HAM RADIO TODAY
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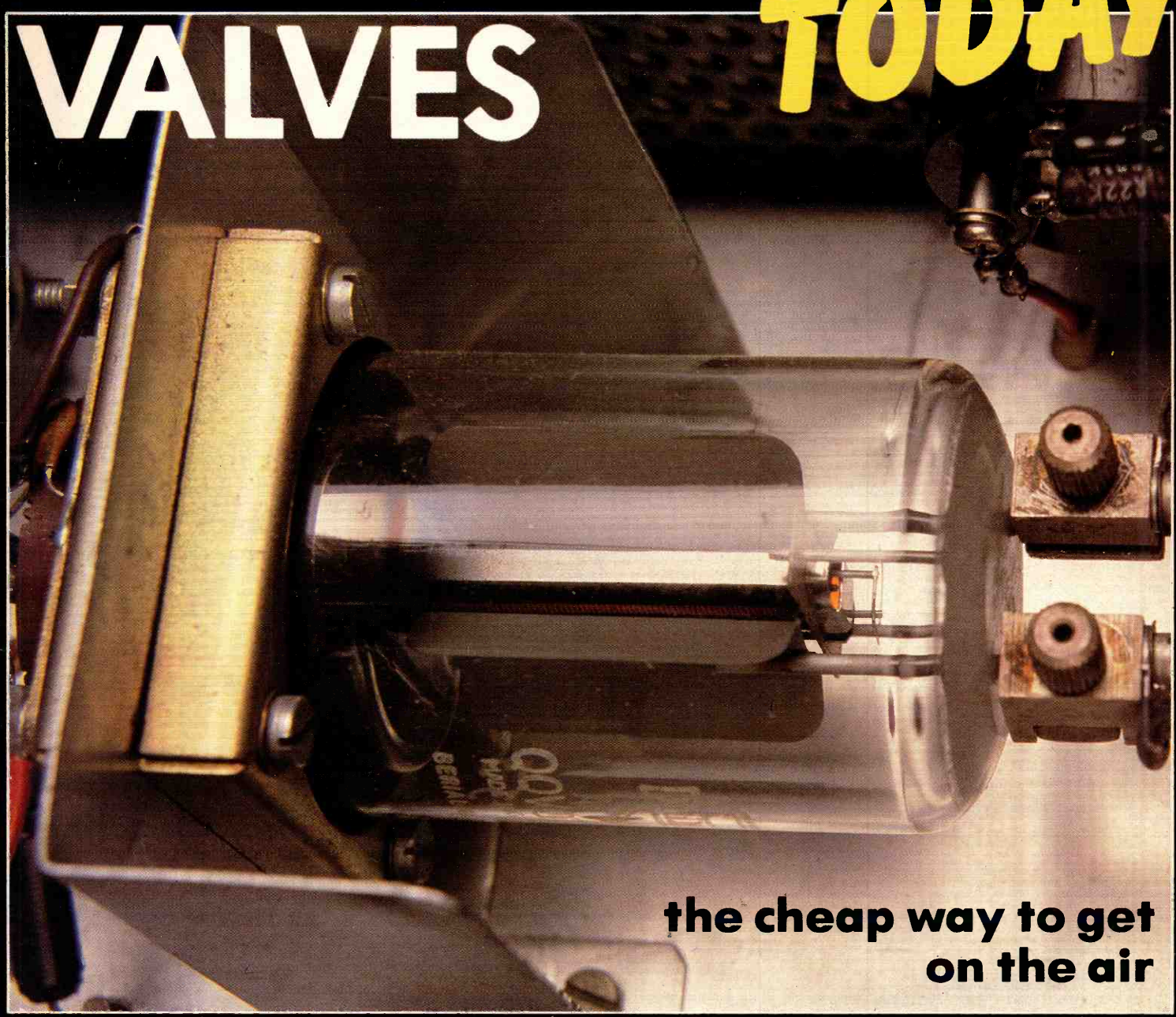
VALVES



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REVIEWED: Trio's new 2m winner? ■

TO BUILD: Attenuator/filter unit ■ Amateur Television receiving system ■ Make your own PCBs! ■

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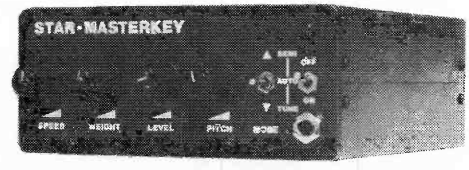

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Access

HAM RADIO TODAY

VOLUME FOUR NO 11 NOVEMBER 1986

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ABC

On the cover: Brian Kendal, G3GDU, supplied us with a VHF valve PA stage.

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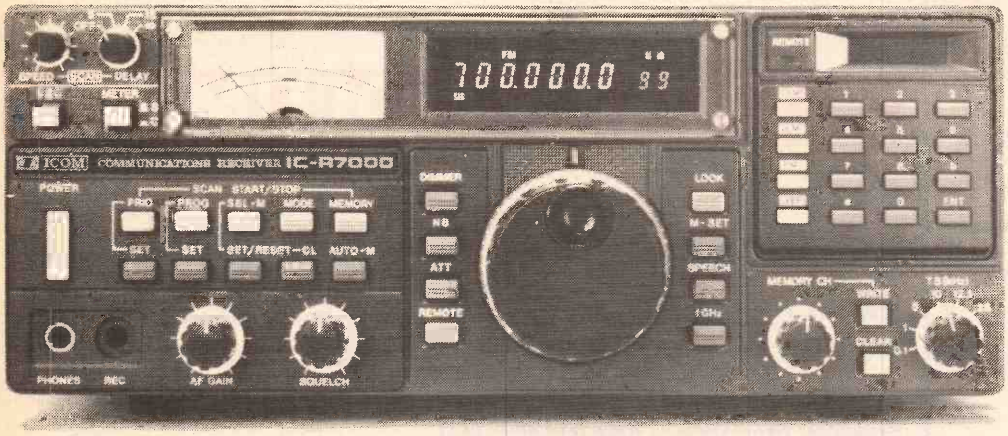
FEATURES

REVIEWS

ICOM

Total coverage... 100kHz to 2GHz!



IC-R7000.

The R71E now has a team-mate – the IC-R7000.
With these matching receivers it is now possible to tune from 100KHz-2GHz.*

The IC-R7000 covers Aircraft, Marine, FM Broadcast, Amateur Radio, Television and weather satellite bands. The IC-R7000 incorporates FM wide/FM narrow, AM, USB and LSB modes of operation with six tuning speeds:- 0.1, 1.0, 5, 10, 12.5, and 25KHz. *Frequency coverage 25-1000MHz and 1025-2000MHz (25-1000MHz and 1260-1300MHz guaranteed specification). With the IC-R7000 you have normal tuning capability with the front panel tuning knob or for quick tuning of a desired frequency by using the front panel key-pad. A total of 99 memory channels are available for storage of received frequencies and operating mode. Memory channels can be called up by pressing the memory switch then rotating the memory channel knob or by direct keyboard entry.

These receivers are available seperately but together would make a superb listening station for the shortwave listener or licensed amateur.

A sophisticated scanning system provides instant access to specific frequency ranges. By depressing the Auto M switch, the IC-R7000 automatically memorises frequencies that are in use whilst in the scan mode and can be recalled later. The scanning speed is adjustable and the scanning system includes memory selected frequency ranges or priority channels. All functions including memory channel readout are clearly shown on a dual-colour fluorescent display with dimmer switch. Other features include dial-lock, noise blanker, S-meter and attenuator.

Options include: RC12 infra red controller, EX310 voice synthesizer, SP3 and SP7 external loudspeakers, HP1 headphones and the ICOM AH-7000 super wideband discone antenna.

The IC-R71E is a general coverage receiver 100KHz-30MHz featuring direct keyboard frequency entry and infra-red remote controller (optional). SSB, AM, CW, RTTY and FM (optional) modes of operation. With 32 programmable memory channels, twin VFO's scanning systems, selectable AGC, noise blanker, pass band tuning and a deep notch filter. Keyboard frequencies can be selected by pushing the digit keys in sequence of frequency. The frequency is altered without changing the main tuning control. Options include: EX257 FM unit, RC11 infra-red controller, CK70 D.C. adaptor for 12 volt operation, CW filter options and a high stability crystal filter, SP3 and SP7 external loudspeakers, EX310 voice synthesizer, HP1 headphones.

Computer Control These receivers can be connected to a computer terminal via a suitable interface.
JT602 Serial Interface for IC-R7000.
JT603 Parallel Interface for IC-R71E (IC-R7000).
The ICOM IC-R71E requires the IC-EX309 interface connector.

IC-R71E.

Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Than

ICOM

IC-3200E Dual-band

If you are a newly licensed or just undecided about which band to first operate, then the ICOM IC-3200E is just the answer. This is a dual-band (144-146/430-440MHz) F.M. transceiver ideally suited for the mobile operator. The IC-3200E has a built in duplexer and can operate on one antenna for both VHF and UHF, and with 25 watts of output power on both bands (the low power can be adjusted from 1 to 10 watts) you can never be far from a contact whether simplex or 2m/70cm repeater.
The IC-3200E employs a function key for low priority operations to simplify the front panel and a new LCD display which is easy to read in bright sunlight, 10 memory channels will show operating frequencies simplex or duplex, and four scanning systems memory, band, program and priority scan.

IC-271 & 471 Multimode Base stations

ICOM can introduce you to a whole new world via the world-communication satellite OSCAR. Did you know that you can Tx to OSCAR on the 430-440 MHz IC-471 and Rx on the 2m IC-271.
By making simple modifications, you can track the VFO's of the Rx and Tx either normally or reverse. This is unique to these ICOM rigs and therefore very useful for OSCAR 10 communications. Digital A.F.C. can also be provided for UOSAT etc. This will give automatic tracking of the receiver with digital readout of the doppler shift. The easy modifications needed to give you this unique communications opportunity are published in the December '84 issue of OSCAR NEWS. Back issues of OSCAR NEWS can be obtained from AMSAT (UK), LONDON E12 5EQ.
This range includes the IC-271E-10W, IC-271E-25W, 271H-100W and the 70cm versions IC-471E-25W and 471H-75W r.f. output. The 271E has an optional switchable front-end pre-amp. The 271H can use the pre-amp AG-25, with the 471E and 471H using the AG35 mast-head pre-amp. Other options include internal switch-mode PSU's: the 271E and 471E use the PS25 and the 271H and 471H use the PS35.

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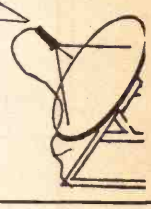

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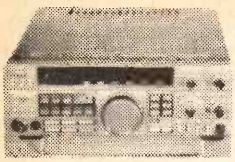

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		Net Inc VAT
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AT940	Auto ATU	229.08
SP940	Ext speaker	81.89
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AT930	Auto ATU	192.75
SP930	Ext speaker	80.67
YK88A1	6Khz AM filter 8.83Mhz	44.95
YK88C1	500Hz CW filter 8.83Mhz	44.95
YG455C1	500Hz CW filter 455Khz	105.31
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YK88A1	6Khz AM filter 8.83Mhz	44.95
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AT440	Auto ATU	135.48
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SC9	Soft case	22.79
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TM2550E	NEW High power 2M FM	435.37
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IC-490E	617.00
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IC-120	582.00
IC-1271E	1140.00

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MB2001	Mobile mounting bracket for control of AR2001/2	255.63
MB2001	Mobile mounting bracket for AR2001/2	11.34

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MR750PE	Round and preset	290.32
MR300E	High speed rotator	255.61
MLC	Lower clamps	17.81
MR750U	Motor	82.17
MR300U	Motor MR300E	82.17
KS065	Bearing	35.72

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MTV7000	Light weight rotator	53.59
AR2200	Low cost rotator	117.14
ARLB	Mast clamp AR2200	29.01

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CN410M	3.5-150 Mhz power/SWR meter	61.72
CN460M	140-450 Mhz power/SWR meter	65.40
CN520	1.8-60 Mhz mini SWR meter	49.25
NS448	900-1300Mhz SWR/Power meter	86.60
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CN720B	SWR/POWER meter 1.8-150Mhz 20/200/2kw	113.21
CNW419	Tuning unit	206.37
CNW919	Antenna tuner	147.40

AC POWER SUPPLY UNITS

PS310M	PSU 30A max 22A continuous	198.95
PS120M	3-15V variable 12A	112.04
PS80M	AC PSU 3-15V variable 8A	79.50

LINEAR AMPLIFIERS

LA2035R	2M Linear RX preamp, 35W.	80.33
LA2065R	2M Linear RX preamp 60 watt	133.29
AF606K	Active filter	99.82
CWR685E	TX/RX unit for RTTY/CW/ASCII	856.51
CWR670E	RX only unit RTTY/CW/ASCII	436.01
CWR675E	RX only RTTY/CW/ASCII with monitor	498.57
CWR610E	RX unit RTTY/CW/ASCI	165.00
CD600	Data receiver	215.14
CD660	Data receiver	264.97
CD670	Built in LCD display	327.77

KEYS AND KEYERS

TRX3	Practice oscillattor	13.65
HK708	Straight Key	21.82
KH702	Deluxe version	43.30
MK704	Squeeze paddle	20.25
EK150	Electronic Keyer	133.75
MK1024	Electronic Keyer	241.98
DK210	Electronic Keyer	73.96
BY1	Bencher lambic	67.42
BY2	Bencher chrome	76.97
BY3	Bencher GOLD plated	141.75
BST1	Bencher single lever	67.42
BST2	Single lever chrome	76.97

BASE STATION AERIALS

HF5	80-10m HF vertical	83.39
HF5R	Radial kit	54.81
GPV5	2m base colinear	54.92
GP23	2M 3 section colinear	51.97
GPV720	band base vertical	45.68
GPV7	70cm 5/8+5/8+5/8 colinear	45.59
REVCONE	30-500Mhz Discone	31.50
2065	5/8 ground plane	31.50
D130	Discone 25-1300Mhz	79.34

MOBILE AERIALS

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2NE	2m 7/8, 4.5 dB gain	24.23
OSCAR430	70cm 5/8+5/8+5/8	27.72
320	1/4 wave	3.30
12B	Car wing mount	5.73
GSS	Gutter/boot mount	6.26
HS770	145/435Mhz Diplexer	18.02
OSCAR720	145/435 Mhz dual band antenna	24.59
RAK	Gutter mount/lead PL259	12.95

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TBWHIP	Tuning whip	5.52
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UR43	50ohm coaxial cable	8.30
UR67	50ohm coaxial cable	0.05
TWIN300	300 ohm twin	8.30
TWIN75	75ohm twin	0.20
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DL600	600W aircooled dummy load	62.74
WA1	AKD wavemeter, 120-450 Mhz	24.96

FILTERS

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ANTENNA ACCESSORIES

CS201	Two way coax switch	21.90
CS201G	With N-type sockets	35.01
CS401	four way switch	69.09
CS4	4 way switch BNC	30.39
EIS	Egg insulator	0.61
EIL	Large egg	0.79

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PL259	Coax plug	0.66
REDUCER	Reducing sleeve	0.15
SO239	Flange socket	0.69
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RA259	Right angle	1.23
LA1	Lightning arrester	1.48
BNCPLUG	50 ohm connector	1.50
BNCFS	Free socket	0.95
BNCIL	In line BNC	1.23
BNCSO239	BNC to SO239	1.68
PL259BNC	PL259 to BNC	1.81
NPLUG	50 ohm plug	2.30
8MS	8 pin socket	1.20
8MP	8 pin plug	1.20
6MP	6 pin mic plug	1.20
6MS	6 pin socket	1.20
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HOWES QRP TRANSMITTERS. We have three QRP CW transmitters in our range at the moment. The **CTX** transmitters are available for 40 or 80M bands, and the **MTX20** is for 20M. All three feature adjustable outpur power, up to about 5W on 80, 3W on 40 and 10W on 20M. The heatsinking for the output stage is onboard, and one crystal is included. There is space for two more crystals on the PCB, and provision is made for connecting a VFO. The CVF VFOs are available for 40 and 80M at the moment, the 20M version is under development. The VFOs have dual buffered outputs, so that not only will they drive the transmitter, they can also drive the DcRx receiver as well, for full transceive operation. Voltage regulation, and IRT (clarifier) facilities are included.

CTX80 80M Transmitter Kit £12.95 — **Assembled PCB Module £18.95**
CTX40 40M Transmitter Kit £12.95 — **Assembled PCB Module £18.95**
MTX20 20M Transmitter Kit £19.90 — **Assembled PCB Module £26.95**
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HOWES 2M to HF TRANSVERTERS

If you have a 2M SSB/CW transceiver (an FT290 for example) you can get on to 20 or 80M without having to spend a fortune on an HF transceiver. These transverters also make HF Mobile operation much more practical, as a small 2M rig is all that has to be mounted within reach of the operator. These units deliver about 10W output from mismatch proof transistors, and do not require any fancy test equipment to set them up. A high proportion of fixed value filter components keeps alignment simple, and the output spectrum clean.

HC220 20M Kit £48.90 — **Assembled PCB Module £79.90**
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HOWES CTU30 ANTENNA MATCHING UNIT

The CTU30 is a "T" match type ATU for use with receivers and transmitters of up to 30W output on all bands from 1.8 to 30MHz. It uses two air-spaced capacitors, and 12 switched inductance settings. An unusual feature in a small ATU is the provision of a balun for feeding balanced antennas in addition to the more common unbalanced types. All the parts are PCB mounted in this novel design. Simply add a case and connectors to fit in with your station, even the knobs are included in this kit!

HOWES CTU30 Kit £24.90 — **Assembled PCB Module £29.90**

HOWES TRF3 SHORTWAVE BROADCAST RECEIVER

The TRF principle was developed 80 years ago. Here it is brought up to date with modern silicon devices. The receiver tunes from about 5.7 to 12.8MHz in three bands, if you wind the coil as suggested in the instructions, although you can easily experiment with the coverage if you wish. The TRF3 has switchable input impedance and attenuator, so it can be used with large or small antennas. This is an excellent educational project for the "junior op", as well as providing a bit of fun for the old timer as well! You should be able to read all about building it in the September issue of Ham Radio Today.

A suitable tuning capacitor is available at £1.50

HOWES TRF3 Kit £13.90 — **Assembled PCB Module £18.90**

All **HOWES** kits come with a good quality PCB which has the parts locations screen printed on it for easy, accurate assembly. Full, clear instructions are provided, as are all board mounted components. We think you will like the quality of our products.

If you would like further information on any item, simply drop us a line, enclosing an SAE. We have a free information sheet on each product and a general catalogue.

Please add 80p P&P to your total order value. Export prices are the same as above, but add £2.00 per kit for airmail delivery outside Europe.

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73 from Dave G4KQH

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AM 150KHz–2194KHz AM 108-136MHz
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The new Sony Air-7 is a superb new monitor having features so far unmatched in a single hand-held monitor by any other manufacturer. Its frequency coverage makes it ideal for airband, public service or marine band monitoring, plus normal domestic use. Highly sensitive, this receiver does everything you could ever desire in one package. The LCD digital display means clear frequency display even under bright illumination and the PLL circuitry ensures drift free reception. Frequency is selected by keypad entry or electronic tuning and there is provision for disabling the keyboard. 10 memories are provided for each of the 4 main ranges (40 in total) and comprehensive scanning is provided in the bands 108-174mHz. Either full band or memory scanning is possible at a rapid rate. Additionally, delays may be programmed into each memory channel, certain channels only may be scanned and any channel can be designated the "priority" channel. Accessories include BNC helical, battery cartridge shoulder strap etc. Options available:- rechargeable battery cartridge **£15.95**; Mains PSU/charger **£13.**

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PLEASE NOTE, unlike some versions on the market, these are not "grey imports" and therefore have both the full frequency coverage and the backing of SONY UK. No other amateur radio dealer in the UK can offer you this guarantee. Be warned!

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At last the only "COMPLETE" vhf/uhf frequency guide available to the UK radio enthusiast. Not just a collection of random frequencies put together in haphazard fashion but a professionally prepared and printed guide based on the very latest information available. 64 pages packed with a mass of information about this fascinating part of the frequency range. Whatever you want to know, if its between 26 and 2250mHz this guide will quickly take you to it. In fact it would be difficult to imagine any enthusiast not having a copy of this beside him! The book very clearly lays out comprehensive details of all the services that use this part of the radio spectrum with their allocations and where applicable the separate mobile and base station frequencies. It would be impossible to list everything that this publication covers but it includes the following:- All UK marine frequencies with coast station listings; Civil airport and ATC frequencies; Military air including air to air and air to ground including Red Arrows; Police; Fire and Ambulance mobiles and base with duplex cross references; NASA voice channels; Russian Space spot frequencies; Weather satellites, PMR; Outside broadcast channels BBC/ITA; 2m and 70cm repeater listings; UHF TV channels; BT radiophones; new band 3 PMR allocations and much more. There is no gaps (like some publications that have attempted to copy us and then got it wrong!); every part of the spectrum is accounted for. No radio shack is complete without this invaluable guide. Send or phone today for your copy.

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Raycom	1/2 G5RV	1/2 size G5RV m/band ant.	13.95
Raycom	1/4 wave 25	145MHZ 1/4 wave PL259 fitting	2.99
Raycom	**GP900**	**3db 800-1000MHZ colinear c/w BNC**	**19.50**
Raycom	**HBD**	**Highband dipole assembly**	**8.50**
Raycom	**2M HB9CV Inc. Post**		**9.98**
Raycom	**70cm HB9CV Inc. Post**		**7.98**
Raycom	5/8 whip	145MHZ 5/8 spring type s/steel whip	3.75
Raycom	SO239-MAG	Magnetic mount SO239 c/w cable PL259	9.50
Raycom	Swivel-mag	Switvel base mag-base c/w cable PL259	9.25
Raycom	Trap-dipole	7.1MHZ trap dipole com. kit	29.95

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13.8V 12A (8A continuous)	**52.50**
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Raycom	V25F-145	2mtr 15W linear amp. 1-3W/pt	48.50
Raycom	V35L-145	2mtr 35W linear amp. 1-3W input	59.50
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YAESU FRG-9600 MKII very latest mod. gives improved 'S METER' on RX and extended coverage up to 950MHz.

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TONNA	20809N	144MHZ 9 ele. fixed ant. 'N'	25.65
TONNA	20813N	144MHZ 13 ele. port. ant.	39.50
TONNA	20817N	144MHZ 17 ele. fixed ant. 'N'	47.83
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Kopek	AR1002	50g loading 3-core auto-rotator	38.50
Raycom	discone	60-600MHZ	27.50
DNT	M40FM	modified 10FM	49.50
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ALINCO	**ALR206E**	**25W mobile**	**249.00**
ICS	**AMT2**	**AMTOR/RTTY CW Terminal**	**169.00**

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OUR NEW 24CMS FREQUENCY LOCKED **FMTV** TRANSMITTER?
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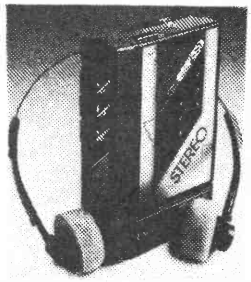

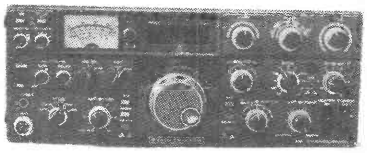

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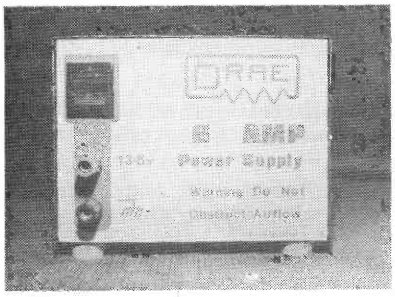

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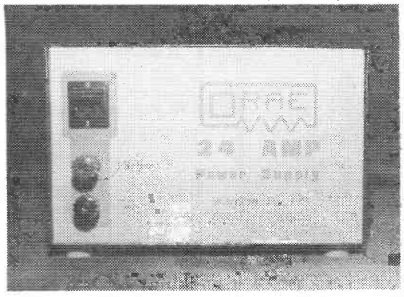
Price **£65.00**



24 amps 13.8V
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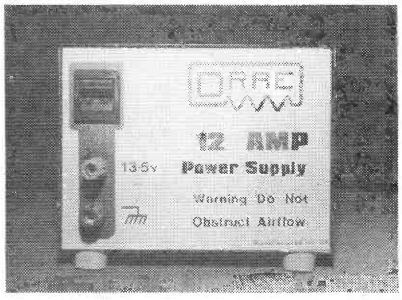

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All PSU's are fully regulated, short circuit protected and incorporate an overvoltage crowbar circuit.

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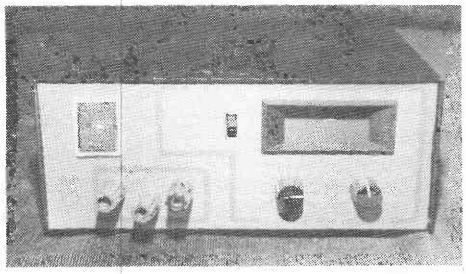

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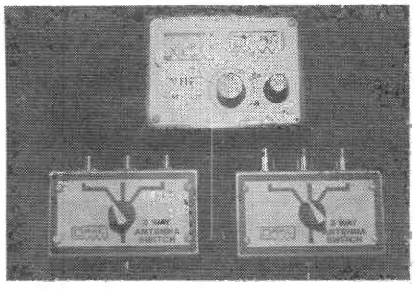

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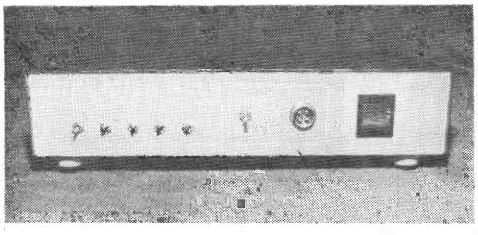

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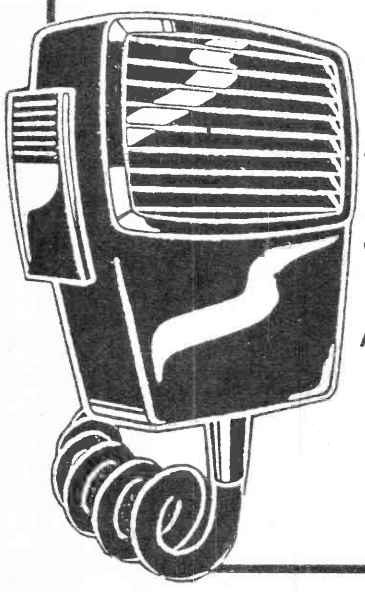

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THE NEW TX-3 RTTY/CW/ASCII TRANSCEIVE PROGRAM

RTTY has selectable auto CR/LF with user-defined line length, LTRCS/FIGS force and selectable Unshift-on-Space.

ASCII has data bits/stop bits/parity/text or binary mode options.

Both have selectable baud rates and shifts, high or low tones, frequency scale for really easy, accurate tuning and keyboard fine-tune.

CW has selectable software filters and TX tone, autotrack fully controllable to 250 wpm or can be locked,
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All modes have:

Receive screen unwrap – no more split words.
Displayed real-time clock can be transmitted or inserted into review store.
Large review store with fully selectable readout to screen or printer.
24 large memories for your standard information.
Pre-programmed RYRY and QBF test messages.
Callsign capture.
Character or word mode sending from type-ahead buffer or keyboard direct.
Re-transmittable receive buffer.
CW indent.
Memories and review store transferable to/from tape or disc.
TX buffer can be loaded from tape or disc to send a pre-prepared file.
Saveable status file contains your current settings for each mode so that the program automatically starts each mode the way you want it.
Ability to use either a T.U. or a simple interface.

All this and more available for **BBC-B** now. Other versions coming soon.

To go with it we have the **NEW TIF1 INTERFACE**, specially designed to reduce computer noise. Receive has RTTY and CW2-stage filters, transmit has outputs for MIC, PTT and key.

TX-3 and TIF1 are compatible with our existing products. TX-3 on tape £20, disc £22 (state 40/80 track). If you already have our RTTY/CW transceive program, return it with your order for a £10 discount.
TIF1 kit (assembled and tested PCB + connectors M cables but not MIC connector or box) £15. Complete assembled, boxed with all connections £25 (state rig), for more than 1 rig state extra (rigs) and add £3 for each.

For the Listener we have the RX-4 MULTIMODE RECEIVE PROGRAM

Lots of features and performance for receiving **RTTY, CW, SSTV, AMTOR. Spectrum** needs no hardware, **BBC-B, CBM64** and **VIC20** use TIF1 or a T.U. on RTTY or CW. Tape £25, disc £27 (not Spectrum, BBC state 40/80 track).

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FM - AM - SSB 32 MEMORIES
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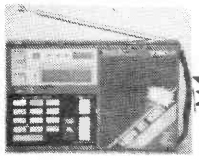

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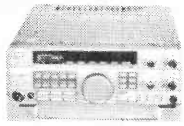

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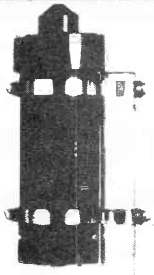

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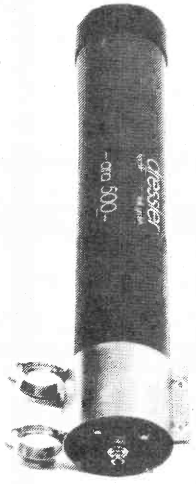

DRESSLER ARA 500 ACTIVE ANTENNA

50MHz to 1300MHz
Gain 17dB Typical

TECHNICAL SPECIFICATIONS FOR ARA 500

Gain	17dB Typical (14-17dB)
Frequency Range	50-1300MHz
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Operation is possible up to 1300MHz with gain of 10dB
Noise 4-6dB
Intercept Point 3rd Order: +18dbm at Input

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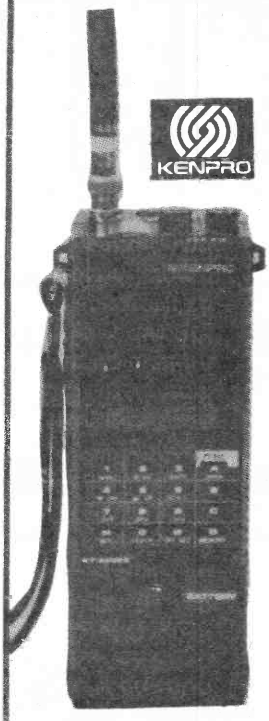

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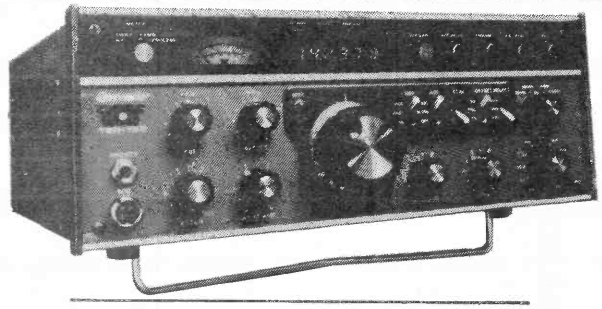

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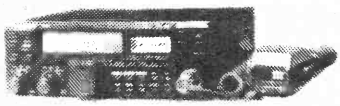

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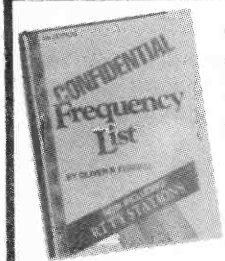

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LETTERS

ARE AMATEURS AGEIST?

Sir, Why is there such an unfriendly attitude by some amateurs on 2m? After spending three years as an SWL, I decided to take the RAE. This was passed and I soon got together some equipment to get on the air. After some time listening and chatting to a local friend, we must have let our ages slip (under 18) because we were soon given derogatory remarks by licensed amateurs (?) and carriers put over my contacts. We wonder if they were licenced because none gave callsigns and were in breach of their licences. I am not alone in this sort of situation. A YL, I heard, was licenced on her 14th birthday and was told "we don't want children on here" when she gave her age. We have all passed the RAE, like everyone else, so why are they superior beings?

Meanwhile I am QRT in disgust and studying hard for the morse to get on "friendly" HF where my SWL days started when I was 14 years old. So please old timers, get off your pedestals and come down to earth and join us mere mortals. This trend of ignoring (or worse) new callsigns is damn ignorant and must stop.

Disillusioned G1, Manchester

Unfortunately, there always seems to be this sick minority who insist on making it uncomfortable for amateurs they don't like the sound of. In London there are some who happily slander anyone who picks up the microphone. They seem to do it to become noticed. If everyone ignores them, changing channel if necessary, perhaps they'll get bored and go away.

To those amateurs who feel that young people should not be allowed on the amateur bands, remember that the level of increase in amateur numbers is falling. Young people are the future of amateur radio — deter them and you might find one day you have no one left to talk to.

WOULD YOU BUY A USED RIG. . .

Sir, A number of retailers are prepared to sell used equipment on a commission basis for a fee of 10 or 12½%. The goods will be on display in the shop and it will be possible to try them out before buying. During the time they are on sale the goods will be reasonably secure and can be covered by insurance. The fee charged seems to be quite fair for such a service.

Contrast this with the bring and buy stall at many rallies. The organisers usually expect a fee of 10% of the sales value and in some cases a small entry fee as well. In return the vendor has his goods displayed for one day, at the owners risk, in conditions which will probably invalidate any insurance cover. The flea market approach adopted at the Dayton Hamfest is much more reasonable. This scheme also proved to very successful at the recent Drayton Manor rally. 5% commission for rally organisers would be reasonable; 10% is a rip-off. The solution is of course in readers hands.

P L Crosland, G6JNS

10m FOR ALL?

