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HAM RADIO TODAY

AN ARGUS SPECIALIST PUBLICATION

JUNE '84

95p

The Civilised Art of Contest Operation

By Al Slater, G3FXB

FT101 Converted to New Bands

SWL Project – Build an Active Antenna

FDK M-750XX Budget 2m Multimode Reviewed

HAM RADIO TODAY

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ABC

REGULAR COLUMNS

CONSTRUCTION

FEATURES

REVIEWS

LETTERS

SHORT AND SHARP

Sir, to all those misguided people who support the introduction of a novice license — I don't
R J Howes, G4OWY

FINAL FINAL PHONETICS

Sir, With reference to my 1922 Copy of 'Boy Scout Tests', the following additions to the Phonetic Alphabet are shown under the signallers badge, together with those printed in the 1914 list, re. April 1984 HRT.

C is called CORK
E is called EDDY
I is called INK
J is called JUG
Q is called QUAD

These Phonetics were originally used by flag signallers, and would be called out by the 'reader' for the 'writer' so that there was no confusion of letters that sounded alike.

B. Smith, GSL,
30th Ormskirk Scout Group

TIME, TIME. . .

Sir, I was greatly amused by the exchange between yourself and G2ABC concerning spelling, grammar, etc, and particularly over the UTC question, since you both seem to have got it wrong.

It is actually Co-ordinated Universal Time, but is labelled UTC because there is a string of other "times" known as UTO, UT1, UT2; and UT(C) follows the pattern.

The enclosed chart shows them all — it might even be worth reproducing for the general edification of your readers! But I think it is wise to stick to accepted abbreviations such as UTC and not go out on a limb with your own variation — what would happen if you decided one day that MTG was more sensible than GMT? Would anyone know what you meant?

Wally Blanchard, G3JKV

RSGB SPEAKS OUT!

Sir, I refer to the April 1984 issue of Ham Radio Today. This issue seems low on factual accuracy and high on misunderstanding; as such I would like to correct the record on a number of points.

Firstly, in your "Radio Today" news item, headed "RSGB Clarifies Transceiver Usage", it is incorrect to say that the RSGB ". . . has entered into the controversy over the legality of the use of transceivers by SWLs for receive only and has stated that this is perfectly legal provided that the transmit facility is not used". The fact of the matter is that the Society was aware that there was some confusion in this area and formally took the matter up with the Department of Trade and Industry on behalf of its members. The reply from the DTI was reported in the February 1984 issue of Radio Communication. In other words, the Society has *reported* the legal position as stated by the DTI, which is not the same as entering into a controversy. Any shortwave listener seeking clarification on this issue may write to our membership services department for further information.

Secondly, referring to your news item entitled "G5CCI on Page 3"! You say that ". . . the RSGB say that they need the whole block of 17,000 to meet their projected (call-sign) needs" and ". . . what will happen when the RSGB eventually issues (or rather re-issues) the call-sign G5CCI"? Flattering though it is to be reported as though the RSGB is the licensing authority in the UK, you are incorrect in your assumption that the RSGB has anything to do with the issuing of call-signs. The only call-signs issued by the Society, on behalf of the DTI, are those used for special events, in the GB series, of which your recent use of GB4HRT is an example.

Finally, I would like to refer to the article "Space Shuttle Post-Mortem" in which we note that its author Mr. Jones, G6GOS, damns us with faint praise when he states that in his opinion, the RSGB ". . . came out of this exercise fairly well" — in fact, "the hugely successful national press campaign" to which he refers in the next sentence was unique in Europe and apart from the efforts of the American Society, was second to none. Our efforts, of course, were designed to enhance the status of amateur radio by bringing our activities to the attention of the general public. In practice, the publicity for amateur radio that was generated was substantially greater than that achieved with any other single amateur radio event in recent years.

Also in his Space Shuttle article, Mr. Jones infers that had the RSGB been able to bring up-to-date information on the STS-9 mission to amateurs through its regular Sunday morning broadcasts, then this would have reduced "frustration". Mr. Jones overlooks the fact that these broadcasts are scripted on the preceding Wednesday and that in order to bring this latest news to the amateur community, a series of special news broadcasts were transmitted from RSGB Headquarters on three bands simultaneously. In all, some eight staff were involved in the collection, presentation and dissemination of information, and had the small minority of amateurs, who caused reception problems to W5LFL, bothered to take advantage of the information which was available, then less problems would have occurred. While Mr. Jones' article seems well balanced in the main, his final insult is to NASA. Not the "North American Space Agency", Mr. Jones, but the National Aeronautics and Space Administration.

I believe Sir that we spotted most of your April funnies.

David A. Evans, G3OUF, General Manager/Secretary, RSGB.

Due to an all-embracing illness among the HRT Editorial staff, much of "Radio Today" was kindly, voluntarily compiled by someone who is comparatively unfamiliar with the world of Amateur Radio. This accounts for the first two points that you raise, for which I apologise.

I certainly would not have said that Mike Jones damns the RSGB with "faint praise". In fact, his only 'damning' (much too strong a word, I think) statement in any sense, as regards the RSGB, is in connection with the News Bulletin. Amateurs do habitually look to the News Bulletin for the latest information on the Amateur Radio scene and have done so for many years. Mr. Jones was probably unaware, as I was, that the bulletin has to be completed four days in advance. In this particular case it would have been nice if a 'Stop Press' item had been possible. That being said, I well know the problems with deadlines. . .

Well done NASA and well done RSGB. I believe Sir that you are being a little sensitive.

Please address correspondence to:
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RADIO TODAY

Solder Into Spring With Ambit?

Ambit International's long awaited Spring 1984 Components Catalogue is now available from newsagents, or direct from the company, at the cover price of 80p. That's fifteen pence cheaper than your fun packed HRT!

The new catalogue covers a comprehensive range of electronics components and offers the useful attraction of three £1 discount vouchers. Among the many features of the publication are a new range of kits, data sheets, batteries, crystals, semiconductors, resistors and a carefully selected list of books on electronics subjects.

All the products illustrated are available by mail-order using order forms in the catalogue or, from any of the three Ambit shops at 200 North Service Road, Brentwood; 53 Burrfields Road, Portsmouth and Park Lane, Broxbourne.

73s Best

If you are thinking of visiting America in the Spring (?), you might care to visit one of the traditionally more interesting of the American amateur radio 'conventions', that promoted by the 73 magazine, published by the redoubtable and oft controversial Wayne Green, W2NSD/1.

To be held April 27-29, 1984 in Dayton, Ohio, this annual event is one of the world's largest amateur radio conventions, and attracts over 20,000 radio enthusiasts from all parts of the globe. Activities range from forums, lectures, and seminars to the buying, selling, and swapping of equipment.

This year's convention promises to be particularly eventful, as, according to a press release received from 73 magazine, amateur radio is "experiencing a resurgence in importance in the American scientific community." "In late 1983, Dr. Owen Garriott, while on-board the Space Shuttle *Columbia* during its ninth mission. . . confirmed to NASA and other official agencies the effectiveness of amateur radio as the ultimate in emergency communications systems."

73 go on to say that the importance of amateur radio was also reflected in the incidents surrounding last year's US invasion of Grenada. Due, reportedly, to a Reagan Administration decision to bar the press from accompanying the Marines at the time of the invasion, amateur radio transmissions from an American medical student on the island were apparently the only reports available to the media.

In this important year, some topics slated to be addressed at the convention include communications with spacecraft, the bouncing of signals from the moon's surface, the intricacies of ionospheric propagation and solar activity, and DX (long-distance) communication.

The RAC Amateur Radio Radio Group Scheme

Membership of this scheme is open to all amateur radio enthusiasts, and provides membership of the Royal Automobile Club at a discount of £2 below the normal RAC membership subscription rate. Since 1 June 1983 the annual subscription for members of the group scheme has been £16.50.

The group scheme's subscription renewal date is 17 May (World Telecommunicaion Day) each year, and all members renew on the same date. Anyone joining the scheme will pay at the pro-rata rate of £1.37 per month until the next group renewal date. In addition, the RAC one-only joining fee of £3 is also payable, regardless of the period remaining in the membership year. Radio amateurs who are already members of the RAC and who wish to transfer to the group scheme will not pay the joining fee.

