HAM RADIO TODAY

AN ARGUS SPECIALIST PUBLICATION

NOVEMBER 1984

99p

Methods and Techniques of Fault Finding for Radio Amateurs

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2m 20W PA from Cirkit

The 'Supernotch' – a tuneable audio filter

REVIEW: The Ten-Tec Corsair HF Transceiver – a CW operators dream?

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HAM RADIO TODAY

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Published by:
Argus Specialist Publications Ltd.,
1 Golden Square,
London W1R 3AB.
Telephone: 01-437 0626

Distributed by:
SM Distribution Ltd.

Printed by.
The Garden City Press Ltd.

Subscription Rate:
UK £14.00
O/Seas Sur: £14.45
O/Seas Air: £27.00
Ham Radio Today,
Subscriptions Dept,
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Peaceful Raynet

Sir, Referring to Sid Frisby's letter "Abuse of Raynet", it should be pointed out that much of the CEPO's work is concerned with peacetime disaster situations. All of our exercises with the CEPO are geared to that end and there is no way that we as a group will be used for any of the purposes complained of by Mr. Frisby.

It seems to me a pity that Raynet, which can provide such a useful service to the Community, should be the subject of such attacks. A general review of Amateur Radio Operating Standards is required, certainly, perhaps at RAE level but don't pick on an organisation which by its very nature is merely trying to help others, free of charge, and in occasionally very trying circumstances. The members of my Group who have endured hours of pouring rain or sub-zero weather in the hills, in support of some local event, are not impressed by Mr. Frisby's organisation or its arguments.

Lets face it, no one is perfect, but it does sound as if SPARS is setting itself up as Guardian of the Air-Waves and in the process attacking one of the facets of the hobby which is not self-orientated.

CJG. Peel G4 NFL, North Staffs. Raynet Group Controller.

RSGB Council Elections

Sir, I wonder if any of you really believe the August Editorial in *RadCom* regarding the Election of Council Members and are aware of its implications. Speaking as an ordinary member of the RSGB, I wish to disassociate myself from it completely. So the Society does not want the person "who has little direct experience of the Society (or a similar body) but who never-the-less believes that s/he is the much-needed new blood which will sort out all the problems of the RSGB at a stroke." But surely, that is the type of person the Society *does* need. Someone with new ideas, drive and enthusiasm, in touch with the growing membership and able to appreciate their problems.

It is absolutely essential that the RSGB Council be composed of a good cross-section of society from the older experienced member of the younger dedicated enthusiast. Without this broad outlook, Council is not truly representative of the membership. But what has the Society done. The very opposite. In last years election to Council it altered the rules so that now you can only say what you *have done* for the Society in the past, not what you *will do* (which is what the membership is more interested in). By this method new blood is already being deterred from putting up for election. Now you know.

HM Holman, G4 KCC

Mixed Up

Sir, Having been involved in some receiver work with diode mixers, it was of interest to read F. Ogden's article on MOSFET/diode mixer type circuitry in May *HRT* ('Radio Building Blocks'). Very interesting reading it was, as is usual. However, the subject of diode mixer termination seemed to be passed over relatively quickly. With reference to DeMaw and Hayward in the ARRLs 'Solid State Design for Radio Amateurs', there is a discussion with regard frequencies into 50 R. The 'convention' of a 3 or 6 dB pad, isn't really needed it seems in the IF port, but does putting it in the LO port help the IF port see a broadband 50 R termination? Indeed the concept of the diplexer arrangement hasn't been mentioned. This system does seem to provide a relatively better port termination.

I wonder if in the article by Angus MacKenzie on (also in HRT April 1984) 'Receivers, assessing RF performance', the 'better match' to the diode mixers he tested, refers to the use of a diplexer or again simply a 50 R pad at the IF/LO ports. Surely this system of pads can't provide the proper terminations or best terminations for these type of mixers.

I don't know the answer, but there is definitely a difference in terminating the IF port in a diplexer type termination c.f. a 6 dB in the LO and/or IF port.

G. Pike

Frank Ogden, G4 JST, replies; *thank you for your comments. I am sorry if I appeared to "gloss over" the matter of port terminations in balanced mixers. The whole subject matter is so imprecise and dependent on external circuit conditions that anything less than three bound volumes would have to leave out important material!*

I agree with you that diplexers — a sort of crossover network akin to those fitted in two-way loudspeaker systems — are a jolly good way of mopping up unwanted mixer products provided that both arms of the diplexer see a resistive termination. Even better of course is the use of a resistive terminated hybrid coupler on each mixer port. It then becomes impossible for the diode ring to 'see anything other than a near perfect match no matter what the external circuitry is like.

In the real world such as ours, a fundamental requirement is to keep it simple. Given that there are all sorts of variables in play such as mixer input resistance being absolutely dependent on LO drive power, etc, my own experiments indicate that padding out the LO port offers a very good compromise between keeping down *the conversion loss and keeping* up *the intercept performance. It is certainly not a perfect solution but has been shown to work well. The receive performance of the Omega project is practical proof of this.*

Finally, you are quite right in pointing out the error in the attenuator pad values. As I said, the real world is less than perfect. . .

Got An FT102?

Sir, Re "FT102 Problems" (July Letters). The letter from VK5KL must have caused a flutter in some shacks (mine included). The serial number of my 102 was within the batch he identifies and sure enough, upon inspection, R84 was missing from the IF strip, at least apparently so — in fact, it *is* fitted on the solder side.

I have corresponded with Yaesu who warn that the resistor (which is 120K, not 100K as previously stated) was thus fitted during a change over in foil patterns. *Fitting one on top of the board in the holes marked R84 will seriously degrade the rig's performance.* The batch 2M071000 to 2M071100 should have the 120K resistor fitted between the 'cold' end of TO9 and J15 (12V) *on the solder side.* Subsequent rigs presumably have a redesigned foil pattern and top-mounted R84s.

Thanks to Yaesu for a speedy reply to my query — hope this sets the record straight for other users of this excellent transceiver.

Sean Quinn, GI4 PCQ

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RADIO TODAY

New Licence Schedule for Radio Amateurs

The DTI, in conjunction with the RSGB, has introduced a new schedule to the licence. The new design for the technical supplement enables easy 'reading off' of frequencies 'A' and 'B' licensees are allowed to use, their status and the maximum power and the type of transmission permitted.

There are also two amendments to the licence: the first reflects the change in British Telecom. References to the General Manager of the British Telecom Telephone area are replaced by the Manager of the Radio Investigation Service district. The second change is — "Clause 1(2)e: this clause, relating to a prohibition of offensive or indecent messages, (Clause 1(2)(f) in the old licence) replaces the old Clause 1(2)(e) (referring to RTTY transmissions) which is now deleted". *(A good example for the Plain English Society?! Ed Asst).*

The formal takeover by the DTI of direct control of the RIS (Radio Interference Service) took place on the 7th August when it became the Radio Investigation Service. The job of its 260 staff in the field is to investigate interference of authorised radio and television broadcasts, land mobile radio and emergency services and, if possible, take action to stop it. The service traces illicit transmissions and prosecutes offenders and also inspects licensed stations to ensure compliance with licence conditions and tests controlled equipment.

The RIS is now a part of DTI's Radio Regulatory Division and will eventually operate from 37 offices in 29 districts. But at present the staff will continue to work from BT's regional offices.

With all this, CB and, of course, 55,000 + licensed amateurs to keep an eye on, it is surprising that the RIS, apparently, dealt with some 85,000 interference cases in 1982 and 65,000 in 1983. Illicit broadcast transmissions were traced on 97 occasions in 1983. 1532 prosecutions were concluded during 1983 for offences under the Wireless Telegraphy Acts, including 1470 against CB operators operating without a licence, or outside the terms of a licence, and 40 people involved in unlicensed broadcast activities.

SSTV With the Spectrum 48K

Scarab Systems recently announced a new program for the Sinclair Spectrum 48K computer to enable the reception of SSTV transmissions with your HF/VHF receiving equipment. This new decoder program will require *no* additional hardware. The user simply plugs their radio receiver into the Spectrum EAR socket once the program has been loaded into the computer and the decoded SSTV transmissions are displayed on your TV set, which has been plugged into the Spectrum.

The program exhibits a range of useful additional features which are too numerous to mention here. It will cost £15 inclusive. Contact Mr Axford on 0634 570441 for more details.

Rugged 2m Yagi From ARM

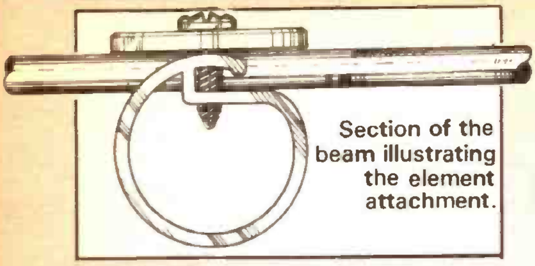
Bill Trezise, G6ZRM, from Paignton has recently set up a small business producing handmade 2m beam antennas. Bill, a mechanical engineer by profession, felt that although many of the commercial 2m Yagis being presently retailed gave excellent gain and directivity, their mechanical design could be improved on. Also, living on the coast, salt erosion and high winds proved a somewhat harsher environment for antennas than that of the average amateur.

Bill then formed ARM Antennas and designed several 2m Yagi type antennas with the idea of producing something with considerable mechanical strength and durability.

A few days ago a four foot box arrived on the Editors desk along with a sheet of instructions. The antenna is ARM's 7 element 'fish-tailed' model which has a claimed forward gain of around 11dB, a front-to-back ratio of 20dB, gamma matched driven element with PL259 PTFE socket for feeder connection and a five year warranty against faulty workmanship of component failure. The antenna has a Q section boom with milled grooves for antenna elements, which are fastened to the boom with self tapping screws via a pressure plate.

In order to test the ease of assembly of the antenna it was given to Julie, HRT's, new Editorial Assistant whom the Editor felt would be a good guinea pig as a fairly new G1 and thus prospective purchaser of a 2m antenna. She writes: "Coming in a long (4'6") box, this beam was handed to met with the comment that it was easily put together. At last, my first assembly project in radio! Borrowing the necessary Phillips screwdriver from ETI's Project

Julie, G1CKF, at 5'2", displays ARM's 2m beam and invents a new exercise — aerialobics!



Section of the beam illustrating the element attachment.

Editor, I set to work, by reading the instructions.

For an absolute beginner, such as myself, the instructions do not make an awful lot of sense. I can determine the order in which they are to be fitted, but to which end of the two pieces of the beam do I fit the longest element? After much deliberation I asked an experienced amateur, G3ZZD. A simple diagram of the whole antenna would have sufficed, but all that was available was a cross sectional diagram of the Q sectioned boom, explaining its unique features.

With the six elements centred and secure, I was faced with the remnants which the instructions explained was the Driven element and G3ZZD suggested was the 'fish tail'. Slightly bemused with the latter, which was left a passing member of 'Digital and Microelectronics' to assemble, I reread the instructions. The driven element is positioned with "face of gamma bracket which holds coax socket so that top face slopes forward towards centre of boom". Not knowing exactly what the gamma bracket was, it took some time to assemble.

The two halves of the antenna are easily slotted together and once inserted are secure because of the Q shape design of the tube. The system seems carefully engineered, the only slight difficulty was found in attaching the completed fish tail to the beams.

Very nice antenna Bill, shame about the instructions at present.

The antenna is available only from R Withers Communications, 584 Hagley Road West, Oldbury, Warley, B68 0BS and costs £32.95

Motorbikin', Motorbikin'

1984 marks the 30th anniversary of the Jawa CZ Owners' Club of Great Britain and Ireland. Paul Thompson, G6MEN, as a member of the club that caters for owners of the two Czech made bikes, wanted to mark the birthday by running a special event station, GB8JCZ, on the 17th, 18th, and 19th August. Originally having to have been motorcycle mobile at the Owners Club Rally in May, the callsign was reallocated because Paul's "trusty" bike unfortunately broke down on the way!

Instead, with the help of operators G1DFT, G6WZO and equipment from G6WZO, and G8XVV, went on the air from a fixed station in Southport. An "unashamedly black box affair" with "the name of the game. . . playing radio and talking motorbokes". Using 2m abd 70cm, GB8JCZ made 177 contacts in all, with many stations manned by active morotcyclists.

Thanks for help and advice go to the Jawa CZ Owners' Club, Ainsdale ARC and the RSGB.

Special event station, GB8 JCZ, in operation.

BARTG Spring VHF/UHF Contest Results

PD Adams, G6LZB, of BARTG reports: Once again, conditions during the contest did us no favours but, even so, a number of continental stations managed to work well into the UK. Although RTTY activity has increased sharply on VHF of late, the number of entries was less than last year, and there was very little activity on 70 and 23 cms and even fewer entries.

My current feeling is that until UHF RTTY becomes more popular that the contest be restricted to 2m only.

Operating on the whole was good but there was the perennial complaint from mechanical operators about the absence of the CR/LF sequence from some computer stations. When are they going to learn? Many people also complained about long CQ calls and endless RYs which seriously waste time. The following is an amalgum of advice and comments received about this subject:- call CQ in short one or two line bursts repeating your callsign as often as possible. Wait five seconds then do it again. The RY string is completely unnecessary as other stations will be able to tune you in on the CQ call. If they have not tuned you in by the time you have dropped carrier, they only have to wait five seconds for your next burst. Similarly when answering a CQ call repeat callsigns an appropriate number of times as a tuning aid rather than send the information-less RYs.

Certificate winners are as follows:-

2m: Single operator	1st G6CZV
	2nd GU6JST
Multi-operator	1st G4PDY/P
	2nd G3WOR/P
70cm: Single operator	1st G5MUR
	2nd NO OTHER ENTRIES.
Multi-operator	1st G3KUE/P
	2nd NO OTHER ENTRIES.
1296: NO ENTRIES RECEIVED.	
Short wave listeners	1st BRS 28198
	2nd NL 4483

Check logs are gratefully acknowledged from G6ZDD, and G8LWY.

AMTOR For Dragon Computer by G4 BMK

Grosvenor Software recently announced AMTOR facilities for the Dragon computers, as a "stand-alone" program not requiring an "AMT-1" or similar electronics. It is a superb full-feature system at around one third the total cost of current alternatives. For those already on RTTY, the savings are apparently much greater.

Most conventional RTTY terminal units, such as those by PNP Commas, B&J, or the ST5 (BARTG), the PAG (G3LIV), or MPTU1 etc can be used. In addition a crystal controlled 1 kHz clock is required, and for transmission a PTT switching interface. A suitable clock/PTT unit is available from PNP Communications (0273 5114465).

The G4BMK software supports all modes of AMTOR (FEC ARQ and Listen) with full type-ahead, plus the sophisticated memory and QSO review facilities already a part of G4BMK RTTY software. The program will also decode commercial TOR/SITOR transmissions, and the NAVTEXT weather report service on 518 kHz. For details of many other interesting transmissions which can be copied, consult a publication such as "Confidential Frequency List". The 6 program specification is as follows:

1) Modes: a) FEC — like RTTY but with far fewer errors. b) ARQ — full "handshaking" mode with automatic error detection and correction. c) Listen mode — monitor one side of an ARQ QSO.

2) Software selectable PTT change-over time — allows many transceivers to be used in ARQ mode without modification.

3) "Split-screen" operation with 2000 character type-ahead buffer. Compose your reply while receiving and continue type-ahead while transmitting. Automatic scrolling with no loss of incoming text.

4) Ten user memories of 480 characters each. Full-screen text editor built in. Memories can call up other memories and pre-programmed messages. Short amounts of text, eg name/callsign, can be put into memories while receiving with no loss of incoming text.

5) Pre-programmed messages including a CQ call with your callsign built in. (A change of call sign can be implemented for a small charge).

6) 24 hour clock always displayed on screen and transmittable.

7) QSO review facility. Up to 19000 characters of QSO are stored in memory for later review/selective printing.

8) MAILBOX facility with choice of single or multiple reply messages.

9) CW Identification. Class A licencees can send their callsign in Morse code to meet licence requirements of identification.

10) Selectable USOS (unshift on space) option for receive. The program always transmits the correct shift after spaces.

A cartridge giving AMTOR, RTTY and CW facilities costs £69.00 and the AMTOR clock/PTT unit by PNP Communications is available in PCB form for £18.70 or as a boxed unit for £26.16. Contact Grosvenor Software on 0323 893378 for further details.

MOT Tests for Transceivers

News recently reached the HRT offices of a MOT style test for amateur radio equipment. This 'test' run by R Withers Communications of Warley (021 421 8201) consists of a 19 point examination which includes spectrum analysis of transmitter output, and receive noise factor. On completion, a matching test sheet is completed by the test Engineer. The 'MOT' costs £12.50 and more information can be obtained from the above telephone number.

5 Bands with 4 Resonators Won't Go...

Glenstar Electric Motors have produced, what they describe as a "discrete looking" antennas for mobile HF operation. Called the 'Navy Special', it comes in two variations. The 'A' pack costs £29 and contains two resonators, these can be for separate bands or for the same band, and two whips to be cut to size for a quarter wave on the band you wish to use. The 'B' pack has four resonators and four whips and costs £49. Thus an aspiring radio amateur can work any of 5 bands, or parts of bands, eg. he could specify two 10 m resonators so as to cover both the FM and SSB ends of 10 m. The other bands available are 80m, 40m, 20m and 15m. As I have mentioned, it is not essential to specify different resonators; the flexibility with the ordering of resonators extends to specifying 2 or 4 *for the same band* — which will enable radio amateurs to club together to buy the packs (and have an individually tailored net!?)

The small size of the resonators and the ability to cut the whip to size ensures a neat and optimised antenna. Furthermore, after 3 years of development in which each stage was given to radio amateurs to test, Glenstar have had very favourable reports of contacts with every continent and very good operation around this country.

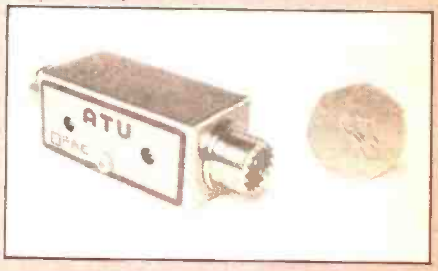
The cheapness of these antennas, especially if sharing the cost with friends, the apparent efficiency and compactness suggest a good buy. But first there is the Morse test... **G1CKF**

Preset ATU for 2m

Traditionally radio amateurs have relied on pruning the antenna to optimise the VSWR of 2 metre mobile antennas *(and rightly so — Ed.)*. Now, Davtrend Ltd of Gosport, have come up with a new solution — the Drae preset antenna tuning unit which, when placed between antenna and transceiver, is claimed to "give optimum performance for any given situation".

The 30 Watt rated, 50 ohm unit can be obtained for £11.80 including VAT. Insertion loss is quoted as 0.2dB at 145 MHz, measured in a 50 ohm system. The circuitry is a pi-network configuration.

The Drae Preset ATU, slightly larger than a 50p coin.



Scouse Special Event

Listen out for the Merseyside Special Event throughout December. The group comprises of 11 amateurs — G4VKV, G4HSK, G4OJK, G4KIN, G4YPD, G4UVB, G4SYW, G6PZW, G1DFW, G6NOO and G6ICR who will attempt to work from 00.00 1st December to 24.00 31st December. Using the special event call sign block GBO 1,2,3,6 and 8BCL, to celebrate the opening of the Beatle City Museum, the group will operate on all HF bands (pre WARC) ie bands 80m, 40m, 20m, 15m and 10m, along with VHF bands 2m and 70cm using *all* modes.

Send for QSL information direct to the QSL Manager, c/o Beatle City, PO Box 12, Liverpool, enclosing an sae if in the UK, in Europe 2 International Reply Coupons (IRC) or if DX 3 IRCs or US$1. All verifyable QSOs and listener reports will be acknowledged with a special QSL card depicting the Beatle City Museum and the Special Event Station. (Probably a future collectors item!).

The ALPHA Transceiver

Part 3

In the third part, Tony Bailey, G3WPO, and Frank Ogden, G4JST, describe the construction of the PA and a suitable case.

Alignment

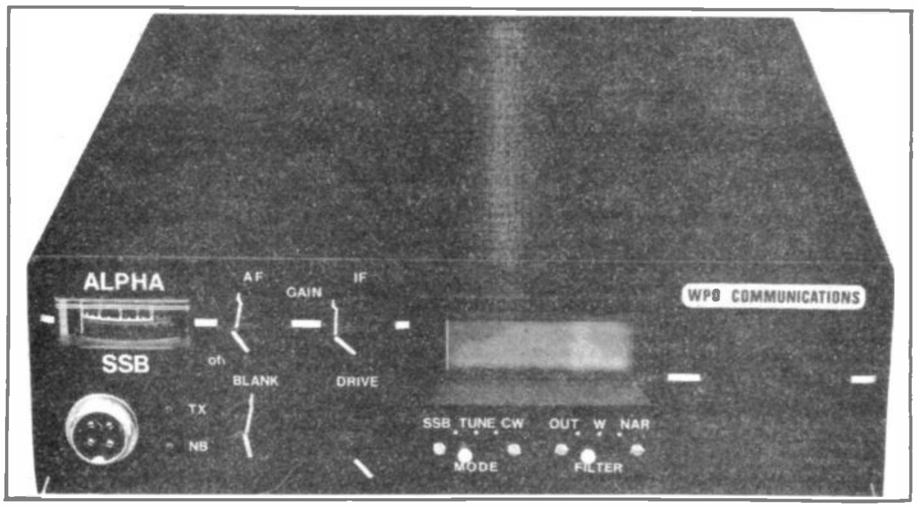
The microphone amplifier is checked first, and a 600 ohm microphone should be connected between point N and earth ( ). A higher impedance mic will result in a very poor audio response.
1. Turn RV4 ( ), RV6 ( ) and RV9 ( ) to the earthy end of their travels. Apply power and switch to transmit (earth point W). An AC voltmeter (multimeter on AC 1 or 5V range) connected across RV3 should show a reading of *about* 0.4V when the microphone is whistled into ( ). Adjusting RV9 away from the earthy end should reduce the reading ( ). If you have a scope available, and a signal generator, a 1kHz signal injected into point N can be used to monitor the waveform across RV3. RV9 should be set so that the crest of the waveform just starts to clip. Otherwise leave RV9 at its earthy end until later.
2. Remove power. Connect in VR3 (drive) and turn it fully clockwise (non-earthy end) ( ). Connect an ammeter (multimeter on 1A range) in series with the +12 — 14V supply ( ). Also connect a power meter, or SWR bridge, via a short length of 50 ohm coaxial cable between the junction of C80/L4 and earth ( ). Then ensure RV6 is at the earthy end of its travel ( ).
3. Reapply power — monitoring the ammeter carefully adjust RV6 until the total current taken has increased by 200mA to set the standing current of the driver stages.
4. Now whistle into the mic (drive at max) — you should get a reading on the power meter showing that power is coming from the drivers ( ). Due to the severe mismatch it will be low (under 1W). As long as power shows, it is assumed the drivers are working OK. Finally adjust IFT9 for maximum output while whistling ( ) (this transformer is very flat tuning).

PA Stage

The power amplifier stage is next to be built and tested, first the PCB part.
1. Insert and solder C87 ( ) & C88 ( ). Then wind and insert L5 ( ) and L6 ( ). These coils are only used on 160m — on 20m wire links are soldered between the appropriate holes ( ). For 160m, each is 5 turns (use 14cm of wire) ( ).
2. Insert and solder C89 ( ) and C90 ( ). wind and insert L7 ( ). For 20m, the ten turns require 27cm of wire, and for 160m, 25 turns needs 56cm of wire. When mounting the coil, turn so that it is parallel with C89.
3. Next wind insert T7 ( ). This is a trifilar wound transformer with three sets of wires used, twisted together. Take three lengths of 0.8mm wire each 40cm long. You will now need to identify each end so that you know what's what after winding! Either very carefully make nicks at the ends of each wire, so that they are numbered 1 & 2, 3 & 4, and 5 & 6, as pairs, or use small spots of paint, or even paper tags.

Clamp the ends as you did with T6, ensuring that numbers 1, 3 & 5 are at one end, and wind to about three turns per inch. Remove from the clamps and wind 6 turns through two of the grey cores held on top of each other, leaving about 3cm of wire protruding when you start. Separate the wires, and then join them up temporarily so that the no.s 6 & 3 and 1 & 4 are paired, and 2 & 5 left single. Try to get them in the same orientation as the layout drawing, then without changing their relative positions strip the insulation and tin them before soldering into place. If you have wound this type of transformer before, then you probably don't need these instructions, if not then it's easier to do than describe.

Note that the circuit diagram and the layout don't quite agree in the way the transformer is numbered — points 1 & 4 and 5 are interchanged on the PCB, but this makes no difference to the operation as T7 is symmetrical at this point.
4. Insert and solder C83 ( ). For 20m this is a 500pF mica compression trimmer soldered to the two connection pins adjacent to T7. For 20m, a 4700pF mica capacitor is soldered in the holes to the right of the pins, which are then unused.

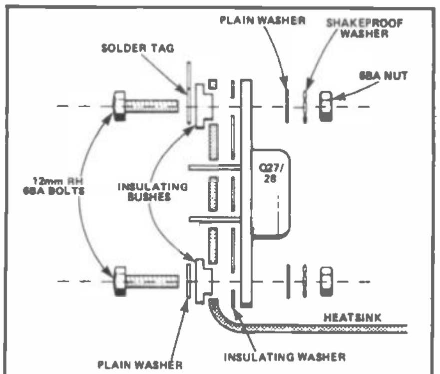


Remote PA Stage

The PA devices and a few associated components are mounted remotely at the end of transmission lines on the heatsink. For the case to be described later, the heat sink consists of a sheet of aluminium which mounts against the underside of the lid, with the devices mounted on a strip at right angles to main sheet. You could of course use any type of heatsink suitable for the purpose — it should be about 2 degrees C/watt or better, mounting the devices in a similar fashion.

The drawings show how the two transistors are mounted, so that the headers are on the inside face of the heatsink. Both sides of the insulating washer should be slightly smeared with suitable compound or Vaseline ( ). Again, the FET's used have *unprotected* gates, so avoid touching them while mounting. Then connect the two sources to the earthed solder tag between them, using as short a length of heavy gauge wire as possible ( ).

Next the transmission lines are wound. Each of the four required is simply made from two lengths (35cm each) of *PTFE covered* wire, twisted to 2 turns per cm (or 5 turns per inch), in a similar fashion to the windings for T6. When you have wound them, reduce each to a total length of 28cm, then

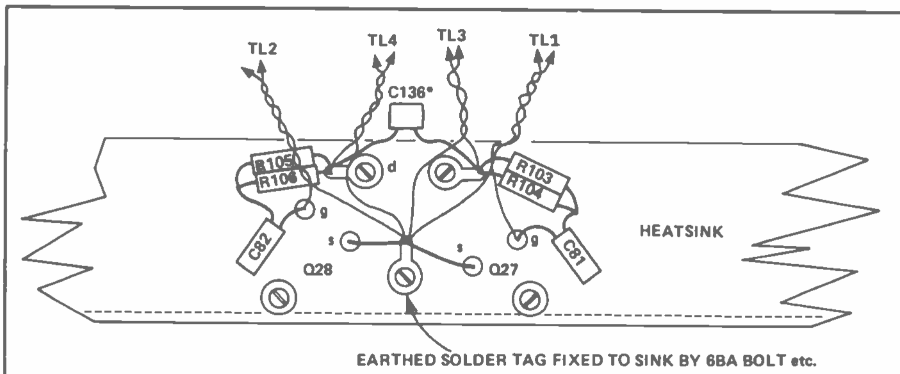


Layout of the PA circuitry

strip (use a knife) 5mm of insulation off each wire ( ).

Now connect TL1 and TL2 to the PCB as indicated (one lead to the top foil where shown). Then use the multimeter to find out which lead at the other end is earthed and solder this on each line to the earthed solder tag on the heat sink ( ). Then solder the remaining lead to the two PA devices, ensuring that TL1 is connected to Q27 ( ). This technique should ensure that the gates are not damaged as there is an earth return via the transmission line through the bias presets. Repeat the operation with TL3 & TL4, connecting the non-earthed leads to the solder tags on the drains of the two devices ( ).

Then connect in the resistor pairs and capacitor between the gate and



Mounting the PA transistors

drain (you can now touch these without problems) of each device — the junctions are left free in the air, using as short connections as possible ( ). Finally, for 20m only, connect C136 ( ) across the two drain tags, with short leads.

Alignment

1. Make sure RV7 and RV8 are at the earthy ends of their travel ( ), RV5 is at mid travel ( ), and VR3 (drive) is at the earthy end ( ). Connect a length of coax between point Y and earth, and to a dummy load via a power meter or SWR bridge ( ).
2. Still with an ammeter (1A) in series with the +12V supply , apply power, monitor the total current consumption and adjust RV7 for an increase of 200mA( ). Then adjust RV8 for a further increase of 200mA ( ) (thus setting each output transistor to 200mA standing current).
3. If your ammeter is capable of reading 10A then leave it in circuit, or change range. You should really have some means of monitoring the total current taken from now on, or, if you have it, set the current limiting on your PSU to 11A.
4. Turn RV3 fully clockwise and measure the output power with a sustained whistle into the microphone. You should achieve an absolute minimum of 45W peak, with 50 — 55W as more likely, providing all the preceding alignment has been carried out correctly ( ). The total current taken should be around 9 amps — *it should not exceed 11A at an absolute maximum*. On 20m only, peak C83 for maximum output (very flat tuning) at mid-band.
5. With no input to the microphone, and the power meter on a very low power range, adjust RV5 carefully for minimum power output — this sets the carrier balance for minimum output ( ).
6. Adjust RV9 to mid-position ( ), then reduce the setting of RV3 so that maximum power output is *just* obtained when the drive (VR3) control is fully clockwise ( ). This then prevents you overdriving the PA stages when you shout into the microphone. Also, adjust RV10 so that the Tx output power meter reads just full scale at maximum output ( ).
7. The last adjustment to the audio is to set RV9 for best compromise between clean audio and the amount of processing — this can be done over the air, or for those with test equipment, by using a 1kHz tone and scope and adjusting so that the envelope is just flattening. You can, of course, use a two-tone generator and scope for the PA setting-up if you have them.

Note: Unless the heat sink is modified for greater power dissipation, the PA should ***not*** be run for any length of time at full continuous output. Under normal operating conditions for SSB and CW it is perfectly adequate.

CW

The CW connections can now be checked and set up. Using audio screened cable, interconnect points AE and AD, and also point AC, to the slider of the volume control pot, with all braids connected to earth ( ). Set RV11 and RV4 near their 'earthy' ends ( ). Detach the microphone connection — earthing point AB should produce a tone on transmit through the speaker — the volume can be set using RV11 ( ). While keying point AB continuously to earth, set RV4 so that the transmitter strip is just delivering maximum power output with the drive at maximum ( ).

All Working

This completes alignment of ALPHA. When built into the case, a small three-position slide switch controls the SSB/CW/TUNE functions. On Tune, the tone is introduced and the transmitter switched on, with this position used for setting up ATUs etc. (The drive control should be used to reduce the output power to the minimum necessary for this operation, both to reduce the PA dissipation, and to avoid inconveniencing other users of the band). On CW, the microphone input is disconnected and the input to the mic amp earthed. Note that the order for the switch is SSB/CW/TUNE, not as shown on the front panel illustrated — the order was changed to avoid switching to transmit between SSB and CW!

The Case

As we mentioned in Part One, ALPHA has a custom designed case which is available ready made, punched, painted and screened, constructed from 16 swg steel. This gives a very robust enclosure suitable for mobile use. Alternatively, you can of course manufacture your own version if you have the facilities. It can be made from steel or aluminium, the latter being much easier to work than steel, especially when shaping the larger apertures in the front panel. There isn't any need to stick to the design given if you don't like it — the only critical thing is that the VFO capacitor is close to its connection points on the PCB. The drives used can be replaced with anything you have that is suitable.

Construction

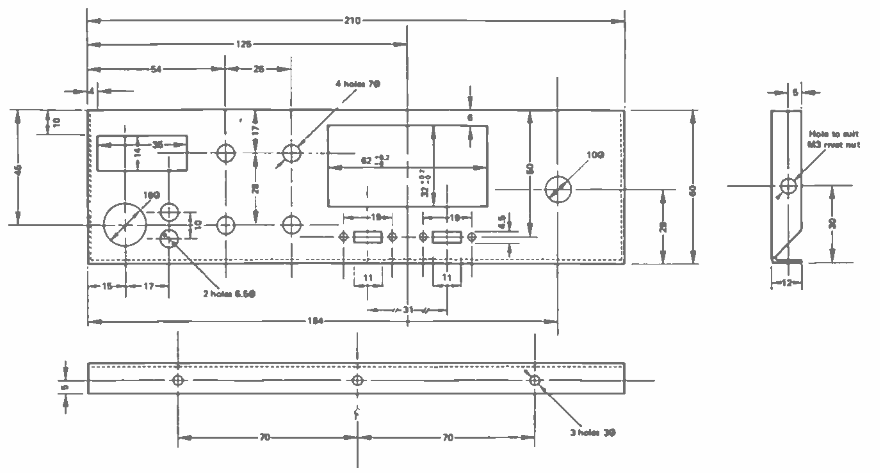
The case consists of four parts — the chassis and back panel in one piece, front panel, lid, and internal heat sink. Plus a mobile mounting bracket, if needed, which comes with the commercial case.

The drawings given are slightly modified for this article as the original uses welded stud bolts for mounting the board and other items, plus welded brackets for the slow motion drives, and it is assumed that the average constructor won't have facilities for these.

There is sufficient detail in the drawings to reproduce the case exactly, providing you are familiar with bending allowances etc. If not, the overall dimensions can be used to get very close. Most people have their own techniques for bending metal (!) and will end up with a close match. The flanges used around the base and front panel are there for mechanical stability, especially when mobile, and should be used if possible. Alternatively, separate angle strips can be made from aluminium, or ready made aluminium angle is available from most stockists.

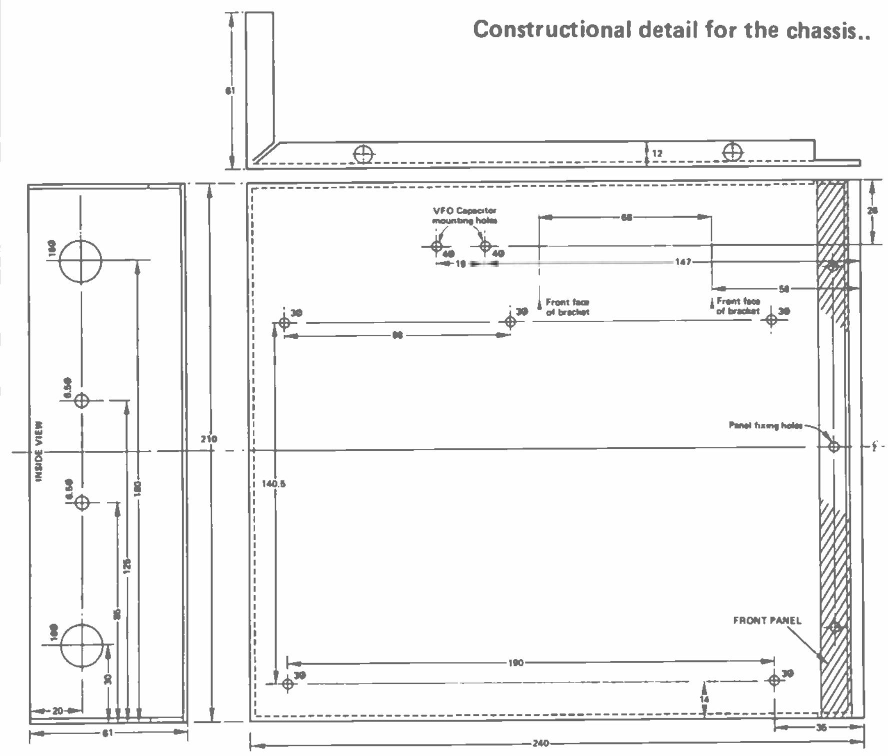
Not shown in the drawings are ventilation slots which have been provided on the base and rear panel. When used in a car on a hot day, the interior of the case can get very hot so some access and exit for air is needed. We have used a row of 25 x 3mm slots just under the front of the PCB, and some more on the rear panel to the side of the power input socket and antenna socket. You could use a rectangular cut-out covered with fine wire mesh to prevent unwanted objects getting inside the case.

