AN ARGUS SPECIALIST PUBLICATION

July '84

HAM RADIO TODAY

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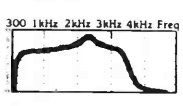

". . . Have not yet heard an FT-101 sound any better than when used with The Key Element . . . " – Paul, G3AWP

". . . I now have a comfortable feeling that my audio is better than the rig was originally capable of . . . " – Ken, W9UBS

". . . Thank you for the fine report: all reports to date have been excellent . . . " – Lee, W1SE

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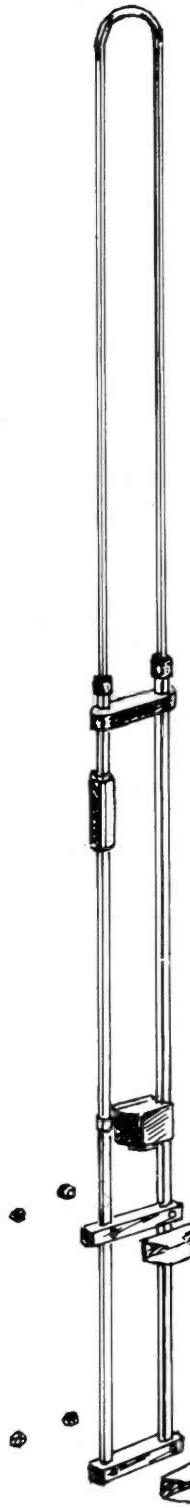

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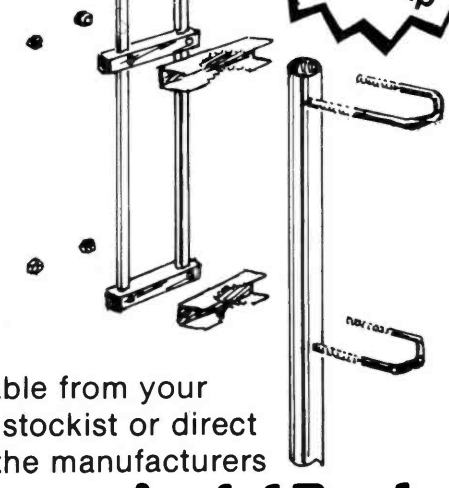

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HAM RADIO TODAY

VOLUME TWO NO.7 JULY '84

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ABC

REGULAR COLUMNS

CONSTRUCTION

FEATURES

REVIEWS

LETTERS

COMPONENT SHORTAGES

Sir, I am an avid homebrewer and take your magazine in part for the excellent construction articles. There is a positive approach in your magazine to encourage homebrewers. However, it should be brought to the notice of prospective builders of the availability of the parts required. My recent experiences certainly damp the enthusiasm to build. The latest project had a "out of stock" label to over half the parts required. The previous project held for six weeks pending supply of parts.

To the already high price of components is added not one lot of postal charges but possible two or three. To the suppliers who can boast adequate stocks and quick replenishment will go success and the others will drop out eventually.

My latest order has been sent labelled "All parts are required. If only PART available, CANCEL (this order).

George Clarkson, G3RHM

Obtaining components for radio projects has never been easy and has certainly got progressively more difficult in recent years. In general, components for projects in HRT can be obtained from Maplin, Ambit and Bi-pak — large suppliers with a substantial turnover — without too much difficulty. However the component business is not the most profitable of businesses and as you are probably aware, profitably is all in the present economic/political climate. . .

In order to circumvent this problem HRT tries to publish designs for which a kit of parts is available. When you count up the aggro, accumulated postal charges etc, the mark up on kits seems pretty reasonable — especially when the kit supplier has to cope with this aggro too!

FT102 PROBLEMS?

Sir, The reason for this letter is so that perhaps somewhere in your publication you could advise owners of FT102 Transceivers who may be experiencing the same as with my new purchase, namely poor selectivity, overloading and poor signal-to-noise level on all bands. Returning the equipment to the import agent has not been successful in clearing the fault. I have finally found the fault myself and wish others to benefit from my experience.

If you are having the above symptoms, take a look at the IF PCB and alongside Test Point 10 which is on the output from T09 and feeds into the Gate of Q2010. Check if R84, a 100K resistor has been installed. R84 will be written on the topside of the board. R84 had been left out in my receiver; installation (of this) will cure the overloading, improve selectivity and signal-to-noise ratio.

The above is not an isolated instance as this seems to be common in the batch of transceivers between 2M071000 and 2M071100.

C.H. Castle, VK5KL

934 MHz CB

Sir, I am pleased to inform you that The 934 MHz Club UK has now been formed. We have a strong steering committee who have already met several times.

We are, of course, aware that it is virtually impossible for us to contact everyone using the band without the assistance of publications such as yourselves. I would therefore be grateful if you would publish details of the Club in your Magazine. Should any of your readers be interested in the Club or the band generally they can contact me at The 934 MHz Club UK, PO Box 424, Chelmsford, Essex CM6 3UR.

We have received an excellent response from the initial mailing and new applications for memberships arrive every day. The Club now has a membership of over one hundred.

The QSL Bureau referred to in the initial letter is now operating successfully. We have a reliable QSL Manager who will ensure that QSL's received are forwarded to the members.

Lastly may I thank you in advance for any support that your Magazine will give to the Club.

Mrs Glenys Anthony, Secretary

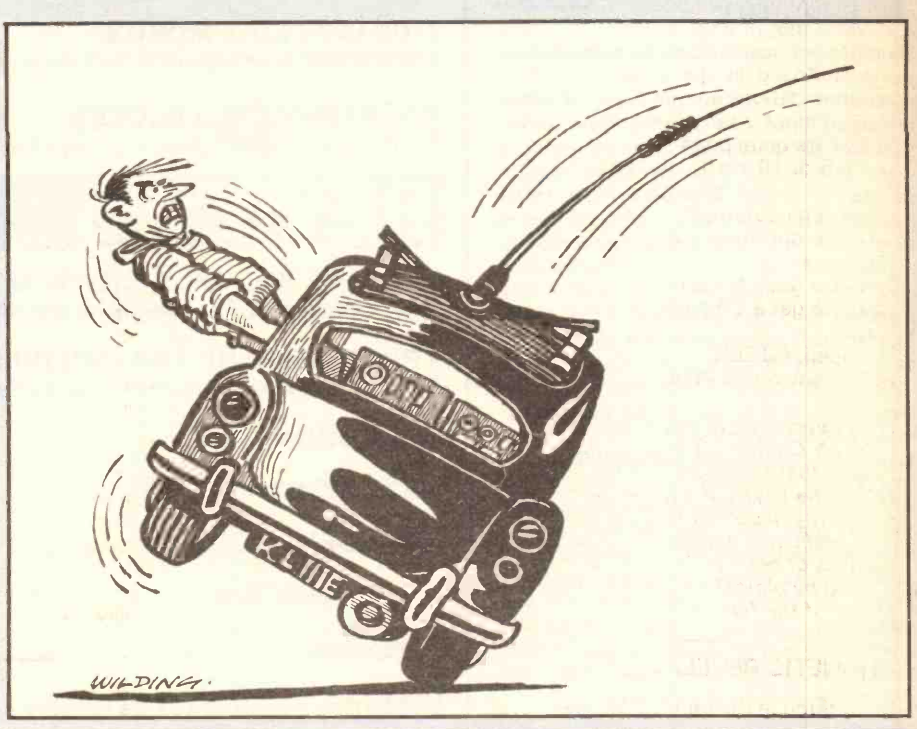
NOT STAND-OFFISH

Sir, As a fairly new licencee may I make a few comments about Tom Wylies' (GM4FDM) letter in May HRT ("Where have all the Class B Licences gone"?)

First of all, up until I let my licence run out, I was quite happy to talk to anyone who happened to give out a general CQ call.

When I first appeared I was given every help and assistance and have made many new friends. Hopefully I will be able to make some more among the G1s who are appearing.

My temporary absence from the bands is due to my attempt at the morse test and the fact that I didn't want to pay



£12 twice (once to renew the VHF licence and another £12 for the HF when I finally pass the morse).

In doing the morse I do not want to 'escape' two metres nor do I want to attain the 'real standard', but at least when I have the HF licence I can use any mode on any band. I shall have to go back to 2m/70cm as that is all I have at the moment (I have an FT290R and a Pye Westminster).

As regards repeaters, there are several very good ones in my area and as I also do a lot of driving I tend to listen to one of them for ease of operating. This has meant that a) people know how to get hold of me, and b) there is someone to talk to the new G1s when no one else is around.

D. J.. Ackrill, ex-G6 VMQ

PS I am looking forward to getting back on the bands with a new callsign.

Glad to hear that you will soon be back on 2m/70cm. Recently I had contact with a new G1 on 2m SSB who complained of an absence of replies to his CQ calls despite a fairly active band. He had a good signal with me despite his relative distance. Let me re-iterate Tom Wylie's plea: c'mon lads and lasses, when you hear a new callsign give then a call. Make friends, don't just monitor.

NOVICE LICENCE

Sir, I should be grateful if you would publish this letter. I realise that you will be innundated by replies but I believe that people like Mr Compton should be put right for once and all.

In reference to Mr Compton's letter, published in HRT May issue: obviously Mr Compton is sorely deluded if he thinks that the amateur radio fraternity needs a novice licence. Our hobby has prospered for years without a novice licence and it will continue to do so, provided people like Mr Compton are not let loose on our bands.

Mr Compton's idea does not stretch beyond that of a typical "CB-er". The novice licence suggested is just an excuse to legalise pirate SSB. The recomendations are pathetic. 250 watts max at night is very QRO, considering QSOs are quite possible world-wide using 5 or 10 watts. Besides, how many people will operate after 1 am — is Mr Compton nocturnal?

If Mr Compton does not like 27 MHz CB, we suggest he uses 934 MHz and leaves amateur radio alone because he is not going to get a CB paradise through our hobby.

P. Juden, G6 ZBN
P. Williamson G4 WUU

I have very little to add to my remarks after Mr Compton's letter in May HRT except that I think he is being hopeful rather than cynical. I would also like to repeat my assertion that the RAE tests the candidates application to radio rather than his or her intelligence and may be passed by almost any candidate with plenty of the former.

PHONETIC REVELATIONS

Sir, reference the item on Phonetics by George Metcalfe, G6 VS (Letters, April '84 HRT).

He states it was not until 1938 that a full phonetic alphabet was introduced for Service Use. This is incorrect.

I am ex-army AIS County Regiment (Royal Signals trained). We were teaching full alphabet phonetics in 1929/30/31 etc.

These were:

Ack	Nuts
Beer	Orange
Charlie	Pip
Don	Queen
Edward	Robert
Freddie	Sugar
George	Toc
Harry	Uncle
Ink	Victor
Johnny	Willie
King	X-ray
London	Yorker
Monkey	Zebra

These come much easier to the mind than the present day ones.

Retired these days, but still playing with CB

Sir, With reference to previous correspondence on Phonetics I enclose a copy of relevant sections of the Signal Training (All Arms) 1928 manual.

Referring to paragraph 6 ("To obtain uniformity by users of military telephones a card is affixed to every field telephone with the complete phonetic alphabet on it."), the card had, some time before 1938, been replaced with a black metal plate with the full phonetics embossed on it.

One explanation is that there may have been two training manuals, one, as quoted by the Curator of the R. Signals Museum, in G6 VS's letter, and the other as mentioned above, as issued to the Field units of the rest of the British Army.

The Royal Corps of Signals were rather more specialized than the rest and did not introduce the full phonetics until 1938 by which time it's usefulness had been assessed by Regimental Signallers.

M. Hughes, GW3 VFZ

The phonetic alphabet in the manual quoted is the same as the alphabet above.

Please address correspondence to:
Ham Radio Today,
1, Golden Square,
LONDON W1R 3AB.

RADIO TODAY

Stop Press!

The winner of the Draw for all those who wisely bought subscriptions to HRT from our stand at the RSGB Amateur Radio Convention was Mr BL Chesworth of Wrexham, Clwyd. Mr Chesworth wins a 7 element 2m yagi kindly donated by MET antennas and the CQ Centre.

Interested in Microwaves?...

The MICROWAVE SOCIETY looks after the interests of all those operating on, or interested in, frequencies above 10 GHz.

Their well known DATAPACK (which includes all you need to know to build a complete system for under £40) has now been completely revised and is now in its 5th edition.

The societies newsletter "WAVEGUIDE" keeps member up to date with society affairs and also includes updates for the DATAPACK. This year sees the start of the societies awards and certificates scheme for achievements on the frequencies above 10 GHz. Some indication of the growth of interest in microwaves is the fact that nearly 200 new members joined the society during 1983.

The society looks forward to meeting as many microwave enthusiasts as possible on its stand at the NEC rally and at the large number of club talks undertaken in the course of the year. Full details from The Microwave Society, 81 Ringwood Highway, COVENTRY CV2 2GT.

Letter From America

In a recent editorial, Wayne Green, publisher of 73 magazine, claimed that the increase in American amateur radio licences over 1983 was 2·6% — which contrasts somewhat markedly with the UK increase of 20%. Although the US have no equivalent to our Class B licence, they do have a novice licence (CW only), for which the annual growth was 9·4%, and their General class, very similar to our Class A in terms of structure, was down by 0·7%, according to Wayne. The crossover from CB to Amateur Radio is undoubtedly responsible for the large percentage increase in this country. Some RAE Instructor friends of the Editor report a small percentage decrease in the popularity of Examination classes for the first time in the last few years. Could the boom perhaps have reached it's peak...

Wayne has also recently proposed to the FCC, American equivalent of the DTI, a change to the licence conditions whereby biennial re-testing of the radio amateurs' proficiency in Morse becomes mandatory. He has also proposed that amateurs be required to demonstrate a 5wpm increase in their morse ability to an ultimate figure of 35wpm at the end of each two year period. Amateurs failing the test would be given a period of 60 days to demonstrate the required rate or lose their licence!

Arrow Hit The Target!

It has probably not escaped the notice of HRT readers that Arrow Electronics have recently moved from their old premises in Brentwood to a rather nice showroom in 5 The Street, Hatfield Peverel, near Chelmsford. A crowd of around 50 enthusiastic amateurs, including HRT's Dave Gadsden, G4NXV, attended the Trade/Press Party on 30th March. The Editor was unable to attend owing to an importune attack of influenza, missing quite a good shindig... Dave was so enthusiastic that he actually made the first purchase, a 5/8 whip...

Dave Gadsden,G4NXV, at Arrow

Arrow received flowers, homemade cakes and wine and many good wishes from their regulars and would like to extend a very big thank you for their support. Peter Clarke, G3LST, of Arrow reports over 500 customers on the first day at Hatfield Peverel!

BARTG Go DATACOM

The British Amateur Radio Teleprinter Group (BARTG) recently launched their new quarterly magazine called DATACOM. This replaces the BARTG Newsletter, and is sent free of charge to all members of the Group.

DATACOM is dedicated to all forms of data communication by conventional teleprinter and by computer, including RTTY, AMTOR, Packet Radio, FAX and so on. The first issue of DATACOM, dated Spring 1984, is 116 pages long, and is apparently the largest publication ever produced by BARTG. It contains a large number of technical articles of interest to teleprinter and computer enthusiasts, plus a number of special interest columns on emergency communication, FAX, clubs, etc.

There is a special feature on Packet Radio, with a tutorial article on the principles of Packet Radio for beginners, plus full details of a Packet Radio experiment being carried out in Cambridge, *using BBC microcomputers*. There is also a full-length article describing GB3PT, the RTTY repeater at Cambridge, with information on how to use it and details of plans for upgrading it to ASCII operation.

For full membership details, please contact Mr. John Beedie, G6MOK, 161 Tudor Road, Hayes, Middlesex UB3 2QG. (01-561 0010).

Amateur Radio And CB In Harmony

A group of radio amateurs and keen CB operators will be taking to the Sutherland Hills on the 2nd and 3rd of June 1984 in aid of the Highland Scanner Appeal. The amateur radio group

will be operating on the 20, 40, and 80 metre bands SSB/CW and also on 144.550MHz SSB. The CB STATION will be using 4 watts FM and hoping to work many CB enthusiasts far and wide. The Amateur Radio call sign will hopefully be GB2 DOS (which stands for DUKE OF SUTHERLAND) and the location will be on the summit of Beinn A'Bhragaidh (XR10B) 1293 feet ASL and 1 ½ miles North West of Golspie. ''CB YL'S and XYL'S will be providing the Scottish Fare to keep 'the spirits high' during the two day event, as the 'Mountain Haggis' is out of season at this time of year(!)'' says the press release. Special QSL cards will be sent from both CB and Amateur Radio Stations.

New UHF GaAs FET

The new Mitsubishi low noise GaAs FET type MGF 1404 is now available from Aspen Electronics. This is a super low noise GaAs FET with a N-channel schottky gate which is designed for use in S to Ku band amplifiers. The hermetically sealed metal ceramic package ''assures minimum parasitic losses and has a configuration suitable for microstrip circuits.'' Features include typical high maximum frequency of oscillation of 90 GHz; noise figure of 1·6 dB at 12 GHz; and a gain of 10·5 dB at 12 GHz.

Repeater Update — 29 MHz Repeaters?

There seems to be a growing interest in the possibility of 29MHz FM repeaters. There are presently six proposals with the Repeater Management Group; for Leicester, Daventry, London, Barnsley, Cornwall and Blackburn. The Leicester Group have recently drafted a complete technical specification for a repeater which is awaiting agreement from the HF committee.

A recent meeting was held to form a new repeater group for **GB3 NN** (RB2), located 3 Km south of Wells Next The Sea in Norfolk (AM095F). Site approval and a franchise has been received, also licencing procedures are in progress within the DTI, and it is hoped to have the repeater operational at its new site by June/July 84. The repeater is a Pye 460 UHF unit converted to 70cm repeater use, the aerials are 4 stacked J poles for Rx and 4 stacked dipoles for Tx, the site is 77 Mts ASL, with aerials at 25m high and an ERP of 12 watts.

Donations from any prospective users of GB3 NN would be gratefully accepted by the keeper, Bill Tuck G8KZP, ''Whalebone Cottage'', Wells Next The Sea, Norfolk, NR12 1EN, or the treasure Malcolm E. Amis G4VDC, ''Arcantell'', 5, Waveney Close, Wells Next The Sea, Norfolk, NR12 1HU.

The repeater support group of **GB3 BP** have asked permission to change the callsign to **GB3 WS** (West Sussex?) and this has apparently been approved. Some difficulties with the relocation of the long licensed **GB3 AE** (Skipton, Yorks R5) has meant that it has not been operational.

The *South West Hertfordshire UHF Group* are responsible for providing and maintaining three UHF/SHF stations in this area. **GB3 HR** is their 70cms FM Repeater Station located at Stanmore. This station was originally sited at Bushey Heath, however, due to financial and coverage problems, the new site at Stanmore was selected which gives a worthwhile advantage on both accounts. Regrettably they have found a couple of gremlins at the new site, which, up until recently, has meant reduced transmitter output power and reduced receiver performance. The transmitting aerial fault has now been rectified and users report good coverage to mobiles over the areas of St. Albans, Edgware, Harrow and Watford. They hope to have the receiver problem cured within the next month. GB3HR can be found on 70cms FM channel RB14 (433·350 MHz TX, 434·950 MHz RX). **GB3 SWH** is SWH's 10 GHz (3cms) Beacon Station located at Bushey Heath. The device is horizontally polarised and provides a good source for checking propagation and alignment of 3 cms equipment. The station operates on 10·368 GHz with facilities for both wide and narrow band users, and is regularly heard in Suffolk and Hampshire. **GB3 BH** is the proposed 1·3 GHz (23cms) FM Beacon/Repeater station, presently being constructed by members, to be located at Bushey Heath. This station is unusual as it will act both as a Beacon, and as a Repeater Station. Frequencies will be 1297·0 MHz TX and 1291·0 MHz RX. Horizontal polarisation will be used.

Contributions are always welcomed by the Group to pay for site rental and electricity charges and should be sent to Mr. Brian Greenaway G3THQ at 5 Lansdowne Grove, London NW10 1PL. Reception reports are also very welcome and should be sent to the *Secretary,* Mr. Trevor Groves G4KUJ, 62 The Crescent, Abbots Langley, Watford, WD5 ODS.

Members of the Group are available to Clubs for talks and demonstrations, for further information please contact the Secretry as above.

Radio Japan Expands Service To Europe

HRT's broadcast enthusiasts may be interested to hear that Radio Japan has expanded its overseas service to Europe and the Middle East by starting relay broadcasts on the 2nd April, from a high-powered transmitting station in Africa. The new relay broadcast will

Miss Yuka Nukina and Mr Hiroshi Shioguchi of Radio Japan, announcers of the 'DX Corner' programme

provide listeners with greatly improved clarity of reception.

Listeners in these areas have so far found it difficult to receive clear broadcasts direct from Japan. Since October 1979, Radio Japan has been relaying broadcasts to Europe and the Middle East for one hour daily from Radio Trans-Europe in Sines, Portugal. Now from the Moyabi station in Gabon, West Africa, Radio Japan is offering relayed broadcasts on a 500 kw transmitter for six hours a day in English, Japanese, German, French, Italian, Swedish and Russian. The programmes are being sent from Tokyo via the Intelsat communication satellites over the Indian and the Atlantic Ocean.

The time schedule and frequencies of relay broadcast from Moyabi in English are as follows: *General Service* 0700-1800 GMT (English) 21·575 MHz, 1500-1600 GMT (English) 21·550 kHz. New regular features include: Science Today; reports on progress in science, medicine and high technology in Japan; and DX Corner; facts and news for short wave buffs on DX broadcasts around the world.

Reg, G6XO, with the winning entry of the Chesham DARS Construction Contest, a 20/80m Trx by G4IWS

QTI Talking Newspaper

QTI Talking Newspaper for blind and partially sighted *radio amateurs* has been granted full charity status by the Charity Commission, (No. 326454). Donations and offers of financial support may be directed to: Mr. J. Feeley (G4MRB), Chairman QTITNA, 79 Narrow Lane, North Anston, Sheffield S31 7BJ. or Contact Dawn Tel: 0909 566301 between 10.00 am to 4.00 pm. Monday to Thursday.

Radio Amateur Micro User Group (RAMUG)

A new group has recently been formed for, as the heading shows, radio amateurs who use their microcomputers within the hobby. It is primarily for owners of the BBC MICRO, although other types of computer may be supported if demand is apparent.

They intend to hold meetings on a bi-monthly basis in East London but will unfortunately *Not* be running a 'Postal Club' as RAMUG feel that more can be achieved by practical use and demonstrations of various peripherals, hardware, software and also discussions 'on the air'. RAMUG propose to have a 'net' on 145·200 MHz (S8) on Friday evenings at 1930 hours local time.

The first meeting and election of committee was held on March 20th, 1984 and was well supported.

Meetings are to be held at The Design Block, Eastlea School, Hilda Road, Canning Town, London E16 and will commence at 1930 hours until 2130 hours. The dates for future meetings in 1984 are: Tuesday, 8th May; Tuesday, 10th July; Tuesday, 11th September and Tuesday, 6th November.

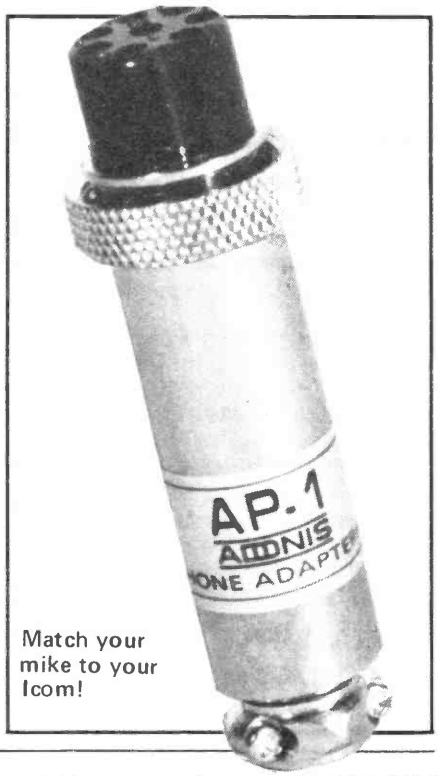
On May 8th RAMUG will have a talk and demonstration of 'Radio Teletype (RTTY)' by Chris Fogarty (G4KBL) and on July 10th a demonstration and chat about 'Database and Log. Keeping in Amateur Radio' by John Hopkins (G60VL) and Rob Webb (G4KCS).

The cost of membership of the group will be £2.00 per annum and all enquiries should be sent, enclosing a stamped, addressed envelope to: The Secretary, RAMUG, c/o R.A. Webb, 39, Aldworth Road, Stratford, London E15 4DN.

Icom Microphone Matching

One of the problems radio amateurs have experienced with the latest Icom series of transceivers is the difficulty of using microphones other than those supplied by Icom. The reason for this is that all Icom microphones have small amplifiers built into the microphone housing and thus the input sensitivity of the transceiver is too low for normal microphone outputs.

A company represented in the UK by Walters and Stanton, Adonis, have just announced their accessory AP-1 to overcome this problem. This is an 8 pin microphone plug fitted with an amplifier and drawing power from the existing DC point on the Icom 8 pin microphone transceiver socket. All that is necessary is to wire this plug onto any current microphone, thus enabling it to be used with all modern Icom transceivers. The price of this unit is £10.95 and they may be ordered direct from Waters and Stanton at 18/20 Main Road, Hockley, Essex SS5 4QS.



Match your mike to your Icom!

BI-PAK BARGAINS

MINIATURE TOOLS FOR HOBBYISTS

Miniature round nose side cutters – insulated handles 4½inch length. Order No: Y043.

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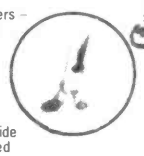
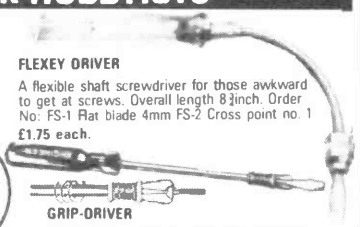
Miniature bend nose pliers – insulated handles 5½inch length. Order No: Y045.

Miniature end nippers – insulated handles 4½inch length. Order No: Y046.

Miniature snipe nose pliers with side cutter and serrated jaws – insulated handles 5inch length. Order No: Y042.



ALL AT £1.25 each



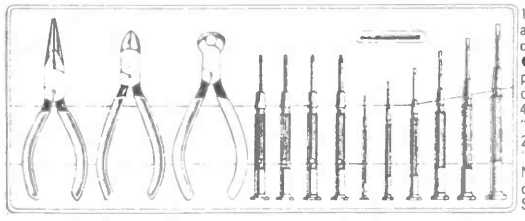
FLEXEY DRIVER

A flexible shaft screwdriver for those awkward to get at screws. Overall length 8½inch. Order No: FS-1 Flat blade 4mm FS-2 Cross point no. 1 **£1.75 each.**

GRIP-DRIVER

8inch long screwdriver with spring loaded grip on end to hold screws in position while reaching into those difficult places. Order No: SD-1 Flat blade 4mm SD-2 Cross point no.0. **£95p each.**

13 PIECE TOOL KIT AND CASE



13-piece tool set housed in attractive moulded plastic case with clear sliding cover ● 1 off 5" snipe nose "radio" pliers with side cutters ● 1 off 4½" side cutters ● 1 off 4½" end cutters ● 2 off hex. "Allen" key drivers 2mm and 2.5mm; 2 off cross-point "Phillips" drivers No. 0 and No. 1 (with tommy bar) ● 6 off precision screwdrivers. Sizes from 1mm to 3.5mm ●

ONLY £7.50 ORDER No. VP102

PRECISION JEWELLERS' TOOLS

Rustproof, Tempered Handles and Blades. Chrome Plated Handles. Swivel Heads for use on Precision Work.

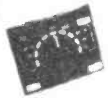
5T21 SCREWDRIVER SET
6 precision screwdrivers in hinged plastic case. Sizes – 0.8, 1.4, 2, 2.4, 2.9 and 3.8mm **£1.75**

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

5T41 TOOL SET
5 precision instruments in hinged plastic case. Crosspoint (Philips) screwdrivers – H0 and H1 Hex key wrenches. Sizes – 1.5, 2 and 2.5mm **£1.75**

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

MULTITESTER



1,000 opv including test leads & Battery

AC volts - 0-15-150-500-1,000
DC volts - 0-15-150-500-1,000
DC currents - 0 1ma-150ma
Resistance - 0 25 K ohms 100 K ohms
Dims - 90 × 61 × 30mm.

O/No. 1322 OUR PRICE £6.50 ONLY

BRAND NEW LCD DISPLAY MULTITESTER

RE 188m

LCD 10 MEGOHM INPUT IMPEDANCE

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

Max indication	1999 or −1999
Polarity indication	Negative only Positive readings appear without + sign
Input Impedance	10 Megohms
Zero adjust	Automatic
Sampling time	250 milliseconds
Temperature range	−5°C to 50°C
Power Supply	1 x PP3 or equivalent 9V battery
Consumption	20mW
Size	155x88x31mm

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

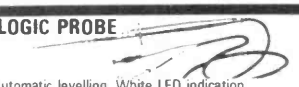
£45.00 each

Leather Case for 188m **£2.50 EACH**

SIGNAL INJECTOR

Simple push button operation. Oscillates at 700 – 1k Hz with harmonics to 30MHz. 1.4V p/p output. Impedance 10kΩ. Ideal for trouble shooting with audio equipment. One "AA" penlight battery supplied. **O/No VP96 £2.50**

LOGIC PROBE



Automatic levelling. White LED indication. Minimum width of measuring pulse 30 millisecs. Maximum input frequency 10M Hz.

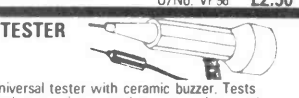
Input impedance:	100kΩ
Power consumption:	40mA maximum
Power supply:	4.5 – 18 V d.c.

ORDER No. VP97 **£10.50**

CURRENT/POL CHECKER

Heavy duty test prods with built-in indicators for testing polarity: indicates whether a.c. or d.c. 3.5V to 400V. O/No. VP98 **£2.50**

TESTER



Universal tester with ceramic buzzer. Tests diodes, transistors, resistors, capacitors and continuity. One "AA" penlight battery included.

Test current:	Max 2μA
Test voltage:	1.2V
Response range:	100MΩ
Max voltage:	500V
Internal resistance:	390kΩ
Length:	135mm

£5.00 O/No. VP99

CIRCUIT TESTER

D.C. continuity tester for circuit checking on all low voltage equipment and components. Diode checking also possible. Takes two AA batteries. 90cm lead has crocodile clip. Body length 145mm. O/No. VP100 **75p**

ELECTRONIC SIREN 12v DC

Red plastic case with adjustable fixing bracket. Emits high-pitched wailing note of varying pitch - 100 cycles per minute. Dims - 90mm (dia.) 60mm (depth). Power - 12v DC. O/P 90dBA 1m type.

Our Price: £5.50 O/No. VP79

TAPE RECORDER SWITCH

Unit to control motor of tape recorder. 1.8m cord and 2.5mm plug attached. On/Off switch. Dims: 55 × 20 × 20mm. O/No. VP 127 **£1.00**

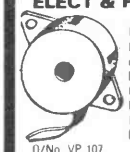
POWER SUPPLY OUR PRICE £4.25

Power supply fits directly into 13 amp socket Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug Input – 240V AC 50HZ, Output – 3, 4, 5, 6, 7.5, 9 & 12V DC Rating – 300 ma VP109.

RATCHET SCREWDRIVER KIT

Comprises 2 standard screwdriver blades 5 & 7mm size. 2 cross point size 4 & 6. 1 Ratchet handle. 5-in-1 Kit. **£1.45 each.** O/No 329B

ELECT & PIEZO BUZZERS



PIEZO
Miniature round piezo-electronic buzzer. White plastic. Low consumption.
Frequency: 4kHz approx.
Output: 70dB (A) @ 1, typ.
Power: 12Vd.c. 4mA.
Dims: 22 (dia.) × 11.5mm.
Fixing Centres: 26.5mm.
O/No. VP 107
95p

PIEZO
Piezo buzzer. White plastic. 90mm leads. For use on a.c mains.
Frequency: 3.5kHz approx.
Output: 85dB (A) @ 1m typ.
Power: 240Va.c. 5mA.
Dims: 32 (dia.)* × 14mm.
Fixing centres: 38mm.
O/No. VP 108
£1.15

ELECTRONIC
Miniature electronic buzzers. Solid state. Ivory plastic. 150 leads. Frequency 500 Hz approx.
Dims: 22 × 16 × 15mm.
Output: 82dB (A) @ 1m typ.
Fixing centres: 26mm.
3V 25mA: O/No. VP 82 6V 25mA VP 83
9V 25mA: O/No. VP 84 12V 25mA VP 86
80p each

SUB-BOX

A neat swivelling disc provides close tolerance substitution resistors of 36 preferred values from 5ohms to 1Kohm. Simply fix clips into circuit and swivel until optimum result is achieved.
O/No. VP 112 **£4.75**

MINIATURE VICE

Miniature plastic and metal vice with strong suction base for portability. Single action to secure or release suction. Plastic jaws with rubber pads 20mm wide, open out to 40mm. Dims: 85 × 65 × 60mm approx.
FANTASTIC VALUE
O/No. VP 95 **ONLY £1.60**

LEARN A LINGO! PILLOW SPEAKER

Slim under pillow unit. 8ohms 2" speaker. 1.5m lead with 3.5mm mono jack plug. Black. Dims: 65 (dia.) ×17mm.
O/No. VP 88 **£1.25**

METRIC & BRITISH MEASURES

Steel tapes in sturdy ABs plastic case. Silk wrist strap. These yellow coated convex tapes have inch and metric graduations. Automatic push-button return.
2m long × 13mm wide. O/No. VP 89 **£1.00**
3m long × 13mm wide. O/No. VP 90 **£1.50**
5m long × 16mm wide. O/No. VP 91 **£2.00**

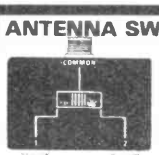
BATTERY TESTER

Tests all types of battery including standard, NICAD, Alkaline etc. Takes all standard sizes including 6V lantern batteries and watch/hearing aid cells. Also tests fuses and lamps by means of internal 9V (PP3) battery. Can also be used to recharge NICAD batteries by means of external 3-12Vd.c. power supply (not included).
Full instructions provided. Dims 185 × 103 × 30mm (approx.).
O/No. VP 101 **£7.00**

SPEAKER PROTECTOR

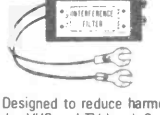
Limits voltage to speaker or to the permissible max., by automatically introducing a resistor in series with speakers. When excessive voltage is reduced the unit resets itself. Electronic voltage-sensing relay circuit. Spring terminals. Cut-off level adjustable from 10W-120W. Full instructions included. Dims: 85 × 74 × 25mm.
O/No. VP 118 **£9.95**

ANTENNA SWITCH 2 and 3 WAY



Co-axial switch for one transceiver to two antennae or one antenna to two transceivers. Dims: 86 × 55 × 32mm (Body).
O/No. VP 113 **£4.50**
As above but 3-way.
O.No. VP 114 **£4.75**

HIGH PASS FILTER/SUPRESSOR



CB/TV. High pass filter. Reduces unwanted signals picked up by antenna. Dims: 45 × 25 × 17mm
O/No. VP 115 **45p**

LOW PASS FILTER

Designed to reduce harmonics on the VHS and TV band. Cut-off frequency: 30MHz. V.S.W.R.: Less than 1.2 to 1. Insertion loss: −0.2dB @ 27MHz. Impedance: 50 ohms. Dims: 80 × 55 × 40mm.
O/No. VP116 **£2.75**

DC-DC POWER SUPPLY

DC to DC adaptor. Plugs into car cigar lighter aperture. Output 3, 4.5, 6, 7.5, 9, 12V @ 800mA. Has universal output spider plug, also 9V battery snap and polarity reversing facility. O/No. VP 119 **£2.45**

ANTENNA COUPLER

Transceiver/car radio antenna coupler. With co-axial cables. One co-axial terminates in antenna plug and the other in PL259 plug. Dims: 67 × 46 × 30mm.
O/No. VP 117 **£2.00**

FM MONITOR

FM monitor for 2 metre band. All metal. Attached earphone. PL259/SO239 connectors. 144MHz 10W maximum. Dims (Body) 55 × 30 × 23mm
O/No. VP 120 **£4.20**

DUMMY LOAD

50 ohms 30W
UHF co-axial plug fitting (PL259)
O/No. VP 121 **£5.20**

PICK-UP COIL

Large telephone pick-up coil for high sensitivity. Suction pad to stick to telephone. 90cm lead to 3.5 jack plug. Connects direct to cassette recorder. Dims: 32 (dia.) × 17mm (body) 36mm (dia.) sucker
O/No. VP 87 **£1.00**

BI-PAK

Send your orders to Dept HRT7 BI-PAK PO BOX 6 WARE, HERTS
SHOP AT 3 BALDOCK ST. WARE, HERTS
TERMS CASH WITH ORDER, SAME DAY DESPATCH, ACCESS, BARCLAYCARD ALSO ACCEPTED. TEL. (0920) 3182, GIRO 388 7006
ADD 15% VAT AND 75p PER ORDER POSTAGE AND PACKING

Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail.
Remember you must add VAT at 15% to your Total order.
Postage add 75p per Total order.