Desirable options are the RAC Recovery Service and the "At Home" Service, the annual subscriptions for which are £13.50 and £5.50 respectively, annually from date of taking up the option.

No additional subscriptions are payable for member's spouse.

The scheme is administered by the Royal Automobile Club's Scottish Western Counties Office, 200 Finnieston Street, Glasgow G3 8NZ. The co-ordinator of the scheme is Mr A.W. Hutchinson, 88 Broomfield Road, Chelmsford, Essex CM1 1SS, from whom application forms may be obtained.

Tread Carefully on Topband

A few weeks ago, it was reported on the RSGB news bulletin that Radio Amateurs had been allegedly causing interference to one of the Coastal Radio Stations operating within the 160m band.

Listed below are the frequencies used by such stations, which should be avoided. Note that North Foreland Radio is on 1848 kHz.

Coastal Station Frequencies

		(kHz)
		1869
		1876
1811		1879
1813		1883
1817		1888
1820		1890
1824		1901
1827		1904
1834		1905
1838		1906
1841		1908
1848	North Foreland	1911
1850		1921
1855		1925
1856		1929
1862		1930
1866		1939

Amateur SSB working generally occurs between 1911 and 1921 kHz.

Wanted Urgently

HRT urgently require the loan of Drake TR5 in good working order for a period of two weeks. We are offering TWO YEARS SUBSCRIPTION to HRT in return and will pay for Securicor delivery to, and from, these offices. We will also, of course, acknowledge the generosity of the person who assists us in the pages of HRT.

RADIO Tomorrow

4 May	Sutton and Cheam DRS: AGM at Scola West Kent ARS: AGM S. Manchester RC: Discussion Evening Axe Vale ARC: *Aerials by G3GC* Cambridge DARC: *Very Low Frequencies by G4FFO*
4/5 May	RSGB 432MHz-24GHz Contest
7 May	Braintree DARS: Receivers, old and new Horndean DRC: *The RSGB by G8FG* Thornton Cleveleys ARS: *Aeroplanes by Jerry Vallely* Stourbridge ARS: Informal + plus On Air Night Todmorden ARS: Demonstration Station and Natter Nite **Dudley ARC have changed their venue to the Allied Centre,, Castle Street, Dudley and will meet on the 1st, 2nd and 4th Mondays of the month.**
8 May	Mid-Warwickshire ARS: *The Electron Microscope by G3OOQ* Goole RES: *Computer Logic by G8VHL* Wirral DARC: Inter Club Quiz at Chester ARS Bury RS: *Confessions of a TV Repair Man by G8XUR* Chichester DARC: ring PRO for details Wolverhampton ARS: Informal
9 May	Lincoln SWC: *DXpedition to St Pierre Et Miquelon by W1PFA/FP8BH* Three Counties ARC: Natter Nite Fareham DARC: Planning for Arts and Crafts Exhibition Wirral DARC: *Build A Repeater by G8UZZ* Nene Valley RC: Natter Nite Dover ARC: Visit to North Foreland Radio Station Farnborough (Hants) DRS: *Talk by AMSAT UK*
10 May	Edgeware DRC: *Ferrite Materials by Neosid* Southgate ARC: Talk by Marconi Electronics (t.b.c.) Preston ARS: *Application of Computers to Amateur Radio by G3NKL*
11 May	S. Manchester RC: *Japanese Morse by G3CSG* Dunstable Downs RC: TV Show Repeat Medway ARTS: *The RSGB by John Nelson, G4FRX* Cambridge DARC: Informal and Morse Class Haverhill DARS: Designing Simple Test Equipment
12 May	**AMSAT UK AGM at London House, Doughty Street, LONDON WC1.**
13 May	WAB LF Phone Contest 1400-2100GMT Wirral DARC: DF Contest **British Amateur Television Get Together at Post House, Crick (a few hundred yards from Exit 18 on the M1). Lectures, Trade Stands, Bar and ATV in action. G8CJS 0532 670115** **Dover ARC Spring Cleaning Rally at Dover YMCA.** **Talk-in on GB3KS and S22. Flea Market and Refreshments. 1030-1600**
14 May	Exeter ARS: Surplus Sale Stratford-Upon-Avon DRC: *Aerials by G3PGQ* Thornton Cleveleys ARS: Club on-air Night Milton Keynes ARS: Video of G6CJ's Aerial Circus Southdown ARS: Homebrew Evening and Microwave Demo with Frank Ogden, G4JST
15 May	Fylde ARS: Equipment Sale Biggin Hill ARS: On-Air Night Wakefield DRS: Junk Sale Goole RES: Bill Richards DF Contest
16 May	S Bristol ARC: Fox Hunt Briefing Wirral DARC: D&W at The Saughall Massie Hotel Cheshunt DARC: *AMTOR and Packet Radio by G3NRW* Nene Valley RC: *The HW8 QRP Tx/Rx by G3DOT*
17 May	Colchester RA: Preparations for NFD Chichester DARC: ring PRO for details **Crawley ARC Antenna Lecture and Demonstration at Crawley Technical College by HV Sims (BBC). All Welcome 8 p.m.**
18 May	West Kent ARS: Construction Contest S. Manchester RC: AGM Sutton and Cheam DRS: *Amateur Satellites by G3AAJ* Kent Repeater Group AGM at Electronics Building, University of Kent, Canterbury at 1930.
19/20 May	RSGB 144MHz and SWL Contest
20 May	Glenrothes DARC: Informal **Mid-Ulster ARC Rally at Parkanaur House and Forest Park, Co Armagh. Trade Stands, video's for the children and all proceeds to charity. Details DF Campbell 0762 42620**
21 May	Braintree DARS: AGM Leighton Linslade RC: Talk on Model Engineering Thornton Cleveleys ARS: NFD Preparation Stourbridge ARS: ring PRO for details
22 May	May-Warwickshire ARS: *The Electron Microscope by G3OOQ* Goole RES: Instructional Evening! Halifax DARS: Demonstration by Lowe Electronics Verulam ARC: *Amateur Radio on a Shoestring by G3RJV* Wolverhampton ARS: Informal
23 May	Three Counties ARC: VHF Repeater Groups S. Bristol ARC: 2m SSB Night with

"ANTENNA HERE IS AN INDOOR VERTICAL"