Front Panel



Constructional detail for the front panel

Constructional detail for the chassis..



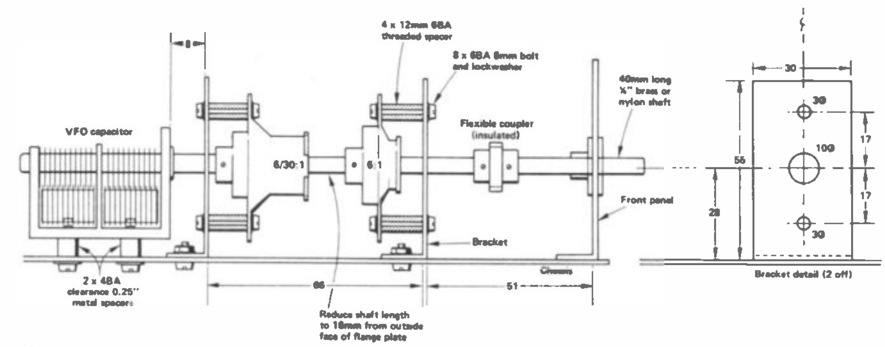
The panel layout is not critical, although if you move it round you should make sure that the various controls do not foul the PCB. As given, the most critical dimension when making the panel is that the drive shaft appears centrally in the panel hole. In addition, a flexible coupler (Jackson Bros) is used between the drive shaft and the spindle coming out of the panel, together with a ¼" brass brush in the panel itself. This ensures that any eccentricity or misalignment is not passed onto the drives and variable capacitor.

Details of the drives and their mountings are given in the drawings. It is important that the 6:1 drive is at the *front* — if they are reversed the torque needed to turn the dual drive when it is at 6:1 is very high and uncomfortable to use. As it stands, there are about 5.5 turns of the tuning knob at a very slow rate (180:1) and then reverts to fast tuning 36:1. The drives are supported by two brackets, which will have to be bolted to the base panel by 6BA hardware. Again, when you make these be certain that the drives are exactly aligned with the front panel hole.

The VFO capacitor itself is mounted on two ¼" long 4BA clearance spacers using 4BA bolts through from the underside. These must be the right length to just screw home into the base of the capacitor — if they are too long, they will hit the vanes and irrepairably damage the capacitor. If the capacitor is not quite at the right height to align with the rear drives' socket, packing washers can be used to get exact alignment.

Neither the meter or the frequency display module have any direct facilities provided for mounting to the front panel apertures. The meter is fixed in place using suitable adhesive on its rear faces. The display bezel should be fixed in place by a similar method, and then the actual display module is glued inside the rear of this. If you can get the aperture the right size, the bezel will stay in place with an interference fit.

The two holes for the LEDs are sized for two RS black nickel types. Other LED indicators will require an appropriate size hole drilled.



Mounting of the VFO capacitor and drives

Rear Panel

This accommodates the Power Input socket (two pin Yaesu type) and is wired to match a standard Yaesu mobile power lead (although rumour has it that Yaesu are now using another connector!). The connections are positive to pin 2 and negative to pin 1 (numbers are stamped on plugs and sockets). These sockets and the matching plugs are available from most retailers. A 0.1uF disc ceramic capacitor should be wired directly across the socket, with the negative lead going directly to the PCB nearby using heavy gauge wire.

The antenna socket is a standard SO239, with an earthing point nearby (6BA bolt/tag) for sockets which don't come with solder tags. The other two sockets are for an external speaker, and the key input (3.5mm jacks).

Cover

The speaker is fixed to the underside of the lid (3" 8ohm used in the prototypes) by three bolts at 120 degree intervals close to the edges of the speaker. Solder tags can then be mounted on these, and when tightened up will hold the speaker securely. The tags can be carefully soldered to the edges of the speaker surround if desired. For the home constructor this method will result in the tops of the bolts being visible on the lid (the commercial case uses internally welded studs). One way round this would be to use countersunk bolts such that the tops of the bolts are just below the surface of the metal. Then fill the recesses with one of the 'plastic metals' available, sand flat and paint over when finishing the case.

The same applies to the two mounting bolts for the optional filter in the lid underside (20mm long 6BA required). These latter two bolts and the remainder of the bolts on the lid are also used for bolting the heatsink flat against the lid underside, with some heat sink compound, or Vaseline, smeared between them. The large clearance holes shown in the heatsink, through which these bolts pass are to clear the bases of the weld studs we use. If you are using bolts, they need only be of sufficient size to clear the bolt threads.

The speaker aperture can either be a series of small holes drilled or punched in the lid above the cone, or a larger hole with suitable covering, such as wire mesh, or a speaker grill.

Mobile Bracket

A simple bracket for mounting ALPHA in a car is shown — this screws into hank bushes fitted on each side of the lid, and is adjustable for angle — it can be mounted either above the lid or below the base depending on application.

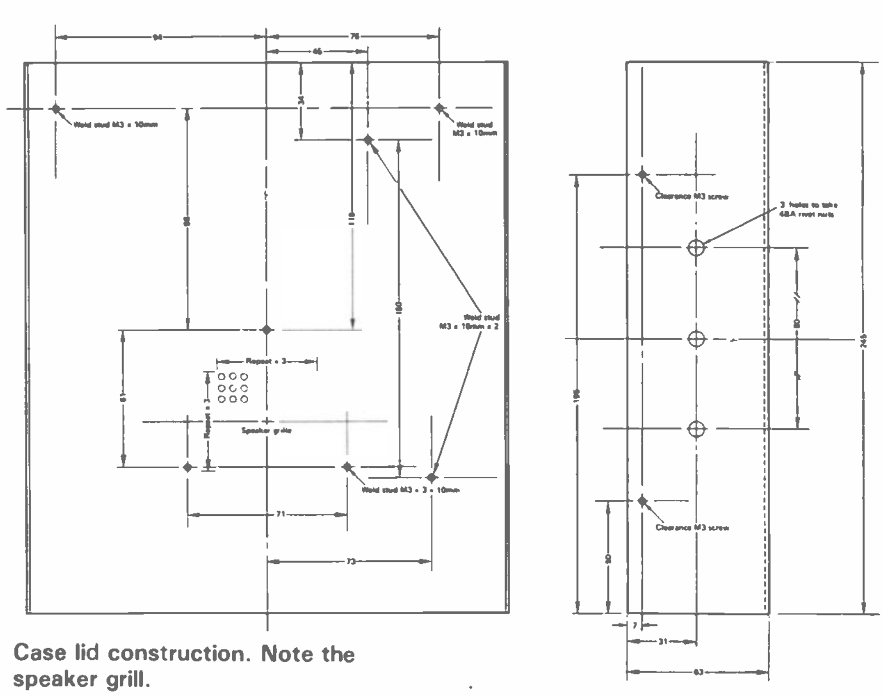
Finishing The Case

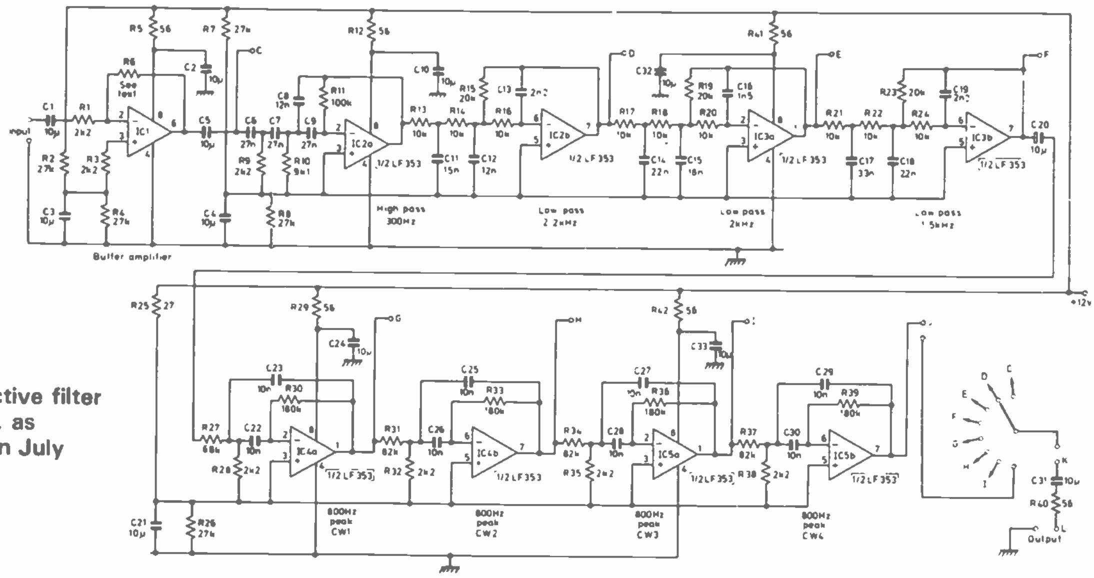
When you have made the case and ensured that everything fits, it should be primed — aluminium will require a chromate based etching type, and the two-part ones available from marine stockists are best for this. It can then be finished in cellulose paint in whatever colour is preferred. Frank thinks that the modern-trend is for bright colours but Tony is not too keen on bright red for a mobile rig. . . .

Getting It All In

The PCB should first be installed into the chassis base. With the commercial case, each of the five supports has two 3mm full nuts screwed onto it acting as spacers, with the PCB sitting on top. This is then secured in place with a lock washer and further nut. A similar method would be used for the home brew case, using 6BA bolts and spacing nuts.

All the front panel controls and switches/LEDs are then mounted in place, together with the meter and display (it will help if the display is wired up with flying leads prior to mounting). The spindles on the four potentiometers will need to be shortened to about 8mm in length beforehand. Note that Alps controls have 6mm spindles — not ¼" — therefore standard knobs will be eccentric on these pots. Collett types are best as they fit either ¼" or 6mm shafts.


Case lid construction. Note the speaker grill.



Optional active filter for ALPHA, as described in July '83 HRT

Populate the rear panel and you are ready to start wiring up. The wiring diagram was given in Part Two. You should follow a logical pattern when doing the wiring — start with the receive side (Power/AF speaker etc) and check that this all works, then go to the transmit side and do this in stages. Don't forget the capacitor across the mic input socket. When connecting up the variable capacitor, use stiff wire for the two leads to the PCB but don't connect a direct earth between the capacitor itself and the PCB — the earth return is made via the metal spacers and the chassis itself. For this reason, any paint on the chassis contact side should be cleared off first to ensure a good electrical connection.

Needless to say, the wiring should be as direct as possible, and can be loomed afterwards for neatness. All AF carrying connections must be made in screened audio cable, earthed at both ends to avoid instability problems. The external speaker jack is wired to interrupt the internal speaker connection when the jack is inserted. There is one diode which is mounted off the PCB — D35 is fitted into the lead while wiring.

The transmission lines which connect the PCB to the PA stage should be coiled up between the flange on the heatsink and the inside of the lid before putting the lid on the case, rather than left lying around inside the case over the PCB — mounted components.

Using ALPHA

The rig will give a good account of itself as either a fixed or mobile station. At home, a good quality PSU will be needed capable of supplying at least 10A without the output voltage sagging. A 13.8V supply is preferred. External fusing is a must, and a suitable fuse should be inserted in the power line to the rig. When mobile, the normal precautions should be observed for such an installation — use heavy cable for the power lines, efficient earthing to the car chassis, and install the antenna as far away from the ignition system as possible! Interference at HF is likely to be more of a problem that at VHF, and if troublesome, there are plenty of articles around which will tell you how to go about reducing it.

Antennas

Like any solid state rig, ALPHA requires a 50 ohm matched antenna system. This applies whether used fixed or mobile, and for most antennas, this will mean the use of an antenna matching unit, and SWR bridge. If used into a poorly matched aerial, the dissipation of the PA stage can become excessive and possible damage may result, besides a loss in output power.

Active Filter

For those who require additional selectivity for CW use (or SSB) ALPHA has provision for an optional active filter to be installed. This is the same design as used in Project OMEGA, and was published in the July 1983 issue of HRT. It takes the form of a multi-pole design using op-amps with 9 positions of selectivity available. In this application, the front panel switch allows the use of two of these selectivity positions (or three if the OUT position is used as well). The best way to decide which to use is to build the filter, then decide on-the-air which positions suit you, then wire accordingly. The circuit for the filter is given here, with the parts list coming next month. The kits come with a copy of the original article, or a photocopy can be obtained from the photocopy service of Argus Specialist Publications at the address in the front of the magazine, for £1.50 inc.

The installation of the filter will be covered in the final short part of this series next month along with a summary of the corrections.

Components Listing (Case)

1 off SO239 single hole sockets
2 off 3.5mm jack sockets
1 off Jackson Slow Motion drive 6:1 4511/DAF
1 off Jackson Slow Motion drive 6/30/:1 4511/DRF
1 off Jackson flexible coupler
1 off 0.25" panel mount spindle bush
1 off 40mm length brass or nylon 0.25" rod
1 off 4 pin mic socket (Yaesu type)
1 off 2 pin power socket (Yaesu type)
2 off RS 3 way slide switch No 337-481
1 off 0.25" collett fix tuning knob
4 off 15mm dia collett fix 6mm spindle knobs
4 off 12mm 6 BA tapped spacers
Assorted 6 BA bolts, nuts and lockwashers
1 off Black recessed mount LED red RS 588-134
1 off Black recessed mount LED amber RS 558-184

Kits

Kits of parts for this project are be available from WPO COMMUNICATIONS. Options available, for either the 160m or 20m version will be a complete PCB KIT, will all board mounted components, PCB, VFO capacitor, pots, wire and drilled heat sink for the PA, priced at £149.50 or a COMPLETE KIT with case (ready punched, painted and screened) plus mobile mounting bracket, and all switches, speaker, hardware etc (leaving only a microphone, key and PSU required) priced at £199.50 (all inclusive VAT & Post).

Printed circuit boards alone (drilled and tinned) are priced at £22.45 inc.

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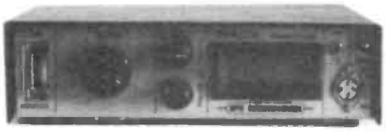

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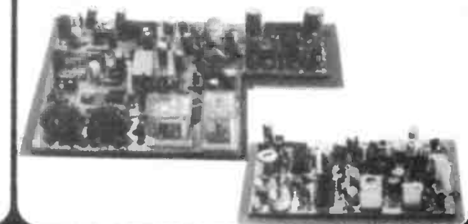
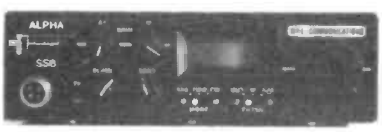


ALPHA — SINGLE BAND SSB/CW 50W TRANSCEIVER KIT

160m or 20m



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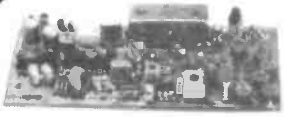

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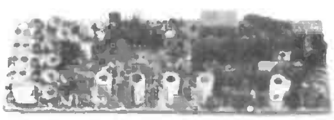

VFO KITS

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75ohm Twin Feeder — Light duty per metre	0.16	(0.04)
300 ohm Twin Feeder — per metre	0.14	(0.04)
UR67 Low loss coax 50 ohm per metre	0.65	(0.20)
UR76 50 ohm coax per metre	0.25	(0.05)
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The MAGIC CHIP

Ken Michaelson, G3RDG, reviews a software addition to the BBC 'B' computer to enable AMTOR operation with the ICS AMT-1.

In my recent article in HRT I discussed AMTOR, and tried to give you a general picture of its operation. The next step is, of course, to get working in the Mode. I have said that I use AMT-1 from ICS Electronics, and it is this same firm who offer a plug-in EPROM for the BBC computer which, in my view, completes the setup.

The EPROM program was written by the same Peter Harris, G3WHO, who produced that excellent program for RTTY, on which I commented some time ago. This also has a split screen, type ahead facilities, six 255 character memories and 2 'scratchpad' memories of 12 characters each. There are 9 keyboard characters each of which cause a different operation to take place; for example when '/' is pressed, your Selcall is transmitted. All these operations are fully described in the Owner's Manual.

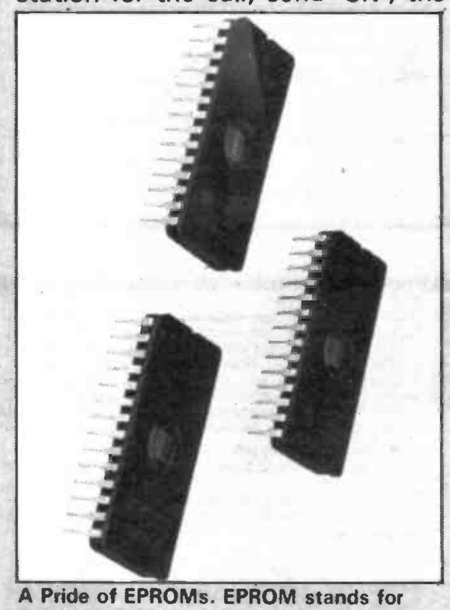
EPROM Functions

After the insertion of the EPROM, (to be done very carefully!), the program is accessed by typing ' ∗AMT' and RETURN. Immediately, your callsign is requested, then your SELCALL and then the time. At this stage any previously saved messages can be loaded. Access is also available to the disc catalogue or to program any of the FUNCTION keys with new information by using the ' ∗' command. I use the left hand arrow cursor control to send the time and the date by typing ' ∗KEY 12 TIME — UTC 01 SEP 84' and pressing RETURN. So that whenever the left hand arrow key is pressed both time and date are sent.

Pressing the spacebar brings on the second menu, where options of AMTOR, RTTY, CW or MAILBOX are available. Pressing 'Q' at this stage shows the current state of the AMT-1 in terms of CW speed, phasing timeout, Selcall insertion etc. It is also possible to vary the speed of sending CW from 00 to 99 words per minute. This is done by typing 'S' followed by the desired speed in words per minute. The varying of the speed of received CW is achieved by 'CNTRL F2' for upwards and CNTRL F3 for downwards.

Any Messages?

The MAILBOX option is only available if a disc drive or printer is attached, and if this option is selected, that station will be activated by someone calling you, using your Selcall. It will acknowledge the call and ask for the message to be transmitted. After which it will thank the other station for the call, send 'SK', the CW ident and revert to 'Standby'. If the other station's call is not received correctly, the program will send 'QRZ' to get a second transmission of the callsign.



A Pride of EPROMs. EPROM stands for Erasable Programable Read Only Memory — the window visible in the upper surface allows erasure by exposure to ultra violet light.

The upper half of the screen is used for incoming information, and the lower half for typing messages to be sent. There is a flashing cursor which moves to the right as the information you have typed is sent to the buffer. Characters can be deleted up to the cursor by the use of the 'Delete' key but if they have been sent to the buffer they cannot be altered. The lower half of the screen can be cleared by pressing the 'Copy' key, and an interesting option is available here. By pressing 'Shift' and 'F5' the cursor can be homed onto the beginning of the message, thus you only type 'CQ etc' once, and each time you send it, you 'home' the cursor and send it again. A great time saver.

Conclusions

I have used this EPROM for some considerable time now, operating almost every day, and the more I use it, the more I am impressed by its capabilities. When using this EPROM with the AMT-1 and the BBC computer there is nothing more that one can ask for, in my opinion, in the way of keyboard communication. AMTOR, RTTY and CW are available with as many options as the most critical operator could wish for, and added to that, should you possess a printer or disc drive, there is the MAILBOX facility. It comes with a fully descriptive manual, and a Function Key overlay is provided as a memory prompt. It is, in my view, value for money for those of you who want the best. The cost is £55 including VAT plus £1.00 postage and packing, and it can be obtained from ICS Electronics Ltd., PO Box 2, Arundel, West Sussex, BN18 0NX to whom acknowledgement is made.

Metre wave

Jack Hum, G5UM, gives an insight into the VHF/UHF bandplanning of today and explains how these 'megacyclic signposts' came to be.

By the time this piece appears in print in the Autumn of 1984, several thousand people within these islands will be enjoying their own special Springtime of amateur radio by having achieved a pass in-the Radio Amateurs' Examination and having obtained the coveted call sign. It must be conceded that to many hundreds of others who did not pass the RAE, the present time maybe seen as a winter of discontent, yet at least with the ray of light on the horizon that the examination maybe taken once again with the hope of "better luck next time".

Always in the minds of those who receive the RAE pass slip, an important decision looms: whether to go for the Class B licence or to apply for the Class A in spite of possible trepidation about essaying the morse test.

If past figures of licence take-up are anything to go by, almost certainly a preponderance of intending licensees will opt for the Class B ticket, not solely because the morse test is to be avoided but, also, because "...it's what we've been used to". In other words, very many new recruits to amateur radio will be coming to it after some experience of Citizens' Band operation and therefore some experience, albeit limited, of speech communication procedures. Real pleasure will come from being able to converse with one's friends on 145MHz very much as one did on 27MHz.

But there the resemblance and the comparison must end. On Citizens' Band there was not a great deal to remember: there were well known channels that could be settled upon almost as easily and simply as dialling a telephone. By contrast, new Class B Stations soon discover that in the 144 to 146MHz amateur allocation there is a great deal to remember, in what is a highly organised part of the radio spectrum. It is fortunate that 'megacyclic signposts' exist to help those who use the metre-waves to do so to best effect. These signpost indicate to the VHF/UHF person what happens and where.

Planning By Geography

Before we take a closer look at those signposts, let us indulge ourselves in a few paragraphs of retrospect on the genesis of band-planning in the VHF/UHF spectrum in the UK. A passing hint about "how things used to be" was dropped here last November in the article about the UK repeater scene. You may recall the phrase "...the planning of the metre waves geographically was on its way out. Planning by mode was on its way in". The words were used in the context of the repeater revolution of the early Seventies and the great swing away from amplitude modulation to the FM which dominates the VHF/UHF bands today.

What, then, of planning by geography? Historically, the concept emerged (from the fertile brain of the late G6FO) when Britain's hams after the war found themselves blessed with an allocation at 2m of no less than one megacycle wide (remember, it was still "cycles" in those days: "hertzes" came in later). Only on the 10m band was there anything like this huge availability of frequencies. Yes, the 2m band was in-

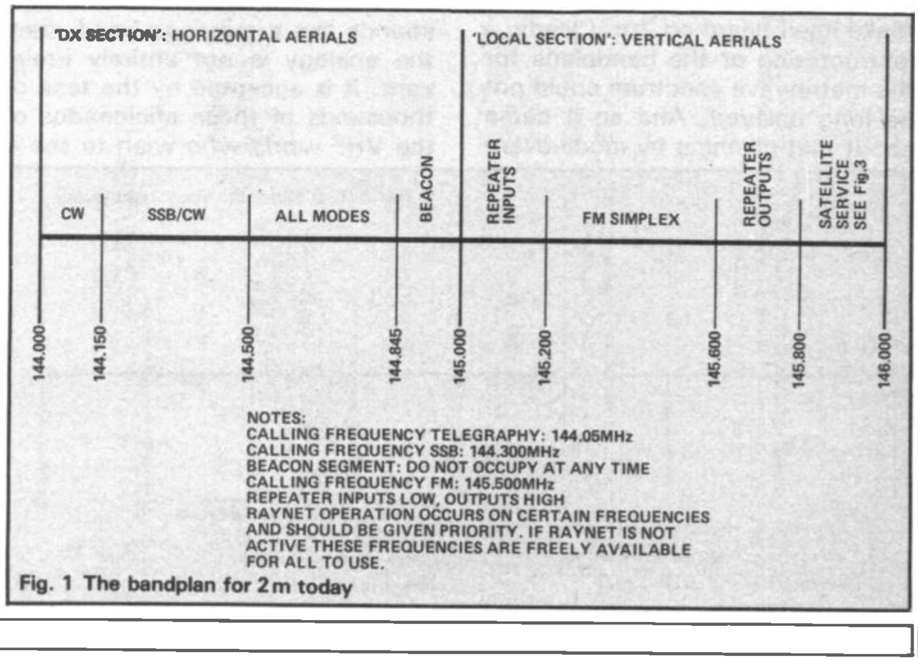


Fig. 1 The bandplan for 2m today

itially only "one meg" wide; not until later was it extended to the 144 to 146MHz allocation enjoyed today.

The suggestion was that operators in the south should transmit only in one part of 2m, operators in the north in another part, and operators in the west in yet a third part. If you wished to work a man in Wigan, you needed only to turn your beam in his direction and tune *only* that slice of the band where you knew he would be transmitting. If you wanted to work a man in Worcester, you tuned only the westerly segment. Out of the window went that phrase "Tuning the entire band for any possible call"—soon bowdlerised into "Any impossible call", and true indeed in those years when occupancy of 2m was low.

Planning by region, then, worked exceedingly well both on 2m and 70cm. Not only would the band user know where to expect signals from north, south, east or west: he would enjoy the further advantage of knowing where to point his beam aerial. And everybody at VHF used a beam. To use omni radiators was looked upon as wasteful of hard won RF, and this is still true today, one might add. Horizontal beams were the norm.

Planning By Mode

The repeater/mobile/FM revolution compelled a re-think of the then existing bandplan structure. There was another factor: a thing called single sideband was beginning to make itself heard on 2m. Clearly, a restructuring of the bandplans for the metrewave spectrum could not be long delayed. And so it came about that planning by mode eventually replaced the well tried planning by geography. But which modes should go where?

Because the 'new' repeaters were to go into the upper 1MHz of the 2m band, and because their primary users would be FM mobiles, it seemed logical to plan this "upper meg" as (virtually) the local communication part of the band, and to suggest that the "lower meg" should in effect be the DX part of it.

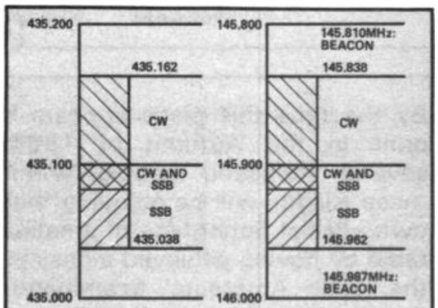
This line of thought dictated the aerial polarization to be used: vertical for the 145 to 146MHz area and horizontal for 144 to 145MHz.

Thus emerged the metrewave bandplan of today. For a while it was accompanied by a mild aberration in the minds of some operators that, because FM at the top end of "Two" was predominantly radiated in the vertical plane, it should remain that way if you effected a QSY into the bottom end of "Two". It took a long time to eradicate the belief that "FM means vertical"; in fact, it still exists in some quarters today, but many decibels down now that it has become clear to all (well, nearly all) that aerials are *not* mode conscious! There is nothing new in so-called "horizontal FM". As has already been remarked a few paragraphs earlier, there was a time when "horizontialis" was the norm.

An Ordered World

Planning by mode, now many years old, is a voluntary agreement freely entered into — and if this sounds like a marriage bond, then the analogy is not entirely irrelevant. It is accepted by the tens of thousands of those aficionados of the VHF world who wish to see it as an *ordered* world rather than an untidy and disorderly one.

Nevertheless, there is at anytime a small corpus of new licensees who come to amateur radio with little knowledge of what makes bandplans tick or maybe no knowledge at all of their existence. As he (or increasingly these days, she) surveys the ordered scene of 2m the question asserts itself:



NOTES:
TELEGRAPHY INPUT 'GOES IN HIGH' AT 70cm AND COMES OUT LOW AT 2m.

SINGLE SIDEBAND INPUT 'GOES IN LOW' AT 70cm AND COMES OUT HIGH AT 2m.

THE DIAGRAM SHOWS THE RELATIONSHIP OF THE 435MHz INPUT BAND TO THE 145MHz OUTPUT BAND WHEN OSCAR 10 IS ACTIVATED.

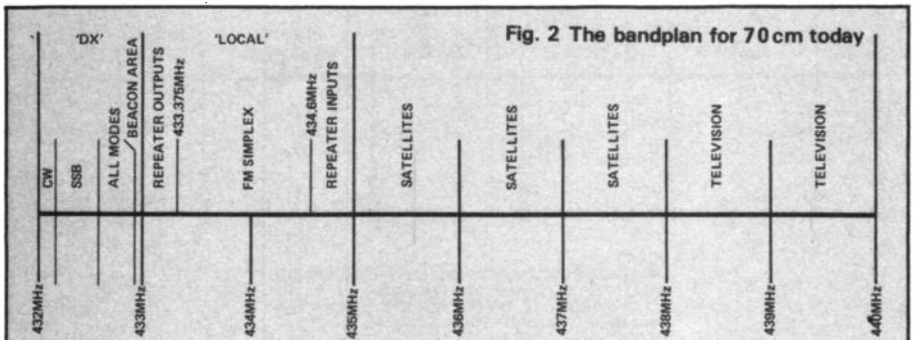
Fig. 3 The bandplan for satellite communication (ie Oscar 10) on 2m and 70cm

"Why wasn't I told anything about this in the RAE course?". Some RAE instructors, anticipating this question, *may* go to the trouble to tell their charges what to expect. The national society, too, has been active in seeking means by which bandplan information may be imparted to the intending licence holder before he or she attempts that first foray on to the 'metrewaves'.

Without such information those new to ham radio operating and ignorant of what happens where, succeed only in making themselves unwittingly look foolish, at least in the initial stages. Worse, chaos can ensue if the right modes are not used in the right places.

Question from the newly licensed, then: 'What are these right places?" The diagram in **Fig.1** shows the megacyclic signposts for 2m. **Fig. 2** shows them for "Seventy cems". They have not been delineated in these pages for over a twelvemonth, and may be new to the many thousands who have taken the ticket since then, and added their numbers to the readership of *Ham Radio Today*. They are the signposts that point the way to trouble-free operating.

Fig. 2 The bandplan for 70cm today



NOTES:
CALLING FREQUENCY TELEGRAPHY: 432.05MHz
CALLING FREQUENCY SSB: 432.20MHz (UK)
CALLING FREQUENCY SSB: 432.3MHz (CONTINENTAL)
BEACON SEGMENT. DO NOT OCCUPY AT ANY TIME.
CALLING FREQUENCY FM 433.2MHz (OLD)

CALLING FREQUENCY FM 433.5MHz (NEW)
REPEATER INPUTS HIGH, OUTPUTS LOW
RAYNET OPERATION OCCURS ON CERTAIN FREQUENCIES AND SHOULD BE GIVEN PRIORITY. IF RAYNET IS NOT ACTIVE THESE FREQUENCIES ARE FREELY AVAILABLE FOR ALL TO USE.

HAM RADIO TODAY — NEXT MONTH

SO YOU REALLY WANT TO GO ON A DXPEDITION?
Martin Atherton, G3ZAY, details some entertaining perils and pitfalls of DXpeditioning

PROJECT OMEGA 100W RF POWER AMPLIFIER
(We know it took a while but the result is worth waiting for...)

THE OLD 5m BAND
- a 'Radio Yesterday' special feature

Peter Metcalfe, G8DCZ, investigates 70cm 'mobile' and the Yaesu FT730R FM transceiver

FREE INSIDE

A series of GRID OVERLAYS to assist in finding your - and others - EXACT IARU locator. Simply apply to a certain readily available map and away you go!

FAULT FINDING TECHNIQUES for Radio Amateurs

Amateur radio equipment has become increasingly complex and miniature over the past decade. The phrase 'black box' came to lie at the heart of our hobby... Well, those days are over, we hope, as James Finnegan, GI4FFL, of QSK Electronics attempts to take the fear and loathing out of fixing your own rig.

There can be little doubt that over the past number of years the nature of amateur radio has changed more than in any period of its history. Whether these changes are for better or worse is often the subject of much debate, both on the air and at the local radio societies. One point of ten raised is that the increased complexity and miniaturization of amateur radio equipment is resulting in the modern amateur becoming almost entirely an 'appliance operator,' "just one more consumer at the end of a chain supply stretching back to Japan." The commercial equipment available is usually of a high standard and often provides more facilities and features, some would say gimmicks, than is arguably really necessary for everyday radio operation.

This has meant that for many amateurs their equipment has taken on the air of a 'Magic Box' — of which they wrongly feel is beyond their understanding and thus ability to repair. As a result, the manufacturers guarantee has tended to take on an increasing importance and in practice is a significant sales feature of much equipment. This should, in general, lead to a satisfactory state of affairs but it brings about a situation in which the amateur has little or no technical involvement with his station and thus little experience of, and knowledge about, the repair of this should it go wrong.

The intention of this series of articles is to give an insight into a logical and systematic method of fault location, down to individual component level, on amateur radio equipment, although the methodology should also enable you to locate and clear faults on electronic equipment in most other fields as well. A study of these articles will also help the reader to understand the procedures involved in the repair of their rig better and they should be able to at least locate the *area* of a fault in it. Even if the reader doesn't desire to fix faults him or herself, this will enable them to provide more accurate information to the service engineer at their local emporium. This state can often be arrived at without even 'taking off the lid', by following the steps outlined in the early stages of this series.

At this point, I feel I must recommend that the complete fault location and repair procedures be followed only outside of the warranty/guarantee period of the equipment since any self-repairs during this period will invalidate the guarantee.

I shall attempt to show that many faults can be cleared on even complex equipment with comparatively simple test gear (eg an ordinary 20 kohms per volt multimeter and a simple diode RF probe), using the steps and procedures outlined, and that more complex faults requiring the use of more complex, and expensive test equipment to 'prove' faults to individual component level, can at least be more clearly understood and appraised by the reader. ***A knowledge of electronics and radio at least to RAE standard is an essential 'tool' in conjunction with this series, since some steps must presume a knowledge of the basic building blocks of receivers and transmitters.***

Methods

In general there are four methods for Fault Finding:-

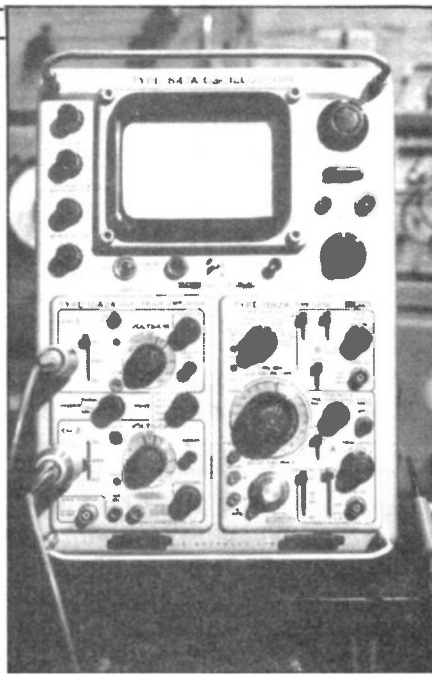
1. Fault Finding by Proving Components to be at Fault.
Logically using the information and techniques described later. This is the best method in terms of learning about practical radio/electronics and putting the knowledge to use and to the test! In commercial terms it is often not the quickest method, but it is the most applicable to the amateur with only one faulty set, limited spares and equipment but with time and enthusiasm it can also be one of the most rewarding and satisfying.

2. Fault Finding by Substitution.
Board swapping and educated guessing! To be honest, this is something most of us have probably been glad to do at some time or other but does require other equipment to be available as a substitute. For the average enthusiast, this depends upon having a good friend with identical equipment to yourself and there is always the fear that you may introduce faults into your friend's equipment by doing so! At best 'substitution' usually tells you what board to buy or send back. At worst it can lead you on a wild goose chase, even into acquiring unnecessary boards and components!

