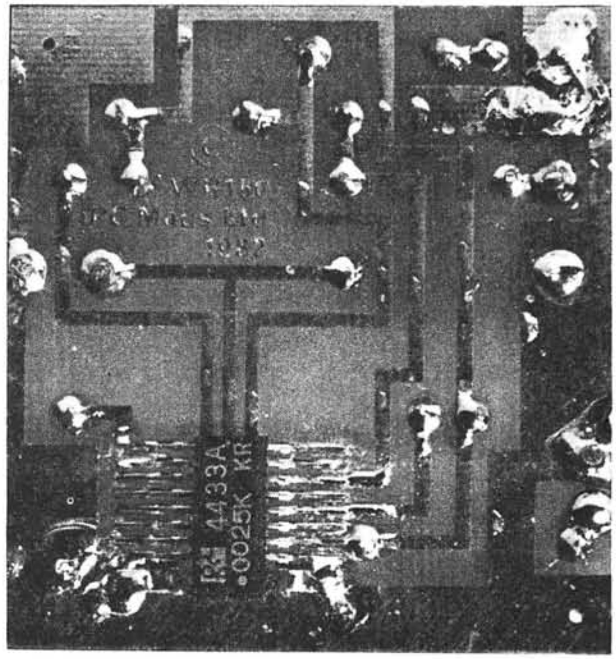


Fig. 3: The component layout and track pattern shown full size



Underside of the p.c.b.

Construction

It is highly recommended that the physical layout shown in Fig. 3 is used as it would be difficult to use any other constructional method successfully. A suitable printed circuit board design is shown full size.

Construction is quite straightforward, with the exception of the mounting of IC1. This device has a rather unusual encapsulation featuring 16 pins and two heat-tabs in a plastic "flatpack" arrangement. Some applications of this device could utilise a specially formed quad-in-line pin configuration; however, for the simple mono circuit the i.c. is mounted directly onto the track side of the p.c.b., as shown in the photograph and the component overlay, Fig. 3. The pin spacing of the KB4433 is only 0·05in, or half that of most i.c.s, so care must be taken while soldering into position. A 15W soldering iron with pencil bit is recommended, taking care to avoid excessive heat build-up. This looks like a precarious exercise but in practice is easily accomplished.

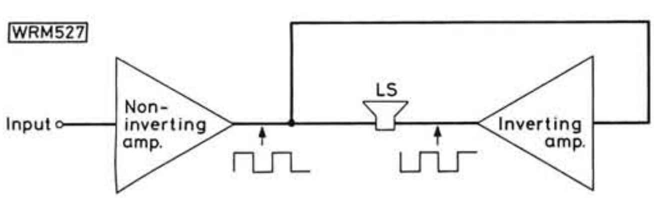


Fig. 4: A bridge amplifier drives the loudspeaker from antiphase outputs, thus increasing the maximum output power for a given supply voltage

★ components

MONO AMPLIFIER FIG. 2

Resistors		
¼W 5% Carbon Film		
1kΩ	1	R2
33kΩ	1	R3
Potentiometer		
Midget ¼W carbon track		
10kΩ*log*	1	R1
Capacitors		
Monolithic Ceramic		
2·2nF	1	C5
0·22μF	1	C6
Polystyrene		
680pF	1	C2
Tantalum 16V		
10μF	1	C4
Electrolytic, double ended		
1μF	1	C1
4·7μF	1	C3
100μF	1	C8
220μF	1	C7
Semiconductor		
Integrated circuit		
KB4433 (Toko)	1	IC1
Miscellaneous		
Printed circuit board; 8Ω loudspeaker LS1; Terminal pins.		

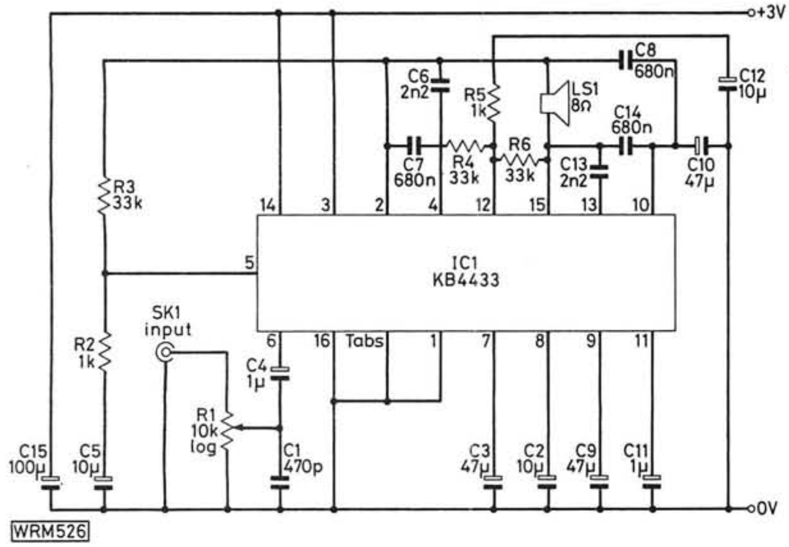


Fig. 5: The circuit diagram of the 250mW bridge amplifier

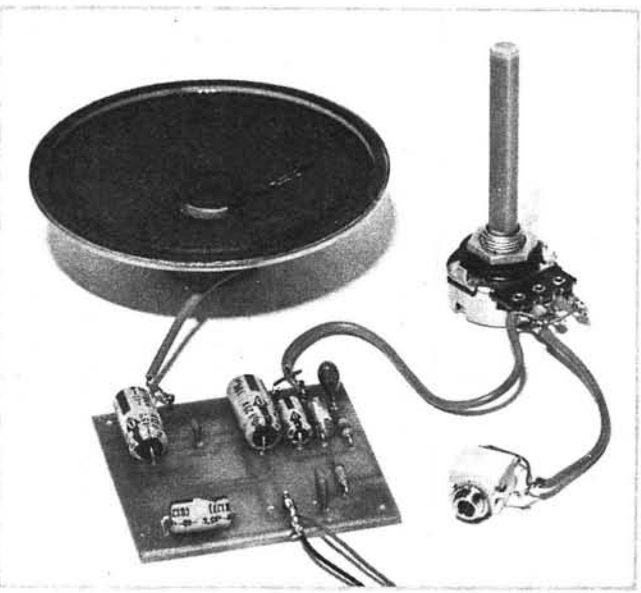
Bridge Amplifier Circuit

When used as a bridge amplifier the KB4433 uses the arrangement shown in Fig. 4.

The non-inverting amplifier is basically just the same as the circuit of Fig. 2, however the inverting amplifier uses the second section of the device in a circuit having unity voltage gain, taking its input from the output of the non-inverting amplifier. The loudspeaker is fed from the outputs of the two amplifier stages and so neither speaker terminal is at earth potential. The two amplifiers must be accurately biased so that there is only a negligible current flowing through the loudspeaker under quiescent conditions. The KB4433 has an internal bias circuit which ensures that the two output voltages are accurately balanced under quiescent conditions.

When the output of the non-inverting amplifier is positive-going, the output of the inverting amplifier will go negative by the same amount. Similarly, when the output of the non-inverting amplifier is negative-going the inverting amplifier output goes positive by an identical amount. This arrangement results in double the voltage across the loudspeaker when compared to a non-bridge circuit, and can be maintained right up to the point where the outputs clip. A doubling of the peak-to-peak output voltage can be attained, and consequently a doubling of the peak output current. This gives a theoretical fourfold boost in output power for a given supply voltage.

In practice the increase in output power that is obtained is slightly less than fourfold, since the increased output current results in a slightly larger voltage drop through the output transistors and a consequent reduction in efficiency. The KB4433 bridge circuit gives a typical output power of 250mW r.m.s. when used with a 3V supply and an 8Ω loudspeaker compared with 70mW for the basic circuit of Fig. 2. It is interesting to note that this is more than the power rating of many miniature 8Ω impedance speakers! The typical output power falls to 130mW with a 2·2V supply and an 8Ω impedance load.



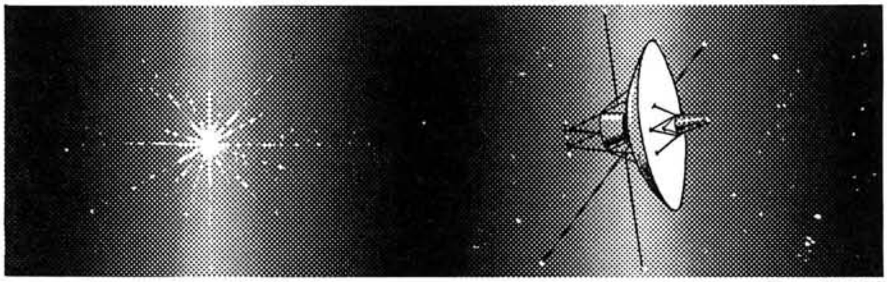
Photograph of the prototype

Bridge Circuit

The circuit diagram of Fig. 5 shows a bridge amplifier configuration employing the KB4433. The two amplifier sections are connected in the same basic configuration as the circuit of Fig. 2, but the non-inverting input of the second stage is unused, and is coupled to earth via C11 to prevent unwanted pick-up at this point. Components C7 and R4 couple the output of the first amplifier to the inverting input of the second stage; the value of R4 is chosen to give the appropriate unity voltage gain.

Capacitors C3, C9, and C10 are decoupling capacitors for the internal bias circuit of the KB4433. The circuit can be muted by taking pin 8 to the negative supply voltage, or to within approximately 1V of this supply rail level. However, in most applications this feature will probably not be required. The bridge circuit should not be used with a loudspeaker having an impedance of less than 8Ω. ●

From spark to space



Ron HAM

As 1982 sees the 50th anniversary of the formation of the British Broadcasting Corporation (earlier Company), the 50th of BBC External Services and the 60th for broadcasting, when better to commence a nostalgic column, especially in the year when our magazine celebrates its 50th birthday?

My first real taste for radio came in 1942 when I was given some parts and a diagram to assemble a one-valve receiver, which, when connected to an antenna and some large batteries, emitted signals through its headphones originating somewhere in the short-wave bands. While working for a long established radio retailer in 1945, I remember unpacking, valving-up and testing the firm's limited supplies of Wartime Civilian Receivers and like many other enthusiasts wishing there was enough pocket money to buy some of the mouth-watering radio equipment which was rapidly appearing in the government surplus shops. During 1946/7 many factories were once again manufacturing radio sets for the domestic market as well as preparing for the development of post-war television.

Radiolympia

The September 1947 issue of *Practical Wireless* announced the forthcoming National Radio Show at London's Olympia and I well remember the first few lines of a poem that was published with it:

Radiolympia! Once again
The good old "show" returns.
And in our Brotherhood of Fans
Anticipation burns.
What shall we see? We cannot say;
We'll know that on the opening day.

Those words inspired me at the age of 16 and now, almost 35 years later, as your scribe and a member of the Radio Amateurs Old Timers Association (RAOTA), I would like this new column to kindle a similar enthusiasm for the history of radio and vintage gear among our thousands of readers.

Early Wireless Books

"I am now 63 years of age but when in my teens I built a Lissen 3-valve set; detector and two low frequency stages and 120V battery and an accumulator, the greatest thrill was on a Sunday morning back in the early '30s when I heard VK2ME and the Kookaburra callsign," writes A. Carswell from Falkirk, who adds: "The big name in *Practical Wireless* in those days was F. J. Camm and I have one of his books, *Television and Short Wave Handbook* published by Newnes in 1935."

This type of book often appears in second-hand book shops and jumble sales and is well worth collecting. Ken Smith went to a church jumble sale in Horsham recently and for 10p, picked up a copy of *Handbook of Technical Instructions for Wireless Telegraphists* published by Wireless Press Ltd., in 1915. These books are fun to read and their pictures very instructive, but do remember the authors were talking about the latest state of the art at the time when the text was prepared. One of my favourites among the modern books is *The Story of Radio* by W. M. Dalton, published in three volumes by Adam Hilger. Do let me know about any recent book on the subject that you would like to recommend to fellow readers.

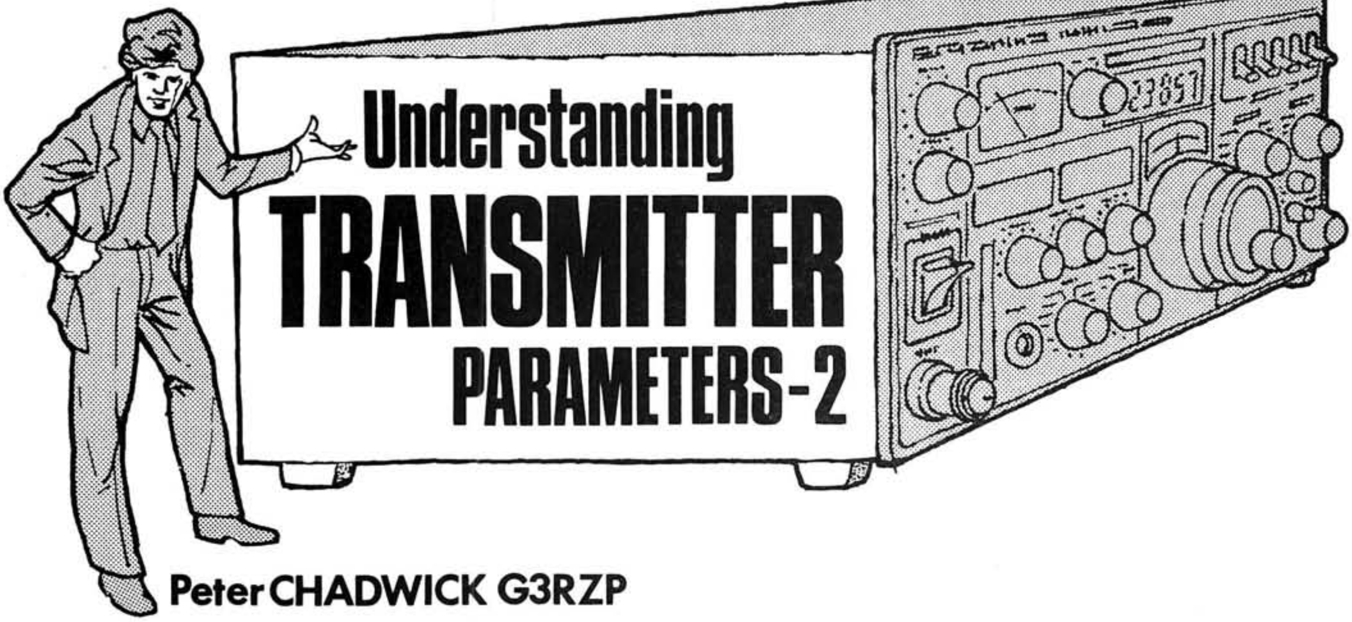
Co-operation

A well-known enthusiast from Worthing, David Rudram, answered an advert in The Vintage Wireless Company's newsletter *The Antique Wireless News Sheet* from Bernd Namendorf DB3QN, a valve collector in Germany who wanted a number of specimens. During their negotiations, David said that he required a Volksempfanger (People's Receiver). In due course their respective goodies were exchanged by post and both Bernd and David were delighted with the outcome. Bernd has more than 1500 valves in his collection dating from 1916 and representing most European countries including Czechoslovakia, Denmark and the USSR. Several models of the Volksempfanger were produced between its introduction around 1934 and the end of hostilities in 1945, and David found most of the information about these sets in three issues of the magazine *Wireless World* (then published weekly) of 1934, '35 and '39, and a centre page spread in the November 1946 issue of *Practical Wireless.*

The German People's Receiver— inside and out

Places to Visit

If you are in the south, don't forget to take a look at the vintage wireless exhibitions at ARRETON MANOR on the Isle of Wight, open weekdays 1000 to 1800 and Sundays 1400 to 1800 and THE CHALK PITS MUSEUM at Amberley, Sussex, open 1100 to 1700 Wednesdays to Sundays inclusive, plus bank holidays between April 3 and October 31. The Chalk Pits is holding a special Wireless Day on June 6 when Geoff Arnold, the Editor of *Practical Wireless,* will officially open the museum's new radio building. Special arrangements for parties can be made at both museums.



Understanding TRANSMITTER PARAMETERS-2

Peter CHADWICK G3RZP

Power

A parameter not yet mentioned has been power. This is obviously very important, and requires definition. This definition however depends upon the service that the transmitter is meant for, and is also dependent upon the modulation mode.

Both a.m. and f.m. transmitters are rated in commercial service in terms of the output power of the carrier. In this respect, a change has taken place over the years; until a few years ago, a.m. and f.m. transmitters were generally rated in terms of the input power to the final stage. The increase in the use of s.s.b. where output power ratings are more usual, combined with the rather different efficiencies from solid-state p.a. stages has led to the change. However, the classical valved transmitter with a Class C final stage is usually assumed to be about 66 per cent efficient in terms of d.c. input power to r.f. output power.