	G6ZTY/G6ZTX
	Fareham DARC: Show at Portchester Arts Exhibition
	Wirral DARC: *Equipment Demonstration by G3LEQ*
	Cheshunt DARC: Natter Nite
	Nene Valley RC: Natter Nite
	Farnborough (Hants) DARC: HF NFD Preview
24 May	G. Peterborough ARC: VHF NFD Preparations
	Edgeware DRS: Constructor's Contest
	Preston ARS: *Effective Use of the FT101 by G3SYA*
25 May	S. Manchester RC: Talk by Winners of Construction Contest
	Dunstable Downs RC: *Oscar 10 by G3VZV*
	Haverhill DARS: Construction of a GDO
27 May	**Ipswich RA East Suffolk Wireless Revival at The Hollies, Ipswich**
	Plymouth Rally at the Devonport Secondary School, Park Avenue, Devonport, Plymouth. Trade Stands. Talk-in.
	Wolverhampton ARS: 2m DF Hunt
28 May	Stratford Upon Avon DRC: Construction
	Thornton Cleveleys ARS: Natter Night
29 May	Wakefield DRS: *Yugoslavia by G4KLN*
	Goole RES: Evening of Videos
	Wolverhampton ARS: *Amateur Radio and the BBC Micro by G3UBX*
30 May	S. Bristol ARC: ATV Night with G8WAX
	Fareham DARC: On-Air Night
	Wirral DARC: DF Practice
	Cheshunt DARC: 2m Portable Operation from Baas Hill
1 Jun	West Kent ARS: Junk Sale
	Axe Vale ARC: The Entertaining Electron
	S. Manchester RC: *Mods to the FT221R by G4MYB*
	Cambridge DARC: Junk Sale at Comberton
	Sutton and Cheam DRS: Receiver Measurements (t.b.c.)
2-3 Jun	**HF NATIONAL FIELD DAY**
3 June	**Welsh Amateur Radio Rally at the Barry Leisure Centre, Greenwood Street, Barry, South Glam. Trade Stands, Bring and Buy, Refreshments, Bar and a Swimming Pool! Free Parking. Talk-in S22. Open 1100-1700.**
	RSGB 70MHz and SWL Contest
4 Jun	Horndean DRC: *Matching Units by G3GVC*
	Leighton Linslade RC: Quiz with Aylesbury RS and Milton Keynes DRS
	Stourbridge ARS: ring PRO for details
5 Jun	Fylde ARS: Top band Fox Hunting Arrangements
	Chichester DARC: ring PRO for details
	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 House, Thingwall
7 Jun	Preston ARS: Annual Quiz with G4DBU
8 Jun	S. Manchester RC: Club Quiz
	Dunstable Downs RC: Summer Barbecue 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'
9 Jun	RSGB 1296MHz Trophy
10 Jun	RSGB 432MHZ Trophy and SWL
11 Jun	Exeter ARS: Inter-Club Quiz
	Stratford Upon-Avon DRC: On-Air Night
12 Jun	Mid Warwickshire ARS: Fox Hunt and Barbecue
	Wakefield DRS: On-Air Night
	Bury RS: ring PRO for details
	Wolverhampton ARS: Informal
13 Jun	S Bristol ARC: Preparations for Longleat Rally
	Fareham DARC: On-Air Night
	Farnborough DRS: *Radio Equipment by G3VCX*
14 Jun	Colchester RA: *How Banks Communicate by R. De La Rue*
15 Jun	S. Manchester RC: *160m DFing by G3WFT*
	Edgeware DARS: *Electronic Music by G4BZY*
	Cambridge DARC: ring PRO for details
	Sutton and Cheam RS: *Maritime Radio*
17 Jun	**RNARS Mobile Rally at HMS Mercury, near Petersfield, Hants. Events for the whole family! Food. Talk-in on 2m and 70cm.**
	Denby Dale Mobile Rally at Shelley School, Skelmanthorpe, Near Huddersfield from 1100. Free Parking and Admission Trade Stands. Bar and refreshments. Talk-in S22 and SU8 Details Jack Clegg 0484 862390
	Fylde RS: 160m DF Hunt
18 Jun	Leighton Linslade RC: *Packet Radio by G8ELA*
	Stourbridge ARS: ring PRO for details
	Todmorden DARS: *Amateur Satellites by G8UVE*
19 Jun	Biggin Hill ARS: Junk Sale
	Fylde RS: 160m Fox Hunt Post Mortem
	Biggin Hill ARC: Junk Sale
	Halifax DARS: Surplus 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
21 Jun	Chichester DARC: Summer Social
	Preston ARS: Natter Nite
22 Jun	S. Manchester RC: DF Hunt and Barbeque
	Dunstable Downs RC: VHF NFD Planning
	Medway ARTS: The WAB Awards by A. Keele
	Cambridge DARC: Informal and Morse Class
	Haverhill DARS: Construction of 2m DF Aerials
23/24 Jun	RSGB 1.8MHz Contest
24 Jun	Worked All Britain 2m/70cm Phone Contest 1400-2000GMT
	Dunstable Downs RC: Car Boot Sale
	Longleat Mobile Rally at Longleat Park, Nr Warminster, Wilts. Trade Stands plus all the usual goodies including Camping Facilities. Enquiries G4FRG 0272 848140
25 Jun	Stratford-Upon-Avon DRC: *Travels in Paradise by G8KGJ*
26 Jun	Mid Warwickshire ARS: *QRP Working*
	Wakefield DRS: ring PRO for details
	Wolverhampton ARS: Informal
27 Jun	S. Bristol ARC: VHF NFD Final Preparation
	Fareham DARC: On-Air Night
	Wirral DARC: The Eileen Medley DF Hunt
28 Jun	Colchester RA: *What Next In Space? by F. Howe*
	G. Peterborough ARC: *QRP by G3RJV*
29 Jun	S. Manchester RC: *Op Amps by G4HON*
	Edgeware DARS: Informal + VHF NFD Briefing
2 Jul	Horndean DRC: *On the Air Cheaply by G2DZT*
	Leighton Linslade RC: ring PRO
	Stourbridge ARS: ring PRO
	Todmorden DARS: Radio Treasure Hunt
3 Jul	Bury RS: Surplus Equipment Sale

Will Club Secretaries please note that the deadline for the August segment of Radio Tomorrow (covering radio activities from 6th July — 7 Sept '84 is 3rd June.

Contacts

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

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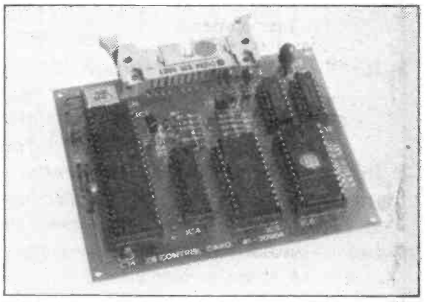

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CH 8/RX Multi-purpose Charger — 01-02204 — 9.40

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Linear IC's

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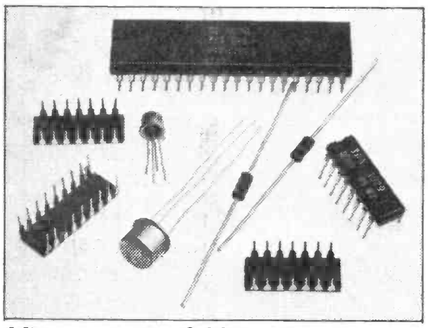
LM308CN	DIL version	61-03081	0.65
LM311CN	Popular comparator	61-00311	0.46
LM324	Low power quad op amp	61-03240	0.67
LM339N	Low power quad comparator	61-03390	0.68
LM346	Programmable quad op amp	61-00346	3.72
LF347	Quad Bi-FET op amp	61-00347	1.82
LM348	Quad 741 type op amp	61-03480	1.26
LF351	Bi-FET op amp	61-03510	0.49
LF353	Dual version of LF351	61-03530	0.76
LM380N	IW AF power amp	61-00380	1.00
NE555N	Multi-purpose low cost timer	61-05550	0.45

for a better service.

NE556N	Dual version of the 555	61-05560	0.50
uA741CN	DIL low cost op amp	61-07411	0.22
uA747CN	Dual 741 op amp	61-07470	0.70
uA748CN	741 with external frequency comp	61-04780	0.40
HA1388	18W PA from 14V	61-01388	2.75
TDA2002	8W into 2 ohms power amp	61-02002	1.25
ULN2283	1W max. 3-12V power amp	61-02283	1.00
MC3357	Low power NBFM IF system and detector	61-03357	2.85
ULN3859	Low current dual conversion NBFM IF and detector	61-03859	2.95
LM3900	Quad norton amp	61-39000	0.60
LM3909N	8-pin DIL LED flasher	61-39090	0.68
KB4445	Radio control 4 channel encoder and RF	61-04445	1.29
KB4446	Radio control 4 channel receiver and decoder	61-04446	2.75
ICM7555	Low power CMOS version of timer	61-75550	0.98
ICL8038CC	Versatile AF signal generator with sine/square/triangle OPs	61-08038	4.50
TK10170	5 channel version of KB4445	61-10170	1.87
HA12002	Protection monitor system for amps, PSUx, TXs etc	61-12002	1.22
HA12017	83dB S/N phono preamp 0.001% THD	61-12017	0.80
MC14412	300 baud MODEM controller (Eduro/US specs)	61-14412	6.85



Microprocessor & Memories

Z80A	Popular and powerful 8-bit CPU	26-18400	3.40
Z80AP10	2 port parallel input/output	26-18420	2.95
Z80A CTC	4 channel counter/timer	26-18430	2.90
Z8671	Z8 Micro comp. and Basic	26-08671	17.50
6116-3	16K (2kx8) CMOS RAM 200nS	26-36116	6.68
Z6132-6	32K (4kx8) quasi RAM 350nS	26-06132	15.00
4116-2	16K (16kx1) 150nS	26-24116	1.59
2764	64K (8kx8) 450nS	26-02764	9.50
2732	32K (4kx8) 450nS	26-02732	5.70