3. Fault Finding by Comparative Measurement.
With equipment known to be functioning correctly (again a good friend is usually necessary) but without the repairer having a clear understanding of the circuitry and the fault symptoms often not clearly defined or understood. This is a rather hit and miss approach but can be useful in a situation when making one measurement will enable you to make a simple right/wrong decision on which to proceed to the next step of your investigations. For example, say we have a transmitter strip which is suffering from low output. By working from the beginning of the strip towards the output (or vice versa) and comparing the voltages obtained with a diode RF probe, to either similar equipment of a table in the equipment manual, the faulty *stage* can be quickly determined. Another example. We have a VCO giving an incorrect frequency output. By comparison we know that to give the correct frequency the VCO requires X volts. If X volts are present then the VCO is probably faulty; if not, then the fault almost certainly lies in the circuitry that provides the voltage.

4. Fault Finding by Knowing What's Wrong to begin with!
What are sometimes known as 'stock faults' in the trade. From the nature of the fault symptoms you realise that this seems the same type of fault as on equipment previously repaired, or on that of a friend and fellow member of the FTXXX, or that it matches faults and modifications about which the manufacturer has made modification. One reason why official distributors/agents should be able to provide good service is that they should be informed about recurring technical problems from the manufacturer — that usually the buyer, and others, wouldn't get to know about it!

Sometimes knowing what's wrong is the least of your difficulties; the *act* of replacing the faulty components can be the real problem. Paying for the devices can also be expensive, as anybody who has had to replace PA transistors in the solid state commercial rigs of today. Fitting these can be a little bit messy too, especially when the faulty ones are buried under components and covered in heat sink compound, as on the Yaesu FT 707 and FT107 PA boards.



There's plenty of scope with this type 647A with plug-ins which is readily available second hand.

In my opinion the first type of method mentioned is the best procedure for an amateur to apply to usefully repair his own equipment and this method is the principal sub ject of these articles. The method can be outlined under *five basic headings* — not dissimilar.
These are:
1. Familiarisation and Appraisal.
2. Fault Symptoms.
3. Area of Fault.
4. Method.
5. Practicalities, Procedure and Limitations.

Remember, removing doubt — determining reference points from which a right/wrong decision can be made is *the* on-going aim in fault finding.

Three Important Steps

Symptoms — of the fault determined as comprehensively as possible.
Area — in which the fault is likely to exist.
Method — to be used in locating the fault.
Consideration of the above before picking up the tools will lead to success!

Fault finding requires a frame of mind in which you try to think logically at all times, work progressively and (try to) develop an ability not to panic. Remember, losing your temper can have very expensive results. Have a picture of Margaret Thatcher (or Neil Kinnock, whatever your preference) in the shack to take it out on rather than kick the rig! On the other hand, if you own a 19 set, the kicking will probably only hurt your foot. . . These procedures may appear a little involved and academic but time spent thinking and determining your next move is much better than 'diving in' straight away — possibly thus introducing more faults than are cleared, which can be very disheartening, not to say expensive.

Now for a more detailed look at the techniques used —

1. Familiarisation and Appraisal.
Do you really know how to work your rig? This may seem a silly question but how often have you been worried by finding some function or facility apparently not working — only to eventually find you had incorrectly adjusted some of he controls, or perhaps had used them in the wrong sequence? This is where the most useful, but to some most daunting, source of information will prove valuable — The Instruction Manual!

As now supplied, modern Japanese manuals have come a long way from the pidgin english and postage stamp size circuit diagrams of the late 1960's and will usually prove to be the first source of detailed information on your rig. Unfortunately, while some are almost up to workshop manual standards, others are not as well laid out and detailed as they could be, making repair that bit more difficult. In fairness, some are not intended to be fully comprehensive, the service or workshop manual being an optional extra usually available on request. Nevertheless, the majority of faults on most rigs can be repaired using only the information supplied with them and the method outlined here.

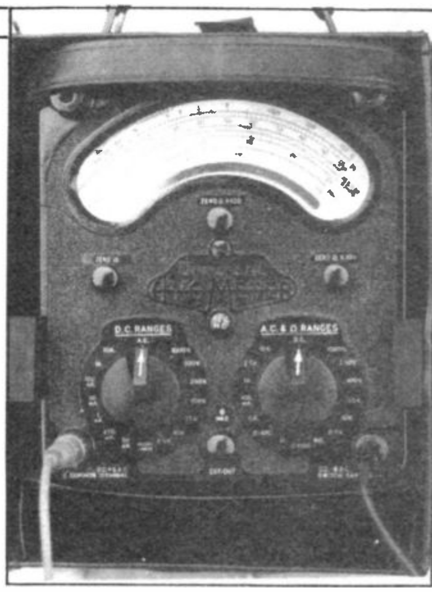
With most manuals you will find the technical information laid out in five ways:
1. Block Diagrams.
2. Complete Circuit Diagram.
3. Board Layouts and Photographs.
4. Individual Circuit Diagrams and Descriptions.
5. Internal (Inter-Board/External Controls) Wiring Diagrams.

Later you may find it very helpful to photocopy the circuits and diagrams so to have them readily at hand. In practical terms this is a very useful step to take, since it is very frustrating trying to keep three fingers in a manufacturers manual at the relevant sections of text while simultaneously attempting to look at a circuit which appears upside down on another page! Your aim is to put the manual to good use — not to become a contortionist.

After double checking with the manual that you have not over looked or mis-set the controls, I'm afraid we have reached the point where your worst fears are confirmed — there *is* something wrong! At this point you also hope and pray that you have a malfunction that remains on the rig — intermittent faults can be most frustrating to locate and have a nasty habit of reappearing at the most inconvenient of times. Usually though, the most spectacular fault symptoms, such a smoke or arcing, indicate component failures which are readily locatable (!) — although the cause can sometimes be obscure even if the effects are spectacular. Some older types of components, such as electrolytic capacitors and transformers produce characteristic smells and smoke when they expire. In one case in my experience, in an older radar set, a certain capacitor often squirted hot wax at the engineer when it failed!

Any Fireworks?

Let us concentrate on faults which usually don't make themselves known by a fireworks display. Some faults have the *potential* to cause firework displays if they are left uncorrected; for example, if the fault appears to be one of little or no transmitter output power it is not advisable to attempt to transmit, or apply constant drive to the PA stages for a long period of time, *since additional damage could occur.* Most other types of fault are likely to get worse or cause damage with continued use during fault finding and will usually involve single or related circuit functions, such as poor Rx sensitivity perhaps corresponding with low Tx drive or Rx and or Tx not working on one mode. A few further simple observations are advantageous; for example, does the fault appear from switch on, or only after a period of time? Only after



The Model 8 Avometer, a high quality, general purpose, analogue multimeter.

transmitting? What functions on the equipment appear to be working OK? Are you sure you're not doing something wrong?

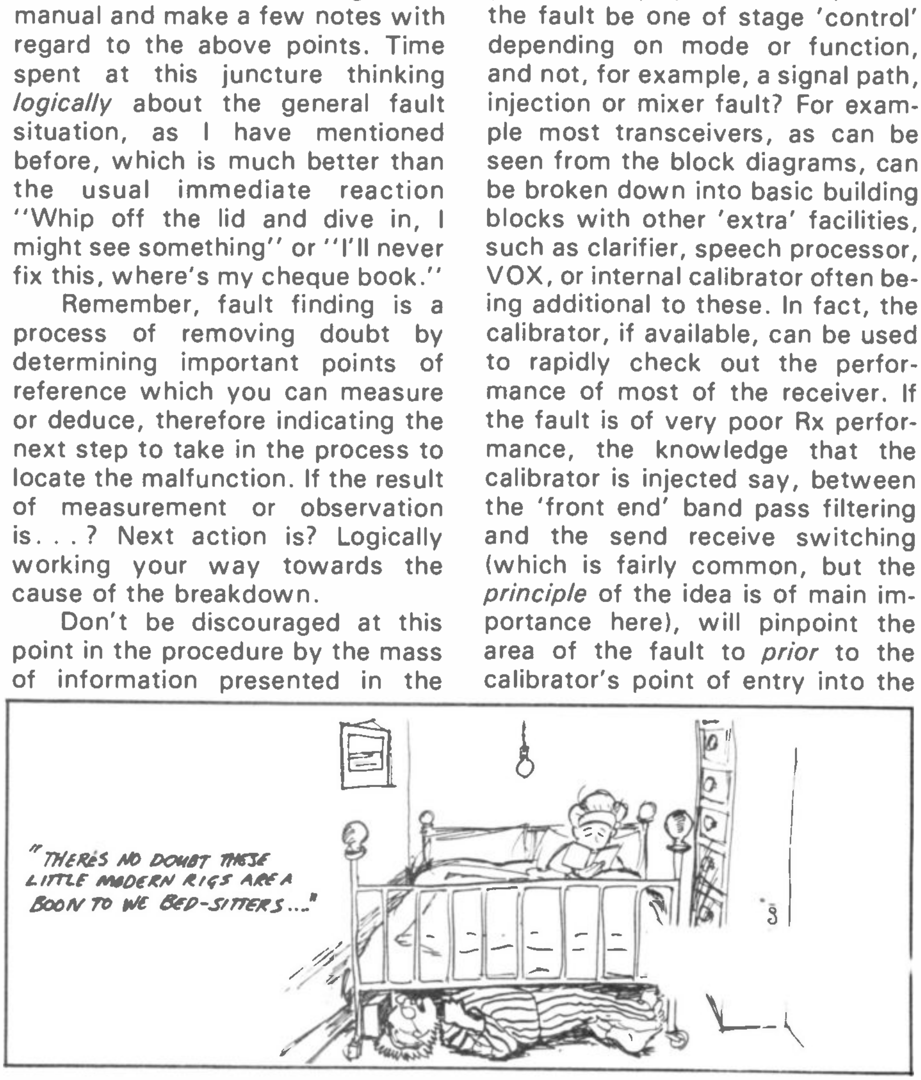
At this point it is a good idea to sit down to have a think, a cup of tea, another look through the manual and make a few notes with regard to the above points. Time spent at this juncture thinking *logically* about the general fault situation, as I have mentioned before, which is much better than the usual immediate reaction "Whip off the lid and dive in, I might see something" or "I'll never fix this, where's my cheque book."

Remember, fault finding is a process of removing doubt by determining important points of reference which you can measure or deduce, therefore indicating the next step to take in the process to locate the malfunction. If the result of measurement or observation is. . . ? Next action is? Logically working your way towards the cause of the breakdown.

Don't be discouraged at this point in the procedure by the mass of information presented in the manual, since this can induce an overwhelming feeling of panic and may also cause undue anticipation of what might be faulty — it's all too easy to worry about what may be wrong — look on the bright side, apart from the faults everything else is OK!

2. Symptoms:

Clearly appraising all the fault symptoms is most important. The more specific the symptoms, the easier it is to arrive at the information for the next step — finding the area of the fault. The working of minor circuit functions seemingly not involved with the fault can sometimes be the key in locating the specific area of the failure. Therefore, take note, not only of that which appears to be wrong but also of the facilities which remain working correctly. From a study of the block diagram, try to be aware of circuitry that is common to several 'modes' of transmisson and reception and also on Tx and Rx. Is any of this common circuitry relevant to your fault symptoms? If so, could the fault be one of stage 'control' depending on mode or function, and not, for example, a signal path, injection or mixer fault? For example most transceivers, as can be seen from the block diagrams, can be broken down into basic building blocks with other 'extra' facilities, such as clarifier, speech processor, VOX, or internal calibrator often being additional to these. In fact, the calibrator, if available, can be used to rapidly check out the performance of most of the receiver. If the fault is of very poor Rx performance, the knowledge that the calibrator is injected say, between the 'front end' band pass filtering and the send receive switching (which is fairly common, but the *principle* of the idea is of main importance here), will pinpoint the area of the fault to *prior* to the calibrator's point of entry into the



'block' of circuitry, if the set functions satisfactorily with it as a test signal.

Be aware of any variations in performance from the normal and check all controls. You are trying to make deductions about what stages are working correctly, without, if possible, to having to directly measure their parameters with additional test gear. For instance, with a faulty Rx, does the 'S' meter read normally or return to zero? Does it's reading vary (normally) with the operation of the RF gain control? Does your IF facilities such as width or shift or pass band tuning function OK? In this way, you are working your way through the various stages of your rig and checking the operation of it piece by piece — each stages have specific facilities associated with them. When checking a transceiver or transmitter listen for the sound of relays changing over — or maybe not changing back and thus not working at all! In some sets, you will *normally* hear relays switching in at changes in frequency or mode.

If your rig is one of these (perhaps you have only noticed this subconsciously) are the relays still operating?

Some Worked Examples

Let's now look at some actual faults that have been found on various rigs — provide somewhat odd but distinctive symptoms.

Equipment — Fault symptoms

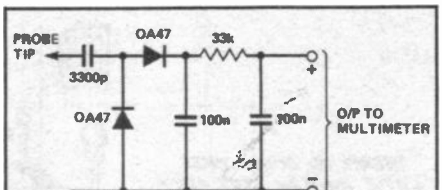
1. Yaesu FT225RD — "Rx not working on FM." In fact its best to be more specific and firstly list facilities which appear to be working correctly — Tx works OK on all modes and all band segments, modulation OK, PWR control and SSB Mic gain functioning, digital readout OK, VOX OK, tone burst and repeater shift OK, noise blanker OK, Rx OK on LSB/USB, CW and AM,S meter functions correctly, RF gain works normally, clarifier and switchable AGC rates OK. However, no signals heard from the loudspeaker on FM. *This isn't quite the same as saying Rx not working on FM!* Let's have a look at this in more detail:-

Although no voices are audible, the S meter is indicating the presence of received signals as we tune around on FM, and, by watching

A homemade RF probe enables easy analysis of the circuit.

the 'S' meter and rotating the RF gain, this can be seen to be functioning. Also significant is the fact that the sets front panel meter, when switched to read discriminator centre current, indicates no signals present at this stage. Lastly, when the squelch is opened manually the Rx 'roars' normally. As will be seen in the next stage, these symptoms alone are very specific in indicating the area of the fault.

2. Drake TR7 — Set Tx and Rx OK on all modes. All facilities work normally, digital readout functions OK, and the rig tunes normally in frequency *except* above about 22MHz or so — when the digital readout 'races', in this case correctly indicating that the rig is rapidly changing frequently up and down within a few hundred kHz apparently at random. The main tuning control is no longer effective in changing the frequency of the rig and you are unable to tune the rig to the upper end of the frequency range available. The band select switch is also unable to raise the operating frequency when it is switched to the highest frequency band. The 500kHz shift 'up and down' controls function correctly only *lower* in frequency when the local oscillator O/P is stable. Sounds as though this fault could be very involved to repair doesn't it?! In fact the fault was so obvious that it was literally staring me in the face and I overlooked it! I also skipped one of my own 'rules' which lead me on a bit of a wild goose chase through the local oscillator frequency synthesizer modules of the rig before returning to the specific area of the fault. More of this later. . .



NOTES:
I/P CAPACITOR TO BE HIGH VOLTAGE TYPE.
OA91's COULD BE USED INSTEAD OF OA47, EVEN SILICON DIODES SUCH AS 1N4148 (1N914), BUT BEST TO USE GERMANIUM GOLD BONDED/POINT CONTACT TYPES FOR BEST SENSITIVITY.

Circuit diagram for the RF probe.

3. Yaesu FT 107M — "Nothing wrong, except the receiver doesn't work after transmitting and you have to switch the rig off to bring it back on again". Again let's be more specific in fully describing the fault symptoms:- The receiver worked normally on all modes from switch on with all facilities — RF gain, attenuator, switchable AGC, marker, clarifier and audio peak/notch filters also working normally. The 'S' meter and digital readout functioned correctly. On changing from receive to send, relays could be heard changing over and the transmitter, compressor, VOX, ALC and output metering all worked normally. On letting go of the PTT switch, relays could be heard de-energizing *but the set only partially returned back to receive.* No signals could be heard from the loudspeaker, but the S meter continued to read correctly, either on received transmissions or on the internal marker. RF gain, attenuator and switchable AGC rates appeared to remain working. On closer examination, a low residual hiss could be heard from the loudspeaker and the audio peak and notch filtering could be heard to work. Lastly and most significantly, only *on AM* could demodulated signals be heard from the loudspeaker. On switching off the rig, some relays could be heard de-energizing (as is normal) and indeed on switching on again the fault symptoms disappeared, only to reappear again after the PTT line had been activated!

These symptoms have some similarities with those seen on the FT225RD. Once again, fully appraising them and carefully studying the block diagram and circuits of the rig, leads us to decide on a very specific area in which the fault is likely to lie. As will be seen next month, although the reason for this malfunction could be readily located, *the* ***cause*** *was more obscure and lay in a part of the circuit far removed from it.*

SETTING UP A STATION...

BACK AGAIN BY POPULAR DEMAND . . .

FT757GX
£719 inc

TS530SP
£669.61 inc

TS430S
£779.55 inc

TS530SP

Designed as a little brother to the TS830S the TS530 uses the same PLL system, the same RF boards, the same readout system and many other features of the 830, but no the variable bandwidth facility. You still have the famous Trio I.F. shift system for dodging the QRM.
Again, too many features to mention, including:- 160 to 10 metres includng the new bands, passband tuning on all modes, 616468 PA values for low intermod, low power tune up, digital readout shoes true frequency at all times, VOX built in CW sidetone, speech processor, noise blanker and notch filter.

FT757GX

This tiny new radio from Yaesu features all mode operation (SSB-CW-AM-FM), full CW break-in, dual VFO plus eight memories, programmable memory scanning, 600Hz CW filter, iambic keyer with dot-dash memory. IF shift and width filters, Tx coverage, 160 through 10 metres, and general coverage Rx (500KHz to 29.999MHz).

TS430S

The Trio TS430S is a compact high performance solid-state transceiver that covers all the WARC bands from 160 to 10 metres — with SSB, CW, AM and the option of an FM add-on unit.
As an added bonus the 430 incorporates a 150KHz to 300MHz general coverage receiver for world wide reception.
Some of its features are 8 memory channels with memory scan notch filter. IF shift and dual digital VFO's. This is certainly one of the most exciting pieces of equipment that have come across for a long time. Come in and try it for yourself.

See the Professionals

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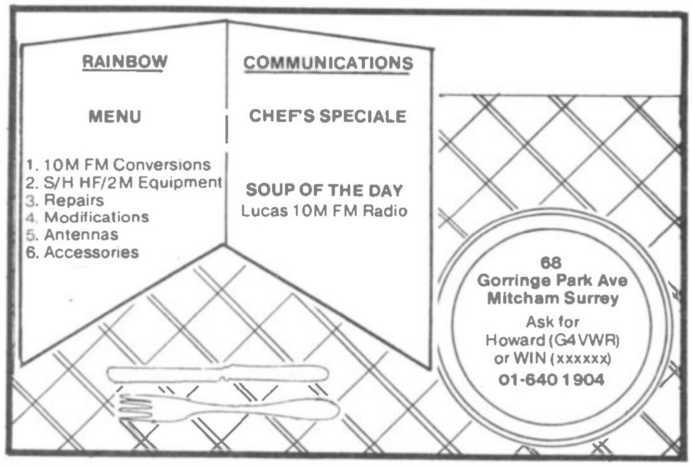


2m 20W POWER AMPLIFIER

This is the first of a series of projects from Cirkit to be published in HRT. Many of these will be specifically aimed at the newcomer. This months project is intended as add-on for 2m transceivers such as the FT290R or HRT's 'Talkbox' and includes an optional RF preamp.

The Cirkit 2 m PA is a high gain SSB or FM power amplifier for use in the 2 m amateur band. It was developed to meet the need for a high quality, low cost PA capable of being used with both mobile and base stations. The power of hand held or portable transceivers can be boosted up to 25 W which should be sufficient to cover most applications.

An additional feature of the 2 m PA is the high performance preamp which can be incorporated into the unit (*to be described in more detail next month*). Switching between the pre-/power-amplifiers is fully automatic, but manual control is also included. Should the preamp not be required, then it can be omitted altogether.

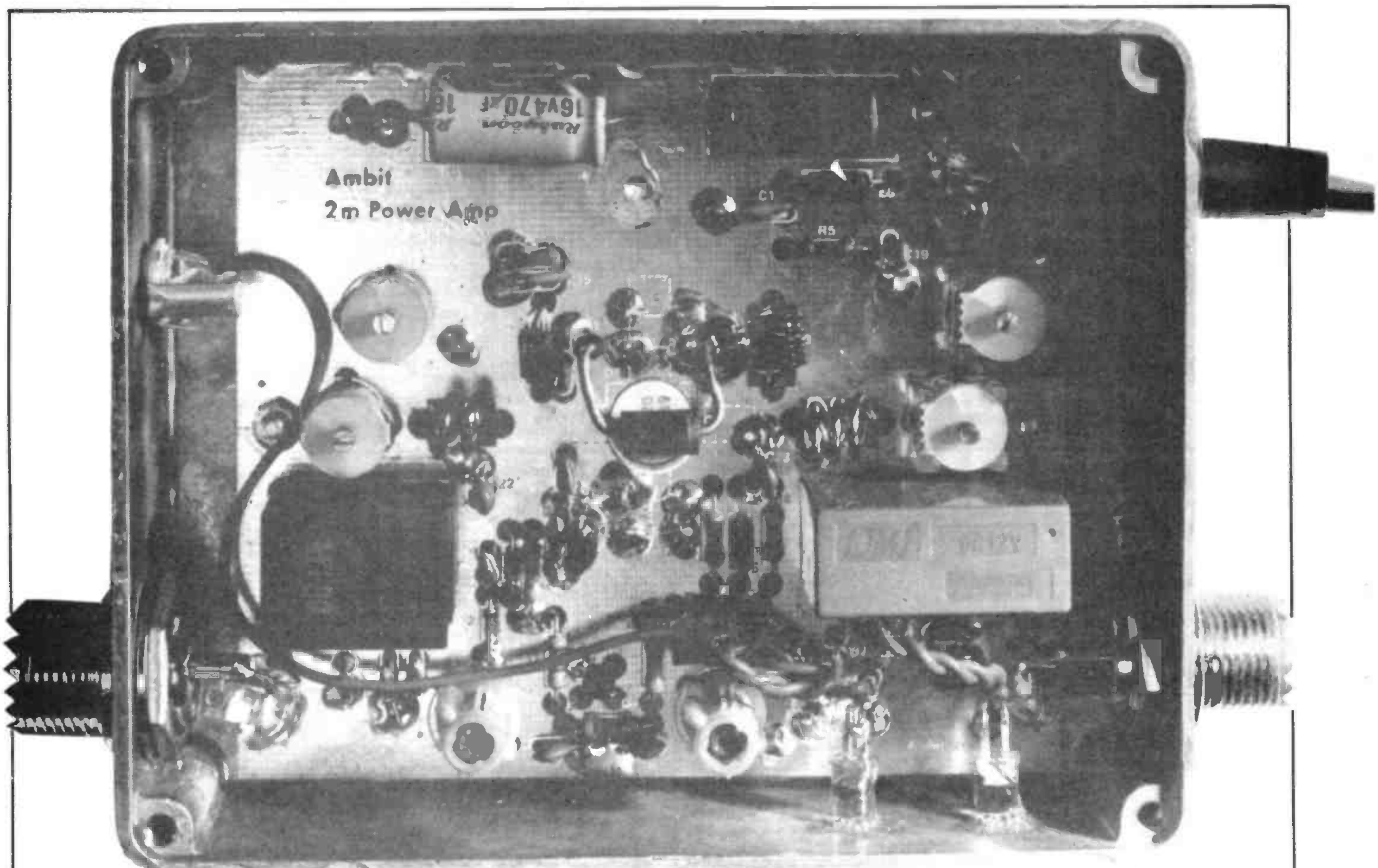
The finished unit is mounted in a tough pre-drilled discast box, thereby meeting the thermal requirements while providing a rugged low profile housing.

Circuit Description

Biasing RF Power Transistors
RF power amplifiers may be operated in a number of different modes. Each has advantages and disadvantages, the choice depending upon the particular application. A brief resume of these modes are useful at this point.

Class C

RF power amplifiers are usually operated in class C for FM signals or class AB for single sideband



(SSB). In class C operation the output transistor takes zero collector current with no signal, the applied drive providing the base bias. When in class C, operation is inherently *non-linear*, in other words doubling the applied drive power will *not* necessarily double the output power. Also the output will be zero until sufficient drive has been applied to supplied the base-emitter bias.

In many applications non-linear operation does not present major problems. With a single frequency drive signal, the only spurious signals generated are harmonics (assuming a stable amplifier) and these are readily suppressed in the matching networks and output filter. Class C is used where linearity is not required ie for CW or for FM, as it provides a high efficiency. This means that the amplifier takes a lower DC supply current for a given power output and therefore runs cooler as less power is being dissipated in the heatsink.

For SSB, video and other complex signals, class C operation is generally not satisfactory. When a signal contains multiplier frequencies at close spacings, odd-order non-linearities will generate spurious outputs which are within the bandwidth of the amplifier and are therefore not suppressed before they reach the antenna. In this case, linear amplification is required if the amplified signals are to be free of spurious outputs. Linear amplification at low levels is achieved using stages with class A bias.

Class A

In class A amplifiers, the base-emitter junction is forward biased so that a large quiescent current flows. The drive signal modulates the collector current equally in either sense giving linear amplification. Class A is not generally used for power amplifiers due to its very low efficiency (typically 20%) and hence low available output power with any given device.

Class AB

Class AB is the most popular form of biasing for linear power amplifiers and is the type used in this design. Here the base-emitter junction is biased to produce a small collector current. A high degree of linearity can be obtained in this mode if the bias point is accurately maintained. The magnitude of the no-signal collector current varies with application and device (typically 20-100mA). The secret of good linearity lies in maintaining the base-emitter DC voltage relatively constant as the RF signal amplitude varies. RF power devices try and bias themselves off with increased drive, therefore a constant voltage source is required for the bias voltage. This simple requirement is unfortunately complicated by temperature effects. As the junction temperature of a transistor increases, the required base-emitter voltage for a given collector current decreases.

VHF power transistors are generally used with their emitters grounded to DC and AC signals. Therefore if the bias voltage remained perfectly constant as the temperature increased, greater and greater collector currents would be taken which could lead to destruction of the device at worst or at least a reduction in output power.

Temperature compensated low impedance bias circuits can be very complicated. A simple solution to the bias problem for low to medium power applications, is to use a forward biased diode in thermal contact with the power transistor. Now, as the temperature increases the voltage drop across the diode junction decreases and reduces the bias with increased temperature. By choosing the right diode for a given power transistor, the correct amount of bias can be provided. Altering the current through the diode gives a fine control of quiescent current, although the current must be sufficient to stop the voltage sagging during peaks of RF. A large electrolytic capacitor across the diode helps to smooth these peak bias requirements as well as providing audio decoupling.

Cirkit 2m PA

The basic power amplification is provided by transistor Q1. The input is tuned to 145 MHz and impedance matched to 50R by the C1, C2, L1 network. Base bias is provided by R4 and D1 and is maintained at approximately 0.6V. The choke, L2, together with C15, C16 and C17 decouple the supply. L5, L3 and R5; C18, C19 similarly decouple the collector supply. The output stage is also tuned and impedance matched by L4, C5 and C6.

A low pass filter — C13, C14 and L5 — with roll off at approximately 150 MHz is included at the output to suppress any harmonic distortion.

The RF sense network formed by C20, D2, D3, C21 and Q3 rectifies the RF, switching Q3, in turn switching the relays. These can also be switched by taking the base of Q4 (via D4) low in voltage.

The preamp also has a tuned impedance matching network C11, C12 and L7 providing the input to G1 of the MOSFET. The R1, R2 potential divider sets the bias on G2 to approximately 5V — the level required for optimum performance. The output, again matched to 50R, is then pressed to the rig.

Construction

A double sided PCB is used to provide good electrical stability and simplicity of construction. Most components that need an earth connection are soldered directly to the earth plane. It is important to note that the uncommitted pads are only included to indicate component postitions, the leads should be soldered directly to the top side of the board. This is shown in **Fig.1**.

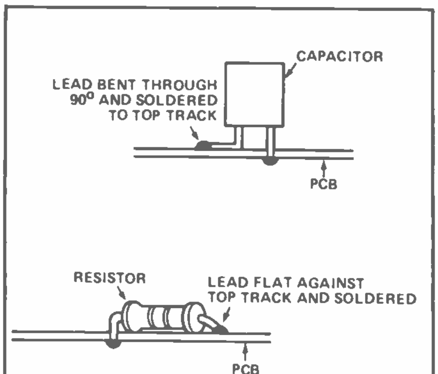


Fig. 1 detail of soldering capacitors and resistors to top (earth plane) and bottom of PCB.

As in all RF circuits, it is important to keep all component leads as short as possible; lay resistors directly on the board, keep capacitor leads to a minimum and mount the transistors with lead lengths 3-4mm. Refering to the

Close up of 2 m PA PCB. Note the mounting of D1 in close thermal contact with Q1.

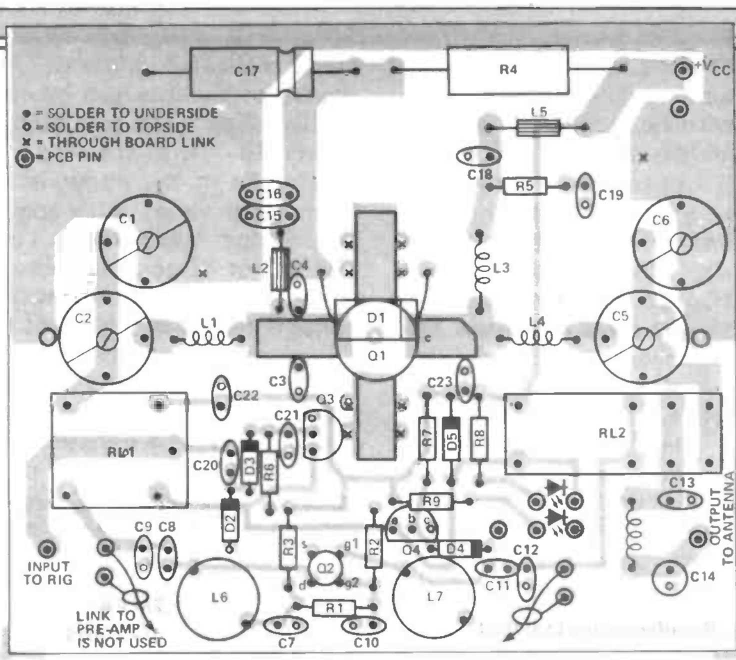


Fig. 2 Component overlay.

component overlay, **Fig.2**, the suggested order of construction is as follows:

1. Fit the PCB pins as indicated by a circle on the overlay, earth pins should be soldered both sides to the PCB.
2. Fit the through board links using 1 mm diameter tinned copper wire (or offcuts of component leads) except those which fit round the emitter leads of Q1.
3. If the pre-amp is not required then omit components R1, R2, R3, C8, C9, C10, C11, C12, L6, L7 and Q2 and fit a length of co-ax between the points indicated on the overlay.
4. Fit all components with solder points on the top plane, marked O, including the transistors but not the power diode D1. Take care over the transistor orientation — refer to the base connection diagrams.
5. Carefully wind and mount the coils. Use a former of the correct diameter (a drill etc) to wind the coils round, note whether the coils are close or space wound, see photo and components listing for details.
6. Fit the remaining resistors, leaving R4 a couple of mm clear of the board.
7. Fit the remaining capacitors and trimmers ensuring correct polarity of the electrolytic.
8. Fit L6 and L7.
9. Fit the two relays.
10. Connect the LEDs using short lengths of insulated wire.
11. Fit Q1 in place in the central hole. Note that the collector has a clipped lead and is marked with a 'C' on the case. Refer to the diagrams to ensure correct orientation. Also fit the links around the transistor legs, soldering them to both top and bottom planes of the PCB.
12. Mount D1 so that it is in thermal contact with the top of Q1 — a dab of thermal compound would be an advantage.
13. Before fiting the completed board in the case, remove any burrs or raised writing around the transistor mounting hole. It is essential that the base of the transistor is absolutely flush with the case, as the majority of heat is dissipated here rather than the stud.
14. Bolt the heatsink to the case using the 6 BA screws with one full nut and one half nut. Place the board over the screws and secure with a shake proof washer and full nut. See **Fig.3**. Should any holes not line up, file out the screw holes on the PCB or the case but not the transistor stud hole. Ensure than no mechanical strain is placed on the power transistor as it contains a very toxic Beryllium compound. Should the package break take

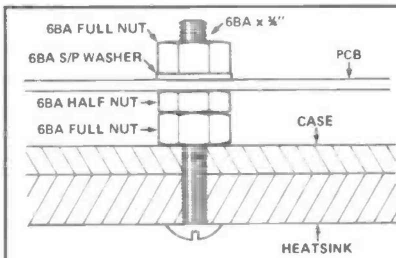
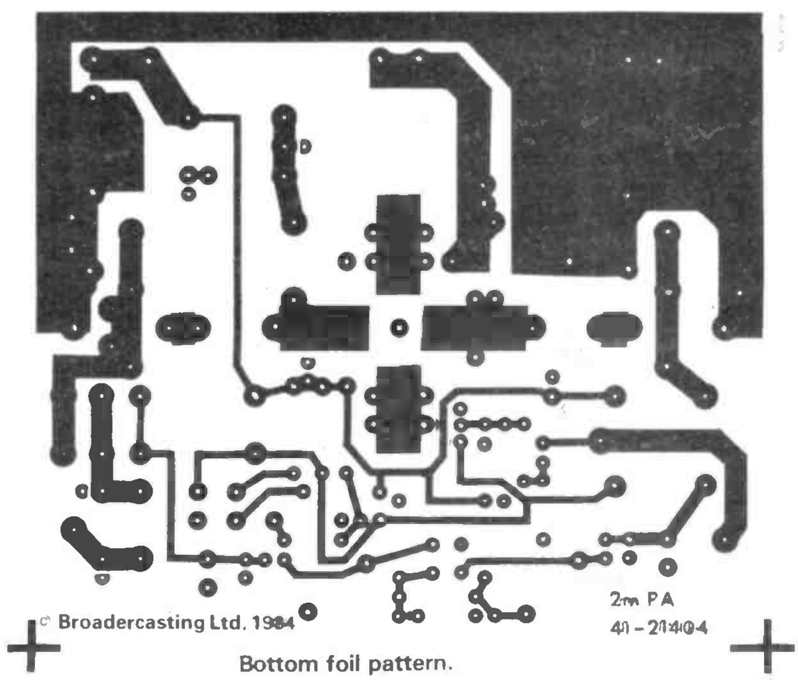
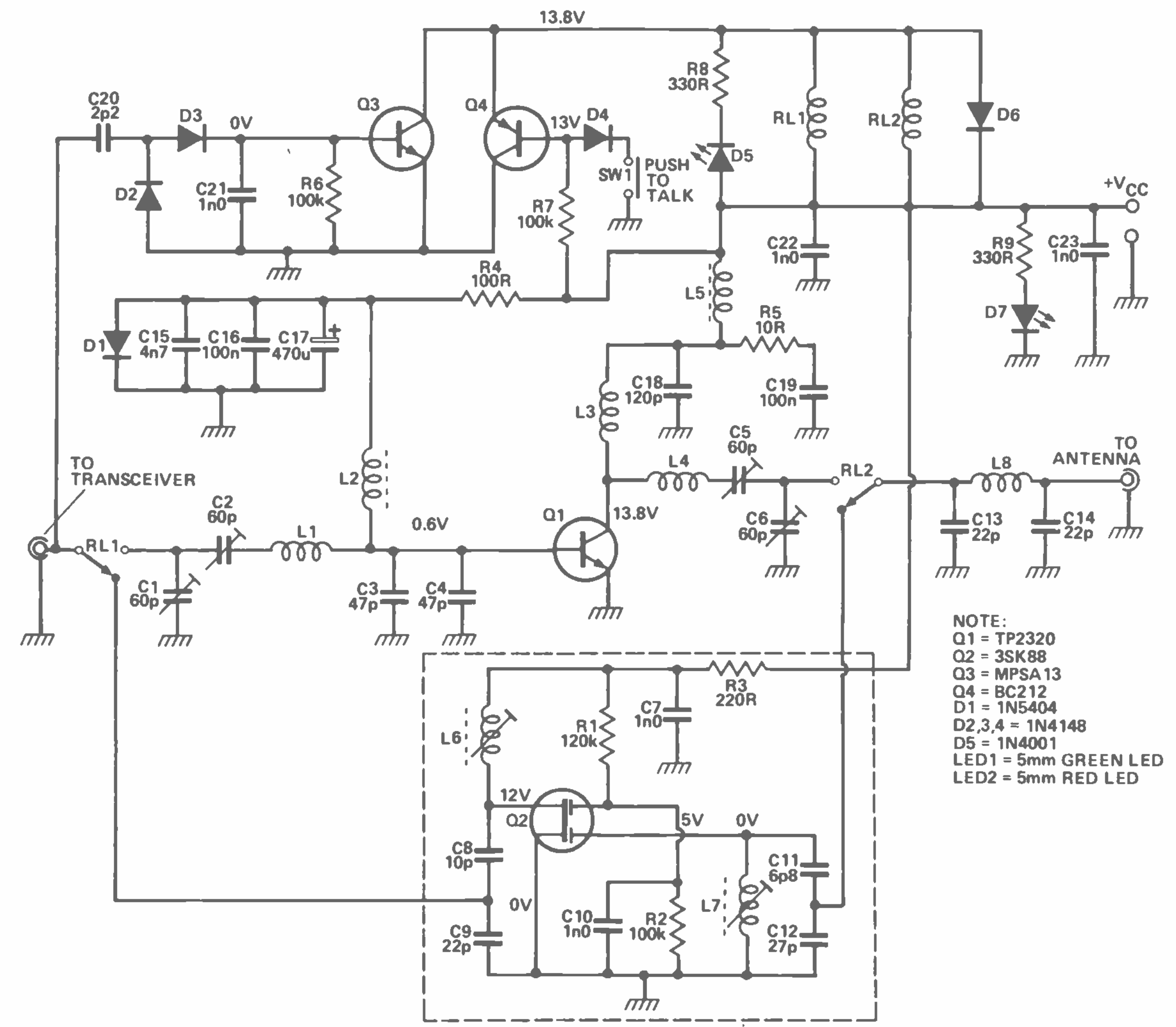


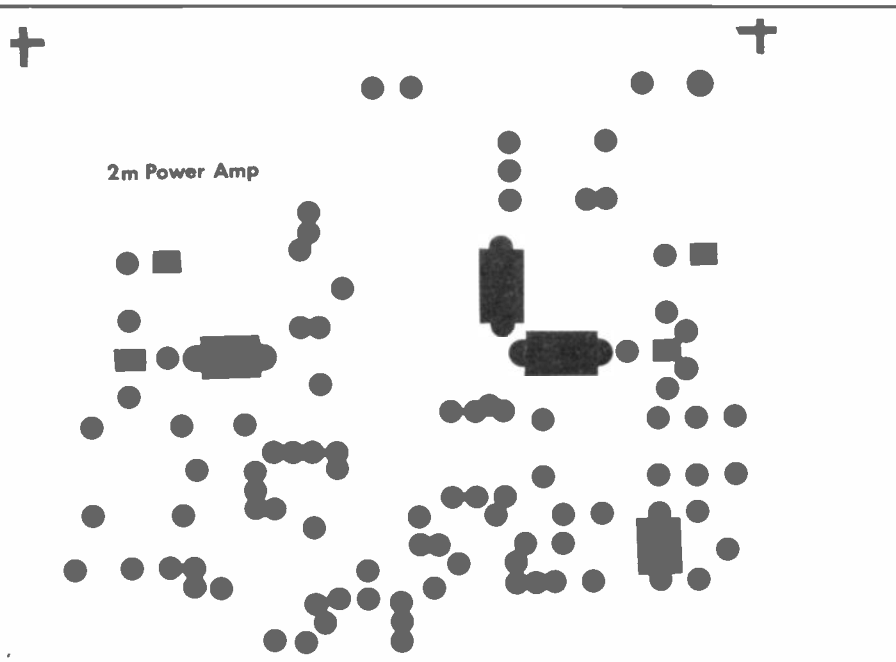
Fig. 3 Method of fixing the case, heatsink and PCB together.