Duty Cycle

A major consideration is that of duty cycle. The broadcast transmitter obviously has to be rated for continuous service, while the taxi-cab radio rarely transmits for more than one minute at a time. Obviously, all components in the broadcast transmitter must be rated for continuous service, but where transmissions are short enough that no undue heating takes place, it is possible to make economies in power ratings. In s.s.b., where unprocessed speech is used, it is fairly common to use line output valves (sweep tubes) in p.a. stages because of their capability of drawing a large anode current at a low anode voltage, and thus give a high output power at low cost. However, the low dissipation associated with such valves limits their use on single or two tone transmissions. On speech, with the 9:1 average to peak ratio discussed earlier, the average power that the valve (and, incidentally, the power supply) is handling enables the high peak power to be obtained without unduly stressing the p.a. stage. However, the use of two tones, a single tone, a.m., RTTY and SSTV, or processed speech at full power is another matter entirely. Modern solid-state rigs suffer similarly; perhaps in some respects, rather more. This is because the valved stage was capable of having its envelope at 150 to 200°C while dissipating some 50 or so watts, while the transistor heatsink needs to be not more than about 50°C above am-

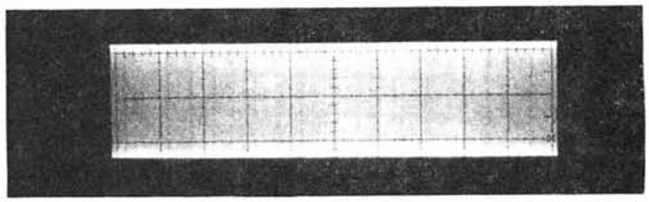


Fig. 1: Single tone on s.s.b.

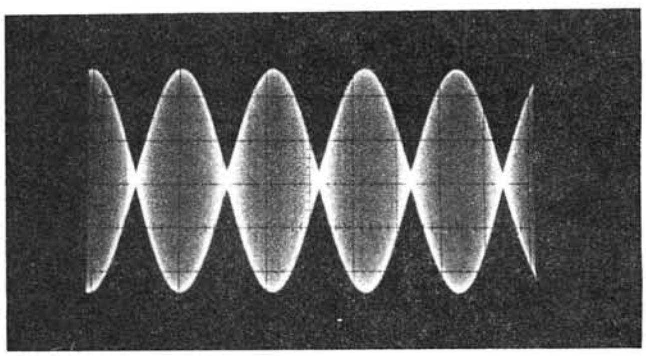


Fig. 2: Two tones of equal amplitude on s.s.b.

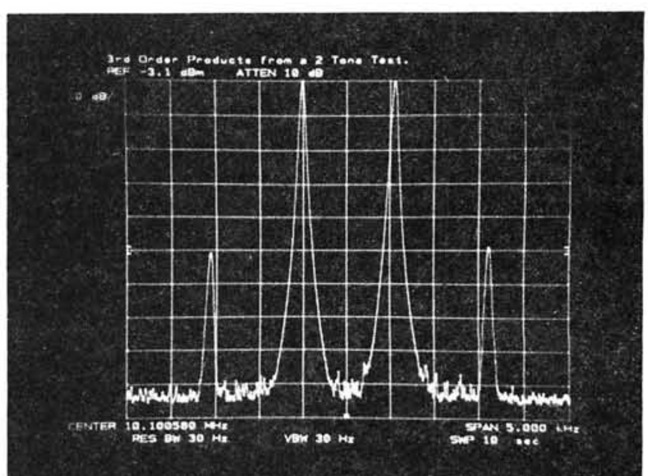


Fig. 3

bient. As a result, the heatsink area and thermal capacity needs to be higher, and the situation is worsened by the lower efficiency of the solid state broad-band p.a.

Single sideband transmitters are rated in terms of p.e.p., or peak envelope power. This is the power represented by the peak of the output waveform when the transmitter is modulated by means of two or more tones, but must be specified at a given level of distortion for the power level specification to be meaningful—a matter glossed over by many advertisement writers. Because an s.s.b. transmitter can be considered as a mixer system which translates the frequency of an audio input tone to a discrete r.f. output frequency, obviously the amplitude waveform as seen on an oscilloscope will be a straight line (Fig. 1).

When two tones are used, the resultant waveform is shown in Fig. 2, provided the tones are equal in amplitude. However, it can be shown mathematically (Ref. 1) that where the two tones are passed through a non-linear circuit, side frequencies are produced (Fig. 3). These side frequencies are intermodulation distortion products, and the ratio of these i.m.d. products, or i.p.s (intermodulation products) as they are known, to the main wanted signals is a measure of the linearity of the transmitter. Because when two equal amplitude tones are applied to the s.s.b. transmitter, they run in and out of phase producing the pattern shown in Fig. 2, the peak voltage varies between zero and twice the individual voltages.

In the same way, the power at the peak of the envelope is four times (twice the voltage) of the individual tone, and thus each tone is 6dB down from p.e.p. The ratio of i.p.s can be specified relative either to one of the two tones, or to p.e.p., and vary by 6dB. For example, when the i.p.s are at −25dB relative to one of the tones, they are at −31dB relative to p.e.p., and the difference is not generally specified. In fact, the author sometimes wonders if the manufacturers of some amateur equipment even know the difference!

Output Power Measurement

The actual measurement of the output power is not always as easy as may be hoped for. That this is tacitly recognised by licensing authorities may be found in type approval specifications, where accuracies of plus or minus 10 per cent are specified as the limits for r.f. power measurement. The classic way of measuring the power in the amateur's case is by means of either a calibrated power meter, or a dummy load and thermo-ammeter. For large professional transmitters, calorimetric methods are preferred, whereby the actual heat released is measured, and although this can be done by the amateur, it is not a simple method.

It is often stated that a thermo-ammeter can be calibrated at d.c., and that the calibration will then hold at r.f. This assumption is however somewhat suspect, as it assumes that the heat generated by so many amperes of r.f. is the same as that generated by the same number of amperes of d.c. This is fine, if the resistance of the heating element is the same. But as the heating element may be made of a material which has a high skin resistance, this is not always true. However, for the radio amateur, this is as good a method as any, and probably more accurate than most. It has the inestimable advantage of responding to the average power, and thus a two tone test will produce the right answer with little mathematical jiggery pokery (p.e.p. = $1{\cdot}414I^2R$ for two tones, and I^2R for a single tone or c.w. signal). The method is used professionally for transmitters such as those used at sea, where the antenna load is normally a capacitor in series with a small resistor.

Although this method is adequate to around 30MHz, v.h.f. and u.h.f. measurements are very different. Absolute power measurement is then best carried by calorimetric methods, although some very small thermocouples are available. A method which is growing more popular at all frequencies is to feed the transmitter via an attenuator to the input of a spectrum analyser, and this is a very accurate method if the attenuator is well calibrated, and the spectrum analyser is used within its limitations.

Meters and Loads

Dummy loads and power meters require careful treatment. Unless the diodes have had peaking capacitors fitted, or the scale has been suitably drawn, the power measurement is only accurate on single tone. However, it may be shown that the reading is out by a factor 2·668, and this can be taken into account. Unfortunately, the linearity of the detectors then leaves much to be desired, and the accuracy is thus doubtful.

Whatever method is used, s.s.b. measurements should hopefully be made at such levels that the 3rd order i.p.s are at least −25dB on each tone if degradation of the on-channel signal is not to be noticeable under all conditions. As the out of channel radiation requirements usually require a better performance than this, the in-channel performance is usually neglected. The main area where this is not the case is for i.s.b. (independent sideband transmitters) where each sideband carries differing information. In this case, i.p.s at −36dB on tone are desirable and incidentally, are very hard to get with conventional solid state linear amplifiers unless running at low powers.

So when the G3 with the big linear says he is running 399·99W p.e.p. output, you are entitled to blow a very large raspberry!

Finally, the measurement of the i.m.d. products requires a spectrum analyser. If done with care, it is possible to use a receiver with good dynamic range, provided it is not overloaded. Ref. 2 suggests a method using an oscilloscope, while the normal method of ensuring that there is no flattening of the peaks of the two-tone signal does not allow the absolute maximum to be obtained from the transmitter, but does ensure a clean signal. The author tends to use the same method with all-valved rigs, which is to adjust the tuning and loading for maximum power output with a large amount of drive on single tone. This requires adjustments to be done quickly, but does tune the rig up correctly. The usual method of tuning up with low anode current and reduced output "to save the p.a." leads to the linearity suffering at higher output powers. Unfortunately, too many people fail to understand how the p.a. stages work, which leads to many of the "whiskery" signals on the bands.

References

1. Pappenfus, Bruene and Schoenike, *Single Sideband Fundamentals and Circuits*, McGraw-Hill, 1964.
2. Ibid.
3. *1981 Radio Amateurs Handbook*, ARRL, Chapter 11.

Part 3

The third part of this article will cover out-of-channel radiation and its causes and some of the problems brought about by the increasing use of frequency synthesis techniques.

HOW THE BBC BEAT THE BLITZ

Chas. E. MILLER

World War Two lasted for very nearly six years. Throughout that period, despite all the dangers and difficulties, the BBC never failed to provide a service to its listeners. It was a remarkable achievement which reflects great credit on the engineering staff, who at one stage had the British armed services to reckon with as well as those of Nazi Germany! It came about this way.

What we would now call "conventional" bombing by aircraft was feared just as much in the 1930s as the nuclear variety is today. For years military "experts" had been producing increasingly gloomy forecasts of what would happen in another war, to the point where they had convinced nearly everyone that in London alone 600 000 people would be killed in the first six months, plus ten times that number wounded. With half a million houses destroyed the underground stations would be packed with homeless refugees who would either go mad with fear or go down with nasty diseases. Air defence was thus taken very seriously indeed. Someone had figured out that the BBC's network of transmitters formed, in effect, a chain of powerful radio beacons centred on densely populated areas. By using basic and well-established DF equipment bomber pilots could easily find their way to Britain's major towns; and there was no reason to doubt that the Nazis were also well aware of this interesting fact.

The reaction of the military chiefs was to demand that the BBC be closed down if and when war broke out. On the other hand, there was a strong case for broadcasting to continue. If the damage to London was to be as severe as expected, there was a good chance that radio would be the only mass-communication system left in working order. It would be indispensable for informing, comforting and rallying the public in the invasion that was likely to follow the bombing. The BBC could point to the only peacetime occasion when newspapers had ceased publication—the General Strike of 1926—when the broadcast news bulletins had been invaluable.

At the same time, the Corporation was as determined as anyone that its transmitters should not assist the enemy. To render them useless as beacons their well-known frequencies and locations would have to be disguised, but this was not as easy as might be thought. It was no good merely to swap around the various wavelengths, because after an initial period of confusion to friend and foe alike the stations could have been re-identified. What the engineers proposed was the synchronising, as they called it, of all medium-wave transmitters to a single wavelength. This would confuse the DF equipment, preventing a positive identification of any one station until it was almost within seeing distance of the aircraft. Meanwhile, the raiders would hopefully have been spotted by the new radar stations being installed around Britain, and a message flashed to the BBC transmitter nearest the plane's target. This would have been closed down immediately until the danger was past. Listeners in the main service area would obviously notice a sharp drop in signal strength, but at least they'd still get some sort of reception from one or more of the other transmitters. Tests proved that the scheme could be made to work without the mutual interference that was at first feared. Now for the bad news. The system could only carry one programme, and those transmitters which could not be made to fit in—the long-wave Droitwich station and television from Alexandra Palace—would have to shut up shop. However, it was felt that the listeners ought to be grateful for anything under wartime conditions, and plans were made to implement the scheme at short notice.

By the end of August 1939 it was pretty obvious that war was inevitable. Television closed down abruptly, without explanation to the viewers, on the first of September. The National and Regional radio programmes closed down as normal on the night of the second, but it was for the last time. Next day the new BBC Home Service was born, in time to carry the Prime Minister's broadcast telling the public that war had been declared on the Nazis. He'd hardly had time to finish before the first air-raid warnings sounded, sending people hurrying to the bomb-shelters thinking that it was the beginning of the end. It turned out to be a false alarm, and it was to be nearly nine months before heavy air-raids took place. This interim, christened the "phoney war", rather left the BBC with egg on its face, for the Home Service had been geared to the idea of frequent news bulletins with appropriately serious items in between, such as messages from the war leaders and religious offerings. News items were thin on the ground, and the listeners never had cared too much for the rest of the fare, so they carried on, in time-honoured manner, to tune to continental stations.

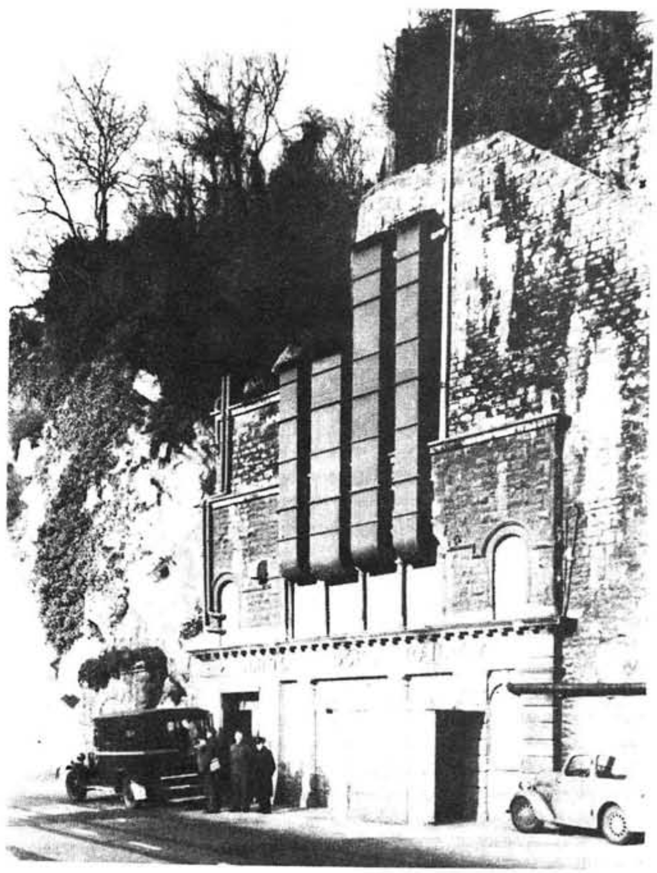
In peacetime those stations broadcasting commercial programmes in English had a combined audience as large as the BBC's at certain times, especially on Sundays. Radio Luxembourg founded its fortunes in the 1930's; Radio Normandie, now a forgotten name on old radio dials, was then an enormously popular station with a 10kW transmitter on 1·345MHz situated in Northern France. The latter kept going for quite a while after the outbreak of war, and was especially liked by the British troops stationed in France. But they were also wooed by the crafty Nazis, who set up what they called a British Forces Service, which had dance music interspersed with news. At home listeners craving for more information than that supplied by the BBC tuned to Hamburg and the blatant propaganda of William Joyce, an American-born, English-educated fascist whose exaggerated upper-class accent soon earned him the nickname "Lord Haw-Haw". He was reckoned to draw an audience of six millions at his peak period. Although some of his stuff was ludicrous—such as reporting the sinking of certain Royal Navy ships which were actually shore stations—he was strong on detailed items concerning the actual or intended attacks on specific districts of towns large and small. This fostered the impression, possibly justified, that there was a first-class German secret service at work in Britain. The BBC countered by setting up their own British Forces programme, which involved another chain of synchronised transmitters. The "Forces" was well received by civilian listeners as well, and for the first time in the BBC's history they gave a choice of light entertainment or a church service on Sundays. The Nazis' audiences began to dwindle away, and never recovered.

London's Broadcasting House damaged by enemy action. A delayed action bomb came through the telephone switchboard room on the 7th floor and landed in the Music Library on the 5th floor at 2010. It exploded at 2102 and blew out through the News Department on the west side of the 5th floor. Listeners to the 9 o'clock news heard the announcer pause and then continue with his reading

BBC Copyright

When air raids began in earnest in 1940 the effectiveness of the synchronised networks could really be judged. The drop in signal strength when some transmitters were shut down was rather too severe for the BBC's liking, so they set about installing low powered stations in and around large towns which could carry on working after the main station had ceased to operate. By 1941 no fewer than 60 of these small transmitters had been set up, again all using one common frequency. A copy of the *Radio Times* for July of that year quotes the Home Service wavelengths as 203·5m (1·474MHz), 391·1m (767kHz) and 449·1m (668kHz), with an additional short-wave service on 49·34m (6·08MHz). The Forces programme was on 342·1m (877kHz) and 48·86m (6·14MHz). (At the rear of this edition is an advert. for Radio Rentals, inviting customers to hire one of 13 models of radios for as low as 1/11d ($9\frac{1}{2}$p) per week, inclusive of free service!)

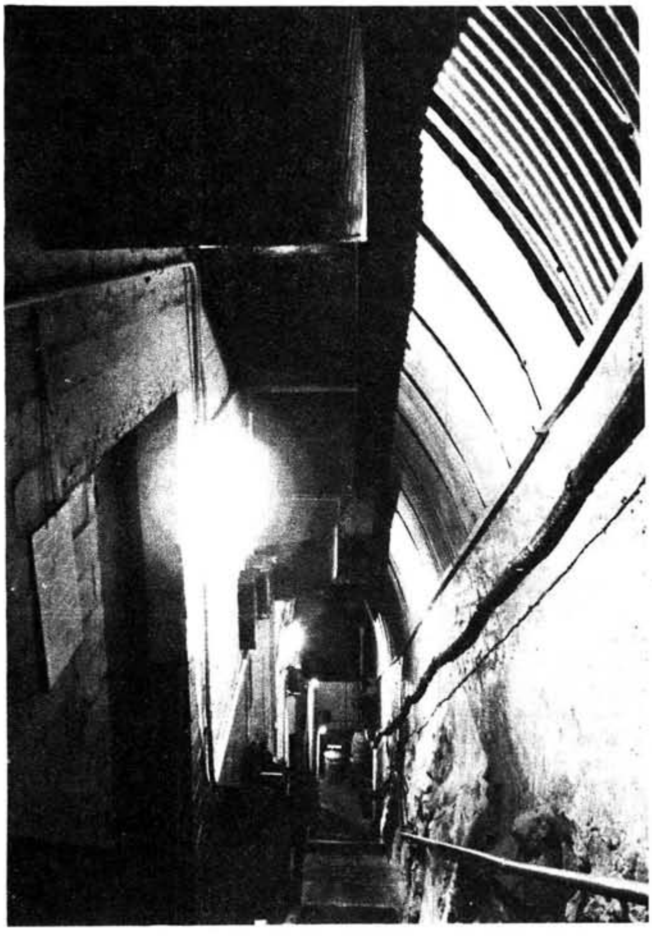
Comprehensive as the transmitter networks were, they would have been useless if the programme matter couldn't have reached them. The BBC had to face up to the unpleasant possibility that Broadcasting House might be badly damaged by bombs or even taken over by invading Nazis. An immediate precaution was to set up an emergency headquarters in Bristol which could have handled programme production if the need had arisen. But since this too could have come under attack, the search began for premises that would be absolutely bomb-proof. Under Bristol was a disused railway tunnel which would probably have been ideal for the job, but instead of grabbing it with both hands the BBC, incredibly, sent its Symphony Orchestra, nearly one hundred strong, to play in it under the famous Sir Adrian Boult, with a view to checking the acoustics. One can only infer that the BBC wanted to make sure that even if Britain was about to be utterly destroyed, radio listeners should not be denied live symphony concerts! The Maestro reported favourably, but the delay had been fatal. The Director-General went in person to inspect the tunnel, but the Nazi Air Force beat him to Bristol. A series of heavy raids forced local people to occupy the tunnel for shelter, and the D-G, to give him his due, said at once that he had no intention of turfing them out. The odds against finding another tunnel in the area ought to have been heavy, but by an astonishing piece of luck, one did exist.