Voltage Regulators

7805	5V 1A positive	27-78052	0.40
7812	12V 1A positive	27-78122	0.40
7815	15V 1A positive	27-78152	0.40
7905	5V 1A negative	27-79052	0.49
7912	12V 1A negative	27-79122	0.49
7915	15V 1A negative	27-79152	0.49

Transitors

BC182	General purpose	58-00182	0.10
BC212	General purpose	58-00212	0.10
BC237	Plastic BC107	58-00237	0.08
BC238	Plastic BC108	58-00238	0.08
BC239	Plastic BC109	58-00239	0.08
BC307	Complement to BC237	58-00307	0.08
BC308	Complement to BC238	58-00308	0.08
BC309	Complement to BC239	58-00309	0.08
BC327	Driver/power stage	58-00327	0.13
BC337	Driver/power stage	58-00337	0.13
MPSA13	NPN Darlington	58-04013	0.30
MPSA63	PNP Complement to MPSA13	58-04063	0.30
J310	JFET for HF-VHF	59-02310	0.69
J176	JFET analogue switch	59-02176	0.65
3SK51	Dual gate MOSFET-VHF amp	60-04051	0.60
3SK88	Dual gate MOSFET-Ultra lo noise	60-04088	0.99
TIP31A	Output stage	58-15031	0.35
TIP32A	Complement to TIP31A	58-15032	0.35
VN66AF	VMOS Power FET	60-02066	0.95
ZTX3866	E-line version 2N3866	58-03866	0.45
IN4001	Rectifier diode	12-40016	0.06
IN4002	Rectifier diode	12-40026	0.07
IN4148	General purpose silicon	12-41486	0.05

Silicon Controlled Rectifiers

BRY55-100	100V .8A	52-55100	0.50
C106DI	400V 4.0A	52-00106	0.70
C122DI	400V 8.0A	52-00122	1.45

3mm Diameter LEDs

V178P	Red	15-01780	0.15
V179P	Green	15-01790	0.16
V180P	Yellow	15-01800	0.18

5mm Diameter LEDs

CQY40L	Red	15-10400	0.12
CQY72L	Green	15-10720	0.15
CQY74L	Yellow	15-10740	0.15

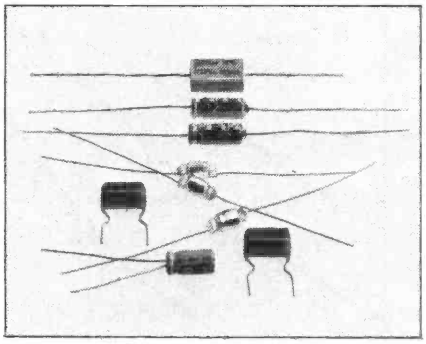
Infra-Red LEDs

CQY99	Emitter	15-10990	0.56
BPW41	Detector	15-30410	1.51

Tri Colour LED

V518	Orange-Green-Yellow	15-05180	0.60

Capacitors



Aluminium Electrolytics Radial PCB Mounting

			Pack of 4
10u	16V	05-10606	0.24
47u	16V	05-47606	0.28
47u	25V	05-47607	0.28
470u	6.3V	05-47705	0.36
470u	16V	05-47706	0.48

Tantalum Beads

			Each
1uf	35V	05-10501	0.18
10uf	16V	05-10601	0.28
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47uf	16V	05-47602	0.92

Monolithic Capacitors

		Pack of 3
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10n	04-10304	0.42
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Low Voltage Disc Cermaic

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10n	04-10303	0.20

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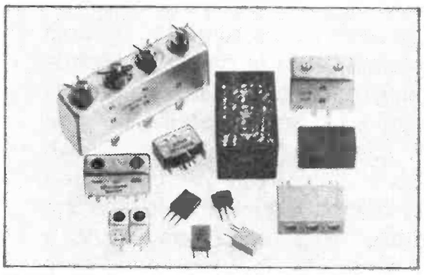
47n	04-47305	0.24
100n	04-10405	0.24
470n	04-47405	0.51
1uF	04-10505	0.66

R F Components



Filters

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LFH6S/ CFW455HT	6kHz	14kHz	16-45525	2.45
LFG12S/ CFW455FT	12kHz	22kHz	16-45528	2.45
CFM2455A Mechanical IF Filters for 455kHz			19-45530	0.77

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XS-240	Iron 25W 240V High heat capacity	54-22500	5.40
SK6	Presentation pack of one XS-240 with ST4 stand	54-22510	7.20
MLXS	Handy 12V 15W soldering iron complete with crocodile clips and solder	54-20004	5.60

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EARTH-MOON-EARTH with simple equipment

The second part of this short series of articles on moonbounce will concentrate on three topics:
1. Putting together an EME station
2. How to check that the equipment is working properly

In Part 2 Charles Suckling, G3WDG, tells how to assemble and operate a practical EME station

1. Putting Together An EME Station

The first thing to decide on before starting to assemble your EME station, is which band to go for. I would recommend starting on 70cm, mainly because a relatively small antenna can be used successfully on this band. It is usually the antenna which poses most difficulties family/neighbour wise, and starting out with a big antenna is usually not a good plan. A 4 yagi array for 70cm measures approximately 6ft by 6ft and is capable of working most stations active on the band, as well as being able to achieve echoes (see Part 1). Typical yagis which could be used are the Tonna 19 or 21el, the DL6WU long yagi (**Ref. 2**) or the NBS long yagi (**Ref. 3**).

Siting The Antenna

Before doing anything else in preparation for becoming active on EME, it is essential to survey your garden to make sure that you can find a site for the antenna, which will allow the antenna to be pointed at the moon with no obstructions between the two. Trees, bushes or houses in front of the antenna will cause too much attenuation of the already very weak signals. If possible, look for a site where the antenna can be mounted relatively close to the ground, as this simplifies the construction of the mount and makes it easier to carry out adjustments etc. Ideally the chosen site should be as close as possible to the operating position to keep cable losses to a minimum.

One way to ensure that a clear shot at the moon is available from the intended antenna site, is to observe the position of the moon throughout the month. Alternatively the information given in **Fig. 5** can be used, which gives the elevation and azimuth of the moon at three reference points in the moon's orbit. This enables the moon's position to be 'plotted' in the sky, without having to follow the moon in real time (which can be rather tedious!) A 360deg. protractor can be used to indicate the azimuth. This can be set approximately by pointing the 0deg. mark towards the north (using a compass), or the 180deg. mark