RADIO Tomorrow

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

1 Jun
West Kent ARS: Junk Sale
Axe Vale ARC: *The Entertaining Electron*
S. Manchester RC: *Modifications to the FT221R by G4MYB*
Cambridge DARC: Junk Sale at Comberton Village Hall
Sutton and Cheam DRS: *Receiver Measurements* (t.b.c.)

2-3 Jun
HF NATIONAL FIELD DAY
Welsh Amateur Radio Rally at Barry Leisure Centre, Greenwood Street, Barry, South Glamorgan. Trade stands, Bring and Buy, refreshments, bar and a swimming pool! Close to Barry Island Pleasure Park. Free Parking. Talk-in S22. Open 11-5pm. Info Reg Rowles 0222 565656
RSGB 70MHz Contest and SWL

4 Jun
Horndean DRC: *Matching Units by G3GVC*
Leighton Linsdale RC: Quiz with Aylesbury Vale and Milton Keynes DRS
Stourbridge ARS: ring PRO for details
Dudley ARC: Natter Night

5 Jun
Fylde ARS: Top Band Fox Hunting Arrangements
Chichester DARC: ring PRO
Wolverhampton ARS: Junk Sale

6 Jun
Three Counties ARC: *Gold and Silversmiths*
S. Bristol ARC: Radio Interference Service
Fareham DARC: Discussion on PSUs
Wirral DARC: D & W at The Bassett Hound, Thingwall
Nene Valley RC: Natter Nite
Three Counties ARC: ring PRO for details

7 Jun
Preston ARS: Annual Quiz with G4DBU
S. Manchester RC: Club Quiz
Dunstable Downs RC: Summer Barbeque at Old Warden
Medway ARTS: Junk Sale
Cambridge DARC: Informal and Morse Class
Southgate ARC: *Receiver Techniques by G4AEZ*
Haverhill DARS: Talk on Radio 'Fox Hunts'
Harrow RS: Constructing Antennas

9 Jun
RSGB 1296MHz Trophy

10 Jun
RSGB 432MHz Trophy and SWL
Elvaston Castle Mobile Rally at Elvaston County Park (5 miles SE of Derby on B5010). Opens 10am. Admission Free. Food. Talk-in. 80 Trade Stands. Bring and Buy. Flea Market. Helicopter rides and childrens entertainments. John Robson 0332 767994
308 ARC: Treasure Hunt

11 Jun
Exeter ARS: Inter Club Quiz
Stratford Upon Avon DRC: On-air
Dudley RC: *Data Transmissions by G4JCP*

12 Jun
Mid-Warwickshire ARS: Fox Hunt and Barbeque
Wakefield DRC now meet at Ossett Community Centre, Prospect Road. Tonight is an 'informal'.

13 Jun
S. Bristol ARC: Preparations for Longleat Rally
Fareham DARC: On-air/natter night
Farnborough (Hants) DRS: *Racal Equipment by G3VCX*
Nene Valley RC: *RTTY and AMTOR by G3NRW*

14 Jun
Colchester RA: *How Banks Communicate(?!)*
Edgeware DARS: *Electronic Music by G4BZY*
Conwy Valley ARC: AGM at Green Lawns Hotel

15 Jun
S. Manchester RC: *160m DFing Today by G3WFT*
Cambridge DARC: ring PRO for details
Sutton and Cheam RS: *Maritime Radio* (t.b.c.)
Harrow RS: Informal

17 Jun
RNARS Mobile Rally at HMS Mercury, near Petersfield, Hants. Events for the whole family! Food. Talk-in on 2m and 70cm.
GB4CSW at Casteldon School Fete, Bromfords Drive, Essex. Special QSL cards, operation on HF and 2m — and all the usual fete stands!
Fylde RS: Top Band Fox Hunt
Wirral DARC: DF Hunt
Denby Dale Mobile Rally at Shelley School, Skelmanthorpe, Near Huddersfield. Opens 11am. Free parking and admission. Trade Stands, refreshments, bar plus family entertainment. Talk-in S22 and SU8. Details Jack Clegg 0484 862390

18 Jun
Leighton Linsdale RC: *Packet Radio by G4ELA*
Stourbridge ARS: ring PRO for details
Todmorden DARS: *Amateur Satellites by G8UVE*

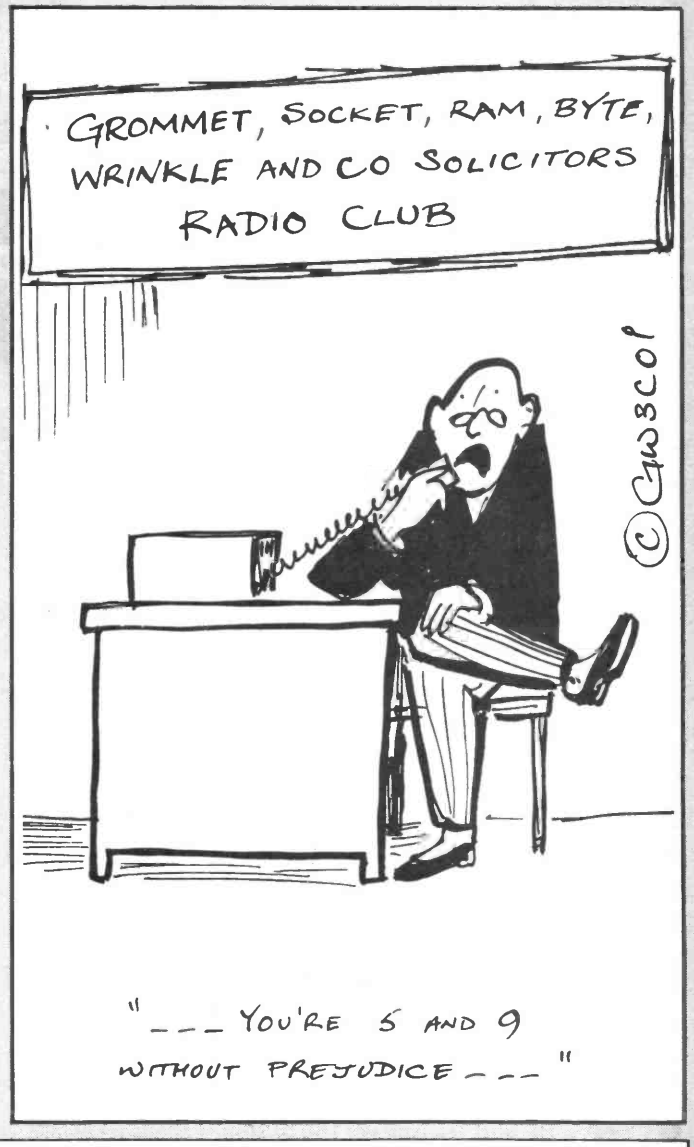
19 Jun
Biggin Hill ARS: Junk Sale
Fylde RS: Top Band Fox Hunt Post Mortem
Halifax DARS: Surplus Equipment Sale
Wolverhampton ARS: *Electronic Music by R. Jeavons*

20 Jun
Three Counties ARC: *How A Broadcast Station Works*
S. Bristol ARC: Final Preparation for Longleat Rally
Fareham DARC: *2m DXing by G3VXM*
Wirral DARC: D & W at The Lighthouse, Wallasey
Nene Valley RC: Natter Nite

21 Jun
Chichester DARC: Summer Social
Preston ARS: Natter Night

22 Jun
S. Manchester RC: 160m DF and Barbeque
Dunstable Downs RC: VHF NFD Planning
Medway ARTS: *The Worked All Britian Awards*

	by Adrian Keele
	Cambridge DARC: Informal and Morse Class
	Haverhill DARS: Construction of DF Antennas for Hunt on 6th July.
	Harrow RS: *Special Event Stations*
23-24 Jun	RSGB 1.8MHz Contest
24 Jun	Worked All Britain 2m/70cm Phone Contest 1400-2200 UTC
	Downstable Downs RC: Car Boot Sale
	Longleat Mobile Rally at Longleat Park, near Warminster, Wilts. Trade Stands, Bring and Buy, Food and Drink, Camping Facilities, Talk-in. Enquiries G4FRG 0272 848140.
	Capital Radio Venture Day with Amateur Radio Show by Harrow RS at Battersea Park, London.
	Wordsley ARC at Wordsley Carnival (GB2WRA).
25 Jun	Stratford Upon Avon DRC: *Travels In Paradise by G8KGJ*
	Dudley ARC: *Radio and the Sun by D. Harris*
26 Jun	Mid-Warwickshire ARS: *QRP*
	Wakefield DRS: ring PRO for details
	Wolverhampton ARS: Informal
	Wakefield DRS: ring PRO
27 Jun	S. Bristol ARC: VHF FD Briefing
	Fareham DARC: On-air/natter night
	Wirral DARC: The Eileen Medley Challenge Cup DF Hunt
	Nene Valley RC: Lecture by The Microwave Society
	Farnborough (Hants) DRS: VHF FD Preview
28 Jun	Colchester RA: *What Next In Space? by Frank Howe*
	Greater Peterborough ARC: *QRP by Rev. George Dobbs, G3RJV*
	Edgeware DARS: VHF FD Briefing
29 Jun	S. Manchester RC: *Intro to 'Op Amps' by G4HON*
	Edgeware DARS: Informal and VHF FD Briefing
	Harrow RS: Informal
30 Jun	Three Counties ARC: Barbeque
2 Jul	Horndean DRC: *On-the-air cheaply by G2DZT*
	Leighton Linsdale RC: ring PRO for details
	Stourbridge ARS: Informal
	Todmorden DARS: Radio Treasure Hunt
3 Jul	Bury RS: Surplus Equipment Sale
4 Jul	S. Bristol ARC: Lecture by the RSGB
	Fareham DARC: *Brewing ATUs by G4GBZ*
	Wirral DARC: Barbeque at Heswall
	Fylde RS: Blackpool Airport Radio and Radar
	Cheshunt DARC: Equipment Evening
6 Jul	Axe Vale ARC: Visit to TV Transmitter at Stockland Hill
	S. Manchester RC: VHF NFD Preparations
	Sutton and Cheam RS: ring PRO for details
	Haverhill DARS: 2m Foxhunt
	Harrow RS: *Basic Microwaves*
7-8 Jul	**VHF NFD and SWL Contest**
9 Jul	Exeter ARS: Film Evening
	Stratford Upon Avon DRS: Homebrewing Tips
	Leighton Linsdale RC: Quiz at Milton Keynes DRC
10 Jul	Mid-Warwickshire ARS: St Johns Ambulance
	Wakefield DRS: 2m Foxhunt with Pontefract ARS
	Bury RS: Visit to Emley Moor IBA TV Transmitter
11 Jul	S. Bristol ARC: 70cms night with G4EIA
	Farnborough (Hants) DRS: Talk by G3IEE
	Cheshunt DARC: Natter Nite
12 Jul	Southgate ARC: To be arranged
	Edgeware DARS: Outside visit (t.b.a.)
	Bury RS: ring PRO
13 Jul	S. Manchester RC: *The Beginning of the Universe (!) by G4ROM*
14 Jul	Harrow RS: Informal
15 Jul	RSGB Low Power Field Day
	Wirral DARC: DF Hunt
16 Jul	Leighton Linsdale RC: *Lightning and EMP Protection by George Jessop, G6JP*
	Stourbridge ARS: A Look at the Club's Artifacts
17 Jul	Biggin Hill ARS: *QRP by G4BUE*
	Fylde ARS: Discussion of Blackpool Airport visit
18 Jul	S. Bristol ARC: *Computer Night with G1DBH*
	Fareham DARC: *QRP from St Kilda by G3WLY*
	Wirral DARC: D & W
	Cheshunt DARC: Visit — ring PRO
20 Jul	Sutton and Cheam RS: *German Wartime Radio by G3IEE*
	Haverhill DARS: *Club Aerials*
	Harrow RS: *Airborne Radio*
21 Jul	**Radio and Electronics Fair held by West Kent ARS at Victoria Hall, Southborough, Kent (on the London Road between Tonbridge and Tunbridge Wells). 40 + Trade Stands. Parking, Video games, computers and Special Event Station. Open 1030 — 1700. Info Dave Green 0892 28275.**
22 Jul	**Anglian Mobile Rally at Stanway School, Colchester. Open 1000 — 1700. Talk-in on 2m. Info G3YAJ 0206 393938**
	Home Counties Mobile Rally at McMichael Sports and Social Club, Sefton Park, Bells Hill, Stoke Poges, Bucks. Doors open 1100. Trade Stands, flea market, demonstrations, including radio controlled models, and a real ale tent! Talk-in S22 and SU8
23 Jul	Stratford Upon Avon DRC: Constructional Evening
24 Jul	Mid-Warwickshire ARS: Fox Hunt and Barbeque



	Wakefield DRS: Pitch and Putt at Holmfield Park
25 Jul	S. Bristol ARC: HF Night with G4TXW
	Fareham DARC: On-air/natter nite
	Wirral DARC: DF Hunt for G8PMF Award
	Farnborough (Hants) ARS: Club Station Work-in
26 Jul	Edgeware DARS: Informal
27 Jul	Harrow RS: Informal
1 Aug	Wirral DARC: D & W

Will ClubSecretaries please note that the deadline for the September segment of *Radio Tomorrow* (covering radio activities from 3rd August — 5th October '83) is 27th June.

Contacts

Axe Vale ARC	Alan Moore	0304 822738
Braintree RS	Roger Jones	Upottery 468
Bury RS	Bryan Tydesley	0282 24254
Cambridge DARC	David Wilcock	0954 50597
Chichester DARC	C. Bryan	0243 789587
Conwy Valley ARC	J. Wright	0492 823674
Cunningham DARC	N. Brown	05055 2052
Edgeware DARS	John Cobley	30 64342
Fylde RS	PRO	Lytham 737680
Halifax DARS	D L Moss	0422 202306
Haverhill DARS	Rob Proctor	0787 281359
Kent Repeater Grp	M W Stoneham	02273 69828
Leighton Linsdale RC	Pete Brazier	052 523 270
Medway ARTS	Andy Wallis	0634 363960
Mid Ulster ARC	D F Campbell	0762 42620
Preston ARS	George Earnshaw	0772 718175
S. Bristol ARS	Len Baker	0272 834282
S. Lakeland ARS	Dave Warburton	Ulverston 54982
Stourbridge ARS	Malcolm Davies	038482 4019
Southdown ARS	P. Henly	0323 763123
Three Counties ARC	Chris Forshaw	0428 713012
Vale of White Horse ARS	Ian White	Abingdon 31559
Veralum ARC	H.Clayton Smith	St Albans 59318
West Kent ARS	Peter Reeve	0892 24689
Wirral DARC	Gerry Scott	051 630 1393
Worthing DARC	Jim Hicks	0903 690415
308 ARC (Surbiton)	Dave Hicks	01 399 5487

ANTENNA PLANNING
a thinking man's guide

Want to put up a mast but not quite got the nerve? Steve Voy gives some encouraging advice on coping with the neighbours and the local authority

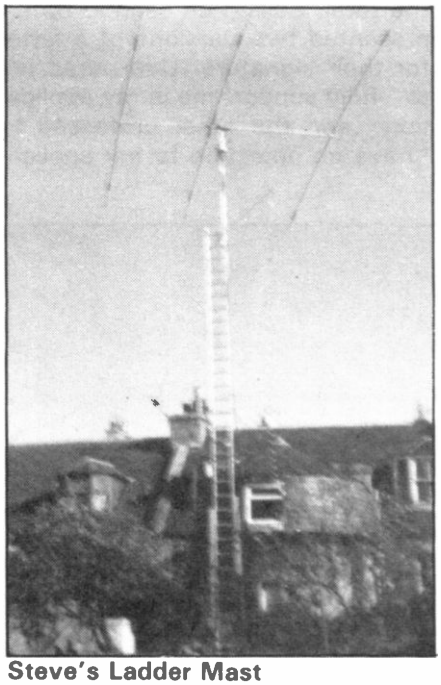
The idea of going through the municipal bureaucracy for permission to erect a HF or large VHF beam antenna is off-putting for many Amateurs. When considering the various forms, obscure questions and obligatory drawing up of plans, it is little wonder that many of us settle for an unobtrusive vertical. If we have an amenable neighbour, perhaps a 'Trap Dipole' with one leg on adjoining land may be permitted — always provided the neighbour on the OTHER side of the fence doesn't object. But for a beam or any other *obvious* antenna array, planning permission is a must.

Going Undercover

You can attempt an unauthorised erection. You may get away with it for a while. But there is always the fear that 'Authority' will suddenly present itself and ask some searching questions. I made an unauthorised attempt with two sections of an aluminium ladder strapped together with Jubilee Clips. This gave me a rather precarious 30 feet on top of which a length of 2" aluminium tubing supported a rotator and TA 33. Getting it up was quite a feat and needed the help of a few friends. Once up it was certainly a thing of beauty to me — especially when the sun caught the aluminium sections. The statement that you can keep a string of sphagetti upright if you guy it correctly was proved in my case. Unfortunately, the garden was thus literally covered in galvanised, steel guy wires — such that my XYL complained of feeling 'caged' whenever she went out to hang up the washing!

A few weeks later a letter arrived from the local Planning Authority. Very tactfully worded. It mentioned (almost casually) that an erection had been noted within my grounds for which it appeared no planning permission had been applied for! Stalling for time, I countered that the erection was in fact an aerial mast. I went on to say that it was only temporary and that it was not thought sanction would be necessary. Not so, came a reply shortly afterwards. I dismantled the support and packed away the beam elements in the garage.

A few months later a friend leaving the district made me an offer I could not refuse, which resulted in a three section, heavy duty tower resting rather incongruously across my lawn.



Steve's Ladder Mast

I believe one of the difficulties when considering applying for planning permission is that there is really no certainty that you are going to get it. You may put in a lot of work and energy — all to no avail. You are at the mercy of a Committee who are unlikely to know very much about Amateur Radio or antennas. I had fortunately kept an excellent article in the Short Wave Magazine of a few years ago which pointed out that it was up to the applicant to make every effort to advance and substantiate his submission. Merely filling in the required forms could be leaving too much to providence.

A start was made on the form filling. In fact there was not too much to write in answer to the questions. I even exagerated the 'area' of the 'proposed building' to 1.5 square metres, which was the extent of my proposed concrete base. Two sets of plans were drawn up. One, a street plan of the area and the second, at a scale of 1:240, showed the proposed site layout in the garden with a sketch of the future beam on top of the tower. The requirement called four copies of the plans — one on linen or film. This condition was relaxed in my case, probably because no further construction or building work was involved. Photocopies were obtained at the local library for 10p each.

First Hurdle

A disadvantage I knew would be that I was living in a Category 'B' house of 'Special Architectural Interest'. I visited the Planning Of-

fice to discuss my project and was told I could submit a letter to the Committee to elaborate on any points I felt may be relevant. I thought about this for a while and then came up with:

a) The antenna would be used purely for Amateur Radio operations; no commercial interest was involved.
b) The erected mast was to be in a semi-commercial area. Nearby telephone poles, power cables and three storey buildings by far overshadowed it in height.
c) The rotating beam on top of the mast would be lower than practically all TV aerials in the vicinity.
d) The supporting mast was telescopic in design. The antenna could well be lowered to around 10 feet (and thus out of general view) for much of the year.
e) A GPO engineer had recently conducted tests on a similar aerial (my ladder mounted job) which proved that my equipment was free from spurious radiation out of the Amateur Bands. No complaints of interference to domestic radio or TV had been received.

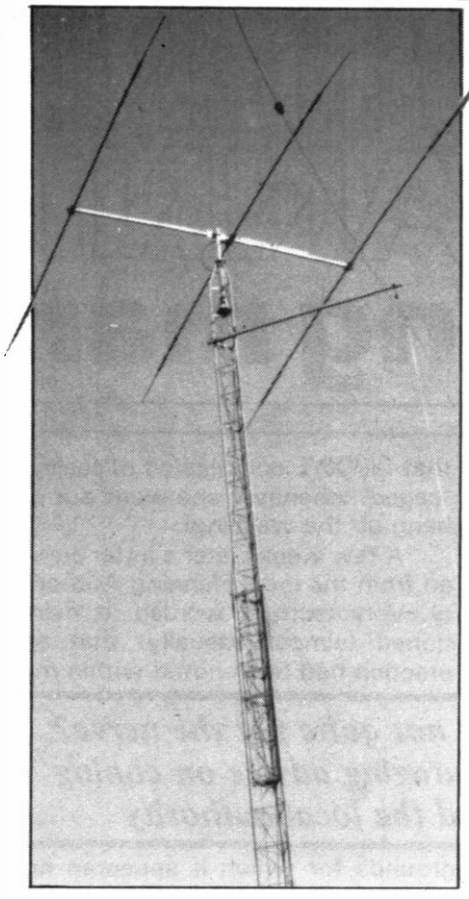
All the above was admittedly of little significance to the dedicated conservationalist on the Committee. But I thought it was plausible enough to sway any borderline cases in my favour. I purposely used the word 'mast' instead of 'tower' — why frighten the uninitiated?

Going Visiting

My next task was to visit neighbours extending to six houses on either side of me, about ten houses opposite me in the street and half a dozen buildings in the parallel street that overlooked my rear garden, which included a few Private Hotels. The occupants were a mixed bag, mainly business practices, consisting of Architects, Accountants, and Medical Specialists. A few private occupants made up the total. Calling on each in turn, I presented two versions of a letter for their signature. One purported to "fully support me in my application" and the other professed to "have no objection to my application". The end result was around 60:40 in favour of supporting my application with two abstentions! Three young female students were in "full support" but a retired lady doctor had reservations and opted for the alternative. I lifted one dear little retired lady so that she could see over her garden wall to where my antenna would be. Full support. I had asked all if they remembered my previous ladder mast but none could recall it. The climax came when I has almost finished my canvassing and knocked on the door of one of my immediate neighbours.

"Hello," I beamed, in what I hoped was an engaging smile. "It's about my aerial. I wonder if you'd care to support . . . . . "

"NO I WOULD NOT," he rasped and quickly shut the door.



Voy antennas in close-up

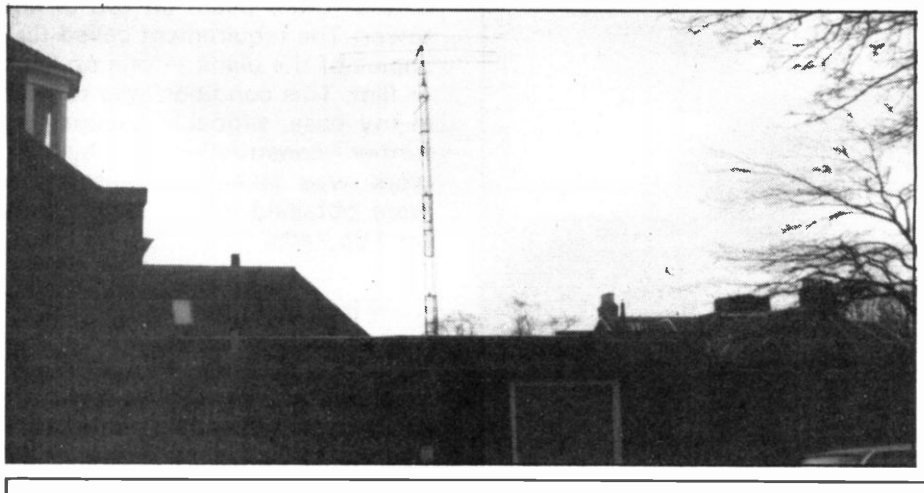
Facing The Music

I realised I had a problem here. A next door neighbour must surely count for at least six more remotely sited residents. Undeterred I assembled my papers, plans and statements together and took them in person to the local Planning Authority.

A week later a Solicitor's letter arrived. It was quite courteous (they usually are) but stated they would be objecting (on behalf of the aforementioned irate neighbour) to the proposed antenna erection on the grounds of TV interference. I was furious. I phoned the advocates but no one would speak to me. I left a message saying that I strongly objected to the allegation and challenged them to provide dates/times and types of interference. I was convinced this was a red herring. I imagined the complainant visiting his solicitor and being comforted with, "Don't worry sir — we can always infer that he will interfere with your television." What really concerned me was that a similar letter would almost certainly have been sent for the attention of the Planning Committee.

I deliberated a bit. I did not want to get into a personal battle with my neighbour but felt I had to defend myself against what I was sure was a wild allegation. Eventually I sent a letter to the Committee stating I had reason to believe a complaint had been made as regards my causing interference to

The present set-up viewed from afar



TV. I was able to refer to my previous submission that no unwanted transmissions had been discerned by competent GPO Engineers. I said that if in fact he was suffering from TVI he had not reported it to the GPO (a wild guess on my part) and it certainly was not originating from my equipment.

A few days later I phoned the Solicitors with the idea of extracting some reaction to my counter objections. I was informed that the person dealing with it was ill.

I contacted the Planning Office a few days after the meeting of the Committee and was told no decision had been made yet. My application had been discussed but deferred

The awaited letter finally came two weeks later. Success! Planning Permission had been granted for 2 years. The actual typewritten comment ended with the condition that "the said mast is removed on or before the expiration of two years . . ." This is not as ominous as it sounds. Just before the expiry date I simply reapply and ask for a further two years. So far the extension has always been granted.

Charge In Legislation

Legislation has since changed in that, nowadays, a form must be completed whereby you state you have *advised* your immediate neighbours of your intention. They do not have to agree; it is sufficient to make a declaration that you have made them aware of your plans. No doubt if they feel strongly enough about it the onus is on them to inspect your plans at the Municipal Offices and make any objections formally. I am now fortunate in having obliging neighbours who unanimously last time returned the form to me endorsed "OK with me."

The process is really quite straightforward. The initial forms seem rather overpowering but really it is the more involved 'Application for Building Warrant' — not normally necessary for a tower siting — where the procedure appears to become more complicated. Local Planning Authority staff were always most helpful. I suppose you could say it is their job to be so but their replies were always friendly and considerate — even if they perhaps thought they were dealing with a crank!

Should the application be disallowed, a reason is given — "conflicts with the amenity of the neighbourhood" is a good one! If the applicant feels strongly enough about it, he has recourse to appeal to the Secretary of State within six months.

I hope this narrative will give a little encouragement to any aspiring tower erectors. Don't assume the cards are automatically stacked against you. With a little thought and effort you may be able to steer your application along the right path — even if you know for certain you have at least one strong objector!

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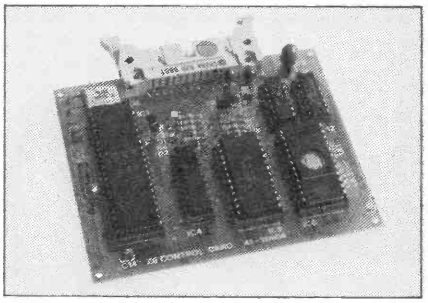

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for a better service.

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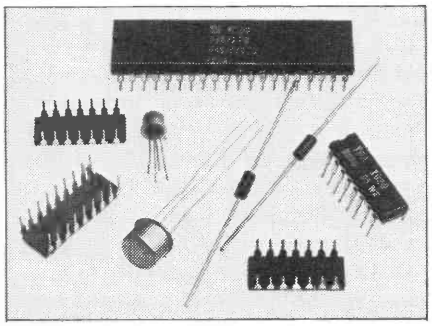

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BC238	Plastic BC108	58-00238	0.08
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BC307	Complement to BC237	58-00307	0.08
BC308	Complement to BC238	58-00308	0.08
BC309	Complement to BC239	58-00309	0.08
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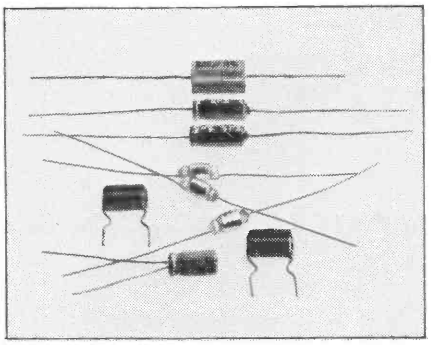
Capacitors



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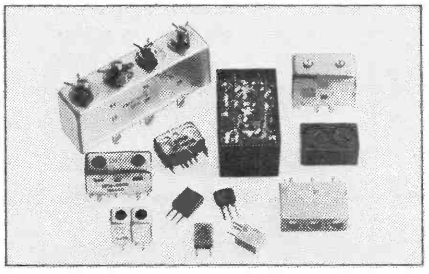
R F Components



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Have one handie... reviewing the Yaesu FT203R 2m Handheld

Thinking about a 2m handheld? Steve Ireland, G3ZZD, took Yaesu's new baby for a walk.

Currently priced at £169, the FT203R is Yaesu's new 'handie' 2m transceiver. Considerably smaller than the FT208R and with around the same power output (although the '203R will give 3.5W with the accessory FNB-4 12V NiCad pack), the FT203R offers straightforward FM simplex and repeater operation.

The frequency selection on the '203R is by thumb wheel switching, easier to manipulate on the move than the Keypad offered on the FT208R and 708R. Simplicity of operation is the watchword with the '203R. On the left hand side of the rig is the PTT control, and above this, the toneburst push control, both with dimpled surfaces enabling slip-free operation. On the right hand side is a similar square button control for illuminating the miniature 'S'/RF Power output meter, which is mounted on the top of the transceiver. As well as the meter, the top panel carries a 'high/low button (which, when depressed, reduces the power output to some 0.3W), the BNC RF output socket, the three switch 'thumbnail' controls for squelch and audio volume (the volume control also doubling as the transceiver on/off switch), two miniature sockets for either the accessory headset/microphone (YH2) or the speaker microphone (MH-12A2b) and, finally, a small square push-button, which adds an additional 5kHz to the frequency selected by the thumbnail frequency selector. This control enables the election of odd channels, ie 144.775 as the thumbnail can only select to the nearest 10kHz. 144.775MHz is thus displayed as 577 — with this '+5kHz' button depressed. The necessity of a fourth thumbnail switch is thus avoided, which, after all, is only going to be set at either 5 or 0.

Set into the left hand corner of the top panel are two LEDs. The green LED indicates that the receiver squelch has opened: if the squelch is set very low — so that the ambient noise breaks squelch — the LED will light, in addition to lighting when a station is being received. The hand book says that this is useful when monitoring in a noisy environment as a 'busy channel' indicator — which is probably true. However, the author is moved to speculate that if the environment is that noisy, the operator will need at least to don the YH2 headset mic or move to a quieter environment before any operation can be done!

On the rear of the '203R, just above the unit belt clip, is a small square panel containing two

Alison listening on S20 with the FT203R and YH2 headset

miniature three-position slide switches. One of these is for selecting repeater/reverse repeater/simplex operation, labelled '-600', 'SIMP' and '+600'. The lower switch selects VOX switching when using the YH2 headset/microphone: two settings are available, HI and LOW. The HI position is for quiet environments, providing maximum sensitivity of the VOX circuitry, whilst the LOW position desensitizes the circuitry in order to prevent 'triggering' from extraneous sounds (motor bikes, slamming doors etc) when operating in a noisy environment. Both of the switch levers are very low profile, in order to prevent the operator from inadvertantly changing the switch selections, a nice touch.

Well Built?

With handheld transceivers ruged construction is a must. The battleship grey moulded-plastic case of the '203R looks as though it will stand a few hard knocks — although I was not moved to test this out! The transceiver PCB is surrounded by a U-shaped chassis, which should also help in this respect.

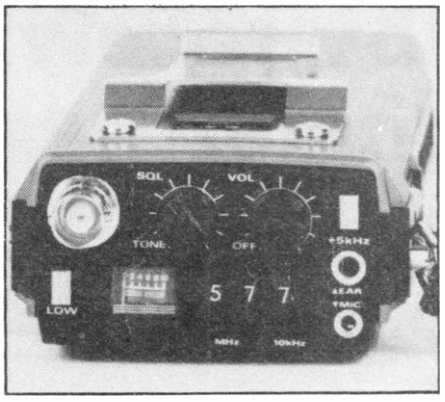
I have recently used the Yaesu FT708R, the 70cm portable transceiver and identical twin to the '208R, and the construction of the '203R seemed somewhat less solid than the aforementioned. However, the other consideration of construction with equipment of this kind is *weight* — and you are less likely to get a tired wrist with the '203R than the '208R, the latter being almost some 50% heavier than the former.

The circuit board of the '203R is well laid out without too much cramming of components and the quality of construction seems up to the usual Yaesu standard.

Operating The Beast

The FT203R fitted perfectly into the small but perfectly formed hands of the author. Even the most dainty of hands should not find this rig too much of a handful.

A number of contacts were initially made through the local repeater GB3NL — sitting at the kitchen table. Reports on the modulation were good, both using the internal mic and the YH2 headset. With many hand portables the audio quality and quantity is often noticeably better with an external mic, but the '203R proved itself a creditable exception in this case. No real difference was noticed between the YH2 and the internal mic by the statons I contacted, who all reported the audio quality as "good".



Top Panel

The FT203R was then taken on a prolonged hike, housed in the protective soft vinyl case supplied with the rig. Operation with the rig inside the case is possible but I did not like this, feeling that the PTT and toneburst buttons were difficult to 'feel' through the case. This was possibly due to my lack of familiarity with the '203R and was not felt to be a serious problem. Thus, most operation was done with the rig 'naked'. If you have large fingers and enjoy operating in a downpour, the FT203R might not be the rig for you. That being said, I don't know of any handheld transceiver which is too good in this latter respect.

Operation on the move was fairly easy and, with familiarity, the PTT and toneburst were easy to operate with a one/two movement of the fingers of the right hand, using the index finger to operate the toneburst. Despite my poor location, sprawled in a grassy hollow somewhere north of Edgeware, Middlesex, with the transceiver beside me on the ground, most of the London repeaters were received at good strength.