Sir, I note that there is at present exceedingly slight use of the 28MHz band (to which I have been listening for nearly 40 years) by British amateur stations, even when it is obviously 'open' at least to Europe. I hear no other, non amateur, users of the band whatsoever and the status of the amateur allocation is primary.

No real harm can be done to anyone if access to the customary telephonic section of the band is given to all those who have passed the RAE and hold a licence. I urge the DTI through your columns that this be done forthwith. This proposal could begin on an experimental basis, as has been done with those favoured by some other parties.

A L Dick, GM6KKP.

COMPONENT PROBLEMS OVERSEAS

Sir, I find your magazine very interesting but a lot of the construction articles are impossible to duplicate because some components which would appear to be relatively common in the UK are impossible to get here in New Zealand. Unfortunately, kits available in the UK are not welcomed by our customs since technically you require an import licence (naturally impossible to get) to bring them in. They don't mind small low value items.

Would it be possible to think of designing projects and use components which tend to be in international usage or at least make the boards more amenable to substitution of parts. For example, the 2m Tx and Rx project you published some time ago. Worldwide there is an unsatisfied demand for designs for relatively simple (as in crystal based) 2m band (and 6m and 70cm as well) that are easy and uncritical to set up, have common parts and yet are well designed to be free from spurious outputs and inputs.

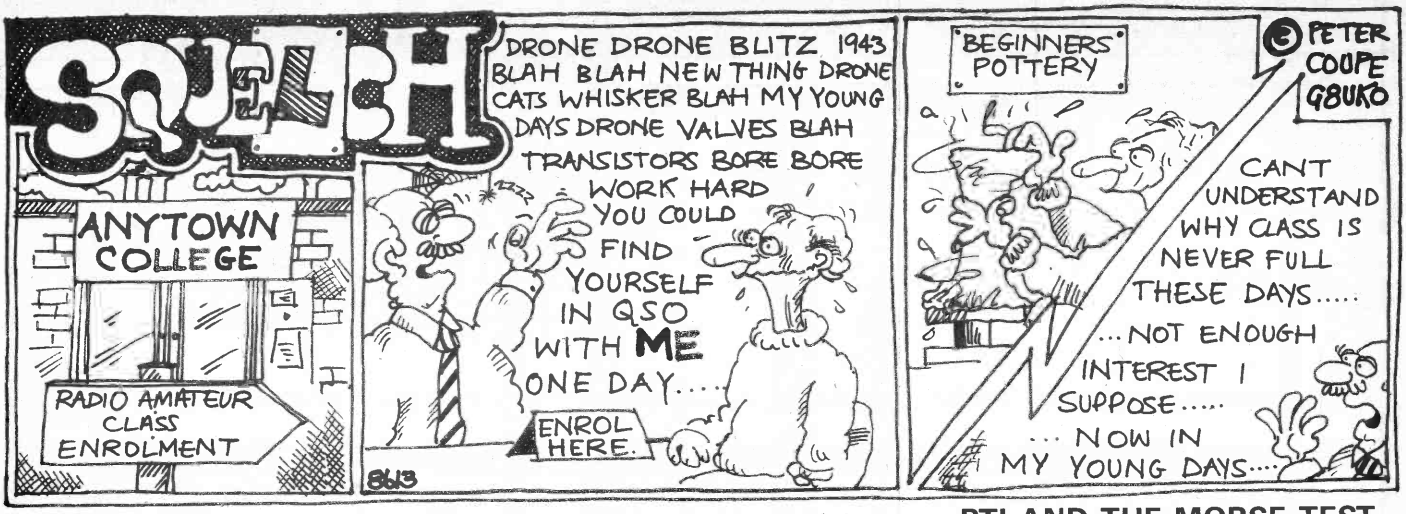
J K Marsh, ZL2TAS

Take note all present and prospective authors. We do have quite a wide distribution around the world and not everyone's junk box contains the same junk as yours. In this day and age, substitution is a necessity to reduce expense.

AN ANTI NON-QSLER

Sir, I feel I must write and have a moan about the hobby I dearly love. This morning I received an envelope from my bureau sub-manager. This contained 14 QSL cards; three were for me and 11 were from me to other G1 stations who hadn't claimed them.

Now I believe that QSLing has been part and parcel of amateur radio from the beginning. It is a part of the hobby that many people including myself very much enjoy and spend a lot of money on. Why is it then that some people stubbornly refuse to get involved with it after giving no indication of any sort in the QSO that they don't QSL? Many times I've said,



"I'll pop a card through the bureau for you," and had the reply, "Yes, I'll QSL via the bureau" only to never get a card.

I do not blame the bureau, they are a very well organised group of volunteers without whom we would be in a right mess. Occasionally I have sent a second card direct to be told that they've sent one via the bureau. I've never received them and I'm sure my postman has no use for them. It is all down to people who cannot be bothered to send envelopes to the bureau or fail to say they don't QSL.

I have QSLed to 312 different stations and received cards from 152 — 135 stations had two or more cards. One station in Jersey has received two cards from me direct, the second with postage enclosed, and I'm still waiting for his card. In the two years that I have been licenced QSLing has cost me around £75.

I personally think that the English (yes not the British) are the worst QSLers. Another fallacy is that of contest stations. The majority of stations I have sent cards to have replied. It is the normal QSL that you've go to watch out for.

Most of us love to get cards. It is a nice, gentlemanly thing to do and it rounds off a contact perfectly. Perhaps we ought to start an anti non-QSLers group or something. So if you don't QSL or you don't want to QSL that particular QSO, please say so if you're asked for a card. It saves a lot of time, expense and disappointment.

M F Newell, G1HGD

A HAPPY ENDING

Sir, You published my letter about my faulty Yaesu FT102 in the April 1985 issue. Well, I can now advise your readers that the fault has at last been resolved. I have waited many months before writing so as to be sure that the remedy was absolute.

Mid way through 1985, a fault developed with the blowing of the mains fuse. Through isolating circuits, I found that the trouble was in the final stage. One 6146 was replaced. However, the following symptoms remained: R01 in rectifier B board heating up and smoking, IF shift/width control not operative, monitor oscillator audible through the speaker on receiving, transmitter signal chirpy, switching transmitter heater/fan on altered the width of the IF.

Checking the board showed that the high current through R01 was due to Q01 being open circuit. Q1, a 2SB705R, was U/S and passing 24V onto the 12V output. This was replaced by a JE2955. The voltage regulators Q02 and Q05 were under rated, being only 400mA, so they were replaced with 1A regulators. The voltages on both transmit and receive had failed and replacing Q03, Q04 and Q05 did not restore them, until it was found that diode, D07, was shorting to earth. When it was replaced, the voltages were restored.

Now the receiver took on the selectivity that had not been evident even when first received from the Yaesu agent. The IF width/shift control now worked by the book. The selectivity is now so good that one does not need to use the CW filter. Whilst checking the rectifier board, I found that there was no Rx 15V due to Q05 being U/S. This voltage goes to the IF width/shift control and the reason why I have had all the trouble has been the lack of that 15V.

One would not expect faults on a brand new piece of equipment like this and my returning the equipment to the agent and a letter to Yaesu did not bring forward any clue to the fault. Many friends around the world have told me that they swear by their FT102 and my reply was that I swore at mine. After many months of testing under all conditions, contests and normal QSOs, I can now say that there is no more swearing in the shack and the FT102 is operating to the highest satisfaction.

C H Castle, VK5KL.

BTI AND THE MORSE TEST

Sir, I should appreciate your allowing me to reply to the criticism in the August edition of Ham Radio Today of British Telecom International's attitude towards the amateur morse test.

BTI is not anti-morse, nor does it seek to prevent BTI employees from taking part in amateur morse activities apart from the actual conducting of morse tests or arranging the attendance of examiners at test venues. The reason for the ban was not in order to preserve BTI's profits. In fact, the profit from the activity was almost negligible. Loss of the work to another organisation, however, results in a consequential staff redundancy equivalent to one man in a small workforce of maritime radio surveyors which is already having to be reduced because of the drastic fall in the number of British ships. We would be doing our employees a disservice were we not to take every opportunity to preserve as much work as possible for them. You might wish to know that the local officials of the BT staff associations concerned view the loss of a job to another organisation using unpaid volunteers with the same misgivings as does BTI management.

The comments of BT employee, G4JBB, that he is no longer permitted to teach morse shows a misunderstanding of the instruction. The leaked telex shown in your magazine shows quite clearly that the ban refers only to the conducting of tests, the later official instruction to BT staff clarified this. Both notices gave an address and telephone number for enquiries and I should like to emphasise that any BT employee who is unsure of the position should write to or telephone this enquiry duty.

I hope this will clear up any misunderstanding of BTI's motives in issuing the instruction. We do not seek to cause difficulties to the RSGB or to those taking the Amateur Morse Test but we are naturally concerned to protect the jobs of our staff.

F R Barnfather
British Telecommunications PLC

RADIO TODAY

Revised Correspondence Course

The Rapid Results College have revised their RAE course. But is it up to much? Sharon Metcalf, BSc, G6LCC, gets down to some serious studying.

The Rapid Results College have gone some way to answering my criticisms of their correspondence course (HRT July 1985) with the publication of a set of updated notes (yes, they really have left valves behind). With the set of five course books you will need just a copy of the current City and Guilds syllabus and you are all set, according to the RRC.

My package included an update bulletin on 50MHz (a good idea for keeping the book on licensing regulations up to date — but in fact this book was not sent to me), one sheet with a few corrections to test questions from the course books (implying that the general text is perfect, which it isn't, or perhaps it hasn't been checked?) and a general information booklet, 'Your Career', which details all RRC courses.

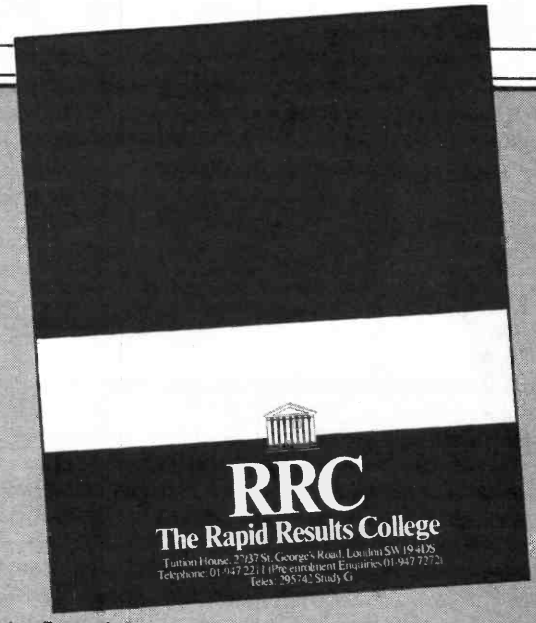
'Your Career' is professionally layed out, with different colours differentiating the main sections, and looks very enticing. Unfortunately the presentation of the course books bear little relation to this 'glossy brochure'.

The different books all have different sizes of type and all too often consist of whole pages of text relieved only by a few subheadings. This is particularly the case with the first book, which contains a very heavy traditional treatment of basic electricity, AC theory and components. The pages of solid text provide little incentive to reward or keep the student's interest. The educationally proven technique of splitting text into short, visually attractive sections, differentiated by colour or at least wide gaps, has been ignored.

In all fairness, most of the courses originally reviewed had the same failing. However, I had hoped that RRC could have taken advantage of their reprinting to update their style. Shorter sections aid studying in short sessions and make revision much easier.

The RAE syllabus is all covered but the depth of treatment varies greatly between topics; the first book has a highly mathematical A level physics approach, but sidebands are superficially covered. FETs and MOSFETs have all of twelve lines of text, although this skimpy treatment is an improvement on the old RRC course.

The mathematical side could cause confusion, especially as in equations the indices are printed the same size as ordinary numbers and the square root signs are hand drawn. Also, although a page lists powers of ten and their equivalents (10, 100, etc), the worked examples show only the equivalents with all their zeros. Where does this leave students using calculators, with numbers as powers of ten? Probably in a mess!



At first sight the second and third books both cover transmitters and receivers, but these are split with the theoretical work in the second and the practical circuits in the third. For the sake of clarity and easier revision, grouping the work on each topic together would seem more satisfactory.

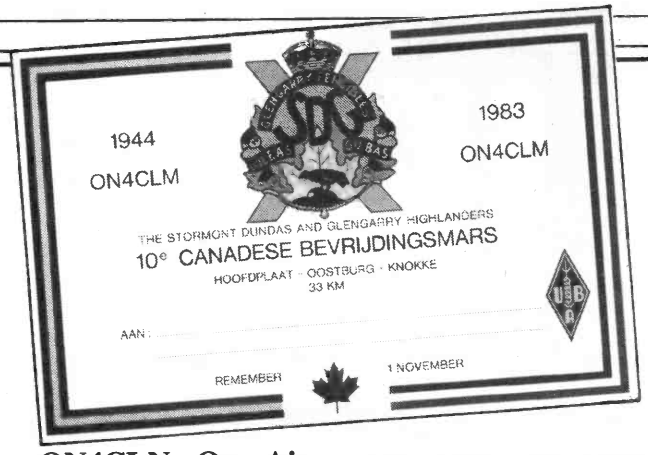
The fourth book on antennas, interference and measurement is by far the easiest book to read (less mathematics and fewer circuits). More antennas are covered than in the RAE Manual (useful, even though the drawings are badly executed) and the interference section contains some useful case studies. However, the book makes sweeping statements, eg "...are known as 'directional antennas' or 'beam antennas' ". What about dipoles or end fed long wires? These are not 'beam antennas' and yet they are directional. Some of the measurement techniques must be questioned, such as the use of an oscilloscope to measure modulation depth, and the scope trace shown for a two tone test is so roughly drawn that it would indicate a faulty transmitter!

It is in respect of the drawings that my main criticism must lie, for most look like freehand sketches and many are inaccurate to the point of being misleading, with sine waves drawn assymetrically or with varying amplitudes and frequencies along the length and without any verbal indication as to how they should look. Also, have you ever seen a sine wave drawn with a ruler (as if sawteeth with just the top and bottom points rounded off)? Why has the TVI filter circuit been printed upside down (so that the earth symbol stands on the top like a Christmas tree)? In fact, most of the circuits are roughly drawn, lacking the professional artwork that 'Your Career' leads you to expect. A well labelled diagram can explain more than a thousand words.

The RRC states that "This is essentially a practical course" but the course contains none of the structured experimental work necessary for the beginner.

I am afraid that this course should only be tackled by an RAE student as a refresher course to back up A level Physics or Mathematics or by a more academic student wanting a better grounding in electronics than that needed for the RAE. It would be a daunting task for the average candidate, who would certainly need additional personal tuition, rather defeating the object of a correspondence course!

When it comes down to it, the cost of £79 may sway you towards a local adult education RAE course or towards getting help from other radio amateurs. Either of these two options would, in my opinion, give you an easier route to getting your ticket than this correspondence course.



ON4CLN On Air Again

Special event station ON4CLN will once again be on the air from Monday 27th October to Sunday 2nd November, in celebration of the liberation of the town of Knokke in Belgium by Canadian troops on the 1st November 1944. This will be part of the annual celebrations in the town.

An award will be available, and, as you can see here, it should be most attractive. All you have to do is contact ON4CLN, and you should listen out on the following frequencies: 3.685, 7.045, 14.145, 21.245, 28.545 and 144.250 MHz in SSB, 3.515, 7.012, 14.020, 21.020, 28.020 and 144.020 in CW, and 145.475 MHz FM.

To enable amateurs to collect the series, there are still limited quantities of the '83, '84 and '85 awards available (honouring the Stormont Dundas and Glengarry Highlanders, the Regina Rifle Regiment and the Canadian Scottish Regiment; the '86 award honours the Royal Winnipeg Rifles. Awards cost £2 each (or $5 or 10 IRCs), with all proceeds going to the maintenance of memorials, displays, etc.

For QSLs, SWLs, claims, etc, contact Radio ON4CLN, PO Box 140, 8300 Knokke, Belgium.

Catch A Bearcat!

Ray Withers Communications are pleased to announce that they have a new range of Uniden-Bearcat scanners. There are three new models: the DX1000 digital short-wave communications receiver, which is 10kHz (that's what they say) to 30MHz all mode (including narrow band FM), the BC100XL, the latest version of the handheld VHF/UHF Bearcat 100, and the BC175XL desk-top VHF/UHF scanner. Contact R Withers Communications Ltd, 584 Hagley Road West, Oldbury, Warley B68 0BS (tel 021 421 8201/2/3) or go and see the units on demo at Guildford Communications, 34 Aldershot Road, Guildford (tel 0483 574434).

Cannock Chasing Events

Cannock Chase ARS is at it again, with two special event stations happening during October and November.

The first is GB6SW, a celebration of the club's call sign G6SW, the first HF call in the Cannock Chase area. Operation will be on most bands and will be supplemented by GB1GCC and GB8GCC. Special QSL cards will be sent to all contacts, and the Cannock Chase award will be available to stations working GB6SW and any of the GB-GCC calls. Awards will be issued with endorsements for all GB-GCC stations worked (maximum six endorsements). The cost of the award is £1 or four IRCs; send a copy of your log book to qualify. GB6SW will be on the air throughout October.

The second event is a repeat of the GB4WAB station, and this will be operating throughout November. Again, special QSL cards are available, and there is no award this time for contacting GB4WAB and any one Cannock Chase ARS member. The award costs £1.50 or three IRCs.

Details, active members lists, direct QSLs, and award claims to G1AZQ or G0BXN at their QTHRs (see call book) or from CCARS, c/o Bridgetown WMC, Union Street, Bridgtown, Cannock, Staffs. Please remember to send an SAE when asking for details, lists or direct QSLs. All proceeds will go to the RAIBC and QTI.

Midlands VHF Convention

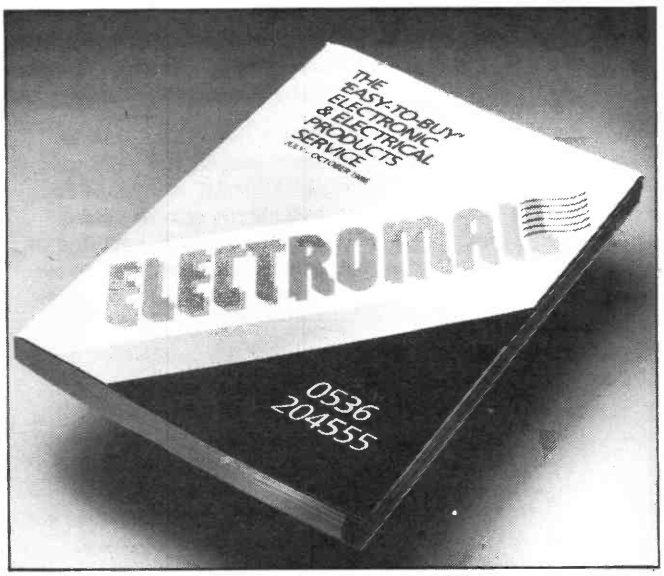
The RSGB Midlands Convention will be held on October 11th at Madeley Court Centre, Telford, Shropshire. The convention will start at 11am, and will include the following lectures, etc:

1330 Opening Address (Keith Fisher, G3WSN);
1345 Cellular Radio — A Technical Perspective (Malcolm Appleby, G3ZNU);
1455 10GHz Amateur Television (Peter Blakeborough, G3PYB);
1605 Meteor Scatter — The Reliable Mode (Ken Willis, G8VR)
1715 VHF Forum (Keith Fisher, G3WSN, RSGB VHF Manager; Julian Gannaway, G3YGF, RSGB Licensing Advisory Committee; Mike Dixon, G3PFR, RSGB Microwave Committee; Dave Yorke, G4JLG, RSGB VHF Contests Committee).

The forum will be followed by an evening buffet with bar. Admission will be £1.20, with tickets for the evening buffet costing £5.

Besides the usual things at conventions, such as a trade show, bring and buy stall and a book stall, there will be a measurements facility which should provide for most requirements up to 18GHz. If you want any unusual measurements, let the organisers know in advance and they'll try their best to help.

The convention site is close to the M54 motorway, and talk in will be provided (though at the time of going to press we had no details of frequencies, etc). A map is available if you send an SAE to the organisers, at Midlands VHF Convention, c/o J P H Burden, G3UBX, 18 Langley Road, Merry Hill, Wolverhampton, WV3 7LH.



Electromail

You can now buy from the enormous range of RS components without having to pretend you're a trade customer, and without dealing through a third party company. This is because RS have set up an easy-to-buy service for everyone — you don't have to have a trade account.

As you'll guess from the headline, the service is called Electromail, and the catalogue for Electromail is identical to the standard RS catalogue except that it has 'Electromail' plastered all over it, and it has different ordering information. You can pay by cheque or credit card for components, and they promise that despatch will be 'fast'.

At £2.50, the catalogue itself may seem expensive until you realise that it has 688 pages (not counting the covers!) listing over 12,500 different products. (The nearest competitor in the heavy catalogue stakes that we know is Maplin Electronics Supplies Ltd, and their catalogue contains a mere 450 pages — but we haven't counted the number of products.)

To get your copy of the catalogue, send £2.50 to Electromail, PO Box 33, Corby, Northants NN17 9EL, or telephone them on 0536 204555 with your Access or Visa number.

2m ATU

Most beams for 2m tend to be peaked for the centre of the band, with the SWR increasing at either side of the centre. If you normally use only a portion of the band, you can get an ATU from B&J Telecommunication to tweak the SWR to the section you use.

The ATU comes in the form of a small PCB with two coils and two preset trimmers mounted on it. You will need to fit this into a metal case and fit either BNC or SO239 sockets for the connections.

Further details from: B&J Telecommunications, 9 Queens Walk, Thornbury, Nr Bristol BS12 1SR.

Please!

We've been sorting through a frustrating pile of letters, releases, scraps of paper, etc, containing information on events that are all due to happen before the next available issue of the magazine will be published.

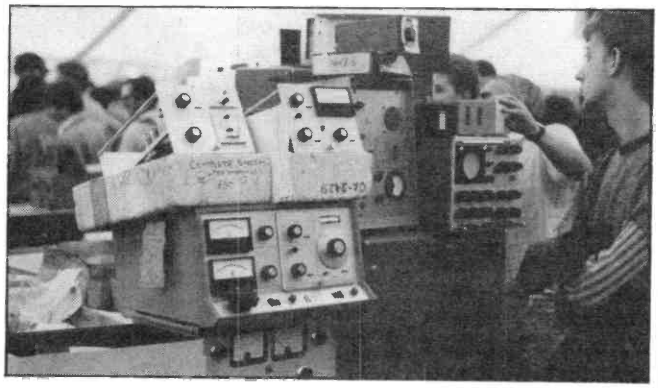
So if your society or club is doing something special, let us know about it as far in advance as you can, and we'll try to publicise it either through the news pages or the club pages. The magazine appears on the first Friday of the month (sometimes a bit before, depending on the distributors), and we need to have any information to be published at least a month prior to that, or it'll be too late.

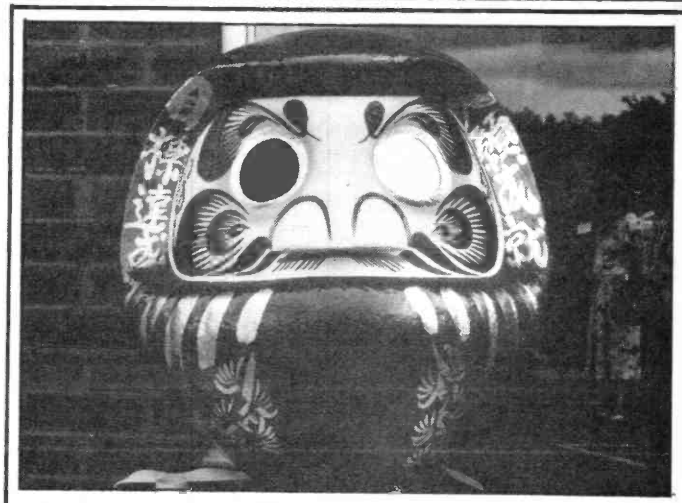
If you can manage to type out your piece (double spaced, please) in a concise and readable form, so much the better your chance of getting it published in the form you want. However, if all you can manage is a few semi-literate runes on the back of a crumpled envelope, send it in and we'll do our best....

Woburn Rally

If you wondered why it rained so hard on Sunday the 3rd of August, it was because that was the day of the Woburn Abbey rally. The team from HRT were there, sporting unsuitable footware, and so were a lot of other amateurs as the photos here testify. And we were all very glad that the predicted electrical storms didn't materialise....

Just a pile of old junk to some people, but solid gold to us.... ARE seemed to do well, if the crowds round their stand were anything to go by; but then there were crowds round all the stands.

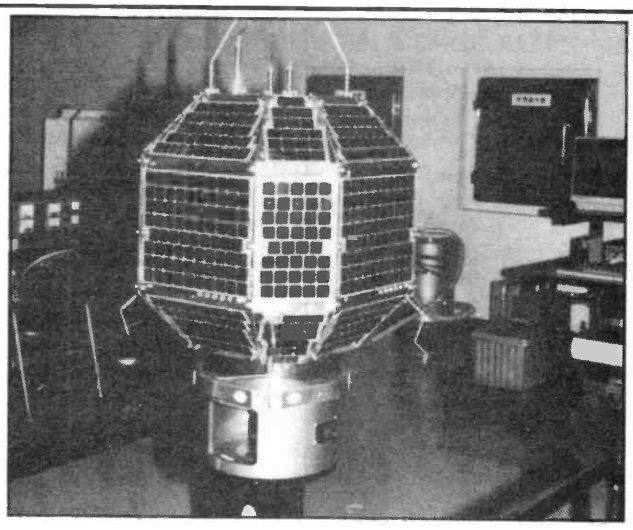




The Japanese doll above will be gracing the new offices of SMC at Chandler's Ford, Southampton. The doll was given to SMC by Mr Shigura, founder and chairman of Yaesu-Musen. The significance of the doll is rather complex, and the story is not for the feint-hearted.

Apparently, in ancient Japan, there was a very holy monk, who, to his consternation, would find that he went to sleep whenever he shut his eyes to meditate over a problem. So, to prevent this happening, he cut off his eye-lids. As a result, the tradition sprang up in Japan of having dolls representing the monk. The dolls would start off with no eye lids, and when it was thought that the task in hand was well in hand, one of the eye lids would be painted in. However, you must never paint in the second eye lid, as this implies that you have done all you ever intend to do and can allow yourself to sleep.

So it was that SMC, with their strong Japanese connections (hasn't every radio dealer nowadays?) came to receive such a doll from Mr Shigura, and to paint in one eye lid on the day of the opening of their new premises.



JAS — 1 "FUGI" Launched

The First Japanese Amateur Radio Satellite was successfully launched at 20.45 hrs UTC on Tuesday 12th August, from the Japanese Launching Site at Tanegashima, a small island to the south of Japan. It separated from the H-1 rocket at 21.47 hrs UTC over Chile and its beacon signal was received successfully on 435.795MHz at the space centre at the University of Surrey at 22.05 hrs UTC. It is functioning well, beacon signals being up to S8 strength at times and QSOs are being made through its transponder. Its period is 115.82 minutes with an increment of 29.28 degrees West. Tables of orbital data and new overlays showing its track on the AMSAT-UK "Osculator" will soon be available from AMSAT-UK, 94 Herongate Rd. London, E12 5EQ.

Roll Your Own Valve Rig

Valves of yesteryear may be technologically out of date, but they're still going strong. Ever thought of using them to get onto HF cheaply? If so, Brian Kendal, G3GDU, provides a few pointers to designing your own.

Since the two part article "HF on the Cheap" was published in the May and June 1986 issues, I have had a number of requests for information on constructing simple, inexpensive transmitters. All the circuits described in this article, however, are for CW operation. If SSB is essential, it is probably more economical to purchase and restore one of the older valve transmitters.

If, to obtain the necessary components, you just shop from catalogues and magazine advertisements, the cost is likely to be high — many valves and components are just not manufactured. However, by "cannibalising" old valve radio and TV receivers, VHF mobile and base equipment and judicious buying at junk sales and rallies, few of the components need cost more than a few coppers each. The old "Pye Base" equipment is outstanding in this respect. It will provide suitable valves, valve holders, fixed and variable capacitors and, in particular, a generously rated mains transformer. This will be quite capable of providing sufficient power for an equipment giving an output in excess of 100 watts!

One of the great advantages of using valves in simple transmitters is that there are few inter-stage matching problems. Thus an oscillator circuit from one transmitter design may be used to drive the buffer stage from a second which in turn drives a power amplifier stage from a third. It is therefore quite simple to build a transmitter from whatever components are available and, provided that you do not object to a relatively "hotch-potch" appearance, the end result can prove quite efficient.

What, therefore, are the requirements for a basic transmitter? The first is that it must have a stable oscillator. This may be either crystal controlled or self excited, in which case the output frequency is variable. This may, in itself, be capable of being used as a low power transmitter but it is normal to follow it with an amplifier. This arrangement can prove quite effective but has certain disadvantages, particularly if a self excited oscillator is being used. Almost invariably the act of tuning the amplifier will pull the frequency of the oscillator. Usually the oscillator is operated at the lowest possible power level and a 'buffer' stage included to isolate the oscillator from the PA. Additionally, further stages may be added between buffer and PA to multiply the frequency and thus enable multiband operation. However, an extremely stable oscillator is necessary if four or eight times multiplication is envisaged.

Oscillators:	Valve Types
Triodes:	6J5 6C5 6C4 EC90 one half of 12AT7 12AU7
Pentodes:	EF91 EF80 6BA6 6K7 6V6 5763
Buffers:	EF80 EF91 5763
Power Amplifiers	
Below 5W output	EF91 EF92 EF80 EL91
5-15W	6V6 6F6 6BW6 6AQ5 5763
15-50W	6L6 807 5B254M 6146

Table 1 Suitable valves for various applications

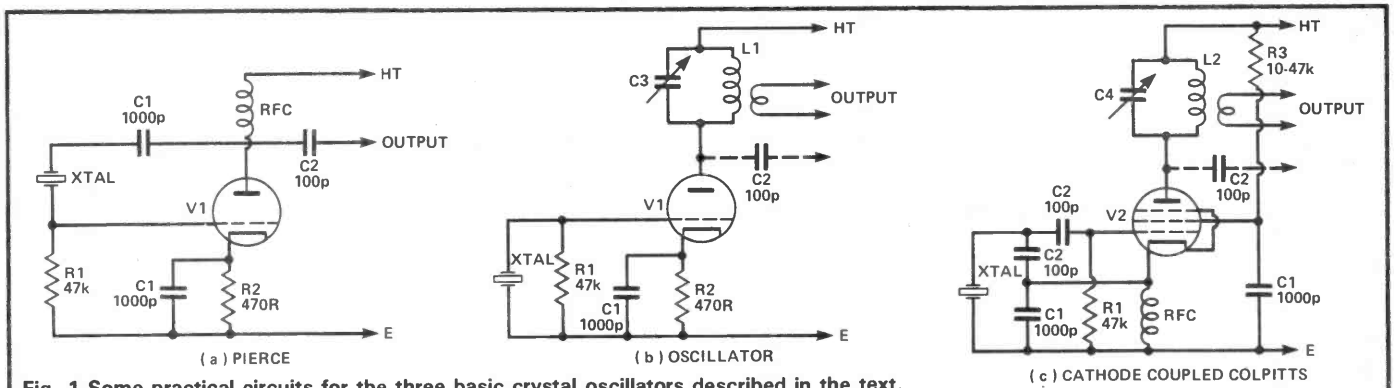


Fig. 1 Some practical circuits for the three basic crystal oscillators described in the text. L1/C3 is tuned to the crystal frequency, L2/C4 is tuned to harmonic of crystal frequency. The output of b and c may be taken by link or capacitively (dotted). V1 may be any small triode. V2 is an HF pentode or small power tetrode.

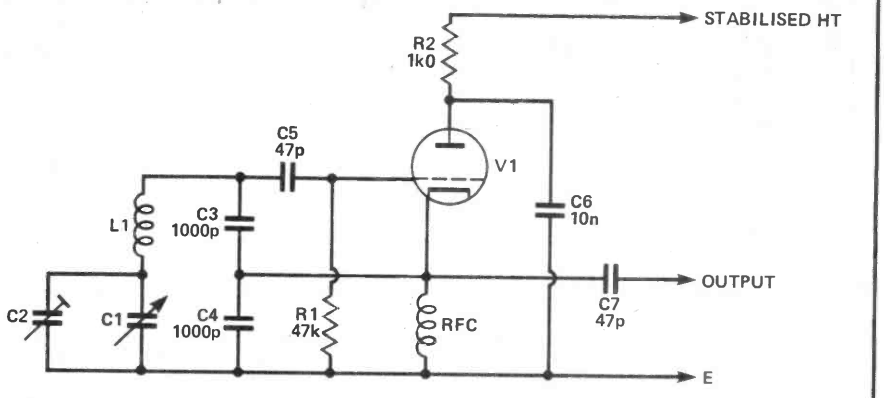


Fig. 2 The basic Clapp-Gouriet oscillator. C1/C2/L1 should resonate on the required frequency. In practice, C3 and C4 are also in circuit but their high value causes them to have little effect. V1 is any small triode.

Even a simple, two stage transmitter can be quite effective. The T1154 set is a typical example which was used by RAF bombers in the latter part of the war and by civil aircraft until about 1960.

Oscillator Organising

The oscillator of a transmitter may be either crystal controlled or self excited. There are four basic designs for crystal control which were widely used. I shall only describe three, as the other, the Tritet, will easily run into heavy crystal current which could destroy modern miniature crystals.

The first design is the Pierce (see **Fig. 1A**). This is of simple design, needs few components and is all right with almost any crystal. The lack of an output tuned circuit, however, means that it cannot stand alone to form a simple transmitter and must be followed by an amplifer. In this circuit almost any small triode such as a 6J5, 6C5, 6C4 or half of a 12AT7 or a 12AU7 may be used with success. When combined with a medium power amplifier, the Pierce oscillator is highly recommended for an extremely simple, single band transmitter.