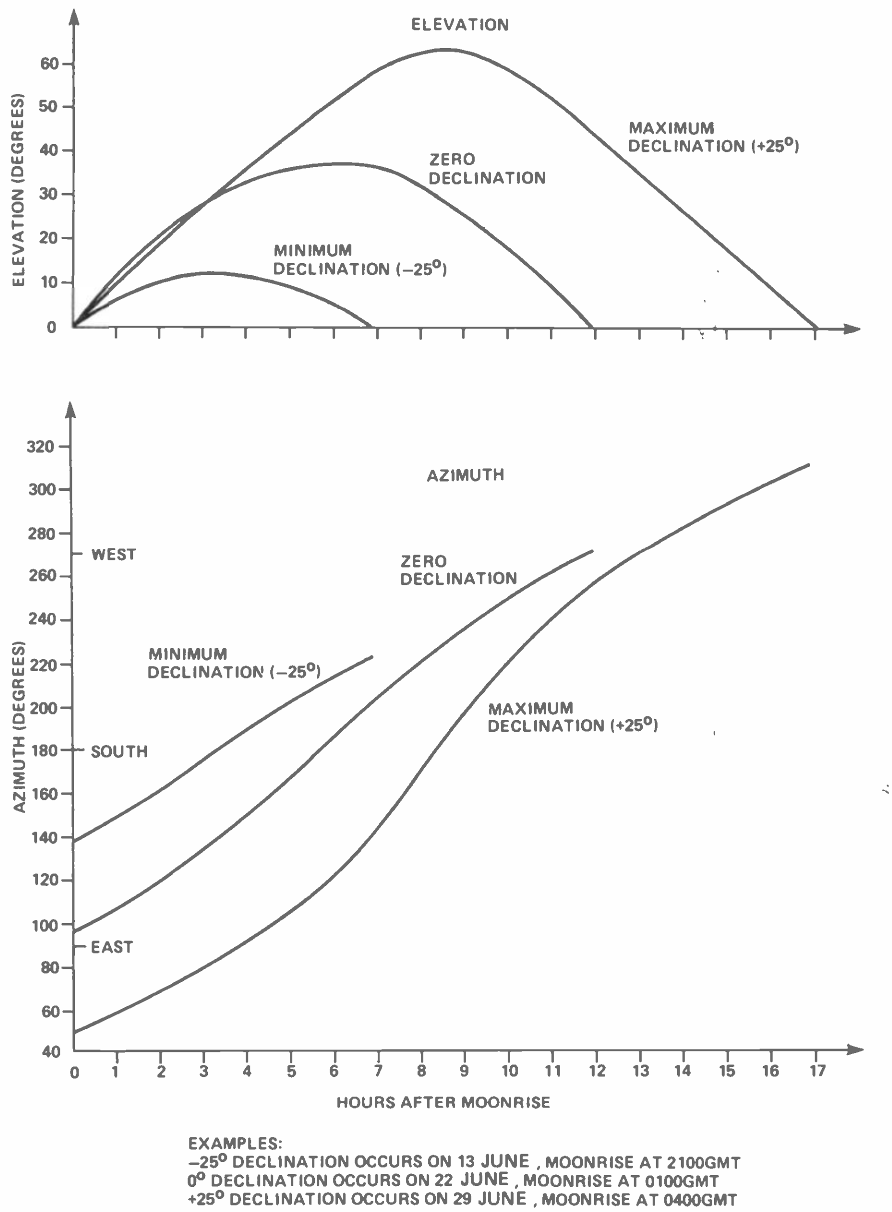


Fig. 5 Elevation and azimuth of moon at maximum, zero and minimum declination

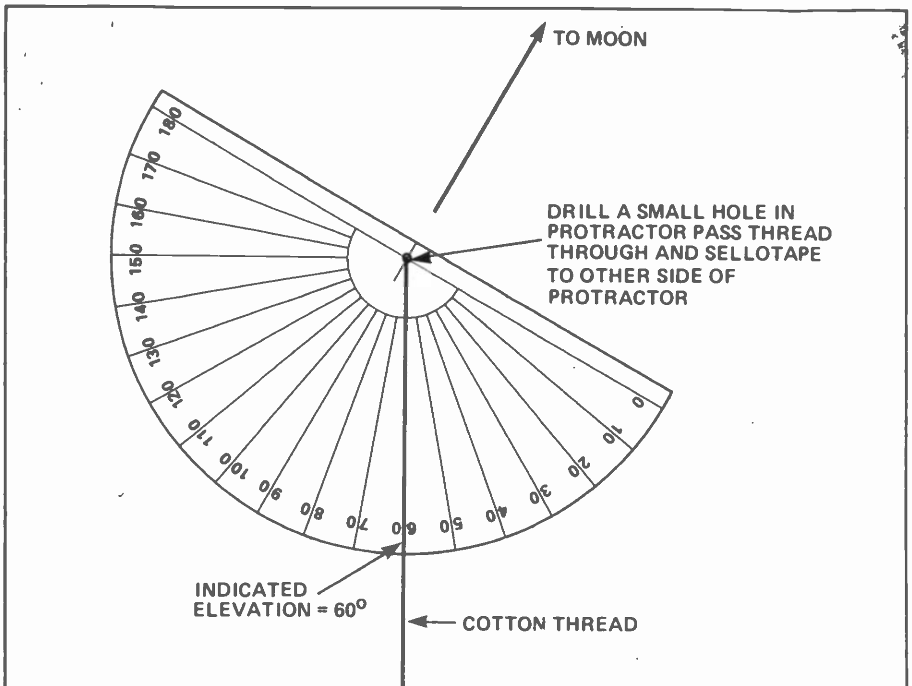


Fig. 6 Using a protractor to show the elevation of moon

towards the direction of the sun at 1200gmt. The elevation can be indicated using a plumb line and a protractor, as shown in **Fig. 6**.

Do not worry too much if you cannot "see" the moon when it is in the southern part of its orbit (negative declination) since it is not very common for tests to be organised at this time in the month. It is not necessary to have horizon-to-horizon coverage; quite a few stations have only a few hours of moon time each day and are still quite successful on EME. Of course, it may happen that you cannot find anywhere in the garden which has a useable moon window, and in this case it will be necessary to mount the antenna high up on a mast, or find a site somewhere else (or move house!).

Antenna Installation

Assuming that a suitable site has been found, the next thing to consider is how to mount the antenna. There are basically two alternatives, the elevation-over-azimuth (el-az) mount or the polar mount. The former has the advantage of enabling the antenna to be readily pointed at any part of the sky, which can be very useful if one wants to use the antenna for other purposes in addition to EME (eg. Oscar). The polar mount has the advantage that only one continuous adjustment is needed to track the moon, but is more difficult to set-up initially. I personally prefer the 'el-az' mount, and would recommend this type to anyone intending to be active on EME.

The next decision to make is whether to use hand-pointing or remote pointing using rotators of some sort. The latter approach is obviously more expensive, but has the advantage of convenience. If the antenna has to be mounted high up in order to be able to see the moon, then remote pointing is obviously essential from the outset. If the antenna can be mounted fairly close to the ground then hand pointing is worth considering to start with for reasons of simplicity. You can always upgrade to remote pointing later on.

Outline details of a simple el-az mount suitable for hand-pointing are given in **Fig. 7**. The dimensions given are only intended to be a guide: the exact dimensions will depend on the recommended stacking distances for the particular yagis used. The horizontal and vertical scaffold tubes may be clamped together using a standard 90deg. scaffold clamp. The vertical tube must be supported in some way, by guying for example. The bottom of the tube should rest on something which will stop it slipping sideways and sinking into the ground. The two vertical members of the 'H' frame can be fixed to the horizontal member using antenna clamps, although it is probably better to use triangular "gusset" plates and bolts. Whichever method is used, make sure that the 'H' frame is properly aligned, with the two vertical members in the same plane and parallel. Some means must be provided for adjusting and locking the elevation. One possibility is to clamp a tube to the horizontal member of the 'H' frame, with a rope going from its end to another piece of tubing clamped to the vertical scaffold pole.

The elevation and azimuth readouts for antenna positioning should be made next. These are required because one of Murphy's EME

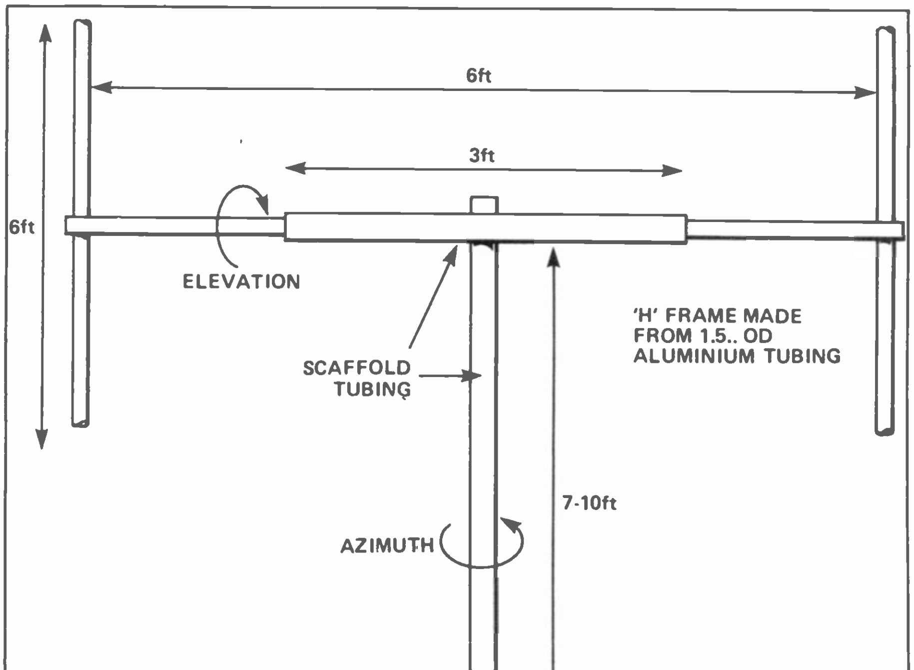


Fig. 7 A simple elevation-azimuth mount for 4 yagi antennas

laws states that EME activity always occurs when it is cloudy! The readouts are used in conjunction with tables of the moon's position (more on this later) in order to be able to point the antenna at the moon, without having to actually see it. The readouts need not be particularly sophisticated. Examples of suitable readouts are shown in **Fig. 8**. The elevation readout is designed to be fixed to one of the 'vertical' members of the 'H' frame. The azimuth readout is placed on the ground with the vertical mast passing through its centre. It is a good idea to peg the azimuth readout to the ground to stop it rotating.