The entrance to the BBC's wartime Bristol HQ showing ventilation intake and outlets. Adjoining these on the right is the antenna mast for reception

BBC Copyright

There was just one snag: whereas the first had been horizontal, the second was very nearly vertical! It was the relic of a funicular railway built in the 1890's to carry passengers up and down the Clifton Gorge, near the Clifton Suspension Bridge. Many cliff railways like it, working on the principle of counter-balancing ascending and descending carriages, were built in the late Victorian era, and some still survive in seaside towns. Where the Clifton example differed was in running the rails in a tunnel instead of in the open air. Maybe the view from the carriages would have been too vertiginous to attract passengers! After a prosperous few years Clifton funicular lost its traffic to buses and cars, and was closed down and forgotten by nearly everyone. The old British Overseas Airways Corporation found out about it and used the top half as a store, presumably having to fit a pretty strong floor to take the load. When the BBC discovered that the lower section was available they wasted no time on musical tests but acquired a 21 year lease at a nominal shilling per annum, and set about designing a complete broadcasting station in miniature which would fit the peculiar space to hand.



The stairway looking down with the transmitter room door in the left foreground. Main extract ducting is overhead and note the living rock behind the handrails on the right. The corrugated iron sheeting on the above right is to prevent water dripping through into the tunnel

BBC Copyright

It took three months' hard work to build a series of four chambers arranged vertically, with another three, smaller in size, just above ground level and set horizontally. In the highest room were installed various transmitters—one to serve Bristol with programmes, and others to keep the emergency station in touch with others up and down the country if the landlines failed. Antennas were erected on the top of the gorge and fed through special cables developed for the purpose. Immediately below the transmitters was a studio equipped with the bare minimum of essentials for small-scale musical, dramatic or feature programmes. Then came a room containing record/playback machines plus sufficient "canned" programmes for many weeks of broadcasting. Beneath this in turn was the control room, for which the BBC engineers surpassed themselves in compressing an enormous amount of kit into a small space. For instance, they put in switching gear for no fewer than 80 landlines leading to the outside stations. The Post Office routed these in various formations to minimise the risk of a single bomb damaging all in one fell swoop. The three smaller rooms held emergency diesel generators, air conditioning equipment, fuel, food and water sufficient for a siege lasting months.

The transmitter room, showing one of the RCA "H" group transmitters

BBC Copyright

Throughout the war the control room was manned day and night, transferring countless thousands of programmes in many different languages from studio to transmitters, but the emergency studio never had to be used. Just in case, whenever there was an air raid on Bristol key programme staff used to make a dash to the tunnel, by armoured car if bombs were actually falling, and would stand by to go on the air if needed. Fortunately the main studios were never silenced, but the usefulness of the control room alone fully justified the work that had gone into the tunnel.

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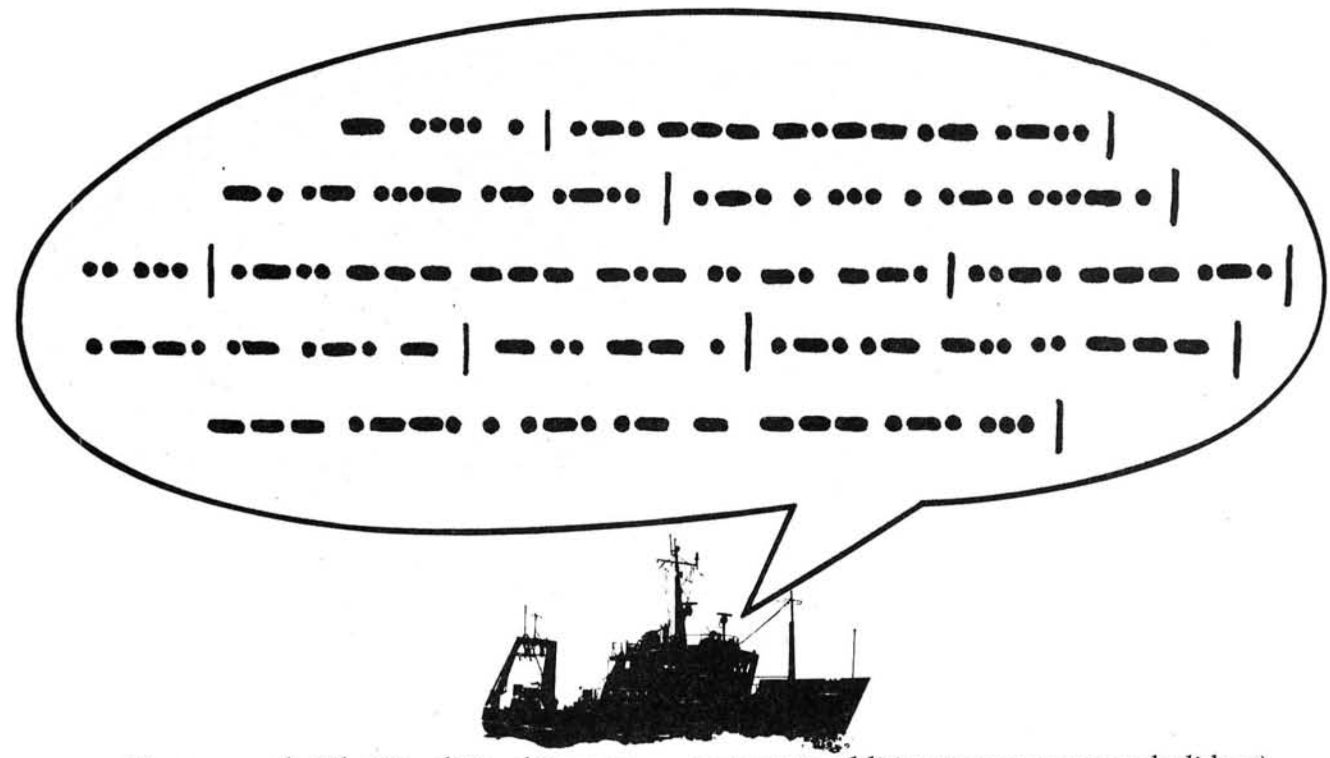


IC of the month

Brian DANCE M Sc

SL6600C f.m. i.f./demodulator device

Many of the new integrated circuits which appear on the market are merely variations of earlier types, but the Plessey Semiconductors SL6600C is something new. The only device, known to the author, to which it bears any resemblance is the now obsolete Signetics NE563, but the latter was intended for a somewhat different application. The SL6600C is mainly intended for use as a low-power, double frequency-conversion f.m. radio device for narrow-band communications applications, although it can also be used in single-conversion narrow-band f.m. receivers. In addition, the device can be employed in f.m. wide-band (broadcast programme) receivers, although it has not been specifically designed for this purpose.

The SL6600C receives its signal input from the output of an f.m. front-end unit; this input signal will normally be at a frequency of 10·7MHz, although 21·4MHz is sometimes used. The signal should be filtered (normally with a ceramic filter) before it is fed to the input of the SL6600C device. This i.f. signal is amplified in the SL6600C and fed to a mixer stage where it is mixed with a signal from a crystal-controlled local oscillator driven by circuitry incorporated into the i.c. The output signal from the mixer circuit at a much lower frequency is amplified and fed to a phase-locked-loop demodulator circuit which is also on the SL6600C i.c. The resultant audio signal is fed through an on-chip audio amplifier before appearing at the audio output pin of the device.

A device which performs all of these functions in a single chip is clearly a very complex i.c. It is therefore rather remarkable that it requires a typical power supply current of only 1·5mA (maximum 2·5mA) from a 7V supply. This low power consumption makes the device ideal for use in hand-held, battery-powered receivers and in remote control applications where battery power conservation is an important consideration. It is clearly a device with which the home constructor can spend many hours of interesting experimental work on circuit variations etc.

The Basic PLL

Some readers may not be familiar with phase-locked-loops, so before we consider the SL6600C in detail, we will briefly review the operation of a phase-locked-loop circuit for f.m. signal demodulation. It must be pointed out that the full design of a phase-locked-loop circuit is a complicated process which lies well outside the scope of this article.

The block diagram of Fig. 1 shows the basis of an f.m. phase-locked-loop demodulator. In the absence of any input signal, the voltage controlled oscillator generates a signal of frequency f_0 which is known as the free-running frequency or centre frequency; this frequency is determined by the value of the capacitor C_0 and by a resistor or possibly an inductor.

If an input signal of frequency f_1 is now fed to the phase detector part of the circuit (which is essentially a frequency mixer circuit), the latter produces an output signal containing the sum and difference frequencies $f_1 \pm f_0$. The sum frequency is greatly attenuated by the low-pass loop filter so that it reaches the output amplifier only with a very low amplitude. However, the difference frequency passes to the output amplifier and is fed back to control the frequency of oscillation of the voltage-controlled oscillator.

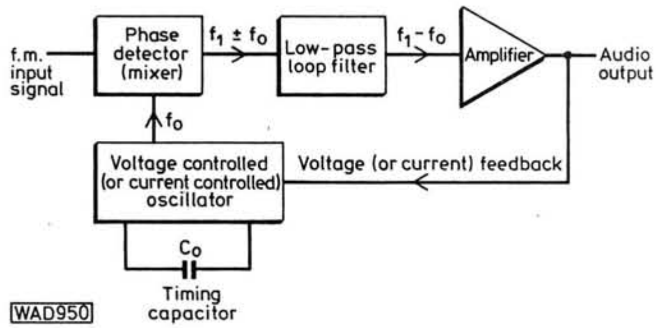


Fig. 1: The basic phase-locked-loop in block form

The circuit is designed so that the feedback signal is of a polarity such that it causes the frequency of oscillation to move towards that of the f.m. input signal. If the input signal frequency is sufficiently close to the free-running frequency of the oscillator, the feedback will cause the oscillator frequency to become locked or synchronised to the input signal frequency and the loop is then said to be "in lock".

There will still be a phase difference between the input signal and the oscillator signal, since this phase difference is required to enable the phase detector circuit to generate the feed-back error signal which maintains the loop in lock. Only when the input signal is of exactly the same frequency as the free-running oscillator will the phase of these two signals be the same.

In order for locking to occur, the input signal and free-running oscillator signal frequencies must be within the "capture range" for the loop in question. The "locking range" is the range of input frequencies over which the loop stays locked to the signal frequency; the capture range cannot exceed the locking range.

When locking has occurred, the difference frequency $f_1 - f_0$ is zero and the output voltage changes relatively slowly only when there is a change in the input frequency. This zero frequency signal will maintain the loop in lock for a constant frequency input signal, but when there is modulation present on the f.m. input signal, the value of $f_1 - f_0$ changes at the modulation frequency to keep the loop locked. Thus $f_1 - f_0$ is the required demodulated signal.

The value of the capacitor C_0 must be chosen so that the free-running frequency of the loop is adequately near to the input signal frequency for locking to occur. The values of the low-pass filter components are important if minimum noise is required, since this filter attenuates any high-frequency transients produced in the phase comparator circuit. Therefore that renders the loop much less sensitive to any short noise pulses in the signal input which could otherwise throw the loop temporarily out of lock. The filter increases the locking time, but also limits the capture range and controls the rejection of signals outside the desired band.

The simplest type of low-pass filter is just a series resistor with a capacitor on its output side to ground. A large time constant used in this filter will tend to keep the loop in lock during a momentary loss of signal owing to fading or other reasons, and will also provide an increased noise rejection and a narrower bandwidth. However, the use of a relatively large time constant will also produce a lower limit on the maximum speed at which the frequency of the voltage controlled oscillator can track that of the input signal. In the case of wide-band broadcast f.m. signals which have a frequency deviation of ±75kHz maximum, a loop filter with a smaller time constant will be more appropriate than in the case of narrow-band f.m. input signals which may have a deviation of ±5kHz maximum.

Phase-locked-loops have the advantage that they can track weak signals as the frequency of the signal drifts somewhat, therefore a constant bandwidth is maintained as the loop tracks the input signal; hence greater noise rejection can be obtained than in most other forms of detector which must have a bandwidth large enough to accept signals whose frequency may drift by an appreciable amount. The feedback action of the circuit enables a simple low-pass filter consisting of a single resistor and a single capacitor to provide a selectivity equivalent to that of three double-tuned i.f. transformers, although for some applications very slightly more complex loop filters may be desirable.

The SL6600C

The SL6600C is an 18-pin dual-in-line device with the connections shown in Fig. 2. The internal circuit is shown in block form in Fig. 3 with some of the external components required in a basic double frequency-conversion circuit.

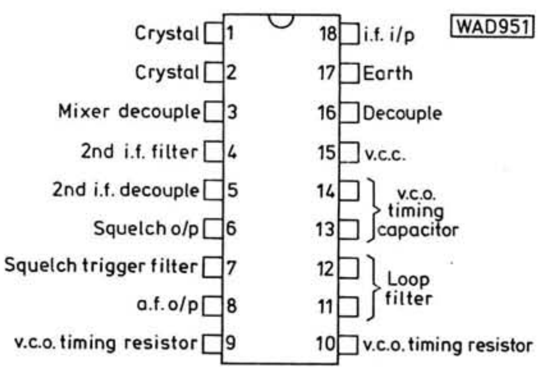


Fig. 2: Connections of the SL6600C

The input signal is fed to pin 18 and passes to an internal amplifier with a gain of 20dB; this amplifier can operate at frequencies of up to 50MHz, so the input signal frequency must not exceed this value if optimum results are to be obtained. The signal then passes to an internal mixer which converts its frequency from the first i.f. to the second i.f. The internal local oscillator circuit requires a crystal connected between pins 1 and 2 of the device, the frequency of this crystal being either the sum or the difference of the two i.f.s to be used. The maximum value of the second i.f. is about 1MHz, although it is preferable to regard 800kHz as the upper limit.

A mixer decoupling capacitor is required between pin 3 and ground, while a capacitor connected between pin 4 and ground will shunt the mixer output and thereby limit the frequency response of the input signal to the amplifier which follows the mixer. In some applications it may be desirable to replace this single capacitor with a tuned circuit, in which case a series capacitor of perhaps 5nF should be used between pin 4 and the parallel tuned circuit to block direct current. In order to avoid damping, the dynamic impedance of the tuned circuit should not exceed 5kΩ.

The filtered second i.f. output is now fed to a further amplifier on the i.c. which provides a gain of about 60dB at frequencies up to about 1MHz and which requires a decoupling capacitor from pin 5 to ground. The signal is passed to a fairly complex phase-locked-loop demodulator circuit in the device.

The timing capacitor (see Fig. 1) of the voltage controlled oscillator is connected between pins 13 and 14 of the SL6600C. The value of this capacitor should be chosen so that the v.c.o. free-running frequency is near to the second i.f. This can be done by choosing a value of the timing capacitor of (300/f)pF where f is the second i.f. in MHz. As this formula is only approximate and there is a variation from one device to another, Plessey Semiconductors have suggested that a variation of the value of this timing capacitor of some 20 per cent should be available; a lower value of capacitor than that calculated may be employed with a parallel trimmer capacitor. The temperature coefficient of the voltage-controlled oscillator is some +1000 parts per million per degree centigrade. So a capacitor with a negative temperature coefficient (such as an N750K ceramic type) is appropriate for use as the timing capacitor.

Fine adjustment to the free-running frequency can be made by adjustment of the timing resistor connected between pins 9 and 10. The frequency at which free-running occurs may be increased by up to about 10 per cent by the use of this timing resistor. This 10 per cent increase is obtained when the minimum recommended value of 47kΩ is used, while a 470kΩ resistor between pins 9 and 10 will produce a negligible effect on the free-running frequency.

The loop filter is connected between pins 11 and 12. In addition, a 33kΩ resistor is required between pin 11 and the positive power supply line.

High speed data outputs can be taken directly from pins 11 and 12, but for normal audio outputs the signal is taken from pin 8. The resistor and capacitor in the output circuit limit the bandwidth and reduce high frequency noise.