If you are a night owl, the lamp inside the top mounted meter is useful for checking the power output (and, thus, your battery condition!). Unfortunately, the light thrown out doesn't quite reach the frequency selector and frequency checking requires a flashlight. Illumination *on* the top panel rather than *in* the meter would have been better.

VOX operation was straightforward, both the 'high' and 'low' positions fulfilling the promises in the handbook. However, I did feel that the 'attack' of the VOX circuitry was slower than I would have liked, particularly on the low position, triggering often not occuring till well into the first syllable.

The Verdict

If you want a basic 2m lightweight FM 'handie', then this could be the rig for you. It lacks the scanning and memory facilities of it's big brother, the FT208R. However, frankly, as far as I am concerned, this is really extra 'icing' and not particularly useful if you are to use the rig for the purpose of a sophisticated 'walkie-talkie' — which is what most 'handies' and 'portables' are intended for, and used as.

The lightness and compactness of the '203R mitigates against dropping the rig through not getting hold of it properly. People often forget to put their hands through the wrist straps of handies in the excitement of hearing someone coming through and wishing to reply quickly. Well, I do anyway and this can sometimes lead to near tragedy . . . By the way, the '203R has a good wrist strap.

Not dissimiliar in size and specification to the Belcom LS20XE, the '203R packs rather a larger punch (2.5W against 1W) but costs some £40 more. However, with the optional FNB-4, the '203R will give 3.5W (!) — which can be usefull as the small antenna on most 'handies' usually means that the transmit capability is often more restricted than the receive. On the other hand, the FNB-4 is another £36. Mind you, you really need NiCads anyway for regular portable operation — and that means shelling out a lot extra on *any* rig. And so on . . . and so on: You makes up your mind what *you* need from a portable, takes your choice and pays the money. As far as I am concerned, if you want a 'handie' this one is pretty OK. OK?

The author would like to thank SMC of Southampton for the review sample.

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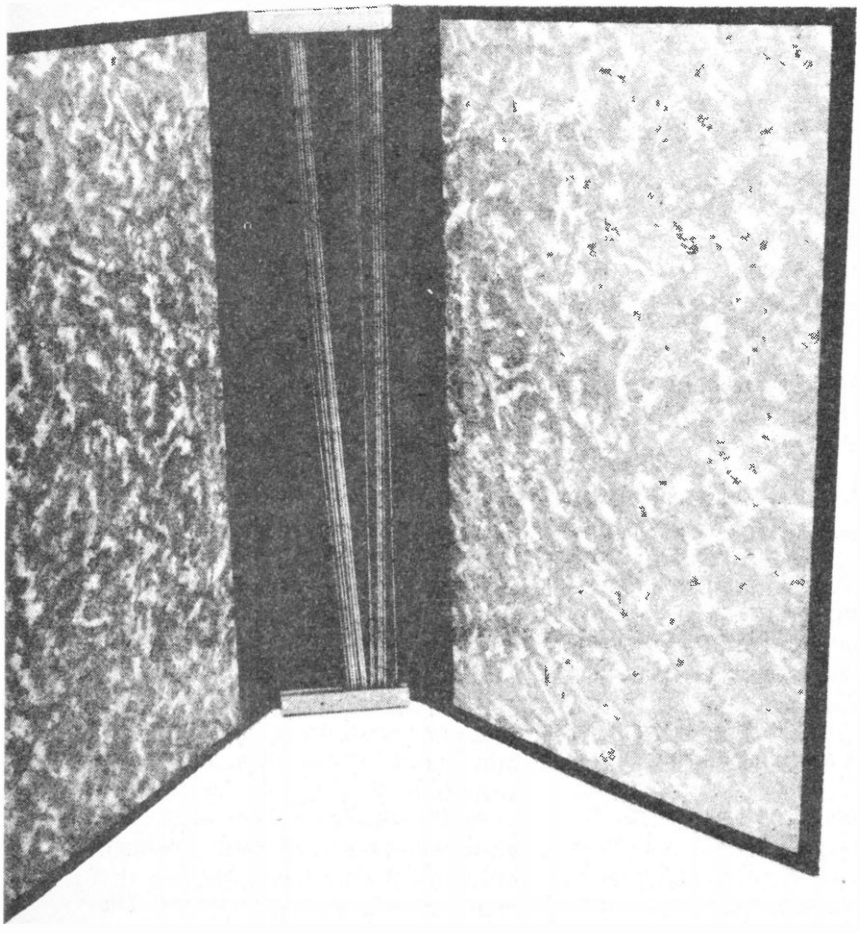

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Single Channel Transverter for 70cm

Hugh Allison, G3XSE, describes a cheap and novel way to get going on 70cm.

Some time ago it was impossible to obtain power transistors that would work on the 70cm amateur band. As a result varactor diode 'triplers' enjoyed a fair degree of popularity amongst the solid state enthusiasts. Although they still represent an easy way up onto the band on the transmit side, especially for FM, one is still left with the problem of obtaining a converter or receiver for listening. This article is dedicated to overcoming this little problem.

Varactor Workings

Not many people know that a varactor 'triples' effectively by mixing. An idler circuit in a typical 'two' to 'seventy' tripler will be tuned to 288 MHz. The incoming two metre signal (144 MHz) mixes with 288 MHz to give resultant 432 MHz. People whose life has been lead without encountering these devices may be surprised to learn that quite a high efficiency can be obtained, typically ten watts of 2m RF will yield six or seven watts of RF on 'seventy'. I digress, however. Why doesn't the tripler do anything on receive, you may well ask. Well, the tripler only triples due to the incoming RF energy on two metres, on receive there isn't any RF input so nothing happens. My idea was to inject some 288 MHz and see what happens, and it works; you get a crude receive converter.

Receiver Degradation

The normal two metre transceiver in my shack is a badly abused TRIO TR9000 which will give about 25 db of quieting for 1 uV of signal. The best I have managed to achieve with this idea is 10 uV in on seventy producing 25 db quieting. This may seem lousy to your keen UHF type but is quite adequate for local repeater (or simplex) work. As a rough guide to someone who is contemplating this idea, a 'proper' 70cm receiver connected to the intended aerial should receive the intended repeater at about S7 for you to use the technique (ie if you can receive the repeater at S7 on purpose built 70cms equipment it should be perfectly copyable with the 'tripler').

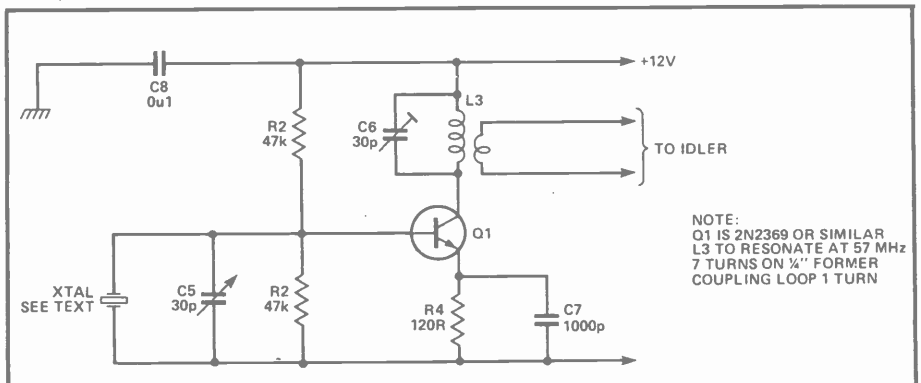


Fig. 1 Suitable crystal oscillator for providing injection to 'tripler' to give receive capability

A Little Arithmetic

The first concept to be grasped is that mixing in a varactor does not produce a 'normal' transverter. Most transverters mix on receive and transmit, thus if you increase your frequency on 2m by 10KHz your receive and transmit frequencies on 70cm increase by 10KHz. Here your receive frequency will increase by 10 KHz but your transmit frequency will go up by 30KHz. That is why this is really a single channel device, although if you wade through the following mathematics you will be able to see that anyone with a two metre transceiver with a non-standard repeater mode can also work other channels.

In my area the local seventy repeater is GB3SV on RBO. This receives on 434.6 MHz and transmits on 433.0 MHz. Remember that is the repeater format; an accessing station does it round the other way round. We thus have to provide a transmit signal on 434.6 divide by three — which equals 144.866 MHz. Simple so far? Well, we are already up

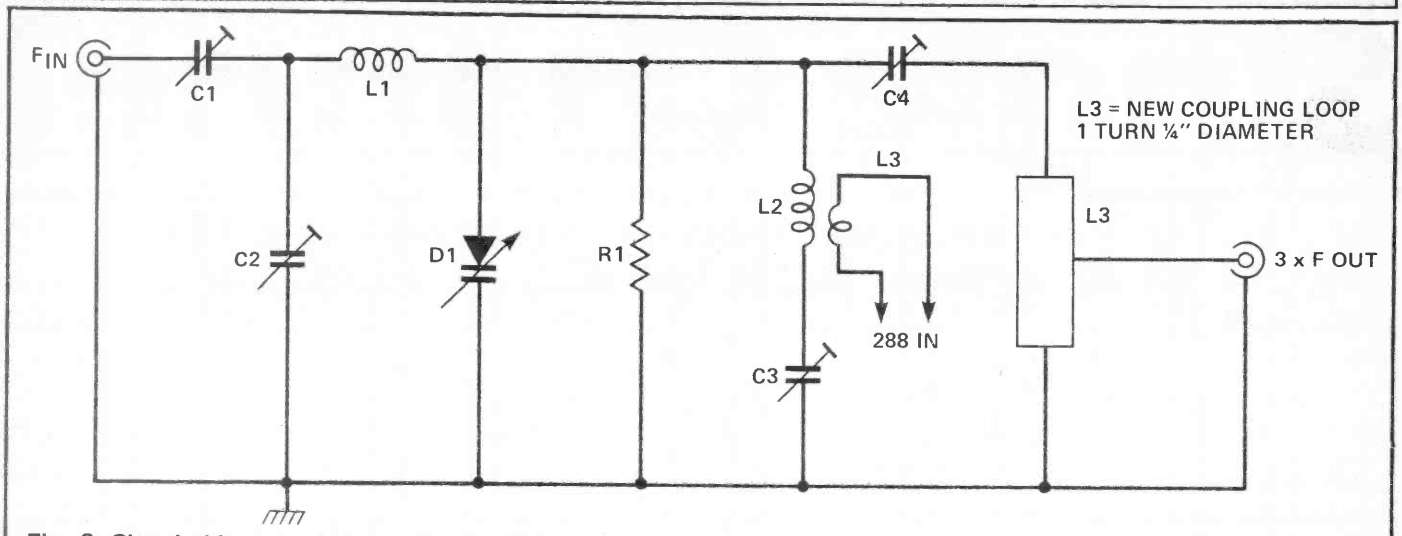


Fig. 2 Classic Varactor Tripler circuit. 'Triplers' may often be found in the secondhand columns of the radio magazines. If no luck there you could try asking around in your radio society. Someone somewhere will doubtless have one gathering dust. . .

against a snag; most rigs put up an accessing tone only when placed in the repeater mode — which means that you either dial up another 600 KHz (The 2m receive/transmit offset is receive 600 KHz higher at the accessing station; for 70cm the offset is *transmit* 1.6 MHz higher!) or you use a non-standard repeater shift of 0 KHz, ie transmit and receive on the same frequency. I shall only work this latter example since it will be of more interest to those owning a crystal controlled 2m rig.

So the 2m rig is set for 144.866 transmit and receive. Now let us consider the 70cm receive path. Here we want to listen to 433 MHz but are tuned to 144.866. Subtracting one from the other gives 288.134 MHz which is the frequency we have to inject into the idler circuit of the tripler.

Modifying the Tripler

It is not my intention in this article to give a step-by-step, hole-by-hole description of how to build a 70cm varactor tripler. Some people may well have one immediately to hand, either home made or one of the excellent Microwave Modules ones, which are often available second hand quite cheaply. The idea of this article is to resurrect an article many people have consigned to the junk box and of which there is a reasonably plentiful supply already in existence. For ease of identification the circuit diagram of the almost classic circuit that has evolved over the years is shown in **Fig.2**. The coil of interest is L2, which fairly often runs from one side of the small diecast box, in which these triplers are normally constructed, to the other. It is normally a one turn loop of half or three quarter inch in diameter. Having identified the idler circuitry the decision has to be made as to whether the 'modification' (a source of 288.134 MHz) is going to be incorporated within the body of the tripler itself.

My original attempt to try out the idea was made using a free running oscillator to provide the necessary 288.134 MHz injection. The energy from the generator (A Hewlett Packard 608 giving about 700 mV into 50 ohms) was coupled via a quarter inch diameter one turn loop, the loop being pushed into place and then held there by simply replacing the lid of the box. If you want to make the unit self-contained the simple crystal oscillator of **Fig.1** can be built-in, though take care not to place anything too close to any of the original components! Alterntively the oscillator could be mounted external to the box; it's up to you. Obviously the frequency of the crystal has to be worked out by the guidelines shown above, and a crystal of one fifth of the required frequency (about 57 MHz) should be obtained. The people with non-standard repeater shift rigs (*and good mathematics! — Ed.*) may be able to use a 'gash' crystal to hand by dialing up some odd receive frequencies.

Obviously a preamp could be used in front of the transverter, but the switching involved spoils the simplicity of the idea — and the attraction of essentially using the 2m rig normally, I think. There have, surprisingly, been no reports of any hetrodynes being produced, which I had expected due to the two lots of 288 MHz at the diode when transmitting. This may well be due to the lower level of the receive 288 MHz compared to the transmit one.

I hope you have as much fun with the idea as I had. It's in the true spirit of amateur radio, getting something almost for nothing and making something work as it was never intended to!

Components Listing

Resistors

R2	47k ⅛W
R3	10k ⅛W
R4	120R ½W

Capacitors

C5,6	30p trimmer
C7	1000p disc
C8	0.1u disc

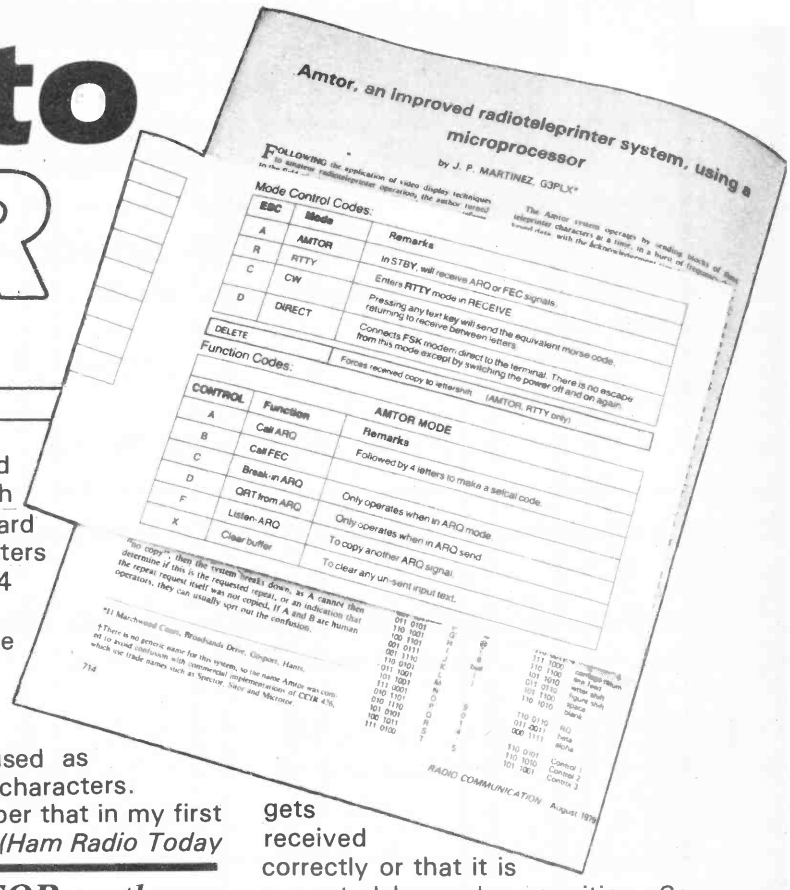
Semiconductors

TR1	2N2369 or similar

Miscellaneous

L3 to resonate at 57MHz. 7 turns on ¼ inch former. Coupling loop 1 turn. Crystal (see text).

A Guide to AMTOR


Amtor, an improved radioteleprinter system, using a microprocessor

by J. P. MARTINEZ, G3PLX*

FOLLOWING the application of video display techniques to amateur radioteleprinter operation, the author turned

Mode Control Codes:

ESC	Mode	Remarks
A	AMTOR	
R	RTTY	In STBY, will receive ARQ or FEC signals.
C	CW	Enters RTTY mode in RECEIVE
D	DIRECT	Pressing any text key will send the equivalent morse code, returning to receive between letters
DELETE		Connects FSK modem direct to the terminal. There is no escape from this mode except by switching the power off and on again.

Function Codes:

CONTROL	Function	AMTOR MODE Remarks
A	Call ARQ	Forces received copy to lettershift. (AMTOR, RTTY only)
B	Call FEC	Followed by 4 letters to make a selcal code.
C	Break-in ARQ	Only operates when in ARQ mode
D	QRT from ARQ	Only operates when in ARQ send
F	Listen ARQ	To copy another ARQ signal.
X	Clear buffer	To clear any un-sent input text.

RADIO COMMUNICATION August 1984

Ken Michaelson, G3RDG, looks at AMTOR — the ultimate in keyboard communication.

Before beginning to discuss this method of communication let me tell you what the letters A, M, T, O, R mean. The first two stand for '**AM**ateur' and the '**TOR**' indicates 'Telex Over Radio'. TOR was the name decided upon by Mr Van Duuren, a Dutch Posts and Telegraphs engineer, in the 1960s. He was endeavouring to find a means of improving the quality of copy on HF radio teleprinter circuits so that they could be connected directly into the international Telex network.

I am sure that readers will appreciate that errors do occur when you have QSOs over the air using RTTY and very frustrating they can be too. The result is, of course, garbled copy, and this is not of great help when trying to discuss, for example, the subleties of the rig you are using.

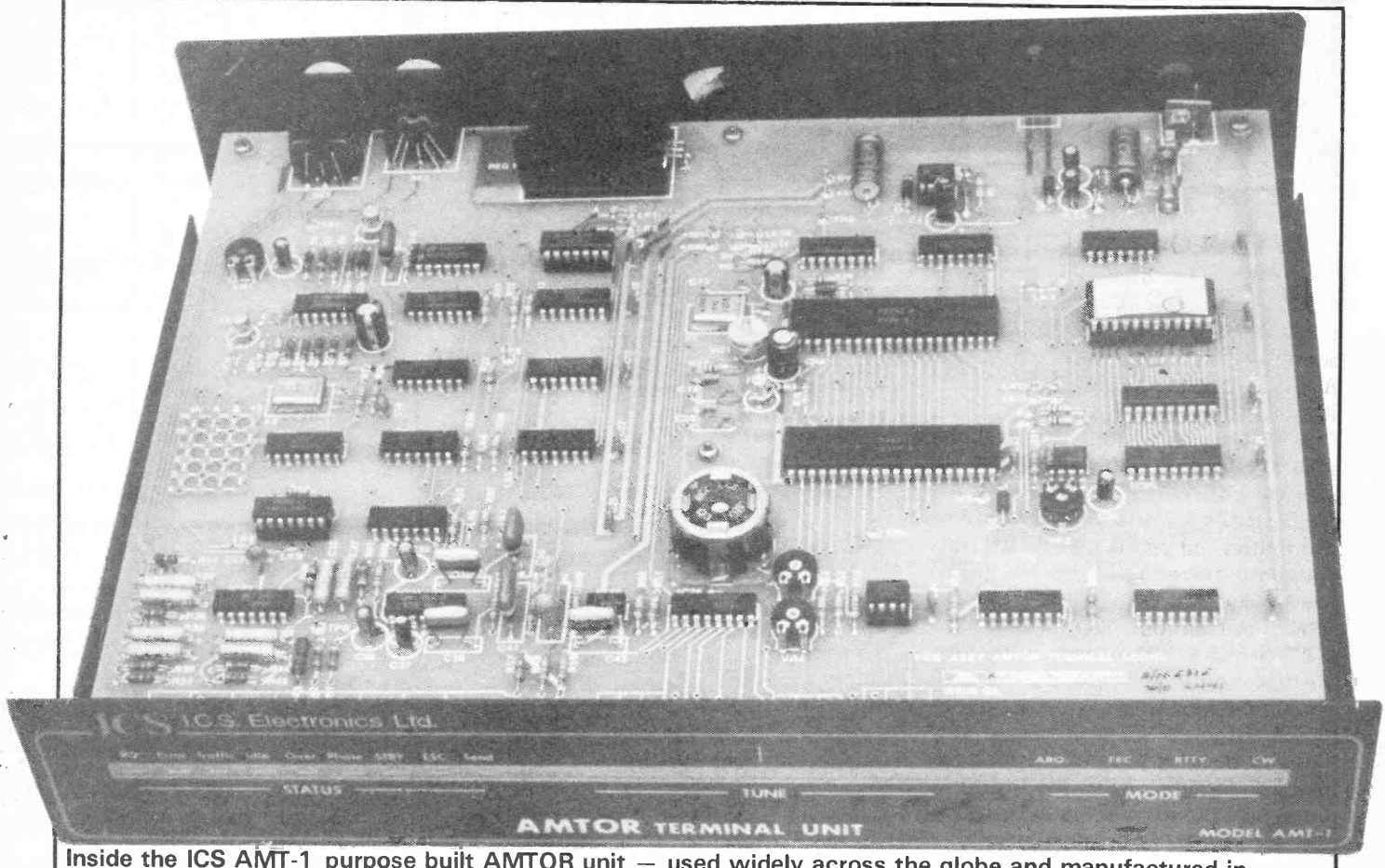
Mr Van Duuren recognised this problem and rather than try to improve the quality of the copy by conventional means, such as improvements to the antenna system or increasing the power of the transmitter etc, he decided on a scheme whereby the errors would be *detected* through a system of 'logic' after the demodulation process and then corrected by repetition. This 'logic' system is a system in which the values of the variables are simply restricted to two possible 'truth values'. These values may be represented by the digits '0' and '1' and therefore can be applied to the BINARY logic of computers. 'Mark' or 'Space', 'Plus' or 'Minus' volts etc can amount to the same thing. In this case it is 'Mark' as against 'Space'.

These errors then, are detected by encoding each of the 32 standard teleprinter characters as a pattern of 4 marks and 3 spaces. There are 35 posible combinations of 7 bits but the remaining 3 are used as special control characters. You may remember that in my first article on RTTY, *(Ham Radio Today May 1983),* I talked about the 'Baudot Code' or 'CCITT No 2 International Teleprinter Code'. That is a 5 unit code but in the first and best known version of the AMTOR system, called 'ARQ' (automatic request for repeat) or mode 'A', instead of 5 data bits, 7 are transmited. Three bits are of one polarity and four of the other, making it in effect, a 7 bit code. Therefore, at the receiving end it is possible to detect whether a character is valid or not by counting the number of 'Mark' bits in it. If there are exactly 4 'mark' bits, then the character is treated as valid; if not, then it is rejected and signalled back to the transmitting station who then repeats the bad characters, several times if necessary, until the receiving station gets them correctly. This is not completely foolproof, of course, because it is possible for two or more bits to be corrupted and still leave a net result of 4 Mark bits giving the appearance of a valid character. This does sometimes happen, but it is much more likely that either a block of characters gets received correctly or that it is corrupted beyond recognition. So in practice there are *very* few undetected errors.'

This automatic request is achieved with the two stations working in an accurately synchronised quick-break mode. When operating in mode 'A' as described above, the transmitting station breaks the message down into blocks of three characters each and, after a block has been sent, the transmitting station switches to 'receive' and waits for a reply from the other end. If the receiver has copied the block correctly it responds with a single 'acknowledgement' character, and the transmitting station proceeds with the sending of the next block of three, and so on. If, however, the other end has not received the block correctly, it sends back a 'repeat' request, and the transmitting station sends the same block again. This procedure continues indefinitely until the particular block is copied by the receiving end, and then, and *only* then, does the transmitting station move to the next block of text.

In Synch'

It is the use in its circuitry, of



Inside the ICS AMT-1 purpose built AMTOR unit — used widely across the globe and manufactured in the UK to boot!

'synchronous' as against 'asynchronous', transmission of serial data which gives AMTOR 'A' such an advantage over conventional RTTY. Instead of a 'start' bit at the beginning of each character, as in normal RTTY, the receiving end is kept in sync' by the transmission of a 'start' code at the beginning of a transmission. In order that this method should work, the speeds at each end must be far more accurate than in an 'asynchronous' system and therefore it is necessary to use crystal oscillators rather than the mechanical governors which were described in my RTTY articles. At no time does the transmitting station send a continuous idle Mark or Space tone.

You might well ask how does the receiving station know when a character starts if there are no 'Start' bits. Well, the answer is that the receiver examines the incoming stream of bits looking for a particular pattern of consecutive bits which correspond to a known synchronisation character. When this pattern is recognised, the receiver knows that the next bit which follows is the first bit of the next character. Clever, eh. In AMTOR, synchronisation is detected either by successfully receiving a known combination of IDLE characters, or by receiving a pre-determined four character Selective Call (Selcall) code. By using this method of sending messages, virtually error-free copy is obtained at the receiving end no matter how much QRM comes up on the frequency.

Mode 'B'

In the second version of the system, called 'FEC' (forward error correction) or Mode 'B', each 7 element character is transmitted twice, thus allowing the receiver to, as it were, get a second bite at the cherry if the first one was spoilt by interference. To reduce the possibility of a single burst of interference corrupting both copies of the character, the copies are separated in time by 350 mS, that is, 5 character times, therefore giving the receiver a greater chance of copying it. The speed is always 100 Bauds; that is, each bit time is 10 mS, so that it takes 70 mS to send a 7 bit character. There are no Start or Stop bits, each character following immediately after the previous one. The transmitting station sends the repeat regardless, so no 'request for repeat' is sent back by the receiving station. This mode is most useful where it is not necessary to have a reverse link, such as when broadcasting. In fact, it is similar in use to normal RTTY in that it is 'simplex' operation. First station 'A' transmits and then passes the transmission over to station 'B', who, when he finishes his transmission, passes it back again to station 'A'. Its efficiency is not as high as ARQ, but nevertheless it is a considerable improvement over traditional RTTY, (sometimes to a factor of 10). A question which might occur to you at this point, is how does the receiver know which is the first copy of the character and which is the second. In mode 'B' two different Idle characters are used, one being transmitted in a 'time-slot' which would normally be used by the first copy of a message character, (time-slot No. 1 say), and the other being transmitted in a time-slot used by the second copy of the

character (time-slot No. 2). These Idle characters are transmitted when no message characters are being sent, and are also inserted at regular intervals, to give the receiving station a chance to get into 'sync'.

W1AW On AMTOR

It might also interest you to know that News Bulletins have been regularly broadcast from W1AW, the ARRL headquarters station, in RTTY, ASCII and AMTOR Mode 'B', and I have on several occasions observed the advantages of AMTOR over the other two modes. Under weak signal conditions, short extracts of the bulletin were recognisable in RTTY, practically nothing in 110 baud ASCII, but almost perfect copy in AMTOR mode 'B'. This was due in the main to the synchronous nature of AMTOR and to the fact that each character, as I described above, has two chances of getting through. Realising this, and appreciating the increasing interest in the mode, W1AW recently announced that the RTTY bulletins would be immediately followed by AMTOR, and finally in ASCII if time permitted.

For several years after the invention of TOR by Mr Van Duuren, the cost and complexity of the logic circuitry put this method well out of reach of amateurs, but the coming of the microprocessor age made the arranging of such a system a possibility, and AMTOR first came into existence in September 1978. Its very operation is due almost entirely to Peter Martinez, G3PLX, who told me one day at a BARTG rally that it was the now familiar 'chirp-chirp' of TOR that first attracted his attention to the mode when turning the dial on 80 meters one evening. He set out to find out about it, in due course discovered that it was TOR and determined to adapt it for amateur use. All praise must be given to his perseverence and foresight that, in a space of 5 years, AMTOR has become an established mode for amateurs on HF and VHF throughout the world.

Amateur Use

Initially experiments were made in the United Kingdon under a clause permitting data transmissions on frequencies above 144 MHz, but in the following year with the help of the late Roy Stevens, G2BVN, permission was given by the authorities to use AMTOR on the HF bands. In 1980, the IARU Region 1 conference adopted a resolution urging all member countries to press for similar permission from their respective Posts and Telecommunications authorities.

In the beginning the only way to get on AMTOR was to write your own program to run on a microprocessor or 'home-brew' computer. This turned out to be very difficult, and the situation was really not made any easier when small computers initially became readily available, as the required programs could not be run in a high level language such as BASIC. However, Peter Martinez, G3PLX published two articles in *Radio Communication*, the monthly magazine of the Radio Society of Great Britain, (June/July 1980) that described a design for a code-converter board which allowed any conventional RTTY station to operate on AMTOR with the addition of a few level-shifting circuits. This became available in kit form and also as a made-up board, and was known as the Mk 1. I purchased one of these at the BARTG rally (British Amateur Radio Teletype Group) at Harpenden in July 1981, and after adding the necessary interfaces, (level shifting circuits mentioned above), to my ST 6 terminal unit, I commenced operation in the new mode. I do not exaggerate when I say that everything I had read about AMTOR was true, unbelievably so! This kit is now obsolete, being superseded by the Mk 2 which is available today from GPW Electronics of Ferndown, Dorset.

Call-up Facilities

One of the big attractions of the AMTOR mode 'A' is the availability of a 'SELCALL', that is, a 4 letter code which is uniquely yours. For example, my selcall code is 'GRDG', where my call is G3RDG. The selcall for GW3DZJ would be 'GDZJ', and so on. When on 'standby' the AMTOR system continuously monitors the incoming bit stream for this particular code, and only when your code is received does the system spring into life. It is possible, therefore, to leave the receiver running for long periods without printing or displaying anything until someone calls you. This is a very different state of affairs to the working of 'Autostart' in conventional RTTY. I used to try Autostart in my RTTY set-up on 2 meters, and I must confess that it was not a great success. I suppose it was because of the fact that some operators use a speed of 45.45 bauds and others use 50 bauds, so that if you have set the gear to receive 45.45 bauds and someone comes up on the calling frequency at 50 bauds, you print a lot of rubbish!

Operating Procedures

When operating AMTOR, the first thing to do is to send 'CQ'. Normal practice is to send 'CQ' in mode 'B' giving your selcall in the transmission. eg: CQ CQ CQ DE G3RDG G3RDG G3RDG. SELCALL GRDG
CQ CQ CQ DE G3RDG G3RDG G3RDG. SELCALL GRDG PSE K K
This message can either be sent by hand keying, or, if you are operating with a computer, it can be put into the memory, and sent out by pressing one programmed key. When the message has been sent, the calling station reverts to 'Standby'. We will assume that a station answers my CQ, and calls me in mode 'A' by my selcall. (Remember that no one else can answer to it). The other station commences by typing 'GRDG' which activates my transmitter. He then perhaps, sends a few words such as 'de G3XYZ' followed by '+?'.Thus the transmission is passed back to me, and the QSO is under way. It carries on in the normal way, each end passing the transmission back and forth by means of the '+?' combination sent from the keyboard. However, there is a most interesting extra in the mode 'A' AMTOR operation. Either end can 'break-in' to the others transmission in order to raise a point or answer a question on the spur of the moment by pressing 'Control' and 'C' at the same time. This action forces the transmission back to the other end, and so the question or whatever can be answered followed by the usual '+?', passing the transmission

back to the originator. In this manner it is possible to have what amounts to a really good conversation — passing the transmission back and forth as if one were face to face with the other.

Amateur stations in many countries are active using AMTOR including Austria, Nigeria, Sudan, Zimbabwe, USA, Norway, Italy, Malaysia, Sweden, Switzerland and Japan to name but a few. In fact, there are over 25 countries active on this mode. There is also activity on 2 meters on AMTOR, at least, in the London area on a frequency of 144.590 MHz. The calling frequencies for the AMTOR mode on the HF bands are 3588 KHz, 14075 KHz, 21075 KHz and 28075 KHz. There is one African station who, at the time of going to press, maintains a standby watch at weekends on 21115 KHz.

Getting Started

As I mentioned previously, the easiest way to get on AMTOR is to purchase the Mk2 kit from GPW Electronics and tie it up with your existing RTTY gear, but a number of people, including yours truly, use the commercially manufactured 'AMT-1' from ICS of Arundel, West Sussex. This unit was reviewed by Tony Bailey, G3WPO, for the technical aspects of the unit, and yours truly (as a well satisfied user!) in this magazine in September 1983 so really I need not add to this. There are other manufactured units appearing in the market place. HAL who are already well-known for their RTTY gear, have introduced their ARQ1000, which is a code converter unit and interfaces with their existing terminal unit and video display equipment. MICROLOG, another name well-known in the USA for their RTTY terminal, are introducing an add-on facility which should be an interesting proposition for existing operators. KANTRONICS in the USA is another name which comes to mind. They have just launched a range of programs to run AMTOR on the VIC20, CBM64 and Apple computers. These represent a low-cost introduction to AMTOR for those of you already owning the computers in question, and they offer facilities equivalent to the original Mk1 kit, using separate ARQ and FEC programs, and no RTTY or CW. *Unfortunately the European versions of the VIC20 and CBM64 will not run these programs because of differences in system timing.*

Commercial Feedback

Although AMTOR was originally 'acquired' from the commercial world, there is some evidence that a growing number of AMTOR units are filtering into commercial applications, mainly because of the much more expensive commercial equipment equivalent. At least two scientific expeditions have used AMTOR units for HF communication back to base, and one maritime radio operator reports that he built an AMTOR kit while at sea and patched it into the ship's equipment, replacing the ageing commercial machine, with much improved results! Apart from the cheapness of AMTOR approach, another area where amateur techniques have shown the way is the use of transceivers for this mode. A comment in passing...Some of you might wonder whether the relays in a transceiver would stand up to the change from transmit to receive every 450 mS. Well, I can only tell you that I have been using my TRIO TS820S for the past two and a half years with more or less continuous AMTOR work, and no fault has developed in the relays yet!