The antennas may then be mounted on the 'H' frame. Make sure that they are all pointing in the same direction! The easiest way to do this is to line them up individually to point at some distant object, such as the sun. The antennas should be mounted with their elements horizontal, so there is no interaction between the supporting structure and the antennas, which could degrade performance. Next, the feedlines and power divider should be installed. Two points are important here: the feeder cables must *all* be the same length, and they must be connected *the same way round* to each antenna. For example, the inner of the cables should go to, say, the left hand side of each driven element. The power divider should be fixed at some convenient point so as to keep the cable lengths to a minimum. One possibility is to fix it to the horizontal member of the 'H' frame. Good quality cable should be used for the feedlines. Heliax cable is ideal, or H100, but UR67 would do. N-connectors should be used wherever RF connections have to be made. The so-called "UHF" connectors (SO239/PL259) are unsuitable for use at 70cm in this type of application. Make sure that the connectors are done up tightly.

At this point, you are probably itching to try out the antenna! Unfortunately there is still quite a lot of work to do before you are ready to listen for EME signals. However there is one test which can be done to indicate that things are progressing along the right lines. The sun is a fairly powerful source of radio noise, and can be used to check the performance of the equipment. Connect the antenna to the 70cm receiver via as short a length of cable as possible (it is best to take the receiver outside for this test), and point the antenna at the sun. A noticeable increase in noise should be heard if all is well. If nothing is heard, make sure that all the connections are properly made, and that the above points concerning equal cable lengths and polarity of connections have been observed.

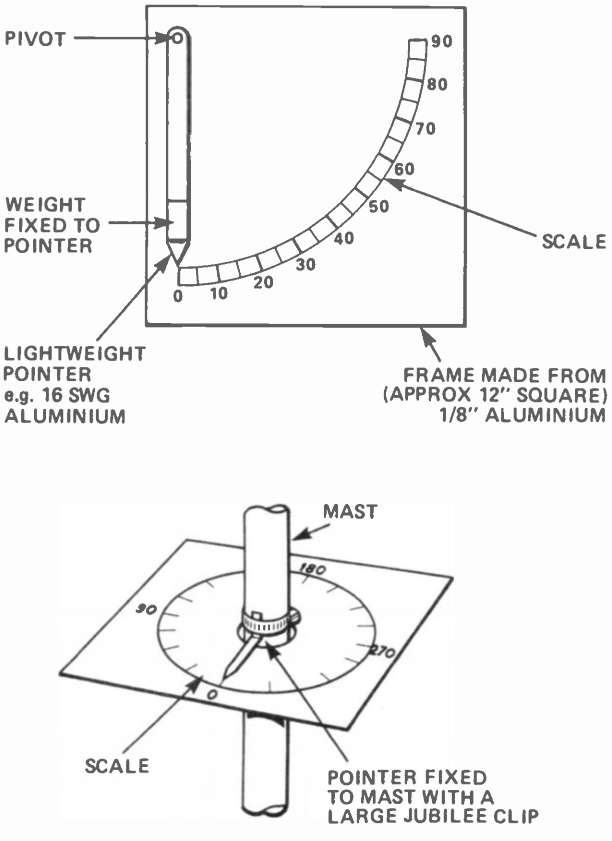


Fig. 8 Simple readouts for antenna positioning

Engineering The Receiver

A good receiver is essential if you are going to be successful on EME, as discussed in Part 1 of this series. There are a few golden rules which must be observed if optimum performance is to be obtained. Firstly a top quality preamp should be used as the first stage of the receiver. This means using a GaAs FET device. A number of good quality preamps are available commercially, and it is probably more sensible to buy rather than build if you are not too experienced in this area. If you feel do feel confident about building one, then there are a number of good designs around (see **Ref. 4**, for example). This preamp *must* be mounted at the antenna as even a few tenths of a decibel of extra loss between the preamp and the antenna will degrade the overall noise figure significantly. Depending on the loss of the cable which will be used to connect the preamp to the rest of the receiver, and the noise figure of the main receiver, a second preamp may be needed (also mounted at the antenna). There is no hard and fast rule to help you decide whether a second preamp is necessary. It is safest to err on the side of caution and assume it is necessary. The noise figure of this second preamp need not be especially low, and a bipolar preamp will suffice (Ref. 4).

For those readers who are interested in a somewhat more analytical approach to EME receiver design, I have written a BASIC program which allows the overall noise figure of the receiving system to be determined. The resulting number can be used in the link budget program, published last month, to see what effect different receiver configurations have on the overall system performance. An important use of the program is to highlight any weak spots in the receiver, such as excessive cable losses, which need to be improved.

The receiving system is assumed to consist of two preamplifiers and a main receiver, with associated 'lossy' interconnecting cables, as shown in