The SL6600C incorporates a "squelch" facility for detecting when no signal at a suitable level is present. The squelch level is set by means of the preset variable resistor connected from pin 7 to the positive supply line; this resistor sets the output signal-to-noise ratio at which the output is muted. The capacitor connected between pin 7 and ground determines the squelch attack time, that is, the rapidity with which the output is silenced in the presence of noise. A value between 10nF and 10μF is recommended. The squelch output pin provides a typical voltage of 0·2V (maximum 0·5V) when receiving an input signal of at least 20μV r.m.s., but this rises to about 6·9V (minimum 6·5V) when no signal is present. This output may be employed to control other equipment. The squelch hysteresis is typically 2dB. This is the difference in signal level at which switching to the muted state occurs and that at which a return to the normal state takes place; without hysteresis excessively frequent switching could occur for very minor changes in signal level.

A practical circuit for the i.f. and demodulator stages of a narrow-band f.m. receiver using the SL6600C is shown in Fig. 4. A front-end unit (not shown) is required to amplify the incoming v.h.f. signal and to change its frequency down to the normal 10·7MHz first i.f. Also the signal is filtered by two to four ceramic 10·7MHz filters before being passed to the input of Fig. 4. The input impedance at pin 18 is typically 910Ω and this should be taken into consideration when calculating the load on the last ceramic filter for optimum matching, although this is not essential.

The circuit in Fig. 4 will operate with signals of over 5μV r.m.s. (although a typical SL6600C will operate with a 3μV input signal), providing there is a signal-to-noise ratio of 20dB.

A 10·6MHz or a 10·8MHz crystal is employed in the circuit of Fig. 4 to produce a second i.f. of 100kHz when this crystal frequency is mixed with the incoming 10·7MHz signal. The 300pF capacitor between pins 13 and 14 tunes the voltage-controlled oscillator to approximately 100kHz to match the second i.f. The exact frequency of the oscillator can be adjusted by feeding an unmodulated 1mV input signal to pin 18 and altering either the value of the capacitor between pins 13 and 14 or, more conveniently, the preset frequency adjusting potentiometer so as to maximise the voltage at pin 7.

The values of the loop filter components, R1 and C8, shown in Fig. 4 have been selected for the particular application concerned where the maximum frequency deviation of the incoming signal is ±5kHz, the second i.f. is 100kHz and the audio bandwidth is 3kHz. That is, these values are suitable for narrow-band communications work only. For the more technically minded readers, the values of loop filter components shown will produce a loop natural frequency of 3·3kHz and a damping factor of 0·707.

The circuit of Fig. 4 has been designed for use in hand-held or vehicle-mounted transmitter-receiver units for mobile communications systems which operate in the v.h.f. or u.h.f. bands. Such systems use f.m. with maximum deviation usually in the range of ±1·5kHz to ±12kHz, the first i.f. being 10·7MHz or 21·4MHz. Now that standards for CB radio are established in the UK this device is suitable for this application.

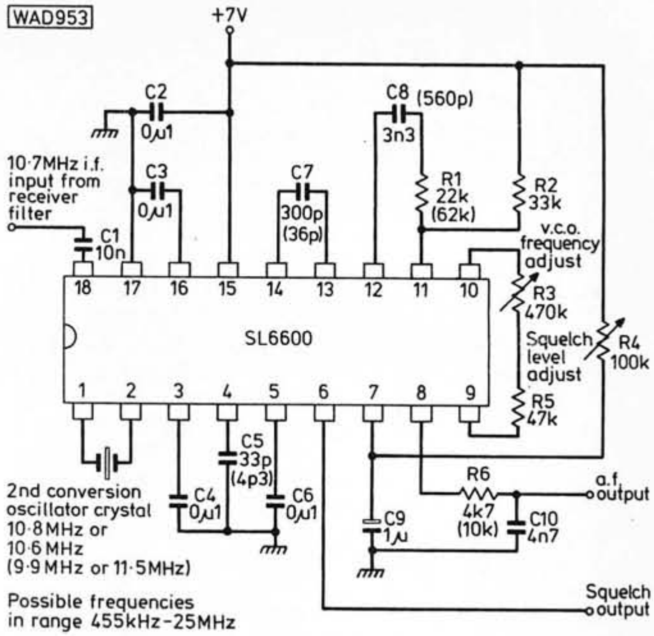


Fig. 4: A narrow-band f.m. i.f./demodulator circuit using the SL6600C (wide-band component values in brackets)

A particular advantage of the use of the phase-locked-loop detector instead of a quadrature detector is its better capture ratio. Plessey Semiconductors state that a receiver using the SL6600C will capture the stronger of two signals in the same channel even if the amplitude is only 2–4dB greater than that of a weaker interfering signal. This is in contrast to the SL6640 (which requires an external quadrature tuned circuit) which will be affected by a co-channel interfering signal even if that signal is some 20dB or more below the strength of the wanted signal. The

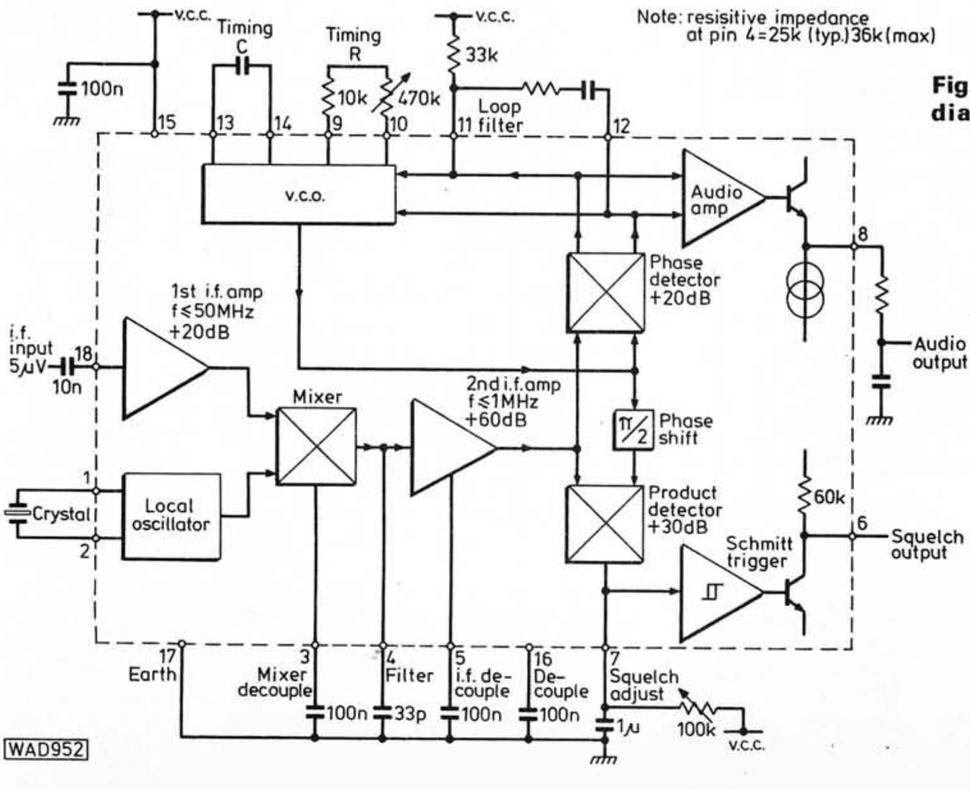


Fig. 3: SL6600C internal block diagram with basic external components

SL6600C double-conversion circuit does involve the use of a crystal, but its double-conversion circuit can result in improved stability, since the gain at each intermediate frequency is less than the gain required in the i.f. circuit of a receiver using only one i.f.

The signal-to-noise ratio at the output of the Fig. 4 circuit for low input signal levels in shown in Fig. 5 for a typical SL6600C device. When the input signal is 1mV, the signal-to-noise ratio is typically 50dB with a minimum of 30dB in any device. If a 10·7MHz signal modulated by a 1kHz tone with a ±1·5kHz deviation is applied to the input at the 1mV level, the audio output is in the range 20 to 80mV r.m.s. (typically 50mV). Total harmonic distortion plotted against the input signal level is shown in Fig. 6.

The stability of the voltage-controlled oscillator against variations of the temperature and of the supply voltage to the circuit is shown in Fig. 7. The Fig. 4 circuit provides an a.m. rejection of not less than 30dB (typically 40dB) when an a.m. signal modulated to the 30 per cent level is applied to the input at a level of 100μV.

The SL6600C device has been designed to operate over the wide temperature range −55°C to +125°C from a 7V supply. The absolute maximum permissible supply voltage is 9V, but 7V should be regarded as the normal limit. As shown in Fig. 8, all SL6600C devices will operate down to −25°C from a 6V supply and a supply of 5·75V is adequate for temperatures above freezing point.

Single Conversion

The SL6600C can be used as an i.f. amplifier/phase-locked-loop demodulator unit in a single-conversion receiver provided that the i.f. used is not greater than about 800kHz. No crystal is required for use in the single-conversion mode, but a 6·8kΩ resistor should be connected in place of the crystal between pins 1 and 2 and a further 2·7kΩ resistor between pin 1 and earth.

The overall gain of the circuit will be reduced by some 12dB when the single conversion mode is employed.

Broadcast Applications

The SL6600C has not been designed for broadcast f.m. signal reception, although it can be employed for this purpose. However, the linearity of the voltage-controlled oscillator circuit is not adequate for providing the very low distortion audio output signals one expects to obtain from the modern f.m. receiver, although the author has found that results acceptable to many listeners are readily obtainable.

Some changes in component values are required for wide-band broadcast reception. The figures in brackets in Fig. 4 apply for wide-band broadcast reception. Plessey Semiconductors recommend that the second i.f. should be 100kHz or ten times the peak frequency deviation, which-

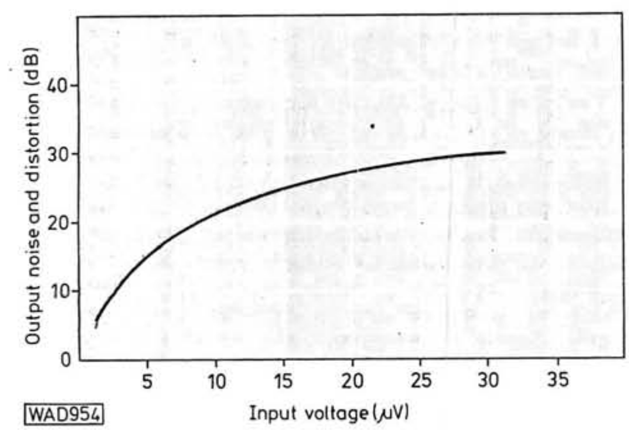


Fig. 5 ▲

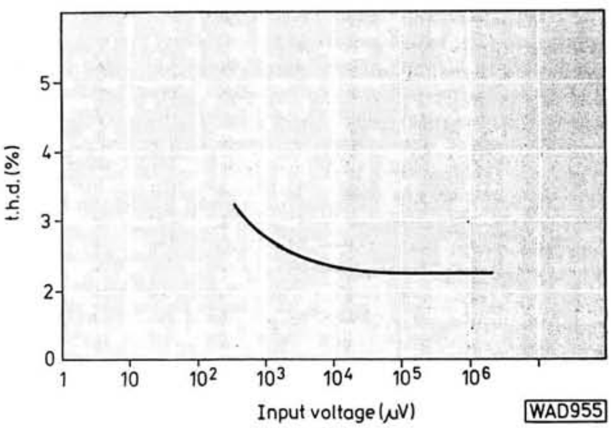


Fig. 6 ▲

Fig. 7 ▼

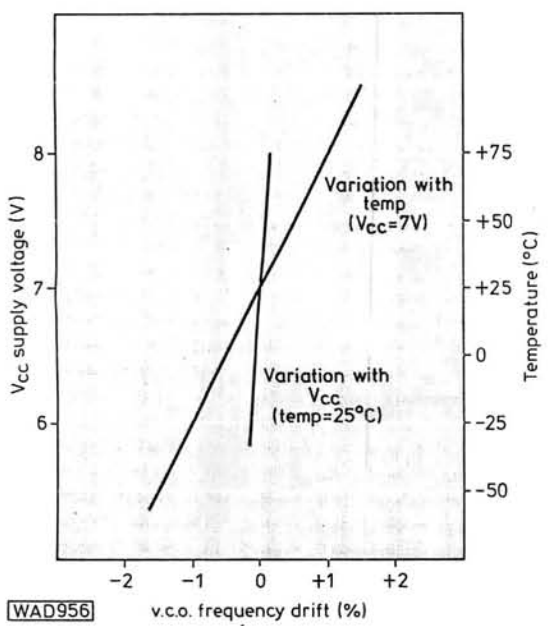
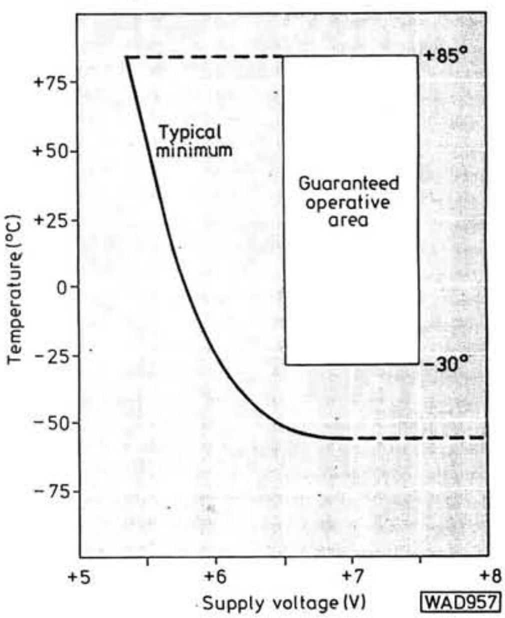


Fig. 8 ▼



ever is the larger. Thus the frequency deviation of ±75kHz of broadcast signals sets the minimum second i.f. to about 750kHz, while the maximum recommended second i.f. is 800kHz! The author initially used a 9·8MHz crystal (Cathodeon code A04951) which produced a 900kHz second i.f. signal, but subsequently used 9·9MHz crystals (Cathodeon codes A07431 and A03903) to produce a 800kHz second i.f. All three crystals resulted in a performance which was satisfactory, although no attempt was made to carry out detailed performance measurements.

For broadcast reception, the value of the timing capacitor was reduced so that the free-running frequency of the voltage-controlled oscillator matched the second i.f. used. Capacitor C7, in Fig. 4, was reduced to 36pF for use with an 800kHz second i.f. and to 33pF for use at 900kHz. Similarly the mixer output filter capacitor C5, in Fig. 4, was decreased to 4·3pF for use at these higher second i.f.s.

The loop filter components, C8 and R1, must also be changed for wide-band use with a higher second i.f. Initially the loop filter was omitted for wide-band use, but this does not produce quite the optimum signal-to-noise ratio. The loop filter is almost essential for narrow-band work.

Plessey Semiconductors have provided the author with some new information on the calculation of the loop filter time constants. From this information it seems reasonable to use a value of R1 in Fig. 4 of 56–68kΩ and a value of 470pF–680pF for C8 with broadcast reception, but the values are not critical.

The output from pin 8 comes from an internal emitter-follower circuit, so the output impedance is of the order of a few hundred ohms. The normal broadcast de-emphasis time-constant of 50μs can therefore be obtained by using a 10kΩ resistor for R4 (but a de-emphasis filter is not required in this position for stereo use).

Crystals

The SL6600C has been designed for use with series resonant fundamental crystals. If a crystal of a suitable frequency is not available, a crystal resonating at one-third of the desired frequency should be used. This third harmonic operation is especially recommended for crystal oscillator frequencies exceeding 15MHz.

The crystal frequency is not at all critical and neither need a crystal with a low temperature coefficient be employed, since any slight frequency drift in the crystal oscillator frequency will not be enough to move the signal out of the demodulator passband nor out of the squelch passband. Thus an inexpensive crystal is quite suitable for this application.

Details of the crystals used by the author for broadcast reception have already been mentioned. For narrow-band work with a 100kHz second i.f., a 10·6MHz Cathodeon crystal of code A04531 has been used and also two 10·8MHz Cathodeon crystals of code A07431. All three crystals resulted in the circuit providing a similar performance.

Acknowledgements

The author is indebted to Cathodeon Crystals Ltd. and to Plessey Semiconductors Ltd., for assistance in the preparation of this article.

Availability

The SL6600C device is available from Ambit International Ltd., 200 North Service Road, Brentwood, Essex, CM14 4SG. The Cathodeon crystals mentioned can be ordered by retailers in reasonable quantities for customers.

HOW THE BBC BEAT THE BLITZ

▶▶▶*continued from page 54*

If all that the BBC engineers had accomplished in World War Two was to keep British listeners supplied with programmes, it would have been praiseworthy enough in the circumstances. However, this was only part of the story. They also built new transmitters around the country to beam broadcasts to all parts of the world, with output powers far higher than any other before them. For instance, the station at Ottrington, near Hull, had four 200kW transmitters able to work singly or in unison on medium or long waves. It was used to send news and other information to Nazi-occupied Europe, and the high powers made it possible for listeners to use simple receivers which they could build from odds and ends. For very long distance broadcasts short-wave transmitters were installed in various locations, including a site in Cumberland which housed no fewer than twelve 100kW units!

Another vital task was the monitoring of enemy broadcasts, especially in the latter stages of the war when radio stations were changing hands literally overnight as the Nazis collapsed in the occupied countries.

In Germany itself, the monitoring service could report that the home broadcasting service worked desperately until the last to continue its output, just as the BBC would have done if the circumstances had been reversed. It also revealed the true identity of the "Werewolf" station, allegedly transmitting instructions from Allied-occupied Germany to guerilla groups who were rising up against Hitler; in fact, it was just another piece of Nazi craftiness. Reading the report on this incident one receives the impression that its author's main concern was not so much the actual aid given to Hitler as the sheer bad form of broadcasting under false colours! Recordings made by the monitoring service of Lord Haw-Haw and some other Nazi broadcasters were used after the war to assist in their successful prosecution for war crimes.