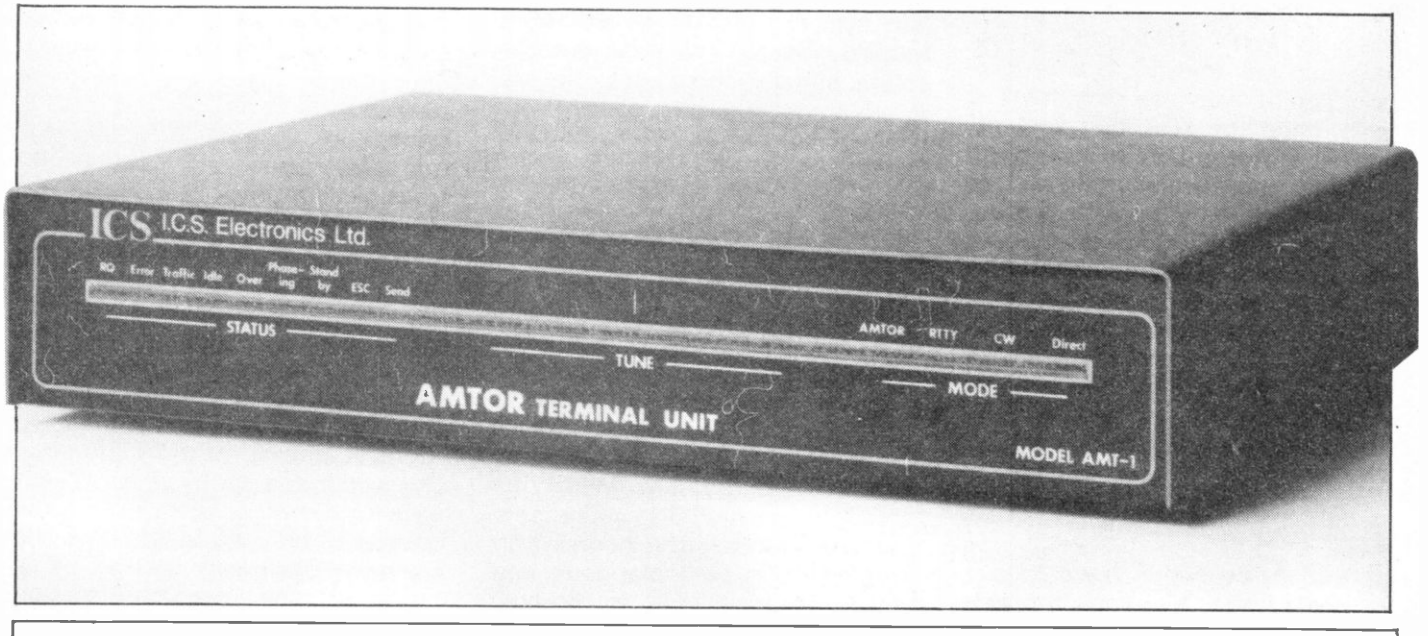
Further Reading

I hope that the above has given you some idea of the working of this latest method of keyboard communication, and perhaps whetted your appetite for more information. In which case, I would recommend reading:-

a. 'AMTOR', an improved radioteleprinter system, using a microprocessor by Peter Martinez,G3PLX. Radio Communication August 1979

b. 'AMTOR the easy way' by Peter Martinez, G3PLX. Radio Communication June/July 1980.

The ICS AMT-1 is controlled entirely by the operator's home computer 'terminal unit'. A number of LEDs behind the translucent front panel insert indicate the status and mode of the AMT-1, which can also be used as an interface for CW and RTTY.



EARTH-MOON-EARTH with simple equipment Part 3

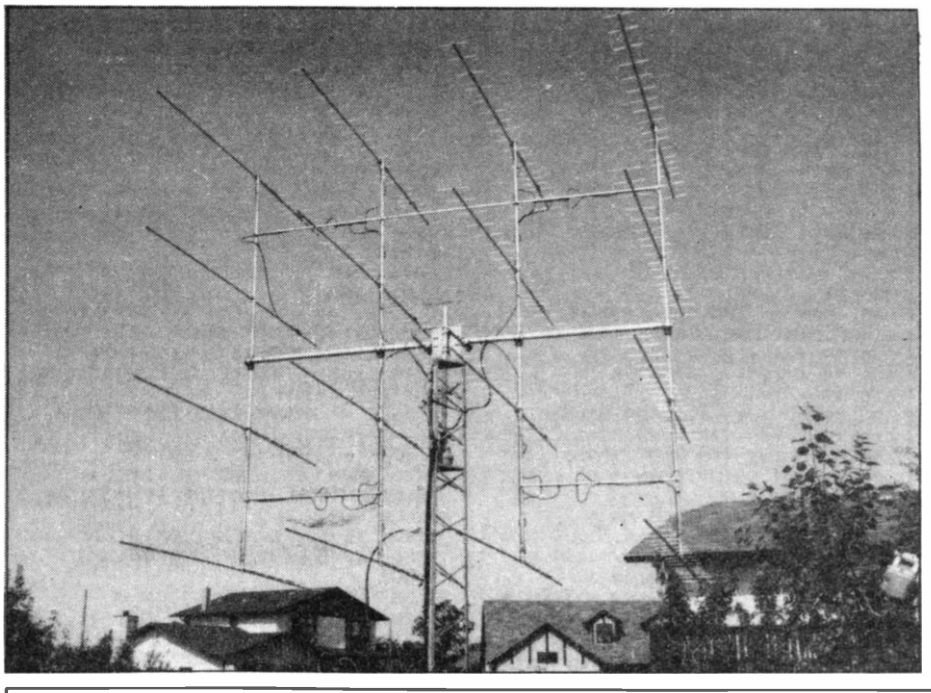
In the final part, Dr Charles Suckling, G3WDG, describes EME operating procedure.

3. Operating

When to listen

The best way to learn about EME operating procedures is to spend some time listening before attempting to make contacts. This usually occurs anyway, as one is usually only too keen to try out the antenna and receiver as soon as these parts of the system are ready. The first question is, when to listen? Unfortunately EME activity levels are not yet high enough to guarantee that someone will be on whenever you want to listen. Activity tends to be concentrated on one weekend per month, referred to as the 'sked weekend'. This does not mean that all activity is in the form of skeds: indeed most activity during these weekends is 'random', ie non-prearranged. Skeds are arranged of course, either by personal arrangement or via the "432 and above EME news" newsletter published by K2UYH. There is a weekly net held on Saturdays and Sundays on 14345kHz between 1600 and 1700 GMT (for stations interested in 70cm and above), and 1700 onwards (for stations interested in 2m). The 70cm net begins with European traffic, and at 1645-1655 to 1700 there is a short period of international traffic, with W1JR acting as net controller. EME oriented stations are also to be found on Oscar 10, around 145.95MHz, or on Mode L. Both the 20m net and Oscar 10 are useful sources of information, and one can often hear skeds being arranged.

The dates for the sked weekends are chosen so that they occur when the moon has a high positive (northerly) declination (to give the maximum amount of operating time as well as the best windows), and if possible when the moon is close to perigee (to give the strongest signals). Since both of these phenomena have approximately 27 day cycles, sked weekends usually occur once every four weeks. The dates of the 70/23cm sked weekends for the remainder of 1984 are: May 12/13, June 9/10 or 23/24, July 21/22, August 18/19, September 15/16, October 13/14 or 20/21, November 17/18 and December 15/16. Activity levels on these dates should be high enough to enable some signals to be heard whenever the moon is up.



Operating Frequencies

On number 2cm, 23cm, most EME occurs in the bottom 30kHz of the normal communication band. On 70cm, this means 432.000 to 432.030MHz. The "newsletter" sked frequencies are 432.000, 432.025 and 432.030MHz, and these frequencies should be left clear during sked weekends. Most of the random activity is concentrated into the segment 432.005 to 432.020MHz. 432.010MHz is the CW 'calling channel', and this tends to get rather busy during sked weekends, and weaker stations usually find it more productive to call CQ a few kHz either side of this frequency.

Operating Procedure

Because EME signals are very weak compared to signals normally found on the bands, special operating procedures have been devised to make contacts easier to achieve. With very few exceptions, strict time periods are used for skeds, CQ calls, replies to CQ calls and all subsequent traffic. On 2m two minute periods are used, and on 70cm 2.5 minute periods are used. During the early stages of a sked or QSO, the last 30 seconds of a period are reserved for reports only. The end of a period

is terminated with a "K" and no callsigns. The rest of the period is used to send the callsigns, usually sent in three-by-three sequences.

The RST reporting system is only used when signals are good. Normally a different system is used, called the "TMO" system. In this, the letters T, M, or O are used as the report. They have the following meanings:

T: very weak, barely perceptible signals which are not strong enough to allow callsigns to be identified;

M: weak signals, but strong enough to allow callsigns to be positively identified;

O: good signals, strong enough to allow callsigns to be copied "in blocks" without too much difficulty.

On 70cm, M or O reports are good enough for the QSO to be valid, while on 2m the minimum is an O report. Of course, reports have to be acknowledged by the other station for the QSO to be complete, and on EME this is done by suffixing an R to the report being sent or by sending R on its own, as appropriate. M or O reports on 70cm, or an O report on 2m, *should only be sent when both callsigns have been positively identified.* This is different to meteor-scatter procedure, for example, where reports are sent before callsigns have been copied.

Worked Example

This procedure may seem a little complicated, and indeed some beginners do get confused! I hope that a short example will help to make things clearer. Suppose that two stations, W1JR and K2UYH have a sked on 70cm, with W1JR taking the first transmit period. If all goes according to the book, the QSO would proceed as follows:

1st period: W1JR sends K2UYH K2UYH K2UYH DE W1JR W1JR W1JR repeated for 2.5 minutes.

2nd period: K2UYH sends W1JR W1JR W1JR DE K2UYH K2UYH K2UYH, repeated for two minutes, then M M M M M repeated for 30 seconds (his report to W1JR).

3rd period: W1JR sends K2UYH K2UYH K2UYH DE W1JR W1JR W1JR repeated for 2 minutes then OR OR OR OR OR repeated for 30 seconds (his report to K2UYH, plus acknowledgement that he has copied his own report).

4th period: K2UYH sends W1JR W1JR W1JR DE K2UYH K2UYH K2UYH repeated for 2 minutes then R R R R R repeated for 30 seconds

```
95  REM     MOON LOCATION PROGRAM
96  REM     DEFINED CONSTANTS
100 P5 = 2.0000000000 *
3.1415926535
110 D5 = 360.000000000 / P5
120 R5 = P5 / 360.00000000
130  DEF  FN A(X) =  INT (X * D5 *
10 + .5) / 10
140  DEF  FN B(X) = (X -  INT (X))
* P5
145  REM     DATA INPUT SECTION
150  INPUT "LATITUDE  DEG,MIN?
";L5,U5
160  INPUT "LONGITUDE  DEG,MIN?
";L6,U6
170 LA = L5 +  INT ((U5 / 60) *
100) / 100
180 LO = L6 +  INT ((U6 / 60) *
100) / 100
190 L5 = (L5 + U5 / 60) * R5
200 L6 = (L6 + U6 / 60) * R5
210  INPUT "INCREMENT IN MINUTES?
";I
220 U5 =  INT ((U5 / 60) * 100) /
100
230 U6 =  INT ((U6 / 60) * 100) /
100
240 I6 = 100
250  GOTO 260
260  'INPUT "DAY,MONTH,YEAR,TIME
START,TIME FINISH? ";D,M,Y,B,E1
270 Y1 = Y - ( INT (Y / 100) *
100)
280  PRINT
290  PRINT
300 NS$ = "N"
310  IF LA < 0 THEN NS$ = "S"
320 EW$ = "W"
330  IF LO < 0 THEN EW$ = "E"
340  PRINT "MOON
";D;"/";M;"/";Y1;" FROM LAT= ";LA
*  SGN (LA);NS$;" LONG= ";LO *
SGN (LO);EW$
350 F1 = 0
360  PRINT
370 I1 = 2
375  REM     CALCULATION OF JULIAN
DATE
380  IF M >  = 3 THEN 460
390  IF  INT ((Y - 1853) / 4) < 11
THEN  GOTO 420
400 C1 =  - 1
410  GOTO 430
420 C1 = 0
430 J1 = 365 * (Y - 1853) + D + 30
* (M + 9) +  INT ((M + 10) / 2)
440 J2 =  INT ((Y - 1853) / 4) + 1
+ C1
450  GOTO 570
460  IF  INT ((Y - 1852) / 4) < 11
THEN  GOTO 490
470 C1 =  - 1
480  GOTO 500
490 C1 = 0
500  IF M = 9 THEN 540
510  IF M = 11 THEN 540
520 C2 = 0
530  GOTO 550
540 C2 = 1
550 J1 = 365 * (Y - 1852) + D + 30
* (M - 3) +  INT ((M - 2) / 2)
560 J2 =  INT ((Y - 1852) / 4) +
C1 + C2
570 J = J1 + J2
580 T1 = J - 17472.5
585  REM     CALCULATION OF DAYS
SINCE LAST PERIGEE AND AGE OF MOON
590 T9 = J + 2397547.5
600 T9 = T9 - 2444507.6
610 T7 = T9 - 14.6
620 T8 =  INT (T7 / 29.5306)
630 T8 = T7 - T8 * 29.5306
640 Q =  INT (T9 / 27.5545)
650 R = T9 - (27.5545 * Q)
660 S = 24 * R
665  REM     START OF MAIN
CALCULATION LOOP
670 D9 = (B -  INT (B / 100) *
100) +  INT (B / 100) * 60
680 D6 = (E1 -  INT (E1 / 100) *
100) +  INT (E1 / 100) * 60
690 D7 = D9 - D6
700 D8 = D7 - I
710  IF D7 >  = 0 THEN  GOTO 730
720  GOTO 750
730  IF D8 >  = 0 THEN  GOTO 1840
740 B = E1
745  REM     CALCULATION OF LUNAR
LAT AND LONG
750 T = (B -  INT (B / 100) * 100)
/ 1440 +  INT (B / 100) / 24
760 T5 = T1 + T
770 K1 =  FN B(.751213 +
.036601102 * T5)
780 K2 =  FN B(.822513 +
.03629116457 * T5)
790 K3 =  FN B(.995766 +
.00273777825 * T5)
800 K4 =  FN B(.974271 +
.0338631922 * T5)
810 K5 =  FN B(.0312525 +
.0367481957 * T5)
820 L8 = K1 + .658 * R5 *  SIN (2
* K4) + 6.289 * R5 *  SIN (K2)
830 L8 = L8 - 1.274 * R5 *  SIN
(K2 - 2 * K4) - .186 * R5 *  SIN
(K3)
840 L8 = L8 + .214 * R5 *  SIN (2
* K2) - .114 * R5 *  SIN (2 * K5)
850 L8 = L8 - .059 * R5 *  SIN (2
* K2 - 2 * K4) - .057 * R5 *  SIN
(K2 + K3 - 2 * K4)
860 K6 = K5 + .6593 * R5 *  SIN (2
* K4) + 6.2303 * R5 *  SIN (K2) -
1.272 * R5 *  SIN (K2 - 2 * K4)
870 L7 = 5.144 * R5 *  SIN (K6) -
.146 * R5 *  SIN (K5 - 2 * K4)
875  REM     CALCULATION OF LUNAR
RA AND DEC
880 D1 =  COS (L7) *  SIN (L8) *
.397821 +  SIN (L7) * .917436
890 D1 =  ATN (D1 / ( SQR (1 - D1
^ 2)))
900 G1 = 50 + .5 + ((D1) / (.792))
* D5
910 G2 = 80 + ((D1) / (.808)) * D5
920 G3 = 141.5 - ((D1) * (.738) *
D5)
930 G4 = 170.5 - ((D1) * (.857) *
D5)
940 A2 = ( COS (L7) *  COS (L8)) /
COS (D1)
950 A1 = ( COS (L7) *  SIN (L8) *
.917436 -  SIN (L7) * .397821) /
COS (D1)
960 A =  ATN (A1 / A2)
970  GOSUB 1230
980 R1 = A
990 L1 = .065709822 * T1
1000 L = T * 24 * 1.002738 +
6.646055 + (L1 -  INT (L1 / 24) *
24)
1010 L = (L -  INT (L / 24) * 24)
1015  REM     CALCULATION OF GHA
FROM LOCAL SIDERIAL TIME
1020 G = (L / 24) * P5 - R1
1030  IF G < P5 THEN  GOTO 1060
1040 G = G - P5
1050  GOTO 1090
1060  IF G < 0 THEN  GOTO 1080
1070  GOTO 1090
1080 G = G + P5
1085  REM     CALCULATION OF LHA
FROM GHA
1090 H = L6 - G
1095  REM     CALCULATION OF
ELEVATION
1100 E3 =  COS (L5) *  COS (H) *
COS (D1) +  SIN (D1) *  SIN (L5)
1110 E2 =  SQR (1 - (E3 * E3))
1115  REM     PARALLAX CORRECTION
FOR ELEVATION
1120 E =  ATN ((E3 / E2) - (1 /
(61.33 * E2)))
1130 F =  ATN (E3 / E2)
1135  REM     JUMP TO TIME
INCREMENTING  ROUTINE IF MOON IS
BELOW HORIZON
1140  IF E < 0 THEN  GOTO 1770
1150  IF E > I6 * R5 THEN  GOTO
1770
1155  REM     CALCULATION OF
AZIMUTH
1160 A2 =  SIN (D1) / ( COS (L5) *
```

```
COS (F))
1170 A2 = A2 - ( SIN (L5) /  COS
(L5)) * ( SIN (F) /  COS (F))
1180 A1 =  SIN (L5) *  SIN (D1) +
COS (L5) *  COS (D1) *  COS (H)
1190 A1 = ( SIN (H) *  COS (D1)) /
SQR (1 - A1 ^ 2)
1200 A =  ATN (A1 / A2)
1210  GOSUB 1230
1220  GOTO 1370
1225  REM    SUBROUTINE TO REMOVE
AMBIGUITIES ASSOCIATED WITH ATN
FUNCTION
1230  IF A = 0 THEN  GOTO 1250
1240  GOTO 1280
1250  IF A2 < 0 THEN  GOTO 1270
1260  GOTO 1360
1270  GOTO 1360
1280  IF A > 0 THEN  GOTO 1340
1290  IF A2 < 0 THEN  GOTO 1320
1300 A = P5 + A
1310  GOTO 1360
1320 A = P5 + (A - P5 / 2)
1330  GOTO 1360
1340  IF A2 =  > 0 THEN  GOTO 1360
1350 A = A + P5 / 2
1360  RETURN
1365  REM    CALCULATION OF
DOPPLER SHIFT FOR ECHOES ON 432MHZ
1370 D7 =  - .38 * ( SIN (.526 * S
/ 57.3))
1380 F = 432 * (D7 - (3.1 *  COS
(D1) *  COS (L5) *  SIN ( - 1 *
H)))
1390 F =  INT (F)
1400  IF (T - I1) > (2 * I) / 1440
THEN  GOTO 1420
1410  GOTO 1430
1420  PRINT
1430  IF  INT (B + .5) > 9 THEN
GOTO 1460
1435  REM    ROUTINE FOR PUTTING
LEADING ZEROS IN FRONT OF TIME
(B=TIME)
1440 S$ = "000"
1450  GOTO 1530
1460  IF  INT (B + .5) > 99 THEN
GOTO 1490
1470 S$ = "00"
1480  GOTO 1530
1490  IF  INT (B + .5) > 999 THEN
GOTO 1520
1500 S$ = "0"
1510  GOTO 1530
1520 S$ = ""
1530 Z1 =  FN A(A)
1540 Z2 =  FN A(E)
1550 Z3 =  FN A(G)
1560 Z4 =  FN A(D1)
1570  IF F1 = 1 THEN  GOTO 1650
1580 R1 =  INT (R)
1590  PRINT "DAYS SINCE PERIGEE=
";R1
1600  PRINT "AGE OF MOON= "; INT
(T8 * 10) / 10;" DAYS"
1610  PRINT
1620  PRINT " GMT    AZ      EL
GHA    DEC    DOP"
1630  PRINT " ---    --      --
---    ---    ---"
1640 F1 = 1
1645  REM      PRINTING OF FINAL
RESULTS (S$=LEADING ZEROS, STR$
CONVERTS TIME TO A STRING,
Z1=AZIMUTH, Z2=ELEVATION, Z3=GHA,
Z4=DECLINATION, F=DOPPLER SHIFT)
1650  PRINT S$; STR$ ( INT (B +
.5));
1660  HTAB 7
1670  PRINT Z1;
1680  HTAB 14
1690  PRINT Z2;
1700  HTAB 20
1710  PRINT Z3;
1720  HTAB 27
1730  PRINT Z4;
1740  HTAB 34
1750  PRINT F
1760 I1 = T
1765  REM     TIME INCREMENTING
ROUTINE
1770 HR =  INT (B / 100)
1780 MN = B - 100 * HR
1790 MN = MN + I
1800 B = 100 * (HR +  INT (MN /
60))
1810 MN = MN - ( INT (MN / 60)) *
60
1820 B = B + MN
1825  REM     LOOP BACK TO MAIN
CALCULATIONS
1830  GOTO 670
1840  PRINT
1850  PRINT "RE-RUN PROGRAM? (Y/N
";
1860  INPUT D$
1870  IF D$ = "Y" THEN  GOTO 100
1880  END
```

BASIC program for determining the position of the moon.

(acknowledging that he has copied his report).

At this point, the QSO is complete, and pleasantries such as TNX, 73, GL etc are usually sent with no special procedure, except for time periods. Of course, things do not always work out as well as this, for example a station may not copy the report, and repeats are then necessary. The lack of an R from the other station will tell you that you have to send the report again. If you can hear your QSO partner, but not well enough to get both callsigns then use the T report, as it tells the other station that you are at least getting something. It is possible that as a result of this your partner might change the polarisation of the antenna and could be stronger on the next transmission. If you hear nothing at all from the other station, the strict procedure is to send nothing during the 30 second reporting period. Some stations do not do this, however, but continue sending callsigns for a full 2.5 minutes. The advantage of not sending anything is that it is a positive signal to the QSO partner that you are hearing nothing. Callsigns sent during a reporting period could be confused for reports.

When answering CQ calls, the same procedure should be followed as for skeds. You have the option of sending callsigns and a report, or just callsigns, in your reply. The advantage of sending callsigns and a report is that the contact can be completed more quickly — which might be desirable in a contest, but in EME working reduces the other stations "callsign deciphering" time by 20%. If the other station replies with QRZ?, then you should reply with callsigns only, as the other station is obviously not copying you very well.

One final point about procedure. Quite often stations do not stick to the 2 minutes of callsigns and 30 seconds of reports once they have copied a report from their QSO partner. Instead, they increase the time spent sending reports, since by that time they know that the other station has already copied the callsigns. Do not be surprised if this happens to you, but I would recommend that you stick to the formal procedure until you are fully familiar with EME procedure.

When you hear your first EME signals, do not be too surprised if you find them rather difficult to copy. Apart from the fact that the signals are weak, they are also subject to rapid fading (libration fading). The net result is that you only hear a certain percentage of what is being sent, almost on a character by character basis. With experience, the fading seems to become less of a problem. In a sked, you know in advance what the callsigns will be. When listening to the signals, try to pick out parts of the morse characters. This helps the brain to 'lock-in' to the sending speed. Sooner or later a complete letter will be heard. The brain can then anticipate what the next letter ought to be, and if part of it only is heard, you can still correlate it with what was sent. Of course, it is more difficult to identify callsigns when you have no idea beforehand who you are listening to, but with experience you build up a 'data base' of callsigns which you can try to fit to what you hear, until you get a positive identification. Taping signals is good idea, as one can go back to the tape afterwards and possibly copy more then than you did at the time.

Moon Tracking

Finally, we come on to one very important aspect of EME operating — keeping the antenna pointed at the moon. If you have followed the suggestions above, you should now have an antenna with calibrated elevation and azimuth readouts. All you need to know is the elevation and azimuth of the moon at the time and you are in business. If your antenna is not equipped with calibrated readouts, then you have only yourself to blame when you have to miss that sked because it was cloudy and you could not see the moon!

There are a number of ways of working out the moon's position, but by far the most convenient is to use a

computer. The program reproduced here was written for an Apple II + (as were all the programs in this series), but should run with little or no modification on most machines. It is based on an original program by WA1JXN, and I have added three useful features. In addition to printing out the elevation, azimuth and astronomical co-ordinates of the moon, the program also gives the number of days since perigee for the day in question, the age of the moon (the number of days since New moon) and the total Doppler shift (in Hertz) which you will find on your own echoes (on 70cm). The program can be easily modified to give the Doppler shift for other frequencies by changing the 432 in line 1380 to the frequency required. The one-way Doppler shift is half the number printed out, and by adding together the one-way Doppler shifts for your site and for your QSO partner's, the overall Doppler shift can be calculated. The number of days since perigee is useful to know, as it allows you to estimate the current EME path loss. Remember that there is a 2dB change in path loss as the moon goes from perigee to apogee. It takes about 27 days for the moon to go from one perigee to the next. The age of the moon is given, mainly so that you can be aware if the moon is close to New moon. At this point in the moon's orbit, it can happen that the sun and moon are close together in the sky, and your antenna could pick up some noise from the sun, which would degrade the receiver's performance.

Suppose that you want to run the program for 29 May, from 0000 to 2400GMT, at intervals of 60 minutes, from a site with a latitude of 51deg 30min North, and a longitude of 1deg 50min West. The program's prompts and appropriate entries are as follows:

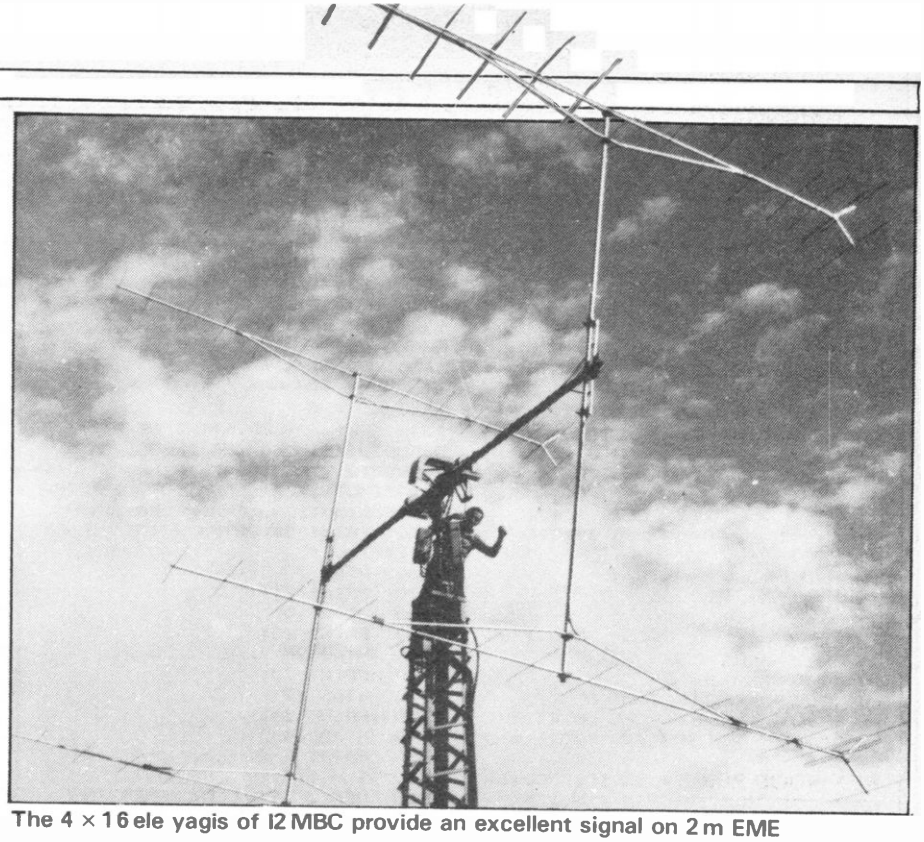
```
LATITUDE DEG,MIN? 51,30
LONGITUDE DEG,MIN? 1,50
INCREMENT IN MINUTES? 60
DAY,MONTH,YEAR,TIME START,TIME FINISH?
29,5,1984,0000,2400
```

The program then outputs the following:

```
MOON 29/5/84 FROM LAT= 51.5N LONG= 1.83W

DAYS SINCE PERIGEE= 19
AGE OF MOON= 27.9 DAYS

 GMT    AZ      EL     GHA     DEC     DOP
 ---    --      --     ---     ---     ---
0400   69.9     4      259     16.3    926
0500   80.8    12.9    273.5   16.5    946
0600   91.9    22.1    288     16.6    913
0700   103.8   31.3    302.5   16.8    833
0800   117.4   39.9    317.1   17      708
0900   133.8   47.5    331.6   17.2    548
1000   154.1   53.1    346.1   17.4    362
1100   177.9   55.5    .6      17.5    163
1200   202.2   54.1    15.1    17.7    -36
1300   223.5   49.2    29.6    17.9    -224
1400   240.8   42.2    44.2    18.1    -387
1500   255.1   33.9    58.7    18.2    -516
1600   267.4   25      73.2    18.4    -603
1700   278.7   16.1    87.7    18.6    -642
1800   289.7   7.4     102.2   18.7    -630
```



The 4 × 16 ele yagis of I2MBC provide an excellent signal on 2m EME

As with the sun program, you must enter the latitude and longitude as negative numbers if your location is south of the equator, or east of Greenwich, respectively.

To track the moon, all you have to do is to set the antenna to the predicted co-ordinates at suitable time intervals. How often this has to be done depends on the beamwidth of the antenna. The narrower the beamwidth, the more often you have to update the position of the antenna. A 4 yagi array on 432MHz ought to be updated at not greater than 10 minute intervals.

Special Research Permits

Since power levels in excess of the UK legal limit are almost always required for EME working, it is unfortunately rarely possible to operate on EME within the terms of the normal UK licence. A limited number of "Special Research Permits", which in some cases allow operation at higher power levels, may be available to licenced amateurs **who can demonstrate a need for one.** These are issued by the DTI as an extension to the normal licence, and enquiries should be addressed to the RSGB, c/o the Chairman of the Licensing Advisory Committee (David Pratt, G3KEP). The RSGB has been asked to process all applications for these permits prior to their submission to the FTI. It should be noted that the Special Research Permits allow the use of high power *only* for the purpose for which they are issued, in this case EME.

Further Information

In this short series on EME operation, I have tried to cover all of the necessary background needed to become active on EME. Best of luck! For further information, the following publications are recommended:

1. "432 and above EME News". This is a monthly newsletter intended for active EME stations needing sked information. It is published by Allen Katz, K2UYH, RD#4, Old Trenton Road, Trenton, NJ 08691, USA. In order to receive the newsletter, SAEs should be sent to K2UYH, together with $1 per envelope.
2. "The EIMAC EME Notes". These contain a lot of very useful information about EME and are available free of charge from Bob Sutherland, W6PO, c/o Eimac Division of Varian, 301 Industrial Way, San Carlos, California, USA.
3. RSGB VHF/UHF Manual, by G.R. Jessop G6JP, pp. 10.16-10.20.

Acknowledgements

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	FC-757AT	ATU	219
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1249	FRG-7700M	General Coverage Receiver with Memory	399
1254	FRT-7700	ATU	44
1255	FRA-7700	Active Antenna	36
1257	FRV-7700	Converter 118/130, 140/150, 70/80MHz	83
1273	MEM7700	Memory unit	59
1246	FL-2100Z	HF 1200W Linear Amplifier	499
1251	Cabinet	for SP-101	17
1276	AM Unit	for FT-101Z	20
		VHF/UHF EQUIPMENT	
1200	NC-1	Desk Charger for FT-202R	19
1201	PA-1	12V Adapter for FT-202R	19
1205	FP-4	AC PSU, 4 Amp	42
1220	FP-80A	AC PSU, 4.5 Amp	53
1234	FT-290R	2m All Mode Transceiver, portable	259
1202	CSC-1A	Carrying Case	3.95
1210	MMB-11	Mobile Mount	25.50
1211	NC-11C	Charger	9.50
	FL-2010	2m 10W LInear Amplifier	60
1241	FT-720RU	70cm FM Mobile Transceiver, 10W	219
1242	FT-720RV	2m FM Mobile Transceiver, 10W	189
1217	E-72L	Extension cable, 4m	14.50
1218	S-72S	Switching box	37
1233	FT-208R	VHF Handie FM Transceiver	189
	FT-708R	UHF Handie FM Transceiver	199
1253	NC-8C	Fast Charger for FT-208/708	49
1258	NC-7C	Base Charger for FT-208/708	29
1260	FBA-2	Battery sleeve for NC-7/8	3
1261	MMB-10	Mobile Bracket	7.50
1262	NC-9C	Compact Trickle Charger	8
1263	FT-230R	2m FM Mobile Transceiver, 25W	249
1237	FT-726R	VHF/UHF Multiband, multimode Transceiver c/w 2m	699
1238	430/726	70cm module	239
1239	SAT726	Satellite Unit	90
1259	PA-3	Battery eliminator/charger for 12V	13
		MICROPHONES/ACCESSORIES	
1208	MH1B8	Hand mic., scanning	14
1214	YM-35	Hand mic., scanning, for FT-1/102/707 series	15.95
1215	YM-36	Noise cancelling mic., 4-pin, 50K	15.95
1221	YD-148A	Desk mic., 50K/600 ohms, 4-pin, for FT-101 series	22.75
1235	YM-38	Desk mic., scanning, for FT-1/102/707 series	26.50
1250	YM-49	Speaker/mic. for FT-290/230R	17
1213	QTR-24D	24-hour quartz clock	32
1216	YH-55	Lightweight headphones	10.50
1219	YH-77	Lightweight headphones	11
1278		Battery Holder for FRG-7	

KENWOOD PRICE LIST. 2 Yr warranty. Free delivery.

Cat No	Type	Description	Price £
1331	TS-930S	Transceiver, HF, W. gen. cov. receiver	1099
1330	TS-930S + ATU	As above, with automatic ATU	1199
1329	SP-930	Speaker and filters	57
1313	MC-60A	Desk Top Microphone, scanning	54
1357	YK-88A1	6kHz AM filter	32
1356	YK-88C1	500Hz CW filter	32
1348	YG-455C-1	500Hz CW filter	75
1349	YG-455CN-1	270Hz CW filter	75
1324	TS-430S	Transceiver, HF, w. gen. cov. receiver	719
1310	PS-430S	DC power supply, de luxe cooled	113
1319	SP-430	External speaker	30.50
1334	FM-430	FM Unit	33.75
1321	MB-430	Mobile Mount	12.50
1322	AT-250	Automatic ATU	280
1313	MC-60A	Desk Top Microphone	54
1320	AT-130	Antenna Tuning Unit	
1354	YK-880	500Hz CW filter	
1315	YK-88CN	250Hz CW filter	36
1352	YK-88SN	1.8kHz SSB filter	
1353	YK-88A	6kHz AM filter	
1314	PS-30	DC PSU	
1326	TS-530S	Transceiver, HF	609
1327	SP-230	External Speaker	45
1325	AT-230	Antenna Tuning Unit	149
1313	MC-60A	Desk Top Microphone	54
1312	MC-50	Desk Top Microphone	32
1302	KB-1	De luxe VFO knob	11.50
1354	YK-88C	500Hz CW filter	
1315	YK-88CN	270Hz CW filter	36
1352	YK-88SN	1.8kHz SSB filter	
1328	R-600	Receiver	259
1333	DCK-1	DC Operation Cable Kit	8.26
1332	R-1000	Receiver	299
1318	SP-100	External Speaker	33
1333	DCK-1	DC Operation Cable Kit	8.26
1335	R-2000	Receiver	399
1355	YG-455C	500Hz CW filter	
1337	TR-2400	Transceiver, 1.5W FM, 10CH Mem.	195
1301	ST-1	Base Stand	45
1309	MC-30S	Hand Microphone	14
1338	TR-2500	2m FM Transceiver	219
1304	ST-2	Base Stand	52
1360	MS-1	Mobile Stand	32
1342	VB-2530	25W Amplifier	75
1306	SMC-25	Speaker microphone	17
1361	BT-1	Manganese Battery Case	6.50
1311	PB-25	Nicad Battery	26
1305	SC-4	Soft case	14
1362	LH-2	De luxe leather case	
1363	TU-35A	Variable Tone Encoder	
1364	TU-35B	Programmable Tone Encoder	
1365	DC-25	DC Adaptor for 12VDC	
1366	RA-4	Rubber Antenna	
1367	RA-3	Telescoping Antenna	
1343	TR-8400	70cm Transceiver	279
1368	PS-10	DC PSU	52.50
1369	SP-40	Compact Mobile Speaker	15.75
1371	MC-46	Auto-patch Up/Down microphone	42.50
1313	MC-60A	Desk Top Microphone, built-in pre-amp.	50
1339	TR-9130	2m All Mode Transceiver, 25W	419
1372	BP-9A	System Base	
1373	SP-120	External Speaker	
1374	PS-30	DC Power Supply	114
1370	BC-1	AC Adaptor for memory back-up	6.43
1371	MC-46	Touch-tone microphone	41.50
1313	MC-60A	Deluxe Desk Top Mic. + pre-amp.	52
1369	SP-40	Compact Mobile Speaker	
1341	TR-9500	70cm All Mode Transceiver	429
1372	B0-9/9A	System Base	48.50
1373	SP-120	External Speaker	34
1307	PS-20	DC Power Supply	59
1370	BC-1	AC Adaptor for memory back-up	8
1313	MC-60A	De luxe Desk Top Mic. + pre-amp	50
1369	SP-40	Compact Mobile Speaker	15.75
1316	TL-922	2KW HF Linear Amplifier	799
1376	SM-220	1.8-150MHz Station Monitor	250
1351	HC-10	Digital World Clock	65
1350	PC-1A	Phone Patch	50
1303	RA-1	Antenna	8
1379	MC-42S	Spare — Up/Down Microphone	16

Prices include VAT and Carriage.