Bottom foil pattern.



Circuit diagram of the 20W PA and preamplifier.



Top foil pattern.

great care over disposal of the device.

15. Mount the SO239 sockets in the case with their earth tags in contact with the top plane of the board. Solder the tags and wire the sockets to the input and output pins. Mount the jack socket using short lengths of insulated wire and remembering to make a connection to the top of the PCB. Finally, glue the LEDs into the case.

Setting Up

Before applying any power to the amplifier, check the following points: that all components have been inserted correctly; that all connections to the top plane have been soldered; that the RF power transistor is correctly inserted and bolted to the heatsink/case.

Using an insulated trimming tool set the four variable capacitors to half-mesh. Connect an ammeter capable of reading 3.5 amps in series with the power supply leads and apply 13.8V to the amplifier, checking that the current drain is less than 220mA. Connect a dummy load and some means of measuring RF power (ie a SWR meter or power meter) to the aerial socket. Earth the centre pin of the Push To Talk socket — you should hear the relays go over to the tranmit position — and connect the rig, set in the FM mode, to the power amplifier. Key the microphone and adjust C5 and C6 for maximum power output and then adjust C1 and C2 likewise. This operation should be carried out quickly because, until properly matched, the transistor can be operating extremely inefficiently and dissipating most of the power as heat. This should be repeated several times until maximum output power is obtained. The amplifier should draw about 3 Amps when supplying 25W out.

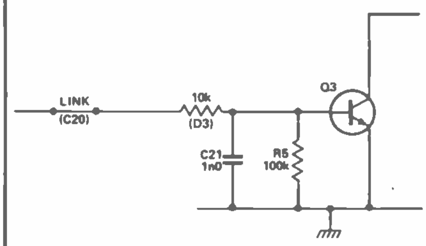


Fig. 4 Modification for using the PA on SSB with the FT290.

To align the pre-amp, connect a signal from the aerial or a signal generator to the aerial socket of the amplifier and tune L6 and L7 for maximum signal, adjusting L7 for the best signal-to-noise ratio when the maximum signal has been obtained.

In Use

The amplifier should be mounted with the heatsink uppermost and, if mounted under shelf or car dashboard, a gap of an inch or so should be left to allow for adequate ventilation.

RF switching is incorpoated into the amplifier, which is fine when using FM, however, if SSB is used then some form of 'hard switching' is required. This is achieved by earthing the Push To Talk socket on the amplifier during transmit. Some transceivers, such as the FT290R, provide a positive voltage on the inner of their aerial sockets during transmit. This can be used to switch the amplifier with small modifications as shown in **Fig.4**.

Finally, if the pre-amp is built into your amplifier, always remember to switch on the supply to the amplifier before transmitting, otherwise RF will be applied to the MOSFET in the pre-amp so bringing about its early demise!

Kits are available from Cirkit Holdings at Park Lane, Broxbourne, Herts (see advertisement in this issue) at £38.40 including VAT and postage.

Components List

RESISTORS
¼W 5% Carbon film (Except R4)

R1	120k
R2,6,7	100k
R3	220R
R4	100R
R5	10R
R8,9	330R

CAPACITORS

C1,2	5-60p foil trimmer
C1,4	47p ceramic
C5,6	4-40p foil trimmer
C7,10,21,22,23	1n ceramic
C8	10p ceramic
C9,13,14	22p ceramic
C11	6p8 ceramic
C12	27p ceramic
C15	4n7 ceramic
C16,19	100n monolithic
C17	470u 6.3V electrolytic
C18	120p ceramic
C20	2p2 ceramic

INDUCTORS

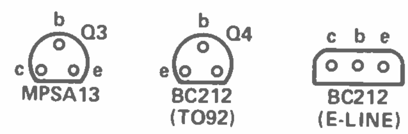
L1	2 turns 6mm dia1.25mm (18 swg) spaced at 1 wire dia.
L2,5	5 turns 0.46mm (25 swg) on FX1115 ferrite bead.
L3	6 turns 6mm dia 0.71mm (22 swg) close wound.
L4	3 turns 6mm dia 1.25mm (18 swg) spaced at 1 wire dia.
L6,7	3.5 turns 6mm dia 1.25mm (18 swg) spaced at one wire dia.
L8	4 turns 6mm dia 0.71mm (22 swg) spaced at 1 wire dia.

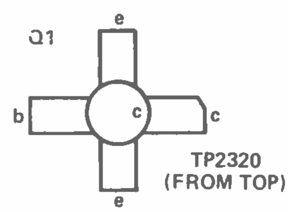
SEMICONDUCTORS

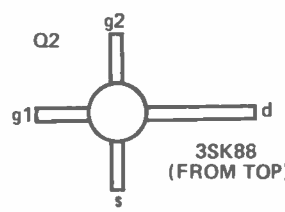
Q1	TP2320
Q2	3SK88
Q3	MPSA13
Q4	BC212
D1	1N5404
D2,3,4	IN4148
D5	5mm LED green
D7	5mm LED red
D6	1N4001

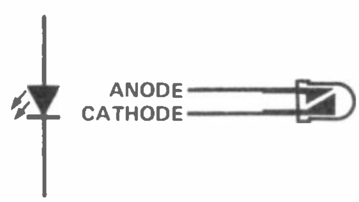
MISCELLANEOUS

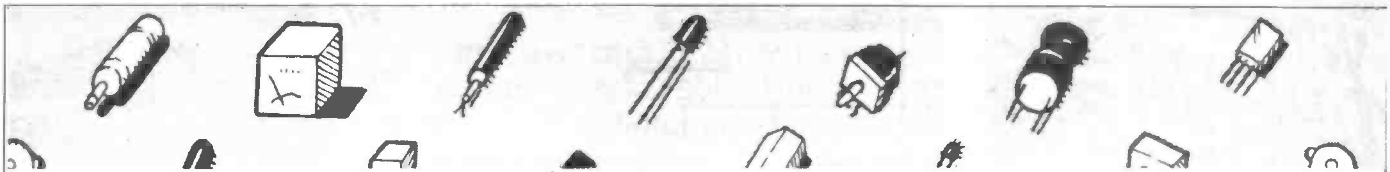
RL1	KU1TB 12V
RL2	OM1 12V
12 off	PCB pins
2 off	S0239 connectors
1 off	Heatsink
1 off	Diecast box
1 off	PCB
1 off	3.5mm Jack socket
1 off	Grommet
2 off	FX1115
2 off	6BA ¾" screws
2 off	6BA half nuts
4 off	6BA full nuts
4 off	6BA s/p washer
30cms	18swg ECW
40cms	22swg ECW
30cms	26swg ECW
30cms	7/0.2mm connection wire
10cms	UR76 co-ax
1m	Power lead — Red
1m	Power lead — Black











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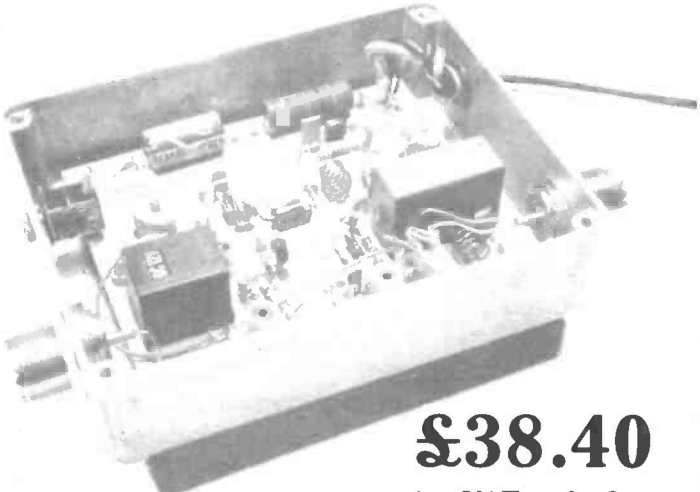

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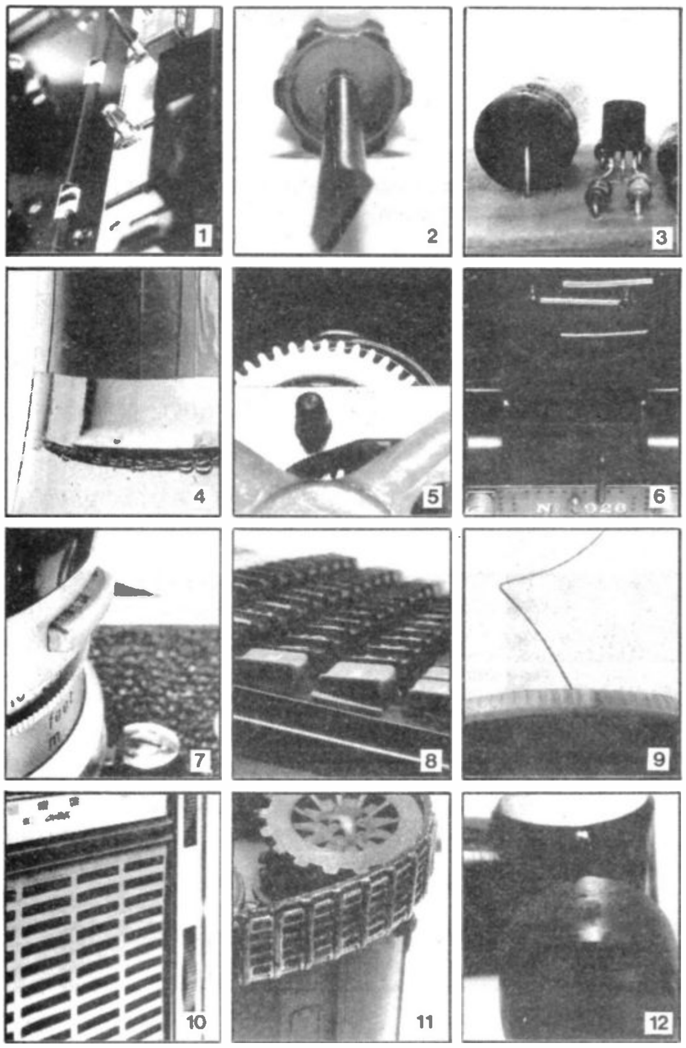

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Model Cars
Woodworker
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---

The 12 objects are

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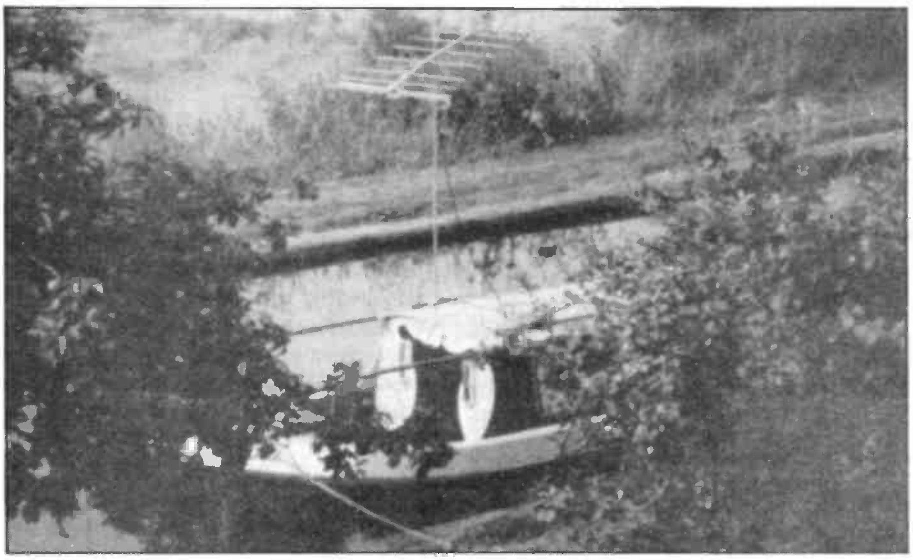
What we did on our holidays . . .

Imagine the scene: five radio amateurs plus a sympathetic wife and young baby cruising peacefully along the Llangollen/Trent and Mersey canals on a hot summer's day. Although peaceful is the word I would use of the scene in general, for our narrowboat, with five (later four) rigs in use for up to twelve hours a day, it is the last thing that can be said! After all, for any radio amateurs on a canal holiday, at least two rigs (of which one must be a portable) should be considered part of the essential equipment.

If you haven't had a holiday this year, this summery tale of canal boating and amateur radio by Sharon Metcalfe, G6LCC, will make you feel you have!



Our holiday began on a busy Saturday morning last July with three separate cars converging for lunch somewhere on our way to the boatyard. It would have been impossible to forecast in advance exactly where this should have been as we'd no idea how busy the M5, M6 and A5 were going to be. Our journey was not without incident as there were indeed traffic jams galore. I was in the first car with my husband Pete, G8DCZ, and our daughter Kathryn who was then aged four months and was already a keen SWL. (Yes, her eyes really did light up at the 'magic' voices and Morse code.) The 'pioneering' work was left to us, but while waiting in queues we were able to pass on information to Richard, G3TDL, and his wife Maya in the second car some twenty miles behind us. They too were patient enough to sit in the traffic jams, Richard putting out CQ calls on S20 at every available moment. However, Peter, G3VRW, and Graham, G3XJM, armed with an OS map, had other ideas. They had set off from London that morning (the rest of us having stayed overnight in the Midlands) and were some fifteen miles behind Richard when they first made contact with him through a repeater. (We had current repeater lists handy and monitored every available one for progress reports of the other members of the party until we were close enough to them to go simplex.) On hearing about the traffic queues, they decided that a map reading exercise was called for and took the 'pretty way' over the hills, thus saving about forty-five minutes. Thanks to the miracle of amateur radio we finally met up at Froncysyllte, near Llangollen.

Pub Radio

Using a good beer guide we chose a pub there and knew our luck was in when the publican said that baby Kathryn could go into the back bar — and that he could provide some filled rolls for lunch. Imagine our surprise when we went up to the bar to order and saw a board nestling behind it covered with QSL cards! We had wondered why the publican had eyed up our Trio 2400 with interest. (In fact when we parked the car, Pete had noticed a long wire aerial strung between the trees and had speculated on it's use.) Of course we started to ask about the cards and were quickly acquainted with Trevor, GW3XZU, of the Britannia Inn, Froncysyllte. (The beer was excellent too!)

After lunch we boarded our narrowboat. The boatyard sent one of it's employees on board to check that at least one of us knew how to drive (Richard, Peter and Graham were old hands at this) and we couldn't wait for him to depart. The first thing we did once we were alone was to rewire the electrics! We had taken a heavy, extensive toolkit filled with all manner of meters, screwdrivers, wirecutters (useful to free wire wrapped around propellers), hammers and spanners. There was a TV socket providing a beautiful 12V supply; the polarity of this was checked and the whole socket quickly and expertly exchanged for a 'chocolate block' connector into which a 2m FM/SSB rig was wired. This was at the front of the boat where the

The happy band. From LHS, Peter, G3VRW, Graham, G3XJM, Kathryn, Pete, G8DCZ, Richard, G3TDL, and Maya.

wires were of the 'standard' red for live and black for neutral. By the back bunks we found another socket and this too was similarly replaced and an FT101 wired in. Unfortunately, when the power was turned on, the rig went up in a plume of smoke. (Artistic license here, but there certainly was a loud bang after which nothing else could be heard — except the sobs of it's owners!)

The wiring was then checked with a meter and it was found that somewhere along the length of the boat, the polarity of the red and black wires had been reversed! Peter and Graham then spent every spare moment, when not steering, cooking on drinking beer, poring over the defunct rig. Even by the end of the holiday they could not find the actual blown-up components. It took somewhat more sophisticated equipment than our humble meter before the rig was dismantled (well, practically) and finally rebuilt in working order.

Check Your Electrics!

On the subject of electrics, check on your fridge if you go 'canalling! It is not a pleasant sight to wake up one morning and see the frozen chickens, that you are keeping for a decent meal later on in the week, de-frost into a watery pool on the floor. We suspected that the fridge may have been fused before we took over the boat, but with our electrical expertise (?) we traced the fault, only to find that our 'extensive toolkit' contained no fuse wire! (We managed to take one strand from a piece of multi-stranded connecting wire and use this.)

Other wiring jobs included such minor details as refixing a BNC connector on an aerial cable. Here our soldering iron came into it's own. So what, you say, but, remember that this is a 12V supply and we'd *only* got a mains soldering iron. However, we had brought this because we had... a petrol-fed mains generator! Buying such a generator just for a holiday would, you'll agree, be a little extravagant but without it you should certainly consider buying/borrowing a 12V iron!

Pack A Portable

Whilst 'mobile' we tended to have one 2m rig at each end of the craft since it is impossible to converse over the length of a narrowboat above the noise of the engine. At the back, our mains generator came into it's own as a stand for a quarter wave 2m aerial! We lost count of the number of passing boats who said to the steersman, "Is that television?"

We did have a problem passing under low bridges, where the generator and ¼ wave had to be snatched off the roof of the boat rather rapidly (it's heavy!) or risk landing in the water. "Why not place the aerial directly on the roof?", you say. Unfortunately for radio amateurs, the roofs of narrowboats tend to be fibreglass nowadays so magnetic mounting antennas won't fix on! At the front of the boat, we had no such problem, fixing a five eights wave vertical with it's mag mount on to the metallic housing of the diesel and water tanks.

We also had two 2m portable rigs for 'ship to shore' communication. It is very useful for someone to go off shopping for essentials (like beer) and to arrange to "meet you at the next bridge", while the rest cruise lazily along. Or so it seemed. From an OS map and canal mapbook, we estimated how long an expedition of this kind should take. Pete and Peter then went off on-foot to the next bridge, where the mapbook showed a pub (sixteen pints of beer were required for a serious evening's drinking afloat). Unfortunately, we must have looked at an old edition of the mapbook, for, when they got to the next bridge, the intrepid pair were confronted with a new ring road and flyover just where the pub should have been. They radioed back to the boat the bad news and decided that, being on the outskirts of Stoke, another pub couldn't be far away and trekked off, keeping roughly parallel to the canal. It actually took a rather long walk, passing a sports club and Conservative club, doubtless with bars, before they found one. After filling the beer containers (and downing a pint each "to give us energy") came the problem of exactly how to get back to the boat. After heading in what they thought was the right direction for some ten minutes, they came to a six foot high fence across their path and had to admit that they were lost! There was a group of lads playing nearby — who at first shouted to them "Are you the Police?", having obviously seen the Trio 2400 — who were able to give Pete and Peter directions. These included getting over the high fence and crossing a very busy four lane dual-carriageway (running the gauntlet while trying not to shake up the beer too much!). They did eventually make it back to the boat — some three miles further on than our anticipated "next bridge"!

The land/water communication was also of great use for passing on information about the state of the next set of locks. Peter and Graham had at least as much fun jumping ashore, across at least three feet of water, and then running on ahead of the boat as they did doing any of the ordinary things, like steering. (Since canal boats only travel at

4mph, it's not difficult to walk alongside if you need the exercise.) This enabled them to set up the locks ready for us, and to let us know whether to tie up first or just cruise straight in. We got the technique down to a fine art (although I personally refused to jump ashore unless the boat was almost stationary and no further than six inches out from the bank!).

Old Friends

The holiday turned out to be quite an occasion for meeting up with old friends. Dave, G3XBX, and his wife were visiting the area while on leave from working on Radio Botswana. Dave had been with Richard, Peter and Graham on their postgraduate electronics course at Southampton University, but all four of them had not met up for several years. Dave knew that we were going to be on the canal and by monitoring S20 and the various local repeaters, he eventually managed to contact us. We arranged a 'sked' for early that evening, when we would be able to see how far the day's cruising had taken us and suggest a suitable pub to meet at. It was lovely to be able to moor up outside a pub and not have to worry about drinking and driving! The evening was such a success that we arranged to meet again the following evening. The beauty of canalling is that you move so slowly that, even after cruising for eight hours, it is an easy car drive (about forty minutes) to catch up with the boat again.

The greatest coincidence was that, while working through a local repeater, Richard was overheard by another amateur who found himself listening to the conversation more closely than usual. Richard had been talking about his time at Warwick University, where he was an undergraduate. The following day Peter, G4TQB, finally contacted Richard on 2m and it transpired that they had been friends doing the same course over ten years ago. Peter had not even been interested in amateur radio at that time but obviously Richard's influence made him consider taking the RAE at a later datel

On our trip we had also taken a nine element 'Tonna' and for 2m portable aluminium mast. When we moored up at night, and after our pub visits, the Tonna and mast came into their own for working any DX. Unfortunately, during our week's holiday conditions were fairly flat but we did manage to work from Cheshire to Ireland and Scotland with 25W on 2m. (Can someone please tell us whether we should have been /P or /M, for, though we were moored, we did tend to drift slightly!)

One night later in the week we could not be bothered (or were we too drunk?) to set up the mast on the shore. We still wanted the advantages of a better aerial but we just couldn't persuade Graham to stand on the roof holding up the beam at midnight! Mounted on the front of the roof the boat had a socket designed for holding a TV aerial. Someone noticed that this would just hold the one inch aluminium pole of the top section of the portable mast. Thus the Tonna was set up and a rig was operated into the early hours of the morning, by which time no one felt like going outside again to remove the aerial.

Next morning, a group of us went off to take photos of Anderton lift bridge while the remainder set about dismantling our aerial system. Oh, the dismay when they found themselves unable to remove the pole from the socket! (That's putting it politely!) We then realised that we had moored overnight by a Cheshire salt works and what is it that corrodes aluminium?! At this point, the heavy duty tools in the tookit came into their own.

Sharon, G6LCC

However, even hammers and sheer brute force were unable to shift the pole. Someone then had the idea that, since the socket was just bolted onto the roof, we could take off the socket and work on the remaining problem at ground level and at our leisure. One bolt came out easily enough but, and isn't it always the case, the second one wouldn't seem to budge...

Mast In The River

The night after this we were back to setting up the mast on shore, while keeping it within arm's reach of the boat in order to rotate the Tonna manually. This had worked well for the rest of the holiday but on this particular night we must have had to moor further from the bank because of shallow water. Rather than run the risk of falling in the canal while leaping on and off the boat to rotate the aerial, especially after an evening of boozing, Pete decided to sink the spike on the lower end of the mast *into the water,* while guying it to the boat and bank as usual. As the night progressed the mast sunk deeper and deeper into the mud, with the boat drifting slightly and the guy ropes coming looser. At about 3am, Pete decided that it was time to dismantle everything. First came the problem that we had drifted an extra couple of feet so as to make leaping ashore rather precarious. Pete managed to leap ashore successfully and untied the guy ropes but then had the problem of getting back on board. Taking courage, Pete leapt back towards the boat, only to find himself slipping, finally landing up with his feet on the bank, with his body straddled across the water and with his hands gripping tenuously onto the boat — which under his pressure was trying to drift even further away!

As you can see, we had a great holiday and booked up to go canalling again this year in Oxfordshire. In fact, you may have contacted us in the last week of July! This year Kathryn is walking and loves pressing buttons, on rigs as well as on her toys, and pulling wires, though she isn't supposed to. So, if we're suddenly cut off in mid-over, QRX a moment while we sort out the problem!

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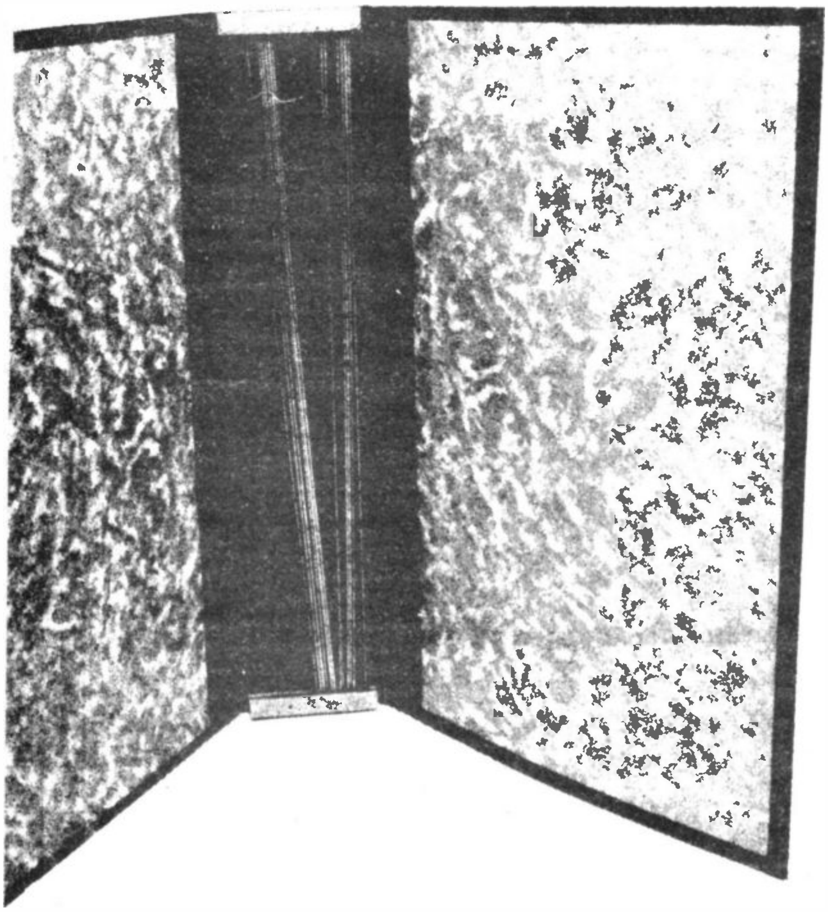

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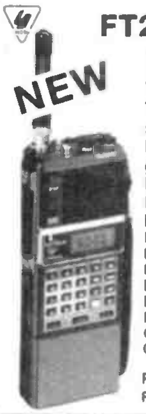

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FEATURES

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. . . or just those of you who sometimes think "I could do better than that!"

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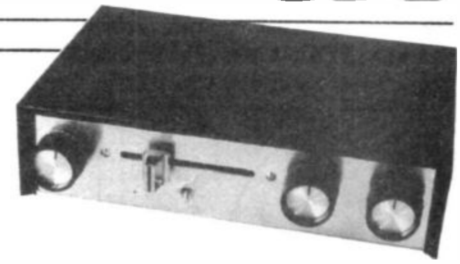
The SUPERNOTCH

The 'Supernotch' will dispose of those nasty heterodynes that always appear when you're having a really interesting contact on the HF SSB and also acts as a bandpass filter on CW with variable bandwidth down to under 100Hz. Design by Stephen Price, G4BWE.



A bugbear of modern general coverage receivers and SSB transceivers is that the rig's product detector, has the rather annoying habit of converting any stray carrier that falls within the IF passband into an audible heterodyne. Murphy's Law dictates that such interference will typically be generated by a transmission much louder than the one you are attempting to listen to and the frequency of the rogue carrier will inevitably be that which gives rise to the piercing, high pitched whistle!

These whistles, often caused by careless operators 'tuning up' on a frequency very close to that occupied by the station of interest, can prove particularly irritating. A really loud heterodyne will tend to 'mask' the wanted signal so that 100% copy becomes virtually impossible. The persistent monotone delivered by the receiver's loudspeaker is far more likely to induce a headache than the notorious Russian 'woodpecker'!

Clearly, a specialised filter, capable of rejecting, or 'notching out', unwanted heterodynes is called for. Such a filter must be made continuously tunable over at least one decade, so that a heterodyne appearing anywhere within the accepted voiceband of 300Hz to 3kHz may be readily eliminated.

This article describes an active audio filter of only moderate complexity which adequately meets the above specification. It is designed to be constructed as an add-on unit that will couple between the rig's loudspeaker socket and an external loudspeaker. Furthermore, use of very versatile design techniques has made it possible to incorporate a tunable bandpass filter option, featuring variable bandwidth. The bandpass function may be used on its own to provide an effective CW filter, but should also prove useful as a tuning aid for the notch facility.

Principles of Operation

The Supernotch utilizes an extremely flexible type of active filter known as the 'state variable'. **Fig.1** illustrates, in skeleton form, a state variable filter section based around three op-amps, labelled A_1 to A_3. A_1 serves as a summing amplifier which adds the input signal, fed to its inverting input via R_A, to a positive feedback voltage, derived from the output of A_3, via R_C. Negative feedback is also presented to A_1 via the potential

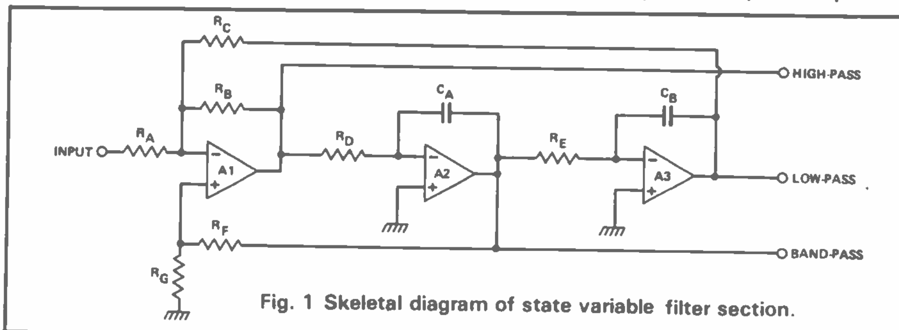


Fig. 1 Skeletal diagram of state variable filter section.

divider consisting of R_F and R_G. A_2, working in conjunction with R_D and C_A, operates as an integrator. This stage produces a phase shift precisely 90 degrees at a frequency where the value of R_D is equal to the capacitive reactance of C_A. A second, identical integrator, comprising A_3, R_E and C_B is cascaded with the first, thus generating a total phase shift of 180 degrees.

The values of R_A, R_B and R_C are made equal so that the summing stage provides unity gain. The degree of negative feedback, set by the ratio R_F/R_G determines the filter's damping factor, or 'Q'. Indeed, if R_F and R_G were to be omitted, thus removing all negative feedback from the circuit, the filter would become a free running oscillator.

The filter is most easily tuned by varying the values of R_D and R_E in unison, thus allowing C_A and C_B to remain as fixed value capacitors. Continuous tuning may therefore be provided by substituting R_D and R_E with a twin-gang variable resistor.

Perhaps the most useful feature of the state variable filter is that it provides simultaneous lowpass, highpass and bandpass outputs. At resonance, the action of the two integrators produces a phase differential between the lowpass and highpass output voltages of exactly 180 degrees. This fact may usefully be exploited in order to generate a notch characteristic using the network shown in **Fig.2**. The lowpass and highpass outputs are summed in equal proportions so that at resonance, where the output voltages are in antiphase, complete cancellation occurs. The resultant response curve, produced using a filter tuned to 1 kHz and having a Q

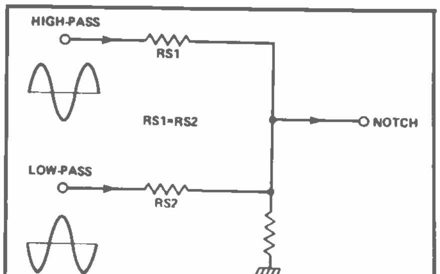


Fig. 2 Network for producing a notch characteristic.

of 5, is depicted in **Fig.3**. As the curve clearly shows, very high attenuation is achieved at the centre frequency but despite this fact, only those frequencies within the range 900Hz to 1.1kHz are attenuated by more than 3dB.

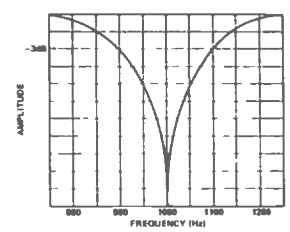


Fig. 3 Response curve using a 1 kHz tuned filter with a Q of 5.