The traditional crystal oscillator circuit, shown in **Fig 1B,** incorporates an anode tuned circuit, which may be used as a single stage transmitter. The only disadvantage is that the act of tuning the anode circuit will pull the frequency of the crystal. This is not serious — rarely amounting to 1kHz. Almost any low to medium power triode or pentode may be used, such as a 6V6 giving typically 5-6 watts RF output.

The third design uses the cathode coupled Colpitts circuit (**Fig. 1C**) which has the advantage that the anode circuit may be tuned to a multiple of the crystal frequency, thus doing the work of another valve. This design has been widely used in commercial VHF equipment where sufficient output has been obtained up to the fifth harmonic to drive the following stage. The most suitable valve to use in this circuit is a high gain HF pentode such as the EF91, but even a 6V6 may be used up to third harmonic output.

Over the years, many designs have been developed for self-excited, variable frequency oscillators (VFOs) but one has become more common than any other. This is the series tuned, cathode coupled Colpitts, which was developed by Charles Gouriet of the BBC and later by Clapp in the USA.

A valve oscillator requires a high L to C ratio in its tuned circuit for optimum stability, yet also requires a high capacity across the valve to damp out any variations in the inter-electrode capacity. The Clapp-Gouriet design illustrated in **Fig. 2** meets both criteria. Any small triode such as a 6J5 or 6C4 may be employed and these will supply sufficient output power to drive a buffer stage or small PA.

As in the construction of all self excited oscillators, the stability of the final product is as much a matter of sound mechanical as well as electrical construction. The precautions which must be taken in the construction of a Clapp-Gouriet oscillator are:

1. The components must be rigidly mounted on a solid chassis - a diecast box is ideal.
2. The HT voltage supply must be stabilised.
3. The tuning capacitor must be of a type in which the rotor plates are supported at both ends.
4. The two 1000pF capacitors in the grid circuit must be of silver mica construction.

Provided that these precautions are adhered to, there is no reason why an oscillator of adequate stability should not be easily constructed.

Divide and Multiply

A buffer stage such as in **Fig. 3A**, as its name suggests, isolates the circuits on its input from those on its output. To perform this task, the stage needs to operate in class A mode so the first essential is to ensure that no grid current will flow under any circumstances. This is best achieved by placing a sensitive meter in series with the grid leak and then reducing the value of the coupling capacitor from the preceding stage until no current flows and then reducing it a little further. Care should also be taken to ensure that no radiation from the buffer output can be induced into the

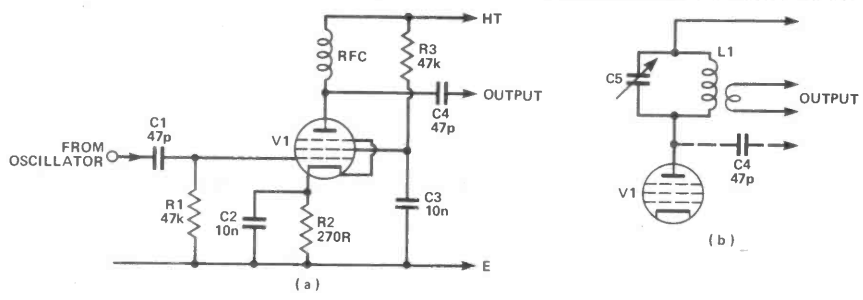


Fig. 3A A basic buffer stage circuit. V1 a small RF pentode.

Fig. 3B Modifying the circuit for use as a frequency multiplier stage. L1/C5 resonate on the desired output frequency. Link or capacitive output coupling is optional.

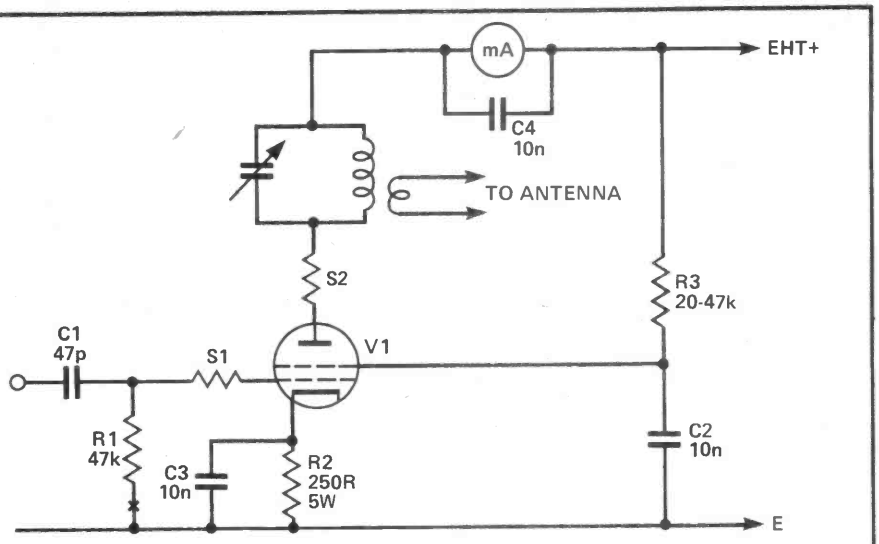


Fig. 4 A power output stage. The anode meter should read 100mA fsd, the grid current may be monitored at the point X. The valve may be any small or medium power tetrode.

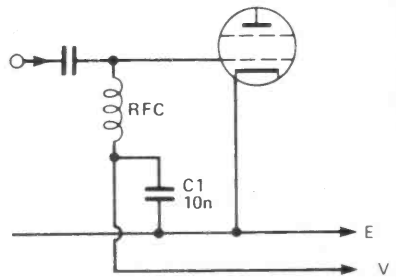


Fig. 5 The modification of the basic PA stage for use with fixed bias. The voltage should be 50V for a 5763, 90V for larger valves.

oscillator tuned circuit. Very often, the output tuned circuit may be replaced by an RF choke.

For buffer stages, high gain pentodes such as the EF91 are most suitable. Although lower gain types, such as the octal series, may be used, these will probably provide less isolation.

As **Fig. 3B** shows, a frequency multiplier stage is very similar to that for a buffer amplifier, the main difference being the RF drive requirements. A multiplier has to be driven beyond cut-off into class C, when its output will be rich in harmonics. This is achieved by applying sufficient grid drive such that grid current will flow, causing a high enough voltage to be developed across the grid resistor to bias the valve into class C. The required output frequency is selected by the tuning of the anode circuit.

Almost any tetrode or pentode may be used as a multiplier: EF91; 6V6; 5763; 6L6; 807 or 6146 are all suitable. The selection depends on the output power required and the RF drive level available.

Increasing the Power

In present day parlance, the power amplifier is often called the "linear", but for dedicated CW equipment this is a misnomer. The stage is operated in class C and is anything but linear in operation.

The advantage of running in class C is basically one of efficiency. A class AB or class B linear amplifier will rarely exceed 60% efficiency, but a class C stage may well reach 75%. This is not quite so important today when our licence conditions specify the maximum transmitter output power, but when we were limited to 150 watts input, it could make a considerable difference. The efficiency of the stage can also make a difference to power supply requirements. If fixed bias is used, no power will be taken in key-up periods, thus reducing the average loading on the power unit.

One of the major problems which may arise in the construction of power amplifiers is that of stability. It is extremely important that this stage is perfectly stable for the sake both of the valve in the circuit and other users of the band. If unstable and keyed, interference will be radiated over a wide band of frequencies.

The mechanical design of the amplifier should be such that the input circuit is completely screened from the output. To test the stability, the RF drive should be removed. The bias is reduced until anode current corresponding to the maximum dissipation of the valve is flowing. The anode circuit should then be slowly tuned through resonance. During this, there should be no variation in the anode current. If there is, this is a sign of instability.

If such instability is present, the mechanical construction should be examined to ensure that all RF leads are as short as possible, that the input circuit is well screened from the output and that all earth connections are good and secure. The decoupling capacitors should be examined for quality and then "stoppers" should be placed as close as possible to, and in series with, the anode and grid connections. The grid

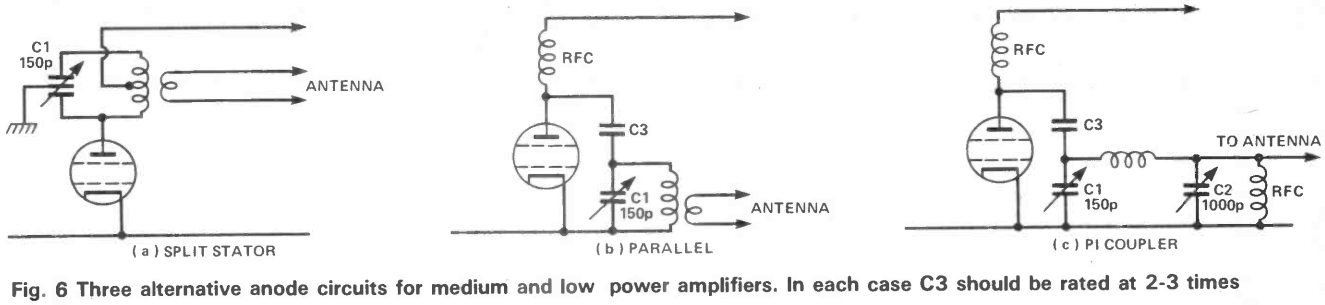


Fig. 6 Three alternative anode circuits for medium and low power amplifiers. In each case C3 should be rated at 2-3 times the HT voltage.

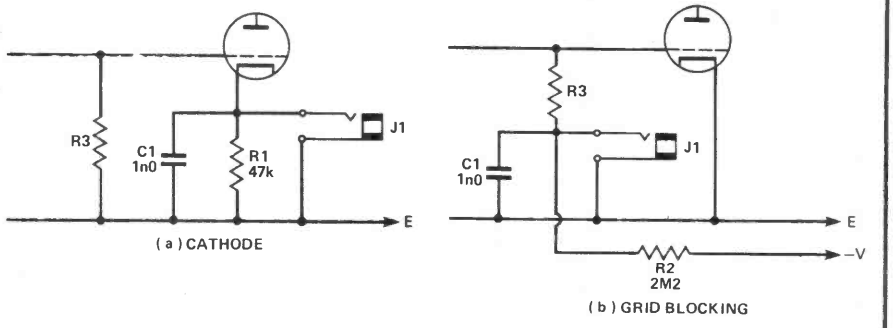


Fig. 7 Two methods of keying the transmitter.

stopper can be a resistor of a few tens of ohms whilst the anode stopper should consist of half a dozen turns of wire around a 470 ohm, 1 watt resistor. If all these should fail, further consideration should be given to the mechanical design and layout of the equipment.

Making a stable power amplifier is largely a matter of experience and it is strongly advised that the first efforts should be in the construction of fairly low power circuits before constructing a full legal power limit equipment.

Almost any tetrode or pentode valve may be used for a PA. Even an EF91 can give up to 3W, a 6V6, 6AQ5, 5763 or 6BW6 will supply 7-10 watts. For high power, a 6146, 807 or 5B254M will give up to 50W or more. If sufficient drive is available, two similar valves may be wired in parallel to double the output power.

All Keyed Up

No mention has so far been made of the methods of keying the transmitter. Two are common: cathode and grid block. These may be applied to any stage of the transmitter but arrangements must be made to switch off the stages preceding that keyed during reception periods and that there is sufficient protective bias on succeeding stages during key-up periods.

If the oscillator is keyed, some "chirp" on the output frequency may be noticeable, in which case it would be advisable to key a later stage. If there is no chirp, oscillator keying is most convenient.

In order to operate in class C, a bias of several times cut-off level is necessary. This may be obtained from a separate small power unit or from grid leak bias developed from the current flowing through the grid resistor. In the latter case the level of bias applied may be easily derived from an Ohms law calculation involving the value of the grid resistor and the current flowing. However, sufficient cathode bias will have to be present to limit the current of the valve to safe levels in key-up periods. If a fixed bias is used, cathode bias is unnecessary and the cathode may be connected directly to earth.

The anode circuit may be one of three types: series feed; parallel feed or Pi coupler. The first has the advantage that no high power RF choke is required but the tuning capacitor is at HT potential and, unless it is a split stator type, has to be adequately insulated from earth.

The parallel feed arrangement requires a high power RF choke in the anode circuit and a high working voltage capacitor between anode and tuned circuit. However, it has the advantage that the rotor of the capacitor is earthed. Both series and parallel feed arrangements use a fixed output link so that, except in the case of coaxial fed antennas, an aerial matching unit will be necessary.

The Pi output circuit is a version of the parallel fed arrangement. This particular circuit can be very easily switched for multiband operation. It is also an impedance matching circuit so in most cases, no additional antenna matching arrangements will be necessary.

As may be expected, the output tuning inductances for the power amplifier should be considerably more substantial than for the earlier, lower power stages. 18 swg wire should be adequate for all legal power levels in the UK. For 80 metres the coil should be close wound, but at higher frequencies the

Table 2 Useful valve equivalents

CV124	QV05-25 807 5B250A
CV133	EC90 6C4 L77
CV136	EL91 6AM6 6P17
CV138	EF91 Z77 6AM6 8D3 6F12
CV209	6V69
CV454	EF93 6BA6 W727
CV455	ECC81 12AT7 B309
CV491	FCC82 12AU7 B329
CV1376	EF80 6bX6 Z152
CV1862	EL90 6AQ5 N727
CV1941	6K7G KTW63
CV2120	5763 QV03-12
CV2136	6BW6
CV3523	6146 QV06-20

Table 3 Valve base connections

Valve Base		Pin 1	2	3	4	5	6	7	8	9	TC
EC90	B7G	A		H	H	A	G	K			
EF80	B9A	K	G1	K	H	H	S	A	G2	G3	
EF91	B7G	G1	K	H	H	A	G3	G2			
EF92	B7G	G1	K	H	H	A	G3	G2			
EF93	B7G	G1	G3	H	H	A	G2	K			
EL90	B7G	G1	K	H	H	A	G2	G1			
EL91	B7G	G1	K	H	H	A	G3	G2			
6C5	IO		H	A		G1		H	K		
6F6	IO		H	A	G2	G1		H	K		
6J5	IO		H	A		G1		H	K		
6K7	IO		H	A	G2			H	K		G
6L6	IO		H	A	G2	G1		H	K		
6V6	IO		H	A	G2	G1		H	K		
6BW6	B9A		G1	K	H	H		A	G2	BP	
12AT7	B9A	A2	G2	K2	H	H	A1	G1	K1	HCT	
12AU7	B9A	A2	G2	K2	H	H	A1	G1	K1	HCT	
807	UX5	H	G2	G1	K	H					A
5763	B9A	A		BP	H	H	G2	K	G1	G1	
6146	IO	K	H	G2	K	G1	K	H	B		A

Legend: A-anode; B-base shell; G or G1-control grid; G2-screen grid; H-heater; HCT-heater centre tap; K-cathode; TC-top cap.
Note the 12AT7 and 12AU7 are double valves thus G1 corresponds to the grid of the first triode and G2 to that of the second etc.

turns should be spaced at one wire diameter. For transmitters up to about 25 watts, a coil diameter of about 1½" would be suitable but for higher powers, 2-2½" would be preferable. The number of turns can easily be determined by trial and error techniques, the required Q of the coil being in the region of 12. For high impedance valve output circuits such as we have been discussing, this corresponds to resonance being achieved with a capacity of approximately 1pF for each metre of wavelength.

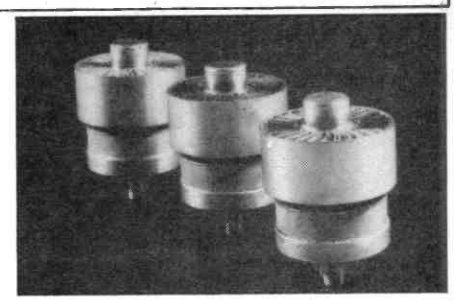
Thus a tuned circuit for the 7MHz band (40m) should resonate with about 40pF of capacity. High accuracy is not required for this, it being sufficient to estimate the amount of capacity in circuit from the maximum value of the capacitor and the degree of enmeshment.

Cathode keying merely requires that the key be placed in series with the cathode of one of the stages of the transmitter. The only problem is that in key-up periods, the potential between the cathode and the heater may exceed the rating for the valve. This may be overcome by placing a high value resistor (typically 47k ohms) permanently between cathode and earth.

For grid block keying, the earthy end of the grid resistor is detached and an RF bypass capacitor fitted. This point is then fed with a high negative potential via a high value resistor (1-3 megohms). The key is placed between the junction of the resistors and earth. It may be thought that applying a high voltage to the key may be dangerous, but the high value feed resistor limits the maximum current to a small fraction of a milliamp, which is quite safe.

Mix And Match

Within reason, almost any combination of the circuits accompanying this article may be used. In almost every case a low power oscillator or buffer will drive a medium power multiplier or PA which in turn will give sufficient drive power for a high power PA. Any combination of valves of the correct power levels may be used thus, for example, a miniature 6C4 oscillator will drive a miniature EF91 buffer, in turn driving an octal 6V6 multiplier



to a UX based 807 to a power of 50 watts or more.

For all the circuits described, a stabilised voltage of 150V should be applied to variable frequency oscillators. 250 volts unstabilised to all other circuits except high power PAs, to which up to 750 volts may be applied.

To Learn More...

As far as can be ascertained, there are no books on thermionic techniques currently available. It is therefore necessary to look for RSGB or ARRL handbooks of the 1948-1970 period. Radio magazines of that era also contain a wealth of information. These can be obtained from time to time at rallies and radio club junk sales.

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Get Onto 50
The Cheap a

Got a Vanguard, Cambridge, Storno or Wessie to put onto 4 or 6m? Well, this VFO design from Ted Nield, GW3ARP, will save you crystals and give you FM as well!

The 4 metre band is not renowned for its great activity especially in my area of South Wales. However, with the increase in use of converted Pye and Storno equipment — which are crystal controlled — for this and the 6m band, a VFO unit could become very useful and an inexpensive alternative to buying crystals. This circuit also includes a simple but effective FM section which will enable you to use your Pye convert on FM.

With Pye Vanguards and Cambridges, the fundamental frequency range required to cover 70-70.5MHz is 8.75-8.8125MHz. For the Pye Westminster, the range is 2.9166-2.9375MHz and Stornos require a range of 3.8888-3.9166MHz, both of which only need the oscillator coil and capacitor to be altered in this design. You may find that the frequency controlling elements of the varicap will need some small adjustment.

Initially, I used a mechanical tuning device consisting of a coil and metal vane which could be moved in relation to the former. However, this has been replaced by the varicap which is much easier to make. It also offers even more stable frequency control if you use a thermistor device.

As you can see from **Fig. 1**, the unit is remarkably stable especially with the thermistor where frequency drift after the first 30 seconds was less than 1.5kHz. After five minutes the drift is less than 200Hz for the next half hour. After running the unit another two hours, the output is still well within the 5kHz band of the receiver. Without the thermistor, you should still get the same stability after two hours.

How It Works

Having experienced the rather unstable Hartley oscillator circuit on HF projects I was unwilling to let it loose on VHF. I decided instead to use the much neglected Franklin circuit which is noted for its stability and immunity from external causes of frequency variation. In applying this idea to solid state devices, I settled on using a pair of 2N3819 JFETs.

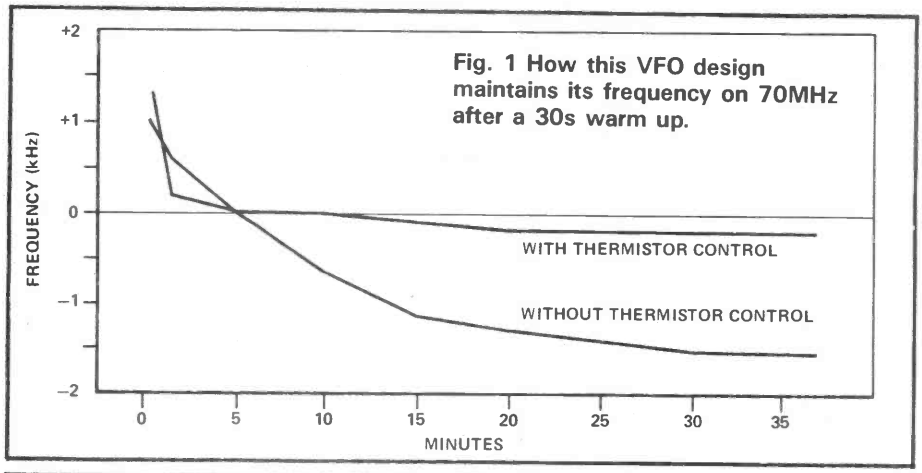


Fig. 1 How this VFO design maintains its frequency on 70MHz after a 30s warm up.

Looking at the circuit diagram shown in **Fig. 2**, you can see that the tuned circuit L1 and its tuning capacitor are isolated by the very small capacitors C6 and C7 to minimise any effects that might alter its natural resonant frequency.

Following the oscillator transistors, Q1 and Q2, is the source follower Q3. This is coupled to the oscillator at its least sensitive point at the base of Q2. Q3 further isolates the oscillator from Q4, the output transistor, driving the transmitter via its crystal socket.

To maintain a constant frequency between overs, the oscillator must run uninterruptedly. Since most conversations are conducted on a common frequency, the oscillator — running during receive periods — would interfere drastically with the received signal. This is avoided by a system of frequency shifting whereby the VFO frequency is automatically shifted down by about 100kHz during reception periods. Then RLA1 shunts point C on the varicap unit to earth via R18 and SW1B. This lowers the voltage applied to the cathode of VD1 and hence the oscillator frequency.

On the modulator side of the circuit, the cathode of varicap diode VD2 is at a higher potential than its anode, ensuring correct bias. The capacitor of VD2, which is in effect in parallel with the tuned circuit L1/C3, is dependent upon the DC voltage at its cathode. This is varied at audio frequency by the microphone signal which enters the board at point 6 after amplification by Q5.

In this way, the oscillator is directly frequency modulated, and the deviation may be adjusted by RV3. The usual moving coil or electret microphone will be found to give a satisfactory level of output voltage.

The 'Net' switch is normally in the 'run' position. When it is required

and 70MHz –
nd Easy Way!

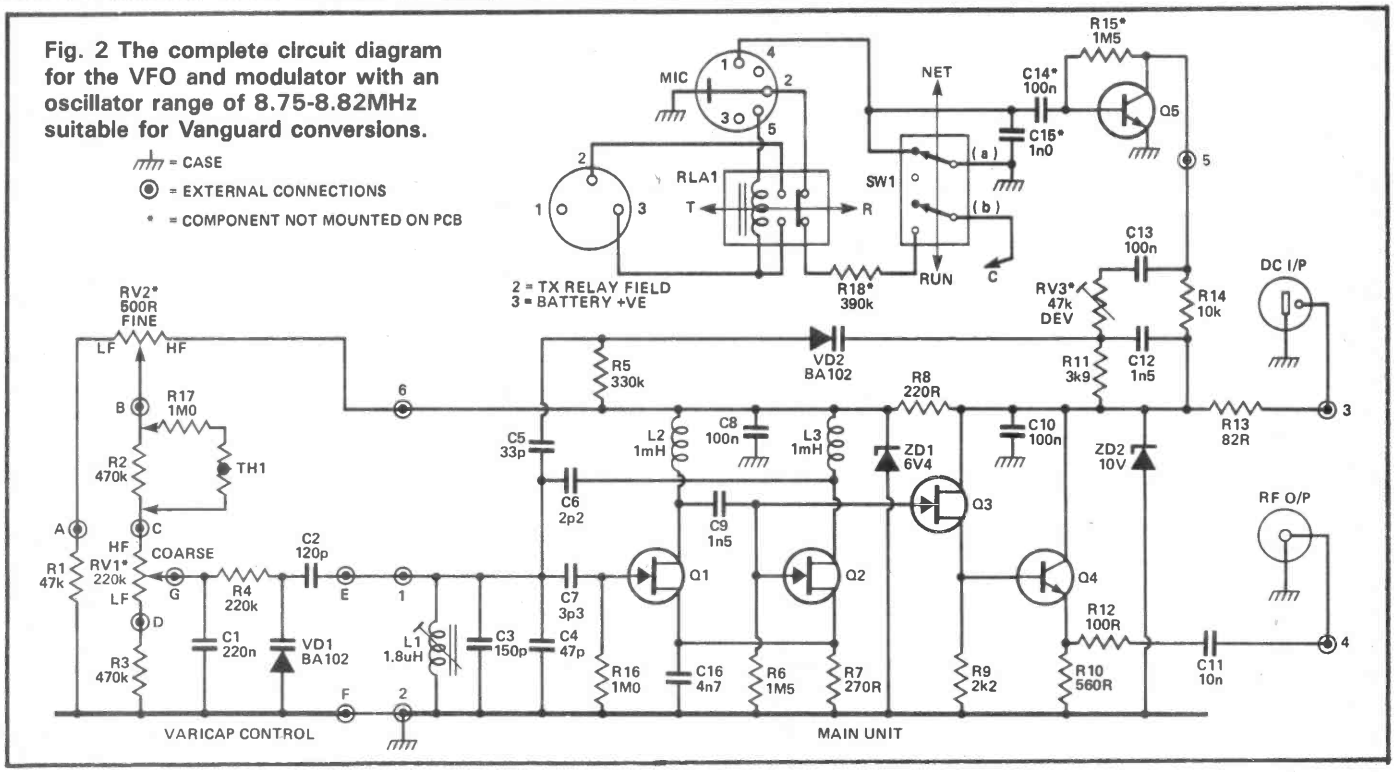


Fig. 2 The complete circuit diagram for the VFO and modulator with an oscillator range of 8.75-8.82MHz suitable for Vanguard conversions.

= CASE
= EXTERNAL CONNECTIONS
* = COMPONENT NOT MOUNTED ON PCB

to tune the VFO to the frequency of the incoming signal, it is moved to 'net'. This allows the oscillator to run at the working frequency and it is now an easy matter to tune the VFO to zero beat with the received signal.

When netting onto a frequency, an S meter can be used if fitted. SW1A shunts the audio signal to ground to prevent audio feedback. SW1 is returned to 'run' before transmitting.

The varicap unit containing the varicap diode VD1 needs some explanation. The diode used is a BA102. If insufficient frequency coverage is obtained due to component tolerances, C2 may be increased in value, or R3 reduced in value. Alternatively, two diodes in parallel may be used with possible changes in value of C2 and R3.

The potentiometers RV1 and RV2 are respectively the 'coarse' and 'fine' frequency controls and act by varying the DC voltage applied to VD1. The resultant change in capacity in series with C2 acts upon the tuned circuit to alter its working frequency. The range of frequencies covered may be shifted bodily by adjustment to the core of L1.

The thermistor, TH1, and swamping resistor R17 act in parallel with R2 to compensate for changes in frequency brought about by

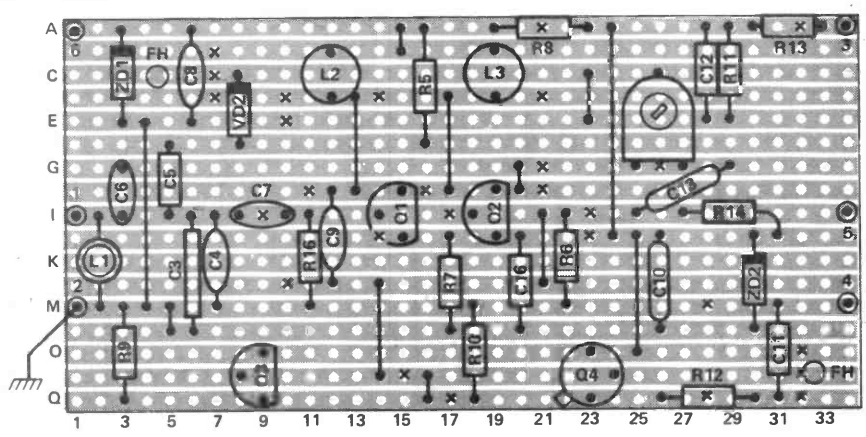
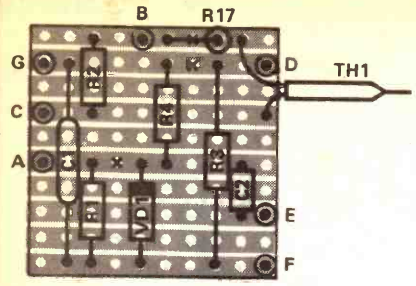


Fig. 3 The overlay for the main board.



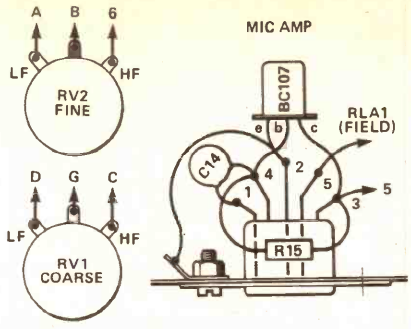


Fig. 4 The varicap tuning board layout and how the mic amp is wired in.

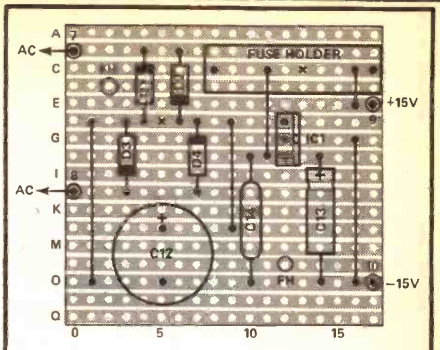


Fig. 5 The power supply layout, and the modification to be made to the main VFO board.

temperature variations.

Power Supply

A separate PSU powers the VFO, but note that in spite of the stabilising effect of ZD2, the VFO is sensitive to supply voltage changes. This requires the use of either a PSU with good stabilisation or else one which supplies only the VFO. A simple PSU without any form of stabilisation is not recommended as mains voltage variations will have a serious effect upon frequency stability.

Any arrangement using the same car battery that is powering the converted unit will be unsatisfactory as load variations between transmit and receive would upset the VFO frequency enough to render the netting process inaccurate. A small 12V car or motorcycle battery, used exclusively for the VFO (and receiver tuner unit published last month) is ideal, and may be considered, particularly if the equipment has its own mains PSU.

12-14V at about 50mA is required, but it is better to budget for 100mA to supply the receiver tuner unit as well.

The 'Transmit-Receive' function is controlled from the mike of course. When the latter was removed from its original location and installed in the VFO unit, the original weird microphone plug was changed for a DIN 5 pin 180° type. A standard mike socket may be used if preferred provided it has enough spare tags to accommodate the AF amplifier which is built onto it.

On the Vanguard, the mike switch completes the circuit between the transmit relay field and the positive supply. In the VFO unit a pair of contacts on RLA1 which close on 'transmit' are used for this purpose and brought to a 3 pin DIN socket. This is linked to another DIN socket fitted to the rear panel of the Vanguard to which the necessary connections to the relay field and battery positive are made. The other pair of contacts on RLA 1 open on 'transmit' and allow the voltage applied to VD1 and hence the oscillator frequency to rise to their normal values.

It will also be noticed that the field supply for RLA 1 is obtained via the link from the main unit supply. This is to avoid a changing load on the PSU supplying the oscillator. Different type sockets prevent accidental wrong connections.

How To Build and Use Your VFO

Veroboard construction was used, with the varicap components on one board measuring 2.5cm^2 and the main circuit on a second board measuring 8.5cm×4.5cm.

The AF amplifier is built onto the rear of the 5 pin DIN socket as shown in detail in **Fig. 4.** The components on the varicap board are soldered onto the track side, as the reverse side, backed by a layer of thin perspex is fastened by a suitable contact adhesive to the rear cover of RV1.

The case is actually a mild steel double wall switch housing, as used in domestic lighting installation. The open side is covered by an aluminium plate with rubber feet attached. Two holes in the plate give access to RV3 and L1. The case must be a metal one and above all perfectly rigid. A die-cast aluminium box is ideal. The larger board is fixed in place by two bolts with spacers to give a minimum clearance of 4mm.

The thermistor may be difficult to obtain, but types G16, GL16 and Th-B11 listed in the current Maplin and BS catalogues should prove suitable. As a guide, the STC component used measures approximately 500k at room temperature. The oscillator

The voltages table

	Q1	Q2	Q3	Q4	Q5
c (d)	6.2	6.2	10	10	3.6
b	–	–	–	4.3	0.6
e (s)	2.2	2.2	4.3	3.5	0

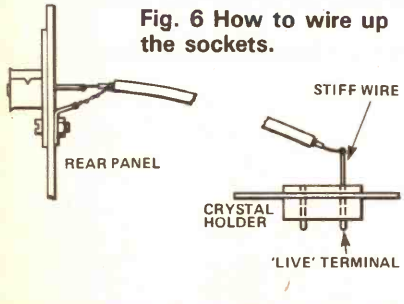


Fig. 6 How to wire up the sockets.

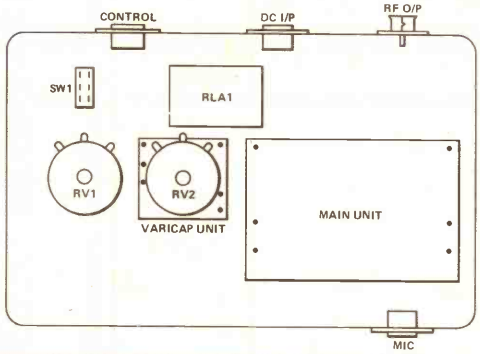


Fig. 7 Putting it all together in the die cast box.

coil is wound on a 5mm former with slug, fixed in a hole in the veroboard with epoxy resin. It holds 20 turns of close wound 24swg wire. For use with Pye Westminster or Storno equipment more turns would of course be needed with an increase in the value of C3.