In the last days of the war Admiral Doenitz took over from Hitler and formally surrendered to the Allies. Yet, astonishingly, he was allowed to broadcast from Radio Flensburg and some satellite transmitters, programmes which, the monitors reported, were openly sympathetic to the Nazi cause. It was also noted that despite the general devastation in Germany there were no fewer than ten fully independent stations in operation in 1945.

In the previous year the Director-General of the BBC had made a promise that broadcasting would revert to peace-time standards within 90 days of the end of the war. The deadline was actually beaten by a handsome margin, for the change over came on July 29, seven weeks after the Nazis collapse. The Home Service retained that name but was regionalised, whilst the Forces Service became the Light Programme, taking the place of the old National and re-introducing the Droitwich long-wave transmitter. Television viewers had to wait nearly another year before they could use their sets again; but as there had only been 23 000 of them in 1939 as against millions of radio listeners they could hardly claim priority. One can't help wondering how many TV sets went off with a bang when switched on for the first time in almost seven years. ●

on the air

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.

March and August are the two periods of the year when there is a subtle change in the make-up of the readership of this humble column. Letters start to arrive with the happy news of successes in the December and May Radio Amateurs' Examinations coupled with grumblings and groans over the time that the Home Office takes to get that much treasured new callsign into the post.

It is particularly rewarding to realise that some of these readers started in amateur radio through the columns of *PW*, perhaps not to be heard from again, but, hopefully continuing to read our magazine. So it might be a good idea to review the aims and objects of this column, if I can recall them, for the benefit of those at stage one in amateur radio, full of questions and queries as to what the hobby is all about.

It can give a certain amount of guidance, especially at the beginning, but personal commitment is required if the ultimate object, an amateur radio transmitting licence, is to be reached. **Dave Shirley** of Hastings is a typical example, coming into amateur radio in April last year when he bought an FRG-7. In less than a year he has passed the Morse test and gained two distinctions in the RAE and is now "into the fourth week of waiting for my G4 call". He says that there is no secret for success other than keenness, hard work and invaluable help from local amateurs, in this case G3CMN. "If anyone thinks that my work involves electronics I have news for him, I'm a metal window designer!"

There is no doubt that young students, often already deep into "O" and "A" level exams, are able to take the RAE in their stride even if they have never touched a receiver, let alone a transmitter. On the other hand there are those way past retirement who have done equally well, like "K.S" who, at **76,** was "knocked to the floor" on the death of his wife yet got into amateur radio, passed the RAE and also now awaits his G4.

If your aim is to pass the RAE you can do it. Don't just sit at home and try to do it all yourself when there are people at the local club willing to assist, as well as RAE courses running at various schools and colleges. Even those unfortunately housebound for a variety of reasons can get help through the clubs of the RAIBC, and eventually take the exams at home.

Back, briefly, to the first question asked by the newcomer, "what's DX?" or "I sent you a long list of Australian (VK) stations heard but you didn't print it. Isn't VK DX?" All a bit confusing but the aim of the DX listings is to help those listeners who are trying to get enough QSL cards to enable them to qualify for some achievement certificate and that often means cards from rare countries where there is little amateur activity normally or calls with unusual prefixes. So "DX" is really a combination of distance and rarity of the station rather than pure distance.

Australian stations can be heard in some numbers almost every day of the week on the 14MHz (20m) band, especially in the early mornings, mostly from the heavily populated south east corner of that continent. Rarity value nil except perhaps for VK1. But let a VK8 appear from the Northern Territories where the number of active amateurs can be counted on the proverbial fingers and the rarity value skyrockets, certainly worth logging and reporting to the column. So, it's all a matter of experience, and listening and digging deep into the general hubbub. Strings of Europeans, Americans, and even Australians can be of little interest on most of the h.f. bands but ask yourself if there is anything special about a particular station before logging it.

In General

A very brief note from correspondent **Rhys Thomas** of Bridgend advises a distinction in both parts of the December RAE and hopes to be on the air "in a few months", when his ticket arrives. Another regular writer for some time **David Warr** of Weymouth is about to depart this column having also passed in an equally satisfying way, but admits to "messing about" on CB in the interim. However he is forgiven as code classes are next on the agenda, and, anyway his RAE manual has been passed to a local CBer who has seen the light.

DX Corner

Our correspondent in Salisbury, Zimbabwe, is **Peter Hawkes** who is studying madly to take the annual RAE out there. He kindly sent me a list of all the current Z2s from Z21AA through to Z28JN, complete with QTHs. He explains the seemingly random callsigns now emerging there by pointing out that the new prefix is Z2 which when added to the suffix of an old call makes the new call. For example if there were a ZE9XX then he becomes Z29XX. Peter also gave the correct QTH of the only legit 7Q7 in Malawi, namely 7Q7LW, Les Sampson, POB24, Mtakatake, Malawi.

Incidentally, talking of Zimbabwe, I was called over the coals by a couple of readers for giving ZE-land its old prefix in the recent list of prefixes issued in *PW*. Honest, I had nothing to do with it! For the record the change from ZE to Z2 was made on November 9 last.

Was glad to hear from newcomer to the game **Paul Williams** of Whitehaven, Cumbria, who has bought a Realistic DX-100 and connected it to a wire 15 metres long. His log is entirely of c.w. stations, which pleases me more than somewhat, from 3·5 to 28MHz (80 to 10m) but not having got the hang yet of sorting out the real DX from the rubbish the only worthwhile entries are FY0FOL on 28 and FY7YE on 14MHz.

Anne Edmondson of Edinburgh (BRS47285) finds time from her RAE studies to log such as C31SP, C6ADV, KG4W, KP2G and VP2EGP on the 3·5MHz band no less, which is pretty good stuff with her Realistic DX-200 and indoor wire. Two goodies on 14MHz were W6QL/PJ2 (QSL Yasme Foundation) and LA1RR/ST0 who wants cards via the LA bureau.

Good news from **Ron Gibson** (Wadhurst, E.Sx) who achieved a credit and distinction in the December RAE and impatiently awaits his G6 call. The h.f. bands are still his ultimate goal in spite of an anticipated spell on 144MHz (2m). Pick of the bunch on 14MHz was VK0AN on Macquarie Is, plus the almost as rare VK8RF, M1D and KL7FI. Sole item on 15m was 5T5AY, while on 28MHz AP2AC, VS6CT, VU2GI, 5N0ATW and 7Q7LW showed up. Receiver is an FRG-7 plus fan dipole for three bands.

Stephen Pearson in Arundel, W.Sx, has finished his a.t.u, and is delighted with the results especially at the way it has enabled him to sort out the QRM on 7MHz (40m), receiver being a BC348 with a wire 20 metres long. On 14MHz it was 6Y5MJ, 8P6PQ, KH6WY, HV1CN, VP2MH, HS1BV, A71AQ, 5H3BH, VS6CT and VP8ANT. Buried deep in a letter from **Jon Kempster** of Berkhamsted, Herts, is news that he made Part 1 of the December RAE but failed the other, to be retaken in December next due to school exam commitments. A period in the CQ Wordwide 1·8MHz (160m) contest raised a lot of new European countries for that band but 28MHz produced HC1HC, A71AD, CP6EL and VP2EX.

From Swansea **Philip Morris** and his CR-100 and long wire found KV4FZ on Top Band plus EA8QL, ZB2FX and RD6DNE, but on 3·5MHz the DX fairly rolled in, like A9XF, 5N0HAS, 5X5JL,

J73PP, 3V8DX, FY7BC, AP2ZR, VP2MKD, VP5RAC, YV1CD, KP4BZ and 8P6OR. A selection from 14MHz shows 9Q5MA, S79ARB, BV2B on Taiwan, FB8WG, KC4AAA at the South Pole, ZL4OY/A and famous VR6TC recently featured on TV here.

In Prestatyn, Clwyd, **Jim Dunnett** found time to play around with a v.l.f. receiver he made up but found little of interest. Main receivers are an SRX30 and AR88D with a.t.u. and audio filters with a Creed 7B printer and terminal unit on the RTTY side. However, to start with stuff copied in the c.w. mode, it was PY1MAG on Top Band, FC9VN on the new 10MHz band, with VU2DMS and ZC4CW/A on 14MHz. Better results on 21MHz (15m) produced HP1XEK, SV1NA/SV5, TU2IE, 6E5MX in Mexico, and lastly on 28MHz it was FY0FOL, HL1AQ, J3AV, V2AM, 3B8CF and 3X1Z. Back to the more usual s.s.b. mode and 6W8AR on 7MHz, with HV3SJ and SU1ER on 14MHz, W3WYA/DU2 and 5H3BH on 21MHz followed by TL8MX, VP2EX, Z22JV and 8P6PO on 28MHz. On to RTTY from Jim Dunnett with FP8HL on 14MHz as about the best DX on the h.f. bands.

John Desmond (Cork City, Rep. of Ireland) seems to have come into amateur radio via a converted CB radio, which, with a short ground plane antenna, found the following on 28MHz: C53EE, 7Q7LW, LU2ZR, J73PD, XC1AUY, 7X5AB, A4XJN and Z23JO. The direct conversion receiver in *PW* for October last has enabled **J. E. Hendy** in Abercarn, Gwent, to log over 100 countries with a long wire antenna wrapped around the roof joists it seems. Latest loggings, all on 14MHz, were AP2SQ, CE9AA, KH6WU, UK0ZAH on the Kamchatka Peninsula, VP8QI on Adelaide Is, ZD7BW and 5N9GM.

Club Spot

Thornbury & District ARC. Second mention for the new club near Bristol that meets on the first Wednesday at the temporary spot of Castle School, Gloucester Road, Thornbury, where you can put your name down for the next RAE course, starting September. Contact Alan Jones G8AZT, 9 Queens Walk, Thornbury, near Bristol.

Stanford Le Hope & District ARC. Another new group deserving of publicity, meeting at the Scout Hut, Hardie Road, S-L-Hope, Mondays 8pm. Morse training for the real beginners or those trying to get over the "hump" to 12 w.p.m. linked to a slow code net on 28MHz. More from Alan Taylor G4KJI, 11 Kathleen Close, Stanford-le-Hope, Essex or S-L-Hope 5057.

Yeovil ARC. It's Building 101, Houndstone Camp, Yeovil, 7.30 Thursdays, with advance news of June meetings. On the 3rd G3MYM holds forth on radiation matters while G3KSK threatens to double your code speed overnight, on the 10th. G3MYM, again, discusses the club's propagation research project on the 17th. All this in addition to RAE and Morse code classes, not to mention the club nets on 3·660MHz and S14 on v.h.f. More help from Don McLean G3NOF, 9 Cedar Grove, Yeovil, Somerset, also (0935) 24956, the club sec.

Biggin Hill RC. Only formed this year and already attractive lectures like one on engineering inside the IBA on May 25 and the RSGB film on microwaves on June 22. So it seems to be the fourth Tuesday every month, 8pm, Biggin Hill Memorial Library. Try Ian Mitchell G6EMW, 37b The Grove, Biggin Hill, Westerham, Kent for more info although Biggin Hill (09594) 75785 might be quicker.

Radio Society of Harrow. Fridays, 8pm onwards in the Roxeth Room, Harrow Arts Centre, High Road, Harrow Weald. Opposite the Alma pub is a bit shorter! May 7 informal and practical evening might seem dull but covers code sessions, club projects and running club station G3EFX for the benefit of beginners. May 14 concentrates on video tape recorders, May 21 is informal again, with a talk and demo on RTTY on the 28th. Beginners are particularly welcome so contact Chris Friel G4AUF on 01-868 5002 evenings and weekends.

Chichester & District ARC. Mourning the loss of its honorary life president Roy Lewis G3PC after long illness but meetings continue on first and third Mondays at the Spitfire Social Club, Tangmere, at 7.30. Main feature in May is G3YHM demonstrating mods and improvements to the current club project, a direct conversion receiver, on the 17th. Outside dates for the club include the Tangmere Fete, June 12; Chichester Festivities with GB2CHI on July 9/10; the Sussex Mobile Rally on July 18 plus Vintage Wireless Day at the Chalk Pits Museum, Amberley June 6, all of which will suit the rest of the family. Hon sec is S. Talbot G8FCX, 31 Pier Road, Littlehampton, W.SX or L'H 5082.

Cheshunt & District ARC. Every Wednesday at 8pm Church Room, Church Lane, Wormley, with club calls G4ECT and G6CRC. In detail, May 5 is natter nite, 12th RAE revision before the big day, 19th RAE debriefing and equipment evening, while G6CFW deals with main frame computers on the 26th. More from Bob Gray G6CNV, 2 Sacombe Green Road, Sacombe, Ware, Herts where Dane End 203 will also get you a reply.

Cannock Chase ARS. Brief note of meetings every Thursday at Bridgtown War Memorial Club, Union Street, Bridgtown near Cannock. Details of club activities from Joe Gregory G8HZP, 22 Tower View Road, Parklands, Great Wynley, Walsall or (0922) 416419.

St Helens & District ARC. It's every Thursday at 7.45 in the Conservative Rooms, Boundary Road, St Helens, with principal outdoor attraction a 144MHz band DF foxhunt on May 6. Paul Gaskell G4MWO, 131 Greenfield Road, St Helens, Merseyside is also St H 25472 or listen on club net Sundays 11.30am on S9 f.m.

Ipswich RC. Repeaters and their operation is the theme of G3ZNU on May 12, the main attraction of the month with meetings on the second and last Wednesdays at 8pm in the clubroom of the Rose and Crown, 77 Norwich Road, Ipswich. However the 26th is given over to final planning for the East Suffolk Wireless Revival event on the 30th, which, we trust, will be blessed with fine weather.

Verulam ARC. A talk and demo of amateur TV is likely to prove a crowd-puller on May 25 at 7.30, at the Charles Morris Memorial Hall, Tyttenhanger Green, near to St Albans, given by Mike Hastings G8ASI. Fourth Tuesdays are formal meetings but equally interesting gatherings take place on the second Tuesdays at RAFA HQ in the New Kent Road, St Albans. Needless to say visitors are most welcome at any meeting. Publicity sec is Peter Hildebrand G3VJO, Hobbits, 31 Crouch Hall Gardens, Redbourn, St Albans, Herts, likewise Redbourn 2761.

Fylde ARS. Yet another recently formed group in Lancashire, meeting on second and fourth Tuesdays at the County Hotel, Church Road, Lytham, at 8 p.m. A comprehensive programme has already been formulated as on May 11 when G3AEP demonstrates and talks on notch filters as an aid to selectivity. The 25th is question time plus Morse tuition and the like. A date for June worth noting is the visit by Harry Leeming G3LLL on the 8th to speak on r.f. interference. Programme officer Harold Fenton G8GG, 5 Cromer Road, St Annes, Lytham St Annes, Lancs emphasises that listeners are most welcome to visit and join the club as well as licensed amateurs.

Edgware & District RS. Territorial Army Communications is the subject for May 13 and might very well turn out to be an outside fixture, with the 27th being taken up with judging in the constructors' contest and briefing for NFD. Normally it is the second and fourth Thursdays at 8pm, at 145 Orange Hill Road, Burnt Oak, Edgware, Middx with a club net on 1·875MHz at 10pm on Mondays. Write to Howard Drury G4HMD, 39 Wemborough Road, Stanmore, Middx or 01-952 6462.

Fareham RC. Sec Brian Davey G4ITG has just about completed the *PW* Exe microwave transceiver, and two more are working, made by members. All that is wanted now is some fine weather in order to try them out! The club meets every Wednesday in Room 12 of the Portchester Community Centre, at 7.30. Brian's QTH is c/o 31 Somervell Drive, Fareham, Hants or F'ham 234903. During May principal event is a special event station at the Portchester Community Centre, Arts and Crafts Exhibition on the 17/18th. On the 12th G3VXM talks on 144MHz DX working while on the 26th G4JCC does ditto for 50MHz.

Southampton, ARS. A slight state of flux with a move of HQ to Bitterne Park Secondary School, Dimond Road, Bitterne, S'hampton, meeting on Wednesday pm, with the possibility of having the RAE lectures on another night. More from Andrew Sillence G4MYS, 80 Coxford Drove, S'hampton or try the club chairman G4LDK on Bursledon 3451, he won't bite you!

Farnborough & District RS. A reminder of the talk by *PW* contributor Ron Ham on May 12, with the 26th devoted to a talk on the Basingstoke Canal (birdwise?) and a look at the forthcoming NFD plans. So it's the second and fourth Wednesdays at 7.30 at the Railway Enthusiasts' Club, Access Road, off Hawley Lane, F'borough, near the M3 bridge seemingly. The club's 1296MHz (23cm) beacon GB3FRS became operational recently. Write or ring Ivor Ireland G4BJQ, 118 Mytchett Road, Mytchett, near Camberley, Surrey, or F'borough 43036.

Pontefract & District ARS. Meets at the Carleton Community Centre, P'fract, on the top floor "long way from the bar" at 8pm on "every other Thursday". Not very informative but looks like May 13 with a visit to the TV station at Emley Moor and May 27 when G4DTO and G3HCX expound on p.c.b.s and construction techniques. So you can extrapolate future meetings from that. Sunday mornings sees all hands to constructing a new club shack, a good idea for getting the OMs out of the kitchen. Morse classes are held at the club on Monday pm run by G4FPO and G4KMW. Sec is N. Whittingham G4ISU, 7 Ridgedale Mount, P'fract.