It is possible to sharpen the notch by simply increasing the filters Q. However, although the attenuation of adjacent frequencies would be considerably reduced by such a measure, the filter becomes far more difficult to tune precisely. In practice, a Q of 5 is more or less optimum. Ignoring for a moment the effect of any heterodynes themselves, the intelligibility of 'phone' transmissions is not noticeably affected by the presence of the notch.

The Practical Design

The complete circuit diagram of the Supernotch is shown in **Fig.4**. Audio from the rig's external loudspeaker socket is first attenuated by the potential divider comprising R1 and R2. This measure helps prevent overloading of the filter by the rig. C1 and C2 serve to strip the input voltage of any RF. IC1a is the state variable filter summing block which operates in conjunction with the two integrator stages that are built around IC1b and IC2a. In order to tune the filter, R9 and R13 are connected in series with gate controlled switches IC3a and IC3b. The tuning arrangement operates as follows:

IC5 functions as an oscillator with its output connected directly to the control pins of the two switches. A series of positive going pulses is generated by IC5 and the repetition rate of these pulses is controlled using RV3. Let us assume that the pulse width is 1uS, and also that, RV3 has been so adjusted that the pulses repeat once every 4uS. The two switches will be held closed during each 1uS period and for this time current is free to flow through R9 and R13. In the absence of a pulse, however, the switch control pins are held at ground potential and this has the effect of opening the switches so that R9 and R13 are taken out of the circuit. In this example, therefore, the integrator resistors pass current for only 25% of the time occupied by each switching cycle. The time averaged effect of such action is to make the integrators behave as though R9 and R13 are four times their true value, ie 8.8kohms.

It should now be clear that by suitably varying the pulse repetition rate, or 'mark space ratio' of IC5's output, we can tune the filter over a wide range of frequencies. RV3 provides coarse tuning and operates in conjunction with the fine tune control, RV4. D1 is included so as to separate the charge and discharge paths of the timing capacitor, C17 (the charge path being provided by R21, RV4 and the discharge path consisting of R20, RV3). Therefore, RV3 determines the pulse repetition rate, and RV4 provides fine tuning of ± 10% by slightly altering the pulse duration.

A Strange Arrangement

In order to obtain a linear tuning characteristic, RV3 must obey an antilog law. Difficulty would be experienced, however, in obtaining such a specialised component and so the problem has been solved by using an ordinary log slider potentiometer, mounted 'upside down' so that it provides an antilog law. This may sound a trifle strange at

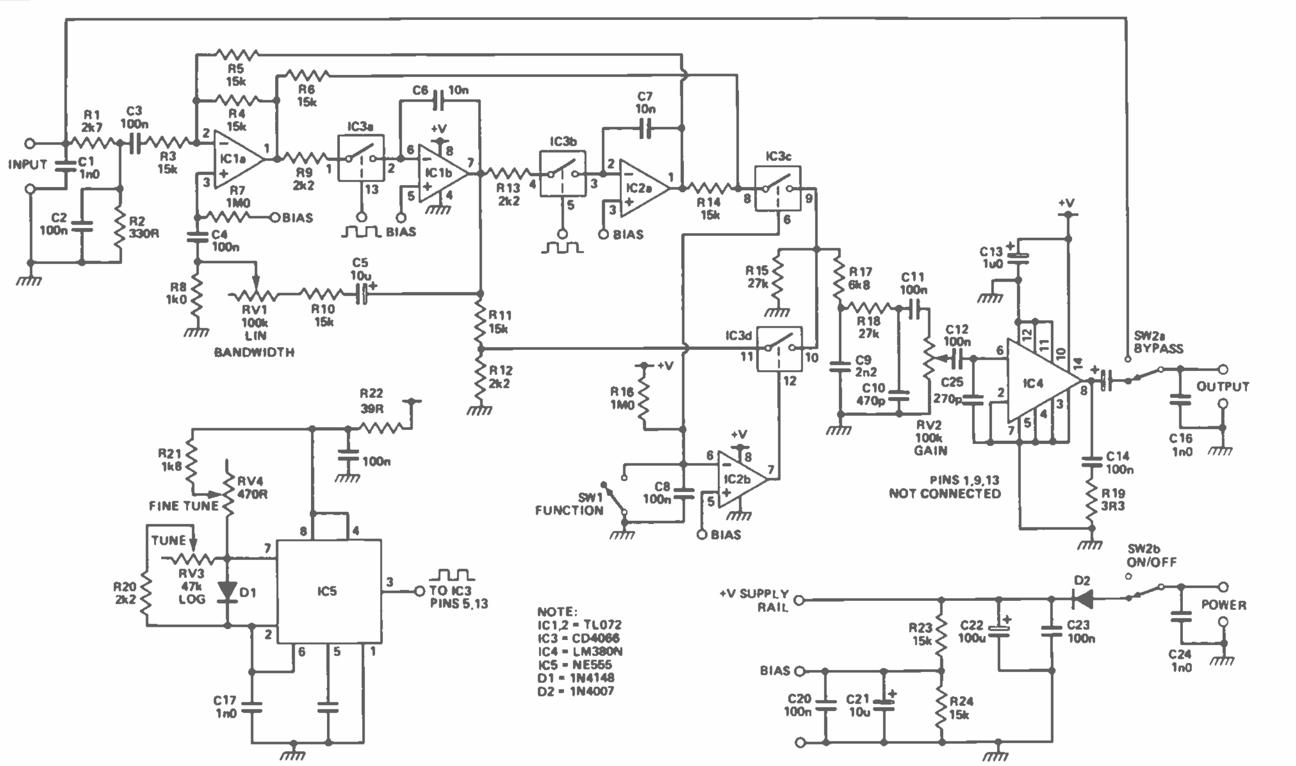


Fig. 4 Complete circuit diagram for the Supernotch.

first but readers may rest assured that the arrangement works perfectly! A total tuning range of 260Hz to 3.6kHz is achieved, and the use of IC3a, b and IC5 enables single gang variable resistors to be used for both fine coarse frequency control.

R6 and R14 are the summing resistors used to obtain a notch by combining the lowpass and highpass outputs of the filter as discussed earlier. The filter's bandpass output is first attenuated by the potential divider comprising R11 and R12 before being fed to IC3d.

IC3c and IC3d operate in conjunction with IC2b which is wired as a logic inverter, to provide function switching as follows: if S1 is open, pin 6 of IC3 will be held high (logic 1) by R16. The analogue gate within IC3c is therefore closed and the notch output flows from pin 8 to pin 9 without attenuation. R16 also maintains the inverting input of IC2b at rail voltage, causing the IC2b output (pin 7) to remain at 0V which, in turn, keeps IC3d open, thereby preventing the bandpass signal from passing between pins 11 and 10.

Conversely, when S1 is closed, pin 6 of IC3 becomes grounded, thus opening the analogue gate IC3c, which prevents the notch signal travelling any further. The output of IC2b now goes high and so closes the analogue switch IC3d. This allows the bandpass output to pass freely from pin 11 to pin 10 of IC3.

R18, R17, C9 and C10 form a simple lowpass filter which provides an attenuation of 6dB at 10kHz. This network has very little effect on the signals of interest but serves to attenuate high frequency ripple generated by the frequency control system described earlier. RV2 is the gain, or 'volume', control feeding an audio output stage, IC4. C14 and R19 comprise a Zobel network to stabilise IC4, with C15 providing DC blocking. The filter will therefore drive an extension loudspeaker of 4-16 ohms impedance. Alternatively, headphones may be fed via a 100 ohm series resistor.

RV1, which may be considered as a bandwidth control, varies the Q of the filter over the range 5 to 40. For a particular Q setting, the −3dB bandwidth of the filter will depend on the centre frequency set by RV3 and RV4. The relationship is given by:

$$\text{Bandwidth} = \frac{\text{Frequency}}{Q}$$

Therefore, if the filter is tuned to 1kHz and RV1 is set to produce a Q of 10, the resultant −3dB bandwidth will be 100Hz.

In order to achieve the optimum notch bandwidth, RV1 should be set at a minimum resistance to produce a Q of 5. Increasing the Q beyond 5 will simply make the notch more difficult to tune, as discussed previously. The bandwidth control really comes into its own when the filter is switched to bandpass mode, for CW reception. **Fig.5** illustrates this point by showing the response curves obtained for Q values of 5, 15 and 40; the filter being tuned to 1kHz. The ultimate rejection ratio improves quite dramatically as Q is increased, and at Q=40 it exceeds 30dB. The price to be paid for such performance is that the −3dB bandwidth becomes very narrow. At the maximum Q of 40 it is only 25Hz and this has the effect of making CW, particularly fast CW, sound somewhat slurred. The intelligibility of most transmissions will not be impaired, however, and the sound imparted by the filter is pleasantly musical. Tuning the filter in bandpass mode is most easily accomplished by first advancing RV1 slightly so as to set the Q at approximately 10. The signal of interest may then be peaked with RV3. If sharper filtering appears necessary it is now a simple matter to advance RV1 further towards the maximum Q of 40. Finally, the signal may be centred more precisely within the narrow bandwidth thus obtained by careful adjustment of the fine tune control, RV4. Increasing the filter's Q also raises the voltage gain of the system. Therefore, it may prove necessary to reduce the volume using RV2.

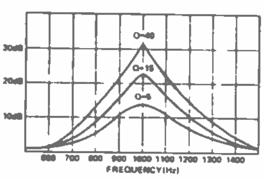
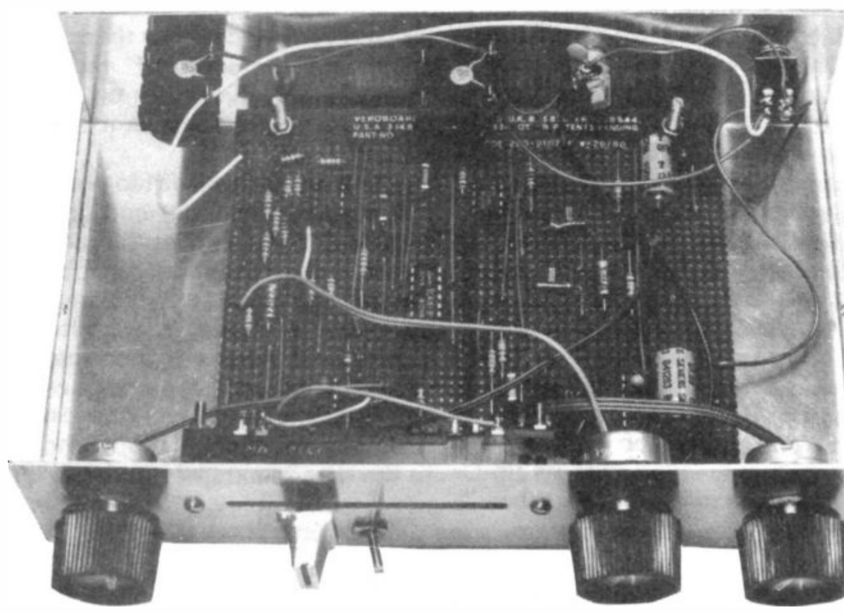


Fig. 5 Response curves for Q values of 5, 15 and 40.

S2d enables the filter to be bypassed so the the receiver's output is fed directly to the expansion loudspeaker. S2b disconnects the supply rail when the filter is bypassed, thereby eliminating the need for a separate on/off switch.

D2 provides supply polarity protection (ie D2 will not conduct unless the supply is wired the right way round) and C22, 23, 24 provide extensive supply rail filtering. A bias voltage for the op-amps is generated using the potential divider R23, 24 and this is decoupled by C20 and C21.

The Supernotch requires a stabilised power source of between 12 and 15 volts DC, capable of supplying at least 1A peak. A regulated, 13.8V mains PSU may therefore be employed.



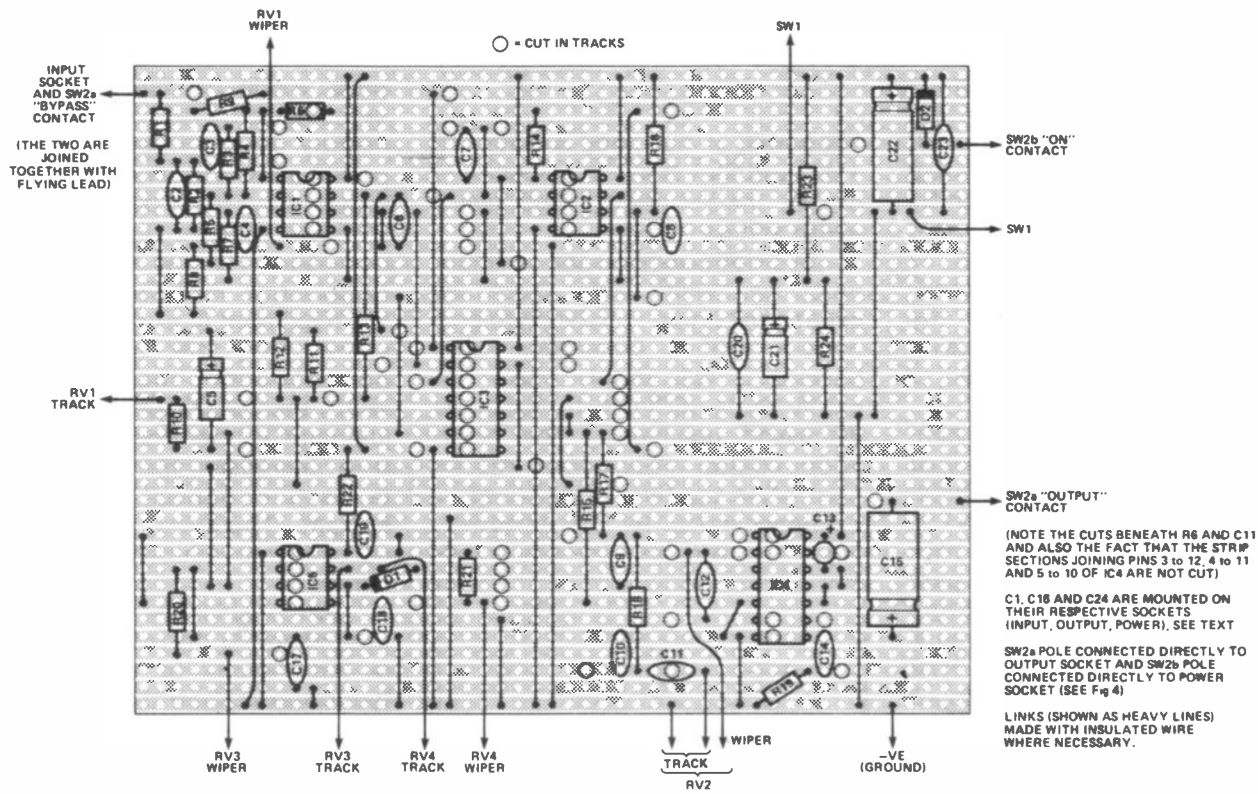


Fig. 6 The overlay diagram for the Veroboard circuit.

Construction

Apart from the six controls (RV1-4, S1-2) and three sockets (input, output and power), virtually all the components may be mounted on a single piece of 0.1" matrix veroboard measuring approximately 5" × 4.75". It is perfectly acceptable to mount IC1, IC2, IC3, and IC5 in dil sockets but IC4 *must* be soldered in place as pins 3 to 5 and 10 to 12 of the LM380N are used to carry heat away from this device. The vero strips to which the aforementioned pins are soldered should, therefore, be left uncut for a length of at least 1" on either side of IC4, thus making a small heatsink. C13, a tantalum electrolytic, serves to decouple IC4 and so this capacitor should be mounted close to the IC supply pin (14). C1, C16 and C24 are small disc ceramics used primarily to provide RF decoupling. They should preferably be soldered across their respective sockets (input, output and power), rather than being mounted on the veroboard.

The authors prototype is housed in a "Norman" multi-purpose cabinet type WB2 of aluminium and steel construction. Other types of enclosure, either commercial or homebuilt may, of course, be utilised, but it is important that the casing is fully screened. Plastic or wooden cases must, therefore, be avoided. Screening is necessary for two reasons. Firstly, it is desirable that the Supernotch should remain immune to transmitter radiation — it may, after all, be forced to operate alongside a 200 watt HF transceiver! Secondly, there is a significant amount of radiation from IC5 and this might be picked up by the station receiver if there is no screening.

The prototype is fitted with ¼" jack sockets for input and output, plus a 3.5mm socket for power. Other types of socket (eg phono) are equally suitable, but whatever sockets are chosen for input and output it is always a good idea to employ a different type of power.

Finally, screened leads *must* be used for coupling the Supernotch to the rig and external loudspeaker.

Testing and Use

Initial testing is best carried out before the circuit board is installed within the case and with the switches, sockets and potentiometers connected to the veroboard using short lengths of flying lead. Having first placed the board on an insulating surface, power may be applied so that the presence of supply voltage on pins 8 of IC1 and IC2, pins 14 of IC3 and IC4 , plus pins 8 and 4 of IC5 may be checked with a multimeter. The bias voltage (half supply + 10%) may also be measured on pins 3 and 5 of both IC1 and IC2, although the presence of R7 will result in a lower reading at pin 3 of IC1 unless a very high impedance multimeter is employed.

In order to verify correct operation of the oscillator, the multimeter may be connected to measure the DC voltage at pin 3 of IC5. Alterations to RV3's setting should now cause the output voltage reading to vary in sympathy over the range 500mV to 6V, approximately. Rotating the spindle of RV4 will produce much smaller but nevertheless noticeable variations in the reading.

On completion of the above voltage checks the filter may be connected between the rig and a suitable loudspeaker as for normal operation. A stable test tone is most easily generated using the rig's own calibration oscillator. If the rig does not have an xtal calibrator, simply tune to one of the strong AM broadcast stations at the top end of 7MHz and use the station's carrier, to provide a free test tone.

Firstly, adjust RV1 for a Q of 5 (minimum resistance setting) and RV2 for maximum volume. With S1 open (notch function) it should now be possible to find a setting of RV3 (tune) that causes the level of the tone to dip quite noticeably. Once this point has been found, careful adjustment of RV4 (fine tune) will make it possible to eliminate the tone almost completely.

Once the correct operation of the notch has been verified, S1 may be closed in order to provide a bandpass response. Advancing RV1 so as to increase the Q will now cause the tuning to become much sharper and will also boost the level of the tuned tone.

While carrying out the optional checks described above, a number of spurious responses will probably be heard. However, when the Supernotch is finally installed in its screened case, such interference will almost certainly disappear.

Complete familiarity with the six controls will, inevitably, take some time to acquire. But once operation of the filter has been mastered, the author is confident that the Supernotch will quickly become an indispensable station accessory.

Components Listing

Resistors

R1	2k7
R2	330R
R3,4,5, 6,10,11, 14,23, 24.	15k
R7,16	1M0
R8	1k
R9,12,13, 20	2k2
R15,18	27k
R17	6k8
R19	3R3
R21	1k8
R22	39R
RV1	100k Linear
RV2	100k Log
RV3	47k Log (Slider) *
RV4	470R Linear

* See Text

All resistors are carbon or metal film, 0.33W 5%

Capacitors

C1,16,24	1nF Ceramic
C2,3,4,8, 11,12,14, 18,19,20, 23.	100 nF Ceramic
C5,21,25.	10uF electrolytic
C6,7	10nF polyester 5%
C9	2.2nF polyester
C10	470pF Ceramic
C13	1uF Tant bead 35V
C15,	220uF, 25V Electrolytic
C17	1nF polyester
C22	100uF, 25V Electrolytic

All polyester capacitors are 10% unless otherwise stated.

Semiconductors

IC1,2	TL072 (8dil)
IC3	CD4066
IC4	LM380N (14 dil)
IC5	NE555
D1	1N4148
D2	1N4007

Miscellaneous

S1	SPST
S2	DPST

Case, sockets, control knobs, veroboard (see text).

REVIEW:
KW Ten-Tec Corsair

Tony Bailey, G3WPO, put the KW Ten-Tec Corsair HF Transceiver to work in his shack and found the American approach to RF technology an interesting contrast to that of the Far East.

Since the conception of *Ham Radio Today*, I have reviewed a number of transceivers, all of Japanese origin — hardly surprising since they seem to dominate the market these days. There was a time many years ago when you could go out and buy transceivers of UK origin, and the name that comes to mind is that of KW Electronics. Many of you I am sure will remember the KW2000 series (I have an old faithful 2000A still in use) and the higher power Atlanta, all of which gave many people their introduction to a commercial transceiver.

As usual, the Japanese caught on to the potential of the Amateur Radio market and, gradually, today's situation was reached where the amateur is ensnared in the marketing techniques of the consumer electronics industry. Each manufacturer competes to provide more and better (necessary?) 'facilities' than the competition — today's transceivers now have 'memories', synthesised VFO's and a lot more lights than they used to. The only snag is that few of these facilities actually assist operation when you come down to it. The whole idea of our hobby is to communicate, and to do that we need to hear the signals!

It is fair to say, I think, that the average 'synthesised' modern transceiver generates more internal noise than its predecessors, often masking weak signals (sometimes also generating some of its own!). Is this progress, we must ask ourselves?!

Back To Basics

KW Electronics is not a name as familiar to the present day amateur as to those more dyed-in-the-wool types — like me! They have now reappeared in the guise of KW Ten-Tec Ltd, to market some of the American Ten-Tec Inc products. Ten-Tec (or Tennessee Technical, which is their full name) are well known in the USA for their HF transceivers. Perhaps especially for those manufactured for the QRP market. Names such as the 'Argosy' or 'Omni' will be known to some UK amateurs, although the best known Ten-Tec creations here are probably the various marques of the 'Argonaut' — a rig which introduced many people to the joys of QRP operation on HF. The subject of this review is the CORSAIR, their top-of-the-line HF rig, covering all bands from 160 through to 10m, including the WARC bands, on SSB and CW.

The immediate thing you notice on unpacking the Corsair and its associated power supply is that here is something different. It is obviously not of Japanese origin — the styling is totally different (see photo) and there is an immediate feel of quality to the whole thing. Perhaps a slight hint of Drake styling about the front panel . . .

At this point I should mention that the Corsair is not for those who expect all the latest gimmicks for the £800 odd they will have to fork out to get one. The Corsair doesn't have any memories, or multiple VFO's, or general coverage facilities. What it *does* have is *all* the necessary facilities for modern day operation, whether SSB or CW, including excellent receive sensitivity and dynamic range, purity of signals, and stability. I suspect that KW kept memories of their previous range in mind when looking around for suitable equipment to sell.

Hooray . . . No Synthesiser!

The first thing you will observe from the manual, and from listening to the signals is that there is just a

plain, ordinary, down to earth mixer type VFO! And you will notice this from listening by the high *purity* of the received signals. It covers all the existing amateur bands in full with some overlap in the 500kHz VFO swing — hence the 28MHz band is covered in 4 segments. Linearity is good, if you use the analogue dial marked round the main tuning knob, but not a major problem as it does have a digital display, reading to 100Hz.

An interesting feature, which the manufacturers obviously like, but I don't, is that the 100Hz digit is green, whereas all the others are red. I found this tended to be more annoying than helpful as the digit was usually moving up and down by a unit and this tended to catch my eye. This latter phenomena is not a fault, just typical of the type of display circuitry used. There was an actual fault on the display which caused erratic readings at some points, but I am assured that this is not typical by KW Ten-Tec.

What It Does

So, what do you get for your money? The Corsair runs 200W input (12 — 14V DC) for an output of 85-100W typical according to the manual. These figures were maintained in practice with a maximum of over 120W obtainable on *all* bands, not even dropping off on 10 metres! The lowest power obtainable was under 30mW, if you are a QRP fan.

The interesting point is that the power output figures are quoted for a 100% duty cycle, for up to 20 mins. After running into a dummy load for 15 mins at 100W output on 20 metres the PA heatsinks were quite hot but no major problems seemed to arise. KW have a scheme whereby a sliding scale of charges for replacement of the PA transistors operates — if they fail within twelve months, replacement is free; up to twenty four months, replacement is at one third the current price . . . and so on. That being said, KW inform me that they have *never* had to replace any PA transistors on the Corsair or the Ten-Tec Omni series of transceivers, which also used the MRF458 transistors.

The Corsair will appeal primarily to the CW operator — it has full break-in' operation (QSK) for the mode, and this works well. 'Break-in' is the CW equivalent of fast VOX operation — you can hear what is going on in between characters (well, between dots actually) so the other operator can interrupt you whilst you're transmitting if they want. You can also hear any 'lids' that come up under you calling CQ as well!

For this mode, two settings are provided — 'fast' and 'slow'. In 'fast', the circuit allows the receiver to recover between dots for really fast break-in (ie contest) operation, but in slow mode, the recovery is much slower to suit which you don't want to listen between individual dots, but only between character pauses. There is some slight 'clicking' from the circuit in operation but this is not objectionable and is at low level.

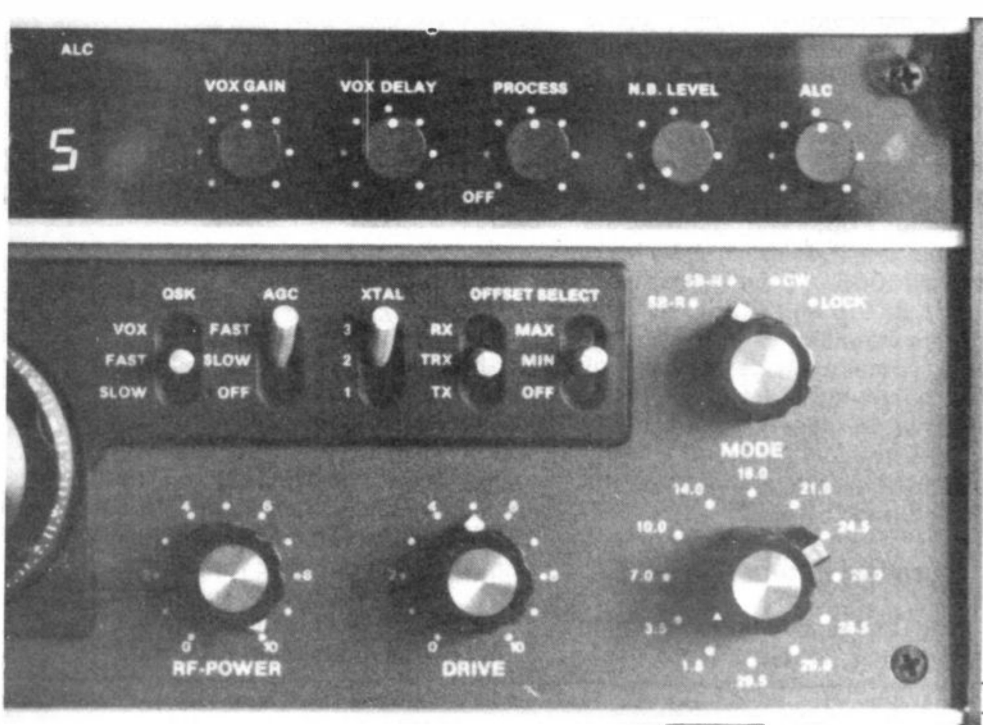
To achieve this break-in operation the Corsair uses electronic antenna switching — the PA is permanently connected to the antenna (via a low pass filter network to prevent signal loss), and a pair of PIN diodes (actually they are 1N4007 rectifier diodes which have the characteristics of PIN diodes — and are much cheaper!) connect the receiver to the antenna. Electronic switches then bias off the Rx side (with suitable delays to prevent 'clicks') every time the key is pressed.

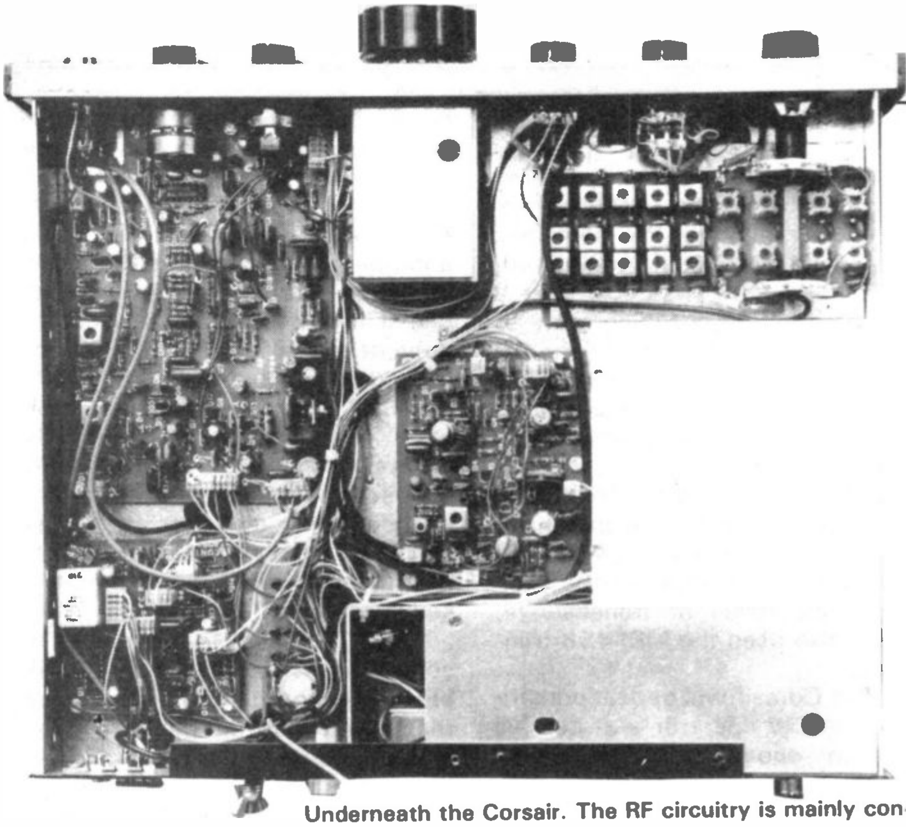
Ten-Tec seem to have gone to some lengths to prevent any possible noise contribution on receive that may result from the PA still being connected to the antenna. Normally, you just bias the PA off but leave the volts on it. In the Corsair, an additional reed relay disconnects the PA from the PIN receive switch/antenna a very short period after you release the key. This relay stays open all the time you are receiving, closing *instantly* as the key is pressed.

Around The Circuit

As already mentioned, the Corsair features a touch of 'back to basics' as far as the use of a 'mixer' VFO is concerned, although the overall design approach and techniques are very definitely modern, particularly with regard to the receive side which is aimed at handling strong signals. A basic VFO covering 5-5.5MHz determines the overall stability of the Corsair. This is not capacity tuned however, but is a *permeability tuned* circuit, where the inductance is varied instead. The output from this is mixed with an appropriate crystal to generate a frequency either 9MHz above or below the wanted frequency, suitable for mixing later with the IF module. Each output from the mixer/VFO module is filtered by bandpass circuits to reject the unwanted mixer products. The only exception to all this is on 20m where the PTO output is mixed directly with the 9MHz IF (9 + 5 = 14).

The stability of the VFO is excellent — there is a little warm up drift, but perfect stability is achieved after this. Quite normal of





Underneath the Corsair. The RF circuitry is mainly constructed on a number of rugged PCBs.

course, but an unusual feature if you have been used to stepped synthesiser rigs which tend to be rock-stable from switch on — but with other disadvantages, as I mentioned earlier.

Signals from the antenna meet a bandpass filter network (switched for each band) before passing to the input RF section. Here, a choice of an RF amplifier or an attenuator is offered, routed by PIN switches. The basic sensitivity of the Corsair is 0.25uV or 10dB S/N + N with the RF amplifier in. With the amplifier out, and the attenuator in, this reduces to 0.8uV. The latter figure is more than adequate on the lower HF bands, but not really enough on 15m and up, so you will probably find the preamp needed on the latter. Without the preamp in, the dynamic range was measured as 92dB (two tone, 100kHz spacing) which is as good if not better than most other transceivers. A front panel RF gain control is provided if required.

The output from the bandpass filters also drives the frequency counter circuitry, which takes into account the difference between USB and LSB settings, and also any IRT etc, in use.

From this point in the circuit, the signal paths depend on whether the Corsair is operating in transmit or receive. The RF input side is bi-directional for this purpose, as is the mixer. On receive, the low level 9MHz signals first meet a noise blanker before any narrow band filtering is done — this gives the best chance of blanking noise pulses. After the blanker, the first IF narrow band filter is met — in the standard Corsair, this is a 4-pole lattice type, actually built up from individual crystals on a plug-in board. This is *not* the main selectivity incidentally, and an 8-pole type can be fitted for better adjacent-channel signal rejection.

The main IF selectivity is achieved through further multi-pole crystal filters, and a maximum of four filters can be used, for a selection of bandwidths. Again, these are not the usual hermetically sealed units you are used to seeing in Yaesu equipment, but consist of sets of single crystals to build up a narrow band lattice filter of the correct bandwidth, mounted on a pluggable PCB. The bandwidths available are 2.4kHz (1.7:1 shape factor 6/60dB, 12 pole), with optional 1.8, 0.5 and 0.25kHz. With all filters installed, as in the review model, you actually get a choice of three bandwidths from the front panel switch, depending on mode. For SSB, the 2.4, 1.8 and 0.5kHz filters can be used, and for CW, the 1.8, 0.5 and 0.25kHz.

Variable Filters

The Corsair also features 'Passband' tuning, where a front panel control adjusts the position of one of these latter filters with respect to the first IC filter. In the case of the wider filters on SSB, you get the effect of a normal variable bandwidth control, allowing the bandwidth to be narrowed from either the high or low frequency side of the signal. When using the narrower filters, you need to retune (using the RIT) to find the signal again after using the control.

The main IF amplifier uses discrete semiconductors for the majority of its gain, and chips for the audio side. The AGC system is audio derived and features a 'hang' type circuit. This is one of the most effective circuits ever developed for SSB and CW use, probably most recognisable in the Plessey 620 series AGC generators. If you have never used a rig with this type of AGC it may be a little strange to 'hear' at first. A normal very rapid attack brings the AGC voltage to the required level quickly. When the signal goes, the voltage 'hangs' for a short period (about 2 seconds) — if the signal does not reappear within this time then the voltage rapidly decays to zero in a few tens of milliseconds. However, if the signal reappears, then the AGC maintains its level. This way you don't get a burst of noise in between speech pauses or CW character breaks. There are of course times when you may want a rapid decay, and the front panel allows for this with a 'fast'/'slow' (and OFF) control. In 'fast', the voltage decays very rapidly (0.2 secs) once the signal has gone. An audio notch filter, tunable from the front panel, is contained within the AGC loop and has a measured 53dB notch depth. The S Meter also derives its drive from the AGC system and is calibrated for 50uV = S9.

Sproggies

As with any RF mixing system (ie the majority of transmitters, receivers and transceivers), there are spurious responses generated within the Corsair. Most are very weak and easily lost below the receive noise level when operating. The manual is actually very honest in telling you the spot frequencies that may cause problems! 1.838MHz is mentioned, but nothing was inaudible on this sample, also 21.3, on which the 'sproggy' just about moved the S Meter and 28.98MHz, the worst at S7. However, you can tune to the low end of 29 – 29.5MHz band for this frequency, where there is no spurious response.

On Transmit

The transceiver can use high or low impedance microphones for SSB but one is not supplied with the basic rig — for this review, a Shure 444 was used. The mic socket is the standard Yaesu 4-pin type. The usual VOX facilities are incorporated in the rig, with the gain and delay adjustable on a series of small pots to the right of the display. As the CW 'break-in' circuit is used on SSB there is no major relay clicking going on whilst using VOX, a nice change from some rigs. I say 'major' because although the small relay used in the break-in circuit is very quiet indeed, there is another relay, used for control of external accessories such as a linear, which operates when changing from transmit to receive and vice versa. This does make a very quiet click which I didn't find objectionable — apparently, if you are annoyed by this, the cure is to remove it!

Speech processing of the audio clipper/compressor type is built in and was found to be effective, without any of the distortion, spatter etc often associated with such processors, providing you don't overdo it. The level is again adjustable on the front panel and there is a meter indication facility when you wish to set the compressor up.