The output is fed into the main unit via a short length of TV coax which couples to another TV socket fitted to the rear of the case. A further short length of narrow coax supplies this to the Tx crystal socket, **Fig. 6.**

The table gives the approximate voltages to expect at the electrodes of the transistors — as measured with a 100kohm/V meter.

To set the VFO to the frequency of any crystal one may possess, you have to switch to the appropriate crystal channel in the 'receive' mode and to tune the VFO until its 70MHz signal is heard in the receiver. Should the rig be fitted with BFO or a S meter, the VFO should be tuned to zero beat or maximum deflection. If using the matching tuner unit, tune in the received signal and zero beat the VFO to it.

Components List

RESISTORS

R1	47k
R2,3	470k
R4	220k
R5	330k
R6, 15	1.5M
R7	270R
R8	220R
R9	2.2k
R10	560R
R11	3.9k
R12	100R
R13	82R
R14	10k
R16,17	1M
R18	390k
RV1	220k linear pot
RV2	500R linear pot
RV3	47k horizontal preset

All fixed resistors 0.25W 5% carbon film

CAPACITORS

C1	220n
C2	120p
C3	150p silver mica
C4	47p polystyrene
C5	33p
C6	2.2p
C7	3.3p
C8, 10, 13, 14	100n
C9, 12	1.5n
C11	10n
C15	1n
C16	4.7n

All capacitors miniature ceramic unless otherwise stated.

INDUCTORS

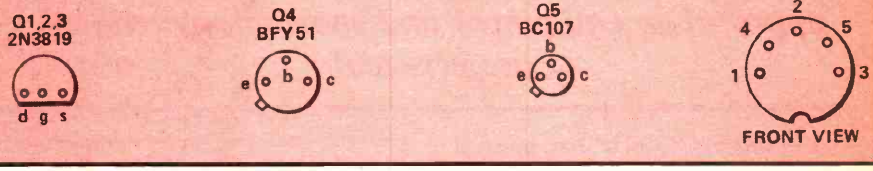
L1	1.8uH 20 turns 24swg close wound on 5mm core with slug.
L2, 3	1mH type Toko 187LY-102

SEMICONDUCTORS

Q1, 2, 3	2N3819
Q4	BFY 51
Q5	BC107
VD1, 2	BA102 varicap
ZD1	BZY88 series 6.4V (400mW)
ZD2	BZX61 series 10V (1.3W)
TH1	Thermistor type A 5513 100 (STC)

MISCELLANEOUS

DIN socket (2-pin); DIN socket (3-pin); DIN socket (5-pin 180°); TV type socket; 12V miniature relay DP changeover; DPDT slider switch SW1; 2 knobs; metal case.



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AMATEUR TELEVISION

Hopefully after reading the first part (last month) in this short series, you're now asking "How do I get going?" As stated, several firms provide ready built equipment, others provide kits, the BATC's quarterly journal 'CQ-TV' has several construction projects with PCBs available. This month we're going to get you established with a simple receiving set up, with the accent on simplicity and low cost. This will form the basis for expansion into a high performance TV transceive capability which we will look into next month.

Having got you interested in ATV, this month Chris Lorek, G4HCL, offers you a simple, low cost receiving set up with reviews of the most appropriate equipment and some constructional projects too!

Receivers

The simplest way of displaying pictures transmitted at 23cm is of course using a standard UHF television receiver. AM is no problem to resolve, although FM signals require slope detection. A downconverter unit, which takes 23cm signals to a lower intermediate frequency for demodulation is the usual method of reception. Several IFs may be used, but by utilising one on UHF, around channel 38 on your domestic TV, we can get going very easily.

Experimenters with video monitors may also be interested in the SL1452 IC from Plessey, **Fig. 1** shows the entire circuitry required to demodulate FM video from a 612MHz input.

In the last few months, Astec Components Ltd have introduced a pair of modules primarily designed to form part of a satellite TV second downconverter unit and video demodulator, the first of these would suit our needs in getting started on 23cm video reception. Don't think you'll have an instant satellite receiver by using these, the tuning range doesn't go high enough to cover the more popular channels when using a standard low noise block, and by far the most expensive part is outside — a first downconverter and dish. But for our purposes, it will do very nicely. Thanks go to Mr Elliott of Comex Systems for the rapid despatch of a trial unit to be used in the preparation of this series.

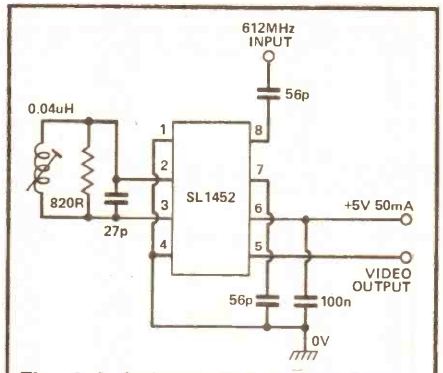


Fig. 1 A 612MHz FM demodulator for those experimenters interested in converting their video monitors. The SL1452 is a Plessey chip only recently come onto the market.

The Astec AT 1020 Tuner Head

This unit accepts a tunable 950MHz-1450MHz input signal and provides a fixed 612MHz IF output, ie just below channel 39 UHF. The 23cm band, 1240-1325MHz comes nicely in the middle of this. The block diagram of the inner workings is shown in **Fig. 2**. The amateur attempting construction at 23cm frequencies will require exceptional soldering abilities to get a working unit first time. Opening the module up shows liberal use of chip components and tiny inductances. Don't try it yourself!

There are two RF input connections, switched by an internal relay. These use F-type sockets,

The Astec AT1020 module shown above is available from Comex Systems Ltd, Comet House, Unit 4, Bath Lane, Leicester LE3 5BF (0533) 250845 at a cost of £35.10 plus £1.50 P/P. Matching F type plugs are also available for 50p each.

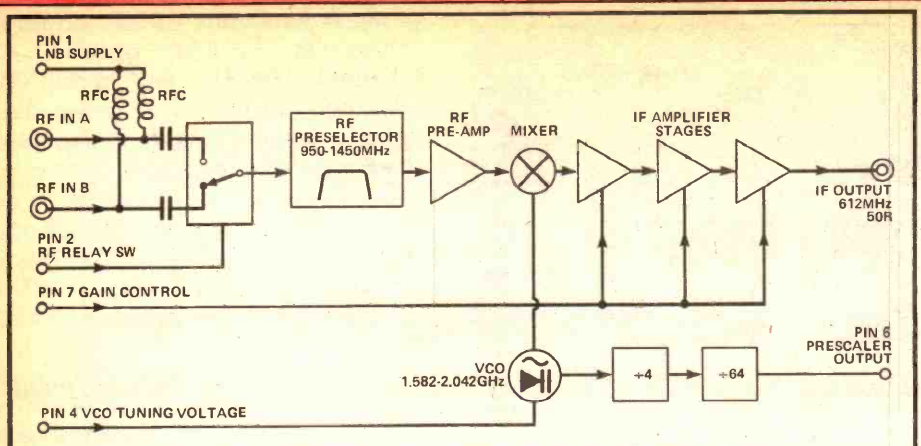


Fig. 2 How the Astec AT1020 downconverter works in block form.

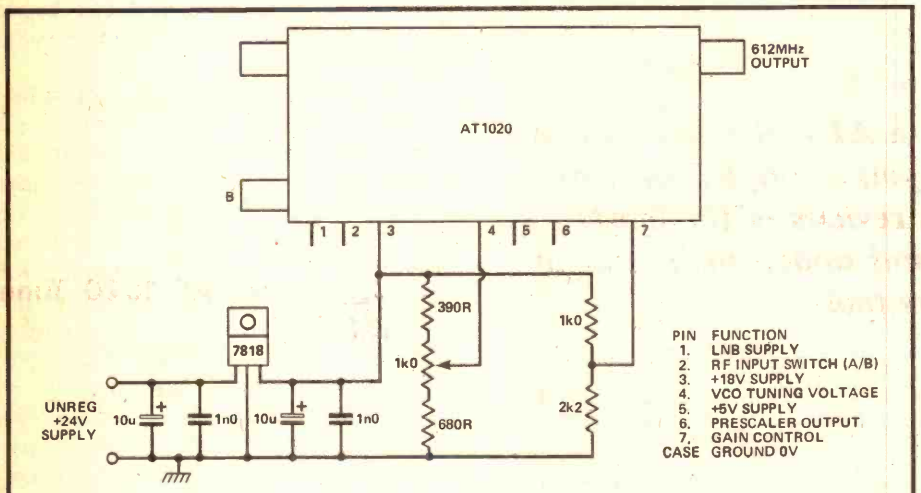


Fig. 3 A simplified circuit for a power supply for the AT1020.

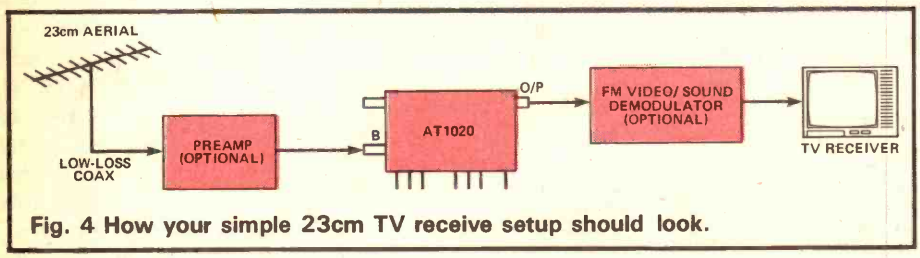


Fig. 4 How your simple 23cm TV receive setup should look.

which many amateurs may not be familiar with but matching plugs and adaptors are readily available. The signal from the relay passes via an RF preselector to reject strong out of band signals, then into an 3SK124 RF amplifier. An internal VCO (voltage controlled oscillator) operates between 1582 and 2042MHz, tuned by an applied voltage of between 0.8 and 17.5V. This combines with the input signal in a mixer stage to achieve the IF of 612MHz. Here it is further amplified using three transistors in separately screened compartments and then fed to the output connector, a standard TV type plug. Overall conversion gain from the module is typically 36dB.

A portion of the VCO signal is sampled using an inductive coupler, fed to a small four pin divide by four prescaler and then into an eight pin divide by 64 IC. This provides an output frequency between 6.18MHz and 7.98MHz for use with a low cost synthesiser.

The module operates from a supply voltage of 18V +/– 5% for the basic downconverter, with a 5V +/– 5% voltage required to drive the divider stages. This 5V requirement may of course be omitted if you do not want this facility, although this is not stated in the module's information and has caught people out who have built it into their circuitry. The 18V line draws a maximum current of 125mA, typically 90mA, and a three terminal 7818 DC regulator may be used following an unregulated but smoothed supply, see **Fig. 3.** I don't intend to go into great detail on how to build a suitable power supply. Most readers will have their own ideas using an existing homebrew variable supply or two 12V power supplies in series driving the 7818. A heatsink on the regulator is advisable although not essential at this current. Remember to adequately decouple the input and output to prevent device self-oscillation.

Tuning in

Depending on manufacturing tolerances, the 23cm band is tuned in with between about 6.8-14.0V applied to pin 4 of the module, according to the specification. A simple potentiometer giving 0-18V would present too coarse a tuning control, so use fixed resistors between 0V, 18V and the potentiometer. A multi-turn pot from your junk box would make the tuning finer. A gain control, giving typically 30dB range between 0 and 12V, may be connected to pin 7. Thus increasing voltage gives an increase in gain. However for our purposes a fixed 12V supply may be used here, made up from a resistive potential divider.

For such a small amount of external circuitry, it is not economic to use a PCB, all the components are assembled instead on simple matrix board or even a tagstrip, the layout is not critical. The module case is used as the common 0V supply connection. Pin 1 is the input changeover relay actuating voltage supply. Unless you specifically want to use this facility, pin 1 may be left open circuit and the 23cm aerial or preamp output conected to coax socket 'B'.

As the unit is designed as the second part of a receiver system — to be used with a low noise first downconverter having a typical gain of 50dB — the unit's noise figure is not particularly low being in the region of 7dB. This makes it suitable for local 23cm signals although it would benefit from an external preamp for DX work. Next month we will examine a suitable design.

So there we are, connect up your gear in the order shown in **Fig. 4** and

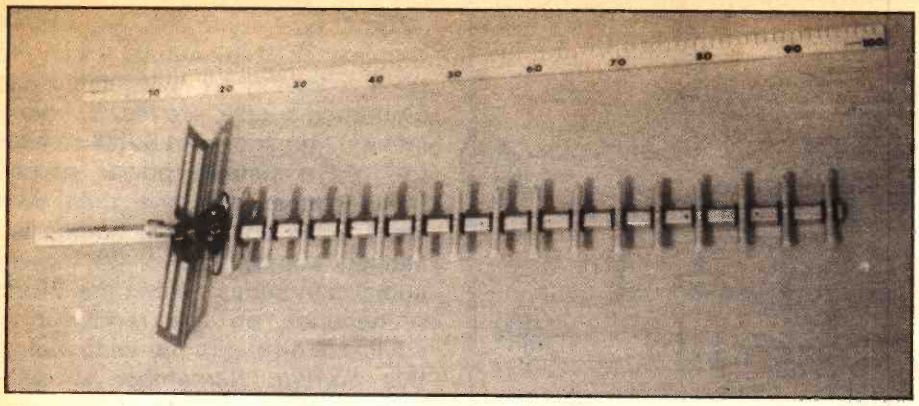


Table 1 The dimensions for Group C/D TV aerial modifications in mm.

Element	C/D Group Aerial	23cm Aerial
Reflector	265 x 75	159 x 45
I/D dipole	167 x 30	100 x 18
1st director	158	95
2nd director	158	95
3rd director	158	95
4th director	158	95
5th director	158	95
6th director	158	95
7th director	151	90.5
8th director	151	90.5
9th director	151	90.5
10th director	151	90.5
11th director	151	90.5
12th director	145	87
13th director	145	87
14th director	145	87
15th director	145	87
16th director	145	87
Spacing		
Dipole/reflector	85	51
Dipole/1st dir	30	18
1st dir/2nd dir	68	41
Further dir/dir	85	51

Table 2 The 23cm splitter/combiner track dimensions.

Impedances	Teflon PCB 1/32", K=2.55	Fibreglass PCB 1/16", K=4.25
70 ohm ¼ wavelength	1.2 x 38 mm	1.6 x 30 mm
50 ohm pad	2.2 x 10 mm	2.9 x 10 mm

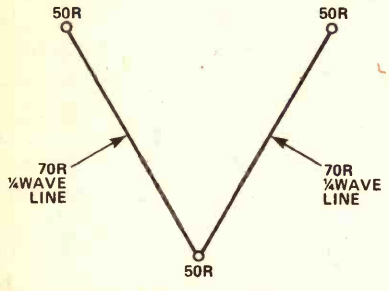


Fig. 5 How a 2 way splitter for 23cm works using stripline construction. With two 70 ohm quarter wave lines connected at one end, 100 ohms is in parallel with 100 ohms which is of course 50 ohms.

you have a basic receive set-up ready to watch other amateurs or your local TV repeater. All you need now is an aerial . . .

A Low Cost Wideband Aerial

One or two commercial wideband 23cm aerials are available. However here is an idea which has been successfully implemented by several amateurs in our area, including Godfrey, G4XHM, who performed much of the original design and construction work.

UHF television yagi aerials are commonly avilable in three groups as well as the odd super-wideband (super-low gain) version. These are group A (channels 21-34), group B (channels 39-53), group C/D (channels 48-68) and group W (channels 21-68). The group C/D aerial is designed and manufactured to operate with reasonable gain over the frequency range of 680-860MHz, so why should one not be used over 1240-1325MHz? Simple calculations showed that the C/D aerial must be scaled in size by 60% to optimise it for use in the centre of the 23cm band, namely 1282.5MHz. **Table 1** shows the dimensions required. Note that the original dimensions may vary slightly depending on the manufacurer, but three different 18 element types were modified in this fashion all with good results.

An initial sample was modified and checked against a working six element beam, with promising results. Extensive measurements were then performed using accurate test equipment. The gain measured relative to a half wave dipole was greater than 11dBd over the entire 1240-1325MHz region, dropping to 10dBd at 1200 and 1350MHz. Maximum gain occurred at 1280MHz which yielded 12dBd. The VSWR measured at 50 ohms impedance was less than 1.4:1 over the band.

A number of other 18 element aerials were modified, all of which showed that the gain bandwidth is very broad. This gives an inbuilt allowance for minor mistakes in cutting accuracy due to the use of broad elements and in variations between manufacturers. The maximum gain is, of course, not equal to that achievable by a high Q, narrow bandwidth beam, but for wideband applications such as TV it is far superior.

Construction

Aerials are commonly available from high street TV dealers and by mail order, but the best bargains are normally from your local TV aerial wholesale supplier. An 18 element aerial would normally cost between £2.50 and £6.00 depending on the quality of construction. Select a type with screwed down elements rather than riveted fixings, this makes modification far easier.

Using a junior hacksaw, cut the elements to their new lengths, then remove them from the boom and re-drill the new mounting holes where

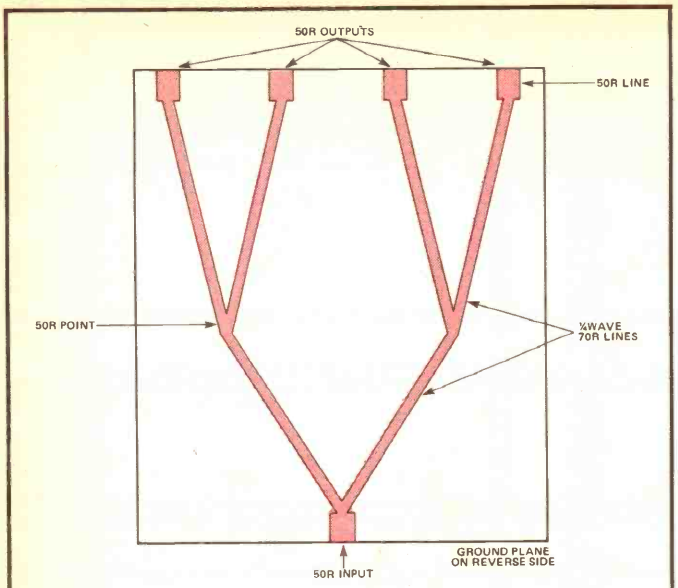
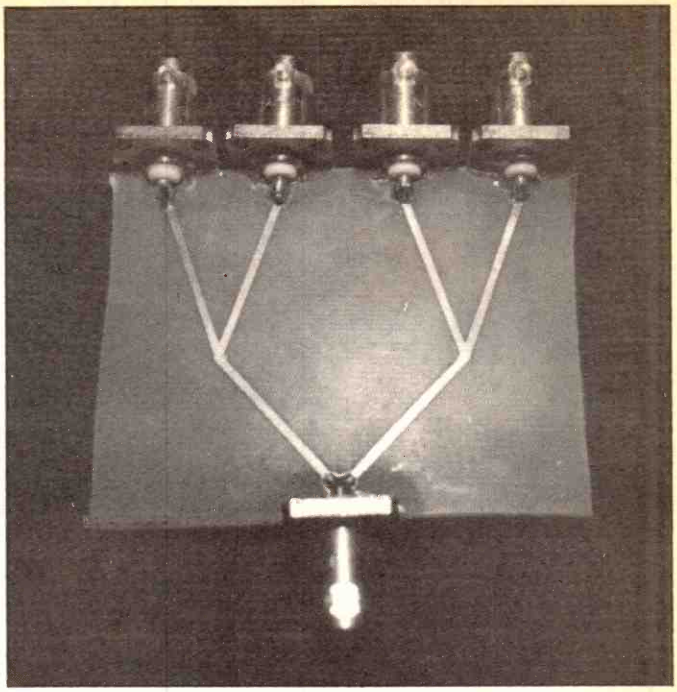


Fig. 6 Combining three 2 way splitters onto a PCB gives a 4 way power splitter for use with four 23cm aerials, improving the gain without the need for a preamp.



necessary. You can cut down the boom length if you want for mounting convenience. Re-assemble the elements. Depending on the form of driven element construction, you may like to either cut this down or re-make a further folded element, to the dimensions given, using thin copper tubing. This way you can solder the coax directly to the element for better efficiency. The element widths are not altered and this retains the original reflector dimensions if this is of the common 'grid' variety — little difference in gain was noted between modified and unmodified 'grid' type reflectors.

Four Way Splitter/Combiner

One method of increasing gain whilst not having an unwieldy boom length is that of combining two or four aerials together using a power splitter unit. These are of course commercially available at a price, but here is a design you may wish to use for a low cost stripline version, using ordinary PCB rather than the usual lathework techniques.

It can be shown, using the Smith chart, that the impedance seen at the end of a 70 ohm quarter wavelength line, which is terminated with 50 ohms, is 100 ohms. Therefore, if two 70 ohm quarter wave lines are connected at one end, it will look like 100 ohms in parallel with 100 ohms, which is 50 ohms. This forms the basis of a two way splitter shown in **Fig. 5.** It may be used on its own, or three of these can be combined to produce the four way version shown in **Fig. 6.**

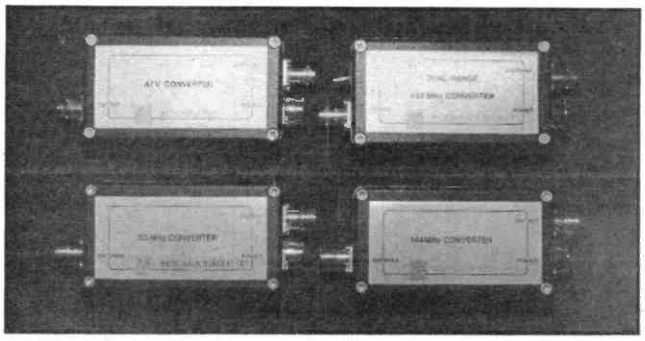
Stripline construction involves using double sided PCB material in which one side is used to etch the stripline, the other side is left as continuous ground plane. The measurements are given in **Table 2** for Teflon board (1/32" thick, K=2.55) and the more commonly available but slightly more 'lossy' fibreglass board (1/16" thick, K=4.25). I would not recommend using the cheaper types of board material, even if you do have it lying around. Ensure that you measure the track dimensions, especially the width, very accurately, this is very important to achieve good results.

To minimise the cost of five plugs and five sockets, the coax may be soldered directly to the board, centre to the 50 ohm pads and outer to the underside ground plane. Make sure that the four coax cables are exactly the same length between the splitter and aerial feedpoint connection and weatherproof the unit well before mounting outdoors. You can solder coax sockets directly to the board, as shown in the photo nearby, but take care you don't damage the track surface by mechanical strain when eventually fitting your aerial coax leads.

Next month — a suitable camera, improving the receiver, a receiver pre-amp and quite a bit more!

MICROWAVE MODULES LT

CONVERTERS



MMC50/28	6m down to 10m Converter	**35.65** A
MMC144/28	2m down to 10m Converter	**36.65** A
MMC432/28-S	70cm down to 10m Converter	**39.90** A
MMC432/144-S	70cm down to 2m Converter	**39.90** A
MMK1296/144	23cm down to 2m Converter	**129.95** B

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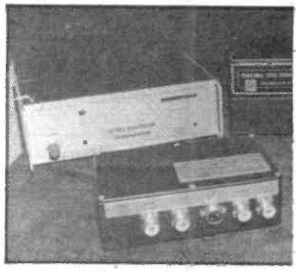
TRANSVERTERS

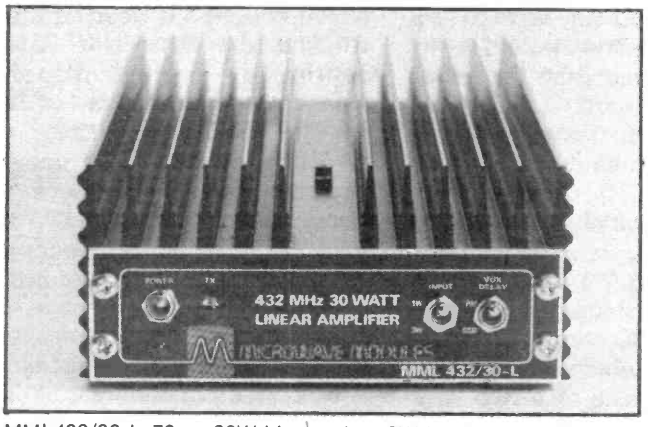


MMT432/28-S	70cm Linear T
MMT1296/144-G	23cm Linear T
MMX1286/144	1268MHz Trar
MMT50/144	6m Linear Tra
MMT144/28	2m Linear Tra
MMT144/28-R	2m Linear Tra

WEATHER SATELLITE EQ

Our METROSAT equipment is professinal market but we kr friends have bought this superl receiving signals from both the the 1691 MHz band (METRO S/ lites around 137.00MHz (NOAA seen other systems demonstra and seen the best.

70cms LINEAR AMPLIFIERS



MML432/30-L	70cm 30W Linear, 1 or 3W input	**169.05** C
MML432/50	70cm 50W Linear, 10W input	**149.50** C
MML432/100	70cm 100W Linear, 10W input	**334.65** D

QRV on 70cms and need a little more power? Our Linears provide the signal and quality you demand. The MML432/30LS has switched inputs for 1 or 3 watts (ideal for the FT708, FT790R, etc). If you have a 10 watt TX and require a modest output then the MML432/50 will give you 50 watts. QRO? Our MML432/100 is just what the doctor ordered. Running a pair of devices in the output a cool 100 watts is delivered to your aerial system. The 30 and 50 watt Linears both have receive pre-amps fitted.

AMATEUR TELEVISION

MMC435/600	70cm ATV Converter, UHF output	**35.65** A
MTV435	70cm ATV 20W Transmitter	**197.80** B

Join the growing number of ATV enthusiasts. Our MTV 435 will give a full 20 watts peak signal. It has two i inputs and an inbuilt test generator. To complement this our MMC435/600 gives you amateur TV signals on any domestic UHF TV. It all helps to keep you in the picture.

RF PREAMPLIFIERS

MMG144V 2m RF Switched GaAs
MMG1296 23cm GaAsFET Preamp
MMG1691 1690MHz GaAsFET Pre

Feedback is always necessary to stay on top if you have any problems or ideas please speak to our reps at any of the rallies or even *one of our retail outlets*. Club Lectures: Sorry if we haven't been able to answer all the mail or visit all the clubs. The response has been overwhelming.

Hope to see some more next year. Best 73's Mick.

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ısmit Up-Converter	**195.50**	D
nsverter, 20W o/p	**245.00**	B
nsverter, 10W o/p	**129.95**	B
nsverter, 25W o/p	**236.90**	B

UIPMENT

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CONVERTER 137MHz	**129.95**
RECEIVER	**145.00**
FRAME STORE	**424.35**
14" COLOUR MONITOR	**908.50**
137MHz AERIAL	**286.35**
137MHz PREAMP	**69.00**
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amp	**129.95**	

Are you unable to hear all that's going on? Perhaps you feel that your receiver is just a bit 'Deaf'. One of our preamps will soon make amends. The two meter version is RF switched and allows you to run 100 watts through.

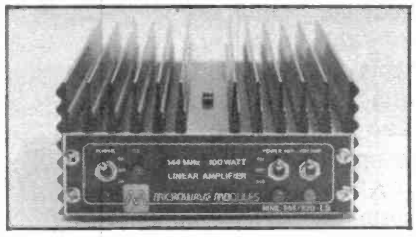
MICROPROCESSOR PRODUCTS

Learning C.W.? The MMS1 will help to achieve the pass slip you require. It sends letter, numbers or both, in groups of 1, 5 or 50 characters. Use the MMS2, and a key and it will even tell you what you've sent! RTTY enthusiasts will love the MM2001. It gives the full range of 45.5, 50, 75, 100 baud ASCII rates and will also provide 110, 300, 1200 baud ASCII range for computer systems. It plugs straight into your UHF TV and gives superb results.

MM2001	RTTY to TV Converter	**189.00**	B
MM4001-KB	RTTY Transceiver with keyboard	**299.00**	D
MMS1	The Morsetalker	**115.00**	B
MMS2	Advanced Morse Trainer	**169.00**	B

2 METER LINEAR AMPLIFIERS

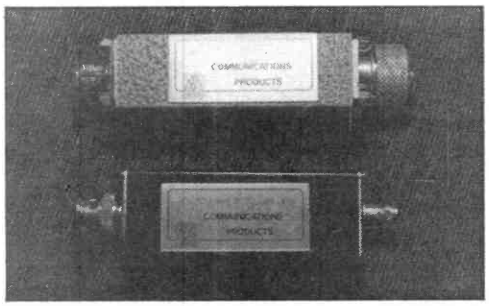
Two meters must be the most popular VHF allocation to UK amateurs and to meet their requirements we produce a full range of linears giving 30, 50, 100 and 200 watts output. Input powers are 1 or 3 watts for the 30 watt linear, 10 watts for the 50 watts, 1, 3, 10 or 25 for the 100 watt range and 10 or 25 for the 200 watt unit. All of our two meter linears are fitted with RF receive preamps.



MML144/30-LS	2m 30W Linear, 1 or 3W input	**94.30**	B
MML144/50-S	2m 50W Linear, 10W input	**106.95**	B
MLL144/100-S	2m 100W Linear, 10W input	**149.95**	C
MML144/100-HS	2m 100W Linear, 25W input	**159.85**	C
MML144/100-LS	2m 100W Linear, 1 or 3W input	**169.95**	C
MML144/200-S	2m 200W Linear, 3, 10, 25W input	**334.65**	D

All of our Transverters and some Linears come supplied with attenuators where needed. However, they are sold as a separate item, so if you need a 3, 7 or 10dB attenuator and just give us a ring.

ATTENUATORS



MMR3/25	3dB 25 Watt Attenuator	**19.95**	A
MMR7/3	7dB 3 Watt Attenuator	**14.50**	A
MMR15/10	15dB 10 Watt Attenuator	**14.50**	A

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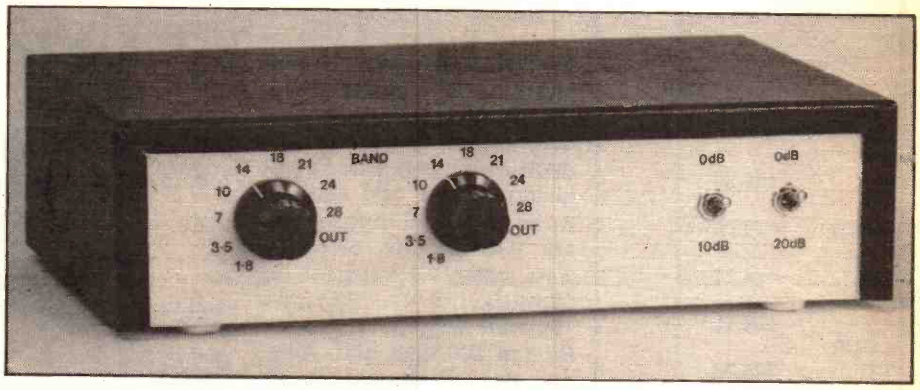
Improve Your HF Reception – An Attenuator and Filter Unit



Does your HF receiver lack something in the performance of its front end? If so, this simple but extremely effective unit, by S. Niewiadomski, will attenuate those excessive local signals and filter out that loud signal masking the weaker DX.

Much emphasis is now placed on the strong signal handling performance of receiver front ends. Most modern receivers are designed with this in mind, but older and cheaper receivers may not perform too well in the presence of large signals. Problems often occur both when receiving a strong local signal or when a weaker signal is being masked by a nearby strong signal.

This front end attenuator and filter unit, is placed in the antenna lead to the receiver to alleviate overloading problems. It provides a calibrated attenuation level of up to 30dB which reduces the strength of signals fed to the receiver in a controlled way. This will hopefully allow the active front end stages of the receiver to cope with the reduced levels without overloading. It also contains a set of fixed tune bandpass filters, one for each of the amateur bands below 30MHz. These help to reduce the strength of undesirable signals outside the band being received.

The circuit diagram of the

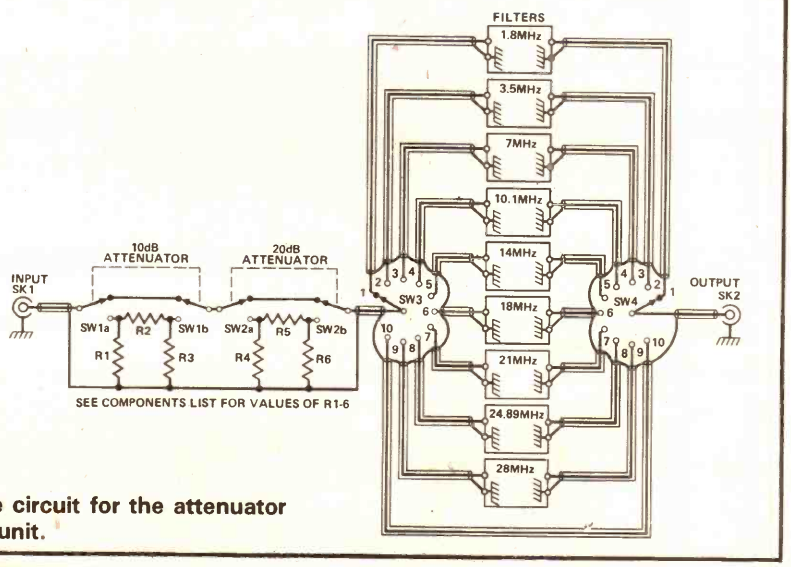


Fig. 1 The circuit for the attenuator and filter unit.

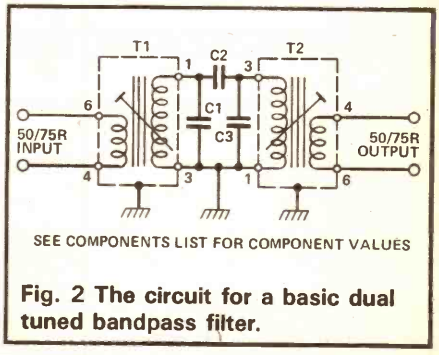


Fig. 2 The circuit for a basic dual tuned bandpass filter.