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- ★ Stainless steel hardware
- ★ SWR less than 1.3:1

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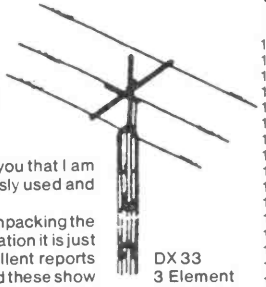

DX 33
3 Element
3 Bands

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Cat No	Type	Description	Price £
1075	DX 7/2	2MHz 2 ele Yagi Gamma matched 20' boom	239.00
1076	DX 7/3	2MHz 2 ele Yagi Gamma matched 40' boom	354.20
1077	DX 51	Rotary dipole for 28,24,21,18 and 14MHz	90.95
1080	DX 6V	1080m Multi-band vertical plus 30m	99.00
1081	DX 31	Fipolr 10/15/20m 2Kw p.e.p.	81.65
1082	DX 32	2 element 10/15/20m 2Kw p.e.p.	125.35
1083	DX 33	3 element 10/15/20m 2Kw p.e.p.	182.85
1084	DX 34	4 element 10/15/20m 2Kw p.e.p.	258.45
1085	DX 31/32	Conversion Kit	50.80
1086	DX 32/33	Conversion Kit	63.25
1087	DX 33/34	Conversion Kit	75.90
1089	DX 103	3 element 10m Yagi	90.85
1090	DX 105	5 element 10m Yagi	113.85
1093	DX 4K	Converts DX 31/2/3/4 to 40m dipole	89.00
1094	DX 27/1	Rotary dipole for 27MHz C.B.	12.65
1095	DX 27/3	3 ele Beam for 27MHz Gamma matched	36.80
1096	DX 24Q	2 ele quad 2, 10, 15 & 20m	199.99
1097	DX 26Q	2 ele quad 2, 10, 15, 16 & 20m	224.25

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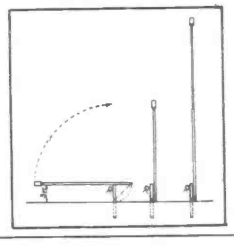

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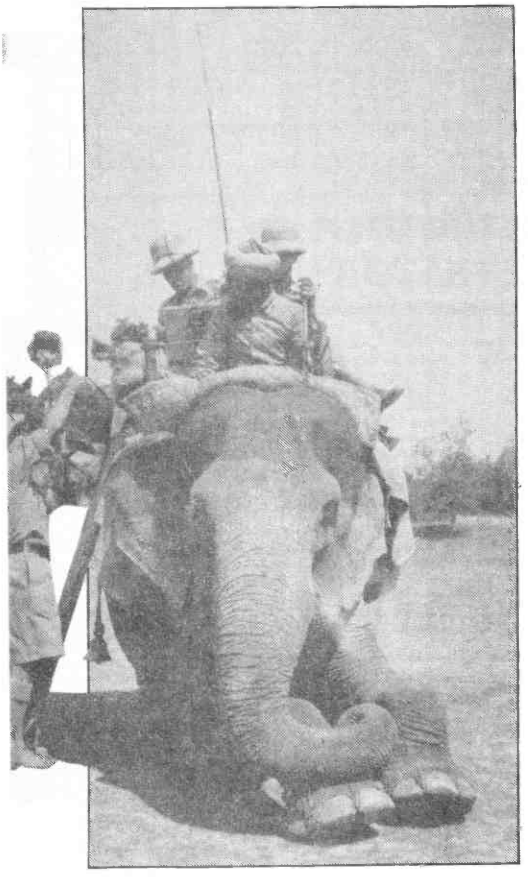
Radio Yesterday

Have you ever operated a 'Mule Packet'? Or been mobile on an Elephant? Well, George Metcalfe, G6VS, has...



mobile on ELEPHANTS!

We could hardly believe our ears, but the order was quite clear. The Section had to provide wireless communication for a Company of Infantry who had been detailed to maintain order during a Hindu religious festival at Horwar, on the banks of the River Ganges, and the radio equipment would be carried used to operating "Mule Mobile" — both phone and CW, whilst walking alongside the mule on the move. Nobody had even considered using elephants, and few had been nearer to those large animals than a visit to the zoo or viewing them in procession in one of the Indian Princely States, and there was no opportunity for a trial run to see how the equipment could be fitted and carried on the elephants. The only solution was to take all the harness used for mule transport and adapt it as best we could when we had an "Eyeball" with the elephants.

The Wireless Set No.1 had been carried on mules for some time and the operators were well

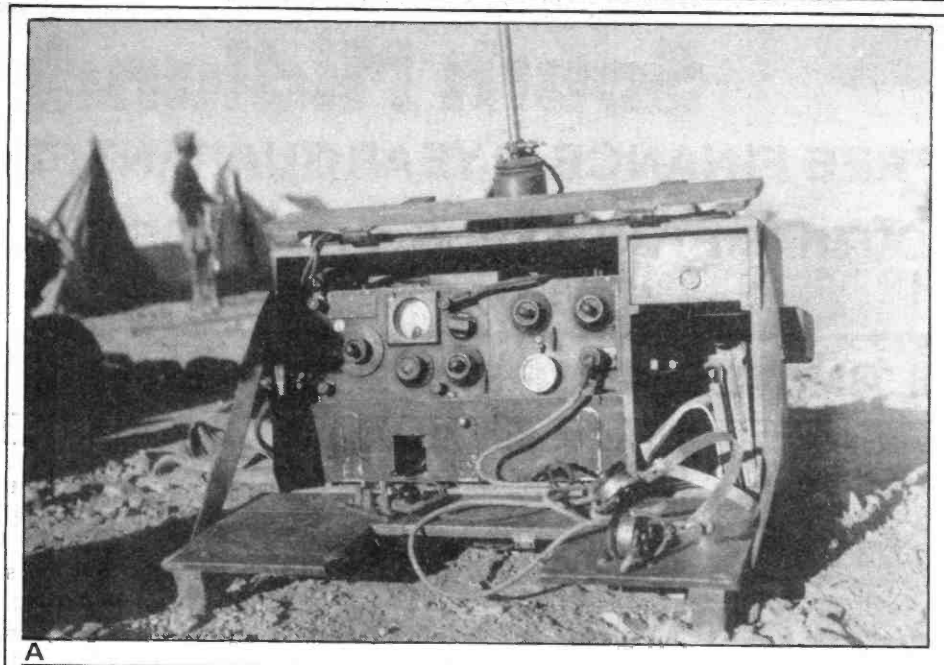
By present day standards, the military radio equipment we used in the mid 1930's would be considered very primitive. The Wireless Set No.1 was housed in a case approximately 14 inches high, 22 inches wide and about 8 inches deep, and the transmitter consisted of an RF pentode with anode and screen pins at one end and grid and filament connecting pins at the other end, mounted horizontally, as a Colpitts Master Oscillator driving a PM1LF power amplifier giving about 2.0 W — truly a QRP rig. The frequency range was approximately 4.0 to 7.0 MHz. The receiving side consisted of the same type of RF pentode, followed by detector and two low frequency stages using the same PM1LF type of valves with resistance capacity coupling. The antenna was a vertical rod approximately eight feet long mounted on an insulated base which was fitted to the top of the case. Photograph A shows this set standing on the ground and the base of the antenna is clearly visible.

Another photograph (B) shows this type of set mounted on a mule, the pannier on the opposite side carried the batteries to operate the equipment. The high tension of 150 volts was made up from 100 1.5 volt inert cells and two volt accumulators were used to heat the valve filaments. The close-up photograph of the Wireless Set No.1 on the ground provides a good indication of the size of the equipment; towards the right hand side, just underneath the second control knob is an attachment for housing a gents pocket type watch, the compartment on the right houses the headphones, microphone and morse key, and the small drawer above that compartment contains spare valves

Mounting the equipment on the elephants presented many problems, as, even with the animal lying or kneeling down, its back was a good six or seven foot above ground, and when the elephants 'saddles' had been designed wireless sets had not even been invented. The 'saddles' were designed to carry the mahout (driver) and two passengers with little room to spare. Eventually it was decided to fit the radio equipment in the space normally occupied by the passengers and the operators would ride with their legs dangling over the side of the elephant.

Not a very comfortable position but it was the only way to overcome the problem — needless to say the operators comments were hardly printable!

The festival lasted a week, six 'Elephant Mobiles' were used and their slow steady pace did not damage the radio equipment but played havoc with the operators

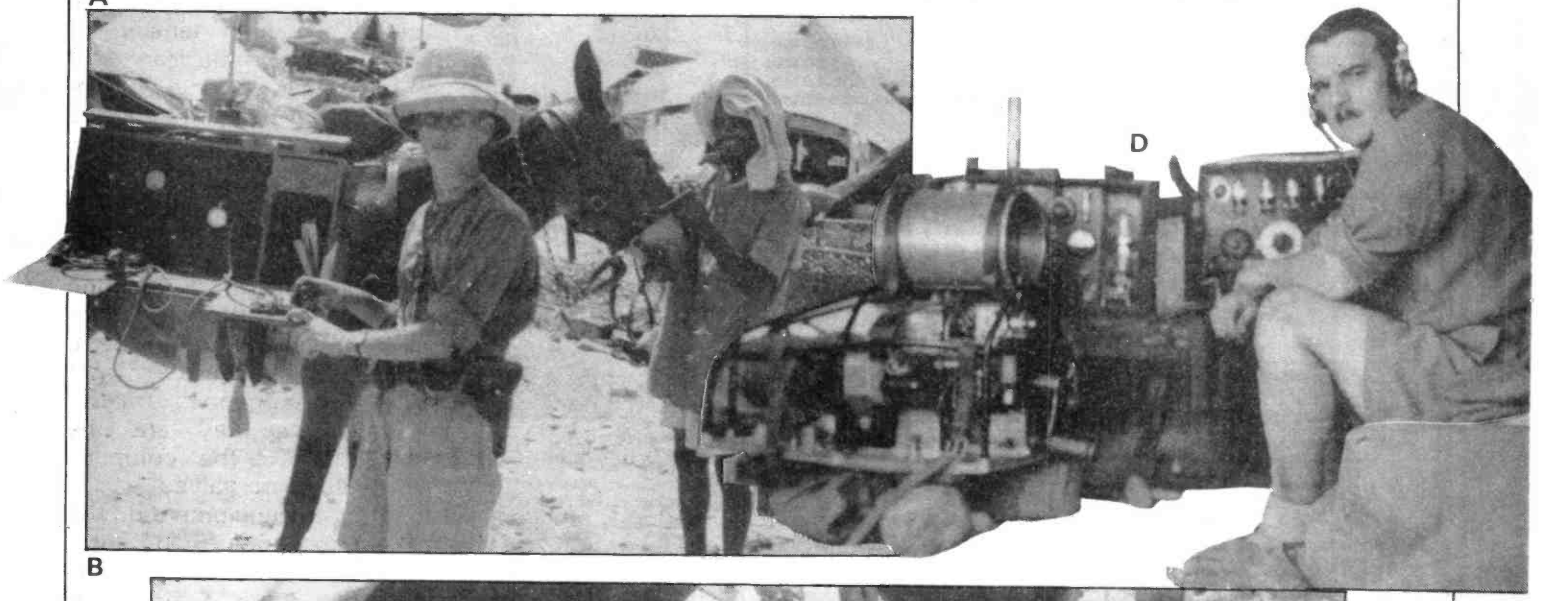


A

stomaches! However by the end of the week most of them overcame the 'elephant sea-sickness' and operating procedure improved considerably.

As far as the writer is aware, this was a unique experience and possibly the only time, certainly the only time before the war, that radio equipment has been carried and operated from elephants on the move.

Photo D shows a 'holy man' sitting on a bed of nails — the nails were very sharp — that was taken at the same festival. The final picture (E) shows a base wireless station on the North West Frontier, the petrol generator and operator are in the foreground and W/T Set 'A' with its bright emitter valves can be seen in the background.



D

B

C

South Midlands

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The ultra compactness of the FT203R is due mainly to Yaesu's chip component circuit board assembly, the chip componnents being installed automatically by robots. THe 203's features include thumbwheel frequency selection, built in S/PO meter, 2.5W RFO/P at 10.8V, (/.5W O/P with FNB4). Vox activated switching is possible when used in conjunction with YH-2. Accessories supplied include FNB3, FTE-* tone unit, CSC6 case and YHA-14A antenna.

FT203R	2.5W tranceiver	**£169.00 inc.**
FBA5	Case for 6AA cells	**£6.50 inc.**
FNB4	12V Nicad pack	**£36.40 inc.**
CSC7	Soft case(when FNB4 is used)	**£6.50 inc.**
YH-2	Headset/Mic	**£13.80 inc.**
MH-12A2B	Speaker Mic.	**£16.85 inc.**
SMC8.9AA	Charger (13A style)	**£8.05 inc.**
MMB21	Mobile mounting bracket	**£7.65 inc.**

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FT208R	2m Handheld 2.5W	**£199.00 inc.**
FT708R	70cm Handheld 1W	**£209.00 inc.**
SMC8-9AA	(13A style) Handy charger	**£8.05 inc.**
NC7	Bass charger	**£32.95 inc.**
NC8	Base quick charger + PSU.	**£54.05 inc.**
PA3	DC adaptor and charger	**£15.35 inc.**
NC9C	Slow charger	**£8.80 inc.**
FNB2	Nicad Battery Pack	**£21.45 inc.**
FBA2	Battery pack sleeve	**£3.45 inc.**
FLC5	Heavy duty case	**£25.30 inc.**
MMB10	Mobile bracket	**£8.05 inc.**

FT726R MULTIMODE UHF, VHF, HF.

FT72R(2)	Transceiver c/w 2m	**£739.00 inc.**
21/24/28	HF module	**£200.00 inc.**
50/726	6m module	**£185.00 inc.**
430/726	70cms module	**£250 inc.**
SAT726	Full duplex module	**£95.00 inc.**
XF455MC	600Hz CW filter	**£39.85 inc.**

MULTIMODES FOR 6m, 2m and 70cm

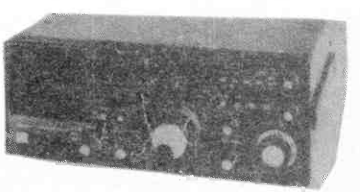
FT690R	Multimode Transeiver 6m	**£249.00 inc.**
FT290R	Multimode Transceiver 2m	**£269.00 inc.**
FT790R	Multimode Transceiver 70cm	**£249.00 inc.**
SMC2.2C	2.2Ah Nicads 'C' size	per set **£21.60 inc.**
SMC8C	220mA Charger (13A Style)	**£8.80 inc.**
MMB11	Mobile Mount	**£26.85 inc.**
CSC1A	Carrying case	**£4.20 inc.**
FL6010	6m 10W Amplifier	**£49.00 inc.**
FL2010	2m 10W Amplifier	**£63.25 inc.**

FM TRANSCEIVERS FOR MOBILE

FT230R

FT230R	2m Transceiver 25w	**£259.00 inc.**
FT730R	70cm Transceiver 10w	**£229.00 inc.**
FT720RVH	Transceiver 2m 25W	**£209.00 inc.**
FT720RU	Transceiver 70cms 10W	**£229.00 inc.**

COMMUNICATIONS RECEIVER FRG7700



FRG7700	Receiver 0.15-30 MHz AM/CW/SSB/FM	**£369.00 inc.**
FRG7700M	Receiver c/w 12 channel memory	**£435.00 inc.**
MEMG7700	Memory option	**£69.00 inc.**
FRT7700	Antenna tuner/switch	**£46.00 inc.**
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FF5	Low pass filter 500 KHz	**£10.75 inc.**

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SP980P	External L/S with phone patch	£74.85 inc.
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FIF65	Computer interface for Apple	£51.35 inc.
FIF232C	Computer interface	£54.80 inc.

FT77

FT77	8 Band Rx/Tx 100W output	£459.00 inc.
FT77S	8 Band Rx/Tx 100W output	£425.00 inc.
FP700	Matching AC PSU	£135.00 inc.
FC700	Matching antenna tuner	£98.90 inc.
FV700DM	Digital VFO unit	£200.00 inc.
MKT77	Marker unit	£10.35 inc.
FMUT77	? unit	£27.20 inc.

FT757GX THE 'NO OPTIONS' RADIO

FT757GX	All Modes and Filters Fitted	£685.00 inc.
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FP757HD	Heavy Duty PSU 100% Duty	£162.50 inc.
FC757AT	Automatic Antenna Tuner	£231.50 inc.

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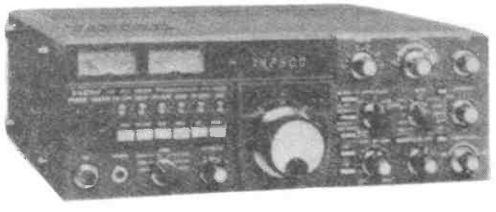
FT102 ALL MODE TRANSCEIVER



FT102	Transceiver 9 band	£685.00 inc.
SP102	External speaker	£52.50 inc.
FC102	Antenna coupler	£179.00 inc.
AMFMUT102	AM/FM unit option	£46.75 inc.

FT ONE 'THE ULTIMATE'

FT ONE	Transceiver HF All Mode	£1495.00 inc.
KEYT 901	Curtis Keyer	£28.75 inc.
DCT1	DC Power Cable	£10.35 inc.
RAMT1	Non volatile memory	£13.80 inc.
FMUT1	FM unit	£42.85 inc.

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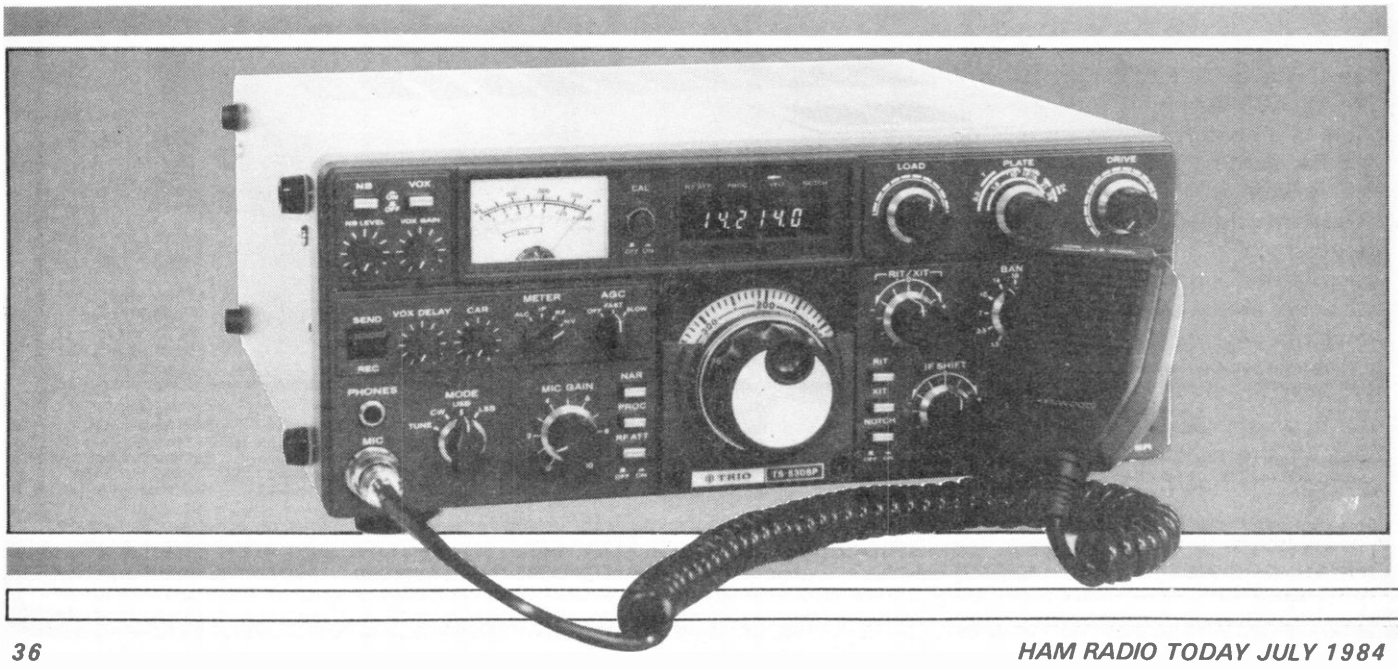
Trio TS530SP— a good rig for the Common Man

I have reviewed many transceivers in the last year, almost all of them having transistorised PA stages, and this new version of the Trio 530 is, therefore, unusual by today's standards as it incorporates both valves for the driver and PA output stages, the PA including two 6146B valves operating at around 900V HT. The transceiver covers all amateur bands from 1.8 to 29.5MHz in 500KHz chunks. There is only one intermediate frequency which is at 8.83MHz, whereas the TS830 has two IFs, thus enabling variable selectivity which is omitted from the 530. The significant difference between the 530SP and the 530S is that the former, the subject of this review, includes a 'turntable' notch filter.

The rig can only operate as it stands on AC, and is therefore only intended for home station use. The main tuning VFO rotates at a rate of 25kHz per revolution, and comes up against end stops, giving around 75kHz overlap at each end of the selectable bands, a band change switch allowing for the three new ones, and, on 10m, 28.5 to 29.0, and 29.5 to 30MHz being accommodated by pushing in a 500kHz 'up' button. The mode switch has just four positions; tune, CW, USB and LSB, AM and FM being omitted. Rotary controls on the front panel include mic gain, IF shift (centre indented), notch filter (with in/out button), AF and RF receiver gain (concentrically mounted), drive (requires peaking on Rx and Tx), plate tuning (with pointer to give approximate frequency position of control), output transmit loading, and a rotary for RIT/XIT. Miniature rotary controls adjust VOX delay, VOX gain, noise blanker level, and RF carrier Tx level. Push buttons select noise blanker on/off, VOX on/off, Tx MOX, 20 dB RF attenuator on Rx processor in/out and IF narrow/normal (optional filters available for narrow CW and SSB). 500Hz and 270Hz CW and 1.8kHz SSB filters are available to special order, with installation details given in the instruction book. Further push buttons select XIT, RIT and crystal marker at 25kHz intervals. This marker is much more convenient than that on the 830 — which is, somewhat unusually, engaged by turning the mic gain off. Two rotary switches are provided for metering (ALC, plate current, relative output

The Trio TS530SP offers the potent combination of modern RF semiconductor technology, without extraneous 'bells and whistles', with rugged valve PAs — and at a reasonable price. Eminently practical thought HRT, and so did Angus McKenzie, G3OSS, as this review reveals.

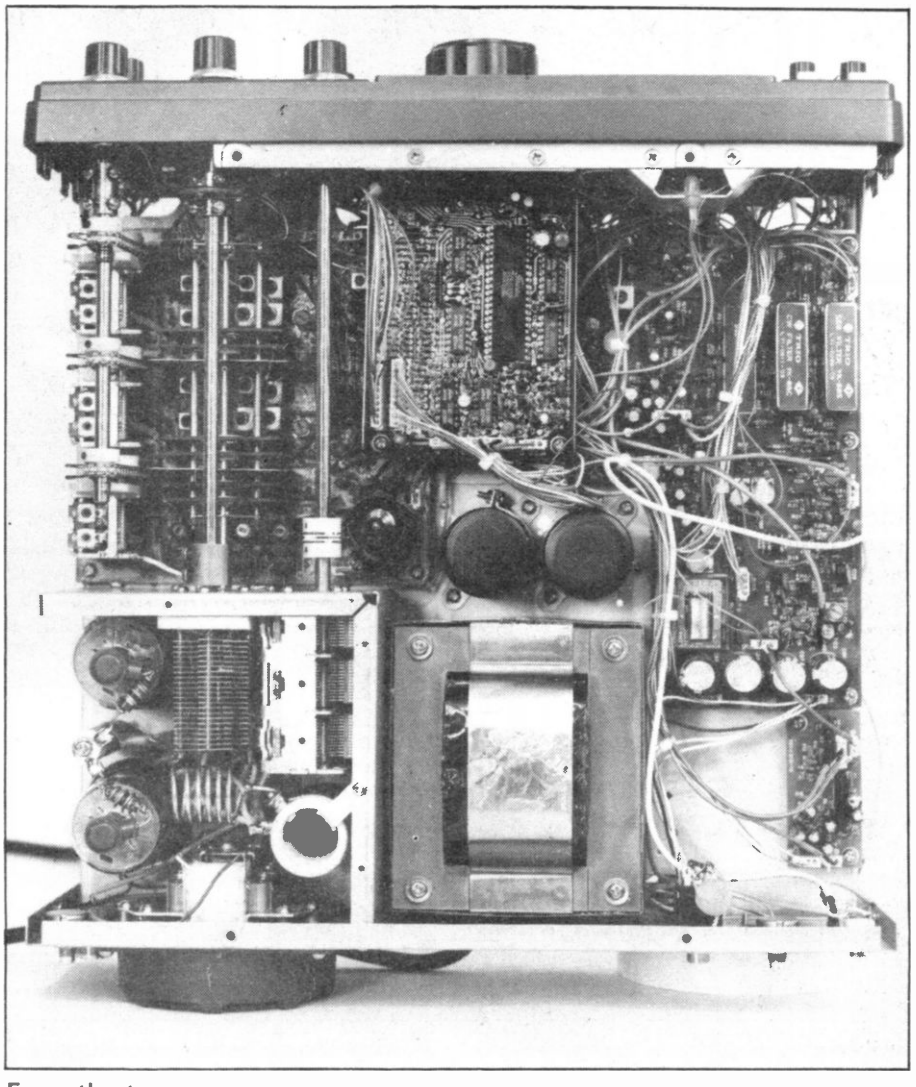


power and HT supply voltage) and AGC off/fast/slow.

Frequency is indicated by a flourescent type display reading in 100Hz increments which very easy to read with a blue on black colouring. The frequency display section also has lights for indicating notch filter, internal/external VFO, processor and RX attenuator in use. The meter is rather small, and therefore not easy to read at a glance. The front panel includes a ¼ inch jack for headphones and a four pin microphone socket to the usual Trio standard, (which is not compatible with Icom or Yaesu microphone connections). The mains on/off switch is complemented by a 'heaters off' switch for the PA and driver valve heaters. A de-luxe tuning knob is available as an accessory, with a finger hole in it for ease of use which is ball bearing mounted, the normal knob having at least an acceptable finger hole, which didn't cause too much friction and is somewhat larger than the usual tuning mechanism finger hole.

Designed For Operability?

On the back panel is a smooth and quiet fan for keeping the PA valves cool, which runs all the time. The antenna socket is an SO239, and underneath it is a shrouded DC biasing screw driver pre-set for adjusting the PA standing current. Another pre-set adjusts the relative output power reading. A large wing nut is available to secure a separate earth (although the captive mains lead is three core) and a fuse is fitted by its side. The mains voltage input can be set to either 220 or 240V AC. As with the TS830, there is a switch which can ground the PA screen grids, thus leaving the valves in a conducting mode between grid and cathode, if the heaters are on. As supplied, no transverter Tx drive output is fitted, but there are two pins on the driver valve board which will give a suitable output if required, and Lowe Electronics recommend that you fit an appropriate socket on the back of the rig for this, and interconnect the board and socket with coax. This would then allow TS530SP to give a few tens-of-milliwatts drive. Similar to that available from the TS830. There are several conveniently pre-drilled holes for fitting extra sockets on the back of the TS530SP.



From the top. . .

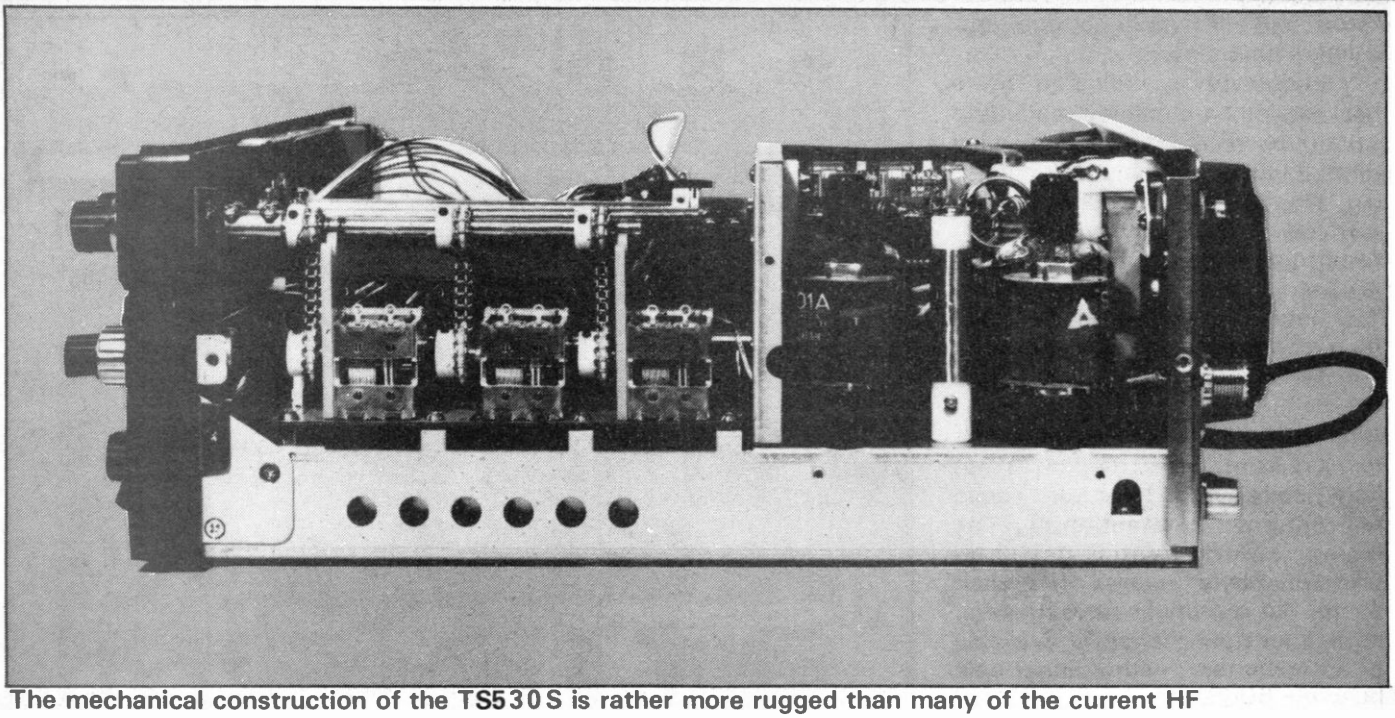
I am delighted to report that the drive available for feeding transverters is subject to ALC *when the screen grids are switched to earth* as the PA valves remain conductive. This is extremely useful as the majority of rigs omit ALC on the transverter drive — with sometimes dire results.

A normal ¼ inch CW key jack is provided, and by its side is an 'anti-vox' pre-set control. A 3.5mm jack can be used to feed an external speaker. Two multi-pin DIN sockets provide interfacing for an external VFO (various options are available), and a remote control socket incorporating pins for AF output into 8 ohms and interconnections for external relays (shorting across to a pin on either Tx or Rx), PTT, and ALC input. There is no provision for antenna Rx 'breakpoints' etc, as is available on the TS830S.

The rig is completely encased in metal and has a resonably good but fairly small speaker in the top casing which throws sound upwards. A carrying handle is fitted to the right side cheek whilst feet are provided both on the left side cheek and on the lower casing. The latter are quite large, and the front ones can have extensions on them to raise up the front half of the rig. The TS530SP is quite handsome and is finished in two-tone grey.

On The Air

I used this rig over two weekends and have found it very pleasant to use. On receive the TS530S appeared to be very sensitive indeed, even on 10m, whilst the front end intermodulation performance seemed quite good. I did not note any problems at LF provided I sensibly used the 20dB RF attenuator. Signals seemed to be



The mechanical construction of the TS530S is rather more rugged than many of the current HF transceivers on the market.

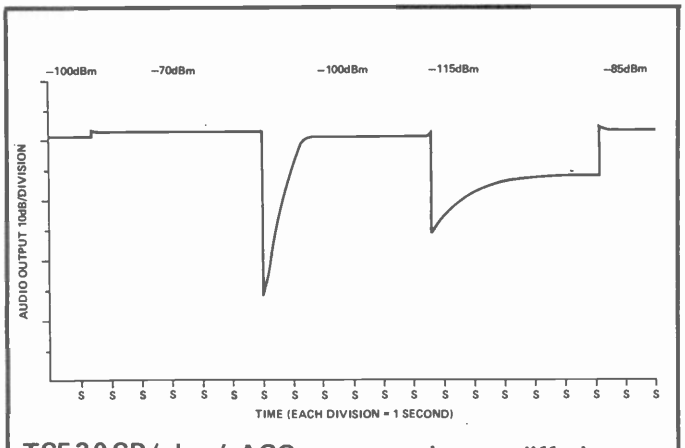
very clean, and the IF pass band quite reasonable for both SSB and CW. The notch filter worked particularly well and was, of course, useful in removing annoying carriers, particularly on 80m. I already own a TS830, and found the handling very similar indeed, PA tuning and loading being simple, whilst drive tuning always seemed to be right on Tx when I peaked the control up on Rx, where the control doubles as a preselector.

The AGC characteristics seemed reasonable, but perhaps long AGC was a little fast. Very strong signals did seem to interfere very slightly with extremely weak ones on 80m, showing that the filter was not rejecting too well waydown it's pass band. Audio quality is very good with plenty of volume available on the internal speaker. I liked the feel of the VFO, and it is rather pleasant to get away from a synthesised one for a change. This may well influence prospective purchasers since there are many folk who do not like synthesiser 'steps'. The noise blanker seemed reasonable, and the VOX circuits worked well. The IF shift control operated well and gave a good range of adjustment. The transmitted quality was considered "better than average", and the transmissions were very narrow. There are not too many bells and whistles' on the rig, and many operators will undoubtedly appreciate this; the rig is easy to master and straightforward in use. It is also very simple to interface the TS530SP with a linear, and it would obviously work admirably with the Trio 922 model for which the interfacing is particularly suitable. Finally, the rig was very free from received spurii.