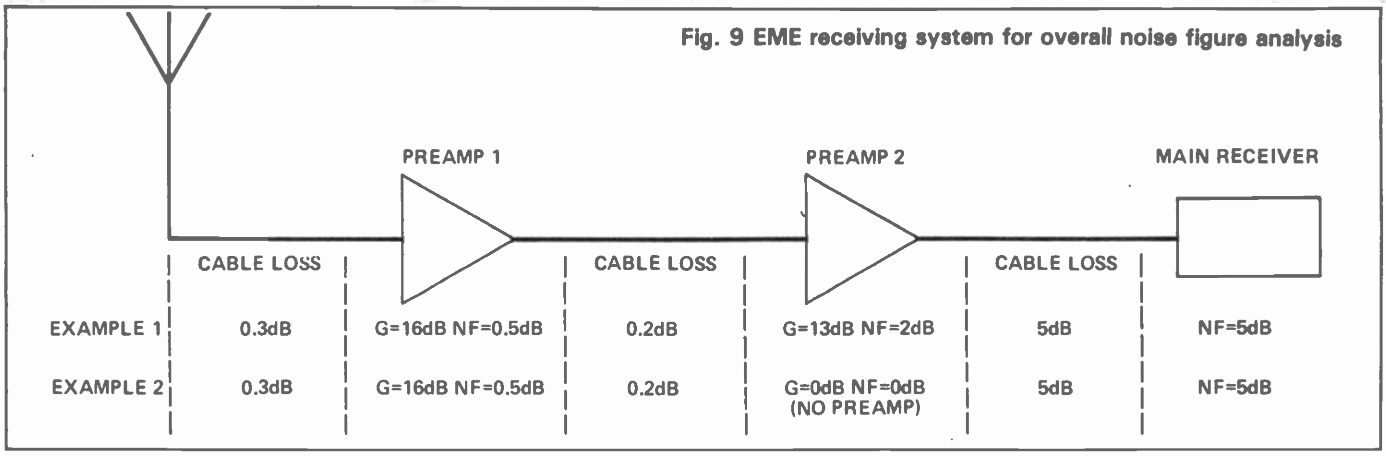


Fig. 9 EME receiving system for overall noise figure analysis

```
95   REM  RECEIVER OVERALL RECEIVER
NOISE FIGURE CALCULATION PROGRAM
96   REM  DATA INPUT DRIVER
100  GOSUB 190
110  GOSUB 210
120  GOSUB 230
130  GOSUB 250
140  GOSUB 270
150  GOSUB 290
160  GOSUB 310
170  GOSUB 330
180  GOTO 350
185  REM  DATA INPUT SECTION
190  INPUT "MAIN RX NOISE FIGURE?
";N3
200  RETURN
210  INPUT "CABLE LOSS. PREAMP2 TO
MAIN RX? ";L3
220  RETURN
230  INPUT "PREAMP2 GAIN? ";G2
240  RETURN
250  INPUT "PREAMP2 NOISE FIGURE?
";N2
260  RETURN
270  INPUT "CABLE LOSS. PREAMP1 TO
PREAMP2? ";L2
280  RETURN
290  INPUT "PREAMP1 GAIN? ";G1
300  RETURN
310  INPUT "PREAMP1 NOISE FIGURE?
";N1
320  RETURN
330  INPUT "CABLE LOSS, ANTENNA TO
PREAMP1? ";L1
340  RETURN
345  REM  CHAIN NOISE FIGURE
CALCULATIONS BEGIN
350 N = N3 + L3
360  GOSUB 810
370 T3 = T
380 DG = G2
390  GOSUB 830
400 N = N2
410  GOSUB 810
420 T = T + (T3 / NG)
430  GOSUB 850
440 N = N + L2
450  GOSUB 810
460 T2 = T
470 DG = G1
480  GOSUB 830
490 N = N1
500  GOSUB 810
510 T = T + T2 / NG
520  GOSUB 850
530 N = N + L1
540 N =  INT (N * 100) / 100
545  REM  PRINT CURRENT PARAMETER
VALUES AND RESULTS
550  PRINT
560  PRINT "CODE           PARAMETER
VALUE"
570  PRINT
580  PRINT "1     MAIN RX  NF=
";N3;"DB"
590  PRINT "2     LOSS.
PREAMP2-MAIN RX=     ";L3;"DB"
600  PRINT "3     PREAMP2 GAIN=
";G2;"DB"
610  PRINT "4     PREAMP2 NF=
";N2;"DB"
620  PRINT "5     LOSS. PREAMP1 TO
PREAMP2= ";L2;"DB"
630  PRINT "6     PREAMP1 GAIN=
";G1;"DB"
640  PRINT "7     PREAMP1 NF=
";N1;"DB"
650  PRINT "8     LOSS. ANTENNA TO
PREAMP1= ";L1;"DB"
660  PRINT
670  PRINT "OVERALL RECEIVER NOISE
FIGURE= ";N;"DB"
680  PRINT
685  REM  RE-RUN MENU
690  INPUT "NEW PARAM CODE.
RERUN(R) OR QUIT(Q)? ";A$
700  IF A$ = "Q" THEN  GOTO 870
710  IF A$ = "R" THEN  GOTO 100
720  IF A$ = "1" THEN  GOSUB 190
730  IF A$ = "2" THEN  GOSUB 210
740  IF A$ = "3" THEN  GOSUB 230
750  IF A$ = "4" THEN  GOSUB 250
760  IF A$ = "5" THEN  GOSUB 270
770  IF A$ = "6" THEN  GOSUB 290
780  IF A$ = "7" THEN  GOSUB 310
790  IF A$ = "8" THEN  GOSUB 330
800  GOTO 350
805  REM  CONVERSION OF NOISE
FIGURE TO NOISE TEMPERATURE
810 T = 290 * ( EXP (0.2303 * N) -
1)
820  RETURN
825  REM  CONVERSION OF DB'S TO
ABSOLUTE NUMBER
830 NG =  EXP (0.2303 * DG)
840  RETURN
845  REM  CONVERSION OF NOISE
TEMPERATURE TO NOISE FIGURE
850 N = 4.343 *  LOG ((T / 290) +
1)
860  RETURN
870  END
```

BASIC program for determining overall noise figure of receiving system

Fig. 9. Two examples will be given to illustrate the use of the program: the parameters which will be used are given in Fig. 9. The program's points and the appropriate input parameters for example 1 are as follows:

```
MAIN RX NOISE FIGURE? 4
CABLE LOSS, PREAMP2 TO MAIN RX? 5
PREAMP2 GAIN? 13
PREAMP2 NOISE FIGURE? 2
CABLE LOSS, PREAMP1 TO PREAMP2? 0.2
PREAMP1 GAIN? 16
PREAMP1 NOISE FIGURE? 0.5
CABLE LOSS, ANTENNA TO PREAMP1? 0.3
```

The program then outputs the following:

```
CODE        PARAMETER                  VALUE

1     MAIN RX  NF=                     4DB
2     LOSS, PREAMP2-MAIN RX=           5DB
3     PREAMP2 GAIN=                    13DB
4     PREAMP2 NF=                      2DB
5     LOSS, PREAMP1 TO PREAMP2=        .2DB
6     PREAMP1 GAIN=                    16DB
7     PREAMP1 NF=                      .5DB
8     LOSS, ANTENNA TO PREAMP1=        .3DB

OVERALL RECEIVER NOISE FIGURE= .89DB
```

It can be seen that the overall noise figure of the receiver is 0.39dB higher than that of the first preamp, 0.3dB of which is due to the cable loss between the antenna and the first preamp. The remaining 0.09dB is due to the noise contribution from the rest of the system. This figure is quite acceptable and is typical of a well-engineered system.

After the program has produced the above results there is another prompt, and one has the option of changing the parameters, re-running or quitting. These options are used in exactly the same way as in the link budget program described last month. The second example shows what would happen if the second preamp was not present. The inputs to the program are as above, except that a figure of 0 is entered for the gain and noise figure of preamp 2. The program output is then:

```
CODE        PARAMETER                  VALUE

1     MAIN RX  NF=                     5DB
2     LOSS, PREAMP2-MAIN RX=           5DB
3     PREAMP2 GAIN=                    0DB
4     PREAMP2 NF=                      0DB
5     LOSS, PREAMP1 TO PREAMP2=        .2DB
6     PREAMP1 GAIN=                    16DB
7     PREAMP1 NF=                      .5DB
8     LOSS, ANTENNA TO PREAMP1=        .3DB

OVERALL RECEIVER NOISE FIGURE= 1.63DB
```

The overall noise figure is now much higher, due to an increased noise contribution from the rest of the receiver caused by the lack of a second stage preamp. The link budget program can be used see how much degradation in signal-to-noise ratio would be caused by not using a second stage preamp (it works out as 1.96dB in this case — a significant amount).

One more thing needs to be considered before the receiver is ready for

EME use, and that is the provision of an audio filter. Many operators find that a narrow audio filter helps them to copy the weak signals, but this is a matter of personal preference. There are many types of audio filter available, but I prefer types which are tunable and have variable bandwidth eg. Datong FL1. The one I use was designed by DJ6HP and uses 4 741 ICs and a few extra components, and is very easy to build (**Ref. 5**).

Transmitters

In order to be successful with a 4 yagi array on 70cm, a transmitter power of 700W or more is necessary. The K2RIW amplifier which uses a pair of 4CX250B type tubes in parallel is very popular with EME stations and is to be recommended (**Ref. 6**). When running this amplifier at high power levels, problems are often experienced with surplus 'tested' tubes, and it is worth considering buying new ones. With this in mind, there are other tubes available which are slightly more expensive than the 4CX250B, but which will last a lot longer. These are the 4CX250R, and the 8930. Both tubes are ruggedised versions of the 4CX250B and work extremely well in the K2RIW amplifier. The 8930 has a larger external anode structure, which makes it a lot easier to cool.

Whichever tubes are used, the amplifier should be run in true class-C on CW (ie no standing current). This of course means that more drive power will be needed than for linear operation, but the efficiency is much higher. The blower should be large enough so that the exit air is cool enough to leave your hand in. Running the amplifier too hot will cause the tuning to drift, as well as shortening the life of the tubes.

Large blowers tend to be rather noisy. Listening to weak signals in the presence of blower noise tends to be rather tiring and headphones are a good idea. Alternatively, it is possible to reduce the voltage to the blower during receive periods, as only a small air flow is needed to keep the tubes cool when not transmitting.

Transmit/Receive Switching

The use of high power levels for EME work makes the design of the transmit/receive control system quite critical if blown-up relays and preamps are to be avoided! The main transmit/receive changeover relay must be capable of handling the power and must also possess sufficient isolation so that excessive power does not leak into the preamp when transmitting. GaAs FET preamps should not be allowed to receive more than about 10mW RF input power, meaning that the changeover relay should have at least 50dB isolation. There is no need to remove the DC power to the preamp on transmit.

If the changeover relay has less than 50dB isolation, a second relay is necessary to protect the preamp, as shown in **Fig. 10**. If you are unsure about the isolation of your main, relay and do not have the test equipment to measure the leakage power, I think it is best to play on the safe side and design in a protection relay from the beginning. The protection relay does not have to be able to handle much power, but should have low loss to avoid degrading the receiver noise figure.