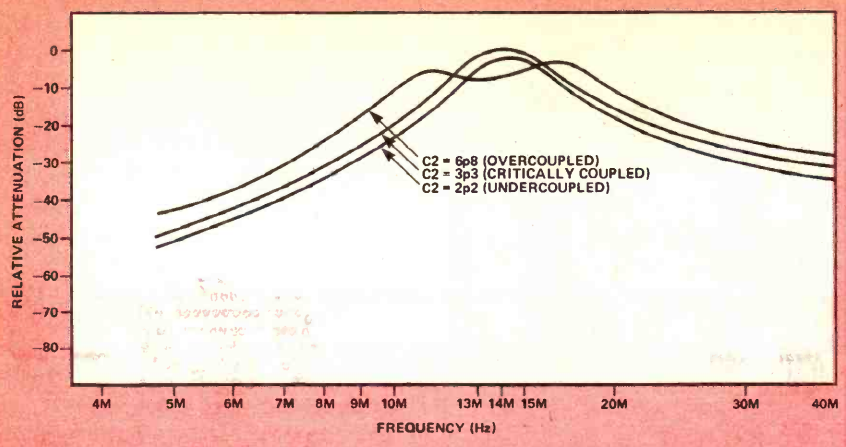


Fig. 3 The frequency response of the 50 ohm 14MHz dual tuned circuit filter showing the effect of different values of coupling capacitor, C2.

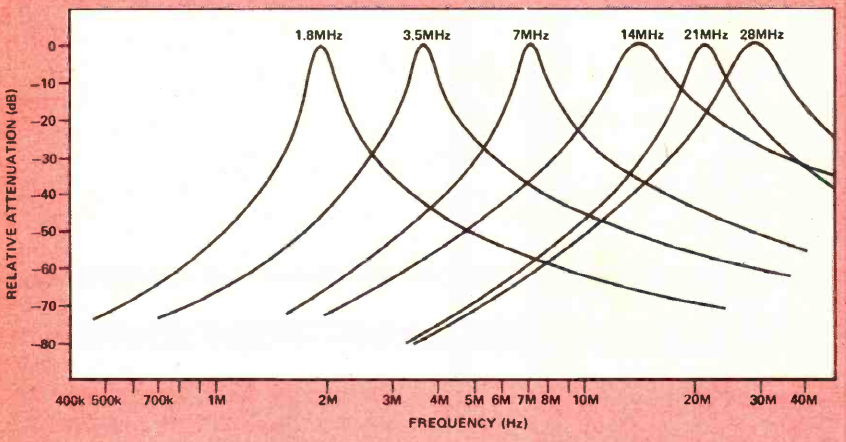


Fig. 4 The frequency response of the 50 ohm 1.8, 3.5, 7, 14, 21 and 28MHz dual tuned circuit filters. To determine the responses above 40MHz, extrapolate from the results given.

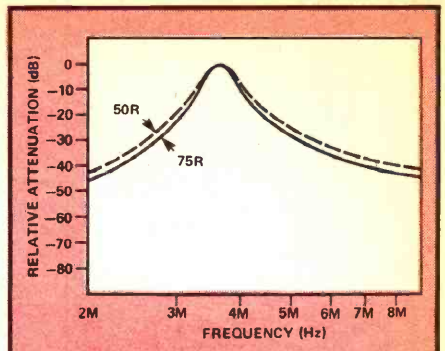


Fig. 5 The frequency response of the 3.5MHz dual tuned circuit filter comparing the 50 ohm and 75 ohm responses.

complete unit is shown in **Fig. 1.** The input from the antenna is connected to SK1 which feeds the wiper of SW1A. The resistor network R1, R2 and R3 forms a constant impedance pi-network giving an attenuation of 10dB when switched into circuit. Similarly, R4, R5 and R6 provide 20dB of attenuation when switched into circuit by SW2. Attenuation levels of 0, 10, 20 and 30dB can therefore be obtained by the combinations of SW1 and SW2 settings. Values for the attenuator resistors for 50 ohm and 75 ohm input/output impedances are given in the components list.

The wiper of SW2B drives the wiper of SW3, which distributes the signal to one of nine possible bandpass filters. SW4 selects the output of the driven filter and should always be set to the same setting as SW3. Separate switches were used for SW3 and SW4 because they were cheaper than using a 2 pole, 12 way switch. A straight through position, where no filter is in circuit, is also provided.

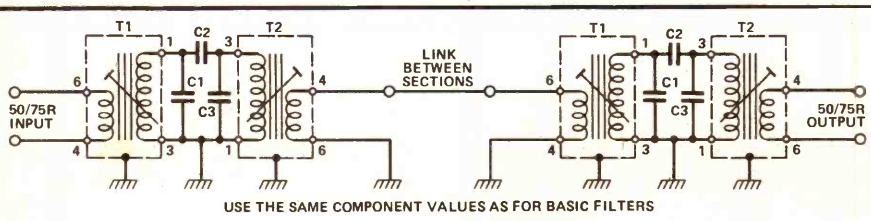


Fig. 6 Cascading two tuned circuit bandpass filters.

The output from the unit is taken from the wiper of SW4 via SK2.

The Filters

Fig. 2 shows the circuit for the bandpass filters. Each filter consists of two tuned circuits, capacitively coupled and linked to the input and output via low impedance windings. Three types of transformer are used: Toko 10k types KANK3333, KANK3334 and KANK3335, which have nominal secondary inductances of 45uH, 5.5uH and 1.2uH rspectively. C1 and C3 are calculated to resonate the inductor secondaries at the centre of each amateur band by adjusting the cores of T1 and T2.

The value of C2 is critical to the filter performance as it sets the coupling between the two tuned circuits. The effect that varying C2 has on a filter response is shown in **Fig. 3.** Here, the 14MHz filter response has been plotted for three different values of C2. With C2 at 2.2pF, the insertion loss of the filter is approximately 4dB, this is the

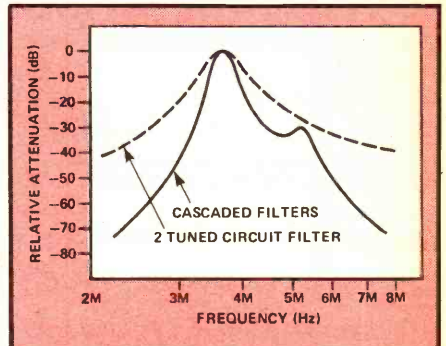


Fig. 7 The response of cascaded 3.5MHz dual tuned circuit filters (the response of the basic filter is also shown for comparison).

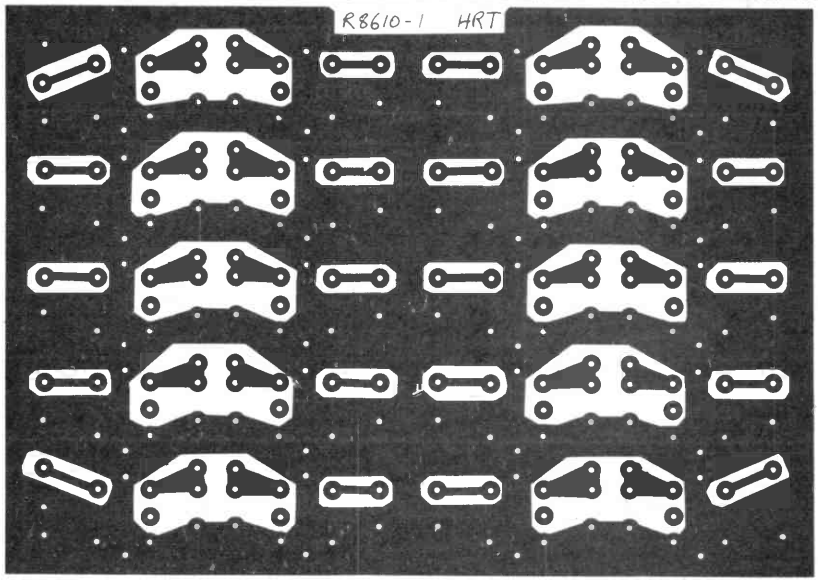


Fig. 8 Foil pattern for the filter PCB.

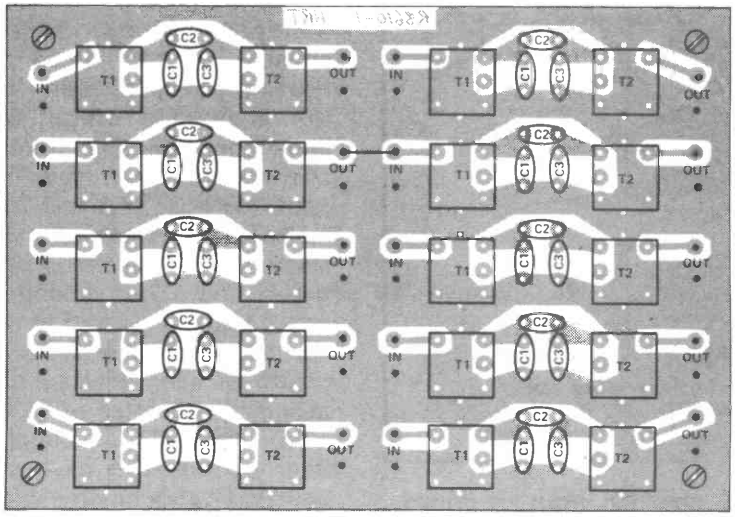


Fig. 9 The component overlay of the filter PCB showing one basic filter and one cascaded filter. Inputs and outputs are via 1mm terminal pins.

under coupled case where insufficient energy is being transferred between the tuned circuits. With C2 at 6.8pF, a single peak in the response cannot be obtained, not because of the tuning but because the two tuned circuits are over coupled. C2 at 3.3pF gives a single peak with low insertion loss in fact, approximately 1dB is obtained. This latter case is when the tuned circuits are critically coupled, to be aimed at for all the filters.

In the components list, two sets of values are given for C2, depending on whether the drive and terminating impedance is 50 ohm or 75 ohm. Generally speaking, C2 can be smaller in the 75 ohm than in the 50 ohm case. In some cases, however, the values are the same because the lower value tried for the 75 ohm system resulted in unacceptable insertion loss.

For perfect results, the filter responses for each band would have 3dB cut-off points at the band edges and rapid roll-offs outside these limits. This ideal cannot be achieved in all cases, particularly for the very narrow new bands such as the 50kHz wide 24MHz allocation. The aim has been to obtain as narrow a response as possible, centred on the middle of the band, while maintaining a low insertion loss.

The responses obtained for the 50 ohm versions of these filters are shown in **Fig. 4**, which only shows the responses for the six pre-WARC amateur bands, since the shapes for the other three bands are very similar. The attenuation has been measured as relative to the centre frequency insertion loss. This loss varies slightly between filters, but is typically 1-2dB.

A comparison of the 50 and 75 ohm responses for the 3.5MHz filter is shown in **Fig. 5**. The effect of T1 and T2 is to transform the impedance seen by the tuned circuits which comprise the filters. Therefore, in the 75 ohm case, they are driven by a higher transformed impedance than in the 50 ohm case. This tends to give a sharper peak to the response. The improvement is typical for all the filters.

Although this performance should be adequate for most applications, improved performance may sometimes be required. One method of obtaining considerably better roll-off outside the passband is to cascade identical filters as in **Fig. 6**. The low impedance output of the first filter is connected to the low impedance input of the second filter. The result, **Fig. 7**, shows the response of a cascaded 50 ohm 3.5MHz filter, with the response of the basic two tuned circuit filter also shown for comparison. A considerable improvement in the stopband response has resulted. However, the improved response is not smooth, having a peak at the high frequency side. This is characteristic of all the responses obtained when testing these cascaded configurations, but it should not cause any problems in practice.

Making Up The Unit

The foil pattern of the filter PCB is given in **Fig. 8.** This layout allows for the full complement of basic two tuned circuit filters (ten in fact) or five cascaded filters, or any combinations between. I have deliberately not cramped the component and track spacings so that the PCB can be reproduced easily. Ensure that the original dimensions of the transformer pin spacing (7mm) is maintained when transferring the pattern to the board. Only the smallest amount of copper is

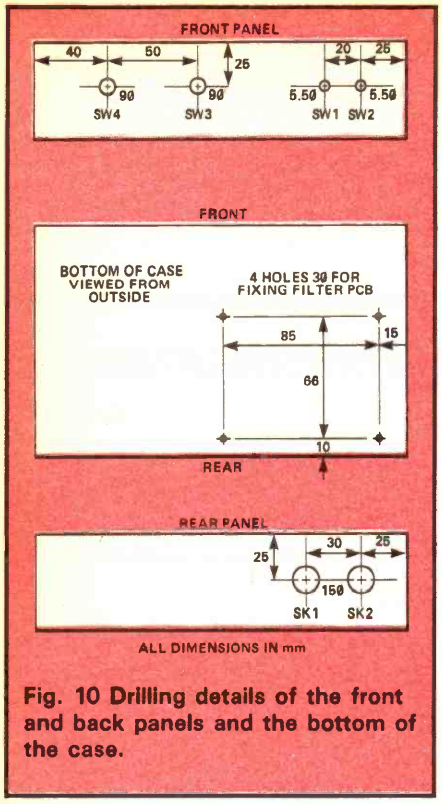
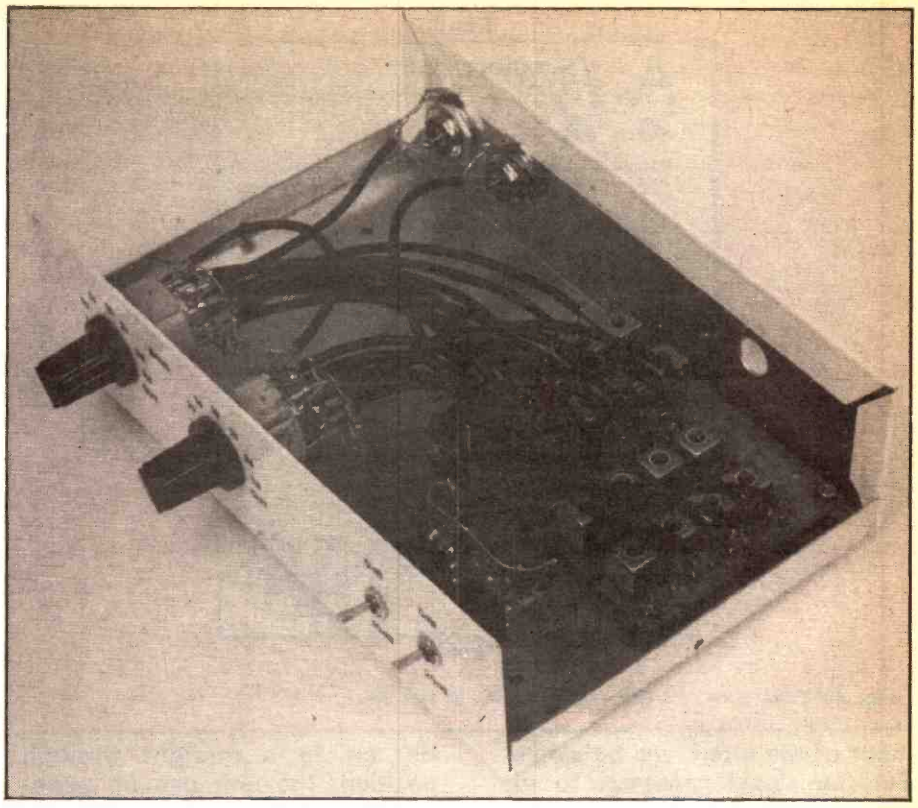


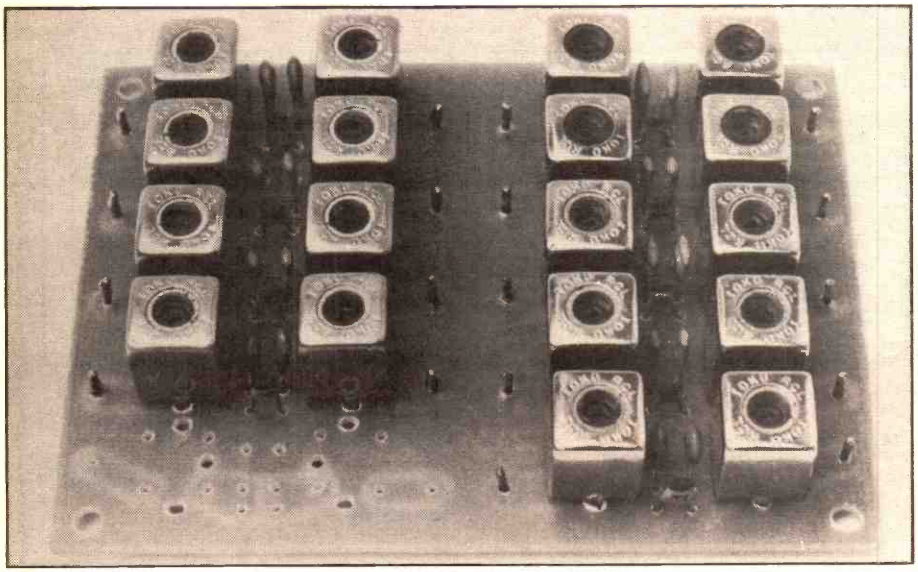
Fig. 10 Drilling details of the front and back panels and the bottom of the case.



removed. The unearthed area acts as an earth plane, which helps the RF performance of the filters, shielding the inputs from the outputs and giving low impedance earth returns.

Fig. 9 shows the positioning of the components on the PCB, for both the two basic filters case and one cascaded filter. Note the connection from T2 of the first basic filter to T1 of the second filter on the cascaded configuration.

Drilling details for the case used for the prototype are shown in **Fig. 10.** There is no need to use this particular case, and any case big enough which is to hand can be used. Obtain all the components to be mounted in the case, including the PCB, before drilling any holes so that the hole diameters and centres can be checked beforehand. The sockets for SK1 and SK2 used in the prototype were SO239, which are commonly used for modern receiver antenna sockets, but any other suitable type can be used. Unless you have a large drill available, the holes for SK1 and SK2 will probably have to be finished with a round file.



The PCB is fixed into the case **(Fig. 11)** using ½" long 6BA bolts and spaced above the base with extra 6BA nuts. Miniature RF coax such as RG174A is ideal for making the connections inside the unit. Use of any larger diameter coax is likely to result in overcrowding, particularly around SW3 and SW4. The attenuator resistors R1, R2 and R3 are mounted directly on SW1; R4, R5 and R6 from the braid of the coax from SK1.

Join together the braids of the coax to and from the filter PCB at SW3 and SW4 on rings of bare tinned wire running around the outside of each switch.

Testing And Alignment

The attenuator networks are so simple that no testing is required. An indication that they are constructed correctly can be obtained by connecting the unit into the receiver's antenna lead and switching the filters out of circuit. Tune to a signal and note whether the S meter reading of the receiver falls progressively as the attenuator switches are set to 10, 20 and 30dB.

If a signal generator and oscilloscope are available, align-

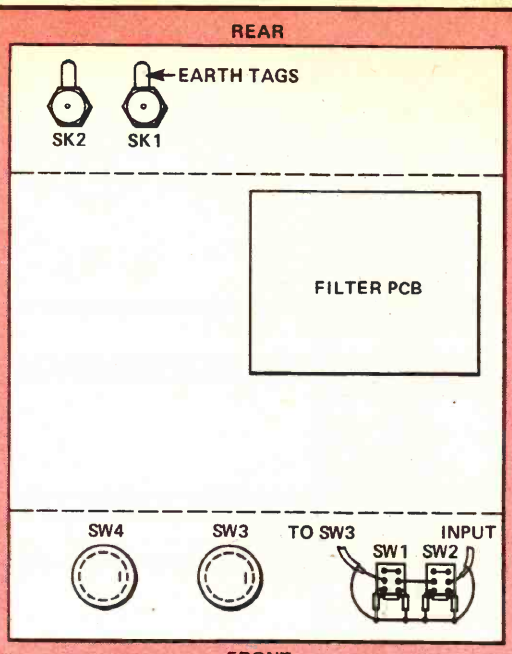


Fig. 11 Where to put the components in the case.

ment of the filters will be simple. Set the signal generator to the centre of each band in turn and adjust the cores of T1 and T2 until the maximum output is obtained. There is some interaction between T1 and T2 so several adjustments of each core will be necessary to obtain the best results.

If this test gear is not available, the cores can be adjusted for maximum signal level (or maximum noise level, if no signals can be found on a particular band) with the receiver tuned to the centre of each band. Again, several adjustments of T1 and T2 in turn will be necessary.

If the cascaded filters have been built, it is easiest to align the two sections separately, and then to join the sections together. This will ensure that the total network is aligned correctly.

And Finally . . .

The front panel of the case can be painted or covered in a material such as Fablon. Using Letraset, or similar, the controls can be labelled like the prototype. Finally, the lettering should be protected either with clear lacquer or transparent Fablon. Stick-on feet should be fitted to the bottom of the case to prevent scratching any surface on which the unit is placed.

Because the attenuator switches have a zero attenuation setting and the filter switches can be set to a straight through position, the unit can be permanently connected into the receiver antenna lead and effectively switched out of circuit when not required. When frequencies outside the coverage of the unit's filters are being received, the attenuators can still be used to reduce the input signal level. When signals in an amateur band are being received, SW3 and SW4 are switched to the band and no further adjustment to the unit is necessary as you tune around.

If antennas other than 50 ohm and 75 ohm, such as random length long wires, are being used, an antenna matching unit will be required to transform to the correct impedance.

Other Bands

The filters can be aligned to frequencies other than the nine amateur bands, such as shortwave broadcast bands, quite easily. Choose one of the amateur band filters closest to the band to be covered and calculate the value of C1 and C3 to resonate T1 and T2 at the centre of the band. Then round this value to the nearest E12 preferred value. Use the value for C2 as for the filter chosen. The alignment procedure is identical to that described for the amateur band versions.

Components List

ATTENUATOR RESISTORS

Resistors	50 ohm value (ohm)	75 ohm value (ohm)
R1,R3	100	150
R2	68	100
R4,R6	56	100
R5	270	390

All resistors are 0.25W 5% carbon film type.

MISCELLANEOUS

SW1,SW2 2 pole changeover miniature toggle switch; SW3,SW4 single pole 12 way (10 used) rotary switch, knobs to suit SW3,SW4; case type WB3 (Maplin) or SB3 (Electrovalue), stick-on feet; miniature RF coax (eg RG174A); 1mm terminal pins; screws, nuts.

FILTER COMPONENTS

Band (MHz)	T1,T2 TYPE	C1,C3 (pF)	C2 (50 ohm) (pF)	C2 (75 ohm) (pF)
1.8-2.0	3333	150	12	8.2
3.5-3.8	3333	39	3.3	3.3
7.0-7.1	3334	100	8.2	8.2
10.1-10.15	3334	47	6.8	3.3
14.0-14.35	3334	22	3.3	3.3
18.07-18.17	3335	68	6.8	3.3
21.0-21.17	3335	47	4.7	3.3
24.89-24.99	3335	33	3.3	3.3
28.0-29.7	3335	22	3.3	3.3

Key to transformer types:
3333: KANK3333R (45uH)
3334: KANK3334R (5.5uH)
3335: KANK3335R (1.2uH)

Transformers supplied may not have codes which correspond exactly with those shown above. This does not matter as long as the numbers, such as 3333, are correct.

Design and Make Your Own PCBs

Printed circuit board (PCB) is taken for granted by commercial electronics manufacturers, but still presents problems for home constructors. Here, Tony Bailey, G3WPO, gives a comprehensive and practical guide to how to design and make your own PCBs.

Back in the 1940's, electronic circuits were assembled using direct wiring techniques, transistors hadn't been invented and no-one knew any different. In about 1947, a bright engineer (called John Sargrove) came up with an idea that is now as familiar as sliced bread. He thought that things would be much easier if all the connections between the components could be pre-made on a suitable backing sheet using strips of etched copper for the electrical conductors, thus inventing the printed circuit board (PCB).

It didn't actually catch on at first and it wasn't until 1952 that things actually started happening, mainly in the form of sub-assemblies in TVs and radios. A few years later, technology had advanced to the stage where complete PCBs started appearing, with the first generation transistors also being used. Needless to say there were problems at first, the biggest being the 'solderability' problem.

Soldering Problems

A human operator soldering a joint can compensate for a lead which doesn't solder very well. He will move the iron tip against the joint until any oxide layer is broken and the solder flows properly. With automatic soldering, which is usually either by dip or wave soldering, there is no choice — either the solder flows round the joint or it doesn't! Many joints didn't flow, or did so in such a poor manner that they failed later; thus ensuring that PCBs didn't get a very good reputation at first.

Since then, many advances have been made in PCB technology to the point where it is now very unusual to see a circuit not built on a PCB. The rapid development of ICs and the need to make many connections between relatively large chips has led to multi-layer technology where there may be many single PCB layers, all with connecting tracks in what appears to be one single PCB. Connections between the tracks are made during manufacture by means of through plating the holes leaving a machine to insert all the components automatically and solder the lot in one go.

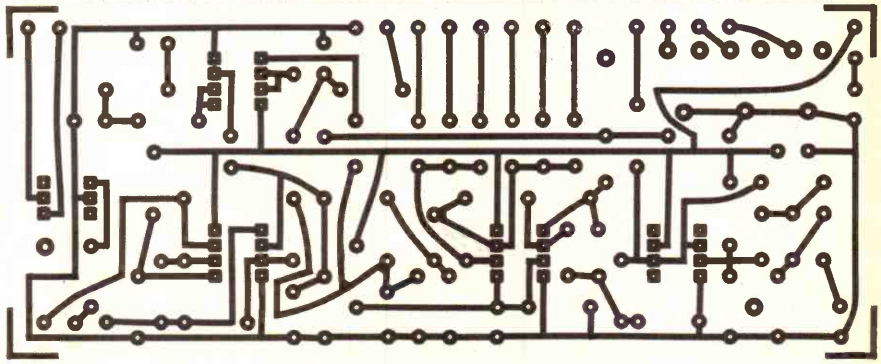
There are applications where PCBs are not suitable, for example circuits in the microwave region because of leakage and self inductance/capacitance effects. However, most things from VHF down to DC can be accommodated using modern techniques. In manufacturing, reproducibility is a major factor. Automatic testing follows naturally as well.

As well as making all the connections, PCB techniques can actually make small value inductors and capacitors as part of the tracks — a great help in VHF circuits where filters and oscillators become very reproducible and reduce setting up times.

The home constructor probably sees the advantage of PCBs in kit type projects. He doesn't have to worry about whether his particular method of wiring everything up is going to work or not, or whether he has made the correct connections in the first place.

Getting Started

How do you go about making a PCB from scratch? It depends of course on whether you have a layout available in the first place. If you are working from a magazine article, a circuit pattern may have been repro-



The foil pattern for the RTTY decoder project published in the June '86 issue. The artworks we reproduce are all laid down with 'Mecanorma' pads and tracks. Tracks can be laid directly on to the PCB if using fine insulating tape available from most component suppliers.

duced for you to use, in which case it will have to be copied onto the copper clad board.

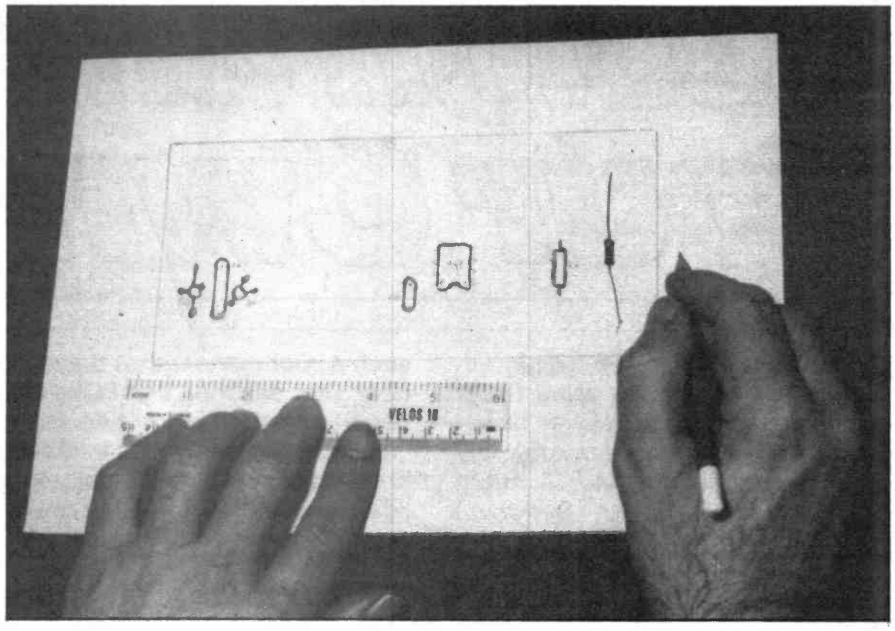
There are several types of material available and most component suppliers have bare PCB available in different sizes and grades. The material to which the copper is bonded (by a special epoxy adhesive) is usually one of three types. The cheapest is a form of compressed paper known as SRBP (sheet resin bonded paper) and is normally brown (Vero type boards are made from the same material). Like other grades, the standard thickness is 1/16th or 1.6mm, with a copper coating of 1oz per square foot. You can get other thicknesses (such as 2oz) for circuits carrying high currents, like on power amplifiers and PSUs, but these thicknesses are not needed for the average amateur circuit.

SRBP tends to chip easily when being cut or drilled and is not really suited to high frequency circuits due to inherent dielectric losses. But for cheapness with audio and low radio frequencies, it has the major advantage of being easily drilled with standard high speed twist drills without blunting after a few dozen holes.

The most common base is fibreglass, which is much stronger, does not have the losses of SRBP and is more widely available. Its biggest disadvantage from a home constructors point of view is that it is amazingly efficient at blunting high speed drills! You will find that after only a few dozen holes, the nice initial clean cut hole you obtained with no burr, rapidly develops an entry and exit burr and drilling gets progressively harder work. The correct drill to use for fibreglass boards is a tungsten tipped type. These are much more expensive (a couple of pounds each) but are *very* fragile and cannot really be used without a drill stand, unless you want to break it quickly.

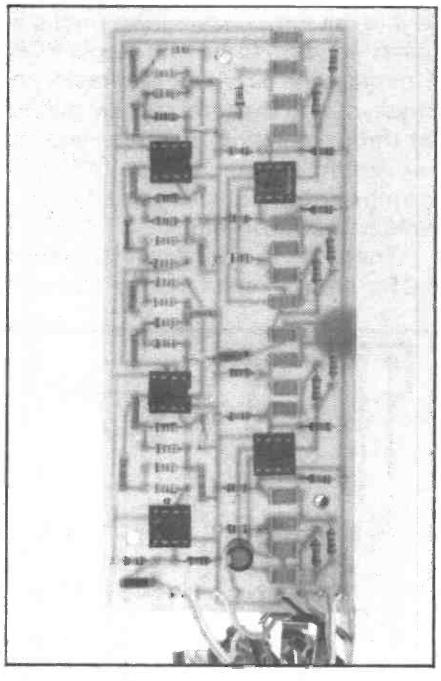
For UHF and higher frequency work, especially where printed inductances are used, 'Teflon' based substrates are available but at considerable cost. They are also much harder to work with.

Your PCB can also come as single or double sided. Double sided board enables much more complex printed wiring to be made on a given board and removes the need for wire links.



To design your own PCB, you must first design the circuit. From this, start the PCB layout with the fixing holes and the major components being laid down first, followed by the smaller ones. Using 0.1" graph paper will ensure that you get the correct spacing between components. One tip is to use one colour for the components and another for the tracks.

Having completed your layout (and double checking it for errors) a useful technique is to transfer the tracks and pads onto tracing paper. The reverse side of the tracing paper will give you the exact pattern that must appear on your PCB. No mental reversals here!



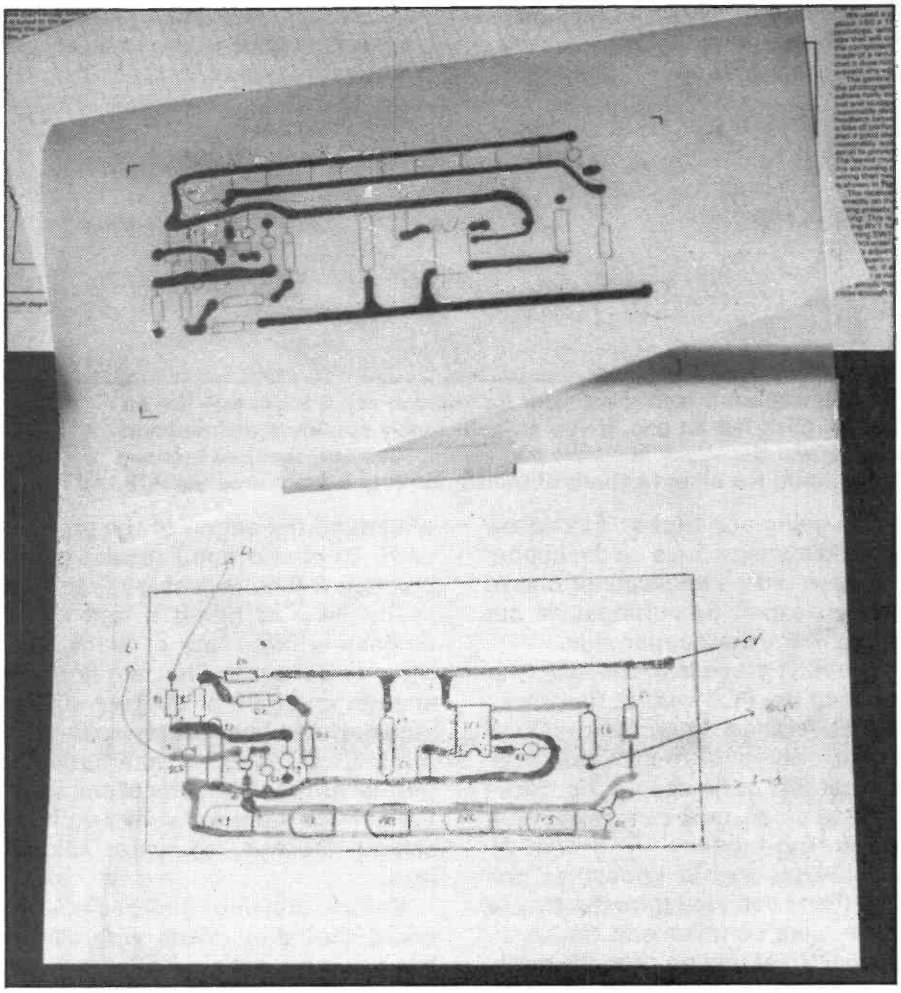
This populated PCB is part of the brick wall audio filter project published March '86. This was a single sided board with the fixing holes well clear of any tracks or pads.