The processed audio is mixed with the 9MHz carrier injection oscillator (BFO) to give DSB which passes through the first IF filter to generate SSB, is then mixed up to signal frequency in the bi-directional mixer, and thence to the PA strip. Low level RF is generated in the driver stages, together with the ALC system, before amplification up to full power in the PA, which uses a pair of MRF 458's. RF power finally reaches the antenna via the PIN switch already described, and a switchable low pass filter network. A separate filter is used for each band.

For CW use, there is both adjustable level and pitch for the sidetone circuit. For the purist, true sidetone means that you are actually listening to a small portion of your transmitted signal. Like most rigs, the Corsair uses an independent sidetone generator, based on a uni-junction transistor, and I wouldn't have thought this would worry anyone. Both the controls are accessible through a hole in the base of the cabinet — set as it arrived the speaker nearly broke with the level, which is independent of the normal volume control!

Other front panel controls not mentioned are the RIT facilities which are selectable to operate on Rx, Tx or both and incorporates control with two positions. In the 'min' position, the RIT swing is about 1.8kHz, and in 'max' about 5.1kHz — useful when operating. It also gives you enough swing to work split frequency pile-ups with only one VFO.

ALC level, Blanker level, 'mode' (SB-R, SB-N, CW and 'Lock') and Power are the other controls. SB-R etc refers to Sideband Normal or Reverse — the Corsair automatically comes up with the correct sideband for the frequency in use. The purpose of the 'Lock' control is for tuning-up, checking SWR etc (on the built in SWR/Power meter). The 'Power' switch is the on/off control and removes power from the rig when pulled.

A phone jack is provided for headphones and disconnects the internal speaker when used. The latter is of quite acceptable quality and could just about cope with the output of the audio amplifier at full gain.

At The Back

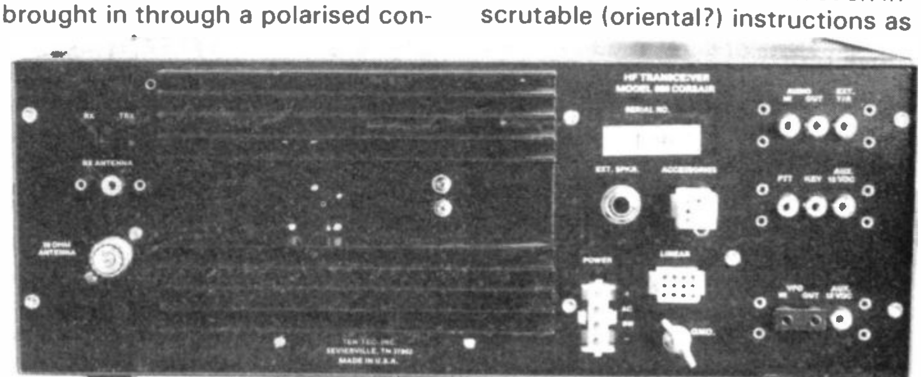
Like most transceivers, the rear panel of the Corsair has an assortment of sockets. The main power is brought in through a polarised connector (spare connectors are provided for extra leads). The current consumption of the rig demands a PSU capable of delivering 18 amps at 12-14V DC, and, as pointed out in the instructions, should have some form of electronic fuse to prevent accidents. A Ten Tec supply (model 260) came with the review sample, and was perfectly capable of meeting the demands on it. It also has an internal speaker which can be used instead of the internal main cabinet one. The response of this is a little toppier because of the smaller effective cabinet, but has the advantage that the speaker output is facing you, rather than emanating from within the main cabinet via louvres in the sides and underneath.

A ground terminal is provided, together with sockets for a key, Aux 12V (12V out), Accessories (external VFO etc), Linear (provides bandswitching voltages etc for the Companion Ten-Tec Linear), Audio in/out (speaker and mic connections), VFO in/out (for remote VFO), PTT and external speaker connections. There is also provision for using an external receiver, or separate receive antenna, with the appropriate switching.

Manual Matters

One of the most important things about your rig is the instruction manual. Now, I know that most people think they can get away with just switching on and actually using the rig! However, there comes a time when you will have need of the manual, either when something goes wrong, or when you can't get the hang of one of the controls (*See our new fault finding series — Ed*). It therefore helps if you can understand the written word.

We are all familiar with such inscrutable (oriental?) instructions as



From the back.

'the control turning back clockwise will remove the oscillations from the amplifier at the innermost setting'. Fortunately, the makers of the Corsair are of English descent, and have almost mastered our language (they spell it funny at times, though). Seriously, the manual is very readable and without any such funnies. In fact, it is an excellent manual, and Ten-Tec are to be congratulated on it. The manual runs to some 48 pages, opening with condensed operating instructions and performance specification, followed by detailed instructions on all aspects of operation.

A section of the manual I found particularly interesting is entitled 'An Important Message'. I quote from this — "To obtain top performance from your Corsair, we feel you should be briefed on new technology such as solid-state no-tune RF amplifiers. Misconceptions sometimes arise from incomplete knowledge which results in erroneous conclusions being drawn that the equipment is faulty, erratic, or not performing to specification. It is the purpose of this message to inform you in these areas so that you can knowledgably approach and correct any apparent improper performance characteristic." This section then goes on to give 10 points about the Corsair, mainly with regard to operating conditions *and solid state PA's*.

I mention all this because from letters and conversations I have, it is apparent that there are a lot of people out there who expect a 'solid state' rig to be capable of connecting straight to *any* antenna and then work. I know from one conversation that this misconception was due to the fact that the rig was described as 'broadband', and he therefore thought it meant that the rig could drive any antenna — "it takes lots of current but doesn't give much output" . . . .

Of course if your antenna is anything other than 50 ohms, you will need an antenna matching unit between this and the transmitter for correct operating conditions. This is not unique to the Corsair — it applies to *any* solid state rig, so if you are not sure about this, get a good radio book and read about it until you are. In any event, read the manual before operation.

Continuing with the manual, there is a short description of each of the PCBs within the rig, together with a photo, circuit diagram and major voltage checks. If you are familiar with this type of circuit design, you should be able to follow everything quite easily.

In Use

The Corsair was used for a period of several weeks, mainly on CW as this is my preferred mode, and I suspect the major input in its design features. A modified TransMatch matching unit and a full size G5RV antenna provided the other end of the system, nothing special so that the results should be reproducable by most people.

I can honestly say that the rig was a delight to use in virtually all respects, only let down by the fact that the excellent on-paper noise blanker refused to do anything most of the time, even on very strong woodpeckers (S9 + 40 — no effect), but occasionally coped with equally strong ignition interference. Possibly a fault I thought but a chat with KW seemed to indicate that this was normal. I know this is not an unusual phenomena — there are plenty of other rigs with useless blankers, but why bother to fit them?

Sensitivity was more than adequate on most bands without the amplifier in, except on 15 and 10 meters, and 20 when it was quiet. No trace of intermodulation products were noticed on 40 metres, always a good testing ground, and weak signals could be heard right down to the noise level at night. Mentioning noise levels, some people may be surprised at the standing white noise coming from the rig via the speaker in the absence of signals. This is purely the result of a very high gain IF strip, with little RF amplification — obvious by the fact that when you reduce the IF bandwidth, the noise level barely changes. I didn't find this objectionable — most of the time the excellent AGC action effectively removes it.

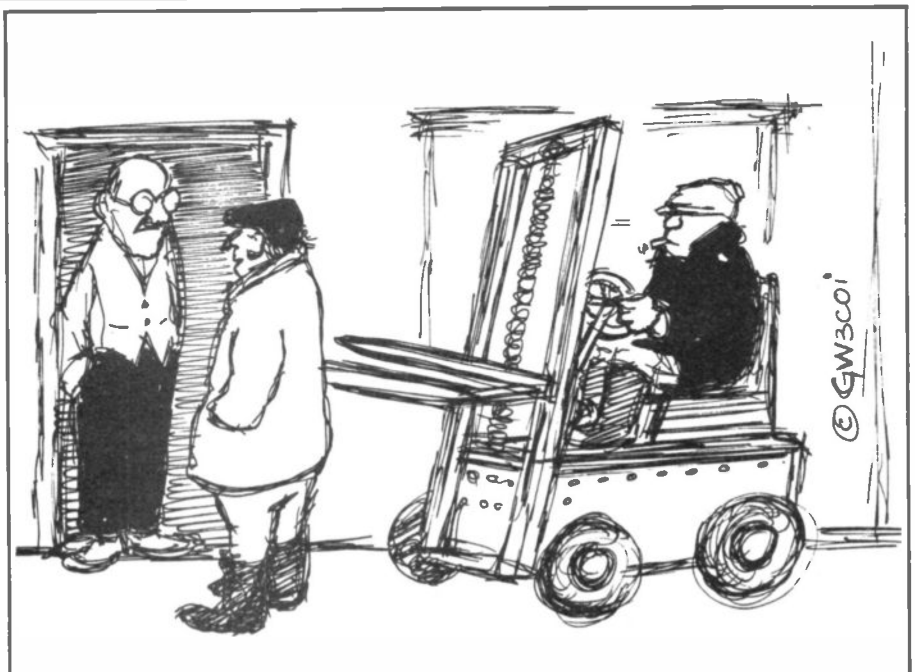
CW operation was a distinct pleasure and the full break-in a joy to use. Its limits appeared to be about 40 wpm, when you could no longer hear between dots. At slower speeds it gave no problems, except for the slight clicking mentioned earlier in the 'fast' position. In 'slow' mode, is an initial slight click at the first key closure, but not after this. The narrow filters are a great aid to reception, and have very sharp cut-offs out of their passbands. In conjunction with the passband tuning control and notch filters, it was possible to get most signals in the clear. The stability of the Corsair is more than adequate to match the bandwidth of the narrow filters, most problems of this type being due to the received station drifting. Transmitted signals were clean and free from clicks. Not that on CW, you can only transmit by touching the key — there is no manual Tx/Rx switch available.

SSB Reports

On SSB, received reports are excellent, as long as the processor gain wasn't wound above about mid-setting. No one complained about the transmission when specifically asked, and a few experiments with Stateside stations (one of whom was using Corsair) determined that the processor was a distinct aid under weak signal conditions. The ALC operated effectively, once correctly adjusted, remembering that any change to the ALC setting also required a change to the drive control.

In terms of operability, the front panel is nicely laid out with plenty of room round the main tuning dial. All controls are smooth and positive in operation. Separate LED indicators above the main display show when various of the facilities are in use — the RF amplifier, IRT (Offset), Processor, and an LAC indicator (you get this to just light on speech peaks). The main tuning is not of the flywheel type, but is smooth and showed no trace of backlash. The tuning rate is 10kHz per revolution on the main tuning knob with analogue dial calibrated for 100kHz/rev. This analogue dial has marks every kHz, excellent for a quick QSY 'up 5', without having to watch the display.

The AGC was effective on all modes, except for a slight overshoot on initial CW characters in the 'fast' mode — for an audio derived system this is a good example of its kind. With SSB, and in 'slow' mode, the hang feature



" WE'VE CALLED ABOUT THE HOME BREW BIG LINEAR YOU'RE ADVERTISING... "

shows its worthiness by the assence of the burps of noise during speech pauses. It also effectively suppresses short bursts of interference.

Both PA heatsinks got fairly hot after extended operation, especially with the shack already at 85 degrees on a hot summers day, but without any disastrous results.

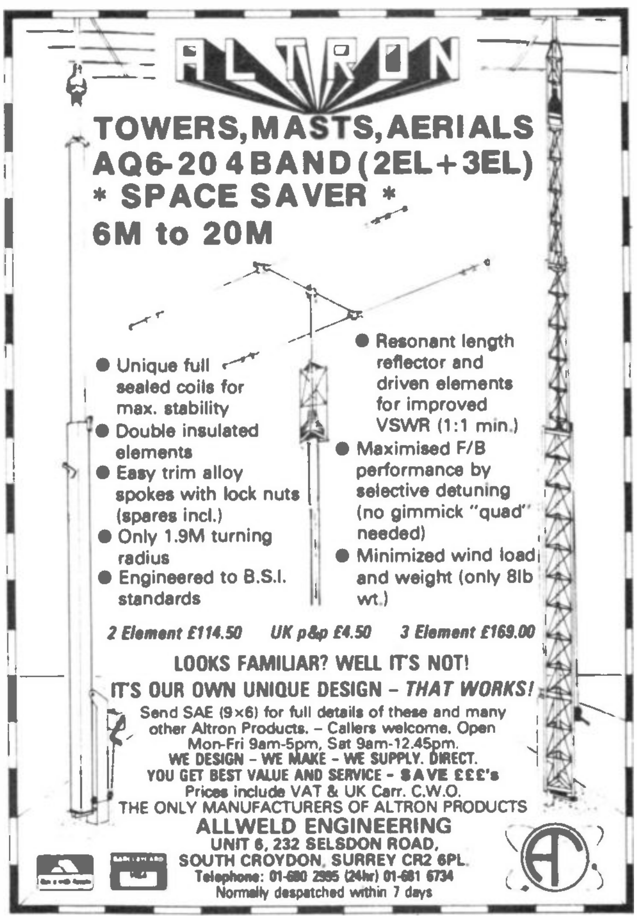
Conclusion

In the USA the Corsair is probably regarded by well off amateurs as a second rig to the main all singing-and-dancing KWM380. Over here, it is worthy of being *the* prime operating transceiver, especially if you have two primary requirements. 1. CW is your main operating mode, and 2., you want a quality rig designed to communicate rather than offer lots of possibly unwanted facilities.

There are a few minor problems, but nothing of major importance that detracts from its excellent performance otherwise. I would heartily recommend it to anyone with the cash to spare, including myself, for either SSB or CW use.

The current advertised price in the States for the Corsair is $999. This equates to around £770 at the moment, so the UK price is quite good if you take tax etc into account.

Thanks to KW Ten-Tec of Chatham, Kent (0634 815173) for the loan of the review unit.



Practicalities

Sometimes it seems to me that dealing with RF is more of an art than a science. Recently when I was designing and building a speech processor, not unlike the one featured in HRT a few months back, I tried the circuit out, feeding it into an oscilloscope, also monitoring the output on a tape recorder to assess what it actually sounded like. To my satisfaction all appeared to be well, that is until I tried it on the transmitter. The audio sounded dreadful and the

This month Ian Poole, G3YWX, addresses a variety of 'practicalities', including choosing a transformer from the 'junk box', and gives an easy solution to the problem of soldering enamelled wire.

circuit was very prone to oscillation. The reason was simple — RF from the transmitter was getting back in to the processor, being rectified and creating a feedback loop with the resulting oscillation. The solution was unfortunately not quite so simple. Although the processor was mounted in a screened box with a filter on the microphone input, there was still plenty of RF getting in somewhere. The problem was overcome in two ways.

The first and most obvious was to decouple all the remaining input and output leads to earth *immediately they entered the unit,* so that there were no leads which were able to re-radiate the RF. Incidentally, any capacitors decoupling leads carrying mains voltage should have a working voltage of about 1kV, as the "240v" quoted is rms voltage — which means that the peak voltage is 400v, and, in addition to this, there are often voltage 'spikes', which will take the voltage considerably higher. The other way in which the RF was prevented from entering the unit was to ensure that all incoming earth leads were taken to chassis earth immediately they entered the box *by as short a lead as possible.* This also prevented any RF being re-radiated.

Having obeyed these basic rules, I found that even with a high level of RF in the shack, which I admit is undesirable, the unit was quite tame and produced good results. This example aptly demonstrates the need for good decoupling on leads entering a unit, and also the need for good earth layouts.

Soldering Techniques

Very often when I have been delving into the depths of a piece of valve equipment, or for that matter any piece of equipment with solder tags in it, wanting to remove a wire, I have had to wrestle with the wire as it has been wound round the tag. This is very often done during the construction of the equipment to mount the component attached to it securely and then solder it. However, electrically there is no difference between winding the component lead around the tag and just placing the lead through the hole. For my part I always place the component lead through the hole and possibly bend it slightly to make the job neat and then solder it. This makes the lead far easier to remove and the job of modifying the unit or servicing it later *very much quicker* as well. The fact that the component lead has not been wound around the tag will not affect the performance of the joint although the joint may not

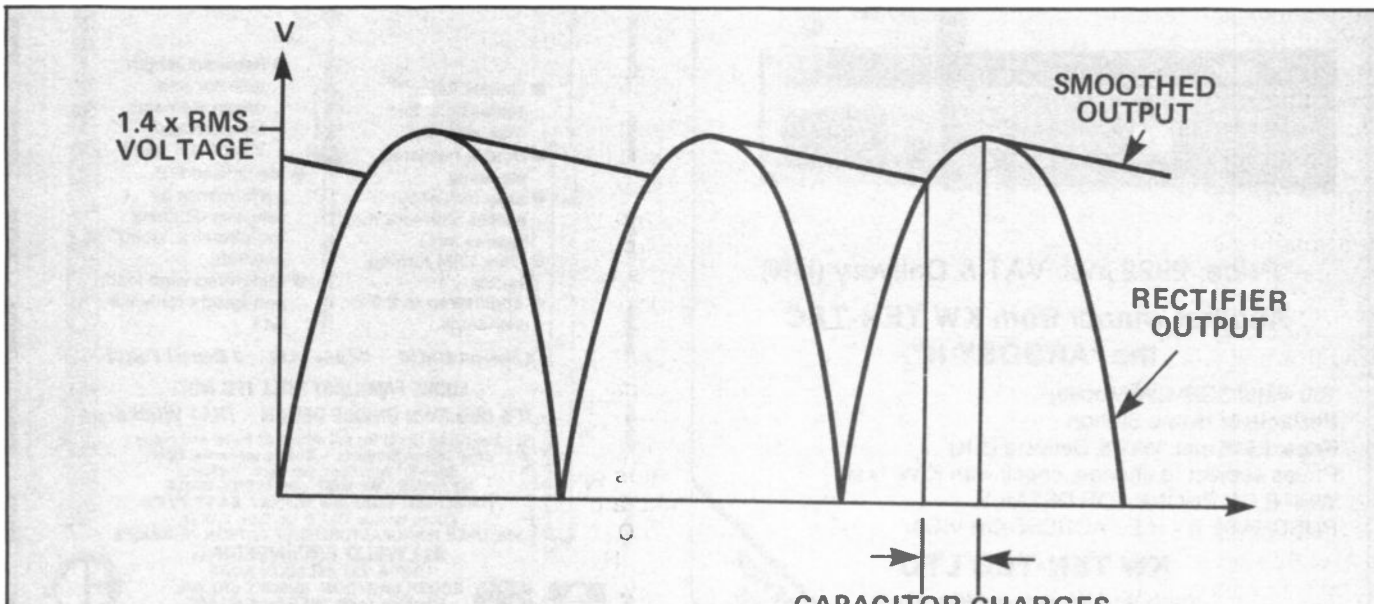


Fig. 1 Diagram showing output of full wave rectifier

be mechanically quite as strong — if the pushed through soldered joint cannot withstand the strain applied to it, or a small jerk, then this is a bad joint!

Coil Winding

One aspect of construction which I always find difficult is coil winding. Firstly, there is the problem of finding or buying a suitable former, secondly, of getting hold of coil details and finally, winding the coil in a manner which looks neat and will also keep the turns in place. I invariably find that somewhere during the proceedings I let go and the coil springs out of place.

One thing which I also find difficult is trying to strip the enamel off the wire whilst holding the rest of the coil in place. Therefore I was very pleased when I recently came across some *self-stripping wire* — where the insulation melts off when a soldering iron is applied, thus saving all the aggravation I have just mentioned. The wire can be obtained from several sources, but one which is easily obtainable is made by **Vero** as part of their Verowire wiring system. Many retailers stock this, including Electrovalue.

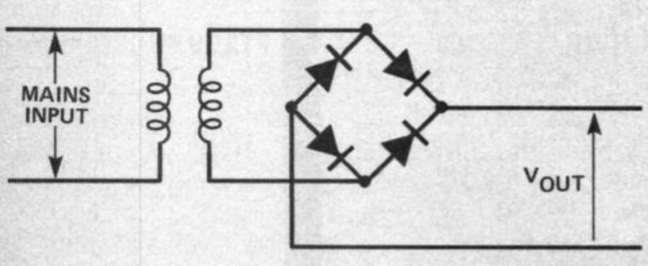


Fig. 2 Full wave rectification using a bridge rectifier

Choosing Transformers

One circuit which is common to most pieces of equipment is a power supply, and this is very often one of the things which is given least thought. Admittedly power supply design has been simplified over the last few years by the introduction of integrated circuits, like the 78-series of regulators which are cheap, easy to use and operate very well. Probably the biggest headache now when building up a PSU is the transformer. Very often, there is one that might be suitable in the junk box which, if it can be used, could save the several pounds a new one would cost. By applying a few simple rules, it is quite easy to calculate whether the rating of the transformer will be suitable for the job.

In order to assess what voltage the transformer is required to deliver, all the voltage losses have to be added up and then added to the regulated output. The first and probably most obvious loss is the voltage drop across the regulator — which unfortunately has to be there for it to operate correctly. For supplies up to about 15V or so this should not be less than 2 volts, otherwise the regulator will 'drop out' and cease to regulate, causing hum to get through.

The second loss, if it can be called that, is 'ripple'. The 2 volt drop for the regulator must be the minimum across it at any time, so any ripple must be added onto this. Normally, one should allow for about 3 volts of ripple on a supply as shown in **Fig.1**.

Incidentally, I came across a very useful rule of thumb for 12 V power supplies which recommended using about 2000 uF of smoothing for every amp the supply was to give — this leaves about 3 V of ripple before regulation. Larger capacitors can be used to reduce the ripple but this is about the optimum — eventually a large increase in capacitance result in only small decreases in ripple.

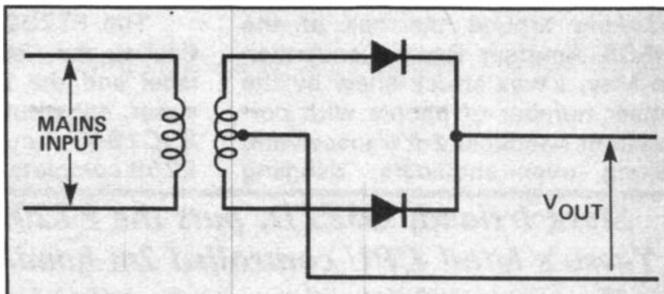


Fig. 3 Full wave rectification using a centre tapped transformer

There are two further losses. There is a voltage drop across the rectifier. If a bridge rectifier circuit as shown in **Fig.2** is used, then the drop will be about 1·4 V, whereas if a centre tapped transformer is used with the configuration shown in **Fig.3**, then the drop will be only 0·7 V. The other loss is the internal voltage drop in the transformer and this will, of course, vary with the load presented to it. Most manufacturers do specify a regulation factor.

When estimating all of these it is well worth being pessimistic and using the regulator to get rid of any extra voltage. This does mean that an adequate heatsink has to be used. Therefore the peak voltage produced by the transformer should be the sum of the regulated output voltage, regulator drop, peak-to-peak ripple, rectifier drop and transformer loss. As transformers are specified in RMS output voltage, the peak voltage delivered by the transformer is 1·4 times the RMS voltage.

Having calculated whether the voltage rating is sufficient, we still have to see if it will provide sufficient current. Unfortunately this is not as simple as we may imagine. A transformer rated at, say, 1 amp will not be man enough to supply a regulator circuit delivering 1 amp. The reason for this is that the rectifier will only pass current when the transformer voltage *exceeds* the capacitor voltage (indicated by "smoothed output" in Fig.1) when it will take a large amount of current ie when the capacitor is actually charging — thus the voltage across it is rising. This, of course can be seen from Fig. 1 to take place for only a fraction of the cycle, thus giving a large pulse of current for a short time. As a general rule, the transformer should be derated to 0·6 or 0·7 of its specified rating

Having just written this out makes me wonder how many of the power supplies I have designed and built in the past have been very marginal in their operation!

A pair of Portables

Steve Ireland, G3ZZD, puts the FT209R and RH, Yaesu's latest CPU controlled 2m handhelds on trial, offers some observations on handheld operation and gets stroppy with GB3SL.

Walking around the hall at the RSGB Amateur Radio Convention in May, I was struck anew by the sheer number of people with portable or handheld 2m transceivers! Slung over shoulders, dangling from belt clips or clasped in hand, they were everywhere — Icom, Trio, FDK and, of course, Yaesu.

Well, the subject of this review is the FT209R and 209RH latest in the short but ever increasing line of 2m handheld transceivers from Yaesu, who claim to have originated the synthesised VHF handheld amateur transceiver. The FT209R retails presently at £239 complete with Nicads, comparable with Icom ICO2E and the Trio 2500 in terms of facilities — digital display, ten memory channels, allowing the operator to store independent transmit and receive frequencies, manual or auto-stop scanning, priority channels, and microprocessor control, programmed by a front panel mounted key pad.

With the FNB-3 Nicad pack, as supplied, the FT209R gives some 3W output for an operating period of two hours. This is with a Tx/Rx ratio of some 1:3 ie 30 minutes of solid Tx to 90 minutes of solid Rx. In operation this claim was proved to be accurate. The FNB-4 Nicad pack can also be provided for this rig at a few extra pounds, although this is intended mainly for the FT209RH. With the FNB-4 the FT209R is claimed to produce 3.7 W at a Tx/Rx ratio of 1:3 for some 130 minutes. Not a huge increase in performance but enough to allow an extra QSO or two!

The FT209RH, seeming identical to the '209R except for the label and the 2SC2287 PA transistor, substituted for the '209R's 2SC1947, currently retails at £259 complete with the FNB-4 and produces a claimed 5W of RF. This must make it the highest powered 2m handheld presently available and with the FNB-4 this level is maintained down to 4W for some 120 minutes (Tx/Rx ratio 1:3). Some people will probably wonder on the wisdom of producing 'handhelds' of apparently ever increas-

ing power because of the attendant effects of 'radiation' and the damage to one's vital organs. Followers of HRT since the days of Frank Ogden will doubtless remember Peter Metcalfe's review of a plug in PA module for 2m 'handies', in October 1983. However, let the author reassure readers that 4-5W of 2m is quite safe in this respect, although, he would not advise them to place the antenna of this (or any!) 2m transceiver in close contact with their eyes or head in order to prove this! That being said, 5W is about the highest he would like to see the power output of handheld transceivers being taken and suggests the manufacturers call a halt at this point.

Both '209R and RH have a high/low switch which reduces the power output by about 10dB (ie 0.4 and 0.5W respectively) on each model.

CPU Control

At the heart of the FT209R and RH are two 4-bit microprocessors. Twenty dual function keys give the operator a choice of 39 different commands for programming the aforesaid CPUs. The number, letter or symbol on the face of each key indicates the primary function of the key, whilst the label above each key indicates the alternative function, activated by pressing the 'F' key, which will cause an F to appear to the left of the frequency on the LCD display. When each key is operated a single audible bleep is sounded; if the keypad is used incorrectly (say, a memory frequency outside the 2m band is selected) a dual bleep is sounded and 'Err' is shown on the display. Below the keypad are three switches, two of which are directly connected with the keypad. The 'keylock' on the RHS disables the keypad unless it is switched to the left and the centre switch has three positions which select the type of frequency scanning desired.

This latter switch is central to the practical operation of the FT209R and RH, for with a CPU controlled handheld the frequency tuning of the device is effectively carried out by the scanning facilities. This switch selects the scan stop mode for the scanning, which is activated by the two keys at the top RHS of the keypad which

The keypad of the FT209R and RH are identical bar the name on the front.

move the scanning either up or down in frequency. With the switch in the centre MAN position, scanning is stopped by manually releasing either of the up/down scanning keys. The CLEAR position causes the scanning to stop whenever a 'clear' channel is reached (ie one doesn't have any signal strong enough to open the squelch, as set by the top panel mounted SQL control.) Conversely, the BUSY position causes the scanning to stop on the first channel which has a signal strong enough to open the squelch (ie when you want the transceiver to continually scan the band in order to find a signal to work/listen to).

The manual of autostop scanning facilities are very sophisticated and include step-programmable full or partial band scan, memory bank scanning for CLEAR or BUSY, 'SKIP' or selected channel exclusive scanning, selected memory or dial priority scanning/monitoring and many other functions, in the words of the opening section of the manual "too numerous to list". The basic operation of the scanning is simple but you can make it pretty complicated if you like!

Knobs, Buttons and Sockets

The operational styling and general appearance of the FT209R and RH closely resembles that of the '203R. The top panel carries the squelch and volume controls, the volume control also doubling as the power on/off switch. On the LHS of these is the LOW/HIGH power output switch whilst above, from left to right, is the BNC aerial socket, two switches controlling the VOX facilities for the accessory YH-2 headset or MH-2 speaker/microphone, one for VOX on/off and the other for either low or high VOX sensitivity (the low setting is very useful if the ambient noise level around you is high) and finally the jack sockets for the YH-2 or MH-2. If these accessories are utilised the internal speaker and microphone are disabled.

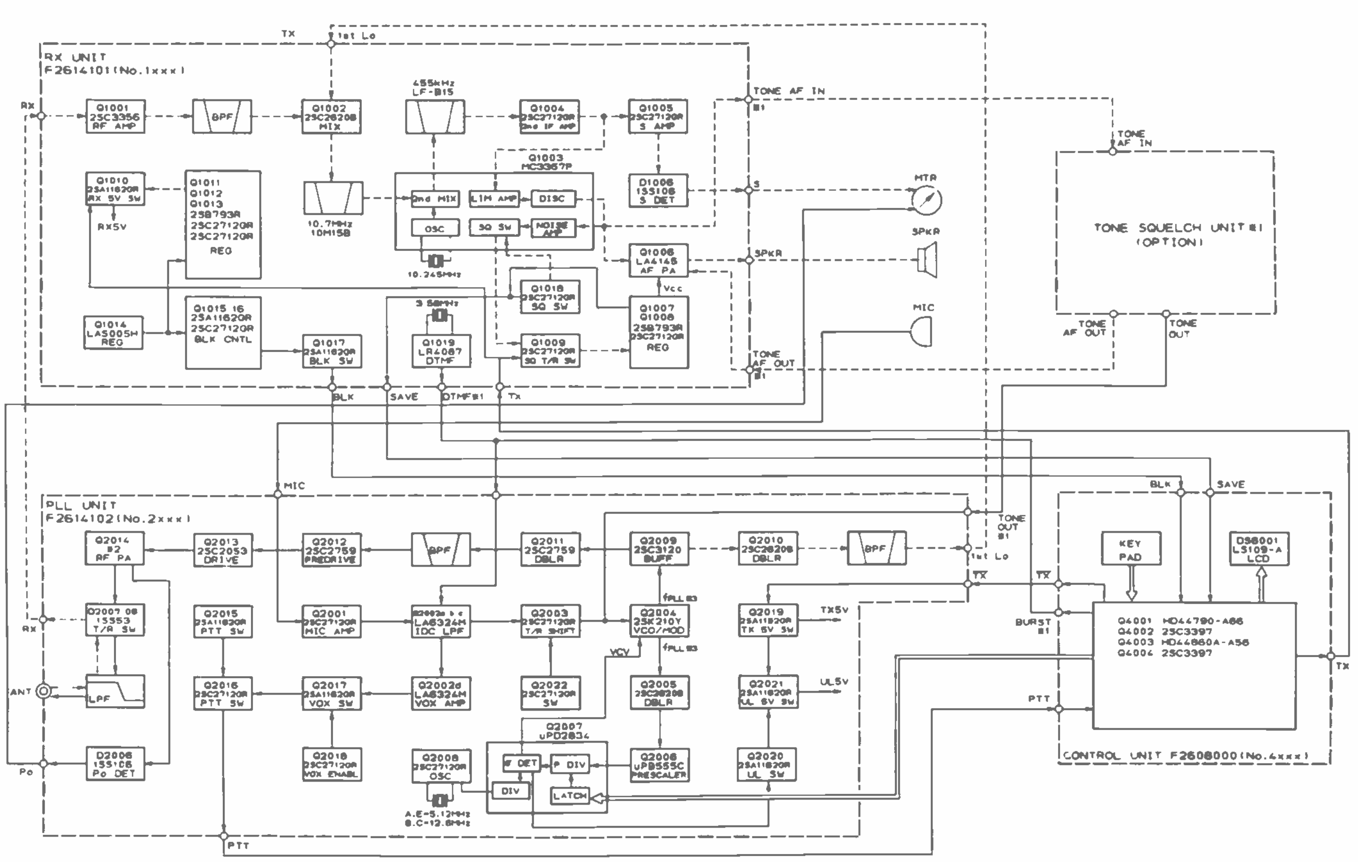
On the left hand side of the rig are the Press-To-Talk and toneburst buttons, identical to those on the '203R and with a nice positive action. On the RHS is a similar button controlling a lamp which illuminates both the 'S'/power output/battery check meter and the LCD display mounted above the keypad.

Finally, on the base of the transceiver, or more correctly, Nicad pack, there are two sockets, one for a DC-DC adaptor for operating the transceiver mobile and another for a Nicad charger. A useful accessory is the PA3, a DC-DC adaptor which also provides a trick charge to the FNB-3 or FNB-4 when mobile.

The case of the FT209R and RH is an attractive two-tone smoked grey plastic affair, similar to that of the '203R and, as I noted in the review of the latter, looks as though it will take a few good knocks.

On The Air

This section of my review of the FT209R was written around a few weeks operation in and around London. A handheld transceiver can be less useful in city than suburban or country areas because of the density and height of buildings — often rendering simplex operations almost useless. As an illustration of this, Dave Bradshaw, G1HRT, and the author, equipped with the FT209R and RH, carried out a series of tests around Central London, finding that reliable simplex contacts were often limited to less than a mile! Of course, in this situation, repeater operation should come into its own. Unfortunately though, in London, with the possible (and only possible) exception of the North London machine, the repeaters resemble an open sewer for the majority of the



FT209R/RH block diagram.

day and night. Dave lives close to GB3SL and, having just received his licence through the post, thought it would be interesting to make a few contacts through this . . . I am still trying to persuade him that not all operators on GB3SL have had a lobotomy . . .

Strong words perhaps, but as far as I am concerned cities are difficult enough to operate in with handheld transceivers anyway and newly licenced amateurs often tend to buy a handheld as their first piece of gear. In London, or any city, the logical thing for them to do is to try the repeaters. People say "where have all the G6s gone?"; if the G6s live in London and bought an FM handheld, probably QRT in disgust.

Not all of the UK live in cities so, in an endeavour to look at the other side of the coin, I took the FT209R and RH off down to the Sussex coast. Wherever you live in the UK, town or country, there is a 2m FM repeater near you and the South Coast is no exception. From GB3PO in Portsmouth to GB3KS near Dover, a handheld transceiver is a practical proposition.

From my temporary location near Eastbourne I could access GB3ES near Hastings, some ten miles distant, from the lounge of my place of residence with the '209R and RH on low power ie 300-400mW. As in most centres of habitation away from cities, the locals tend to use the repeater as a calling channel and my transmissions were immediately acknowledged. Comments on the audio with the internal microphone typically were "good" and "very clear for a handheld". Very few people could tell the difference between this and the YH-2 headset microphone, which says quite a lot for the tiny condenser mic.

No Ear Ache

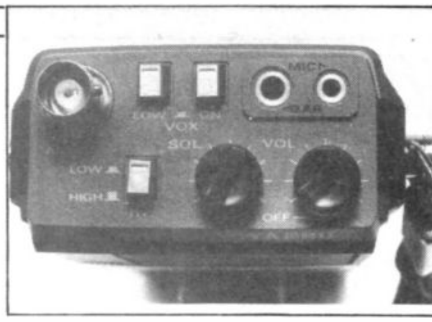
Received audio quality was excellent, the small speaker giving a crisp, clear reproduction which was easy on the ear. I often monitored GB3ES for several hours at a stretch without experiencing any aural fatigue (even with good conversation the old ear can get tired with *very* small amounts of distortion).