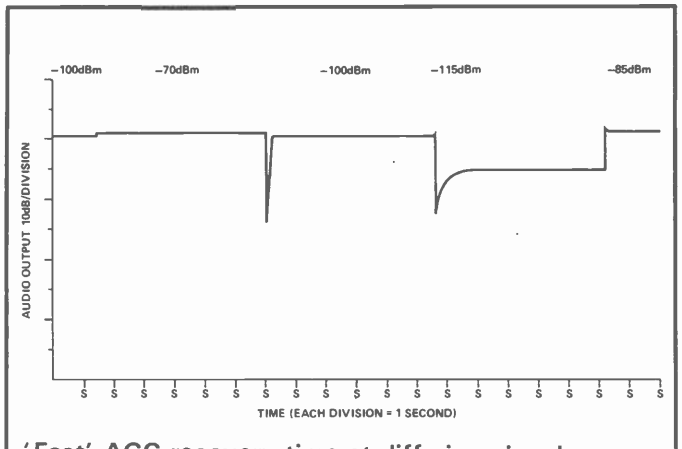
In the Lab

The input sensitivity was quite the best that I have checked out on any HF transceiver in the last year. The TS530SP will thus winkle out remarkable weak DX on 10m when the band is almost closed, showing the benefits to be gained from good sensitivity. It was phenomenally sensitive at LF, although this is really not necessary (see my article on receivers in April '84 HRT). All the measurements were taken after carefully peaking the preselector.

The mixer performance was



TS530SP 'slow' AGC recovery time at differing signal levels

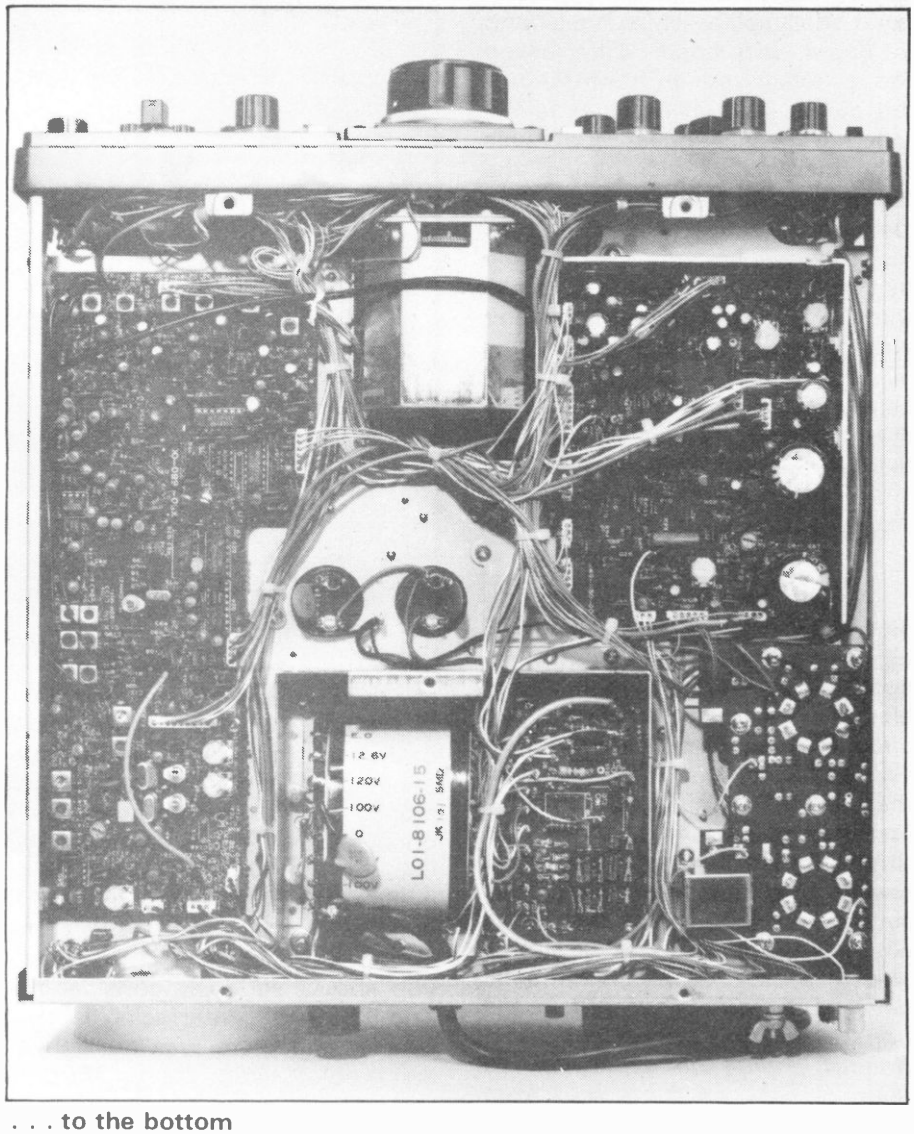


'Fast' AGC recovery time at differing signal levels

good, with the RF intercept point being quite acceptable although not in the very top league. To put matters into perspective, this parameter is far better than on most older transceivers, let alone many receivers. However, somewhat surprisingly, the reciprocal mixing performance, whilst not being poor, was nowhere near as good as it could have been, especially as it was not synthesised, and Trio need to increase the signal-to-noise ratio of their local oscillator feed to improve matters here. The IF selectivity on SSB was beautifully shaped down to −60dB but (the response) opened out badly below this level. The CW selectivity was not quite so sharp, but reasonably well optimised in practice, although again the filter response opened out badly below −60dB.

Useful 'S' Meter

The S meter produced a reasonable reading of S9 for 40uV, gave 34dB difference between S1 and S9 and gave useful and reasonably logarithmic readings up to full scale deflection. The product detector worked extremely well, giving surprisingly low distortion, which obviously contributed to the clean received audio. Output power was adequate into an external 8 ohm speaker, and appreciably more power was available into 4 ohms. The receiver frequency calibration was accurate to within 10Hz, which is superb. I was pleased to see that when you switched from upper to lower sideband, neither the indicated frequency nor the carrier reinsertion frequency changed, which is ideal in my opinion. The position of the filter on CW coincides with USB, and, when switching from LSB to USB and vice-versa, I was pleased to see that there was almost no change in the relative position of the pass band referred to the carrier, with the variable band pass IF shift in its centre 'indent' position. The AGC pen charts show 'fast' AGC to be very fast indeed, whilst 'slow' is slightly faster than average, but having a slower recovery on weaker signals. The notch filter measured extremely well, and far better than those on most of the competition. The notch was quite sharp, so the filter can be used within a speech pass band without affecting intelligibility too much. The RIT control had a range of approximately +/−2.6kHz which is a little limited for some special needs.



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Very Low Harmonics

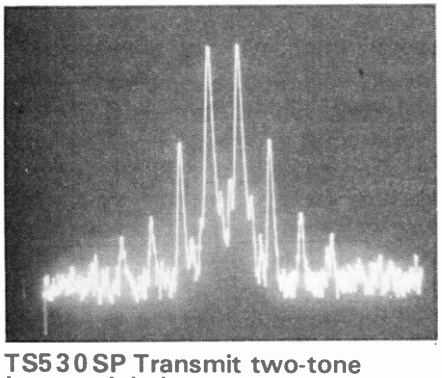
The transmitter gave between a maximum of 100 to 112W output on CW, whilst SSB PEPs were around 120W across the bands. We had a good look at the intermodulation products at both 100W and 25W PEP output resulting from two-tones in the audio pass band. You can see from the photographs that high order products fell back very rapidly, which obviously contributed to the good transmitted audio reports. They clearly vanished more quickly than I have usually noted on transistorised PA stages, and it is for this reason that many operators prefer valve PAs. The specification for transmitter harmonic rejection states that none should be higher than −40dB. The worst measurement was 5dB better than spec, and this was almost always the second harmonic (this was common across the spectrum of the bands). I don't think that anybody could possibly moan about the harmonic performance, 21MHz being particularly good. We checked the residual carrier and noise output referred to the peak sideband output level, and rejection was excellent. Alternative sideband rejection was amazingly good at −63dB. The transmit frequency accuracy on CW was within 20Hz which is stunningly good.

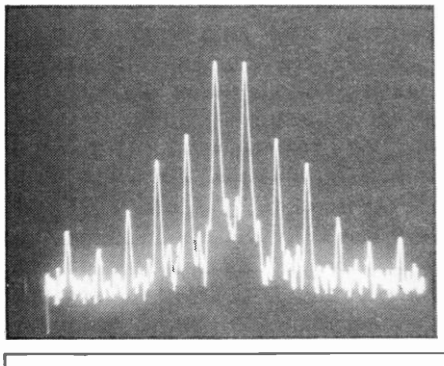
The transmitted frequency response, checked from the mic socket input to RF carrier out, was very flat from 400Hz to 2kHz and 3dB down at 2.3kHz, falling very steeply above 2.7kHz. I consider the response just about ideal for

good intelligibility whilst preserving a narrow pass band. We checked the receive response from the output of the product detector to the external speaker socket, and it was only marginally wider than the transmit pass band, and is thus ideal. In practice, therefore, the response will be controlled entirely by the IF filter. I was pleased to see that it was not tailored in any strange way, and in my opinion this helps readability a lot, for tailoring can severely effect intelligibility. I did not notice any VFO drift in practice after a brief warm-up period.

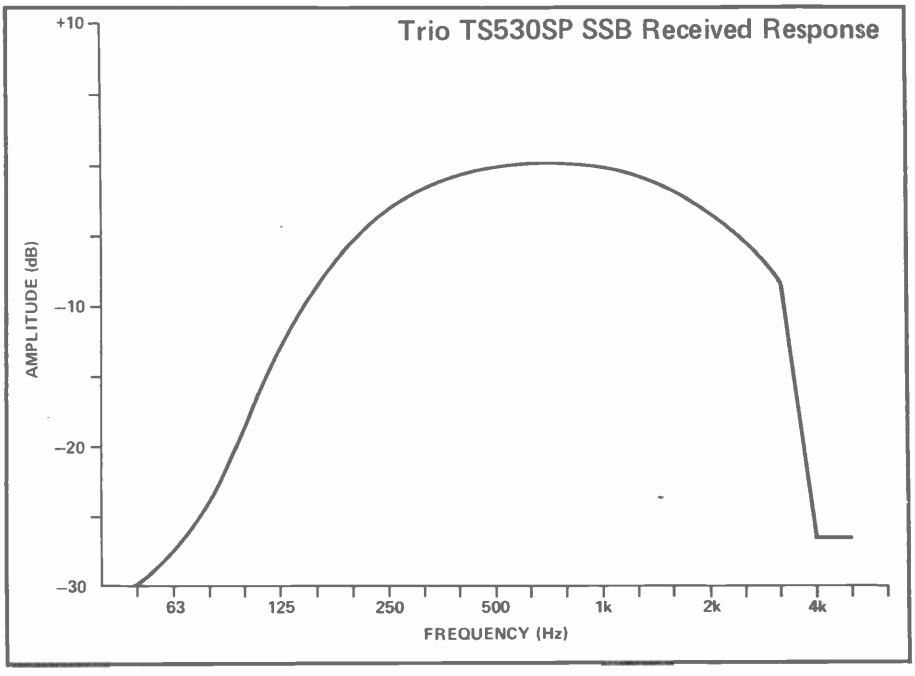
Conclusions

Before giving my overall opinion of this rig, I do want to have a big grumble about the instruction book which fails to contain any block diagram or explanation of the circuitry. I gain the impression that Trio seem to be talking down to their intending purchasers, and I feel they must improve on this attitude. I also feel that Trio should have provided a transverter drive socket, which is, in this case, after all, only a piece of coax and a phono socket. *Lowe Electronics have kindly offered to put in the transverter drive socket and cable free of charge on application to them for any products sold from the publication of this review.*



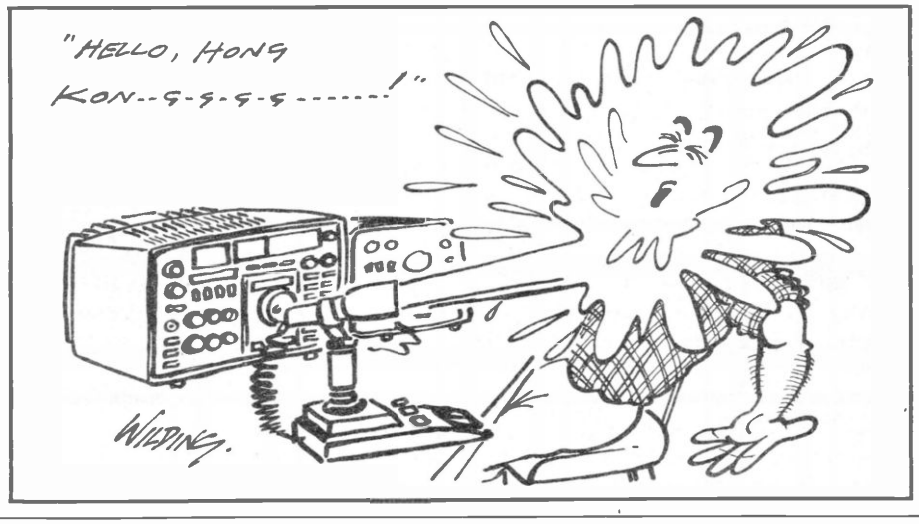


TS530SP Transmit two-tone intermodulation.
Upper pic. At 25W output.
Lower pic. At 100W output.



Noting that this design was 2 or 3 years old, I was pleasantly surprised that almost all the performance measurements were very good, some being superb. We couldn't find *any* parameter that could really be regarded as poor. If you want a basic rig that has a few extra frills which all work well, then you should seriously consider the Trio TS530SP. Interfacing is very simple, and there was no sign of any problems with the rig. My only real criticism performance wise is the reciprocal mixing performance, but again there are many more expensive rigs that are worse in this respect. Do not think that because the TS530SP has been on the market for quite a time that it is "old hat", for I am much happier with a rig that has proven RF performance rather than some 'whizbang' modern ones that are all too often cluttered up with 'bells and whistles'. I must admit to preferring the TS530SP to the TS430S, but this is a very personal opinion. It is as a result of considerable demand from radio amateurs that Trio have retained this model in their catalogue, and I hope it will remain available for quite a time. Do not rule out this rig just because it has valves in it, for I consider this a good rather than a bad point. Ergonomically it is very well designed, and is a worthy little sister for the TS830 and 930 models.

I would like to thank Lowe Electronics for the loan of this rig, and my colleague Mike Hatch, G1DEW, for spending many happy hours peering at all the meters and oscilloscope screens. Highly recommended then as a sensibly designed rig, particularly useful for driving VHF transverters because of its sensible ALC provisions.



TRIO TS530SP LABORATORY MEASUREMENTS

Receiver Measurements

Sensitivity for 12dB Sinad, SSB (1kHz beat note)

28.4 MHz	−124dBm (0.14uV)
21.3 MHz	−124.5dBm (0.13uV)
14.3 MHz	−125dBm (0.12uV)
7.05 MHz	−125dBm (0.12uV)
3.7 MHz	−124dBm (0.14uV)
1.9 MHz	−125dBm (0.13uV)

Measured RF attenuator value (at 14.2MHz) 20dB

Selectivities

	SSB	CW (Narrow)
3dB Bandwidth	2.4kHz	0.4kHz
6dB Bandwidth	2.5kHz	0.6kHz
40dB Bandwidth	3.4kHz	1.1kHz
60dB Bandwidth	4.2kHz	1.3kHz
80dB Bandwidth	22.1kHz	8.8kHz

Reciprocal Mixing Performance
RF Levels required off channel to degrade Sinad by 3dB (ref. noise floor)

20kHz spacing	86.5dB
50kHz spacing	91.5dB
100kHz spacing	94.5dB
200kHz spacing	107.5dB

RFIM Performance, **SSB**

Carriers spaced at 100/200 kHz off channel for 12dB Sinad product.

	RF Level (ref. 12dB Sinad	Calculated RF intercept pt.
28.4MHz	81 dB	−2 dB
7.1 MHz	85 dB	+2 dBm
1.9 MHz	86 dB	+4 dBm

S Meter: RF Levels required to give the following readings

S1	−109.5dBm (0.75uV)
S3	−107dBm (1.0uV)
S5	−102dBm (1.8uV)
S7	−91dBm (6.4uV)
S9	−75dBm (40uV)
S9+20dB	−51dBm (0.65mV)
S9+40dB	−30dBm (7mV)
S9+60dB	Not Calibrated

SSB Received Frequency Accuracy
+/− 10Hz

Product Detector Distortion 0.7%

Audio distortion at 125mV output (8ohms)
0.7%

Maximum audio output level for 10% THD into 8 ohms
2.1Watts

Maximum audio output level for 10% THD into 4 ohms
3.3Watts

T Notch Depth (average)
Ratio between two tones notched in turn 37 dB

Transmitter Measurements

RF output Power, CW (after careful tuning)

28.4 MHz	100W
24.9 MHz	108W
21.3 MHz	100W
18.1 MHz	105W
14.3 MHz	107W
10.1 MHz	102W
7.05 MHz	105W
3.7 MHz	112.5W
1.9 MHz	105W

RF output power, **SSB PEP** approx. 120W on all bands.

Transmitted Frequency Accuracy, CW (28.4 MHz) +20Hz

Harmonic output (at full power ref. fundamental)

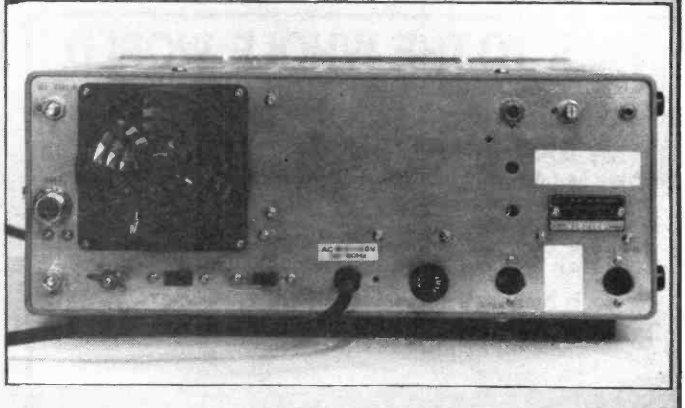
	2nd	3rd
28.4 MHz	−48dB	−60dB
21.3 MHz	< −60dB	−60dB
14.3 MHz	< −55dB	−65dB
10.1 MHz	< −52dB	−63dB
7.05 MHz	−46dB	−65dB
3.7 MHz	< −46dB	−67dB
1.9 MHz	< −45dB	−67dB

SSB Residual Carrier and Noise −57dB

Unwanted Sideband Suppression, USB −63dB

Two Tone Transmitted Intermodulation Products. (See photographs)

	Full Power	1/4 Power
3rd Order	−25.5dB	−31dB
5th order	−34dB	−54.5dB
7th order	−52dB	−62dB
9th order	−73dB	−70dB
11th order	−67dB	In noise



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An investigation by Tony Bailey, G3WPO

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Interested in DXing on 2m? Then build yourself this innovative design, by John Matthews, G3WZT

Addendum

Practicalities, May '84
The capacitors in Fig. 3 are 10p not 10n.

Active Aerial, June '84
The capacitor in series with the antenna is mica. All the other capacitors could be polystyrene except the 10n and 100n, which are ceramic.

Plain Man's Guide To 6m Reception, June '84
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Plain Man's Guide To 6m Reception, June '84
This was missed off the contents page by mistake.

This is PY1ZFX mobile...

Roger Crofts, G3UPK (ex ZD8AY, ST2AY and VK6YA to name a few), and Mary Carpenter set out on a journey that was to take them the length and breadth of South America. This is their story, seen through Mary's eyes.

When I first heard about G3UPK's Trans South American journey I was immediately interested in getting him to write an Amateur Radio flavoured travelogue for HRT. He had taken an Atlas 215X HF transceiver with him and reports had filtered back to me of Roger working UK stations with a ¼ wave 'whip' antenna made of wire supported by a piece of the Brazilian jungle (*you mean a 'twig' — Ed. CB*).

I wrote to Roger's home address only to find that he was out of the country on business, in Cameroon, Africa. His father kindly wrote back to me and said he would pass the letter on to Roger who would be in Africa for some months yet. However, shortly after this, I received a letter from Mary Carpenter, Roger's girlfriend, who had shared the journey with him. Roger's father had told her about my request. She had kept a careful diary of the journey — would I like her to write the journey up for HRT? Looking at Mary's prose style, I decided to tell her to go ahead.

This is the result. It perhaps isn't what readers usually find in HRT inasmuch that Mary is a radio spectator rather than an operator and the emphasis in this article is on the travel rather than the radio. That being said, I hope you all enjoy reading this as much as I did. **G3ZZD**

On a cold December day in 1981, we dropped off Myrtle, our 1974 LWB land Rover, at Harwich Port which was partially covered with snow and ice after recent snowfalls. That was the last we were to see of her until Montevideo, Uruguay on 1st February 1982, the beginning of an adventure during which this plucky little 4 cylinder diesel van would take us over a dozen passes in the Andes and Rockies, 5 of which were at 15,000ft, and over thousands of miles of unsealed roads. One set of tyres was to succumb to the sharp gravel roads of Patagonia and another to the attack of Mexican prickly pear thorns. (*I don't have this problem mobile on the M1 — Ad Manager G4NXV*).

After delays and hold-ups with the shipping company, we were told finally when the ship would arrive and flew out to meet it, changing planes at Paris, the last we would see of wonderful Europe for 16 months. There was alarm when only my bag arrived as Roger's bag contained his camera, binoculars and the ham radio gear among the important items! The lady at the airline office was very helpful, a trait we found almost everywhere in Uruguay, and a few days later the bag reappeared minus its handles but with all its contents intact. Not unexpectedly the ship bringing our car had been further delayed in the meantime.

So we had to stay for 10 days in a pension, run by a kindly middle-aged couple who spoke no English (the case we found through most of Latin America) — and our Spanish was very poor at that stage, too — though we enjoyed our stay there. It was an old place, cheap enough, the best part being the hot water shower! I need not elaborate on the plumbing which we found the same in most places in Latin America. When the toilet blocks there is no water, no-one seems very concerned about it! This 'manana' attitude was difficult to accept at first, but obvious right through to Mexico.

Myrtle with 'twig' antenna

Myrtle Arrives

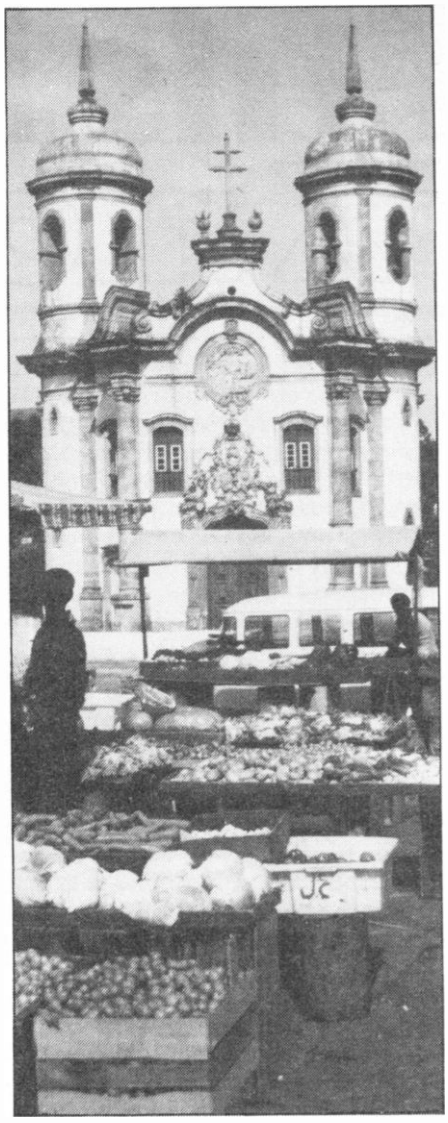
The ship with Myrtle aboard finally arrived but, as our home-on-wheels was being unloaded by crane, we could already see that the thieves had got to her. Myrtle's side window had been force. The thieves were probably disturbed in the act, as our sleeping bags and various items were scattered about on the floor and we had lost only a few unimportant things. The jemmy marks are still a reminder of the determined but ultimately unsuccessful attempt to get into the main cupboard. With formalities completed, we waved goodbye to our friends and headed east to Punta del Este and Fortaleza de Santa Teresa, only to be pulled up by three traffic cops for overtaking in a forbidden zone. After much persuasion, telling them it was our first day on South America roads, and with the Customs sticker still glued to the front window, they let us off with a reprimand, saluting us courteously before bidding us "Buen Viaje" (Good journey).

Unfortunately this good police attitude was not to be found in many other parts of South America.

Uruguay was our first South American country and the best one by our experience. We then spoke very little Spanish and I shall never forget the kindness of most of the Uruguayans we met. We crossed to Argentina over the huge Uruguay River at Fray Bentos (*Corned Beef Country! — Ed*) on 8th February, passing through mosquito ridden swamp country, south to Buenos Aires, where we spent five days with an Argentine friend. He and his lovely wife extended us wonderful hospitality and delighted in showing us places of interest by day and night, taking in restaurants with one inch thick steaks, a tango show with wonderful dancing and music, and theatre shows which appeared to be censured by the military Government. The people of Buenos Aires are proud of their cosmopolitan city, which boasts as many theatres as London or New York and more taxis than either of them. People eat very late and the restaurants are packed after midnight. If you think parking in UK is bad, you should try Buenos Aires. Parked cars are literally bumper-to-bumper in every street and it is always necessary to shunt several of them to make a little room to get in or out. Driving a Land Rover has distinct advantages!

Southern Travelogue

After Buenos Aires we headed south across the pampas, visited a sea-lion colony on the Valdes Peninsular, the petrified forest near Sarmiento, and enjoyed a real Welsh tea in a quaint tea-house in Gaiman, a town in the old Welsh colony where the people still speak Welsh. We arrived in Ushuaia, the most southerly town in the world, on 25th February at the height of their summer, although it had snowed the previous day. In Tierra del Fuego we battled through the strongest winds we have ever encountered as Patagonia is known for its winds and, no matter in what direction we headed, they always seemed to be against us! We then made a very worthwhile detour to the magnificent Perito Moreno glacier and on into the beautiful lakes district. The Puyehue Pass into Chile was another amazing experience, the vegetation being extremely beautiful, especially the



Oro Preto, Brazil

fuschia flowers which grew in wild profusion. From Osorno, passing snow-capped volcanoes, north to Santiago to cross the Andes again at Las Cuevas on 16th March, (already snow on the ground!) down to Mendoza (a popular wine area of Argentina) and back to Buenos Aires. It was a very quick departure north on 1st April, heading for the Iguacu Falls and the next day we heard on the BBC of the invasion of the Falklands. There was dancing in the streets and the blue and white Argentine colours flying from every car and house. We were lucky to get through numerous military checks and safely onto a the ferry across the Iguacu River to Brazil on 5th April.

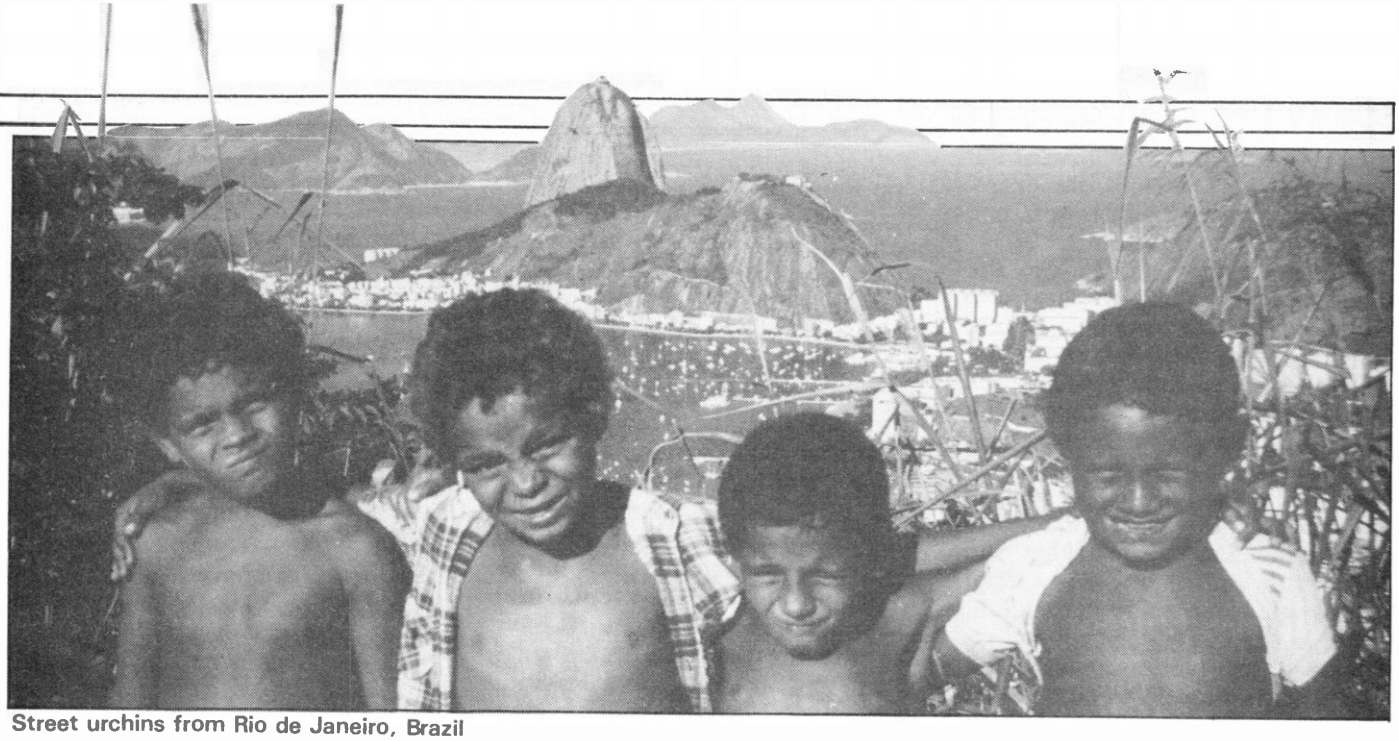
On-Air In Brazil

We then spent three months in Brazil, keeping a low profile until the war ended and, just off the Belem-Brazilia highway, we toasted the victory with champagne (on ice since Rio, two months earlier). Twice we visited Rolf, PY1RO, a very keen and well known 160m operator, and his charming wife, Rosangella. She spoke little English and we no Portuguese but we enjoyed marvellous hospitality with churrascarrias (Brazilian barbecues) and trips to beautiful beaches, some of which we camped peacefully by for days while sunbathing and catching up on odd tasks which never seem to get done whilst on the move. While in Brazil, we had a great reception from Europe on 14MHz. From the beginning of May, Roger made contact with Eddie, G4KHG, and Frank, G4HBI, almost every night, up till we reached Florida at the end of September, 1982. After this reception deteriorated, Europe cut out by the seemingly thousands of North American stations on-the-air.

Viva Gran Bretannia

We missed Frank and Eddie very much for the remainder of the trip. They were such fun to speak with and we had some hilarious and tense moments when some irate Argentinian stations would come on-the-air, abusing the Falkland Islanders, British and anyone else who supported them. But, from the point when we crossed to Paraguay over the Parana River, most of the people we met in Bolivia, Peru and Ecuador applauded 'Gran Bretannia'. There seems little love lost between the South American nations. Another example of this occured while we were watching the World Cup, Brazil v Italy match on

Mt. Salcantaz, Peru



Street urchins from Rio de Janeiro, Brazil

an open air TV in Ascunsion. We were surprised when everytime the Italians scored, the Paraguayans went wild with joy. Meantime, in Brazil, the hospitals were being overwhelmed with cardiac patient

We had Myrtle's engine serviced because Paraguay is the only South American country where anyone has heard of Land Rover. There was 19,000 miles on the clock since Montevideo. On the next stage of our journey we were held up, first, by unseasonal rain, which washed out the road for several days, and then by soldiers demanding gifts. After spending a night under military guard, we were ordered to take two officers and a soldier's wife to the border outpost, a day's drive down the track. There was much handshaking and backslapping with their military friends at each checkpoint plus a quick stop for lunch along the otherwise deserted track, which reminded me of the Austalian Outback. This land was the scene of a bitter and bloody war, fought against Bolivians earlier this century in the mistaken belief that oil lay beneath the infertile surface.

By late afternoon we reached the border outpost and our passengers left us without a backward glance or "gracias", except for the wife, a young, part Guarani, Indian girl, with a gap in her front teeth as so many of the Indian people seem to have. She politely offered us a delicious grapefruit, and her husband, who was there to meet her, thanked us for bringing her safely home. This extremity of character, the aggressive arrogance of the rich and those in power set against the gentleness and humbleness of the lower classes, made itself felt through all Latin America, especially in Andean countries. About this time, Roger realized he was not fully equipped for the cold of the approaching high Andes. The air waves hummed with urgent messages and the knitting needles of G4HBI's Mum were set into mation. In next-to-no-time, a pair of extra thick, high-altitude type, woolly socks were winging their way to Bolivia!

Cassette And Run

At the next checkpoint we reached, the officer who lived in the adobe hut was after music (so he said). He spotted our cassette player and there followed a detailed search. The HF transceiver was of no interest but his eyes lit up when he opened our box of cassette tapes. We begrudgingly parted with "The Carpenters Greatest Hits". "That's her name", said the officer, pointing at me. "We have a cassette player but no tapes", he explained — which made us wonder if that, too, had also been procurred from some unsuspecting travellers like us. They insisted on hearing the tape played and the officer tapped his finger and the soldiers danced completely out-of-step to the music, but none-theless, they pronounced it good and gave us back our passports. The pleased officer even drew a small map to the next town, Boyuibe, as from then on the country was very isolated. In the 1½ days it took us to get to Boyuibe, we passed only a few ranchos and three vehicles — and no signposts!

Stopping for the night, we camped just off the track, hidden in the thickening vegetation, and heard on the BBC World Service that a coup had taken place that day in La Paz, the capital. Later, we heard the droning of engines and saw headlights approaching. We switched off the inside light and, peering through Myrtle's little roof window, we saw a convoy of army trucks, packed with heavily armed soldiers, grind past. They were going because of the coup we thought. But it was such a long way across the mountains to Sucre, let alone La Paz. Where could they be going way out here at this time of night? . . .

Next morning from our camp, we could see the beginning of the majestic Andes once more. The last time we had seen then was from Argentina. The weather was gorgeous. Being still in the lowlands, it was fine with clear blue skies and the night had been warm and balmy, such a contrast to the humidity and rain of much of Brazil. At Boyuibe town we were escorted to meet the (local) Colonel, who invited us for lunch consisting of delicious vegetable soup followed by salad. The other officers present were courteous and the Colonel was proud to show off his English, dismissing our attempts to speak Spanish. The Colonel had hoped that he might change 1,000 dollars of our money for us but accepted the 100 dollars that we wanted to change willingly enough. It turned out that everything in Bolivia was so cheap

that 100 dollars was plenty for our two week stay. Diesel, for example, was only 12p per gal. and petrol not much more.

After Boyuibe it was into the mountains, climbing higher and higher up to the Altiplano, never leaving them until Nazca on the coastal plain of Peru (OA). It took four days to reach Sucre, one of the best kept old Spanish towns in South America. We had to wait here six days to pick up our mail as the Post Office was on strike. The restaurants were so excellent and cheap that we ate out every night but always returned to our secluded camp site in a eucalyptus forest, on one of the hilltops overlooking the town. Our only visitor there was Alfredo, a little Indian shepherd boy, who stayed for lunch, consisting of sandwiches, tea, and cracker biscuits with marmite. The marmite was, of course, new to him and he loved it. Later he went home and we were surprised when he returned half an hour later carrying an armful of maize for us and insisted on putting some of it on the gas to boil, which seemed to take ages, as it was very hard, the only variety able to grow at 10,000 ft.

Potent Cheap Music

We enjoyed a concert at the local theatre of the delightful music of the Andes, produced, in part, by that exquisite instrument, the pan pipes, the haunting sounds of which conveyed to me all the heaviness, sadness and suffering of the life of the South American Indian. Cost of the two hour concert? — around 5p each.