Digital circuits tend to make great use of this technique. Another use for double sided board is in RF circuits where a continuous ground plane on one side provides screening and earthing and can be made with tracks for further interconnecton of say power rails.

On a professional board, many connections are made between tracks on each side by plating copper through the holes during manufacture. These through connections can be made at home using short wire links through the holes, or inserting special pins.

Designing a PCB

Assuming you don't already have a layout for your circuit, there are a number of ways of designing your own, several of which don't actually require any etching of the PCB after preparation. Simple circuits of the 'one-off' variety, where you are not too worried about the final appearance, can be made by cutting up small pieces (5mm square approx) of



PCB material. Stick these directly on to a larger piece of PCB material using 'superglue' or epoxy type adhesives. Each square then becomes an insulated point to which a lead, or leads may be soldered, with the larger piece of material providing a large earthing point.

A variation on this is to mark out on the board, using a pencil, a series of square or oblong areas, each representing an isolated circuit connection. Using a sharp blade or miniature saw cut small strips of copper out along the lines, ending up with the isolated copper squares as with the previous method.

An intermediate stage between these simple methods and that of producing a PCB with more standard tracks and pads is to use one of many 'prototyping' boards available ready made. Veroboard is a simple example of this, consistng of a series of straight tracks, drilled at 0.1" intervals with a series of holes. The idea is that you work out where the tracks need to be cut and use a special tool to produce the necessary circuit isolation, then put your components on in a neat orderly method. Wire links are used where required to link between tracks when it has not been possible to use a component to make the connection directly.

More complex prototyping boards are available which suit specific purposes such as multi-integrated circuit designs. Here again tracks are cut where required and links made as necessary. Tracks are usually provided to be used as busses for earth and power rails to aid layout.

The design of a PCB using the more conventional tracks and pads is something that tends to be like learning morse: either you take to it easily and become more proficient the more you do it; or it will be a hard slog and may be abandoned, eventually. It is impossible to really describe how to design so that anyone would end up with good results. Probably the best way is to have a look at some simple ready made PCBs or magazine layouts such as an audio oscillator or an IC circuit and try to do something similar yourself. Here are some hints on designing based on practical experience.

Rough Layouts

I find it easier using some 0.1" squared graph paper to come up with a very rough layout first. Interestingly PCBs are still effectively based on the imperial system of measurements, ie 0.1" steps, although often referred to in their metric eqivalents where 2.54mm = 0.1". If your local stationer says they don't keep such graph paper as it is obsolete, kindly inform him that the whole electronics industry is based on it; CAD systems work in this size and his electronic till is full of 0.1" spacing components!

It is useful to decide on a size for your PCB first, or if the circuit is complex, to determine one of the board dimensions before starting. If mounting holes are going to be required then design these in before you start. A 0.3" x 0.3" square with a central 3mm hole for 6BA screws is the usual requirement. This space is then sacrosanct with no tracks or components allowed inside it.

Mental Reversals

One question you will have to answer is which way up you are going to do the drawing — from the top (component side) or the track side? I work from the track side which does not require you to reverse everything when laying out the final artwork. If you do it this way remember that ICs will have their pin numbering a mirror image of its correct format. There is nothing more frustrating than finding that pin 1 is where pin 8 should be.

Having made a rough layout for the major components, go on to think about the smaller ones such as resistors and their interconnections. Most people try to mount resistors horizontally with a 0.4" (10mm) spacing between mounting holes for 0.25W types. You can also fit them on a 0.1" spacing side by side if you have a lot to get in a small space. If space dictates vertical mounting, then a 0.1" spacing can be used or 0.2" if tracks need to go up between the pads.

Capacitors such as disc ceramics tend to come with either 0.1" or 0.2"

spacing between leads and the same with most PCB mounting radial electrolytics. Test this out by bending leads over on a sample component and measuring what the spacing needs to be. I have a box containing one example of every type of component I use and this gets used not only to check spacings but also to dummy 'mount' components on the graph paper to ensure spacings are correct.

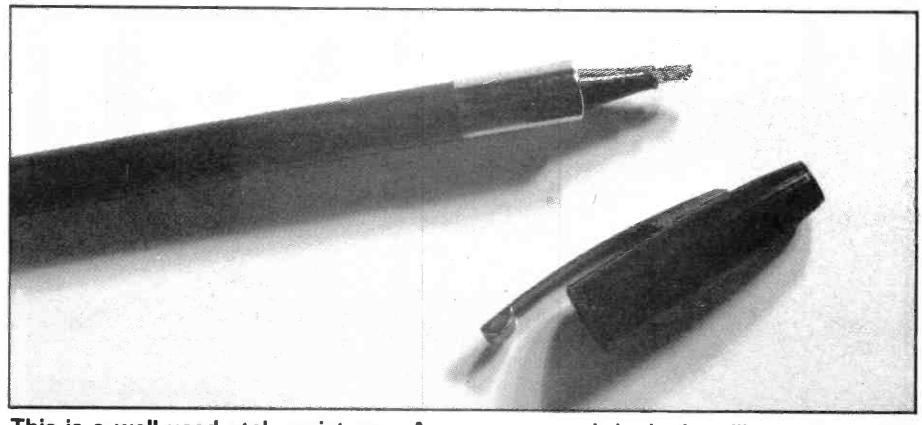
Don't be afraid of using links if you cannot find a way to arrange the components which avoids them. At first you will probably use a lot. Just mark the rough with letters of the alphabet at each end of a link. Take care that links don't unintentionally pass under places where they shouldn't, such as running near both the output and input of an amplifier. The same applies to the tracks themselves of course. Avoiding unwanted feedback in audio and RF circuits now will ensure you may not have to redesign the board later. A complex RF PCB may well need several attempts at designing, building and debugging before an acceptable and workable design appears — the intermediate boards usually end up looking quite a mess!

Incidentally, when wiring up prototype boards, don't bend the component leads over on the soldered side. You will almost certainly have to remove and replace a lot of components and it is much easier to do this with a good solder sucker and leads that haven't been bent. It also means you can salvage all the components for use on the next version of the board.

Making A PCB

If you are attempting a double sided board, it is useful to draw the tracks on the top side in a different colour to reduce confusion when transferring to the board proper. If the top is the ground plane though you will not need to allow for earthing on the track side, these are all made on the top side by direct soldering. I usually indicate ground plane earthing by a cross at the appropriate end of the component. It is up to you whether you have holes for the earthy ends; in the case of ICs it is usual, but for discrete components these can usually be omitted.

I normally cut the PCB to size before going any further. First draw up the dimension lines on the copper side then with a hacksaw or one of the more expensive cutting tools, cut to size from the copper side.



This is a well used etch resist pen. As you can see it looks just like an ordinary thick felt tip pen. If you are reasonably confident at free hand drawing and the circuit is simple and well spaced out, they are a cheap alternative to the other methods of transfering your pattern onto the PCB.

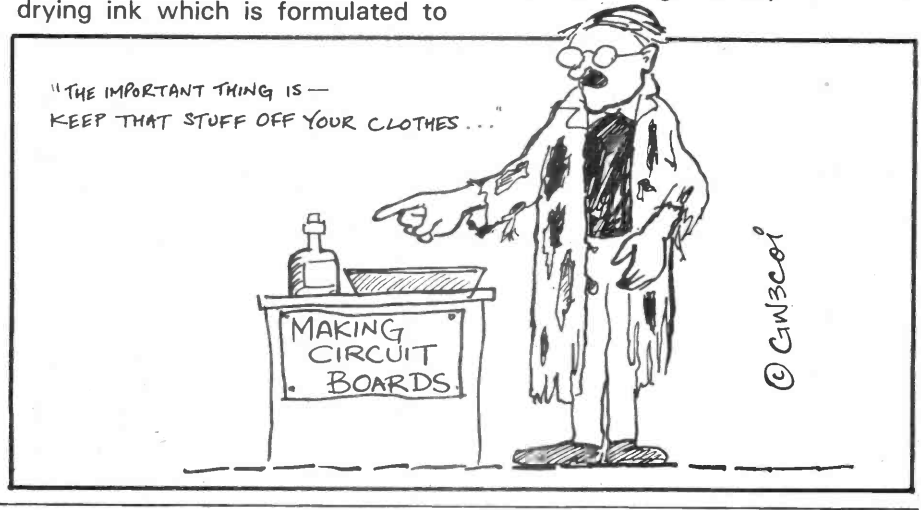
The next stage is to transfer your layout to the PCB so that the tracks can be etched later. You will, of course, only want to etch that copper that will not make up the tracks so these areas must be masked from the etching fluid.

This masking is known as the 'resist' and can vary from the simple to the more complex and time consuming. What you do depends partly on whether you want a 'pretty' result, or a functional but faster result, and your own personal 'neatness'. Given the choice, most people would probably opt for producing a result which looks much like a professional board. If you are after only a functional result and want speed without a lot of trouble and cost then one of the various etch resist pens available will be your best choice.

These consist of a special fibre tipped pen loaded with a quick drying ink which is formulated to withstand the action of the etching bath. To obtain good results some practice will be necessary first on a spare piece of board to get clean outlines without lots of blobs. You often find that the lines are not fine enough and a bit of surgery will be required later. They are cheap though at about £1 each. An alternative is permanent marker pens of the spirit type which are usually very etch resistant. Do not use water soluble inks.

Before drawing the tracks, the board should be drilled with all the holes that have been marked on your layout. This technique can also be used for magazine layouts providing the track density will allow you to reproduce it sufficiently accurately with the pen. Cut out the layout so that it can be temporarily fixed over the copper clad board. Then using an automatic centre punch on a fairly light setting mark the position of each hole on the layout.

Besides an etch resist pen, cellulose paint has been used as an alternative. However, it is less accurate and takes longer to dry.



RADIO Tomorrow

Your at-a-glance guide to what's happening around the clubs, on the air and in general radio-wise.

1 Oct
Chesham DARS: meets every Wednesday at Bury Farm, Pendor Road, Chesham.
Fareham DARC: natter night.
Hornsea ARC: meeting at the Mill, Atwick Road.
SE Kent (YMCA) ARC: natter night.
Stroud ARS: meeting.
Telford DARS: natter night.
Three Counties ARC: HF Antennas and Feeders by G5RV.
White Rose ARS: meeting

2 Oct
Bredhurst RTS: inter club quiz.
Douglas Valley ARS: meeting.
Horndean DARC: AGM.
N Wakefield RC: meeting.
Salop ARS: natter night.
Sunderland ARS: meetings every Monday and Thursday evening at 7pm in the Brewery, Westbourne Road, Sunderland.

3 Oct
Aberdeen ARS: junk sale.
Clifton ARS: club meeting.
Coventry ARS: AGM.
Maidstone (YMCA) ARS: mobile rally briefing.
Maltby ARS: activity night
N Bristol ARC: Microwave Modules talk and display.
Nunsfield House CA ARG: Railways.

5 Oct
Eastbourne EARC: meeting, RAE and morse classes.
Wakefield Mobile Rally (formerly Bretton Hall) at Outwood Grange School, Potovens Lane, Wakefield. Doors open 11am, 10.30am for disabled visitors. Free admission with stalls for radio, electronics, computers, handicrafts and kidstuff. Licensed bar and refreshments, parking and talk in. Phone G4RCH on Leeds 536633.
Welsh Amateur Radio Convention at the Oakdale Community College, Blackwood. Doors open at 10am although the official opening by the President of the RSGB is at 11am. Programme schedule is planned and there will be morse tests (apply to the RSGB) available. Admission is £1.50 and talk in is on S22.

6 Oct
Basingstoke ARC: AGM.
Braintree ARS: Consumers and Public Protection.
Central Lancashire ARC: noggin and natter at the Priory Club, Broadfield Drive, Leyland at 8pm.
Felixstowe DARS: social.
Sheffield ARC: QRP Techniques by George Dobbs, G3RJV.
Southdown ARS: meeting.
Stourbridge DARS: informal.
Todmorden DARS: surplus equipment sale.
Welwyn Hatfield ARC: The Work of the RSGB by G4RRX.
Worcester DARC: club publicity night.

7 Oct
Fylde ARS: Aerials for DX by G6DJ.
Green Grass Social Club AREG: meets every Tuesday at the club, Watling Street, Fenny Stratford, Milton Keynes. The group welcomes all who are interested in constructional and experimental side of amateur radio, TV and electronics.
Stevenage DARS: organising for JOTA at Sitec Ltd, Ridgemond Park, Telford Avenue, Stevenage.
Wakefield DRS: Getting Through After Getting Through.
Warrington ARS: open forum.
Wolverhampton ARS: AGM.
Worksop ARS: return quiz vs Maltby. Note change of venue to the Woodhouse Inn, Woodend, Rhodesia, Worksop.
308 ARC: AGM starting at 8pm.

8 Oct
Chiltern ARC: informal at the Sir William Ramsey School, Science Block, Rose Avenue, Hazlemere, near High Wycombe, starting at 8pm.
Crawley ARC: informal.
Fareham DARC: Packet Radio by G4CJO.
Farnborough DRS: EMC presented by the RSGB.
Hornsea ARC: meeting.
SE Kent (YMCA) ARC: Fire Service Communications.
Stockport RS: Logic Circuitry by G8OMH.
White Rose ARS: meeting.

9 Oct
Bredhurst RTS: construction and natter night.
Edgware DRS: Syntony by G4HFL.
N Wakefield RC: photography night.
Pontefract DARS: visit by Goole ARS to give ATV demonstration.
Salop ARS: AGM.
Southgate ARC: DBS and ATV.

ELOHEX '86. Amateur radio, computer and electronics exhibition at the Floral hall, Hornsea. Local club and trade stands, raffle and tombola, junk and bring-and-buy stand. Talk in on S22 with G4EKT. Refreshments available and doors open at 10am.

10 Oct
Aberdeen ARS: 40th anniversary cheese and wine evening.
Clifton ARS: club meeting.
Coventry ARS: night on the air.
Dunstable Downs RC: badge engraving service by G3WLM.
Loughton DARS: informal.
Maidstone (YMCA) ARS: natter night and RAE class.
Maltby ARS: Aligning ex WD Receivers.
Nunsfield House CA ARG: junk/surplus sale.
Wimbledon DARS: AGM.

11 Oct
Armagh Radio Rally in Armagh Cricket Club, The Mall, Armagh. Ample parking, model demonstrations, stalls and bring-and-buy.
RSGB Midlands VHF Convention at Madeley Court Centre, Telford, starting at 11am. Programme of lectures scheduled plus a measurements facility and small trade show. Bring-and-buy and book stalls will also be on hand. Admission is £1.20 with car park free. The site is readily accessible via the M54 (talk in available).

12 Oct
Eastbourne EARC: meeting, RAE and morse classes.

13 Oct
Borehamwood and Elstree ARS: QRP demonstration and lecture by G3JPJ at the Organ Hall community centre, Bairstowe Close, Borehamwood.
Milton Keynes DARS: AGM.
S Cheshire ARS: AGM.
Sheffield ARC: AGM.
Southdown ARS: meeting.

14 Oct
Armagh and Dungannon DARC: meeting at the Winemarket, Lonsdale Road, Armagh.
Bury RS: construction contest.
Chester DRS: quiz with Ellesmere Port RS.
Dartford Heath DFC: pre hunt meeting.
Delyn RC: meeting.
Keighley ARS: informal.
Wakefield DRS: on the air competition.
Warrington ARC: Spectrum Analysis by G3OGQ.
Wolverhampton ARS: The Skin Effect discussion.

15 Oct
Burton upon Trent DRS: meets every Wednesday at the Stapenhill Institute. DF hunt on 2m and 160m.
Hastings ERC: junk auction.
Hornsea ARC: meeting.
SE Kent (YMCA) ARC: natter night.
Stockport RS: informal.
Stroud ARS: meeting.
Three Counties ARC: Oscar Operation by G3RWL.
White Rose ARS: The TDZ Portable Transceiver by G3TDZ.

16 Oct
Bredhurst RTS: Ack-George.
Felixstowe DARS: East Anglian Daily Times visit.
Pontefract DARS: RAYNET junk sale.
Salop ARS: natter night.
Solihull ARS: AGM at the Shirley Centre, 274 Stratford Road, Shirley, Solihull.

17 Oct
Aberdeen ARS: Amateur Radio Microwave Demonstration.
Clifton ARS: meeting.
Coventry ARS: DIY forum.
Maidstone (YMCA) ARS: junk sale.
Maltby ARS: cheese and homebrew evening.
Nunsfield House CA ARG: Telephones.

18-19 Oct
BARTG Autumn VHF contest.
Jamboree on the air (FOTA).

19 Oct
Dartford Heath DFC: DF hunt.
Eastbourne EARC: meeting, morse and RAE classes.

20 Oct
Braintree ARS: construction contest.
Central Lancashire ARC: meeting.
Felixstowe DARS: Testing and Troubleshooting by G4SYG.
Stourbridge DARS: meeting.
Todmorden DARS: ANT Products visit.
Welwyn Hatfield ARC: video show.
Worcester DARC: informal.

21 Oct
Biggin Hill ARC: antenna demonstration.
Chester DRS: Avionics by G1LML.
Fylde ARS: informal.
Midland ARS: AGM.
Stevenage DARS: Lundy Island DXpedition.
Wakefield DRS: home construction display.
Warrington ARC: VHF NFD and Other Contests by G4HGI.
Wolverhampton ARS: RTTY by G8VXY.
Worksop ARS: AGM.

22 Oct
Burton upon Trent DRS: Clandestine Radio during the Second World War by G3BA.
Chiltern ARC: 10m Conversion.
Coventry ARS: visit.
Fareham DARC: lecture.
Farnborough DRS: surplus equipment sale.
Hornsea ARC: meeting.
SE Kent (YMCA) ARC: DF hunt on 160m.
Stockport RS: Shocks and Socks by G4SSN.
White Rose ARS: natter night.

23 Oct
Bredhurst TRS: construction/natter night.
Edgware DRS: informal and club history by G3MNO.
G Peterborough ARC: meeting.
N Wakefield RC: DX Chasing.
Pontefract DARS: Construction of a G2DAF Valve Receiver by G4LOS.
Salop ARS: Spread Spectrum Communications.
Southgate ARC: informal.

24-25 Oct
Leicester Amateur Radio Show.

24 Oct
Aberdeen ARS: 40 Years of Amateur Radio by the members.
Clifton ARS: meeting.
Coventry ARS: night on the air.
Dunstable Downs RC: Radio Test Gear.
Fylde ARS: informal.
Loughton DARS: 2m DF hunt.
Maidstone (YMCA) ARS: natter night and RAE.
Maltby ARS: A Look At Scanning Receivers.
Nunsfield House CA ARG: Lowe Electronics visit.

26 Oct
Basingstoke ARC: 2m DF hunt.
Eastbourne EARC: meeting and classes.
Wolverhampton ARS: 2m DF hunt.

28 Oct
Chester DRS: Basically Speaking by G4FJQ.
Delyn RC: meeting.
Dorking DRS: junk sale.
Keighley ARS: junk sale.
Wakefield DRS: bonfire party.
Warrington ARC: meeting.
Wolverhampton ARS: night on the air.
308 ARC: junk sale starting at 8pm.

29 Oct
Crawley ARC: Microwave Modules visit.
Fareham DARC: natter night.
Hornsea ARC: meeting.
SE Kent (YMCA) ARC: natter night.
Stroud ARS: meeting.
Three Counties ARC: HF and VHF stations on the air.
White Rose ARS: bring-and-buy sale.

30 Oct
Bredhurst RTS: QRP/homebrew components contest.
Glossop DARG: natter night.
Salop ARS: natter night.

31 Oct
Aberdeen ARS: 40 years Haloween night festivities.
Clifton ARS: club meeting.
Coventry ARS: construction contest.
Dunstable Downs RC: visit to RAF Croughton.
Maidstone (YMCA) ARS: Construction of a Valve 100W 29MHz Amplifier.
Maltby ARS: The Early Days of Amateur Radio.
Nunsfield House CA ARG: Hoppers Choppers.
Wimbledon DARS: surplus equipment sale.

1-2 Nov
Suffolk Scouts Corroborree.

2 Nov
Eastbourne EARC: meeting, morse and RAE.

3 Nov
Basingstoke ARC: construction competition.
Braintree ARS: Second junk and jewels sale, bring-and-buy and surplus equipment.
Chester DRS: return quiz vs Ellesmere Port.
Felixstowe DARS: social.
Sheffield ARC: annual construction contest.
Southdown ARS: meeting.
Stourbridge DARS: informal.
Welwyn Hatfield ARC: 80m CW QRP Rig Construction by G3BYG.
Worcester DARC: meeting.

4 Nov
Dartford Heath DFC: pre hunt meeting.
E Lancashire ARC: home construction.
Fylde ARS: equipment sale.
Stevenage DARS: organising for the New Town 40 year festival.
Wakefield DRS: talk by G4JKH.
Warrington ARC: open forum.
Worksop ARS: quiz night.

5 Nov
Central Lancashire ARC: visit to Red Rose Radio.
Chesham DARS: meets every Wednesday.
Fareham DARC: RFI vs EMC by Alan.
White Rose ARS: natter night.

6 Nov
Bredhurst RTS: construction/natter night.
N Wakefield RC: talk by G4OOC.
Pontefract DARS: AMTOR by G1BLT.
Salop ARS: PAL TV Systems by G1TFQ.

7 Nov
Aberdeen ARS: 40th AGM.
Loughton DARS: informal.
Maltby ARS: activity night.
Nunsfield House CA ARG: Blowing Hot and Cold by Ken Smith.

9 Nov
BATC Autumn Vision new ATV contest from 0001 to 2359 local time. All bands and modes. Contact Mike, G6IQM, for further details.
Bridgend DARS: rally at the Recreation and Leisure Centre, Angle Street, Bridgend. Opens at 10.30am, 10am for disabled, with talk in on S22. Free parking, bring-and-buy, and special event station. For details ring GW1OUP on 0656 723508.
Dartford Heath DFC: DF hunt.
Eastbourne EARC: meeting and classes.

10 Nov
Borehamwood and Elstree ARS: RTTY demonstration and lecture by G0DDJ.
Milton Keynes DARS: junk sale.
S Cheshire ARS: Railways by P Johnson.
Southdown ARS: meeting.

11-17 Nov
Stevenage DARS on the air to celebrate the New Town 40th anniversary.

11 Nov
Armagh and Dungannon DARC: meeting.
Chester DRS: Amateur Radio on a Shoestring.
Delyn RC: meeting.
Dorking DRS: informal.
Keighley ARS: informal.
Wakefield DRS: talk by G3WWF.

12 Nov
Chiltern ARC: informal.
Crawley ARC: junk sale without the real junk, please. New venue: TS Cosack, London Road, Crawley.
Fareham DARC: natter night.
Farnborough DRS: 21st AGM.
Stockport RS: G3PYE lecture by G3LX.
Stroud ARS: meeting.
Three Counties ARC: HF Mobile Antennas by G3NDI.
White Rose ARS: Microwaves For Beginners by G3PYB.

13 Nov
Bredhurst RTS: A Packaging Problem by G0DCA.
Edgware DRS: meeting.
N Wakefield RC: lecture/visit.
Pontefract DARS: on the air from S Kirkby Town Council HQ.
Salop ARS: on the air night.

14 Nov
Aberdeen ARS: President's address.
Maltby ARS: A 100W Linear using The QQV0640A.
Nunsfield House CA ARG: junk/surplus sale and natter night.

16 Nov
BATC new Slow Scan (SSTV) contest from 0001 to 2359 local time on HF and 2m.
Eastbourne EARC: meeting and classes.

17 Nov
Braintree ARS: meeting.
Central Lancashire ARC: Microwave Modules visit.
Felixstowe DARS: visit to Gaumont Cinema, Ipswich.
Stourbridge DARS: surplus sale.
Welwyn Hatfield ARC: construction competition.
Worcester DARC: informal.

18 Nov
Biggin Hill ARC: surplus equipment sale.
Chester DRS: Electro Statics by G4JYQ.
Fylde ARS: informal.
Midland ARS: homebrew contest.
Wakefield DRS: film night.
Worksop ARS: video night.

19 Nov
Burton upon Trent DRS: DF hunt.
Fareham DARC: QRP Update by G3CCB.
Hastings ERC: 2m and 70cm Linears by Ken Willis, G8VR.
Stockport RS: informal.
White Rose ARS: pie and peas supper and visit by J Birkett.

20 Nov
Bredhurst RTS: construction /natter night.
Pontefract DARS: RSGB video.
Salop ARS: equipment bring-and-buy (not junk!).
Solihull ARS: surplus sale, auctioneer G3RGD.

21 Nov
Aberdeen ARS: Do You Believe Your 'S' Meter? by Frank Dinger.
Loughton DARS: The History of Laser 558.

	Maltby ARS: RSGB video.
23 Nov	Eastbourne EARC: meeting.
25 Nov	Chester DRS: surplus equipment sale.
	Delyn RC: meeting.
	Dorking DRS: EMC Interference by G3AEZ.
	E Lancashire ARC: informal.
	Keighley ARS: films.
	Wakefield DRS: Amateur Satellites by G4JJ.
26 Nov	Chiltern ARC: lecture.
	Crawley ARC: Magazine Production.
	Fareham DARC: natter night.
	Farnborough DRS: chairman's evening.
	Stockport RS: construction competition.
	Stroud ARS: meeting.
	Three Counties ARC: Bonsai Aerial Farm.
	White Rose RS: natter night.
27 Nov	Bredhurst RTS: construction contest.
	Edgware DRS: film show.
	Glossop DARG: AGM.
	Pontefract DARS: informal.
28 Nov	Aberdeen ARS: RSGB videos.
	Maltby ARS: Three in a row lectures.
30 Nov	Eastbourne EARC: meeting and classes.
1 Dec	Basingstoke ARC: Clandestine Radio by G3VA.
	Braintree ARS: film show.
	Central Lancashire ARC: Christmas junk sale.
	Felixstowe DARS: computer evening.
	Southdown ARS: meeting.
	Stourbridge DARS: informal.
	Welwyn Hatfield ARC: AGM.
	Worcester DARC: meeting.

Will club secretaries please note that the deadline for the January 1987 segment of Radio Tomorrow (covering radio activities from 1st December to 1st February 1987) is 24th October.
The contacts list will appear next month.

HAM RADIO TODAY NEXT MONTH

Morse Keys
More than just expensive on-off switches, Hugh Allison, G3XSE, recommends 'good buys' for budget CW afficionados.

BUILD A TRANSVERTER
Onward and downward with Tony Bailey's, G3WPO, new 2m to HF transverter.

REVIEW
George Dobbs, G3RJV, looks at the Howes Communications 20m transmitter kit.

AMATEUR TELEVISION
Part 3 of Chris Lorek's series on ATV focuses on alternatives to cameras and improving receiver performance.

HAM RADIO TODAY/VERULAM CLUB CONTEST
Don't forget our friendly club contest run in conjunction with the Verulam ARS. There are prizes to be won and sections using SSB, AM and CW.
Section 1: Saturday 15th November 2000-0000 GMT on 1900 to 1990kHz.
Section 2: Sunday 23rd November 0900 to 1300 GMT on 144.150-144.400MHz.

SECONDHAND
Harry Leeming, G3LLL, takes the lid off secondhand rigs and gives a potted guide to what's available.

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Listening On...

Interesting trends have been developing in the world of international broadcasting that would make any amateur green with envy. Our resident listener reveals all and provides the very latest news and views from the broadcast bands.

Wouldn't it be marvellous to be able to have a remote transmitting and receiving site in, say, Australia when trying to work some rare Pacific DX on 80 metres when conditions are bad, or to have a receiver and transmitter in California so as to be able to work the west coast of the USA every day? This is not as ridiculous as it sounds, for it is exactly what more and more international broadcasting stations are organising, so as to be able to make their programmes audible in all parts of the world.

At one time all stations had to make do with one transmitting site within their national territory. (There are still plenty of stations which still fall into this category such as Radio Finland or Radio Yugoslavia). With the increasing overcrowding on the short wave broadcast bands, ways had to be found to improve audibility. One way was to increase the power of the transmitters, from 10kW (AM carrier power) which was common 30 years ago, to 50kW, then 100kW (the norm about 15 years ago) to 250kW or even 350-500kW as used today.

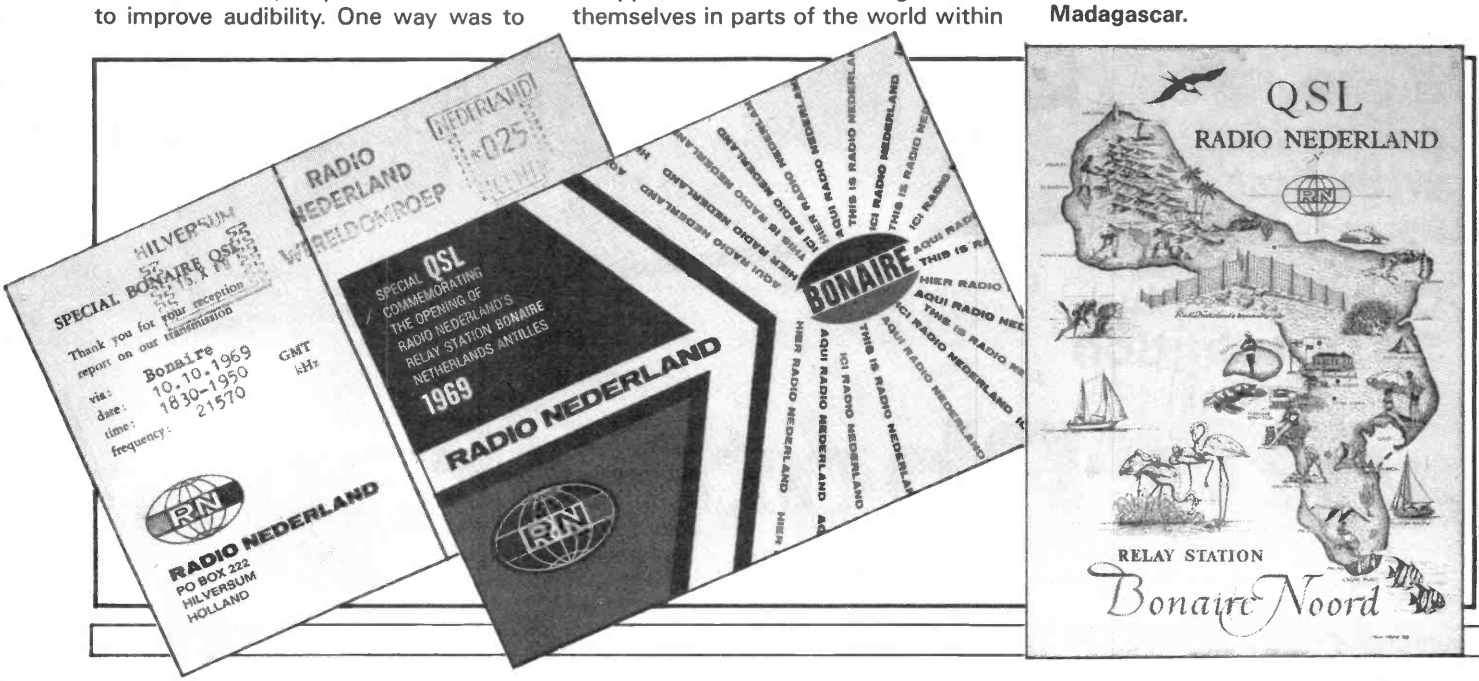
Some stations, most notably the Voice of America and the BBC, however, in addition to improving their transmitting facilities in the USA and Britain, have also built relay stations abroad. The Voice of America chose sites in the Philippines, in Sri Lanka (then Ceylon), on the island of Rhodes and on mainland Greece, at Tangier, Morocco and at Monrovia, Liberia. All these sites were carefully chosen so as to be able to put good signals into important target areas (eg the European part of the Soviet Union from the Greek sites, Indo-China from the Philippines) as well as being located themselves in parts of the world within the American sphere of influence.

The BBC built relay stations on Ascension Island in the mid-Atlantic — a British colony and virtually uninhabited island in an excellent location for putting strong signals into both west Africa and South America — as well as in Malaya, on Malta and in West Berlin. Due to political changes, the relay stations in Malaya and Malta have long since closed down, the Malaysian one being replaced by a more modern station consisting of four 250kW and four 100kW short wave transmitters at Kranji, Singapore in the 1970s. In addition, the Foreign Office maintains transmitting stations on Cyprus and on Masirah Island, part of the Sultanate of Oman, both of which are also used by the BBC.