With the fairly hilly terrain, simplex contacts were possible on high power up to ten miles with the 1/4 wave helical antenna of the '209R and RH. While I was on the Coast the barometer kindly dropped quite suddenly and I awoke one morning to find the band full of strange signals. A walk up to a convenient 600' hilltop produced received signals from as far as North Yorkshire with the helical quarter wave (the North Allerton repeater) and a good test of the RFIM performance of the receive sections of the transceivers. Despite intense local activity no sign of 'bleed over' from adjacent channels was noticeable with the transceivers. As an experiment, the 12.5kHz channel step facility was brought into use (a small inset push button switch in the base of the transceiver selects either 12½ or 25kHz channel spacing) and although some 'bleeding' was noticeable with this 12½kHz channelling, it would have been usable despite the present UK deviation, which is fixed to suit the 25kHz spacing. My best QSO was with a station in Harrogate, Yorkshire — via the West Flanders (Belgium) repeater!

Memories and Stuff

As I remarked earlier, the CPU control offers very sophisticated memory and scanning facilities. I did not really use the former much, finding that the basic scanning was so quick, simple and easy to set that it hardly seemed worth bothering with memories. The priority channel facility I did find useful. You simply store a frequency in a memory channel with the squelch control set for the desired threshold level. The dial mode is then reselected and you go ahead and operate in the dial mode as you normally would (say, S22) until a signal appears on the priority channel (say, the local repeater) while you are receiving, at which time the operating frequency automatically shifts back to the priority channel. If you are in the middle of a QSO (!) in the dial mode, you will need to press D (the dial mode re-select) to go back to that frequency. You can then inform the other station that you have to go to another frequency to make your 'sked' (or whatever) which after saying 73 you return to (the priority channel) by pressing MR.

Although the above was useful, by far the most useful memory related facility was the 'power saver'. This function allows the FT209R and RH to monitor a frequency for activity *while drawing less current than is required for normal squelch reception*, thus prolonging battery life. This is done by removing the power from all circuits except for a timer and the



Top panel controls and switches. The low/high RF switch provides for extended battery life.

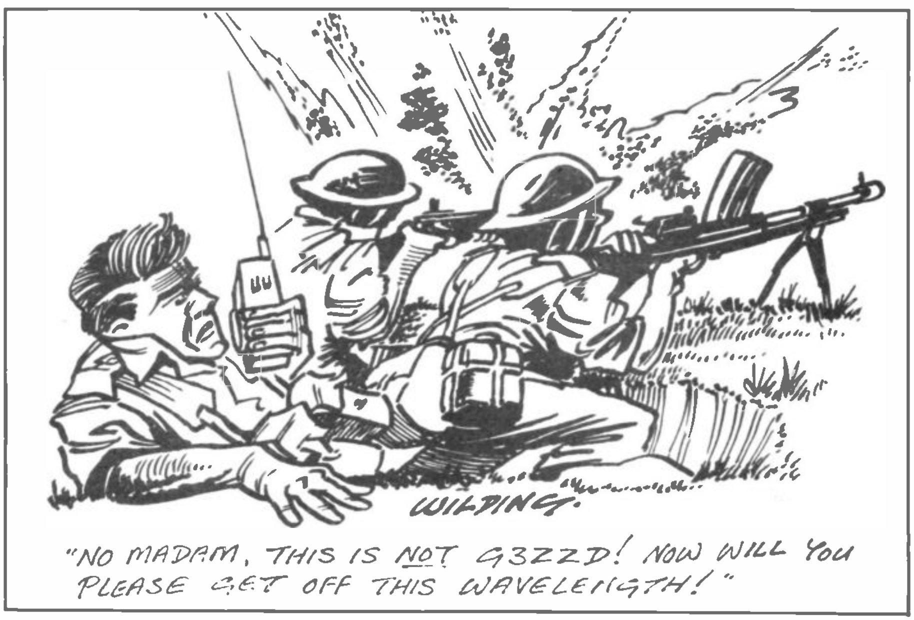
display for programmable intervals, during which SAVE will be displayed along with the operating frequency. Between save intervals, programmable with the keypad from 300ms to 3 seconds, the receiver is enabled for about 300ms to check the preselected operating frequency for activity. When a signal appears the receiver will function normally. However, if the carrier drops for more than 5 seconds, power saving resumes automatically. If the transmitter is activated during power save operation it operates immediately, as usual. If no station responds to your transmission within 5 seconds of releasing the PTT, power saving resumes.

Summing Up

The FT209R and RH represent the top end of the handheld market. Earlier this year as I have said, I looked at the Yaesu FT203R, which could be said to occupy the middle ground. Currently retailing at around £175 with Nicads, this offers synthesised control but with *no* scanning memories or digital display facilities and with frequency selection by thumbwheel switches. Down at the bottom end we have the FDK Palm Comm II at around £135, some sixty per cent of the price of the FT209R but with the choice of only six crystal controlled channels (less if you wish to use repeaters — two channels are needed for each repeater, due to the transmit/receive frequency offset required), 1.5W RF output to the '209R's 3.7W, no Nicad pack included in the price or memories or scanning.

This preamble was intended to show, if you didn't already know, that there are a variety of handhelds available at a variety of prices — and that what you get very much depends on what you pay. You get quite a lot for the £239 you pay for the FT209R in terms of basic RF goodies — decent power output, good sensitivity and RFIM performance. Although, many of the CPU controlled scanning memory functions seemed extraneous, the power saver functions are very useful and I found that the basic keypad controlled scanning functions made the FT209R *very* pleasant to use and were much preferable to the thumbwheel switches of the '203R. With the 4 and 5W output powers, the FT209R and RH are very acceptable for mobile working and with the YH-2 headset would make a very safe mobile setup, as long as you didn't wish to change channels too often. That being said, another £20 (on the price of the FT209RH) will buy you the very ubiquitous FT290R (although the Nicads will cost you extra) and although this is a rather largish device to hump around the hilltops, and gives slightly less power than either versions of the FT209, it will give you SSB facilities as well as FM.

The FT209R and RH provide state-of-the-art FM handheld operation at a competitive price. If you live outside London or in most cities, I'm sure you'll have a ball. If you're a newly licenced Londoner, you'd better think about a set with SSB as well.



The author wishes to thank the suppliers of the FT209R and '209RH, SMC of Rumbridge Street, Totton, Southampton.

RADIO Tomorrow

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

1 Oct Stourbridge ARS: Informal.
Stowmarket ARS: *The RNLI by Mike Smith.*
Todmorden DARS: Secret Listeners Video.
Marconi Basildon ARC: *RTTY/AMTOR/Packet Radio.*
Dudley ARC: Committee Meeting and Natter Night.
Sutton and Cheam RS: Natter Night.

2 Oct Wakefield DRS: On-The-Air/Natter Night.
308 ARC: AGM.
Fylde ARS: *Aerials For Confined Spaces by G8GG*
Chichester DARC: ring PRO for details.

3 Oct Fareham DARC: Talk on *VHF Propagation.*
S. Bristol ARC: *Submaritime Mobile by G3OUK.*
Cheshunt DARC: Natter Night.
Nene Valley: *Town and Country Planning 1971.*
Hornsea ARC: Slide Show by G4IGY.
Braintree DARS: *TVI — Theory and Practice* at the new venue **St. Peters Church Hall, St. Peters Close, Braintree.**
Listen to S15 for Talk-in directions.

4 Oct Horsham ARC: Ring PRO.
Cray Valley RS: The Grand Surplus Sale.
Newark DARC: Lecture to be arranged at Palace Theatre, Newark, 7.30 pm.

5-6 Oct Dartford Heath DFC Slade 2 Station Night Event.

5 Oct Axe Vale ARC: Microwave Evening.
Radio Society of Harrow: Informal and Practical.
Sutton and Cheam RS: Visit to Vintage Wireless Museum.

6-7 Oct **IARU 432 MHz-24 GHz Contest.**

6 Oct **RMG Open Meeting — 13.30, Crest Hotel off A63 North Ferriby, Hull. Includes talk-in on GB3HS and/or S22 Buffet available.**

7 Oct **RSGB 21/28 MHz Phone Contest.**

8 Oct Exeter ARS: AGM
Milton Keynes DARS: AGM
Dudley ARC: Natter Night.
Sutton and Cheam RS: Committee Meeting.

9 Oct Mid-Warwickshire ARS: *Aircraft Radio by G3III.*
Bury RS: Construction Competition.
308 ARC: Junk Sale at St. Marks Church Hall, Surbiton.
Westmorland RS: *'Photographic Audio-Visual Evening' by G3VEC,* at the Strickland Arms, Sizergh.

10 Oct Fareham DARC: On-Air/Natter Night.
Farnborough (Hants) DRS: Film Night at G4MBZ.
S. Bristol ARC: Club Winter Project.
Cheshunt DARC: Film Show with G3TIK.
Hornsea ARC: Preparation for ELHOEX 84.

11 Oct Southgate ARC: *Audio by G6GOS.*
Edgware DRS: To be announced.

12 Oct Haverhill DARS: Video.
Dunstable Downs RC: Film Night.
Radio Society of Harrow: Construction Contest.

13 Oct **Midlands VHF Convention at BT Training College, Stone, Staffordshire. VHF forum plus lectures, software display, Bring and Buy and trade stands. Free parking. Admission £1.30. Further info from Peter Burden, G3UBX, 18 Langley Road, Merry Hill, Wolverhampton, WV3 7LH. (sae please).**
RNARS Social (14.30) and AGM (19.30) at HMS Mercury.
BARTG Autumn VHF Contest 1800 Sat-11.00 Sun. 144 MHz only. Info about log sheets and completed ones to BARTG Contest Manager, 464 Whippendell Road, Watford. DAFG 13th Short Contest 80m/40m part 5.
BARTG Committee Meeting.

14 Oct **QRP Convention organised by Yeovil ARC at Preston School, Monks Dale, Yeovil (entry via Preston Road). Lectures, light refreshments and talk-in (S22). Pub nearby.**
Info Eric Godfrey 0935-75533.
Dartford Heath DFC: Club Hunt.
DAFG 13th Contest 2m/70cm part 5.

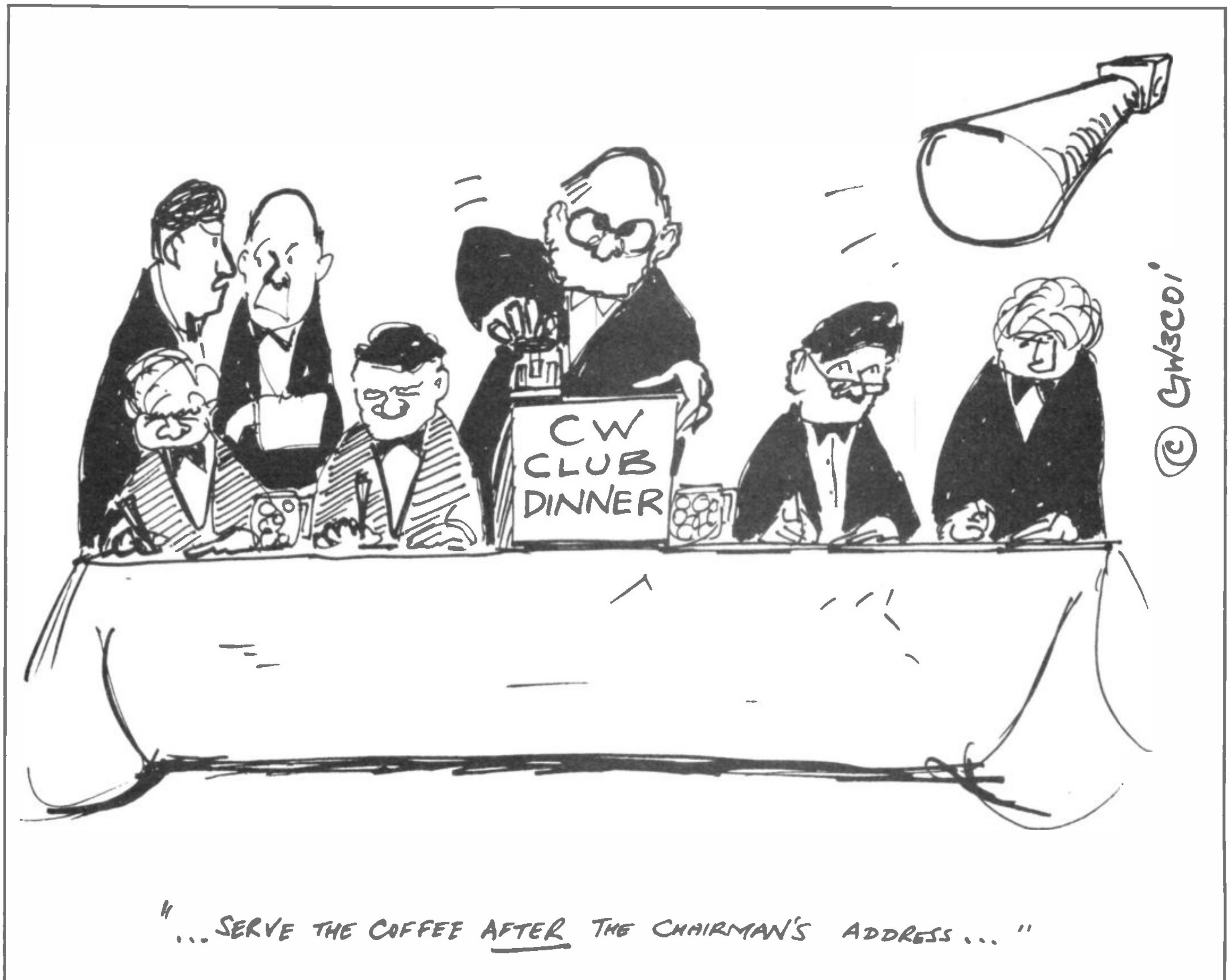
15 Oct Stourbridge ARS: Ring PRO.

16 Oct Biggin Hill ARS: Construction Contest.
Wakefield DRS: *PCBs by G8UCH.*
Fylde ARS: Natter Night with Morse.

17 Oct Fareham DARC: *Meteor Scatter by G6BBS.*
S. Bristol ARC: Computer Activity Night with G4WOD.
Cheshunt DARC: Natter Night.
Hastings ERC: Junk Auction (non-members 50p).
Hornsea ARC: Preparation for ELHOEX 84.
Braintree DARS: Construction Contest at St. Peters.

18 Oct Chichester DARC: *AMTOR lecture by G4CJO with demonstration by G4EMR.*
Greater Peterborough: RSGB video evening.
Cray Valley RS: Natter Night.
Sheffield ARC: *RTTY, AMTOR and Packet Radio.*
Sheffield DRS: *AMTOR and Packet Radio by G3NRW.*

19 Oct Bridgend DARC: AGM



	Radio Society of Harrow: *Counterpoise Design by G4 UBB*
	Sutton and Cheam RS: *Fast Scan ATV by G8MNY.*
20-21 Oct	**Scout Jamboree — On-The-Air.**
20-22 Oct	**CARTG Maple Leaf Contest.**
21 Oct	**RSGB 21 MHz CW.**
	Hornsea Radio, Computers and Electronics Exhibition at the Floral Hall, Hornsea. Trade stands, junk sale, Bring and Buy, cafe, bar and refreshments. Doors open 12 noon and admission is 30p.
22 Oct	Dudley ARC: AGM.
23 Oct	Mid-Warwickshire ARS: *Talk by G8MWR.*
	Haverhill DARS: Junk Sale.
	Verulam ARC: *Larkspur Ex-Military Equipment by G8MQT.*
24 Oct	Fareham DARC: On-Air/Natter Night.
	Farnborough DRS: Surplus Equipment Sale.
	S. Bristol ARC: Discussion regarding 1985 Calendar.
	Cheshunt DARC: *Coaxial Cables by G6BTQ.*
	Hornsea ARC: Committee Meeting.
25 Oct	Shefford DRS: *The History of the Fire Engine.*
26-27 Oct	**Leicester Amateur Radio Show at Granby Halls. Entrance in Welford Road, a short distance from City Centre. Over 50 trade stands, food and drink available in plenty. Park opposite entrance. Talk-in on S22 and SU8. Admission £1.00. Further info Frank Elliot 0533 553293. See you there!**
26 Oct	Haverhill DARS: BARTG.
	Hornsea ARC: AGM.
	Dunstable Downs RC: *Talk on HF aerials.*
27-28	Mid Thames 3 Station Night DF Event.
28 Oct	**RSGB 70 MHz Fixed.**
30 Oct	Wakefield DRS: *The Human Machine As A Radio Operator* (slide lecture).
31 Oct	Fareham DARC: *6m Operation by G4JCC.*
	S. Bristol ARC: Bring and Buy Night with G4RZY.
	Cheshunt DARC: Natter Night.
	Hornsea ARC: ATV with Goole Club.
1 Nov	Horsham ARC: Ring PRO for details.
	Sheffield DRS: *Outside Broadcasting at the BBC by Ron Chown.*
	Cray Valley RS. Surprise Evening.
2 Nov	Axe Vale ARC: AGM
3-4 Nov	**RSGB 144 MHz CW and Marconi Memorial.**
3 Nov	**North Devon Radio rally at Bradworthy Memorial Hall near Holsworthy. 10.30-5 with all the usual stalls including Bring and Buy and a talk-in on S22.**
4 Nov	**Worked All Britain LF CW Contest 1400-2100 UCT.**
5 Nov	Stourbridge ARS: A Surprise (?) Informal.
	Stowmarket ARS: *Getting Started on 13 and 23cm by G3ZQU.*

Dudley ARC: Committee Meeting/Natter Night.
Sutton and Cheam RS: Natter Night.

6 Nov Chichester DARC: Junk Sale.
Fylde ARS: *Morse Code — History, General Usage and Value to the Amateur by G4CSA.*

7 Nov Fareham DARC: On-Air/Natter Night.
Cheshunt DARC: *Modern TV Receivers by Peter Tingey of the BBC.*
S. Bristol ARC: *Informal talk about GWR Steam Engines by Ron Gardner.*
Braintree DARS: *HF Aerials.*

8 Nov Southgate ARC: G6QM Construction Contest.
Edgware DRS: Emmet Key Evening.

9 Nov Haverhill DARS: Sudbury Repeater Group.
Dunstable Downs RC: *Talk by a CEGB Engineer.*

10 Nov **RSGB Second 1.8 MHz Contest.**

12 Nov Milton Keynes DARS: Bring and Buy Junk Sale.

13 Nov Mid Warwickshire ARS: Natter Night.
Wakefield DRS: Pen and Pie Supper at the Rose and Crown Inn, Methley.
Bury RS: *Home PCB Manufacture by G4KLT.*
Westmorland RS: *St. John First Aid Talk.*

14 Nov Farnborough DRS: AGM
Cheshunt DARC: Natter Night.
S. Bristol ARC: 10m FM activity night with G8BDZ.

15 Nov Sheffield DRS: *Security Alarms by G6PTB.*
Cray Valley RS: Crystal Set Judgement and Natter Night.
Chichester DARC: Club Meeting.

16 Nov Sutton and Cheam RS: *Packet Radio by G3CDK, G3MES and G3HSK.*

19 Nov Stourbridge ARS: Annual Junk Sale.
Dudley ARC: *Microwave Society* talk and demonstration.

20 Nov Biggin Hill ARS: To be announced.
Fylde ARS: Equipment Sale.

21 Nov Cheshunt DARC: AGM.
Hastings ERC: *Recce and Image Processing* (Not to be missed!)
S. Bristol ARC: Top Band activity night.
Braintree DARS: Junk Sale.

22 Nov Shefford DRS: *Home Constructed HF Transceiver by G2DXK.*
Edgware DRS: *Professional Video Tape Recording by G3PSP.*

23 Nov Haverhill DARS: Video.
Dunstable Downs RC: Film Night.

26 Nov Dudley ARC: *The Burma-Siam Railway Experience* by *G3BA.*

27 Nov Mid-Warwickshire ARS: SGB Films.
Wakefield DRS: On-The-Air/Natter Night.

28 Nov Farnborough (Hants) DRS: The Chairman's Evening.
Cheshunt DARC: Natter Night.
S. Bristol ARC: *Pocket Phones Revisited by G4SDR.*

1 Dec **S. Bristol ARC: Christmas Fayre at the YMCA, 6 Park Road, Kingswood. Special event callsign GB2KCF.**

Will Club Secretaries please note that the deadline for the January segment of Radio Tomorrow (covering radio activities from 1st December — 1st February '85) is 22nd October.

Contacts

Axe Vale ARC	Roger Jones	Upottery 468
Barking RES	R. Woodberry	01 594 4009
Braintree RS	J. Roberts	0376 44857
Bury RS	Bryan Tydesley	0282 24254
Cheshunt DARC	Roger Frisby	0992 464975
Chichester DARC	C. Bryan	0243 789587
Cambridge DARC	David Wilcock	0954 50597
Dunstable Downs RC	Phill Morris	Dunstable 607623
Exeter ARS	Roger Tipper	0392 68065
East Kent RS	Stuart Alexander	0227 68913
Edgeware DARS	John Cobley	30 64342
Fylde RS	PRO	Lytham 737680
Halifax DARS	DL Moss	0422 202306
Harrow RS	Dave Atkins	0923 779942
Hastings ERC	Dave Shirley	0424 420608
Haverhill DARS	Rob Proctor	0787 281359
Hornsea ARC	Norman Bedford	0262 73635
Horsham ARC	Pete Head	0403 64580
Westmorland RS	G. Chapman	0539 28491
Leighton Linslade RC	Pete Brazier	052 523 270
Maltby ARS	Ian Abel	Rotherham 814911
Medway ARTS	Andy Wallis	0634 363960
Mid Ulster ARC	DF Campbell	0762 42620
Preston ARS	George Earnshaw	0772 718175
S. Bristol ARS	Len baker	0272 834282
S. Lakeland ARS	Dave Warburton	Ulverston 54982
S. Manchester ARC	Dave Holland	061 973 1837
Stockton DARS	John Walker	0642 582578
Stowmarket DARS	M. Goodrum	0449 676288
Southdown ARS	P. Henly	0323 763123
Vale of White Horse ARS	Ian White	Abingdon 31559
Verulam ARC	H. Clayton Smith	St Albans 59318
West Kent ARS	J. Green	0892 28275
Welland Valley ARS	J. Day	0858 32109
Wirral ARS	Cedric, G4KPY	625 7311
Wirral DARC	Gerry Scott	051 630 1393
Worthing DARC	Jim Hicks	0903 690415
308 ARC (Surbiton)	Dave Davis	01 399 5487

Radio Building Blocks

This month's look at radio design covers the detection and generation of SSB signals. Although there are vast numbers of ways in which both functions can be achieved, it is quite surprising how the practical choice boils down to the use of narrow band crystal or ceramic filters combined with a balanced mixer of some sort.

Would you like to know about the practicalities of SSB generation? Frank Ogden, G4JST, explores the options.

Technically speaking, there is very little difference between the mixing 'down' of an SSB signal to obtain audio and the mixing of audio with carrier to produce double sideband, the progenitor of SSB. When both functions are required as in a transceiver, there is a great temptation to maximise the amount of common circuitry. This should be resisted because carrier and signal leakage in and around the main SSB filter and balanced mixers can seriously impair receiver performance.

Fig. 1 shows the ideal extent of common circuitry in a typical transceiver design. To ensure that both receiver and transmitter are spot on the same frequency, it is an engineering requirement that the main Rx and Tx strips should share the same oscillators, but it is generally better to use separate filters for the transmit and receive function. It is worth noting that, while the receive filter needs to have an 80 to 90dB stopband, the transmit filter needs only to shave some 50dB off the unwanted sideband and is thus quite cheap to buy. *(The same rules about terminating FM crystal filters apply to SSB components. See the last article in the 'Radio Building Blocks' series).*

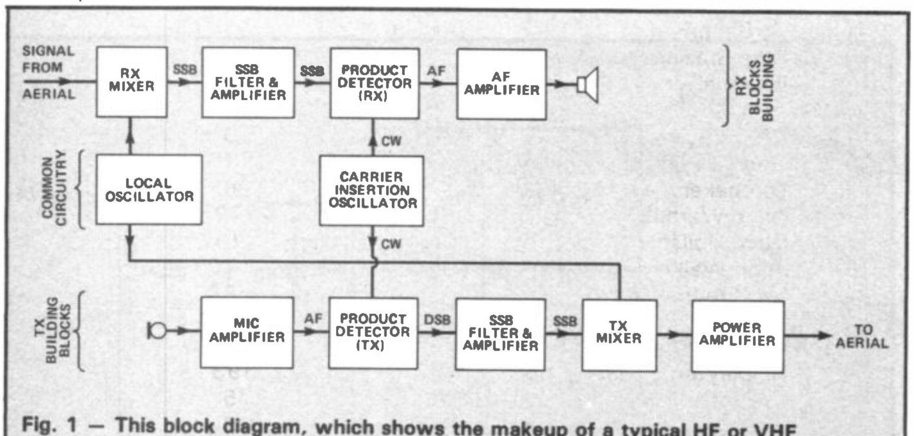


Fig. 1 — This block diagram, which shows the makeup of a typical HF or VHF transceiver, gives the impression that much of the circuitry is common to both receive and transmit. The author's experience shows that the end result works rather better if common circuitry is limited to the local oscillator, carrier insertion oscillator and — perhaps — the SSB filter.

Mixers and Product Detectors.

What ever method is used to generate or detect an SSB signal, an essential ingredient will a mixer of some sort. Mixers and product detectors are essentially the same thing. They both accept two signals, mix them together and produce a wanted 'product'. In the transmit mode, speech frequencies are mixed with an RF carrier to produce two products: an upper and a lower sideband. Collectively, the two products together are known as double sideband (DSB). If the speech band stretches from 300Hz to 3kHz and the carrier frequency inserted into the mixer is, say, 10.7MHz, the lower sideband at the output will occupy a band of frequencies from 10.697 to 10.6997MHz while the upper one, 10.7003 to 10.703MHz. If the filter which follows such a mixer is sharp enough to allow one through while blocking the other, the result will be single sideband. Equally, if one of these sidebands were mixed with a signal of exactly 10.7MHz, the result would be audio speech together with an unwanted sideband product at 21.4MHz. A single capacitor on the output of a receive sideband mixer is quite sufficient to remove the unwanted product.

Those who know all about sideband mixers will have skipped these words but, occasionally in radio design, it helps to look hard at the obvious. There are practical differences between receiver and transmit sideband mixers although they are nominally the same beast. One function of transmit version is that it has to keep the carrier signal out of the PA strip while carrier nulling is immaterial to the receiver circuit.

Fig.2a shows the minimum circuit for a receive product detector. The single transistor acts as an amplifier switched on and off by the carrier insertion signal fed to the emitter. It produces plenty of demodulated AF at the collector of the transistor and the only constraint is that the input SSB (or DSB) should never rise beyond the level where, if it were a true amplifier rather than a detector, it would distort the through signal.

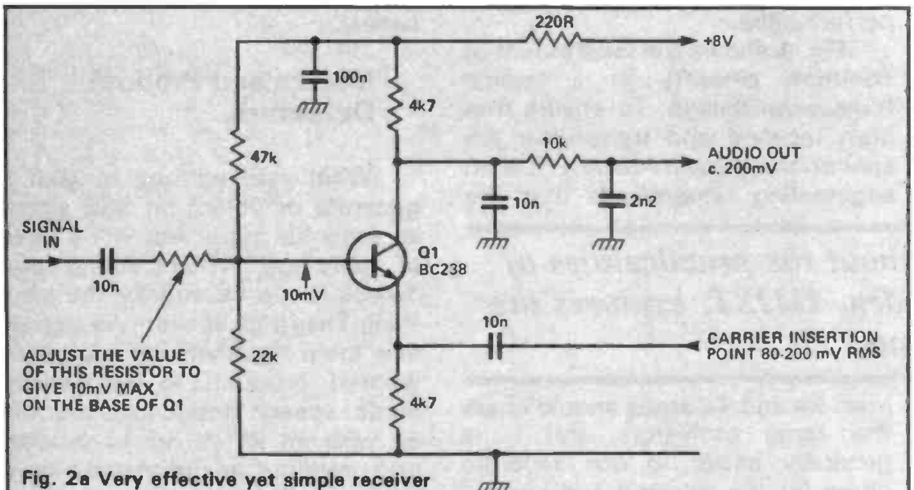


Fig. 2a Very effective yet simple receiver product detector circuit. It offers a high level of recovered signal and gives good AM rejection provided that it is not overloaded.

This shows up another obvious requirement: an SSB product detector should *only* demodulate those signals which are a product of a carrier and input. Signals which are widely displaced in frequency (ie. beyond the audio passband of the lowpass filter following the product detector) should produce no audible output. This last statement is of the highest significance to builders of direct conversion receivers. If a nearby broadcast band is demodulated by un-linearity in the product detector then the interference produced is likely to swamp out the far weaker amateur band signals.

A receive product detector capable of handling high levels of interfering signals is shown in **Fig. 2b**. It is of course the standard diode balanced mixer as discussed in an earlier part of this series. The preset resistor connected between the two diodes should be adjusted for minimum interference from off-band signals. When correctly set up, it becomes quite possible to hear a sub-microvolt signal among millivolt broadcast interference using this same circuit in a direct conversion receiver. The diode balanced mixer circuit finds wide use in transmit DSB/SSB generators because the same characteristic which allows it to reject unwanted off-channel interference in a product detector role, enables a virtually complete nulling of the transmit carrier.

Fig. 2c shows the IC way of doing things. The Plessey 1640 and 1641 balanced mixers are just about as simple a method of SSB processing as it is possible to get. To get DSB, simply feed audio into pin 7, carrier into pin 3 and remove DSB from pin 5. To get audio from an SSB input signal, feed the signal to pin 7, the carrier to pin 3 and collect the recovered audio from pin 5. This last configuration is the one shown in the drawing. There are only a couple of points to note. The capacitors used to couple signals into the chip should be of low leakage type. Use tantalums for the audio feed and polyesters for RF. Aluminium electrolytics and ceramics will work, but, with some, there is enough DC leakage as to unbalance the mixer. Also bear in mind that 1640/1 ICs are very easily overloaded on the signal port. Levels appearing here should be kept to below 20mV for both audio and RF. I once spent a long evening trying to locate the cause of some very nasty two-tone intermod products which appeared to be independent of transmitter output power. It will come as no surprise to learn that the transmit gain control was placed after the sideband mixer!

Occasionally, it is useful to be able to set up bias condition, have access to push-pull inputs and outputs or generally require an IC balanced mixer which is more adaptable than the 1640 series. This last description fits the 1496 analog multiplier/double balanced mixer. The basic application circuit is shown in **Fig. 3** for use as an SSB generator.

The signal handling ability is controlled by the amount of current injected into pin 5. The typical range is 0.5 to 5mA. Even at the higher end of the scale, signal input levels should normally be limited to around 50mV or so. As an aside, I have carried out a few experiments recently in replacing the bottom pair of the classic transistor tree balanced mixer circuit (in discrete form, of course) with a pair of mat-

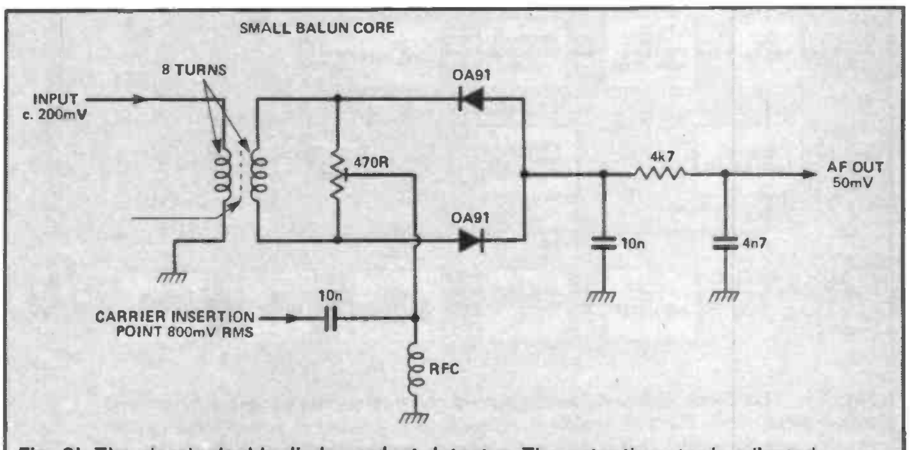


Fig. 2b The classic double diode product detector. The potentiometer is adjusted for best AM rejection. Its ability to cope with a very wide level of signal levels makes it popular for use in direct conversion sets.

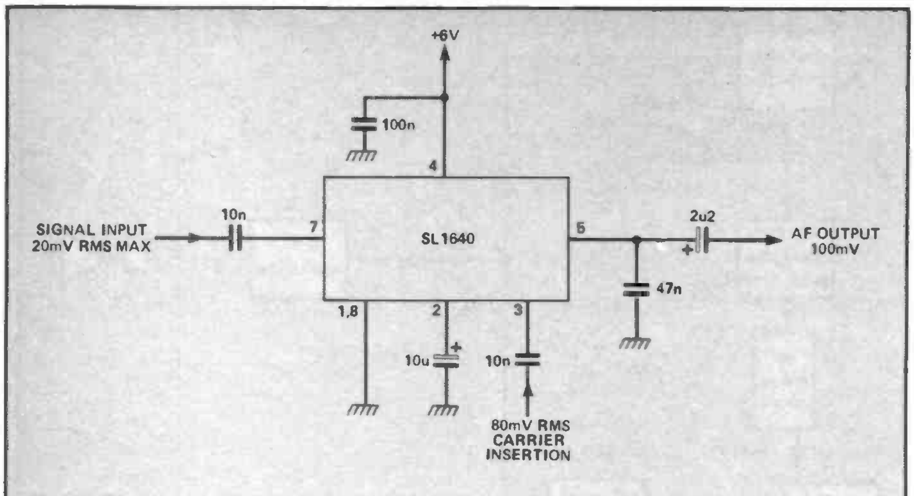


Fig. 2c The Standard IC product detector circuitry using a Plessey SL1640 balanced mixer.

not simple, that it is not easy to design accurate AF phase shifters, that the transmit/receive switching is a nightmare, etc. The basic setup for phasing method SSB is shown in **Fig.4**. Although the circuitry has many parallels with the much loved directed conversion system, the difference in complexity between that and a phasing SBB system is about the same as that between monochrome and colour television. Phasing SSB can be done successfully provided that operation is restricted to a single band and the plenty of test gear is available to carry out the horrendous setting up procedure. As a designer, every time that I am asked to produce a simple, cheap SSB set, I dutifully look at the possibility of a phasing exciter and equally dutifully throw it out in favour of a conventional crystal filter job.

ched JFETs. This was done on the basis that nearly all unlinearity is caused by the log-law input characteristics of bipolar transistors. It is sufficient to say that my efforts have been rewarded. More about this in a specially written note in a later article.

Phasing Techniques

No piece of SSB generation or detection is complete without raising that hoary old chestnut, phasing method SSB. It is one of those things which, at first sight, seem full of promise for simple, cheap equipment. All that one needs is a good, steep AF active filter, and AF 90° allpass phase shifter, a pair of TTL flip-flops for generating quadrature carrier signals, and a couple of IC balanced mixers. These blocks would enable the manufacture of the SSB equivalent of a direction conversion transceiver.