Worcester & District RC. First Mondays at the Oddfellows Club, New Street, W'cester, for formal meetings, like May 10 when G4EYJ also deals with p.c.b.s and construction techniques, and informal get-togethers on the third Monday at the Old Pheasant, New Street, W'cester, when old and new hands can get together for a QSO. Date for the diary is June 7 when Dr Alfrey's subject will be "The ionosphere and all that". Drop a line to David Pritt G8TZE, 15 Paxhill Lane, Twyning, near Tewkesbury, Glos.

Greater Peterborough ARC. Meetings usually on the fourth Thursday at the Southfields Junior School, Stanground, at 7.30pm. An illustrated talk is promised for May 27 on long-distance TV reception, by Dave Wright G8BKG. June's meeting on the 24th is booked with preparations for VHF Field Day in July. Write to Frank Brisley G8ZVW, 27 Lady Lodge Drive, Orton, Longueville, Peterborough where (0733) 231848 will also prove effective.

North Devon RC. Some changes to meeting night, now fourth Wednesdays of the month, at the Bideford Community Centre, Abbotsham Road, Barnstaple, on odd months, and at the Pilton Community College, Chaddiford Lane, Barnstaple on even months, all at 7.30pm. It's G. Hughes G4CG, Crinnis, High Wall, Sticklepath, Barnstaple for up-to-date info on meetings etc.

Horndean & District RC. Let us dispel any lingering doubts on the meeting day, it is the second Thursday of the month, 7.30, at the Merchiston Hall, H'dean, with the May meeting devoted to G8HVO and his demo of video disc equipment. Ought to be interesting with the imminent release of two such systems in the UK. Dan Bernard, who is now G6GBM, is sec and his QTH is 33 Greenfield Crescent, Cowplain, Portsmouth, for further info.

Cambridge & District RC. Every Friday evening during term time at 7.30pm in the Visual Aids Room, Coleridge Community College, Radegund Road, said to be a turning off Coleridge Road. Club station G2XV operates on h.f. and v.h.f. bands. On May 7 G8XLE discourses on crystals, with a visit to the Applied Psychology Unit on the 21st. Fridays in between are informal with the club station getting a good workout. Advance notice now of a junk sale on June 4 at the Comberton Village Hall as the College will be closed at half term. More from David Wilcock G2FKS, 19 Cavendish Avenue, C'bridge or give a tinkle on (0223) 247220 some time.

Watford RC. First and third Wednesdays, a bit late at 8.30pm, in the Small Hall, Christ Church, St Albans Road, W'ford. This may be in time to get you to the Junk Sale on May 5 and certainly to the lecture on slow scan TV by G3WCY on the 19th. Don't miss the big event on Sat, Sun and Mon, May 29/30/31, the Watford Carnival and special event station, probably GB8WRC. Ring G8RCK on Garston 72832 for the latest on the club.

Aylesbury Vale RS. Just a year old and thriving but moving to a new venue, the Stone Village Hall, Stone, which is two miles west of A'bury on the A418, from 8pm, the next meeting being on May 18 when the construction contest will be judged. Informal meetings are also held but contact M. J. Marsden G8BQH, Hunters Moon, Buckingham Road, Hardwick, Aylesbury, Bucks for the latest on club activities. That is also (0296) 641783.

Swale ARC. Second mention of this new Kent club, meeting every couple of weeks at the Town Hall in Sittingbourne, with Brian Hancock G6HZZ waiting at Leahurst, Augustine Road, Minster, Sheerness, Kent to fill in the details, or try Minster 873147.

Mid Ulster ARC. Annual rally on May 23 at Parkanaur, near Dungannon, Co Tyrone, with every expectation of beating the £600 cheque sent to a school for handicapped youths last year, the proceeds of the rally. The sec Daniel Campbell GI4NKD, 109 Drumgor Park, Craigavon, N. Ireland has all the details for you.

Bournemouth RS. Meeting on May 7 will be a joint effort by three members discoursing on aids for the blind, the subject on the 21st turns to DF hunts by G8EOJ. Stand clear! The club could be taking part in the antenna erecting competition at the Longleat Rally on June 27. The club newsletter has contributions on such diverse subjects as mods for the FT290R, 432MHz TV, the first telegraph line to B'mouth in 1870, and the mysteries of s.w.r. Write or ring Elaine Howard G4LFM at the *PW* Editorial offices for the latest on the club.

Lincoln SW Club. Celebrating its Golden Jubilee on Sunday, May 9, with a traditional hamfest at the Lincolnshire Showground, $4\frac{1}{2}$ miles north of Lincoln on the A15, hopefully coinciding with the opening of the Lincoln 144MHz repeater GB3LM located in the central tower of the cathedral. Hamfest attendance could reach 5000 with many attractions for all the family. More on this from John Middleton G8VGF on (0522) 25760/5 in the daytime or 31788 in the evenings.

Medium Wave Broadcast Band DX

by Charles Molloy G8BUS

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

"It is only recently that I have become interested in m.w. DXing" writes **Michael H Thomas** from Gateshead, who goes on to say that he is surprised at the quality of reception during the mornings before and after sunrise. "This is often a good time for DXing as stations which are never audible during daylight hours or during the evening can be caught at this time of day." Our reader is referring to the DXing of local radio stations in the UK and it is true that the most productive time for picking them out, and a lot of other DX as well, is around sunrise and sunset. Why is this and how can we best exploit this phenomena?

Ionosphere

The ionosphere is a region of rarified gas lying between 48 and 480 kilometres above the earth's surface. It is maintained in an electrified state by radiation from the sun. During the day, the lowest region which is called the D layer, absorbs medium wave frequencies and consequently the only stations we can hear are those whose signals have followed the earth's surface. This is ground wave propagation. The range is limited and as a result the medium waves are quiet during the day, reception being restricted to locals and a few high power medium range transmissions.

After dark the absorption in the D layer disappears, signals now penetrate to higher regions of the ionosphere where they are bent back towards the earth to arrive at the surface a long way from the transmitter. It is the period of changeover from daylight to darkness and vice versa that is of interest to the DXer for it is at this time that the unexpected occurs.

Sunset

The terminator is the name given to the dividing line between daylight and darkness and this terminator arrives at our location at either sunrise or sunset. It is not essential for the terminator to be exactly at our QTH for DX to be heard. At sunset, if we are listening for broadcasts from the east, then reception is

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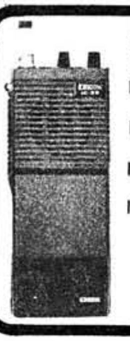

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possible when the terminator has reached the point to the east of us where the signals are being reflected from the ionosphere. In practice this means that distant stations to the east fade-in first, to be followed by those which are nearer. In mid-winter when conditions are favourable broadcasts from China are audible as early as 1400, in a band which for the moment is comparatively free of QRM.

As the terminator approaches, the band begins to fill with broadcasts, stations to the north and south coming in as darkness approaches. The terminator only lies in a North/South direction in March and September. In summer it is tilted NE/SW causing stations to the south to appear before those in the north. The converse happens in winter. Stations that lie to the west of us are the last to appear, at sunset, after it is dark.

To summarise. As sunset approaches, distant broadcasts from the east are the first to appear, followed by those at medium distances. Then DX from the north and south is audible and, after dark, DX comes in from the west.

Sunrise

At sunrise, the situation is reversed and we are now talking about signals fading out. The sequence of events is the same as before. Signals from the west are the last to be heard before daytime conditions are established, a fact of very great importance to the DXer. This is especially so in summer when signals from North, Central and South America are audible after the QRM from Europe has faded out. Moreover, those Western Europeans that have signed off for the night will still be off the air. There will be a relatively quiet band with DX possibilities from Region 2, the Americas.

Starting approximately one hour before sunrise in May, June and July, listen for stations on the eastern seaboard of Canada and the United States such as CJYQ in St John's Newfoundland on 930kHz, CBA Moncton New Brunswick on 1070kHz, VOCM St John's on 590, CHNS Halifax Nova Scotia 960, WNEW in New York City on 1130, WCAU Philadelphia 1210, WITS Boston 1510, WQXR New York on 1560. From the Caribbean and Latin America search for Radio Jornal in Rio de Janeiro Brazil, in Portuguese on 940kHz, ZDK St John's Antigua on 1100, Radio Globo in Rio on 1100 and 1220, Radio el Mundo in Buenos Aires, Argentina on 1070kHz, this one is in Spanish; Radio Caribe Dominica in French on 1210 and Radio Tupi in Rio on 1280.

ORU is on 1512kHz

Static can be a problem in summer. Most of it comes from tropical areas to the south of the UK so it can be nulled-out with a loop without affecting DX from North America or the Caribbean. In the absence of static, a long wire can be used without the usual risk of overloading the receiver.

Daytime Only DX

A number of readers have asked why it is that some stations can only be heard during the day. It is the interaction of the ground wave and the sky wave which causes the signal to deteriorate after dark and the effect occurs just beyond the service area of the station. The sky wave, which appears after dark, will be comparable in strength to the ground wave and as the two go in and out of phase with each other, deep fading will occur. More distant occupants of the channel may also appear and the result is that the signal we could hear well in daylight is now unusable. This explains the disappearance after dark of AFN in Shepton Mallet and Manx Radio in Manchester.

Anti-fading antennas came into general use in the 1930s at transmitting stations. They deliver maximum low-angle radiation which enhances the ground wave, and reduces the strength of the sky wave at the receiver. The idea is to extend the night-time range of the station but the enhanced ground wave extends the daytime range as well. Of course if you move further away, the ground wave disappears and you may then get satisfactory night-time reception. It is only inside the service area of a transmitter that you will have satisfactory reception during the day and night-time.

Vintage Receivers

"I used to run a B40 receiver but when everything started going wrong with it I part exchanged it for a BRT400E which I find superior" writes **Ian Davidson** from Carmarthen, who managed to pick up Radio Forth on 1548kHz after dark. Ian also heard the English Service of Radio Algiers on long wave 251kHz between 2000 and 2030 UTC. Talking of long waves, Bulgaria now seems to have started up on 263kHz; the Geneva Plan gives Plovdiv with 500kW.

Hope you have better luck with the BRT400 Ian. Pity this receiver is so old as it was specifically designed for broadcast band monitoring. I had an unusual fault with my BRT400 recently. A smell of "cooking" was tracked down to a partial earth on the h.t. line. There is a plug attached to the rear of the BRT400 for use with external power supplies. When the receiver is used on mains, a socket with appropriate cross-strapping inside, is fitted to the plug and it was leakage inside this sealed socket that caused the problem. An example of what to expect with vintage gear. Modern receivers are a lot more reliable than their valved predecessors. Lower voltages are used, less heat is generated and the components used are more reliable.

Zimbabwe

PW reader **Peter Hawkes** who lives in Salisbury Zimbabwe has an AR88 and 91 metre long wire which pulled in the BBC World Service relay in Cyprus on 1323kHz at 0300 UTC for him. He wonders if it is possible to hear UK medium wave stations from his QTH and if so, at what time of night. Darkness occurs about an hour later in the UK in winter and approximately four hours later in summer, than in Zimbabwe. This would be the start of the period when reception is possible. European stations ought to be heard as there are many high-powered broadcasters on the band though how well domestic stations in the UK would come through is a matter for conjecture. Has anyone any experience of DXing on this path?

Short Wave Broadcast Bands

by Charles Molloy G8BUS

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

Newcomers to short-wave broadcasting are often surprised by how much it differs from domestic broadcasting. Local stations are reliable. They can be heard at the same time at the same place on the dial, year in, year out. Not so on the short waves. Your favourite broadcast may suddenly disappear, or reception may be poor with the programme below entertainment level. Why is this and is there anything we can do about it?

Broadcasting Seasons

Propagation of the signal from transmitter to receiver on the short waves is via the ionosphere, which is a region surrounding the earth that is maintained by radiation from the sun. It follows from this that the amount of radiation received at any place outside the tropics will depend on the time of year, more arriving during the long days of summer than in the short days of winter. This means that broadcasters will have to change the frequencies they use to keep in line with the seasons, and many of them do so, four times a year in March, May, September and November.

The trend is towards higher frequencies in summer and lower ones in winter. Changes are usually announced in advance over the air, and major international broadcasters will supply a copy of their programme/frequency schedule to the listener free of charge, on request.

So watch for changes at the start of these four "seasons" and you may avoid the disappointment of finding that your favourite broadcast is missing.

Poor Reception

Fadeouts and periods of poor reception may occur without warning. Obviously, if there is a complete blackout there is nothing that can be done, but when reception is poor it may, if the listener understands what is happening, be possible to improve reception.

SID

These letters stand for Sudden Ionospheric Disturbance. A SID is caused by radiation from a solar flare which reaches us in about nine minutes and penetrates to all levels of the ionosphere on the sunlit side of the earth. A complete radio blackout may occur though often the effect is less severe. A SID comes on suddenly, in a minute or so, but only during the daytime. Fortunately SIDs are short lived, lasting from a few minutes to an hour or so. Night-time reception is not affected and the high frequency bands are the first to come back to normal. If you experience a SID, which used to be known as the Dellinger Effect, then it is probably as well to switch off and try again an hour later.

Ionospheric Storm

As well as producing radiation, a solar flare emits charged particles. They travel much more slowly, taking about a day to reach the earth. On arrival they are deflected to the earth's magnetic poles and on the way they pass through, and have an effect on, the top of the ionosphere. All parts of the globe are affected so a storm can occur at any hour of the day or night. The highest frequency bands suffer most, so move to a lower frequency to improve reception. For example, Radio Canada International broadcasts simultaneously on three different bands during the evening. These are 11MHz (25m), 15MHz (19m) and 18MHz (16m). If you normally listen on 18MHz then move to 15MHz or even to 11MHz, reception may be better there.

The ionospheric storm starts and finishes much more slowly than an SID. It may last for several days. Transmission paths near the earth's magnetic poles are affected more than those over the tropics so a storm does not mean that reception from everywhere will be poor. The golden rule is to move to lower frequencies until the storm has passed.

A recent QSL from Radio Bras

Time Signal Stations

"The illustration of the WWVH card (February issue) brought back a few memories" writes **Don Redhead** G4KXW who goes on to say that he used to get great fun out of QSLs from Time Signal stations. He has cards from LOL Observatories Nacional Argentina, WWVH, WWV, CHU, ZUO (5MHz), FFH (2·5MHz), DGI East Germany. "The ones that didn't QSL were IBF and BPU" concludes Don. Anyone have better luck? **Alan Proctor** (Bristol) finds that time signal transmission can be heard from at least five countries on each of the "popular" 5, 10 and 15MHz frequencies. "Identification is simplified by getting to know transmission times, signal format, language, voice (male or female), etc." Alan reckons that as well as being useful time and frequency signposts to the DXer, these stations provide helpful propagation information both in relation to their own "opening" at the time and also to their spoken data on prevailing conditions generally (WWV). "I wonder if in RSA, Colin Brooks has heard LOL Argentina on the above frequencies?"

Tropical Band DX

A Realistic DX160, a.t.u. and 11 metre long wire pulled in some useful 4·7MHz (60m band) DX for **Neil Cummings** who lives in Port Sunlight. From South America, Radio Barquisemeto was heard on 4·99MHz at 0250, Radio Reloj on 5·03 at 0335, R. Rumbos 4·97 at 0355 and R. Yaracuy 4·94 at 0245, all in Venezuela plus R. Apintie in Surinam on 5·005 at 0415. Africans heard included Lagos on 4·99 at 0500, Kaduna also in Nigeria on 4·77 at 0410, Garoua Cameroon on 5·01 at 0525 and Bata in Equatorial Guinea on 5·005 at 0530. **David Hyams** (Manchester) pulled in Namibia on 4·965 in Afrikaans at 1903, Ghana on 4·915 at 2300 and Conakry Guinea on 4·91 in French at 0002.

It is during the period starting about one hour before sunset and lasting until an hour after sunrise that DX can be heard on the 4·7MHz band. The path from transmitter to receiver must be in darkness otherwise signals will be absorbed in the ionosphere. At first sight, winter would seem to be the best time for the tropical bands but this is not so. The length of day varies little in the tropics throughout the year and consequently most parts can be logged in the UK at any season. As a rough guide, try for Africa at sunset and for Latin America before sunrise.

Those who have not tried 4·7MHz before, usually complain that they cannot hear anything at all, except of course for the ever-present commercial stations from outside the tropics. Even if you do listen at the right time of day do not expect signals to be comparable in strength to those heard on the international bands. You need a good antenna, a sensitive receiver and a lot of patience to pick up more than a handful of broadcasts but the results—listening-in to domestic radio in far-off places—are worth the effort.

This one is from Radio Tashkent

International Christian Radio

The query from Mark Slater in the March issue concerning this broadcaster brought replies from **Julian Clover, Ian Kelly, Martin Smith, Stephen Dyke** and **Gavin Robertson.** ICR studios are in Ashawa, Ontario in Canada and this is where the programmes are produced. The transmitter is in Malta and belongs to IBRA radio. Its frequency is 9·515MHz with a power of 250kW, and ICR is on the air daily from 2030 to 2125 UTC. The station is looking for feedback from its listeners since there is some QRM from Radio France and reception reports should go to ICR, PO Box 521, Station F, Toronto, Ontario, Canada, N4Y 2L8.

News from the Bands

At the time of writing WRNO in New Orleans USA has started test transmissions. Reports are requested which should go to WRNO World Wide, New Orleans, Louisiana 70002, USA. The station intends to operate on or near the following frequencies: 17·895MHz from 1800 to 2000, 15·355MHz from 2000 to 2200 and 11·89MHz from 2200 to midnight UTC.

A disturbing piece of news comes from Radio New Zealand. As an economy measure the NZ government is proposing to close down the overseas service of Radio New Zealand. Although this is not the first time such a closure has been proposed it will, if it happens, be a matter for regret in the DX World. If you have not yet had a QSL from the station then this is the time to send them a report. They can be found on 11·945MHz and 15·485MHz in the morning before 0800 and it might be an idea to enclose a letter of protest with the report.