1970s — The Decade of the Relay Station

It could be said that the '70s was the decade of the relay station, for it was then that many stations decided they had to catch up with the VOA and the

Radio Netherlands is very proud of their relay stations and issued these special QSL cards when the first one, on Bonaire in the Netherlands Antilles, was opened. Radio Netherlands' second relay station was inaugurated in 1971 at Talata-Volonondry on the island of Madagascar.



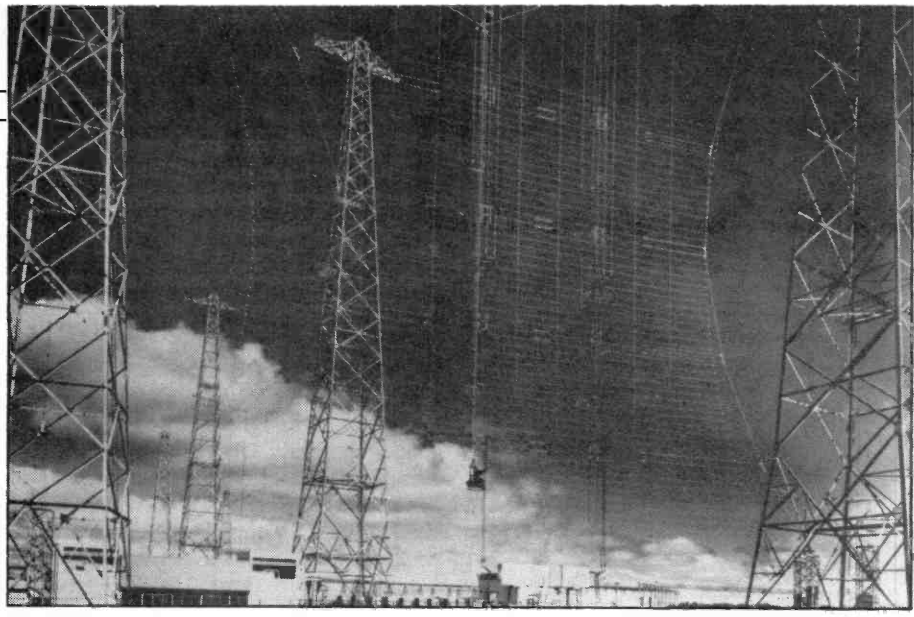


Fig.1 The second Radio Netherland relay station, this time based in Madagascar had 13 curtain antenna arrays.

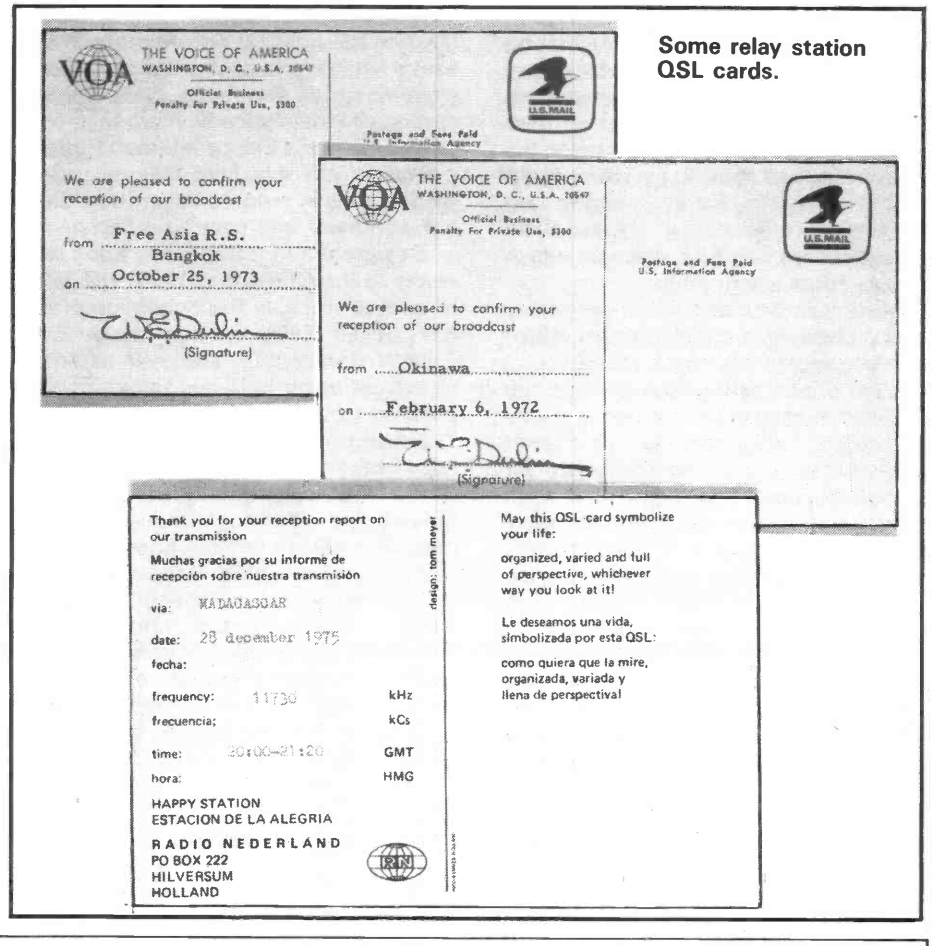
BBC and build their own relays. Radio Nederland (as it was called — even in English — in those days) led the way with the commissioning of their own relay station consisting of two 300kW short wave transmitters on the island of Bonaire in the Netherlands Antilles, just off the north cost of Venezuela, in 1969. In 1971 Radio Netherlands did it again, with a second relay station, also consisting of two 300kW transmitters, connected to 13 massive curtain antenna arrays, at Talata-Volonondry on the island of Madagascar (see **Fig.1**). This was a bold decision, as the political situation in Madagascar was a little uncertain. It paid off; as the station has proved to be very reliable and is hardly ever off the air.

Other stations quickly followed suit, with Deutsche Welle, the West German international broadcasting station, completing construction of a station in Malta in 1974, although they already had a smaller station at Kigali, in Rwanda, Central Africa on the air some years before. Deutsche Welle also combined forces with the BBC, to form the Caribbean Relay Company, which built and now operates relay stations on both Antigua and Montserrat for BBC and Deutsche Welle programmes.

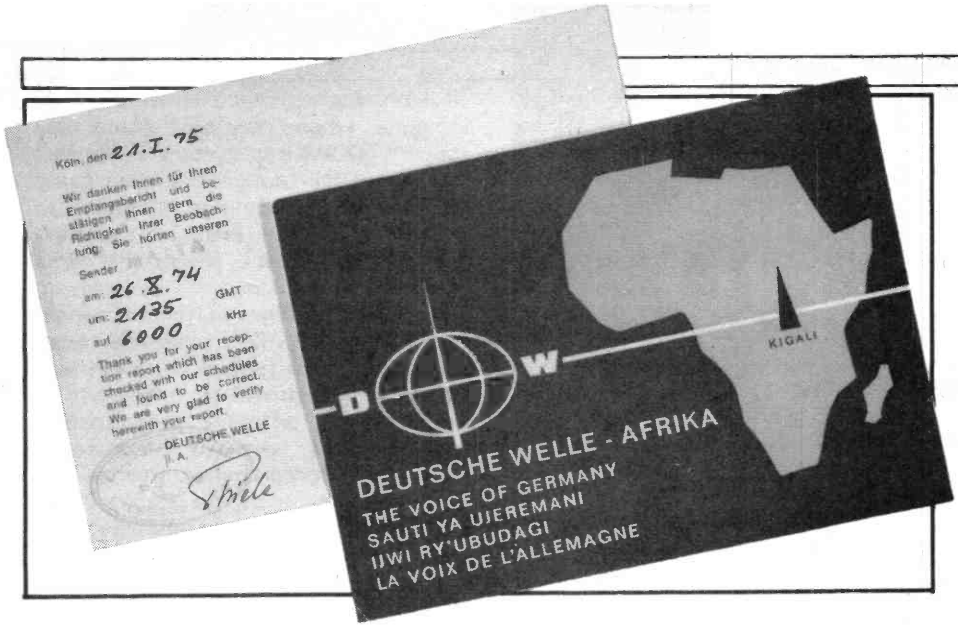
A series of co-operation agreements between various broadcasting organisations with similar idealogical viewpoints has led to the reciprocal re-broadcasting of other stations programmes. For instance, Radio Canada International relays the BBC from its own transmitting station at Sackville, New Brunswick, on Canada's Atlantic coast, while the BBC relays Radio Canada International programmes from Daventry. Similarly, the Voice of America relays BBC programmes from Greenville, North Carolina and other sites in the USA, and VOA programmes emanate from Wooferton, Shropshire. This is virtually solely a VOA relay site, but still theoretically a BBC transmitting station and manned by BBC engineers.

I believe the first example of this sort of "co-operation relay" was during the Vietnam war, when the Voice of Vietnam's English programmes were relayed by Radio Havana, Cuba, thus ensuring excellent reception in the USA. These days, Radio Havana relays Radio Moscow programmes and vice versa. There are some unlikely "marriages of convenience" though: earlier this year Radio France International concluded an agreement whereby its programmes would be relayed by Radio Beijing (Peking). Radio Beijing's programmes for North America would be relayed not from France, but from RFI's own relay station at Montsinery, French Guiana, South America, where they have three very modern 500kW transmitters. This was a short lived deal though: the relays came to a halt in the summer, according to "Media Network" because the new French government thought it was politically inadvisable to be relaying Chinese programmes to North America.

Also in the 1970s several relay companies were formed, with the sole intention of providing transmitting facilities for different broadcasting organisations, without necessarily making any programmes themselves. One such company is Radio Trans Europe, which owns and operates three 250kW short wave transmitters at Sines in Portugal. It does not produce any programmes, but leases out air time to various religious broadcasting organisations as well as Radio Canada International, Deutsche Welle, and Radio Japan. In 1979 a similar station came on the air from Gabon in West Africa. Called "Africa Number One", their four ultra modern 500kW transmitters relay Radio France International's programmes, replacing France's former relay in Brazzaville in the Congo, which had been closed down six or seven years earlier. Africa Number One also has its own commercial programmes — a sort of African version of Radio Luxembourg — and more recently also started relaying Radio Japan's programmes.



Some relay station QSL cards.



Some stations issue or used to issue, different QSLs for their relay stations. Left — QSL for reception of Deutche Welle's Malta relay during its initial test transmissions in 1974. Right — QSL from Deutche Welle's relay in Kigali, Rwanda.

Tapes, Satellites and Cables for Quality

The prime intention of all these relay stations is, of course, to provide the listener with better quality reception than he would get if listening to the station from its home country. However, in the past it has not always been possible for the relay station itself to receive good quality reception from the originating country. Propagation difficulties and sometimes the high power transmitters causing interference problems to their own receiving station! For this reason the transmitting and receiving stations of the BBC's Atlantic Relay station on Ascension Island are situated on opposite sides of a high volcano, which affords some attenuation.

Most radio stations which used relay sites prepared pre-shipped tapes which were sent out to the relay station in good time for broadcasting directly from the site itself, relying only on off-air pick-ups for news programmes or other programmes which had to be live for various reasons. This meant that such things as request programmes were often recorded weeks or even months before the broadcast date, which often gave programmes a "stale" sound. These days, however, satellites are used almost exclusively for feeding relay stations, which means better quality for news and music programmes alike, with an off-air relay or sometimes a cable link as a back-up should someone pull the plug out on the satellite circuit (it does happen!).

Often, relay stations are located in countries or on islands that do not have international broadcasting stations of their own. These can be of great interest to broadcast band DXers — increasing the numbers of countries verified, that is assuming the originating station can be persuaded to indicate on their QSL cards where the transmissions came from. This is not always the case, but certain stations, such as Radio Netherlands or Voice of America will verify their relay sites on request.

What of the future? I expect that there will be increasing co-operation between broadcasting organisations for the reciprocal re-broadcasting of each other's programmes. In fact, Media Network reported in July that Radio Canada International was looking at the possibility of relaying Radio Japan's programmes, possibly for just an hour a day to begin with, from this autumn. Despite the political disturbances in Sri Lanka (which have caused the temporary close-down of Deutsche Welle's relay station at Trincomalee on more than one occasion), Radio France International are still talking about building their own relay on Sri Lanka in order to cover the Indian sub-continent and east Asia better.

Despite the fact that Hong Kong will revert to the Chinese in 1997, the BBC is well on the way to completion of its East Asian Relay Station there. Two 250kW transmitters and four antenna arrays are being built and the station is planned to be on the air by late 1987. There were also plans for another BBC relay station on the Seychelles, as East Africa is at present one of the worst areas in the world for reception of BBC programmes, but I do not know how far these plans have progressed. One thing is for sure. With the increasing overcrowding of the short wave broadcast bands, higher powers being used all the time and more stations all wanting *their* voice to be heard, further relay stations will be built by more radio stations in even more unlikely locations.

What's News?

For fans of World Service programmes, here is my own selecton of programmes coming up in October. "John Bull's Other Islands" is a series which began in September, in which Keith Hindell looks at some of Britain's off-shore islands and describes the character of the people who live on Anglesey, the Isles of Scilly and the Channel Isles. It can be heard on 6th October at 1615 and 2315 GMT, repeated 7th October at 0145 and 0730 GMT, and at the same times the following weeks. On 5th October at 0100 and 1130 GMT is a chance to hear a one hour "Classic Pop Concert" with the Jeff Beck Group, recorded in 1972. Earlier programmes in this series have been with Genesis, Deep Purple and Fleetwood Mac, all recorded in the 1970s. Finally, on Sundays at 1330 and 1830, repeated on Mondays at 0030, is a series of plays of international repute, under the overall title of "Globe Theatre". They are being broadcast simultaneously on Radio 4 to "the largest English speaking audience in the world", according to the BBC. All these programmes can be heard on 648kHz (except at 1830) as well as 5975, 9410, 12095 and 15070 kHz.

Once again Radio Monte Carlo is in the news, this time because t been widely heard testing in th 21 metre band. This is not become an official broadcasting some years yet, despite the Radio Moscow, Radio Netherlan Bangladesh and Radio Baghdad, but four, have been using it time. Radio Monte Carlo's te been heard on 13695kHz wit signals for approximately 10 every hour, from 20-10 minute each hour. At other times, Rad Carlo's programmes in Arabic ar continue to be broadcast on 1 during the day and 9795kHz in mornings.

Although beamed to East General Overseas Service of Radio has been coming in recently on 15335kHz until sigr a news bulletin in English ju 1500 GMT.

The 60 metre band, one of so-called "tropical" bands, is int internal broadcasting in countri the tropics, where high static l the often very large distanc covered make medium wave br impractical, except perhaps fo around the capital city. Ho number of stations use this international broadcasting — being Radio RSA in Johannesb evening broadcast to West Afric United Kingdom and Ireland can at 2100, beginning with a pr called "Africa Today", on 481 well as on 7270 and 11775kHz. frequency is generally the best as there is a jammer on 727(often 11775 is above the muf (r useable frequency) at this tim

METRE WAVE SPECIAL
The Leicester Show

The Leicester Show — a good mix of equipment, new, old and not so old. See you there?

With the Leicester Amateur Radio Show taking place on 24th and 25th October at the Granby Halls, Leicester, Jack Hum offers a special Metre Wave guide on what to look for.

Some people call it 'The Leicester Rally', others — more correctly — the Leicester Show. Each refers to the same event, the exhibition held every Autumn at the Granby Halls in Leicester. If you want to discover whether it's a rally or a show you need only look in the dictionary to find it's both: "Rally: to reassemble, get together again" and "Exhibition: Showing, display (of thing)".

Certainly at the Granby Halls on October 24th and 25th there will be an immense amount of "reassembling" and "getting together again" — the social side will be of great importance to many. But the primary objective of the exhibition is to give manufacturers and dealers the chance to show their wares in three-dimensional glory and for amateurs to buy in great quantities.

What to buy? There are many amateurs who go to exhibitions prepared with a shopping list of items likely to be required in the radio room over the next several months. They know in advance what they want. But there are many more with open minds and only a broad general idea that the old transceiver back home is due for replacement and the Leicester Show might be where something suitable will be found.

Then there are those from the last RAE output now in possession of shiny new late alphabetical G1— — — callsigns. They will be making their first purchases and, faced with the abundance of goodies at the Granby Halls show, will be torn between many options. To help them canalise their thoughts on VHF, here are a few suggestions.

Target: 2m

A majority of new licensees will have settled for the class B ticket for the time being. Many of them will already have had communications experience via CB. Thus, they will tend automatically to make the 2m band

missing

Free Readers' ADS!

FOR SALE, Ham multimode II, 28/30MHz, all mode, vgc, £115 ono. Wanted, 60ft tower, base or post mounting Versatower or similar. Phone 0624 815889, PMs only, 2.15 to 6 pm.

SONY 2100D, AIR/AM/FM 32 mems digital, £225. Commodore 64k, runs 16k and +4 tape unit, 12 games, £50 bargain. Stereo IC amp, tone controls, PSU, £10. 5w/channel, ideal for Walkman. ITT, CTV 26in, remote, £30, intermittent fault. Call 31c Anerley Park, Penge SE20.

PANASONIC RF3100L, mint condition, complete with manuals, box, etc, would consider exchange hand held RX Airband or other considered. Cash adj if necessary. Phone (0783) 43868.

PACKER comms, 2m, ATU, pristine condition, £14. Sun base, colinear antenna, triple 5/8 wave, used only 3 weeks, £25. 70cms base colinear, double 5/8 wave, good condition, only £15. Hansen ZQM2 transistor-diode tester, boxed, excellent condition, £12. Mike, G6MNX, 0904 422773.

INTERNATIONAL seafarer, VHF, glassfibre aerial for marine 156 to 162MHz complete with 15 metres RG58CU. Absolutely brand new, unwanted gift, bargain, £28. Brand new Alinco 30 watt output, 1 to 3 watt input, linear built-in pre-amp, £47, un wanted gift. Mike, G6MNX, 0904 422773, QTHR.

HY-GAIN 5 (8795), boxed with CCT diagram and frequency chart, complete, in good condition, uses PLL02A phase lock loop on cybernet PTBM-125A4X board, 4 bands of 50 channels, 25.965MHz to 28.005MHz, easily converted to 10m, £160. Tel 01-471-0669, ask for Danny, after 6 pm.

FOR SALE, 2 off TS180S HF transceivers, 2 off PS30 20A PSU for above, 2 off AT230 tuning unit, VFO180, SP180 speaker, SM220 monitor scope, MC50, station mic, all good condition, also Microdot RTTY terminal (video module needs attention), offers. Telephone Rugby 536626 evenings.

SELLING Drake R7A receiver, absolute mint condition, four months old, fitted 4kHz, 6kHz, AM, filters, £1000. Ring (0772) 704009 after 6 pm.

TRIO TS780 multimode 2m/70cm base station, boxed, c/w workshop manual, £550 ono. G8RZG, 0462 811930/ 813235.

TRIO R599D amateur bands receiver, late model, £175. Heavy duty, 25ft, free standing lattice tower, £85. Trio 2200, 2m, FM, Tx/Rx, six channels fitted, £60. Ring Dursley 811454 after 6 pm.

TRIO TS120S Kenwood AT120, SP120, PS30, DFC230, MC42S, up/down microphone, all books, cartons, no split, £475. Also Datong ASP clipper for above, £65. Ring 0670 855953, North'Land.

FOR SALE, handbooks, Racal RA17, £6. Pye Bantam HP1FM, £4. Westminster W15FM, £4. HRO series, £4. Ham Concorde II, £4. Eddystone 840C service sheet, £1. GW3YGM. 0437 2015.

FOR SALE, FT 709R Yaesu UHF hand held, three months old, pristine condition, c/w charger, leatherette case, YHI Vox headset. Sell for £240 or would exchange for FT690R. Phone Livingston 412636. GM4UQD QTHR.

SENTINEL Auto HF preamplifier 2-40 MHz, 9-12v, can be transceiver switched, £12. Class D wavemeter, No 1, Mk 2, 100/1000 kHz, Xtal, VFO 1900-8000kHz, plus harmonics, mains, instructions. Good condition, £9. Yaesu speaker extension, mobile £5. Alan, Bury St Edmunds, phone (0284) 60984.

FOR SALE, oscilloscope telequipment model D66, dual trace, solid state, 25MHz probe and manual, offers; also RCS counter timer, type 401, 32MHz, part manual, offers. Tele East Kilbride 25588, Scotland.

FOR SALE, Thorn EMI oscilloscope, type WM16 with differential amplifier, type 7/6, wide band amplifier type 7/1, any offers. Tel Nigel 0298 (Buxton) 71834.

YAESU 101ZD Mk 3 FM, all band, CW filter, fan, mike, £500 ono. FC902 ATU, £100. SP901 SPKR, £30, all together £550. G4ZRG. 01-638-1550.

TONNA 20199 9 and 19 element Oscar aerial, vgc, boxed, £18. Telequipment double beam laboratory oscilloscope, DC-15MHz, dual timebases, seen working, heavy but good, £40, test and collect. G6XHR QTHR, 0705 255459.

COMMODORE C128D computer with built-in 1571 double sided 'fast' disk drive + hi-res green screen monitor + cassette + joystick + disks, 2 months old, still boxed, £520 ono (cost £630). Phone Lincoln 0522 46109.

MICROWAVE modules, MML432/30-L 70cm 30W linear, 1-3W input, £100. Wanted, Welz AC38 HF ATU. Phone Roy, Worthing 0903 67764.

COMPUTER, Atari 800, plus cassette recorder, joysticks, program and technical manuals, software including Basic, assembler, chess, complete French tutor, star raiders, scram, space invaders, encounter, etc, £125 ono. Phone Paignton 843970 (Matthews).

REVCONE Discone 50-550MHz aerial with clamps and various lengths of co-ax totalling 44ft and quality BNC connector, £20. Also 14ft 2in aluminium mast, £10. Buyers collect. Phone 0272 506208.

GWR-610E, vgc, £105 + postage. Wolfsen FM 144-146 VHF/FM scanner with VFO and PSU six crystal fitted, £40 + p/p. Microwave 28MHz to 144MHz converter, £15 + p/p. All items in very good working condition. Mr Brimming, 43 Atwood Drive, Lawrence Weston, Bristol.

FOR sale or swap, 60ft three section tower, £225 or TR1000 Rx or 2m portable or WHY radio. Phone 0642 456801, Ray, 75 Attlee Road, Grangetown, Middlesbrough, Cleveland TS6 7NA.

FT107M, used only Rx, FT480 SMC, serviced, £285. FT290 MuTek, vgc, £250. 6m multimode, 0.5W out, 3 ele, 50MHz beam, £150. Mirage VHF linear, minimum 60W out for 10 in, remote switching, £150. G4SUI, Martyn Bolt, 112 Leeds Road, Mirfield, Yorkshire, phone 0924 495916.

HALLICRAFTERS S108 communication receiver, 500KHz to 30MHz, 8 tubes, £55. Hallicrafters S72, mains/battery, 8 valves, portable comm rec, £55. American echophone commercial GC rec, £55. Trio JR599 comm Rx, boxed, £140. Canadian 1943 army walkie-talkie transceiver, £50. Wanted, old crystal sets, wireless receivers. Bournemouth 0202 510400.

HIDAKA 4 band 4 ele Yagi type antenna, 10 to 40m, 2kw handling, complete with Balun, well constructed, stainless steel fittings, virtually brand new, longest element 10.8m, boom length 5.3m, £180. Phone (evenings) Ian, G4GWB, Morpeth 0670 790090.

FT230R 2m FM transceiver + mobile mount, 25W output, vgc, £170. Sanyo 12in green screen monitor, composite input, brand new, boxed, £50. Simons basic for Commodore 64, £20. 01-467 5351.

PLEASE, no triflers! The ultimate in 2m multimodes, Standard 5800, 25 watts out, 17 months old, in definitely new condition and no mods, never used mobile. Going VHF/UHF base station, £275 ovno, could deliver reasonable distance Manchester. 061-624 2808.

DATONG PC1 gen cov converter, HF Rx on 2m multimode, £75. Sentinel 50W 2m linear with variable pre amp, £45. G3MEW QTHR, Portsmouth 0705 820315.

FT790R 70cm multimode, 8 months old, fitted N type

socket, otherwise unmodded, no NiCads as used only mobile and homebase, offered by dealer £225 in part exchange, offered privately at £245. John, G4WLD, 01-857 8096 (evenings please).

FOR sale, Ham Jumbo 160 ch AM/FM/SSB, ideal for 10m conversion, £100 ono. Bremi BRL200, 100W, 26-30MHz, 12v/240v, £40. Wanted, January 1986 HRT magazine for 10/11m conversion. Phone Zelah 380, ask for Joe.

RECEIVER, R107, for sale, or exchange for 10m Tx/Rx, ie modified CB, sale price £30 ono. Phone 0272 575202 (evenings only), G1PNF.

NEW radio harness to fit Burndept and similar. Pye PF1 Tx Rx xtalled on RB6 with batts, ext speaker, manual. Wanted, Whitehall control head, Burndept BE600. Or have you anything ex PMR Pye you do not want? 0302 835280 (S Yorks).

SALE, Avo valve tester & literature, HRO tuning condenser & SM drive. Valves, TD1-100A £10, 5B255M £5, 4X150A £15, E182CC £5, 6F33 £10, 11E2 £3. Wanted, circuit dia, air min test set type 210, ref no 105/16002. Mr Tate, 0272 615159.

YAESU FRG 7700 gen cov receiver with FRT 7700 and FRV 7700, also VHF Discone, radio books, WRTH, thrown in, excellent condition, £260, buyer collects. Phone 0634 404096. 149 Warren Wood Road, Rochester, Kent.

FT101E, excellent condition, 160m-10m, complete with mic fan, manual, DC lead, original packing, £375 ono. Trio 2200 NiCads, charger, case, with Trio 30G external VFO, original packing, one owner, £125 ono. George, GM3NVU, 0324 813349.

SPECTRUM converter, 50-28MHz, no box, £10, would swap for JR310 bits, the xtals, etc, also for VLF converter. Harmer, 9 Park Square, East Jaywick, Clacton, Essex CO15 2NL.

REALISTIC DX 200 general coverage communication receiver, AM plus SSB, LW, MW plus 3 SW, bandspread for ham and broadcast bands, built-in quartz calibrator, £85. Phone 0257 792695 (Lancs).

YAESU FT One general coverage transceiver, all factory mods and options inc. FTV107 transverter with 2m, vgc, boxed with mike and manuals, £850. Phone 0386 830614, G4PCM.

FT101ZD with FM, mint condition with spare pair of PA valves, offers over £390, buyer collects. Phone 0602 847728, G4ABT.

MICROWAVE modules, MMT 144/28 transverter, 10m to 2m, £45. G4JHB QTHR, 0935 23873.

FOR sale, Lafayette 1200FM 480 channel transceiver, AM, FM, SSB, one owner from new, internally untouched, great condition, owner going for something bigger, offers around £100. Phone Belfast 0232 224381 (after 7 pm) or 0232 657913 (1-6 pm), ask for Harry Ashe.

SPEAKERS, pair, 3in, Philips, 80 ohm, £3. 20 60ma 1¼in fuses, £2. 6L7, metal, £2. KT66, GEC, £6. Yaesu FSP1 extension speaker or mobile, 8 ohm, £5. Meter, Weston, 25ma, 2½in diamater, £3. Add postage. G3MBL, Bury St Edmunds 0284 60984.

TRIO 2130 2m multimode, ex cond, original packing, less than 10 hours Tx, never used mobile, £460 ono. James, G2OOB, phone Street 0458 42200 (evenings after 6 pm), QTHR.

FDK multi 800D 2m FM, 25 watt max, £125 ono. Commodore C16 complete starter pack and games, £40. 3in refracting astronomical telescope, very good condition, £150. Phone Chris, G1PCR, 0235 24379.

TAU SPC 3000 3kw ATU, very little used, cost £350, sell £250 ono or swap FT709R, reason for sale, given up HF in favour of higher frequencies. Phone G0CCV, Bristol 0272 717226 or 721744 (anytime).

COMMODORE CBM64, 1541 disk drive, MPS 801 printer, C2N cassette unit, all under warranty, RTTY/CW progs + interface, morse tutor, utility cartridges, easyscript, easyfile, lots of games on disk and tape, manuals, magazines, etc, £325 ono. Phone Bradford 0274 679499 (after 6 pm).

TRIO 9130, £400. Portable video, JVC-HR 2200, £150. Colour video camera, Akai VC90E, £150. Creed-7E teleprinter, £10. Cossor Commando mobile Tx/Rx, £40. Phone 0438 814648 (evenings).

WKS1001 CB, unmodified 120 channel digital readout, ideal 10m conversion, £55 inclusive postage. Phone 023987 274.

LINEAR parts, 2×813s bases, fil choke, an choke, 2.5KVPS 10-400pF vac var, 2.5-0-2.5V 14A HTR trans chokes, 8H 400ma, 2×10MHz 7.7A caps HV 4u5kv, 12u 2kv, 4u 1.2kv, 8u 1.5kv, large 3 ohm roll coaster with counter, Datong ASP 8 pin Yaesu, W&D ATV1 70cm ATV, Pye camera, no lens, 48 el, 70cm ant, all offers. Wanted, 1kw load 4.400 valves. Phone Tim, 0734 RDG 866122.

DRAGON 64, RTTY terminal, colour portable TV, loads software, radio games, £175. Tiger LY10 2m beam, brand new, £20. Audioline twin SWR/PWR meter, 3.5-150MHz, boxed, £10. Sun 5/8 2m mobile whip, brand new, £10. Wanted, FR400/500 receiver, power supplies, 6/7amp, £10. G4SWV, Nottingham 0602 275087.

VANGUARD AM/CW transmitter receiver, 10, 15, 20, 40, 80m bands, 50W to PA input, 200/250V AC, 45-64 cycles, table top model, c/w operating procedure and circuit diagrams, ideal collectors model. Phone 0455 202381 (evenings).

TELEQUIPMENT S51B oscilloscope, fully checked, £50, postage £4. Microwave modules, 2m, 30 watt, linear amplifier, £50, perfect, both guaranteed. G3HHZ, Point One, Barton Drive, Paignton, Devon.

HAVE Pye F460 UHF (station) Tx and Rx and control unit (remote) in cabinet, frequency 450MHz, requires tuning to 70cm, will swap for any 35mm camera and flash gun or enlarger or Super 8mm projector. G8BSK, 290 Priory Road, St Denys, Southampton.

EDDYSTONE 6405w receiver. Working order £35; Eddystone 840 5w receiver, gwo, £45; FR100B plus FL200B Rx/Tx 10mts-80mts, 240w on SSB & CW, gwo, £160; Datong speech processor £25. All itams plus carriage. Phone 0324 814269; or write GM3CAN QTHR.

ANTENNA for sale. Met 14 element 144MHz Yagi, in very good condition, cost £45 new, selling at £35. Phone Doug, G1KKL (0295) 57141, Oxon; evenings only.

YAESU 901DM, FTV901R with 2m/70cm modules fitted, Tokyo HL400 ATU SP901, all just realigned, in vgc. Also Azden 25/3W mobile TCVR FM, as new, all with manuals and boxed. £1,000 the lot. 05436 75301 (after 6 pm), G1NOH QTHR.

YAESU FRG7700 receiver with memory, mint condition, very little used, original packing, £295. Also Creed 444 teleprinter, £25. Phone Merstham 2095.

FOR SALE, Yaesu FT7 transceiver plus FP12A PSU with speaker, in nice condition, £220 or exchange for FT101D receiver. G Matthew, 2 Old Milnafua Road, Alness, Ross-shire. Tel Alness 882941.

FOR SALE, Icom R70 Rx FM board fitted, £450 ono. J Wright, 12 Norn Hill, Basingstoke, Hants RG21 2HD.

70cm LINEAR Microwave Modules MML432/30-L 1/3 watts, gives 30 watts output. V.good condition, perfect working order, £110 ono. Phil, G6YAL QTHR. Tel: Alfreton 835546 (evenings). Buyer collects.

TELEQUIPMENT Scope D33 D/Beam £40, small scope CT84 2½, £20; Dawe v/voltmeter £10; Mullard valve/tester with 400 cards £30; counters large £10 each; large valve/amp £5; Jennings Bush FM tuner £5; tape recorders £5 each. Phone 01-883 3474.

PYE EUROPA Crystalled RB2, RB14, RB13 £60, realistic 4w CB handheld nicads power pack telescopic and rubber duck's £60. Optomax 135mm F2.8 lens Olympus mount £40. G1OMI 0604 52730, most evenings.

SELLING TRS 80 11/12 computer, 1.2mb internal disc, 15 meg hard disk, system desk DMP420 printer with trolley, printer controller, model-2 3-disk expansion, software; basic, cobol, assembly, graphics, visicalc, bisync 3780 menu-gen. Immaculate; manuals, covers, disks, lockable storage. Cost £7000 accept £3000. (0788) 536626.

AR88D Hybrid, carefully modified product detector FM discriminator, squelch, external digital readout, using B7/9 valves, no drift or

backlash, all in good clean condition, £100. G4SFP, 0293 27288 (Crawley).

ADVANCE Mainframe storage oscilloscope, dual trace type OS2200 with OS2006 and OS2007 plug-ins, including instruction manual; not working, requires new transformer, hence very low price, £75 ovno. Mr K. L. Phillips, 3 Linden Court, Frithville Gardens, London W12 7JJ. Tel: 01-743 0811.

FRG 9600 all mode scanning receiver modified 60-950 MHz, no gaps, £350 ovno; FDK ATC 720 hand-held airband receiver 118-136 MHz 720 synthesized channels £125 ovno; FDK Rx40 receiver 141-180 MHz £100. K. L. Phillips, 3 Linden Court, Frithville Gardens, London W12 7JJ. Tel: 01-743 0811.