The catch is of course that it is

A footnote to this is that many of the consequences of running phasing type equipment can be heard almost any time on the HF bands. In Eastern Bloc countries where most equipment is still home constructed, the non-availability of HF crystal filters in ready made state has led to widespread use of phasing SSB equipment. Because

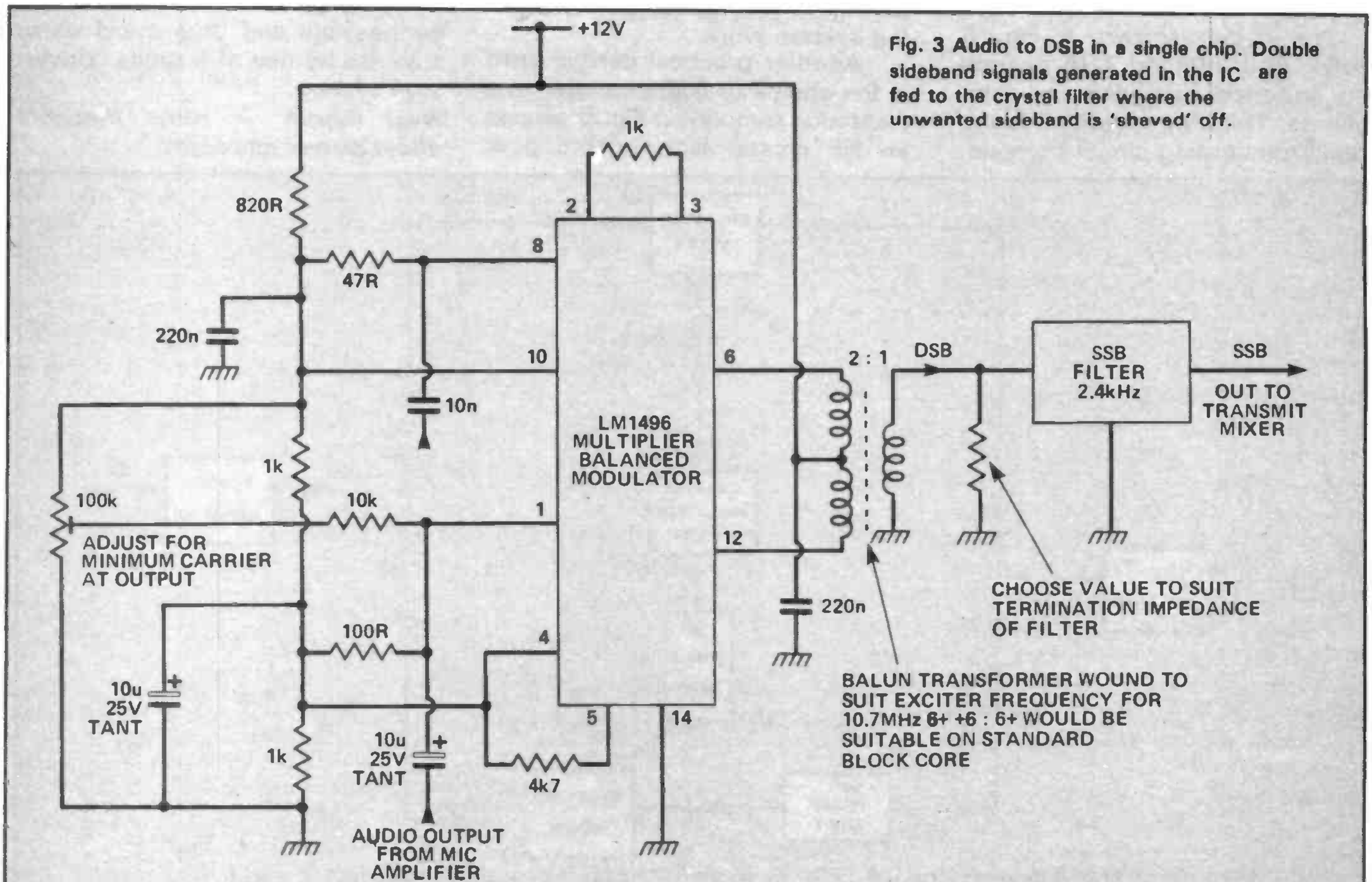


Fig. 3 Audio to DSB in a single chip. Double sideband signals generated in the IC are fed to the crystal filter where the unwanted sideband is 'shaved' off.

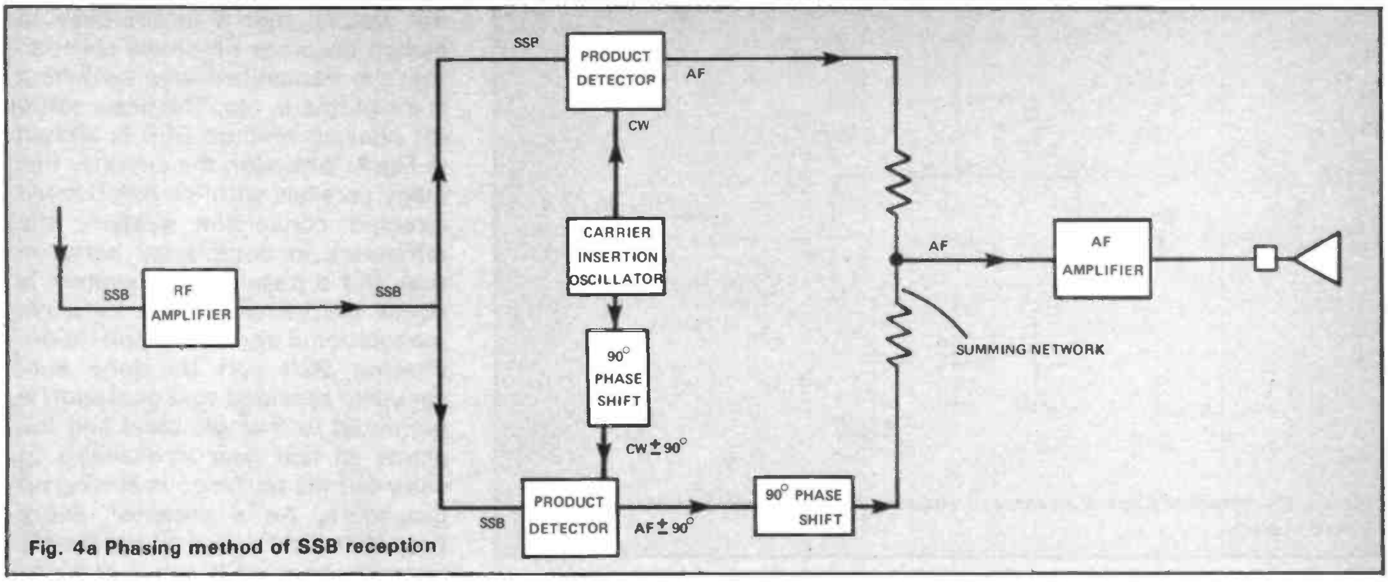


Fig. 4a Phasing method of SSB reception

the AF filters are far less effective than our crystal equivalents, comecon splatter has become the hallmark of the countries amateur radio movements. As for the Italians, the cause of the ubiquitous splatter is far less worthy. Everything on their commercial boxes is wound up to maximum without regard to anyone else trying to use the same — or harmonically related — bands.

A Practical Circuit

The circuit shown in **Fig. 5** shows filter method SSB generation designed from discrete components. The only exception is the speech processing circuit comprising IC1 and IC2. It can be seen that the processor — an extremely effective circuit incidentally — is a good deal more complex than the RF side of the diagram.

There are just two adjustments required to get high quality SSB out of the exciter. The sideband oscillator crystals need to be set within about 100Hz of their specified frequencies and the carrier balance control adjusted for best carrier rejection. Compare this scheme with the dozen or so adjustments required to make a phasing system work.

Another practical design point is the choice of SSB detection and excitation frequency. Fig. 5 shows an HF crystal filter operating at 10.7MHz. This device will cost anywhere from £14 to £30 depending on supplier. An alternative would be to use one of the mechanical filters operating around 455kHz. In this case the cost will be in the order of £8 to £10. However low frequency SSB will need to be mixed to or from a much higher frequency for use at HF or VHF. This carries with it the attendant real possibilities of unwanted 'sproggies' and responses in the extra mixer/filter circuits. It is much better to go to the highest frequency possible and thus avoid these troubles by use of a single conversion system.

Next month — some thoughts about power amplifiers.

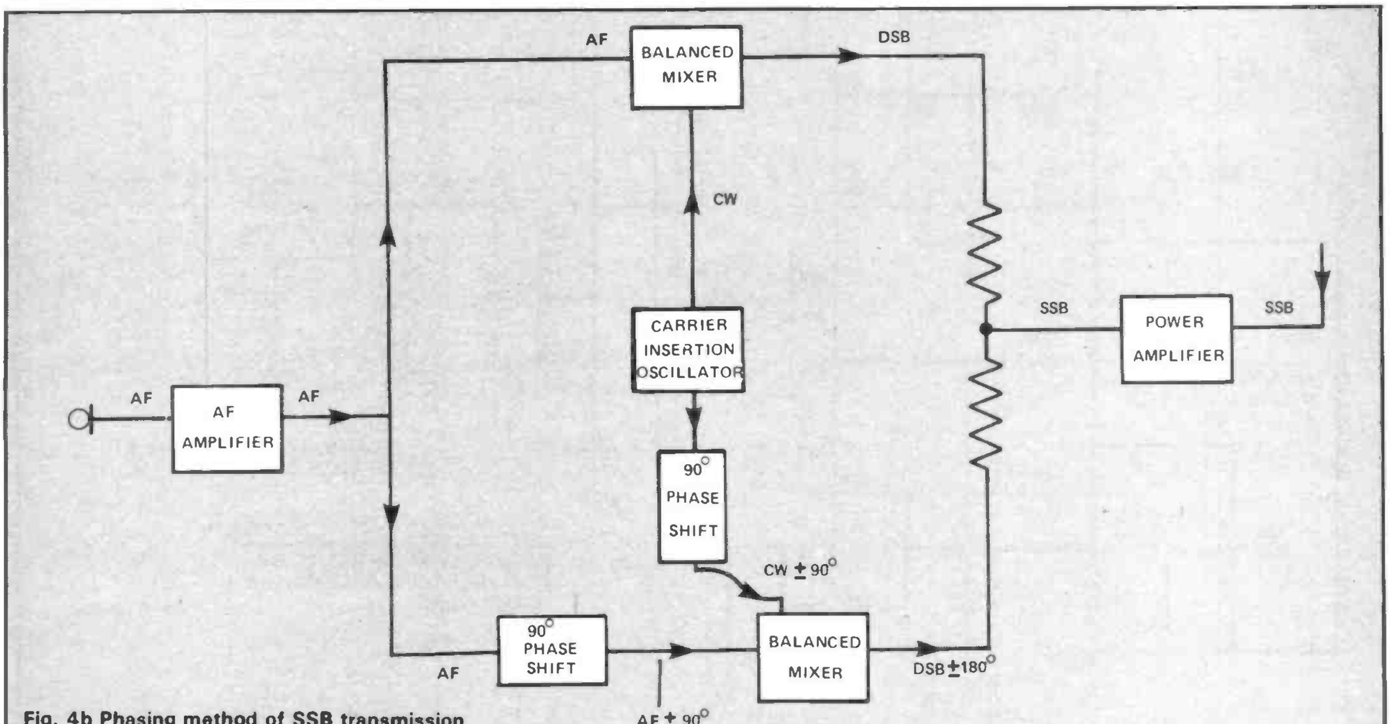
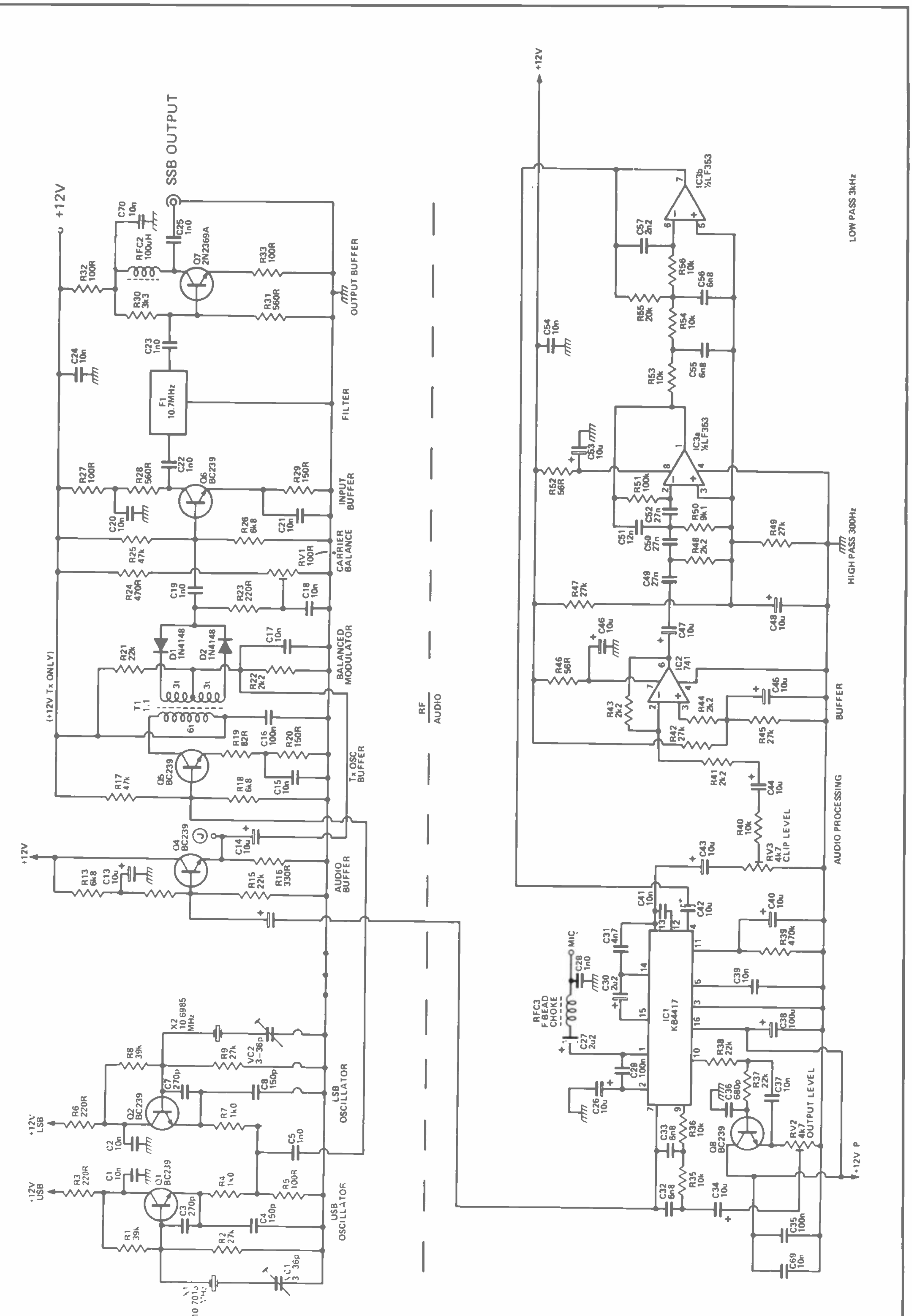


Fig. 4b Phasing method of SSB transmission

Fig. 5 Practical 10.7MHz SSB exciter adapted from Omega



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373's Dave Gadsden, G4NXV Advertisement Manager

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DATONG Model PC1 Converts any good 2m SSB rig into a superb general coverage receiver. Coverage is 0-30 MHz in 30 synthesised bands of 1MHz and no receiver mods required £85 ono. Ring 01-247 6097 daytime.

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WANTED Yaesu FRG 7700, reasonably cheap but good working order. Contact B O'Neill, 4 Greenview Place, Antrim, N. Ireland. BT41 4EP.

YAESU FT501 HF TX/RX digital readout. 560, 80-10M, superb high power rig. £280 ono. Wanted FT7 or similar mobile HF rig, also would part exchange VHF equipment for above FT501. Cash either way. Brian G4NXW Tel. Rossendale (0706) 224617 Lancs.

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FRG7 communications receiver plus matching ATU FRT 7700. Both handbooks excellent condition £230. Or exchange for good value communication receiver. Phone 0582-25519.

WANTED Digital aircraft band receiver preferably portable but anthing considered. Phone Clive on 0322 523214.

YAESU SP901 speaker, mint £25. FT901DM Service Manual including circuit update on FT902DM, mint £7.50 G4FXS, QTHR. Tel. 021 458 3537, after 7 pm.

TRIO TS130V 80/10m SSB/CW 25W including WARC. fitted narrow SSB filter £395, external VFO120 £300, digitial frequency controller DFC230 £30. All above items £445. MMT 144/28 transverter £70 with cables. MMT 432/28 transverter £110 with cables. Phone Graeme 0689 29230 evenings.

ICOM 251E 2m base with TRIO MC50 desk mike M/M50S 50W linear amp, DAIWA 144/250MHz SWR bridge, 2WAY ant switch AR40 rotor ZL12 beam inc. all cables £550 complete. Will split, contact Phil G1DHE 0642 604408.

TS700G 2m multimode immaculate, original packing £295 also 48k spectrum PSU plus ZX printer + games £125. Or swop both for good HF Rig 101ZD or similar. Tel. Peter Oakamoor. 702208 G6UHH QTHR.

YAESU FT102 9 band HF transceiver 270 Hz, CW filter-fitted. Condition as new, only 9 months old £630 o.n.o. Tel. 0427 872712 or at 72 fieldside, Epworth, Doncaster, S. Yorks.

ICOM IC2E. Zharger rubber duck, newsagent ⅝ whip AE, SWR meter Hanson £100 ono. Wanted circuit diagram and book for Lafayette HE30 radio. Wil buy, hire, or photocopy. QTHR. GM30DM phone 0475 705896 after 7pm or after 2pm.

YAESU FT200, FP200 HF TX/RX all 10m Xtals fitted excellent condition £210 ono. G3ZNK QTHR. Tel. 0532 504599.

SANSUI QA7000 Semi-pro quadraphonic amp, plus TU7500 tuner £220. Also Awai AD6500 cassette deck £70, Bowers and Wilkins DM2 MK2 speakers £175 or swop for modern HF rig or good computer with cash adjustment. Tel. Northampton 491627 (all mint).

WANTED FM board for Yaesu 101ZD MK3, also Shure 444 Mic. Good price paid. Contact Mr. Davies, 9 Paisley Avenue, Eastham, Wirral.

YAESU FT102 HF transceiver AM/FM CW/SSB, 9 bands. 7 month's old, used for SWL only last 6 months. Mint condition , original packaging mike and manuals £650. No offers. Phone Tom Davidson 01-444 0359 day and evenings.

LOWE SRX30 receiver 0.5 – 30MHz, very sensitive £115. Yaesu FR50B amateur band receiver 80m-10m, even more sensitive £55. Can deliver within 30 mile radius. Phone Norwich 743852.

6Y2/12Y70 Beam £10, 25W wide-band dummy load £5. 27MHz SWR and Watt meter £3.50. Telephone 0604 811246.

YAESU FT-DX560 HF transceiver 80m-10m 560. Built in power supply, 600 Hz narrow CW filter. Yaesu base station mike, handbook, all packing good condition, £350 ono or swap for tandy TRS-80 expansion interface + disk driver. WHY? S Cowell, G4XKH. Tel: 098 064 675 not QTHR.

TONNA 9 ELE crossed Yagi £25. Swiss quad 2M £25, HFS with radials £35. KW. E-ZEE match ATU £25. Tel. Yateley 878221.

ITT 2020 Apple compatible microcomputer with high resolution monitor serial-interface, disk drive, and software including business, games and amateur radio programs, £350 or P/X HF transceiver, cash adjustment either way. Phone Tim (G4UDA) on 021 351 7129.

WANTED TRIO 2000 mint condition. Tele: 0326 290485.

MARINE VHF transceiver commercial equipment plus 2 remote control units, handsets technical manuals £250, or swap for FT290R, O.W.H.Y. Also coutant 10A P.S.U. presettable output £50. Prefer buyer views ring 08045 3610.

AOR 2001 Comm/Rec 25 550MHz £295, HP41/C hand computer £90, Usomic alarm system £20+post, MM144/432 transverter +PSU £150, WEL2/SP400 130 500 Mhz PWR/SWR £40, 7" green computer video £30+post, TRS80 Model 100 portable computer 32K with cables, PSU, Programs £300 cost £800. Ring John 04738 5526.

SPECTRUM ANALYSER 10 MHs-40.86 GHz, new medium persistance tube serviceable sadly must sell £400 ono. VHS Comms RX 50-500MHz £50 ono. Pye UHF base station rock bound 10W £50 ono. Buyer collects G8NLF 04203 2741 not QTHR.

WANTED for cash FT101 or FT102. Aeron 0570 470739.

MARCONI CR-100 in working order, complete with operating and servicing manual. Exchange for Collins air band receiver R278/GR or sell 0491 36837.

WANTED Yaesu YR-901 CW RTTY reader in very nice condtion. Colchester 394336 (Essex).

WANTED FT101ZD MK3 must be in mint condition. Phone Colchester 394336.

WANTED Heath RA-1 receiver. phone Slough 75780.

FOR SALE SOMMERKAMP FT 7B, boxed mic, £285 or exchange for TRIO TR9000 + Ken P10 KR400 + 30m cable. Could deliver 100 miles from Manchester. Tel: 0625 527250.

WANTED drum kit. Swap for 16mm Debrie sound projector, or Bell Howell 636, plus 1800 sound film, Bell Howell silent 16MM, 8 track stereo car unit, and PSU 13.8 5A. G8BSK, 290 Priory Road, St. Denys, Southampton S02 1LS.

EXCHANGE, Pye Vanguard Part converted 145MHz, with manual, plus Pye Continental TV 405 line almost antique, plus Amstrad CB — very little used, for rotator suitable 8 ele Beam 145MHz. G1DJV, 30 Chatsworth Rd, Brislington, Bristol, BS4 3EY. All letters answered.

SONY ICF-7600D superb portable communications receiver. AM/SSB 150KHz-30MHz, FM 76 MHz-105MHz. Perfect condition. All accessories plus handsbooks. Cost £170 asking £130. Phone Uttoxeter 3495 evenings.

PAN ADAPTOR SM220 scope, for use with TS520 and TS520S TX/RXs £20 OVNO. Sedgley 79131 W. Midlands for more info.

FT101 HF rig urgently required must be in good condition and Bank Manager says reasonably priced. Pete 021 373 0060.

WANTED VHF marine band 152-162 MHz receiver type SR9 or near equivalent. Phone Peacehaven 2963 anytime.

WANTED YAESU 7700 Receiver Norfolk area Telephone Framingham Earl 2477.

WANTED KW202 RX and KW204 TX. must be free of mods, undamaged and in first class condition. Fair preice paid for right rigs. All letters answered. Would consider any other ancilliary equipment. PRYSE. 36 Hart Rd., Byfleet Surrey KT14 7NH.

WANTED secondhand, in good condition 2M transceiver including FM and SSB at reasonable price G1GJH Box, 43 Tunbridge Wells, Kent TN2 5BX.

FT208R HANDHELD 2 NICAD PACKS. Spkr. Mic. charger £155, or consider P/X FT290R. Also scarab RTTY I/FACE plus software for ZX81 £12 G4UKO. 0622 859129.

AR88D spare valves, copy manual £60. Pye AM10 dashmount 6 channels Xtalled 2M FM £30. TAndy HF SWR/PWR meter remote sensor £10. Contact G4UGR, 29 Bury New Rd., Ramsbottom, Lancs.

FOR SALE Ham international Concorder 2 AM/FM SSB, mint conditon. £100 ono. TAGRA BT104 Sigma 4 copy never-assembled £45 ono. Spectrum 48K brand — new never used £100 ono. Phone 0375 676685 after 5.30 pm.

PASSED RAE May, will swop. Tandy TRS80 colour computer with accessories for 2M handheld with repeater shift, or sell £75 ono. J. Taylor, 73 Caeau Rd., Newport, Gwent. 0633 28051 (office.

WANTED Radio facsimile reception equipment in good condtion or computer software for this application. Details to Pinnell, 19 Grove Place, Lymington, Hampshire S04 9SS.

KENWOOD R2000. Communications receiver 8 months old, very little used. £300. Telephone 0472 823027.

WANTED Star com RX model no SR40 circuit diagram or manual. Phone 0278 423288.

HAMMOND L102 Tonewheel organ with drawbars and presets. Also printed circuit making gear, exchange for HF/VHF transceiver or separates or general coverage receiver. Phone 097-422-326. Can deliver. West, New Row Stores, Pontrhydygroes Dyfed.

TRIO TR7800 25W 2m synth TX £150. Standard CC7800 70cm FM TX £150. FR50B HF RF £50 and Redifon terminal VDU KBRD PSU AN £25. Computer PSU £10 PFI TX/RX £15 pair G4YRT Brighton 600647 eves.

BELCOM LS202E 2M FM/SSB radio, mint condition and original packing £200. Sony ICF-7600D general coverage receiver £150. Telephone 01 247 8131 Ext. 287 during work hours.

YAESU FT7 mobile transceiver complete with B.N.O.S. 12/6A PSU SEM transmatch, separate EZITUNE, Hansen PEP Power Meter, YHSS headphones £390. Carr — included. Contact John 091-4162606.

MICROWAVE MODULES MMT432/144R transverter £100 ono Jaybeam 8XY/2M crossed Yagi with phasing harness £25 ono. Ring Ray G6RNP. Tel: 06455 2342.

HAM INTERNATIONAL MK 3 cost £385 3 months old £300. Must sell going abroad. Phone 0283 221870. Wanted NATO 2000.

WANTED Heathkit R.A.I. receiver, also codar AT5 TX. Marris, 35 Kingswood House, Farnham Rd, Slough SL2 1DA.

IC720, fitted with LDA unit, CW/N filter, AM filter. ICPS20 PSU ICAT100 automatic antenna tuner unused. ICSM5 desk-mic. All in excellent condition. £825 the lot. IC215 15 channel 2M/FM case, nicads, helical antenna £95 ono. Phone Mick 021 458 7878.

SYNTHESISED Scanning VFO with keyboard 12 memories FV101DM and FT101ZD FM MK III 9 band fitted CW filter fan AM plug-in, mic, workshop VGC £575 ono cash. G4MBZ. Ring 0252 837581 evenings QTHR.

REALISTIC PRO-2008 Scanning receiver. 68-88MHz, 144-174MHz, 410-512MHz. Up to 8 channels with delay on channel and lockout facility. Also small indoor antenna to suit with instruction manual. £60. Phone 061 494 2729.

ZX81 16K, professional keyboard, computing course and books £59 ono. Amstrad multiband portable radio, covers LW/MW/SW (2.4 -23MHz) VHF (88 - 136MHz) includes airband, separate marine band (4-6MHz). £21 ono. 16 draw componnts box with resistors, capacitors, ICS transistors, will include SWR, £9 ono. 0253 45431.

TRIO 9-R59DS Xtal cal fitted spare set values boxed manual £50, carr extra. Phone Smyth, 0436 71181.

MM2001 RTTY TO-TV converter £100. Complete ATV-STW TX-70cms camera lens monitor £200 or will exchange good FT290 2 ants for 2M 7/8 mobile Mag base colinear £30 for both Tel: Northwich 45584.

HI-GAIN 14AVQ 10-40M vertical with mounting stand and guys £30. G6IF 1 squirrel Lane, High Wycombe, Bucks. 0494 20733.

WANTED extended basic for Texas Instruments TI99/4A Home computer must be in good condition "Redheugh" West Main St., Blackburn, W. Lothian, EH477LS. Tel (Bathgate) 56429 Ask for Duncan after 5 pm.

TRIO TR2500 handheld brand new, complete with ST2 quick charge base unit. Surplus to requirements, cost £300 accept £250, will not split. Phone 01-540 3959.

WANTED 70cm transverter module for FTV107R, would consider purchase of complete FTV107R including 70cm module. G3SYS c/o 18 Fraser Court, Handbridge Chester. Tel: 0244 676570.

ILLEGAL CB radios with USB and LSB wanted for modification amateur bands workers £30-£50 non-workers negotiable. G3ROZ, 13, Abbey Grove, Sandy, Beds. SG19 1QP or ring 0767 80828 weekends. Collect within 100 miles Bedford.

COMPLETE super 8 movie outfit Eumic S910 sound twin projector carrying case. Sanyo EM60XL camera rexette. striper Fujica splicer cine editor, folding screen 7000 FT coloured films MHz cost £400. Swop best short wave Foley, 20 Hanover Court, Madeley. Telford Shropshire TF75HT.

WANTED Europa B transvertor 10-2M must be in full working order and good condition. Also needed rotator for 2M beam. Contact Tony 0632 661310 cash waiting.

TS-120V 20W mint condition never used mobile can be seen working at 6 Princess Close Dunkinfield Cheshire or Phone 061 344 5484 £350 ono.

YAESU FRG-7700 general coverage receiver, mint condition with FRT-7700 AITU manual. Original packing securicor delivery. £245. G13GTR 3, Rhanbuoy Park Holywood Co. Down BT18 0DX Tel: Holywood 6466.

BELCOM LS102L 25-30 MHz transceiver. Excellent condition, narrow fm filters fitted, digital frequency readout, £200. 0202 301691 (days) 28758 (evenings).

HRO500 General coverage synthesised all solid state RX. Superb condition, recently professionally serviced. £300. FT101 series workshop manual. £20. FRG7700 mint. £260. Kantronics mini-reader, morse, RTTY, ASCII, clock manual. £30. Phone Liss 892143.

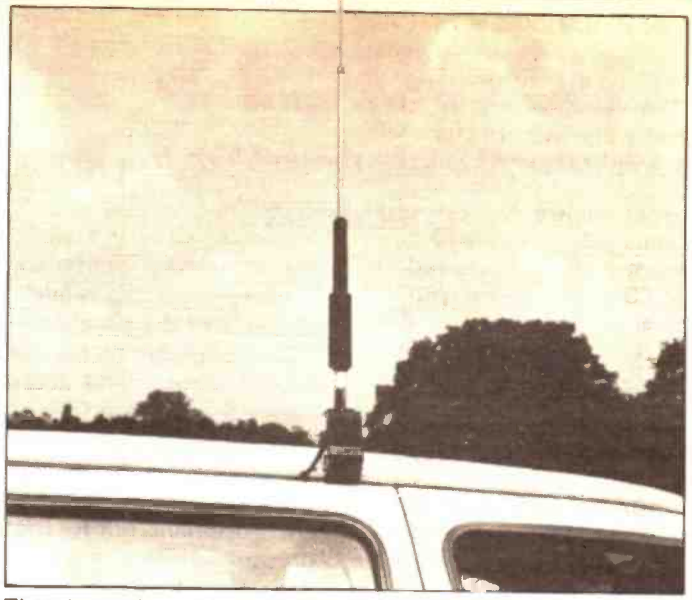
FOR SALE Boat and outboard motor, sell for £800 or exchange for 70cm multimode with cash adjustment. Call Hampstead Marine Phone Maidstone 812673. To view "Levante". contact G4UYL or G8STO QTHR. No time wasters please. Mrs Hills, 51, Charter St, Gillingham Kent.

SIX RCA beam deflection valves. Unused in original cartons. £6 each ono. Tel: 051-608 3362.

FT200, PSU/SPKR and all 10m Xtals, good condition and working well. Buyer collects/arranges carriage. £210. G4LUF (QTHR) Tel: Swindon 782787 after 6pm.

WANTED partridge variable antenna (joystick), and tuner unit good condition. Latest model. 44 The Avenue, Hetton le Hole, Tyne-Wear, DH5 9DQ.

OFFERS invited for BC342m RX in reasonable condition, Hitachi CCTV camera (HV62K) cw Tamron 16mm f1.6 lens, excellent condition. Wanted good reasonably priced general coverage receiver for school radio club. Phone Alan Elcoate, King Edmund School, Southend 545771 daytime.



The photo above shows variant of the Glenstar (Navy Special) in a gutter mounted position (see this months Radio Today).

WANTED ITT starphone (UHF) batteries and manual for purchase. All replies answered. B. Rutter, 7 West Howe Close, Icinson Bournemouth NH11 8AE. Tel: B'mouth 422286.

FT2AUTO 2m Transceiver for sale or exchanve for 48K Spectrum. Wanted circuit of heathkit HW12, Photocopy will do, also ZX81 16K Cheap wanted. Robert Williams, EI7AF Martineus Mountain Rd, Clonmel Co. Tipp, Eire.

PENTAX or Olympus 35mm camera outfit in fitted case. W/A, Tele zoom lenses, dedicated flash, tripod. Exchange same value VHF/UHF scanner and discone. Telephone Reading 860148 for further details, evenings.

WANTED FRA7700 active antenna and frequency counter for High gain mod V. For Sale Homebase CB 27MHz FM Model 407 £70 ono. Wanted good base mike. Mr O'Brien 12 Church Street, Caernarvo, Gwynedd. LL55 1SW.

2M COMPLETE FT290R, case, charger, mobile antenna, bremi 5A PSU, 9-element tonna, rotator, 10' aluminium pole, rotator, mounting brackets, plus leads etc. £350. Telephone Emsworth (Hants) 77532.

FOR SALE Yaesu FR101DD:RX £275 ono, Yaesu FR50B/RX £80 ono, or swap for Trio R820 RX + cash either way. Wanted Trio R820 RX. Phone Basingstoke 68649 (Mr Wright).

YAESU FT209R, multimode transceiver, PSU, Nicads and charger perfect as new condition. Any test OK. £185 ono. Daiwa SWR/power meter £20. Would consider swapping all for home computer. Tel: Dudley 213699.

WANTED FT480R all mode. FM/SSB must be in very good conditon, not modified. Offers up to £250. Phone 073121353. Between 6-8pm.

TR2400 with leather case, excellent condition, £180. Telephone answering machine, phonesitter P70. £50. Eddystone 898 dial, unmarked, £8, new VCR139A CRT with base £8, 600X 0.6A mains transformer. £6. G3ZLS QTHR. Knowle 70235.

SELL/SWAP FDK multi, 700AX 2M FM 1-25w variable with accessories in good condition, rarely used. £135 or will swap for Yaesu FT790R with cash settlement. Phone Mike G1AVU Harpenden 69854.

FULL set of golf clubs, bag + trolley would exchange for any amateur equipment. Old or modern. Please contact Bob at 29 Ainsworth St, Belfast. 13 Northern Ireland. or Phone Belfast 248988 between 6pm and 8pm.

NEC PC8000 plus dual disc drive, loads S/W CP/M, NBASIC, Wordstar, Database, Games etc. Colour or B/W monitor. £400. B/W £450. colout. Swap Eddystone EA12 or TS515/KW2000 or why also centronics S1 £25. ring glenn S1 £25. Ring Glenn G6VRQ 0734 863881 after 7pm.

SWITCHED mode power supply input 115-120V AC, 12V 10A. Marconi oscilloscope type TF2200A. Complete with handbook. Need Frequency counter Urgent 0376 29089 (Henry).

YAESU FT200B SP200 HF TX/RX 240W PEP. Excellent condition clean almost as new. Purchased 1977 and used only frequently. Complete with home brew cooling fan, spare PAs instruction manual etc. £250. GM4 FSB QTHR. Tel. 0382 543069 after 6 pm.

GENUINE SIGMA IV antenna £35, Zetagi, B150. Inear £30, turner + 2B power microphone £18, or will exchange the lot for 144MHz linear. Tel: Harlow 26647.

Yaesu FT480R boxed £270; 7XY Jaybeam, Hirschmann rotator, Mast, £50, 20m RG213/U Kabelmetall £20, Toyo 2m/70cm THRY-line watt meter £20. Icom IC4E+IC-DC1 (70cm H/held) £140; bench PSU 13.5V for FT480R £20. N-type UHF coaxial switch £5. toyo 100w 500MHz Dummy load £20. Tel: Orpington 26469.

FT707 plus PSU £375, TR7500 2m FM synth transceiver £100, Acorn Atom fully expanded, good condition £75. Wanted. FT290, or 480, or IC260E will swop W.H.Y. Dave G3VFP. Tel: 061 439 2377 not QTHR.

TRIO TS-130s, PS-30 20A supply, DFC-230 digital vfo, 250Hz cw filter workshop manual. All absolutely mnt condition. Worth £850 new. Must take £500 firm. Tel: Paul Evans, G4BKI, (Not QTHR). Towcester 51823 (home), 51871 (work).

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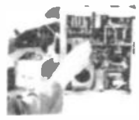

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