Reader **Ian Kelly** (Reading) has been tuning round the bands again with his radio cassette. He mentions hearing Radio Tashkent, Uzbekistan in English on 11·785MHz at 1400, Buenos Aires on 11·71 at 2212 with a weather forecast and announcement "11710 kilohertz per second" and Radio Bras in Brazil with a strong clear signal on 17·855 from 1900 to 2000.

VHF Bands

by Ron Ham BRS15744

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

Once again the metre wavelength radio noise from several groups of sunspots warned that the sun was active and that aurora or ionospheric disturbances were likely to occur.

Solar

The long period of solar activity which began on January 28 has continued and **Cmdr Henry Hatfield,** Sevenoaks, **Reg Taylor,** Shillington and I recorded varying degrees of radio noise from the sun, at 136, 151 and 243MHz respectively, on 17 of the 28 days between February 18 and March 17. Individual bursts, Figs. 1 and 2 were recorded on February 18, 22, 26 and 27 and March 3, 5, 7, 10 and 14 and noise storm conditions on days 18, 19, 20, 21, 25, 1, 15, 16 and 17 in February and March respectively. The noise was so strong on March 1 that I was not surprised when **Ted Waring,** Bristol reported seeing 43 sunspots and at 1700, **George Grzebieniak** G6GGE, London, heard the noise when he turned his 16-element 144MHz (2m) beam towards the setting sun. Ted also counted 19 sunspots on February 16, 14 on the 25th, 27 on March 8 and 48 on the 13th. Reg Taylor is using a Astrotec radio telescope with an 8-element Yagi for solar work and has plans for an interferometer antenna system for other celestial sources. Around 0715 on March 7, **Ian Shaw** G4MWD turned his 144MHz beam towards the rising sun and heard an increase in the background noise level, then suddenly at 0727 he heard a massive burst of solar noise lasting a couple of minutes.

Aurora

During the extensive aurora which, by all accounts, began around 1500 on March 1 and ended around 0300 on the 2nd, **John Tindel** G3JXN, London, worked stations on the 144MHz band in DL, GM and OZ and between 2300 and 0130, George Grzebieniak worked G6AJH, G6ABU, G8GEA, G8MLJ, G8VHB, GM8OEG and GM8OFX and heard GM8MBP, GM8ZOQ and GI8UPV. "Very interesting" said **John Matthews** G3WZT, Chairman of the Horsham Amateur Radio Club, who first heard tone-A signals on 144MHz at 2230 and then worked stations in DJ, EI, GI, GM, OZ and SM on c.w. and the event was still going when he closed down at 0230. Although John found the aurora was varying rapidly, the most powerful signal with him was SM4IVE. John uses an FT-225 and a 16-element Yagi some 12m a.g.l. and by rotating this beam he found the auroral curtain spread between 345 and 45 degrees. In nearby Cowfold, **John Cooper** G8NGO worked about 10 stations, mainly GI and GM, on s.s.b. between 2300 and 0200 and having taken part in many auroral events, he is now sure that aurora comes in several phases, some as short as 30 minutes, and suggests that some operators thinking that it is over, switch off too soon. I received the alert at 1530 via G8JNV, part of Phil Hodson's auroral warning chain and then heard the burbling auroral signals from eight continental TV sound channels between 48·25 and 66·8MHz. G6GGE also heard auroral signals on February 14, 16 and 22. "Maureen GW8ZCP, in Wrexham tried to contact an OH on Aarland Island off the south west coast of Finland during the aurora on February 14," writes **Phil Hodson** G8RBY, from Leicester, who adds, "I would have been pleased simply to have heard this one." Too true Phil, and well done Maureen.

Around 2315 on March 1, **Alan Baker** G4GNX, Newhaven, had auroral c.w. contacts with G3BW, PA0OOM and SM4IVE and heard GM3WCS, GM3JIW, GM4CXM and PA2VST. Alan, using a crossed-8 Yagi found that east was the best direction and said that with him, G3BW in Cumbria was a thumping great signal.

For some 10 years the callsign G3WZT has been well known in meteor scatter circles, but last June, John branched out and with his 16-element Yagi established a QSO with K1WHS, via the moon (e.m.e.). "All credit to K1WHS, who uses 24 × 16-element Yagis, for making the QSO possible," said John who, to date has worked over 40 countries on 144MHz, by all modes of propagation.

The 28MHz Band

An ISWL member, **Joseph Harkin,** Co. Londonderry, uses a Ham International Jumbo transceiver which covers 26·315 to 28·305MHz to listen to c.w. and beacon signals at the lower end of the 28MHz (10m) band. Although Joseph's current speed is about 8 words per minute and at present he misses out on some of the fast c.w. around 28·150MHz, he has logged stations in Austria, Italy, Scandinavia, Spain and the USA as well as several of the regular beacon signals that are listed in Fig. 3. My thanks to the 10/UK group for their very impressive 26-page newsletter produced by G3ZEV and a keen production team. They now have 83 members and with all the gen in this March issue about activity and equipment for all modes of operation on the 28MHz band I am sure that their membership will soon top the 100 mark. Anyone interested should contact N. J. O'Brien, 88 The Maples, Harlow, Essex.

During the period February 19 to 28, **Harold Brodribb,** St Leonards-on-Sea, using an AR-88 communications receiver logged stations in Bermuda, Canada, South Africa, the USA and USSR. "March 5 was a fantastic day" writes Harold who from 1715 heard signals from Ws 0,2,3,4,5,6,8 and 9, many of them twice. This was a good day because at 0920 I received a strong signal from ZL2BFU when he worked G4FBS/P and OH5NW who was commenting about the prevailing excellent conditions and the blackouts on the 2nd and 3rd. The band was also dead for limited periods on February 18, 19, 20, 23 and 25 which is not surprising due to the high amount of solar activity around this time. On most days between February 18 and March 17 strong signals were received from Canada and the USA during the afternoon and much weaker from Australia and Japan on those mornings when the band was open. One of my beacon contributors, **John Coulter,** Winchester, has been

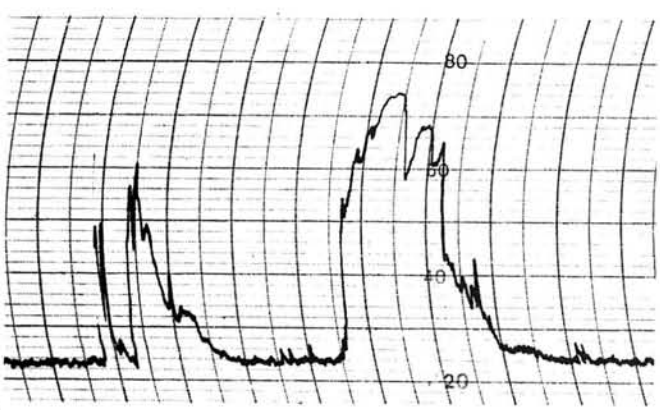

Fig. 1: Solar bursts recorded by the author on March 7

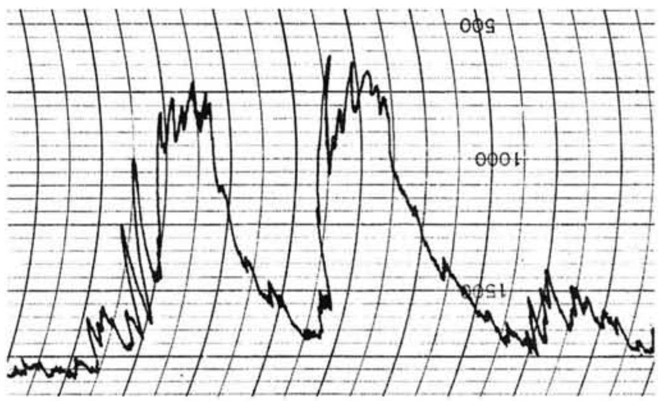

Fig. 2: Large double solar burst, lasting 7 minutes, recorded by the author on February 18

listening to signals from the RS and OSCAR satellites and has written to AMSAT-UK for more gen.

During the good conditions in mid-March, **Barrie Cook** G4BWJ, Hove, using a TS-520 and a trap dipole at 7·5m a.g.l. worked many parts of the USA and added California, Oregon and Wyoming to his states list.

28MHz Beacons

Contributors to the list of 28MHz beacon signals heard between February 18 and March 17, Fig. 3, are John Coulter, Ted Waring and I. John heard a new beacon from Belgium, ON5AV and he and I logged the Indian beacon VU2BCN around 28·295MHz. Although nothing was heard during the period from U2ABJ, I did log the New Zealand beacon ZL2MHF at 0944 on March 5. I am looking forward to receiving reports from **Arnold Hewitt,** a new s.w.l. in Leicestershire who is interested in the International Beacon Project stations.

The 50MHz (6m) Band

I see from the first issue of *SIX NEWS* that congratulations are due to G3COJ, G4BPY and G5KW who have worked all continents on 50MHz to 28MHz cross-band. Details of your 50MHz activity would be helpful to G4JCC, 52 Salterns Lane, Hayling Island, Hants who intends to start a 50MHz ladder in *SIX NEWS*. Also keep an ear out for a new beacon in Hong-Kong VS6SIX on 50·075MHz.

RTTY

I am looking forward to RTTY reports from **Ian Anderson** in Lerwick who has purchased a MM2000 and intends to use it on the 14MHz (20m) band. Another MM2000 user is **H. Winter,** Bristol who copied two-way QSOs between DL6UD and F6EBY, G3TLC and GM4FYK, EA3BDK and PA2CMA and EA2AKU and 4U1ITU on 14MHz on March 8 and I0ACY and WD8OBO on the 21MHz (15m) band on the 9th.

"I find that if someone tunes up on the same frequency I lose the transmission," writes H. Winter. This unfortunately cannot be avoided because the RTTY converter must have the right audio tones at its input to produce the correct output. At 0900 on March 1 I copied "THIS TRANSMISSION IS COMPUTER CONTROLLED (TIMING EACH 60 MIN) 73 DE HB9AK" and at 1510 on the 11th I read "DK0NO the EXHIBITION-STATION IN NUERNBERG."

During the 28-day period from February 18 to March 17, I copied 200 RTTY stations spread over 26 countries, CN, CT, DL, EA, EI, F, G, GI, HA, HB9, HC, I, LA, OE, OH, OK, ON, OZ, PA, VE, VK, W, YU, C3, Y3 and 4X4. Of this number, only 10 were received on 21MHz and 3 on 28MHz, the rest were on the 14MHz band around 14·090MHz. Among the interesting two-way QSOs I received were DF9SX and F6DXY at 1315 on February 19, CT1AMO and F6DXY at 0819 on the 20th, EA3AYW and IN3GNV at 0939 on the 21st, G3ICJ and EI4EH around 1400 on the 22nd, DL9OV and OE6KCG at 1413 on March 1, DJ0HX and SM6KIN at 0750 on the 6th, a local QSO between I6DZB and I6PNY at 1350 on the 9th, OE6KCG and VK1RY at 0813 on the 10th, I8KGB and SM7LZO at 1450 on the 11th, EA3AYW and DF0BUS at 0935 on the 14th, DL4GN and I0AYC at 1722 on the 15th, OE6KCG and 4U1ITU at 0945 and DL9YBY and PA2CMA at 1335 on the 16th and a 3-way between F6EPJ, F6DXZ and ON5YE at 1448 on February 20. Although the numbers of RTTY signals on the 28MHz and the 21MHz band are small compared with the 14MHz band, it is always worth tuning around these bands each time you run the equipment.

Tropospheric

Since George Grzebieniak connected a pre-amplifier to his 144MHz receiver he can now hear the Paris beacon, FX0THF around 0800 on most days, and when Ian Shaw replaced his antenna with a 16-element Tonna he too noticed a marked increase in signal strength from the Paris beacon. Although the atmospheric pressure was low at 29·9in (1012mb) and falling on February 28, John Cooper G8NGO managed to work EI2DW in Dublin and F3GB in Paris on 144MHz s.s.b. During the RSGB 144,432MHz and SWL contest over the weekend of March 6 and 7, Ian Shaw, as a single-operator entry, worked 219 stations on 144MHz s.s.b. which included 2 DLs, 10 Fs, 2 GMs, 1 GW, 6 ONs and 4 PEs. Ian, operating from his home in Ockley used a FT-480R and a 16-element Tonna and calculated his final score of around 950 points with a ZX81 computer.

Steve Osliff, GM6AMJ is down south for a while and with his TR-2300 is often on 144MHz in the Gosport and Portsmouth areas.

Static

During the bad weather on March 4, George Grzebieniak made an interesting observation and writes, "Around 1700 we had a thunderstorm and I was receiving static rain noise coming through the loudspeaker. Just before a lightning flash, the noise rose sharply to a very high level, then after the flash the noise died down and then re-started again." I experienced precipitation static (sounds like screaming) over a wide frequency spectrum during the frequent heavy squalls on March 1 and 16. No doubt other readers heard the same but did not realise what it was.

Fig. 4: Richard Norman

Band II

"With the atmospheric pressure up and down like a yo-yo recently there seemed great potential for a couple of tropo openings, but they did not materialise," writes **Ian Kelly** from Reading on March 10. However, during the ups Ian did receive French broadcast stations in Bologne, Caen, Lille and Rouen and from Belgium, BRT2 and 3. At 2145 on March 5, **Simon Hamer** heard a discussion programme *TDF-Cultur* from Brest fading in and out around 97·8MHz and at 2000 on the 7th he received very strong signals from BRMB on 94·8MHz and ILR Mercia Sound on 95·9MHz. I noticed some interference to the BBC signals in Band II during the evening of February 19 which was not surprising because the pressure was around 30·3 (1026mb) at the time, in fact it rose from 30·1 (1019) at midnight on the 18th to 30·3 by midnight on the 19th. Around 2300 on the 20th the pressure began to fall slowly, reaching 29·7 (1005) at midday on the 25th where it fluctuated until 1600 on March 4 when it shot up to 30·5 (1032) by noon on the 5th. By midnight on the 7th it was down to 30·25 (1023) and a steady fall continued to 29·4 (995) at 2000 on the 10th.

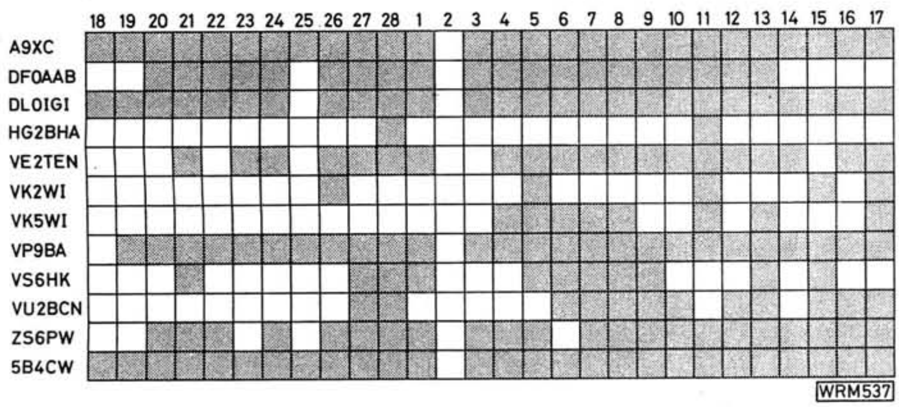

Fig. 3: 28MHz beacon reception. Note the blackout on March 2

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70 cms 10W Power Amp/Pre-Amp	70PA/FM10	34.65	48.70
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Full details will be forwarded on receipt of a large SAE. *Non-technical enquiries only* can be taken during the day on 07356 5324. Technical enquiries between 7-9 pm on either 07356 5324 or 0256 24611. Kits when stock will be return of post when humanly possible otherwise allow 28 days. Assembled items 20-40 days. Stock is held also at **Amateur Radio Exchange** in Ealing and **J. Birkett** in Lincoln.

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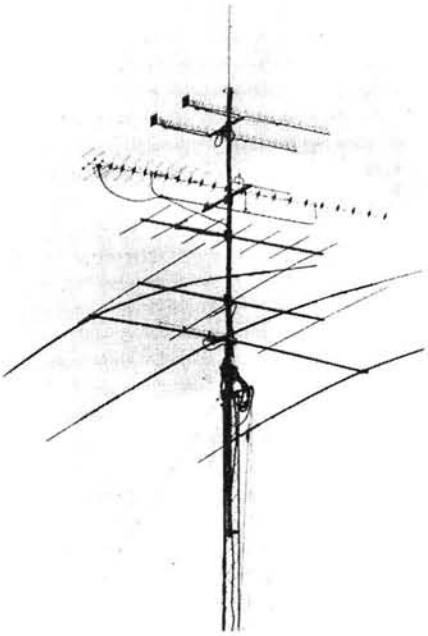

Fig. 5: 1296MHz Yagis at the top of VK2BDN's stack

UHF in VK and ZL

"I have been experimenting on u.h.f. for over 35 years," writes **Richard Norman** VK2BDN from New South Wales, Australia, Fig. 4. At 1920, local time, on January 25, Richard received a telephone call from an amateur in New Zealand stating that the 144MHz band was open. Richard stoked up his 432MHz gear and worked ZL1TBG, ZL2TAL and ZL2THG and at 0630, Sydney Time, on February 9, Richard worked Brian ZL1AVZ on 432MHz and as the signals were so strong they agreed to try their luck on 1296MHz. "I decided to leave my carrier running whilst I had breakfast and heard Brian on 432MHz saying that he was receiving my carrier on 1296MHz," writes Richard. He called Brian on 1296MHz and suggested they try for a two-way QSO, which they did and for a period of 20 minutes, using c.w. and s.s.b. they secured a possible VK/ZL record of 1326 miles on 1296MHz. "The

Fig. 6: 2·5m dish for 1296MHz

contact was even more remarkable since Brian was using 5 watts c.w. and 1·3 watts s.s.b.", says Richard who uses two 27-element loop Yagis, Fig. 5, a home-brew transmitter giving 35 watts and a Microwave Modules pre-amplifier and converter down to 144MHz. ZL1AVZ uses a Microwave Modules transverter to a 4m dish antenna. Richard gives special thanks to Geoff Campbell VK2ZQC for many tests and computer calculations and much encouragement with the project. Richard also has a 2·5m dish, Fig. 6, for 1296MHz experiments.