YAESU FT757GX transceiver, 9 months since new, £595; FC757AT ATU, £205; Diawa PS310M p/supply, 30 amp, £155; Diawa 2 mtr mast head linear/pre-amp, 50 watts output, £55; Eagle SG70 signal generator and labgear AF power meter £25 both. G0EGX, Tiptree 815978 (Essex).

FOR SALE, World Wide Countries Checklist. Book covering 160m through to 23cm plus satellites; HF, VHF and UHF sections contains over 390 prefixes plus fully detailed index plus much more, £1.50. A Goodier, 35 Rose Lane, Marple, Stockport, Ches. SK6 6DS.

YAESU FRG7 comms Rx, excellent condition, no mods, recently realigned with manual and box games, complete with aerial, wire and beginners DX guide. Price £115 ovno. Philip Le-Brun, 22 Russet Road, Cheltenham, Glos. GL51 7LW. Tel: 0242 571279.

GRUNDIG Traveller Superhet FM, LW, MW, SW 5.9 to 18 MHz. Battery and AC, mint cond, £30. Sharp portable 6 band FM, LW, MW, SW 5.9 to 18 MHz, BFO, battery or AC power unit, £55. Ring 01-794 9790.

COLOUR GENIE computer. Split screen transceive RTTY. Receive CW. New tape recorder, b/w TV, used once, ready to go on air. Handbooks, cables, etc, £140. Buyer collects. Will split. Original packing. Ipswich 49139, Noel, G3ZLN.

WANTED

ATTENTION. Wanted, Cobra 148 GTL-DX No.2 or Superstar 360FM. Must be in vgc with no mods, ie 120CHS. Phone Andy on 021-744 8411, after 2pm.

WANTED, New 572B valves, FT101, TX. Rx, FT101ZD, 144, 200 wts amplifier. Phone Glemsford 0787 280259.

WANTED, circuit diagram or photo copy for Bearcat 210 Scanner, all exp paid. Ring Fleetwood 03917 79733.

WANTED, Drake T4XC Tx with or without power supply; also 1.5MHz Filter for Drake R4C Rx, G4LW. 118 Bradford Road, Trowbridge, Wilts BA14 9AR. Phone Trowbridge 3166.

WANTED, FM Module PB2218 for FT101ZD. Excellent price paid. Phone (0622) 681294.

WANTED, Heath Kit SB10 sideband adaptor. Phone Norwich 58983.

WANTED, Valves KTW61 DH63 KT63 D63 X63 KT66 KT8 info on Marconi wireless RX1250C Tx TV5, PSU TV5. G4EUW, 020630 (Brightlingsea) 3071.

WANTED, FC-901 ATV, will buy or exchange BSA airsporter under lever air rifle with scope and or Bell and Howell 16mm optical sound projector model 652; also wanted FTV 901R transverter. Phone 0302 531927.

WANTED, Expander 430X for FDK 750XX with connector cables. G3TFN, 061-761 2952.

WANTED for beginner, 2 metre Receiver in good working condition. Phone Dave on Banbury 0295 55488, between 5pm and 7pm.

MOVING to Italy in December, urgently require President Jackson in mint condition, Fully working and of good sensitivity between frequency 26.515 to 27.995 MHz. preferably unmodified in any way. 148GTL may suffice if v.reasonable price. Peter, Box 3, Keswick, Cumbria.

WANTED, Transvertor, serial No. FTV650, suitable for use with FL DX 400 HF Tx. Tel: 0782-612868, ask for Allan.

PENSIONER wishes to purchase receiver for obraining trawler and aircraft bands, must be in good condition and not too expensive. Phone 021-745 6681.

WANTED, "A Guide to Amateur Radio" by Pat Hawker G3VA, Eighteenth Edition only. Trowell, G2HKU, Tel. 0795 873100.

WANTED, FT107 FT707 (QRO version), must be perfect cond; also wanted SP45 Welz meter, must also be in good cond. Phone (0634) 30822. Seller must be local to Kent.

OLD-TIMER restoring vintage rig requires ¾" pin spacing crystals (10X/, etc) 3.5-3.8, 7.0-7.1 MHz. £1 each offered for active crystals. Look in the junk-box and send to G3GGL, Livery House, Sandbourne Drive, Bewdley, Worcs. Cash by return or phone 0299-403372.

EXCHANGE

EXCHANGE Drae morse tutor, as new, for roller coaster with wide spaced capacitors or WHY. Redruth 123542.

EXCHANGE, 10M Cobra 148 GTL-DX; also RAE course never used for Ham Jumbo or Yaesu F C 707 ATU or WHT. Please write Ian, "The Dormouse", 5 Sunset Walk, Bush Estate, Eccles-on-Sea, Norfolk, NR12 0SX. Sorry, no phone.

SWAP Ferguson DC01 CD, player Cobra 148GTLDX, fully converted 10-11 meters, frequency counter, zegarhi BV131, TM100, PODOZI, turner JM42U, Hygain 3, 15amp PSU. All in brand new condition, for Yaesu FT757GX; and ATU, or equiv. Phone 01-637 5393 office hours, ask for Terry.

SX.200N multi scanner, AM,FM,UHF, as new, boxed with manual. Exchange for 2 meter base station monitor receiver, or what. Any reasonable offer. GDBUT QTHR, 3 Kerrowcruin Stn Road, Kirkmichael, Isle of Man.

EXCHANGE, Pye Cambridge model AM10D'S', TX 170.573 RX 165.775, with mike PSU plus 1KP mod FM board, plus auto squlch plus six chann TX/RX board, and all schematic and con vert papers by Garex with some xtals. WHY. Call me on Brighton 0273 559373, ask for Brian.

EXCHANGE Maxcon 20E with mod output power transistor to 5.5 watt. York JCB 861 at 6 watts ith DMC 510 power mike and Altai 45CB ext speaker, plus PSU 3 amp. All as new, too good for "10" want item's of interest or £80. Please call me on Brighton 0273 559373, ask for Brian.

EXCHANGE, 48 Spectrum Interface I, microdrive (boxed) for Belcom LS102L or Somerkamp TS788DX or SPL300ATU or 30 to 40 amp PSU or 70cm multimode portable or mobile. G4XPP, 10 Bowness Road, Coniston Park Estate, Tinparley, Cheshire WA15 7YA.

HAVE STACK RS232 interface for C64 or Vic 20, ZX Spectrum 48K, micro professor (needs RAM) Vic 20 home computer, would exchange for communication receiver or KW2000A. Phone 039 67 23811.

SWAP Amstrad CPC 464 with colour monitor, basic course PT1, games and joystick, home computer course mags, complete series; also Harvard 40ch H/held CB nicads char, rubber duck, for FRG 9600 or AR 2002 general receiver. Phone David on 0375 640275.

EXCHANGE. Have Thanet Electronics brass keyer; also Kenpro practise oscillator, both brand new and complete. Exchange for SWL type antenna tuner in good condition. Exchange reason explained. Lane, 19 Smugglers Way, Birchington, Kent. Telephone Thanet (Kent) 45561.

SUPERSTAR 360 expanded to 28.305 BV 131 200w mains linear AVO model 7 'Snap on' auto technicians roller tool cabinet. Exchange for decent SSB tcvr or multimode. Anything considered. G1PDA, 01-857 1813.

EXCHANGE, mint Trio 9130 2m multimode, only three months old, for mint FT77 and 2m transverter or FT707 and transverter. Write to Bob, PO Box 73, Luton, Beds LU1 1QD; or phone Luton (0582) 36961, office hours, ask for Bob.

COMPUTERS TI99/4A, complete set up, modules, minimem, speech synthesiser, chess, music, parsel, munchman, invaders, football, also lots of good software on tape, books, listings, manuals for software, cassette. Would exchange for electronic keyer or sell £75. Telephone 0773 810010.

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The Trio TR751E – A Complement or Replacement TR9130?

First they said the Trio TR751E was to be a complement, now it's officially the replacement of the older TR9130. It is smaller and has extra facilities, but do these make it better? Chris Lorek, G4HCL, finds out.

First there was the TR9000, Trio's 2m multimode mobile with a host of features which made many amateurs use one in their home station too. Then came the higher power TR9130, which was basically similar in many respects but incorporated refinements such as battery memory backup, memory scan and switchable high/low transmit power. The appearance changed little and it took more than a quick glance to differentiate between the two.

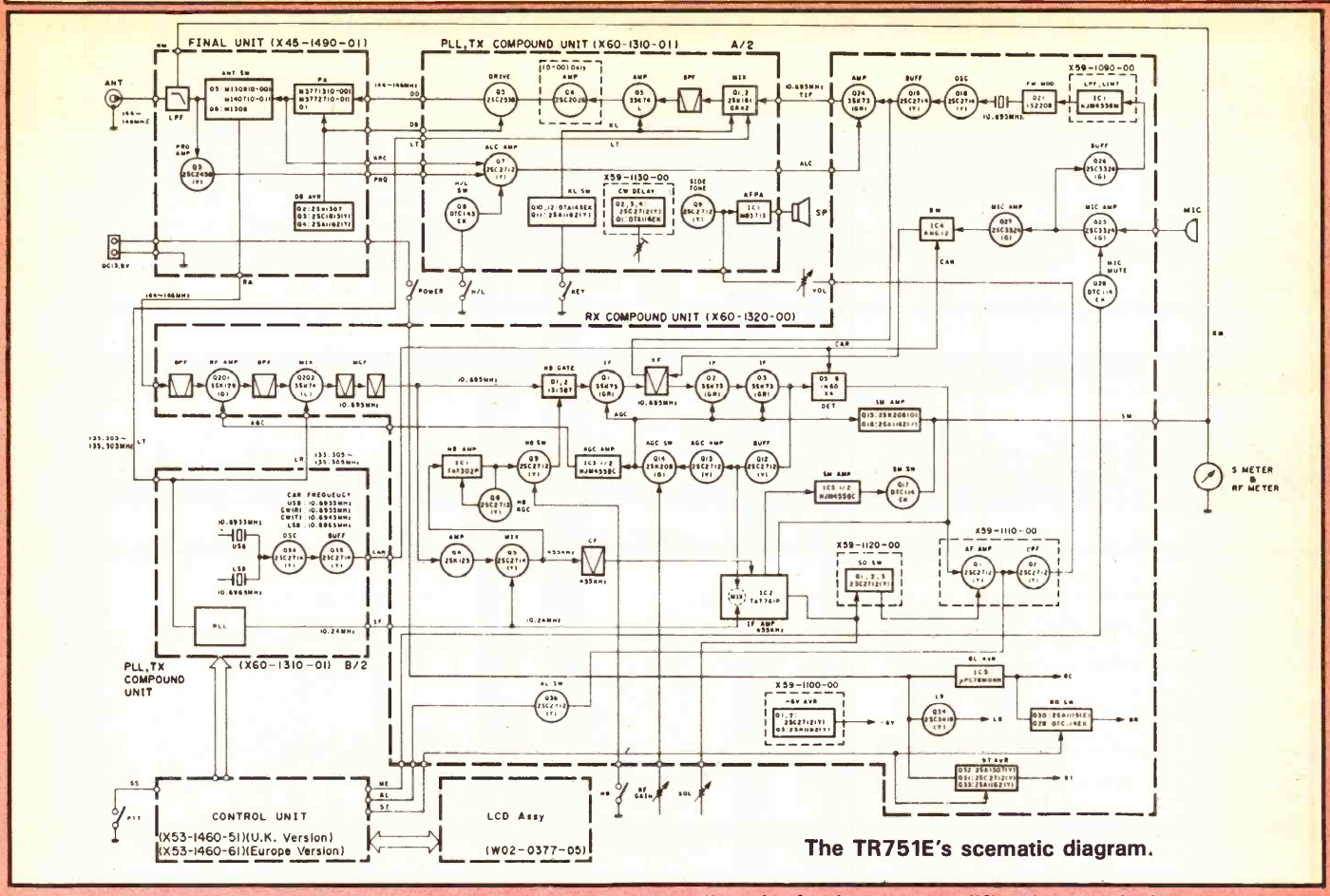
The 9130 has had a long lifetime, some may say too long, but it has certainly been popular. Trio have finally come up with another, the TR751E. It offers more operational features than its predecessor, by taking advantage of more available microprocessor control facilities, however it is smaller and lighter, looks very different, and clearly appears to give you more for your money. Now that the 9130 is no longer in production we ask is the 751 really better value, or do all the features cover up for a lack in real performance?

Offerings

The rig operates from a standard 13.8V battery supply and delivers 25W of CW/USB/LSB/FM on transmit, with a switchable low power to 5W nominal. Semi break-in coupled with side tone is provided for CW operation. A GaAsFET receiver front end gives a claimed high receive sensitivity combined with good dynamic range. An SSB noise blanker and all mode squelch is fitted, together with the usual RF gain and RIT controls.

In terms of frequency control, 'microprocessors with everything' appears to be the order of the day with this set. Two digital VFOs are provided, tuning in 50Hz, 1kHz, or 5kHz steps on SSB/CW, and 5kHz or 12.5kHz steps on FM. As well as push button manual mode selection, the set offers an 'auto' mode, where CW is automatically selected between 144.0 and 144.15MHz, then SSB up to 145.5MHz, from there FM up to 145.85MHz and SSB again then up to 146MHz. Ten memories let you store mode, offset and tuning speed as well as frequency. It is also possible to QSY from memory by a twist of the main tuning knob.

Scanning modes are many and varied of course, with scanning of memories or between any two pre-programmed frequencies possible, together with a 'priority' channel watch every six seconds. A further scan mode is also possible that will only sample those memory channels with the desired operation mode programmed into them. A switchable repeater shift of +/– 600kHz may be selected during FM operation and a further button gives an instant reverse check. An automatic 1750Hz



The TR751E's scematic diagram.

toneburst is selectable.

Physically, the transceiver measures 180mm(W) × 60mm(H) × 195mm(D) and weighs 2.1kg. A mobile fist microphone with up/down frequency control buttons is supplied with the set, together with a mobile mounting bracket, DC power lead with a spare fuse and four rubber feet which may be fixed to the bottom of the set for base station use. An instruction manual is provided which gives operating details together with simple user adjustments and a circuit diagram.

Options

The Trio Digital Channel Link (DCL) system may be fitted to the set if required. This was tested in the TM2550 review in the August '86 issue. Basically it offers code squelch, where a five figure code may be programmed to allow selective calling between similarly equipped sets, plus — most useful when mobile — an auto QSY to a free channel. On instruction the set searches a pre-determined frequency range for a free channel, goes back to the original calling or repeater frequency and then takes both stations in contact to the QSY channel automatically. A further optional display tells you the callsigns of stations who have called you in your absence.

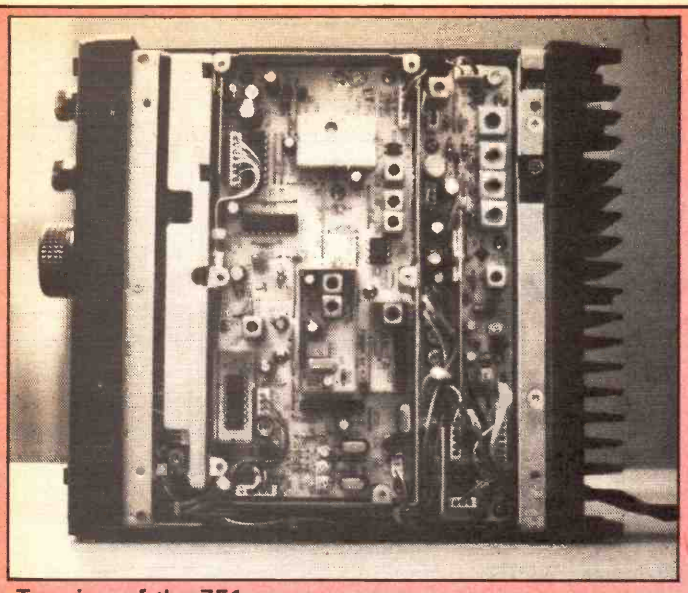
A voice synthesiser module may also be fitted, when the 'voice' key is pressed the data on the frequency display is audibly announced.

Circuitry

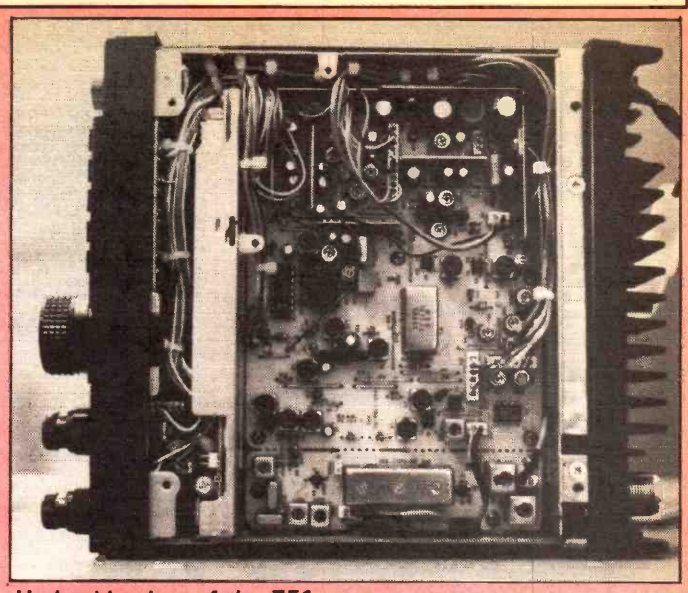
On receive, the signal passes via a low pass filter and diode RF switch to a bandpass filter, offering out of band blocking rejection. A 3SK129 amplifies the signal and passes it to a further bandpass filter. It is interesting to note the now common use of Toko pre-aligned 2m filters in these transceivers, from other manufacturers as well as Trio. The filtered signal is passed to a 3SK74 mixer, where it is combined with the PLL signal to achieve a first IF of 10.695MHz, a pair of monolithic dual pole crystal filters give a broad amount of selectivity.

Following the filters, the IF is split two ways. On SSB, it passes through a noise blanker gate made up of a pair of diodes, a 3SK73 audio gain controlled amplifier and into a multi-pole crystal filter to provide the bulk of selectivity. Further IF amplification and detection takes place before squelch switching and audio power amplification. On FM, the 10.695MHz signal is amplified and mixed with the synthesiser reference crystal of 10.24MHz to achieve a second IF of 455kHz. A portion of this signal is sampled and detected to drive the SSB noise blanker gate. A ceramic filter gives further selectivity on FM before passing the signal to a TA7761 FM amp and detector, which also provides a squelch output used on both SSB and FM. The resulting audio signal passes via the common squelch gate to the audio amplifier.

On SSB transmit, the microphone audio is amplified, passed to a balanced mixer to create the first IF of 10.695MHz and the common crystal filter to select the required sideband. There is further ALC controlled amplification. Finally, the signal is mixed with the PLL output to produce 145MHz. This signal passes through a bandpass filter to remove undesired mixing products, further amplifiers and into the M57727 block PA module. A sample of the output power is detected and fed back to control the driver stages. Following the diode RF output switch, the RF voltage is detected to



Top view of the 751.



Underside view of the 751.

drive the meter. It is then sent through a low pass filter to a directional coupler (the block diagram is slightly incorrect here) and to the aerial connection. Reverse power is sampled and used to reduce the output power in the event of high SWR.

FM transmit uses much of the SSB amplification circuitry. The amplified microphone signal in this case branches off via a buffer to a dual op-amp processor where audio is pre-emphasised, clipped and filtered, then used to directly frequency modulate a 10.695MHz oscillator. This signal is then passed to further mixer stages and amplifiers common to the SSB path.

Frequency control is performed as usual by lots of little black things having up to 80 legs each. A uPD750 central microprocessor drives the uPD751 LCD display, DCL and speech options, and a multi-loop synthesiser. This employs a multiplicity of Toshiba ICs combined with several mixed VCO's to give an output signal of final frequency minus 10.695MHz, plus any superimposed spurii.

First Impressions

I'm sure readers will tend to agree with me that it would appear the TR9130 has met its match, the photos show how they compare. The 751 is shorter, enabling fitting into today's smaller dashboard spaces, as well as saving a bit of desk top area if used in the shack. The number of extra push buttons is staggering. I'm pleased with the analogue S meter, which allows more precise comparisons between aerials, preamps, etc when used in more demanding applications such as weak signal SSB work; although it does look a little odd on the front panel amongst the LCD and LEDs.

Impressive receiver sensitivity figures are quoted which stem from the use of a GaAsFET front end. However, slightly degraded spurious response specifications are given compared with the 9130, suggesting the extra digital frequency generation circuitry may not really be an improvement.

It is not possible to use the selectable 600kHz offset on SSB, unlike Yaesu perhaps Trio have not heard of experimental SSB repeaters for local working. One memory channel may be used for normal split frequency operation however. The manual gives very limited detail on the inner workings of the set. I feel that a couple of pages of component layouts and technical description would save most technically competent amateurs the further expense of a workshop manual to perform minor repairs.

Internal Construction

The set chassis uses the now familiar Trio 'bent metal' type of case, with self-tapping screws holding everything together. A rear alloy heatsink dissipates power from the block PA module mounted onto it.

The main circuit boards are fitted on either side of a central metal section and connected together using multi-way sockets and several bundles of wires. Components are reasonably well spaced out and are mainly leaded discrete. This makes fault finding and repair relatively easy providing you know what you are doing. Internal screens also use self tapping screws which could present a problem, I certainly had some trouble when trying to remove one of the screws which was rather tight. All it would take is an ill-fitting screwdriver to wreck the heads, and the resultant loose screw near the synthesiser would cause all sorts of problems. I'm not impressed with this economic form of mechanical construction on a relatively expensive piece of equipment, meant for operation under high vibration conditions in a vehicle.

In Use

I normally test sets first for use in a base station environment, however this time I contented myself with an evening of familiarisation with the basic controls, as the set was supplied just nicely in time for a weekend of travelling. Happy at knowing what to do, the set was then tested for around 20 hours of motoring, during which I must say I took an instant dislike to the method of control.

The 9130 has features such as memory channel control, repeater shift and toneburst control on positive switches, which may be operated without taking your eyes off the road. On the 751, however, these are selected by momentary button pushes, you must either remember what you last did or take your eyes off the road to glance at the LCD display. Facilities such as

scan, mode, and repeater offset were also, in my opinion, awkwardly placed to make selection difficult whilst on the move.

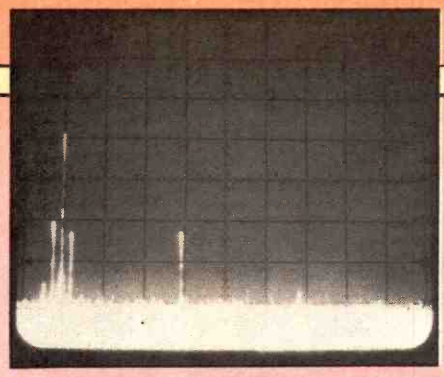
The memory facilities proved quite useful, these could be changed by the microphone mounted up/down buttons and by storing the calling channel in one memory, you could QSY easily just by turning the main knob on the set. Some of the memory channels are used for scan limits and DCL information, limiting the number available for normal use, but this did not present any problems. I would have liked a 'skip' mode when scanning, to stop the set locking on one QSO all the time.

Operating in the middle of the car park at the Woburn Rally showed few problems with receive strong signal handling, past experiences with older Japanese sets were dreadful. The DCL controls were well positioned for mobile use, this facility would certainly increase the usefulness of the set if many other amateurs were similarly equipped. This will just not happen unless Trio start fitting this option as standard to their sets.

After having been repeatedly informed that I had left my toneburst in or that I was not using the correct offset the set was placed in my shack and connected to the main aerial system on my tower. Here the set really scored, as I could keep my eyes on the controls and display and use it to its best ability. The receiver appeared remarkably efficient at pulling weak signals in, when I connected in an external RF switched GaAsFET preamp at the aerial socket I noticed very little improvement.

On FM, the set could be tuned in either 12.5 or 5kHz steps which was useful in getting to odd local net channels. I did find the rejection of local signals 12.5kHz away a bit poor though. On SSB, tuning in 1kHz steps was useful in quickly finding signals, switching then to 50Hz steps for final clarification. The minimum step size was just about adequate for resolving SSB, I didn't feel the need to use the clarifier very often as with 100Hz stepping sets. QSYing using 50Hz steps was extremely slow, but the step button is sensibly positioned right next to the main tuning knob.

On both FM and SSB transmit, received audio reports were excellent, no excessive spreading



The TR751's output spectrum.

was noted. The 'Auto' mode was sometimes useful, sometimes annoying — it really is a matter of personal preference. Changing from SSB to FM gave me an unwanted blast of noise, because I always turn the squelch off when tuning SSB, but the SSB squelch was useful when monitoring for activity. Maybe a squelch defeat button would be useful on future sets . . .

In repeater operation, the one touch reverse repeater facility was very useful in checking before QSYing. I found the toneburst a little long at just over half a second, but no problems were experienced as long as I remembered to switch it off after initial access. The length of tone is determined by the microprocessor and cannot be altered by the user.

Laboratory Tests

The receiver sensitivity measurements confirmed the excellent results obtained on the air, only the addition of a masthead preamp would make much difference in practical use. Intermodulation rejection was quite reasonable and the blocking performance was excellent. Despite the quoted spurious rejection of 70dB with the exception of half IF, all were found to be greater than 80dB down, ensuring my worries regarding the frequency synthesiser output were put to rest. The S meter linearity was not what anyone would call linear, limiting its use to relative reports on one mode at a time. 25kHz selectivity was quite good, but degraded at 12.5kHz to what I would not consider useable, this confirmed on-air tests again. The SSB selectivity was good for a set of this calibre, reciprocal mixing being the limiting factor down at −80dB.

On transmit, the set was fairly clean in terms of spurious outputs, the spectrum analyser photo above shows the fundamental notched by -58dB. All unwanted outputs were at least 80dB down, including the +/−10.695MHz components superimposed on the final signal, showing efficient bandpass filtering. Two tone SSB intermodulation was rather good, driving the set hard into ALC showed very little degradation, you shouldn't get too many complaints of spreading when DX chasing using a processor. The output power was accurately regulated to 25W, you could no doubt achieve more than this but at the expense of degraded linearity.

FM deviation was just a shade too high but within a reasonable tolerance of the recommended 5kHz

Laboratory Results

RECEIVER

Sensitivity — signal strength in uV pd required to produce 12dB SINAD.

Mode	144MHz	145MHz	146MHz
SSB/CW	0.095	0.090	0.085
FM	0.065	0.155	0.150

Squelch sensitivity

Mode	Threshold	Tight
SSB/CW	0.078 uV pd	0.280 uV pd
FM	0.058 uV pd	0.425 uV pd

Blocking rejection — increase in level of off channel signal to give 6dB degradation in 12dB SINAD on channel signal.

Mode	+0.5MHz	−0.5MHz	+1MHz	−1MHz
SSB/CW	102dB	107dB	108dB	110dB
FM	92dB	95dB	96dB	98dB

Image rejection — rejection of (2x10.695MHz) on **SSB/CW 88dB; FM 88dB.**
Other spurious rejection — 100-200MHz all greater than 80dB.

S-meter linearity

Reading	SSB		FM	
	in uV	in dB	in uV	in dB
S1	0.495	−18.4	0.285	−16.1
S3	0.740	−14.9	0.720	− 8.0
S5	1.30	−10.0	1.20	− 3.6
S7	2.14	− 5.6	1.50	− 1.6
S9	4.10	0dB ref	1.81	0dB ref
S9+10dB	18.4	+13.0	2.49	+ 2.8
S9+20dB	137	+30.5	3.64	+ 6.1
S9+30dB	1050	+48.2	5.40	+ 9.5

RF gain range — on SSB/CW greater than 100dB; on FM 59dB.
RIT range — +3.45kHz and −1.50kHz.

Adjacent channel selectivity — FM two signal, increase in level of off-channel signal modulated with 3kHz dev 400Hz mod to cause 6dB degration of 12dB SINAD on channel signal.

+12.5 kHz 18 dB	+25 kHz 69 dB
−12.5 kHz 18 dB	−25 kHz 68 dB

Intermodulation rejection — increase in level of two off channel signals to give 12dB SINAD on channel.
No degradation noted when noise blanker enabled.

Mode	Separation	
	25/50kHz	50/100kHz
SSB/CW	76dB	76dB
FM	75dB	75dB

Harmonics and spurii

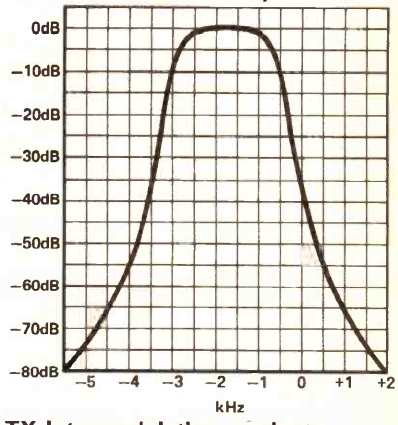
Harmonic/Spurii	Level
2nd harmonic	−83dB
3rd harmonic	−97dB
other harmonics	less than −100dB
Spurii −10.695MHz	−80dB
+10.695MHz	−83dB

Two-tone SSB Tx intermodulation

Order	Level
3rd	−27dB
5th	−46dB
7th	−53dB
9th	−60dB

Frequency accuracy −330Hz
Tx FM deviation 5.3kHz peak
Toneburst deviation 3.9kHz

Receiver SSB selectivity.



TX Intermodulation products.
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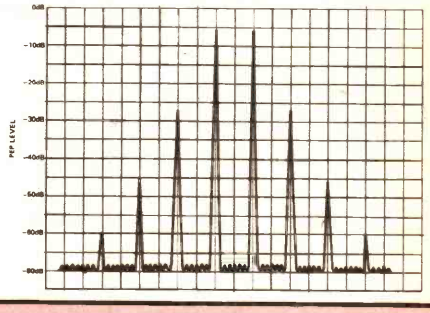

TRANSMITTER

Transmit power and current (in Watts/Amps)

Mode	144MHz	145MHz	146MHz
SSB PEP high	24.6/4.75	24.8/4.75	24.9/4.75
SSB PEP low	3.75/2.40	3.80/2.40	3.80/2.40
FM/CW high	24.5/4.55	24.9/4.60	25.0/4.60
FM/CW low	3.80/2.35	3.80/2.35	3.80/2.35

maximum, the toneburst level was such that you could talk over it and be understood if you forgot to switch it off when not required. The current consumption on high power was quite good, but dropping to low power did not reduce it as much as I would have expected — using low power when operating mountain top portable would not conserve battery life that much.

The frequency accuracy on switch on was within the limit of quoted tolerance. This did not drift by more than 100Hz during warm up, but personally I would be in there with a trimming tool as it is a bit too far out for some weak signal applications, then again I'm rather fussy.

All in all, a good technical performance.

Conclusions

A very nice set for base station operation, possibly combined with the occasional burst of mobile or portable work. In terms of ease of operation whilst mobile, I feel Trio have gone in the wrong direction by using momentary operation push buttons rather than controls as fitted to the 9130. The receiver performance is very good, the transmitter better than I expected in view of all the bells and whistles which often degrade rather than improve RF performance.

How does it compare with its predecessor, well for mobile use I don't believe it is a much better set unless you want the DCL facility. The 9130 is certainly far easier to use whilst not sacrificing too much in performance. For base station use the 751 exceeds the 9130 in many respects, making it in my eyes certainly a better buy.

My thanks go to Lowe Electronics Ltd for the loan of the review sample.

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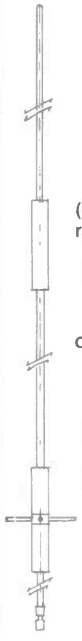

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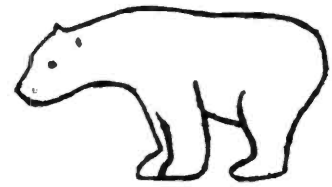

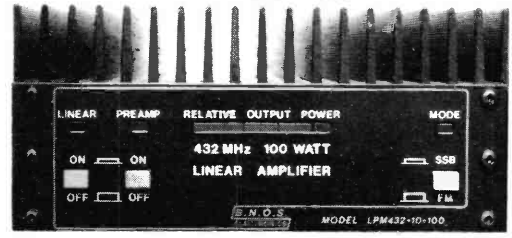

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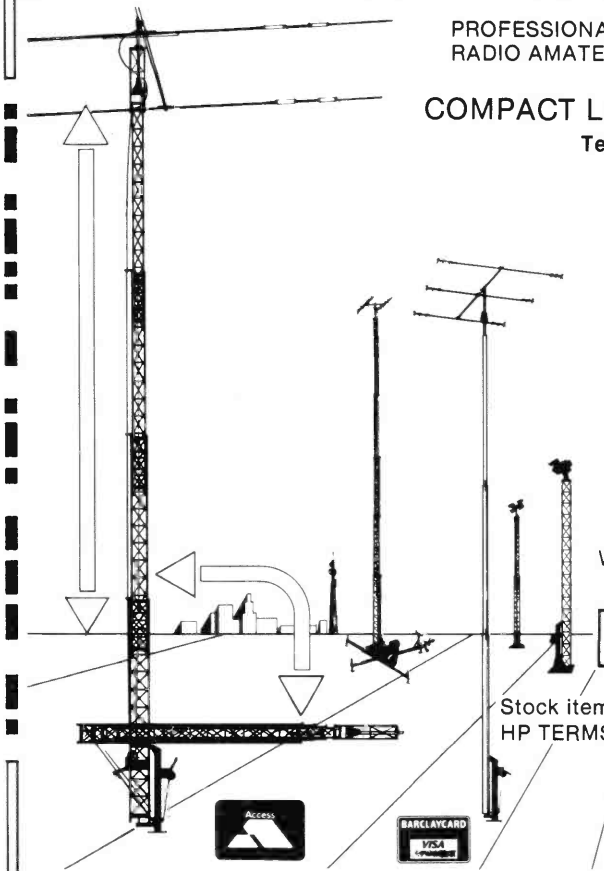

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