From Sucre it took two days to reach Cochabamba, in a warm and dusty valley that produces an abundance of fruit and vegetables. That was the last of the warm weather, for the next day we climbed the two miles to the barren windswept Altiplano. We spend the first evening in a blizzard, parked near a lake by the deserted roadside, deep in our sleeping bags, gloves and caps to combat the bitter cold. The next morning there was a covering of snow and the lake had frozen over. Just down the road a truck full of Indians had broken down. None of them were wearing gloves, and they had only sandals on their feet — the hardiness of these people never ceased to amaze me. In the cold and rarified atmosphere, starting the engine was a real problem even with aerosol ether. The solution was to park Myrtle facing east and lift the bonnet before taking breakfast. The early morning sun luckily did the rest.

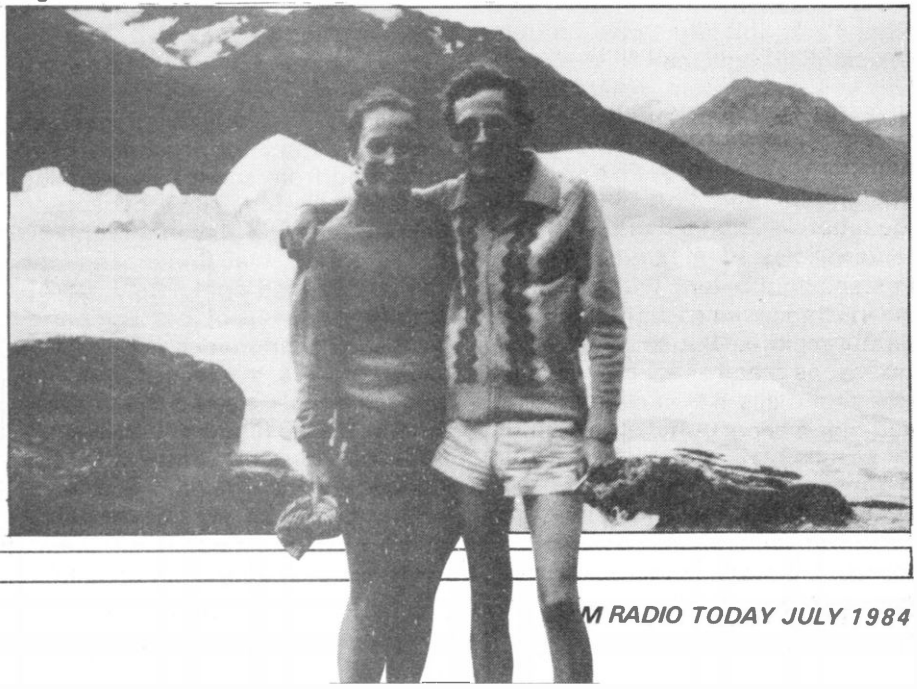
We had virtually no trouble with the military in Peru but found the civilians the opposite of the Bolivians. We remembered that the Colonel and his officers had told us that the Peruvians were "mucho loco". The were right! We only once had occasion to use public transport (thank heavens), from Ollantaitambo to Machu Picchu, the famous Inca ruins, by train, which arrived five hours late and packed. After arguing with, and being thrown off the train by the conductors in the first and second class carriages (we had first class tickets!), we eventually jumped on to the outside of the train and hung on, as the train slowly chugged out of the station, leaving many people behind, including three English back-packers, who vehemently cursed Peru Rail! I was also suffering from altitude sickness and fainted up at the ruins, while waiting for the fast bus to take us back down the thirteen hair-pin bends *(I'll stick to the M1 — G4NXV)* to the station below. After two failed attempts to revive me with smelling salts, I recovered in the little clinic after oxygen was administered by a kind nurse. The train back was four hours late and total chaos, as about 200 tourists and Peruvians fought their way onto an already packed three carriages.

Goodbye To South America

After the month in Peru, we crossed into Ecuador at the noisy, filthy, border town of Huaquillas. There are, invariably, at least three policemen at every road junction in Ecuador. One signals you to stop, whilst another frantically waves you on. A third makes such ambiguous signals that you don't have a clue what he means. Whatever you do, you are bound to be wrong. It's good idea to take several driving licences as these are frequently torn up into little pieces and scattered all over the road. The Ecuadorians have built a monument to mark the exact and precise line of the equator, just north of Quito. We visited the monument and also the equator itself — which is located a little bit further on! From Ecuador we shipped Myrtle to Miami whilst flying ourselves but, at the time of writing, we still have not reached our goal of Alaska. This we hope to do in July 84, but that is another story.

Roger and Mary are presently finishing their Trans American journey. This time Roger has equipped Myrtle with a 1KW amplifier for the Atlas 215X. Look out for him on the American County Hunter's net on 14.336MHz from 1400 UTC onwards. A further instalment should be appearing in a future HRT. . .

On the shores of the iceberg filled waters of Lago Argentino, Patagonia, Argentina



A Plain Man's Guide to 6m Reception

2m and 70cm seem a little familiar these days? You could try exploring 6m or 4m with this intrepid little converter from VHF guide Jack Hum, G5UM. Simple step-by-step construction without even denting the bank balance.

This article is the sequel to my article in last months issue which introduced the reader to "Fifty", meaning 50MHz, meaning Six Metres. It will take this expedition a few stages further, but, most important, it will introduce the simplest-ever converter for construction by those wishing to essay "Six" for the first time.

Before getting that far, though a comment on a query which a number of people have made. It is this: "Am I allowed to listen on the 6 metre band?". The answer is simple: "Of course you are". Anyone is allowed to listen anywhere they like within the amateur radio spectrum. If this were not so, how would, say, the budding Class B aspirant to the so-called HF bands ever acquire any knowledge about them if he never listened on them? (You could say that if he did listen on them he might be dissuaded from wishing to use them, but that's another story).

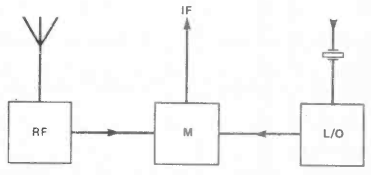
It should be emphasised, then, that even though you may not be licensed to transmit on 6 metres (or, for that matter, 4 metres) there is nothing to stop you from listening there. You may report back what you hear on those bands, but you must do so on a band for which you are licensed. Never embark on a crossband contact with a station using a band which you are not permitted to use. Put another way, this means that if a local friend asks you, as a Class B licence holder, to give him a report on his emissions on 4 metres or 6 metres, tell him that you will be glad to oblige, but emphasise that you must meet him back on 2 metres or 70 centimeters — to enable him to take his report direct from you on a band you are entitled to use.

So much by way of foreword.

On now to the world's simplest converter for use on "Six". It is called the *Extrapolator*, a name which perhaps requires a modicum of explanation.

Look in the dictionary for the definition of "extrapolate" (accent on the second syllable) and you will find it to mean: "Calculate from known terms a series of other terms which lie outside the range of the known terms". This exactly fits the concept of the intended converter for 6 metres. It is a venture into the (comparatively) unknown, and it lies outside the range of our "known terms".

Fig. 1: The basic concept of the "Extrapolator" converter described here is shown in block form, crystal oscillator at right, RF stage at left, each of them feeding its output to the mixer stage, centre, to give output at 5 MHz.



Wearing his VHF field day headgear, Author G5UM contemplates his first mock-up prototype of the "Extrapolator" 70/50MHz converter described here.

These "known terms" are represented by any existing converter design for the 4 metre band, and their number is considerable. We could take a known 70MHz three-transistor converter and by altering its inductor and crystal values, change it into a 50MHz converter. You extrapolate from the known (70MHz) into the unknown (50MHz).

Something else we need in addition to our extrapolation device is to provide ourselves with a reasonably adequate aerial system for "Six", a requirement which was dealt with here last time. Often one is told by newcomers to the 433MHz band that they are pressing into service their 145MHz antennas rather than instal something that will do justice to 433MHz — and then, wondering why their results on 433MHz appear to be so dismal, they abandon the band without having given it a real chance.

The same thinking applies to "Six". Maybe the sizeable beams, big as a Band 1 television aerial, which would do justice to the band are beyond your pocket — and your backyard space: but at least instal something that is resonant at 50MHz rather than attempt to make do with something which isn't.

What IF To Use?

Back to the converter, then. Remembering that its output is to be presented to the station receiver used as a tunable IF, the constructor must decide at the outset what value of intermediate frequency he wishes to employ. The options were set forth here last time. Although the "Extrapolator" uses 5MHz as its IF, there is no reason at all why readers should not choose a different one if this should suit their circumstances. One elegant professionally designed 6 metre converter provides an IF in the amateur 2 metre band by mixing the incoming 50MHz signal with a local oscillator frequency of 95MHz, and by this additive process up-converts to 145MHz.

The "Extrapolator" by contrast presents the incoming 50MHz signal with a local oscillator value of 45MHz and by a subtractive process down-converts to 5MHz. It could have presented the incoming signal with a local oscillator at 22MHz: the IF would then have been the 28 to 30MHz band. Some readers may prefer this IF to the 5MHz in the present design.

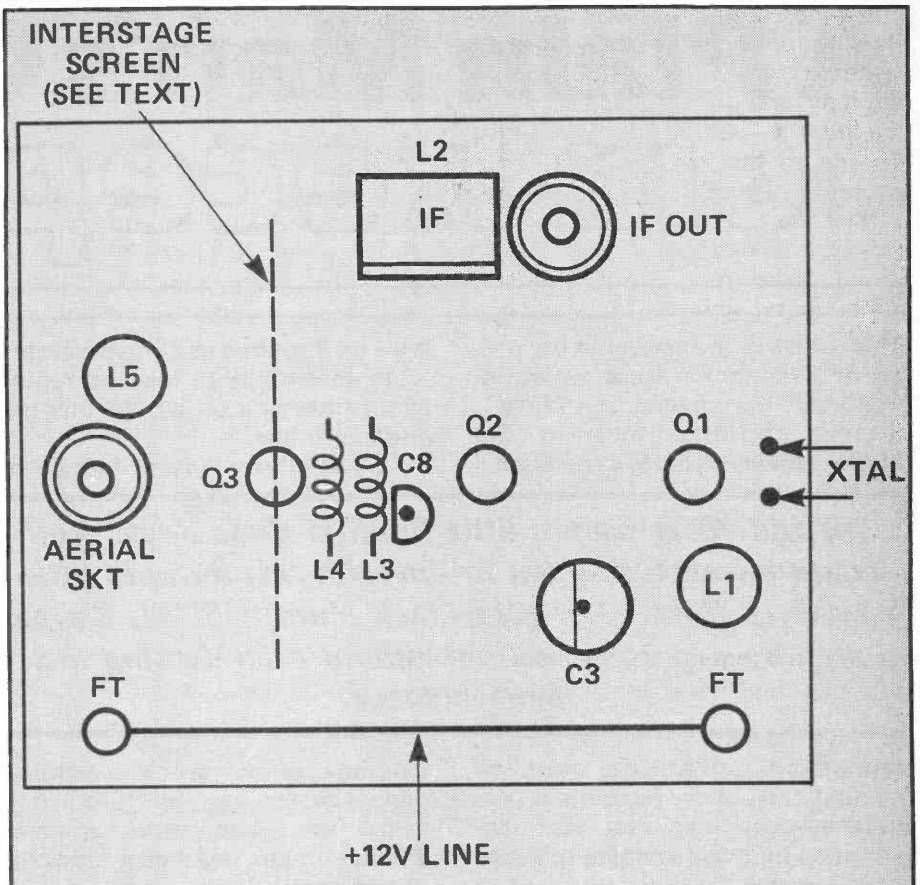


Fig 2: Circuit layout of the "Extrapolator" converter constructed on a 4½ by 3½ inch rectangle of printed circuit board intended to fit into the top of an Eddystone die-cast box. The first components to be mounted should be the two feedthrough capacitors, one at each end of the assembly as indicated at "FT". The 12V+ lead is to be connected to one of them above chassis. Below chassis the two feedthroughs are interconnected with a length of bare wire, well scraped and cleaned for good contact. This is the busbar to which go the various feed resistors from oscillator, mixer and RF stages.

As will be seen, to select one's IF is to select one's required crystal value, 45MHz in the present instance. Contact with Bruce Norclife at P.M. Crystals (whom G5UM has used for many years) established that 45MHz crystals were stock items. Within days one appeared in the morning's mail, complete with tiny plastic socket using 10mm pin spacing and centre-fixing lug for printed circuit board mounting.

Next item on the construction agenda was: What oscillator circuit to use? The number of options is legion. The sure-fire one shown in **Fig 3** was adopted for the present project. And what transistor to use with it? The writer has a penchant for that workhorse the BF180, and a visit to the emporium of Frank Elliott (Elliot Electronics) not far from the home base produced a fistful (you will have seen his regular advertisement in the 'Emporium Guide' in HRT).

Many would-be constructors will wish to use what they have to hand in their spares boxes such as the old-time but ubiquitous 2N708, ZT81 and the like, which though elderly should loaf along at the comparatively DC frequency of 50MHz. "Using what I've got" is one of the rewarding features of any home construction project.

Layout Considerations

Before construction can commence, the following question asserts itself: What form of mechanical design layout should be

employed? If you are into PCBs and the photographic-and-etching processes of the contemporary scene, you may well prefer to use them. If you are not — and this article is addressed to the thousands of HRT readers likely to be in that category — then the following simple layout is recommended:

Purchase from one of the HRT components advertisers an Eddystone (or similar) aluminium die-cast box measuring 120 by 95 by 50mm deep. You will not need the lid for the "Extrapolator" converter, but keep it lest it should come in useful for some future project. The space occupied by the metal lid is to be filled by a rectangle of single-sided PCB cut to fit the top of the die-cast box. If you already have some PCB you can mark off the required dimensions in pencil and then carefully hacksaw it to fit the box. If you don't, then ask your supplier if he can do the job for you when you buy the box.

Radius the corners of your newly acquired piece of 'raw' PCB to fit the radiused angles of the die-cast box. Drill 4BA holes in each corner — to secure the PCB to the box when the converter to be built upon it is completed.

Single sided PCB is to be used, as I have said previously. This allows components to be mounted on to the insulated side of the PCB (to face downwards). The copper clad side is to face upwards. Small holes are to be drilled in it through which will pass the wire ends of those components (beneath the PCB lid) which need to be grounded. In addition to these earthing points, the only items visible on the top face of the PCB will be the coaxial socket for aerial input, another coaxial socket for IF output, the IF transformer, and a couple of feed-through capacitors. From one of these will extend the +ve DC supply lead, a length of red wire. The −ve DC supply lead, a length of black wire, is to be soldered firmly to the edge of the copper laminate on the top face of the PCB. At extreme right of the PCB top the tiny crystal socket is mounted. (see Fig. 2 which shows the PCB from the 'lower' component side). Beneath the PCB the two feed-throughs will be interconnected with a length of stout bare wire. To this 'HT rail' will be soldered those resistors which require a 12 volt positive supply.

Take One Oscillator. . .

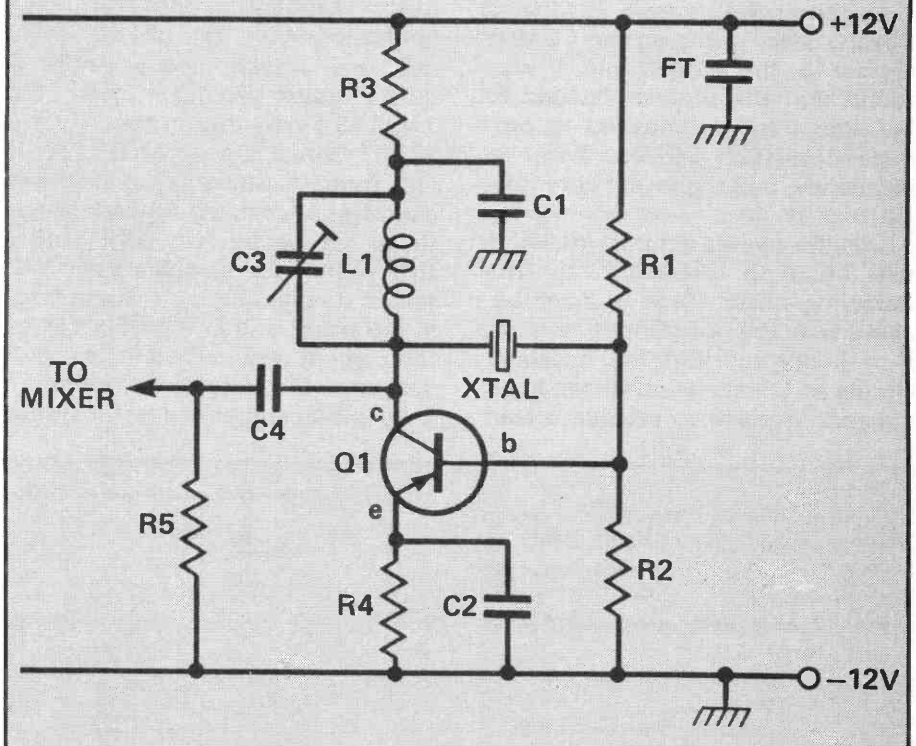
Down the years the custom at G5UM when building converters is to start with the oscillator section. One knows "clever devils' who are able to start with the RF section and work with insolent ease through the mixer section and build the oscillator section last. If you have the expertise, fair enough, do it that way in the present instance. If you don't then play safe and get the oscillator going first. It's position on the PCB chassis is shown in this half-size diagram, Fig 2, which gives an idea of the compact construction of the unit.

In Fig 3 is shown the 'sure-fire' oscillator circuit referred to earlier, complete with a table of component values, and, equally important, a description of what each component does.

Let construction commence! Lay resistors and capacitors on the insulated side of the PCB so that their wire ends may pass through holes on to the copper-clad upper side of the PCB where they are to be grounded, or to the "HT Rail", the feed through capacitors where they are to accept the +12 volt supply. The tuning capacitor C3 and it's related inductor L1 are the largest components and should be mounted first. When soldering in the transistor, grip its lead-out wires with a pair of long nosed pliers which will act as a heat sink and prevent the heat of the soldering iron from killing the semiconductor.

With construction of the CO stage completed, it is time to plug in the 45MHz crystal and to rotate

FIG 3: The "Extrapolator" converter crystal oscillator stage:



R1	22 Kohms and R2, 12 Kohms, base bias network.	FT	2,200pF feedthrough capacitor, feed-line decoupling
R3	750 ohms, collector output decoupling.	L1	inductor to resonate with crystal X: approx 12 turns of 24 SWG enamel or dcc wire close wound on ¼-inch former fitted with iron dust core alug.
R4	2.2 Kohms, emitter bias.	X	crystal, 45MHz, for 50MHz version, 65MHz for 70MHz version.
R5	150 Kohms, mixer input load resistor	Tr 1	2N708, ZT80/81, BF180 or similar
C1	1,800pF, collector output decoupling		
C2	1,800pF, emitter decoupling		
C3	0-15pF miniature trimmer (3 plate + 4 plate), collector tuning		
C4	5pF, coupling to mixer input.		

C3 to induce oscillation.

"But how shall I know if the stage is oscillating?". The question is a basic one. A few lucky readers who possess a receiver with 45MHz in its tuning range will actually be able to listen on that frequency for the oscillator 'starting up'. For everybody else a visual means of observing that the CO is functioning is essential. This is how to go about it:

Insert a low reading milliameter or multimeter set to a low DC mA range in the 12-volt-**plus** lead and rotate the preset trimmer C3. A change in the standing current will be noted when oscillation starts. Touch the crystal socket with the fingers: the standing current will change again because oscillation has probably stopped.

In the prototype converter, the 65MHz crystal used in the 70MHz version went into oscillation with the C3 trimmer almost fully out and the ferrite core of the inductor barely in. Extrapolating from 70MHz to 50MHz after changing the 65MHz crystal for the 45MHz one, it was found that the trimmer needed to be almost fully enmeshed to produce oscillation 20MHz lower in frequency, and the ferrite core fully in.

In the circuit diagram at Fig 3 the coupling capacitor to the following mixer stage is included, along with the mixer input resistor. It is important that the oscillator should be checked with these components in place to provide a load for transistor Tr1.

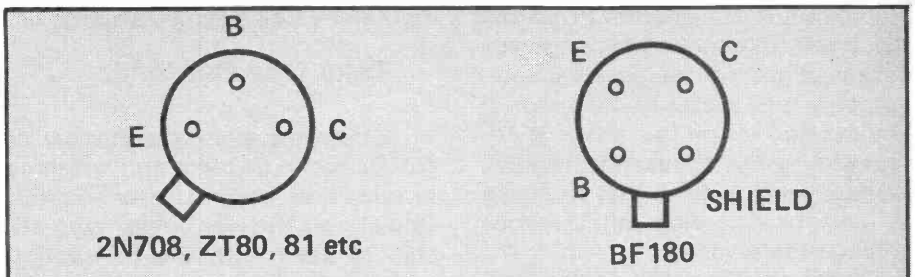


FIG 4: The "Extrapolator" crystal oscillator stage may employ any one of a variety of readily available transistors. Base connections of a typical examples are shown here.

...Next, Mix Gently

As with the oscillator stage so with the mixer: several configurations suggest themselves. Earlier converters built at G5UM have employed the ubiquitous BF180, and indeed the initial layout of the present project used it.

A change to one of the earlier FETs, the 2N3819, provided a useful reduction in converter noise compared with the BF180. Why not, one argued, use a device a dozen years younger than the 2N3819? Why not, in fact, try the BF981 small signal MOFSET? It was found to be readily available at a modest price in the Ambit International list issued with HRT earlier this year. Four samples were obtained to evaluate their worth both in the mixer and in the RF stage of the present design (two in use, two spares just in case of fatalities).

Fig 5(a) shows the mixer layout when a 2N3819 is used, and **Fig 5(b)** with a BF981 MOSFET. The latter improved both performance and oscillator isolation.

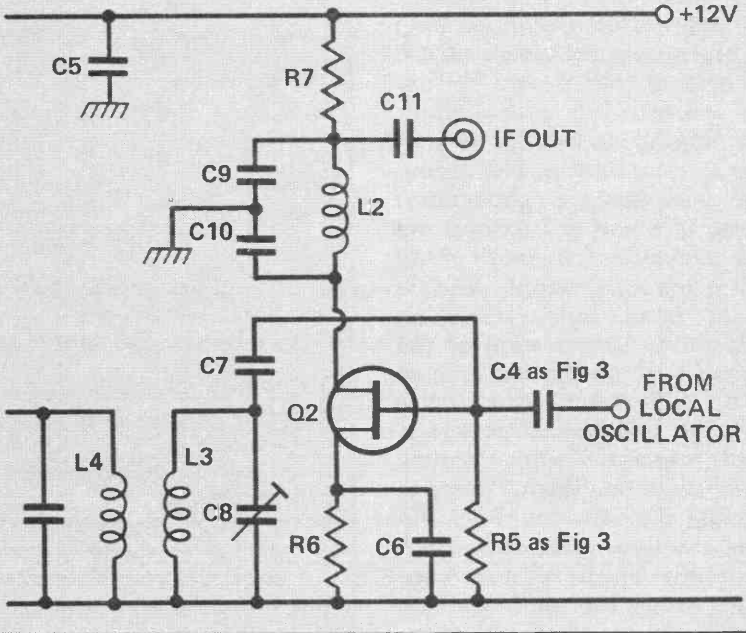
In the IF output circuit, the inductor resonating at the IF of 5MHz would traditionally have a few turns of wire wound around its earthy end to provide a low impedance output. Less traditional is the capacitor output network shown in Figs 5(a) and (b). It was suggested to the writer many years ago by G8ACE, has been incorporated in many home built converters since then, and offers the advantage of a two-terminal IF output instead of a four-terminal one.

Now heat up. . .

At this point, by interconnecting the oscillator of Fig 3 with the mixer of Fig 5, the constructor will have a ready-to-work converter to hand but by no means a 'hot' one. Add a stage of RF heating' by preceeding the mixer with a high gain front end amplifier and the

Fig 5 (a): The "Extrapolator" converter mixer stage using a 2N3819 FET:

- **R5** 150,000 ohms mixer input load resistors.
- **R6** 2,200 ohms source bias resistor.
- **R7** 100 ohms IF inductor feed resistor.
- **C4** 5pF coupling from oscillator.
- **C5** 2,200pF feedthrough HT decoupling.
- **C6** 1,800pF source decoupling bypass capacitor.
- **C7** 33pF gate circuit blocking capacitor.
- **C8** 0-15pF preset trimmer, mixer input tuning.
- **C9** 320pF, IF inductor output network.
- **C10** 47pf IF inductor output network.
- **C11** 1,000pf output coupling to IF output socket



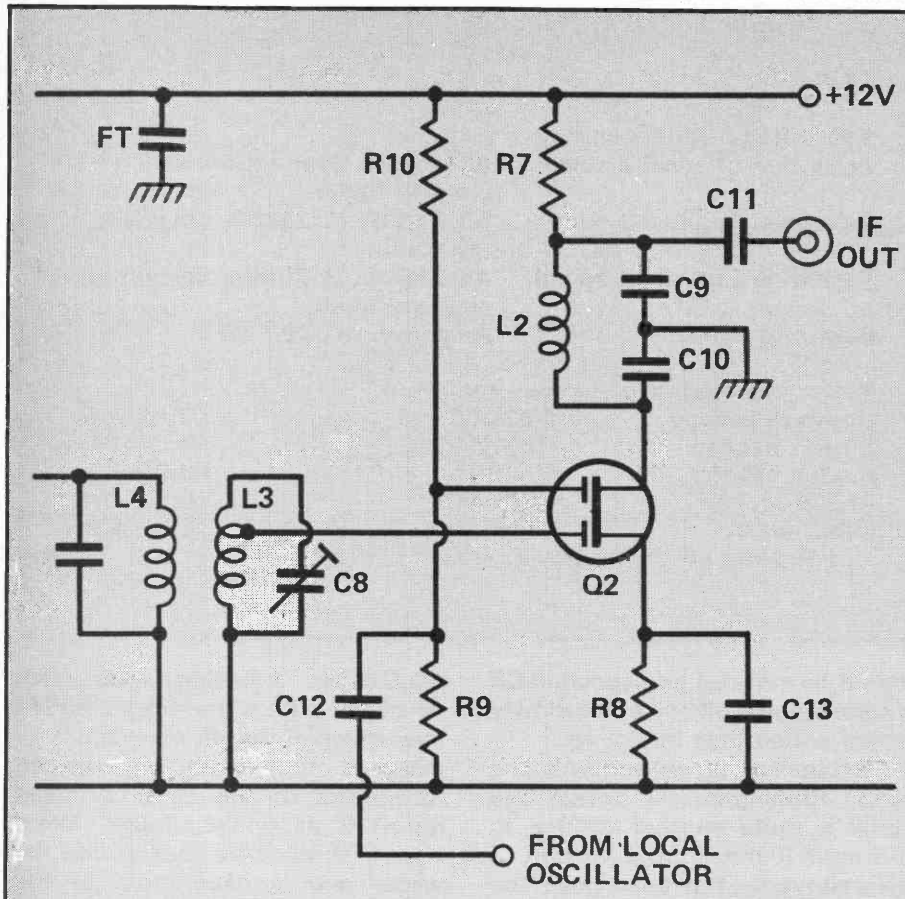


Fig 5 (b): The "Extrapolator" converter mixer stage using a BF981 MOSFET:

R7 100 ohms IF inductor feed resistor.
R8 100 ohms source bias.
R9, R10 both 100,000 ohms, gate 2 bias.

C8 0-15pF preset trimmer, mixer input tuning.
C9 320pF, IF inductor output network.
C10 47pF, IF inductor output network.
C11 1,000pF output coupling to IF output socket.
C12 4.7pF local oscillator injection to Gate 2 (in this configuration C4 above is not required).
C13 1,800pF source decoupling bypass capacitor.
Inductors: See Table 1.

converter is ready to do justice to itself — and the reader's efforts in making it.

This RF stage like the mixer is to be a BF981 and the circuit diagram is given in **Fig 7**, quite straightforward and no frills. Coupling to the mixer stage is from L4 into L3, the two coils close-coupled. Their construction is left to the readers ingenuity: they may be wound end-to-end on a single plastic former fitted with a separate ferrite core for each with which to peak them up at mid-band. Or they may be air-spaced, wound separately and positioned in close proximity for maximum coupling between them.

The 12 volt feed to the BF981 drain is via a small RF choke. It so happened that the G5UM spares box contained an old 1.6MHz IF coil that was small enough to be accommodated on the compact PCB layout of the converter.

Although the functions of the remaining components are described in the table of values, a word of explanation about the aerial input inductor is necessary. This component on the G5UM prototype was positioned vertically close to the aerial input socket so that it would not be in the same plane as the RF stage output coil. Self-oscillation of this stage was thus avoided. No screen across the RF stage MOSFET connections was found to be necessary. The prudent constructor nevertheless may wish to mount a strip of copper foil at this point, so that input coil does not 'see' output coil. If such a screen is provided this need measure more

TABLE 1

The "Extrapolator" 70/50MHz Converter: inductor details.

L1	to resonate with 65MHz and 45MHz crystals. Approx 12 turns of 24SWG enamel or dcc wire close wound on ¼-inch former fitted with iron dust core slug.	
L2	IF output coil, 65 turns on ¼-inch former to fill ¾-inch. Wire size 28 to 32SWG. Former fitted with adjustable ferrite core.	
L3	mixer input inductor:	70MHz 11 turns 28SWG enamelled on ¼-inch former, or self-supporting. 50MHz 19 turns as above.
L4	RF stage output:	70MHz 13 turns 28SWG enamelled on ¼-inch former, or self-supporting. 50MHz 24 turns as above.
L5	aerial input inductor:	16 turns 28SWG enamelled on ¼-inch former (fitted ferrite core). Aerial input tapping 2 turns from earthy end, Gate 1 tapping 11 turns from earthy end. Coil resonates to 50MHz with slug full in and to 70MHz with slug nearly full out.

than 1 inch tall by 2 inches long. Solder an inch of wire to each of its ends, pass this wire through holes drilled in the PCB, and solder the wire ends to the top, copper surface of the PCB.

Aerial input is via a Belling-Lee type coaxial socket. From this socket half an inch of bare wire extends to a tapping two turns from the earthy end of L5. Gate 1 of the MOSFET is also connected to L5 at a tapping 11 turns up. If enamel wire is used to wind L5, ensure that the enamel is scraped away at these two tapping points and that they are well tinned before attempting to solder the tappings to them.

As will be seen from **Table 1**, this input coil is close-wound on a quarter-inch former fitted with a ferrite core. This single inductor is good for 70MHz as well as for 50MHz without any change. For the higher frequency the core will be almost full out and for 50MHz, almost full in.

All Ingredients In One Vessel. . .

The three stages of the 'Extrapolator' converter have now been dealt with in detail. No diagram of the complete unit is necessary: the inter-connection of the three is self evident from Figs 3, 5 and 7 and a suggested physical layout is at Fig 2.

The moment has come to check that all the ingredients have come together happily and that the result is "a tasty dish". To do so proceed as follows:

Connect a short length of thin coaxial cable from the output IF socket on the top face of the converter to the input socket of the station receiver. To minimise IF breakthrough, bond converter to receiver ground terminal via a separate lead.

Connect a 9 volt or 12 volt battery pack to the converter via the black lead which has been soldered to the upper, copper face of the PCB and via the **+ve** red lead which extends from one of the feed-through capacitors.

Plug in the 65MHz crystal and set the station receiver at 5MHz. At once an increase in the receiver's noise level should be evident, to tell the constructor the joyous news that the converter is working. A further increase in conversion noise should be noticed as capacitor C8 is adjusted and all coil cores slowly turned within their inductors.

TABLE 2

Your "free" signal generators for "Six"

Television Channel 2 vision:	**51.75MHz (just within the amateur band).**
Television Channel 3 sound:	**53.25MHz (1.25MHz outside the band).**
Television Channel 2 sound:	**48.25MHz (1.75MHz below the amateur band).**
Beacon GB3SIX:	**Anglesey, 50.02Mhz**

Your "free" signal generators for "Four"

Cornwall beacon	**GB3CTC**	**70.03MHz**
Sussex beacon	**GB3WHA ***	**70.04MHz**
Buxton beacon	**GB3BUX**	**70.05MHz**
Angus beacon	**GB3ANG**	**70.06MHz**
Irish beacon	**EI4RF**	**70.13MHz**

*** Presently off-the-air due to site problems.**

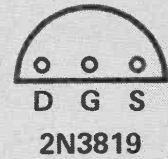
Achieving converter hiss is one thing. Homing-in on a real live signal is quite another. Where to find one? If the 70MHz version of thiks converter has been built, the question is answered by the word: 'beacons' (See **Table 2**). One of these beacons, high in the hills of Derbyshire, is GB3BUX, available all day on 70.05MHz and audible over much of England if a reasonable aerial is used. When the 65MHz crystal is in position in the converter and the station receiver set to 5.05MHz the GB3BUX beacon is likely to be detectable. If it is not, switch receiver BFO on to listen under CW conditions. Finally, readjust capacitors and ferrite coils in the converter for maximum signal from GB3BUX on "Four".

With 6 metres a different set of circumstances prevails. There is at the time of writing but one UK beacon available, GB3SIX on 50.02MHz, beaming west from Anglesey. The signal from GB3SIX over much of the UK mainland is so marginal that even experienced navigators of the 50MHz ocean report it as rarely audible. What hopes, then, have people like the writer and perhaps most of the readers of this article who merely paddle on the edges of that ocean?