Help Wanted

"Do you know of any continuously tunable receiver which covers the 30 to 50MHz and 200 to 450MHz ranges," asks **Graeme Wilson,** Nunthorpe, who is interested in all bands between 150kHz and 870MHz. At present Graeme uses an FRG-7 communications receiver with converters for 144MHz and 432MHz and a Tandy Patrolman 50 for the 30 to 50MHz range.

Radio Weekend

About 30 members of the St Dunstan's Amateur Radio Society gathered at Ian Fraser House, near Brighton, on March 20/21 for one of their special amateur radio weekends.

Fig. 7: Special event callsign for St Dunstan's Amateur Radio Society

At midday on the 20th, some 70 members and guests assembled for lunch presided over by the Chairman of St Dunstan's, Mr Garnett-Orme. Among the special guests were Barrie Cook G4BWJ, John Houlihan G4BLJ and Steve Osliff G6AMJ, representing the RAFARS, RAYNET and RNARS, respectively and Alan Baker G4GNX and Griffith Rockwood G3JGR from the Brighton and District and Mid Sussex Amateur Radio Societies, Frances Woolley G3LWY from RAIBC and Elaine Howard G4LFM and Ron Ham representing *Practical Wireless*. At the lunch, another guest, Len Wooller G8GEZ, learnt that he had been awarded the magnificent "G3MOW Memorial Trophy", presented annually for outstanding service to the SDARS. For some time, Len has assisted them by solving their antenna, equipment and interference problems. Later, St Dunstaner Bill Shae proposed the vote of thanks to the guests and Elaine Howard replied on their behalf.

During the afternoon, members and guests saw the SDARS picture board, especially prepared by St Dunstan's PRO, David Castleton, for display in the new radio building at the Chalk Pits Museum in Sussex. The lecture session was opened by Ron Ham demonstrating some historic Morse keys, followed by Elaine Howard talking about her training as a marine radio operator and Joan Ham brought the meeting up to date with the latest developments at the Chalk Pits.

Periodically during the weekend their station, GB4STD, Fig. 7, was on the air.

TV

by Ron Ham BRS15744

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

"Could you please tell me how to get started in TVDX and what kind of receiver, antenna and amplifier to use" asks **Mr R. Ward** of Mansfield, Nottingham, whose letter is typical of many in my postbag.

Receivers

While looking around the radio section of a department store recently I saw the Hitachi K2400, 4·5in mono television receiver, complete with a.m./f.m. radio and tape recorder, all in a compact framework. Above the picture tube is the tuning scale, calibrated for v.h.f. Chs. 2–12 and u.h.f. Chs. 21–68, just right for the DXer. One feature that fascinated me was the tuning cursor, which, at the press of a button, appeared on the screen. This set or one of the similar small screen sets made by JVC, National Panasonic, Plustron, Sanyo and Sony, may well suit Mr Ward and **David Dauris** of Mexborough who is a medium wave DXer and wants to install gear for TV. Do make sure when you purchase a set that it has two tuners for TV, one for v.h.f. covering Chs. 2–4 and 5–12 and for u.h.f. Chs. 21–69. **C. J. White,** Huntingdon, uses an ex-Royal Navy B40 communications receiver for short wave listening and has recently installed a JVC CX610GB colour set for DXTV. Unfortunately he is short of antenna space so I suggest he tries a horizontal dipole, cut for about 55MHz and installed facing east which should give reasonable results in Band I Chs. 2–4 during the sporadic-E season.

Antennas

Obviously, a combined Band I/III fully rotatable antenna is ideal for getting the best results out of your receiver, but some DXers prefer to use a separate antenna for each band all stacked on a single rotatable mast. If you are not sure, write to one of the antenna manufacturers or suppliers for advice especially about the number of antennas that can safely be fitted on a rotator.

Station Aids

Most serious DXers find it well worth having copies on their bookshelves of the *World Radio TV Handbook, Guide to*

World-Wide Television Test Cards by Keith Hamer and Garry Smith and *Long Distance Television* by Roger Bunney. The *WRTVH* gives precise details of both national and local transmissions and the address of the broadcaster which is good for QSLing. The test card book is invaluable during an opening and one major feature of Roger's book is the explanation of the different television bands.

Fig. 1: UHF signal from Tyne Tees received by George Garden

Sporadic-E

Graeme Wilson, Nunthorpe, a member of AMSAT-UK and the British Amateur Television Club, uses a modified Thorn 1500 chassis with an ELC 2060 tuner which covers 40–860MHz and the 405, 525, 625 and 819-line standards and either negative or positive vision modulation. Like most of us, Graeme has already seen bursts of test card on Ch. R1 49·75MHz and is looking forward to the 1982 sporadic-E season. **Harold Brodribb,** St Leonards-on-Sea, using an RL85 v.h.f. communications receiver, heard the familiar buzz of television sync pulses on Chs. E2 48·25MHz and E3 55·25MHz around 1225 on February 19 and on Ch. E2 again at 0925 on March 9.

I received strong bursts of test card from Poland between 0800 and 1000 on February 20, 22 and 24 and March 3, 15, 16 and 17. Austria ORF-FS1, on February 21 and 28 and March 4, 10 and 14, Bucharest on March 10 and Czechoslovakia RS-KH on February 22 and March 16. At 0830 on February 23, there was a long period of test card from MTV-1 Budapest, followed at 0839 by the MTV clock showing 0939, one hour ahead of GMT, and later at 0848 there was a programme about children. Many bursts of picture were seen during the early morning of February 25. At 0904, I saw a military uniformed news reader with Poland's "dt" caption beside him and at 0810 on March 16, a caption in rapid QSB appeared and looked like EZYK POLSKI. Any ideas? I would also like to know the origin of a clock which appeared briefly at 0830 on the 15th showing 0930 and with a picture of a tree on the right hand side.

One of our overseas DXers, **Dr Miklos Prekop,** Borno State, Nigeria, referred to the pictures, Figs. 4 and 5, that I published in our January issue. He tells me that these were from Hungarian Television and that the actor seen in Fig. 4 is Georg Jabronkay, and the heading BABSZINHAZ in Fig. 5 means Puppet-Theatre. Thanks Miklos, these details are valuable for identifying future pictures from that source. During last summer, Miklos received pictures from France and Spain on his Tatung receiver and Yagi antenna. **Wenlock Burton** has moved QTH in Victoria, Australia and has re-installed his u.h.f. antenna and Ch. 6 175·25MHz Yagi on a fascia bracket. Wenlock also made a temporary antenna for Bands I and II with 300 ohm ribbon feeder, and although it is only 1·2m from the fence outside his window, it works very well.

Tropospheric

"February was an excellent month with a lot of DX from ITV Midlands" writes **George Garden** from Bracknell, who on the 19th received strong colour pictures from Tyne Tees, Bilsdale Ch. 29, and enjoyed one of their local programmes *Friday Live.* At 2204 on the 19th, I received pictures from Central TV, Lichfield Ch. 8, with only a dipole feeding my 405-line receiver, and during the evening there was a lot of patterning on the u.h.f. channels. On March 4, George Garden watched snooker on Central TV and around 2200 he received pictures from Anglia. Just before midnight on the 6th, he watched strong pictures from Tyne Tees (Fig. 1) and Central and saw their late night spine chiller *Taste Of Evil.*

"The 405/v.h.f. DX in your column brought some childhood memories back to me" writes **Simon Hamer,** Presteigne, who continues: "In the autumn of 1966, at the age of 10 years, I was switching to ATV Ch. 8 (now Central TV) Lichfield, to watch *Tingha and Tucker* when I came across Anglia ITV on Ch. 6 with *Anglia News.* In the summer of 1973, I received Anglia ITV on Ch. 6 and on one Sunday morning I saw LWT (London) with Eric Coates Covent Garden music before the start of their day's programmes". That's how DXers start Simon.

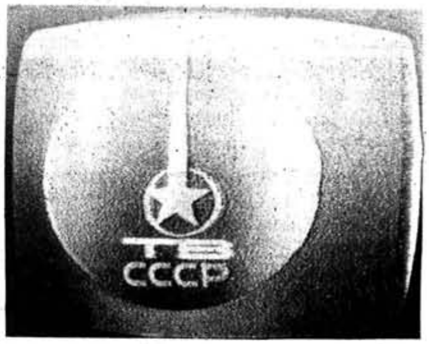

Fig. 2: Satellite picture received by Ian Roberts

Satellite TV

From Glenstantia, South Africa, **Ian Roberts** sent a picture from Soviet TV, Fig. 2, which he received on the Ekran TV Satellite during January on 714MHz.

F2

Early on March 5, the very good h.f. conditions affected signals up to around 55MHz and at 0900, on Ch. R1, I received the usual "F2" type smeary, multi-image pictures. At 0916 several strong images of a YL announcer appeared followed by a smeary caption which looked like the Arabic writing which we saw earlier in the year.

Amateur Television

I see from *TV on the Air* compiled by Andy Emmerson G8PTH, that in the Essex area weekly activity sessions for SSTV will take place every Wednesday evening on 144·500MHz f.m. Stations to look for are G4JIE, G4IMO, G4KXN, G4MYQ, G8RAN and G3LUI. There is new activity for fast scan ATV in the Wealden area with G8TLB, G4GPK, G4NAJ, G8WZK and G8PPQ on the air. I will certainly look forward to getting reports from the new stations as they clock up the ATV DX.

Letters

Letters to the Editor intended for publication must be original, and not duplicated to or copied from other publications. We reserve the right to shorten or edit them if necessary.

Iambic Keyer

Sir: Many thanks for your project "Iambic Keyer" which I am at present constructing. I would, however, like to add a memory to the keyer and wonder if any reader could supply me with an appropriate circuit.

R. Thompson
6 Reach Close
St Margarets Bay
Kent

Help Please

Sir: I have recently acquired a Star S.R. 550 Receiver which needs attention, and I was wondering if any reader could supply me with a circuit diagram in order to get it back into use.

J. J. Purcell
78 Jarrow Street
Barrow-in-Furness
Cumbria LA13 9QB

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	1X012	12+12	1.25		
	1X013	15+15	1.00		
	1X014	18+18	0.83		
	1X015	22+22	0.68		
	1X016	25+25	0.60		
	1X017	30+30	0.50		
50 VA 80 x 35mm 0.9 Kg Regulation 13%	2X010	6+6	4.16	£5.83 +£1.10 P/P	£4.93 +£1.10 P/P
	2X011	9+9	2.77		
	2X012	12+12	2.08		
	2X013	15+15	1.66		
	2X014	18+18	1.38		
	2X015	22+22	1.13		
	2X016	25+25	1.00		
	2X017	30+30	0.83		
	2X028	110	0.45		
	2X029	220	0.22		
	2X030	240	0.20		
80 VA 90 x 30mm 1 Kg Regulation 12%	3X010	6+6	6.64	£6.51 +£1.43 P/P	£5.47 +£1.43 P/P
	3X011	9+9	4.44		
	3X012	12+12	3.33		
	3X013	15+15	2.66		
	3X014	18+18	2.22		
	3X015	22+22	1.81		
	3X016	25+25	1.60		
	3X017	30+30	1.33		
	3X028	110	0.72		
	3X029	220	0.36		
	3X030	240	0.33		
120 VA 90 x 40mm 1.2 Kg Regulation 11%	4X010	6+6	10.00	£7.55 +£1.43 P/P	£6.38 +£1.43 P/P
	4X011	9+9	6.66		
	4X012	12+12	5.00		
	4X013	15+15	4.00		
	4X014	18+18	3.33		
	4X015	22+22	2.72		
	4X016	25+25	2.40		
	4X017	30+30	2.00		
	4X018	35+35	1.71		
	4X028	110	1.09		
	4X029	220	0.54		
	4X030	240	0.50		
160 VA 110 x 40mm 1.8 Kg Regulation 8%	5X011	9+9	8.89	£9.92 +£1.43 P/P	£8.44 +£1.43 P/P
	5X012	12+12	6.66		
	5X013	15+15	5.33		
	5X014	18+18	4.44		
	5X015	22+22	3.63		
	5X016	25+25	3.20		
	5X017	30+30	2.66		
	5X018	35+35	2.28		
	5X026	40+40	2.00		
	5X028	110	1.45		
	5X029	220	0.72		
	5X030	240	0.66		

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	6X014	18+18	6.25		
	6X015	22+22	5.11		
	6X016	25+25	4.50		
	6X017	30+30	3.75		
	6X018	35+35	3.21		
	6X026	40+40	2.81		
	6X025	45+45	2.50		
	6X033	50+50	2.25		
	6X028	110	2.04		
	6X029	220	1.02		
	6X030	240	0.93		
300 VA 110 x 50mm 2.6 Kg Regulation 6%	7X013	15+15	10.00	£13.67 +£1.73 P/P	£11.66 +£1.73 P/P
	7X014	18+18	8.33		
	7X015	22+22	6.82		
	7X016	25+25	6.00		
	7X017	30+30	5.00		
	7X018	35+35	4.28		
	7X026	40+40	3.75		
	7X025	45+45	3.33		
	7X033	50+50	3.00		
	7X028	110	2.72		
	7X029	220	1.36		
	7X030	240	1.25		
500 VA 140 x 60mm 4 Kg Regulation 4%	8X016	25+25	10.00	£18.17 +£2.05 P/P	£15.53 +£2.05 P/P
	8X017	30+30	8.33		
	8X018	35+35	7.14		
	8X026	40+40	6.25		
	8X025	45+45	5.55		
	8X033	50+50	5.00		
	8X042	55+55	4.54		
	8X028	110	4.54		
	8X029	220	2.27		
	8X030	240	2.08		
625 VA 140 x 75mm 5 Kg Regulation 4%	9X017	30+30	10.41	£25.10 +£2.20 P/P	£21.54 +£2.20 P/P
	9X018	35+35	8.92		
	9X026	40+40	7.81		
	9X025	45+45	6.94		
	9X033	50+50	6.25		
	9X042	55+55	5.68		
	9X028	110	5.68		
	9X029	220	2.84		
	9X030	240	2.60		

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EABC80	1·20	GY501	2·75	QQV03-10		6AU6	1·08	6SG7M	2·50
EB91	0·82	GZ32	1·25		5·80	6AW8A	3·39	6U8	0·80
EBF80	0·50	GZ33	4·00	QQV03-20A		6B7	1·50	6V6GT	1·60
EBF89	0·85	GZ34	2·50		17·50	6B8	1·75	6X4	1·20
EC91	7·56	GZ37	4·00	QQV06-40A		6BA6	1·00	6X5GT	0·85
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ECC35	3·50	KT66	10·00	QV03-12	4·46	6BE6	1·08	7C6	2·25
ECC81	0·88	KT77	8·00	R18	4·25	6BH6	1·52	7S7	2·25
ECC82	0·72	KT88	12·00	R19	1·20	6BJ6	1·08	12AT6	1·20
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EF50	1·50	PCF808	1·60	UY85	1·04	6DQ5	5·94	150B2	3·02
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EL34	2·20	PL82	1·20	5Y3GT	0·85	6K4N	1·25	2050	6·96
EL36	1·60	PL83	2·22	5Z3	1·50	6K6GT	1·30	5763	3·75
EL81	3.50	PL84	1·08	5Z4GT	1·50	6K7	1·50	5814A	3·72
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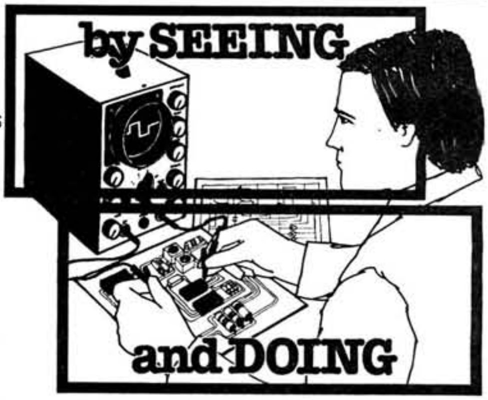

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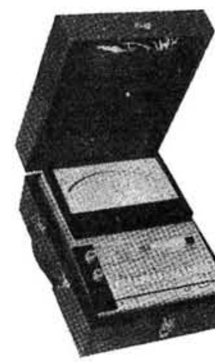

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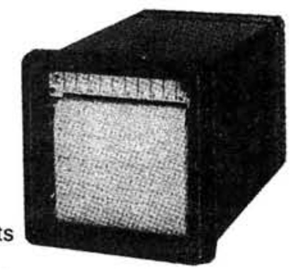

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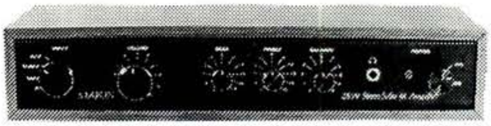

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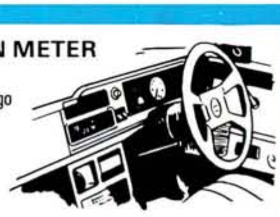

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