Nil desperandum: all is not lost by any means. Available on "Six" there are many permanent signal generators that will assist the alignment of the 50MHz of this converter. They are called television broadcast stations! Three of them with frequencies near the 50MHz band are listed in **Table 2**. Let us take a closer look at how they may be used:

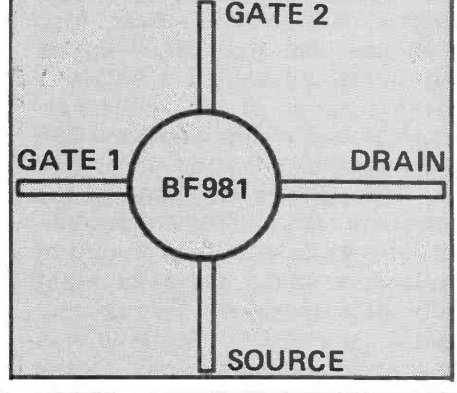
After the converter prototype had been safely breeched on GB3BUX on the 4 metre band, its parameters were extrapolated to the 6 metre band by the simple expedient, already described, of changing the crystal from 65MHz

Fig 6 (a) Connections to the 2N3819



2N3819

Fig 6 (b) Connections to the BF981



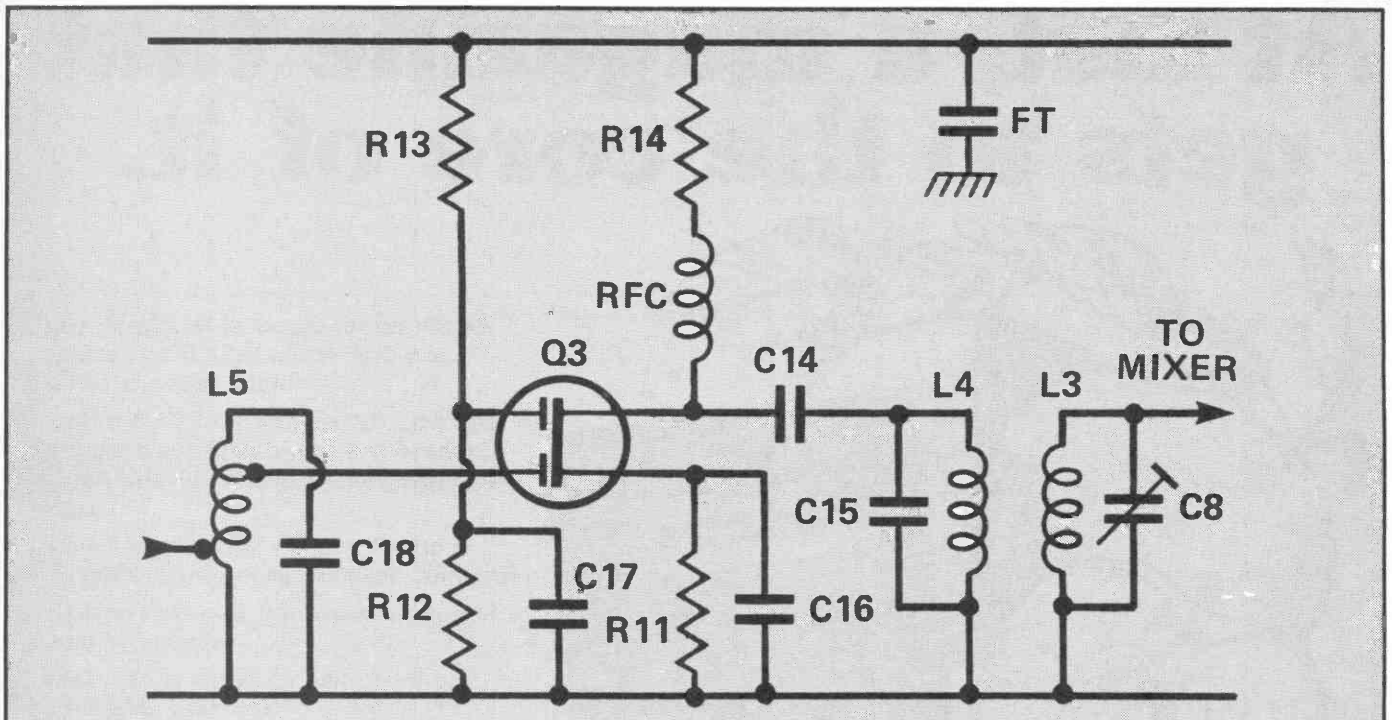


Fig 7: The "Extrapolator" converter r.f. stage. using a BF981 MOSFET.
C8 mixer input tuning as Fig 5.
C14 18pF, drain circuit blocking capacitor.
C15 6.8pF output stage tuning (select for maximum signal output).
C16 1,000pF source bias decoupling.
C17 1,000pF gate 2 bias decoupling
C18 18pF input tuning (select for maximum signal output)
FT feedthrough decoupling, as Fig 5.
R11 100 ohm source bias.
R12 47,000 ohms gate 2 bias.
R13 68,000 ohms gate 2 bias.
R14 100 ohms drain feed resistor.
RFC drain feed choke (see text)
Inductors: See Table 1

to 45MHz and replacing inductors L3 and L4 for the larger size versions shown in Table 1. The station receiver was set at 6.75MHz, representing 51.75MHz where the Holme Moss vision signal should appear — and it did! Tweaking of the mixer input capacitor C8 brought the 405-line buzz up to a full throated roar. The IF inductor having been initially peaked at 5MHz on converter noise needed a small adjustment of it's ferrite core to peak it at 6.75MHz, and up came the video buzz to even greater strength (this on a horizontal dipole in the roof space at 80 miles from the station).

The next operation was to set the station receiver at 3.25MHz to represent 48.25MHz, or somewhat below the limit of the 50MHz band, and up came the Channel 2 sound signal.

Each constructor will have available in this own district BBC video and sound transmissions in Television Band 1, on which to check that the "Extrapolator" is capable of receiving signals from the outside world.

More satisfactory, of course, is to receive a real amateur signal within the 50-52MHz band. You may be fortunate enough to hear one if you tune slightly above 5MHz (representing 50MHz) outside of television hours. You may be even more fortunate to have locally one of the few holders of 50MHz transmitting permits who would be pleased to radiate a signal for you on which to align your "Extrapolator".

If listening to your first amateur signal on "Six" you feel inclined to murmur to yourself: "Rarely, rarely comest thou spirit of delight" you can console yourself with the thought that "spirits of delight" exists somewhat more plenteously at present on the higher frequency band of 70MHz. I hope you feel that you should have facilities for listening on *both* bands. You can, with the greatest of ease: go ahead and build yourself two "Extrapolator" converters while you are about it, one for "Four" and the other for "Six". The two of them won't cost you much!

Final-Final

The foregoing discourse has said nothing about in-house test facilities. It has assumed that very few readers will have access to professionally built signal generating and alignment equipment, much less *own* such expensive artefacts. It has been suggested that both versions of the "Extrapolator" converter be evaluated on external signals. This is a valid and practical procedure. But other methods exist for those readers who are prepared to construct their own cheap and cheerful home testing equipment. More of this in a later article.

Reader should note this article is not intended to be in the realms of the latest "state-of-the-art" of converter construction. Perhaps it will appal the cognoscenti. No matter: it will appeal to the constructor-domesticus. That is my intention at any rate. In its development stages it was "made up as one went along", prompting the thought that it might have been called "The Extemporizer" instead of "The Extrapolator"! One hopes that you, too, will extract as much enjoyment from building it as the writer did, and that you will gain quiet satisfaction from the loud results it gives you.

RADIO Building Blocks

This month Frank Ogden, G4JST, delves into FM, in particular FM IF strips.

FM circuitry is nearly always within the context of VHF. All the following examples assume operation at VHF frequencies (or transposing from them in the case of discussion about IF strips) and that the mode is narrow band FM. There are other frequencies and FM modes used in amateur radio such as SSTV, RTTY, wideband FM for microwave but these are not often encountered; FM means narrow band FM in 98 per cent of cases.

A Bit About FM

Everyone knows what FM stands for (I hope!) but what does it actually *mean*? You start off with a carrier at constant amplitude and then waggle it about at a rate determined by the modulation frequency. The amount by which the carrier frequency is altered gives the amplitude of the modulation. Unlike SSB or AM where the bandwidth is limited to a precise value determined by the modulation frequency, the sidebands of an FM carrier are much wider, naturally, but extend out much further than the peak deviation would suggest. Unlike AM, FM sidebands show a Gaussian distribution at the sum of the peak deviation and modulation frequency. In practice, this means that it is very difficult to tell if that box of grubby looking filters offered for sale by a grubby looking trader at a mud-up-to-the-ankles rally is a bargain or not.

Choosing A Filter

The delight of NBFM is that the circuitry is simple; any other mode is a nightmare by comparison. However looks are deceptive. The system filter is the most important component in any successful NBFM transreceiver design. The correct choice is far more significant than, say, transmitter output power, receiver de-emphasis or even the 'front end' noise performance. The incorrect choice (or circuit design for an otherwise suitable unit) leads directly to receiver blocking, audio distortion low-level signal readability and one or two other nasties. If you don't read any other part of this article, make sure that you take in the next bit.

There are two ways (three, actually but I don't propose to discuss DC PLLs here) of designing a practical NBFM receiver system. The first, shown in **Fig. 1**, uses single conversion to 10.7MHz where the signal is both amplified and detected. Chips such as Plessey SL6650 can provide the entire IF/demod function for NBFM at this single frequency very effectively.

The second variety of design, as depicted in **Fig. 2**, is by far the commonest and full of treacherous pitfalls. The circuitry here uses double conversion: from signal frequency to 10.7MHz, and from 10.7MHz to 455kHz. Nearly all the amplification and detection is carried out at this last low frequency. Either variation requires a top quality crystal filter which operates at 10.7MHz. Assuming that the hypothetical system is designed for 25kHz channel spacing, it must pass, with negligible phase error, a band of frequencies 15kHz wide derived from the expression $2(f_{dev} + f_{mod})$ while providing a minimum of 80dB of rejection for signals just 25kHz away.

This type of performance does not come cheap. Any useful NBFM design requires a first crystal filter with at least 8 poles. A design using a filter with less than this will show an unacceptable disposition to co-channel interference. With decent units costing in the region of £20 to £30, there is a great temptation to use those ubiquitous three legged 2-pole filter units or, even worse, ceramic filters as intended for FM tuners. The result will never be satisfactory, even though the filter may be simply providing the 'roofing' function in the double conversion scheme shown in Fig. 2. It may appear that, since the 15kHz bandwidth is provided by a ceramic filter operating at 455kHz, then the requirements of the 10.7MHz filter before the 2nd mixer are lessened. This is not the case. The second mixer provided on chips such as the MC3357 is of a low level type. If a 'barn door. . . as wide as' type filter is used ahead of it then the contents of around 12 FM channels adjacent to the wanted one are heterodyned down to it simultaneously. The result is 'sproggies', intermod and an unbelievable amount of co-channel interference. Adjacent signals of just 100uV at the aerial can wipe this type of IF clean of useable signal if the first filter is of

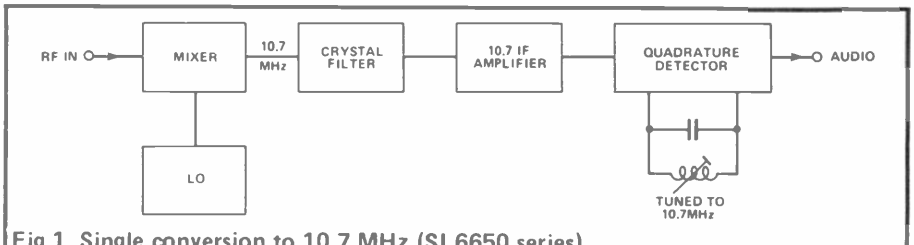


Fig.1 Single conversion to 10.7 MHz (SL6650 series)

the cheap and cheerful type, no matter how good the 455kHz unit is.

Terminating The Filter

Monolithic crystal filters are very fussy about what they are connected to. The high rejection and the closely defined bandwidth is produced by the critical coupling of a number of independant crystal resonators, 'the poles'. The unit will only function as a single controlled bandwidth resonator if the termination conditions, particularly in respect of the resistance, are carefully controlled. They must 'see' a non reactive resistance as specified by the manufacturer — typically in the range 1 to 4 kilohms in parallel with a specified capacitive loading — generally around 20pF. These conditions should prevail at each end.

Most IC IF strips require around 5 to 15 microvolts to achieve satisfactory noise limited operation. The output of the average front end using a couple of dual gate MOSFETs tends to be around two or three microvolts at noise limit. The difference between the two represents a shortfall in amplification when going straight from front end to IC via a filter. **Fig. 3** shows how to bridge the gain gap and provide a very predictable termination for both ends of the filter. The IF transformer presents a very high impedance load to the drain of the mixer MOSFET. Any resistance placed across it becomes the 'real' resistance presented to the filter. In use, the tuning slug of the transformer is adjusted for minimum passband ripple. The input resistance of the following JFET stage is determined entirely by the gate resistor with a small value capacitor for reactive adjustment.

I make no apologies for going on at length about the qualities and requirements of the first IF filter. The goodness or otherwise of this component and its installation sets the standard for the finished piece of equipment. Even some of the biggest names in amateur radio equipment — I'm thinking of Icom gear in particular — tend to economise on this component for their FM boxes with a shortfall in performance as a result. The almost universally poor perfor-

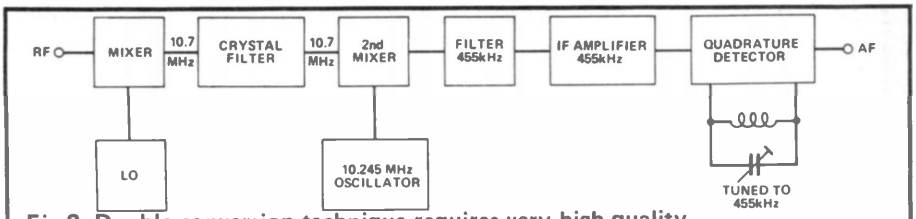


Fig.2 Double conversion technique requires very high quality 10.7 MHz filter to avoid blocking of 2nd mixer with adjacent channel signals

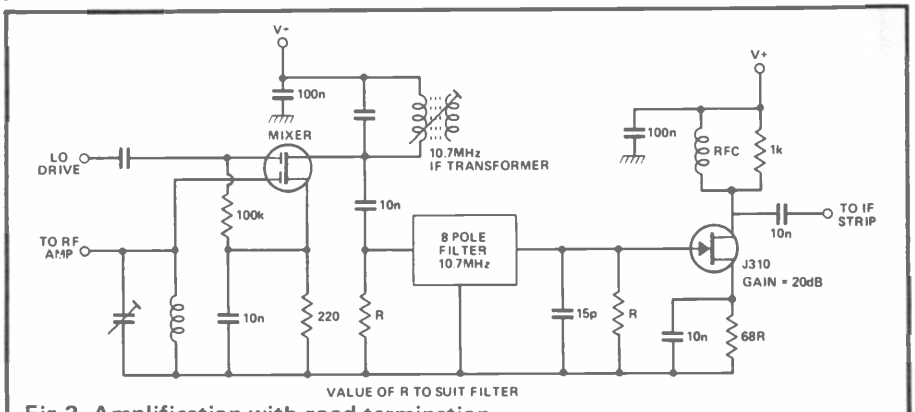


Fig.3 Amplification with good termination

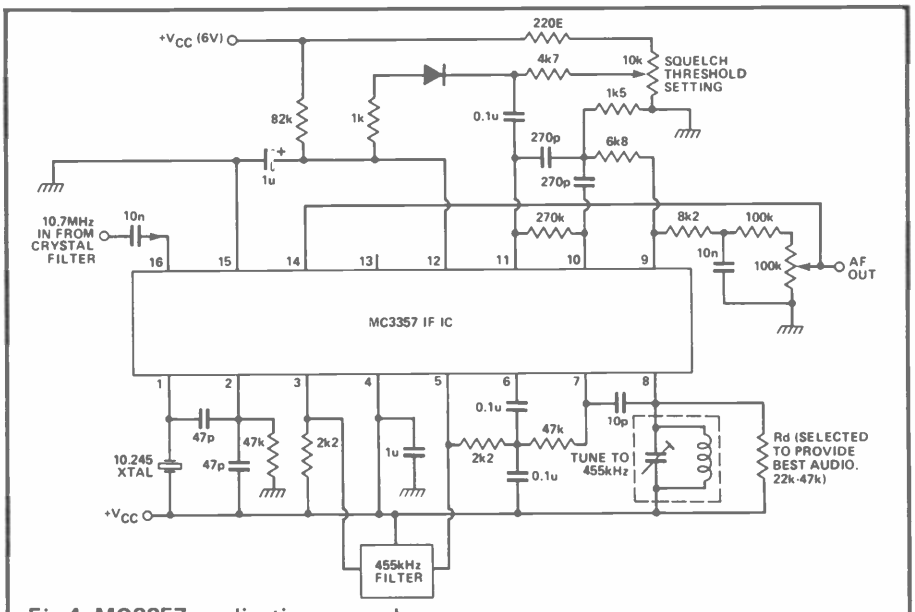
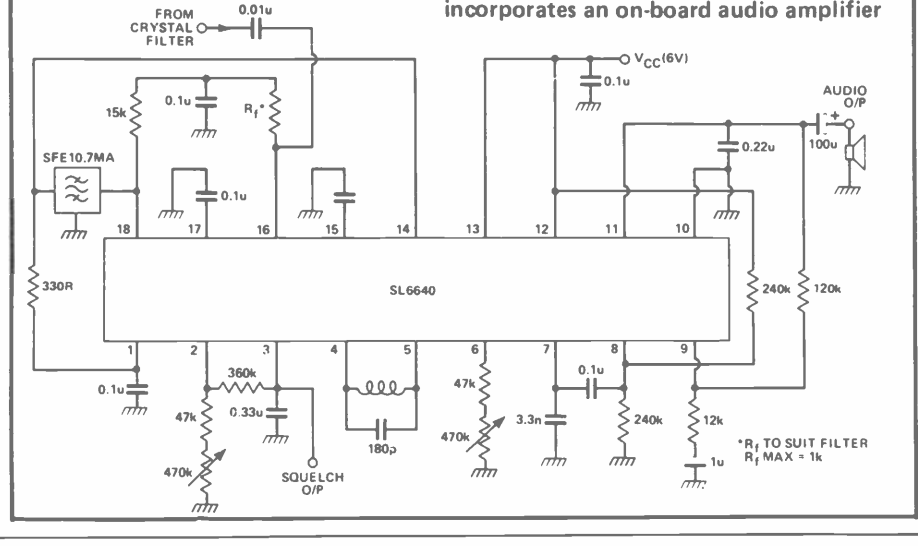


Fig.4 MC3357 application example

Fig.5 SL6650 series. The 6640 chip shown here incorporates an on-board audio amplifier



mance of CB set receivers (the transmitters are almost universally good) can be attributed directly to the filter factor.

If you have fitted a decent filter and the recovered audio is distorted at low signal strengths — and you can't get it any better with adjustment of the quadrature coil at the end of the IF strip — then the termination conditions of the filter are probably wrong. It is possible to verify this by setting up a weak carrier from a slowly tuneable signal generator and then tune through the receiver IF passband. If the termination conditions are wrong, it is possible to hear ripple as a series of peaks and troughs in the noise. Remember that these represent phase errors which lead directly to distortion of the modulation envelope recovered from the detector. This is because NBFM is all about phase. Addition of the JFET circuitry as shown in Fig. 3 nearly always effects a dramatic improvement in low signal performance under these circumstances.

If you have got the filter right and delivering enough IF signal to whatever follows it, the choice of what chip to use to provide the bulk of amplification and detection is largely immaterial. It will depend on what you have to hand, the squelch characteristics (I have a personal hate for squelches with hysteresis as found on the *MC3357/9)* and the power supply (only use a CA3089 if you've got a built in generator).
I offer a few experiences of the common types.

MC3357 Family

The typical circuit diagram s shown in **Fig. 4**. The basic circuit works well but extra amplification after the first crystal filter is usually needed. Low power drain, around 4mA, is a real asset, which is why this device (MC3357) has become the standard component for handitalkies manufactured the world over. The logic level output from pin 13 derived from the squelch circuit is useful for switching off the entire power supply to the AF section. A *VN66AF* driven from this pin can be used as the switch element itself. I have never found any instability problem with this device largely because it is of the double conversion variety. 10.7MHz to 455kHz; 10.245MHz oscillator on chip (crystal needed).

SL6650 Family

Typical circuit is shown in **Fig. 5**. A difficult device to use because all the amplification is done at 10.7MHz. With around 100dB available on a single chip, the layout requires extreme care. It is my view that a groundplane PCB is mandatory. Also, the device needs to handled with great care as it is extremely sensitive to static. A badly earthed soldering iron will kill it stone dead. This circuit and all the Plessey radio chips are very fragile. This is because the small geometry transistors which exhibit such excellent RF properties are as sensitive to *static damage* as the old fashioned MOS devices.

Having said this, the Plessey circuits are my choice for the majority of FM IF applications. The current requirements are minimal (about the same as the *MC3357*) there is a DC volume control, the squelch system uses a series of detectors throughout the chip which provides a log response (SL6650 only). It provides the only on-chip S meter function which gives readings that make sense with NBFM (think of all the other S meters which read S9 with 4uV). There are operating disadvantages. The quadrature coil core requires critical adjustment and an outboard gain stage is mandatory.

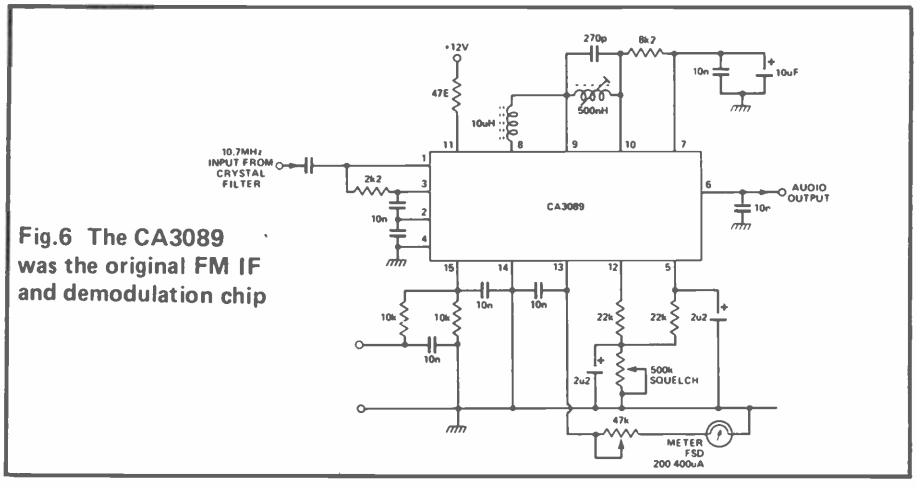


Fig.6 The CA3089 was the original FM IF and demodulation chip

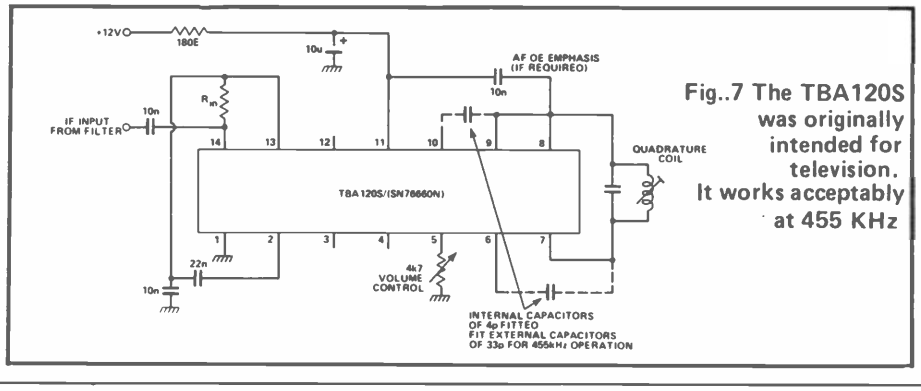


Fig..7 The TBA120S was originally intended for television. It works acceptably at 455 KHz

CA3089 Family

The original IC as used in successive generations of FM tuners. The power consumption of this chip is very high and the low impedance of the quadrature circuit means that the coil is excessively damped when the chip is used for NBFM at 10.7MHz. It is possible to increase the recovered audio by using a 0.5uH coil tuned by around 270pF. The coupling inductance needs to be reduced to around 10uH under these conditions. Good qualities of the chip include an excellent log response on the S meter feed. An outboard IF stage is mandatory.

TBA120S

Very primitive chip. No mute or S meter function (it was intended for a TV sound strip). Lacking in gain at 10.7MHz but works reasonably effectively as the second NBFM IF at 455kHz.
Next month — product detectors and SSB generators.

Practicalities

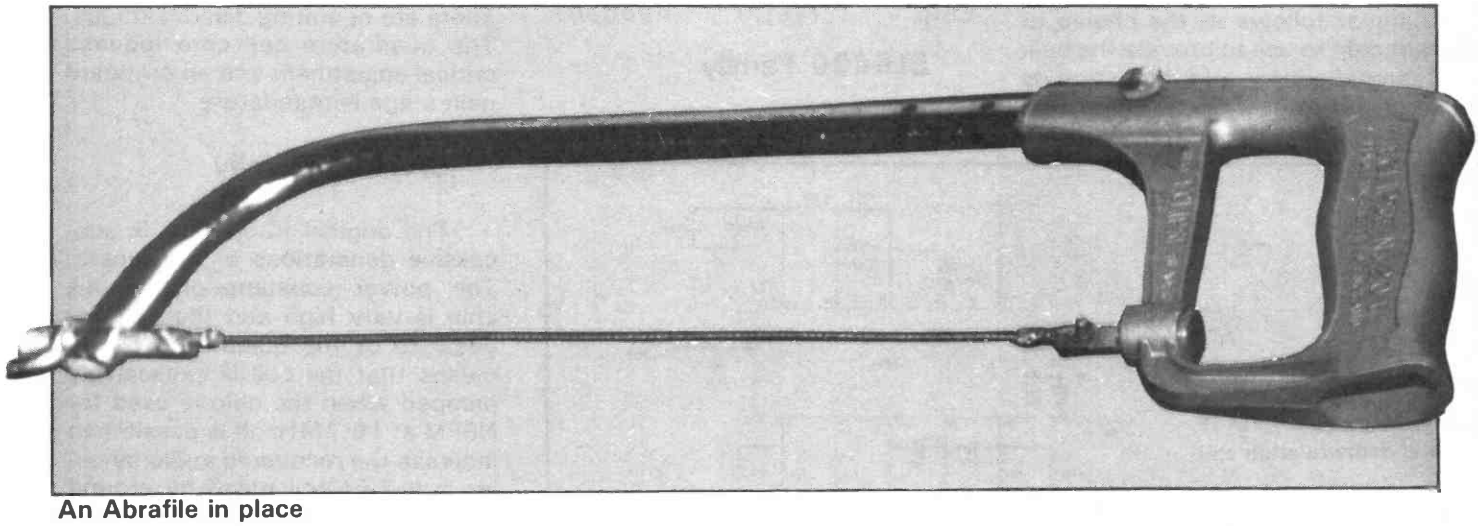
One problem, always present for the home constructor, is that of how to achieve a reasonably professional finish to the metalwork with the minimum of equipment. A few months ago, I mentioned a way of labelling front panels to improve their appearance, and here are a few more ideas to help make the finished article more presentable.

One way in which the appearance of a piece of equipment can be greatly improved is to have a nicely *painted* case and front panel. This is most easily achieved by purchasing one of the large selection of ready painted

Get a professional finish and build a dummy load with Ian Poole, G3YWX

cases available from most major component stockists! The main drawback with this (apart from the expense of course) is that the paintwork is very easily spoiled when the necessary drilling is being done. One trick I have found very successful in overcoming this is to cover all the vulnerable areas with masking tape, remembering that any exposed surfaces which are uncovered will be at risk. It is better to cover too much rather than too little! One further advantage of this is that having covered the surfaces which are to be drilled, then it is possible to draw on the masking tape and plan out the layout of the panel *before* drilling starts. If the project becomes delayed — as many of mine have done — and the masking tape remains on the panel for more than about two weeks, the job of removing the tape becomes progressively more difficult and, also, the surface will remain sticky after the tape has been removed. If this happens, as much of the tape as possible should be removed and the remainder cleaned off with a freon based solvent, which is often used in the aerosol cleaners available from many electronics shops.

One tool which I have found very useful in the metalworking I have done is an Abrafile. This tool is possibly not well known to many home constructors and is extremely useful for cutting large or irregular holes in sheet metal. It is therefore ideal for making cutouts in front panels for which the correct size drill is not available or the hole is not circular. Basically, an abrafile is a long circular file about one sixteenth of an inch in diameter and designed to fit into a standard hacksaw frame. If a hacksaw is already available, all that has to be bought is the abrafile and the small fitments for either end of the file. These are all readily available from hardware shops. To use an Abrafile, a hole large enough to take the file should first be drilled. The file can then be fed through the hole and attached to the hacksaw frame. The file should be kept under tension by tightening the nut at the end of the hacksaw by two turns (on most types of saw) after the slack has been taken up. This tension is sufficient to prevent the file bending unduly and thus causing the saw to wander, and not so much that the file snaps. It is then a simple matter to make the cutout follow an outline — which should have been marked out previously, of course.

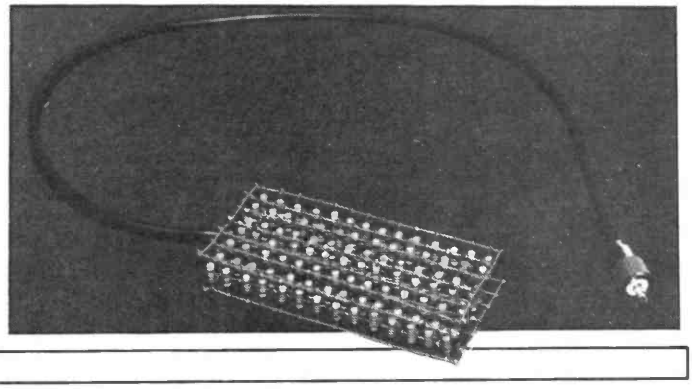


An Abrafile in place

Homebrew Dummy Loads

With the availability of many off-the-shelf ancillary pieces of equipment, very often it is easy to forget that

Fig. 2 Matrix construction



some of them are easy to construct. Although the homebrewed equivalents may not look quite as professional, they do perform perfectly satisfactorily. I found myself in this position some time ago when I wanted to repair an HF sideband transmitter that I had bought cheaply in a partly working state. I looked through the advertisements for 'dummy loads' only to find that the cost of a suitable one cost nearly as much as the transmitter! However, in fairness to these loads they did possess an excellent frequency specification.

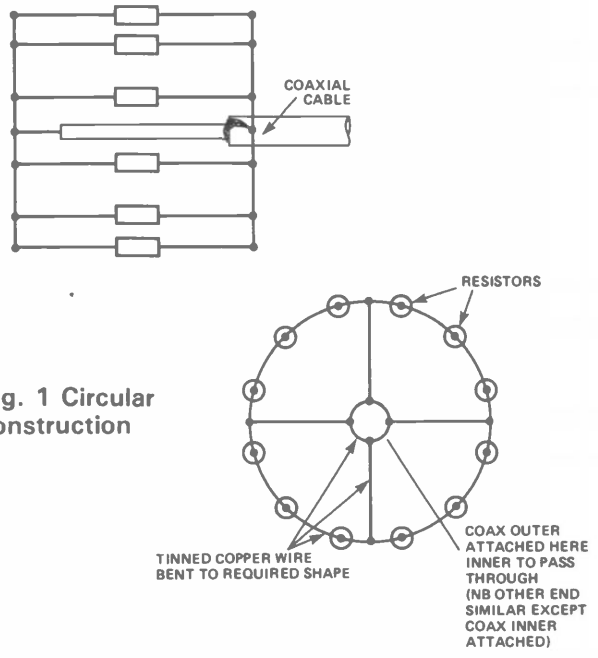


Fig. 1 Circular construction

Accordingly I decided to build a load from a bank of discreet resistors. The main point to watch when constructing an RF load is to avoid introducing any inductance. With this in mind, wire-wound resistors must be avoided at all costs because they become almost totally inductive at RF and hence totally useless for this purpose. Carbon or metal film resistors are both equally suitable, and the load which I constructed actually used carbon resistors as they are available quite cheaply. This used 100 5K1 resistors to give a 51 ohm load — which is near enough to 50 ohms not to pose any problems! In order to reduce the overall inductance to a minimum, the leads should be kept as short as possible within the load itself. If only a few resistors are to be used, then the arrangement shown in **Fig. 1** can easily be used. If more resistors are to be used then the matrix style of layout shown in **Fig. 2** will probably be more easily constructed and the leads kept as short as possible. One point to be born in mind is that there should be sufficient spacing between the resistors for ventilation; also, if the load is to be mounted in a case there should be adequate air flow through to avoid overheating.

This type of approach is normally quite suitable for HF loads — in fact the unit which I built gave SWRs of below 1.2:1 at 30MHz. However at VHF, the inductance of both the leads and the resistors becomes more significant giving rise to a substantial increase in reflected power.

Free Readers' ADS!

Vintage Radiogram GD 1050C in three upright cabinets walnut. 1). 5 band radio bandspread tuning 2). Turntable with record storage 3). Bass reflex speaker cabinet. Exchange modern G.C. receiver or offers. Tel: Newcastle 2868291

Yaesu FT 290R with motor matched preamp and mobile mount, NICads, charger. Mint condition £250 ono. George, 8 Kestrel Drive, Dalton. In Furness Cumbria 0229 63284 after 6 pm.

NRD 515 Rx. Mint Condx 18 months old. £750 D. Menzies, 11 Glebe Road, Newton Mearns, Glasgow.

Tonna 9 element crossed YAGI 144MHz £25.00 ono. IC260 needs attention £130.00. Pye pocketfone PFZUB 3 Ch's. £30.00. Extel Teleprinter 50/75 Bauds £190.00. Tel: 025 481 3182

Linear Amplifier: Skipmaster HF-15 2-30 MHz. AM-FM-SSB Pre-ampt 5-10in 20-15 out: £60.00 ono. Tel: 01-998-4713

Wanted — Crystal set for exhibition. Must be genuine item of the early 1920s. Details please to: Stan, G3XON, 14 Dageden Road, Shalford, Guildford, Surrey. GU48DD or telephone Guildford (0483) 36953.

Exchange Realistic Pro 2001 Scanner Brand new. Programmable with memories. Covers all VHS, UHF bands. For HF transceiver, tel: St. Albans 39333.

Heath Kit Short Wave receiver S.W.717 and general coverage. Phones and Manual good order. £20.

Wanted Digital readout of frequency for FRG 7. Telephone 0325 — 482983 Evenings. G6BCG QTHR

URGENT QST's from 1970 to 1983. Ring with Price. For disposal radio comms Mags 1968 to 1983 offers. Watned information for Book 2. Whats on frequencies from 36 MEegs to 4 GHz with so many scanners about a lot must be known. Ring for free book 1. Anytime. 0473-85526.

R600 General coverage receiver, good condition, two years old. £200 (ono) G4GLT 'Newhaven', Beveridge Lane, Bardonhill, Leics., LE6 2TB. Tel: Coalville 35835.

Commercial Multi band dipole £10. Icom Electret desk mike £15. 2m 5/8 mag mount £10. AIWA HS-JO2 Personal Stereo as new £50. wanted good unmodified WS No.62. Kemp 0793 (Swindon) 783462 after 6pm.

Yaesu FRG7000 General coverage communications receiver 0 to 30 MHz digital frequency display very good condition £150. Tel: Hampton (01) 941-0993 after 5.30 pm.

Reftec for sale. Perfect working order £200. Phone Brighton 774381 after 6pm.

Yaesu FT757GX HF transceiver plus YM 38 Mic, Hardly used, £630. G4BUO. Tonbridge (0732) 359742.

Wanted F.M. Board for Yaesu FT101ZD and SP.901 exspeaker good working order and condition. Please phone John Reading 598326 anytime.

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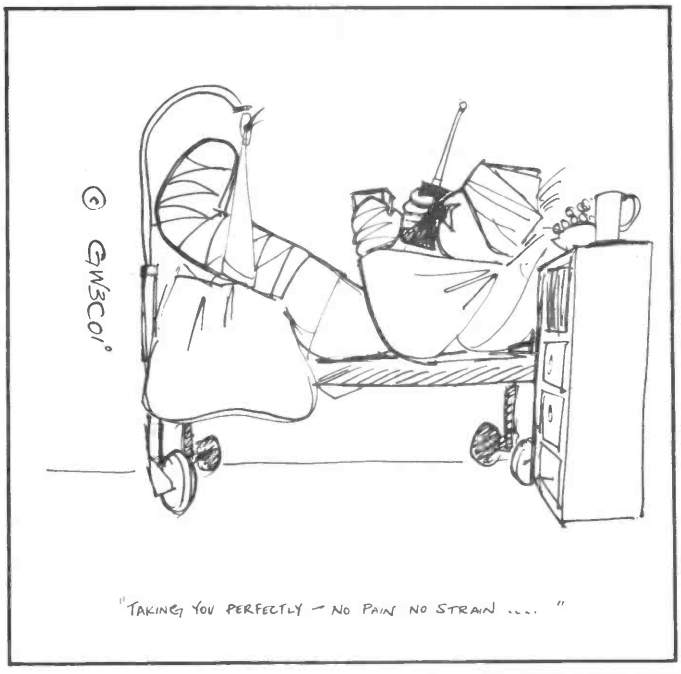

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