The sequencing of the relays is very important. Disastrous things will happen if the transmitter power is allowed to reach the changeover relay before the relay has operated, even for an instant. The transmit/receive control system should ensure that there is a small delay between the main changeover relay going over and the transmitter actually coming on. If a protection relay is used, the sequence should be to activate the protection relay first, then the main changeover relay and finally the transmitter. This will ensure a long life for the relays and the preamp!

Some stations even go a stage further, and build in a 'belt and braces' feature, which prevents the transmitter from coming on if the changeover relay(s) have not gone over. Some changeover relays have extra contacts provided which can be used in a 'handshaking' system to achieve this desirable goal. Relays without such contacts can often be modified by taping a reed relay switching element to the coil (thanks to G3SEK for this idea).

Finer Points

We have now covered most aspects of putting an EME station together. This section deals with a few last technical points.

Some means of accurate frequency calibration should be available to ensure that transmit and receive frequencies can be set to better than 1kHz accuracy. This is especially important for skeds, since many stations do not search more than 1 or 2kHz around the sked frequency. Most modern transceivers have an accurate frequency readout, but frequency errors can often creep in due to crystal offsets in transverters. At a pinch, one can use beacons for checking calibration, but a crystal calibrator is best. This need not be very complicated — a 1MHz crystal oscillator and TTL dividers will produce harmonics up to 432MHz, and can itself be calibrated by beating it's output with the 200kHz Droitwich Radio 4 transmission (which is a *very* accurate frequency standard). One word of warning though: owing to the fact that the calibrator puts out powerful signals at lower frequencies, it is possible that a number of carriers will be received due to images, intermodulation products, LF feedthrough etc. You must be certain that the signal you are calibrating to is the right one! One reasonably foolproof way of doing this is to precalibrate using a beacon, and use the calibrator more for final checking. If

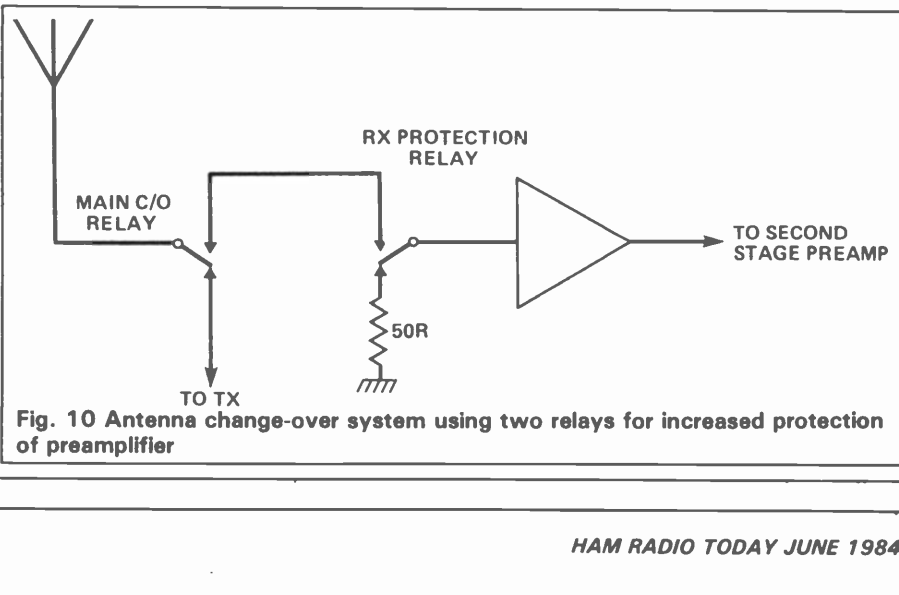
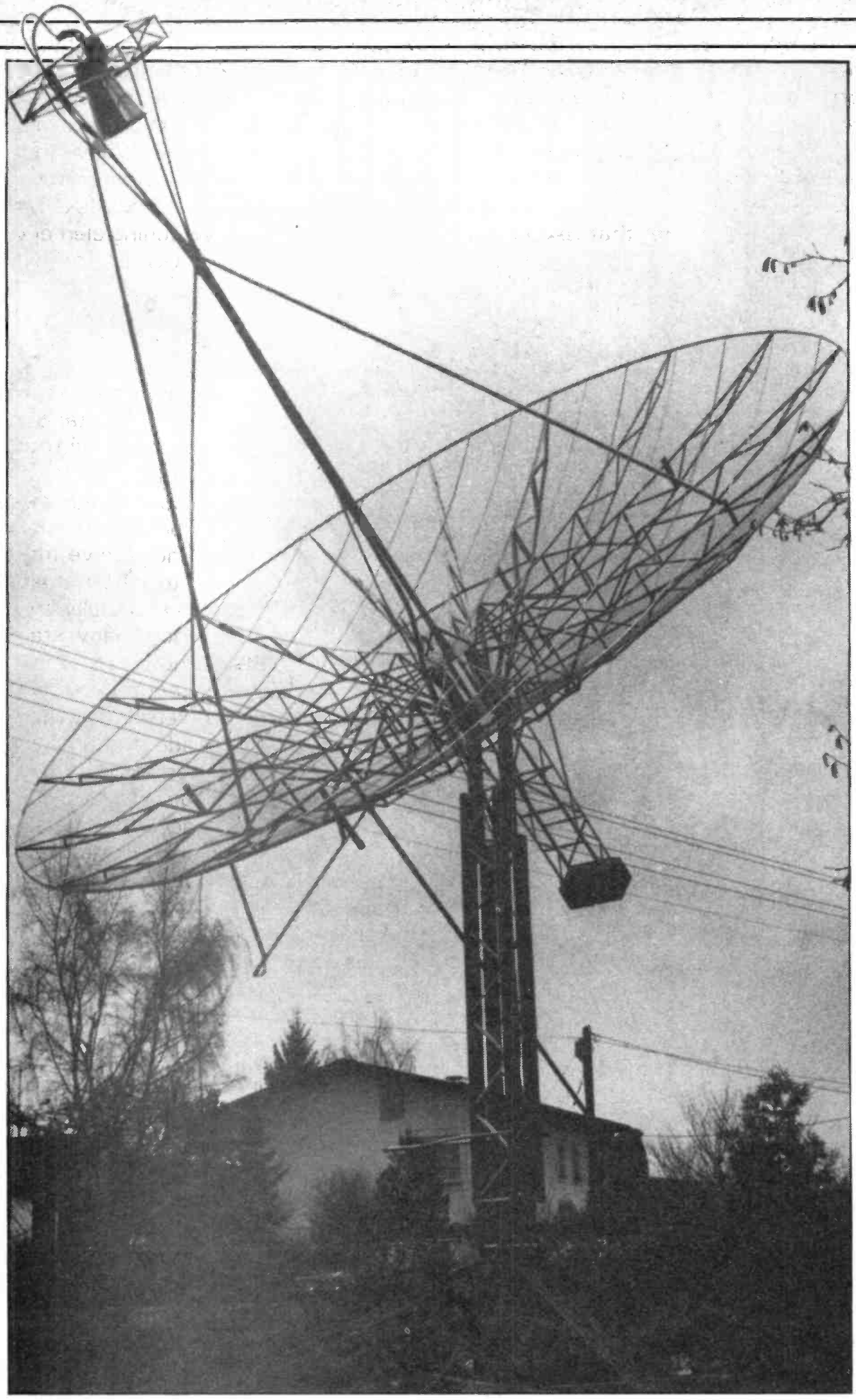


Fig. 10 Antenna change-over system using two relays for increased protection of preamplifier



The 20ft dish used by the OE9XXI group on 70, 23 and 13cm EME. The 23cm feed was in place when the photograph was taken.

there is a serious discrepancy, then you are probably listening to the wrong signal!

A lot of EME operating occurs at night, and it is useful to have some sort of lighting installed at the antenna site, if only to enable the antenna position indicators to be read. From the safety point of view, it is best to use a low-voltage lamp, eg a car headlamp bulb, with the mains transformer inside the house out of harm's way. It is also very useful to have the shack audio available at the antenna, so that you can continue to listen to signals whilst re-pointing the antena, for example.

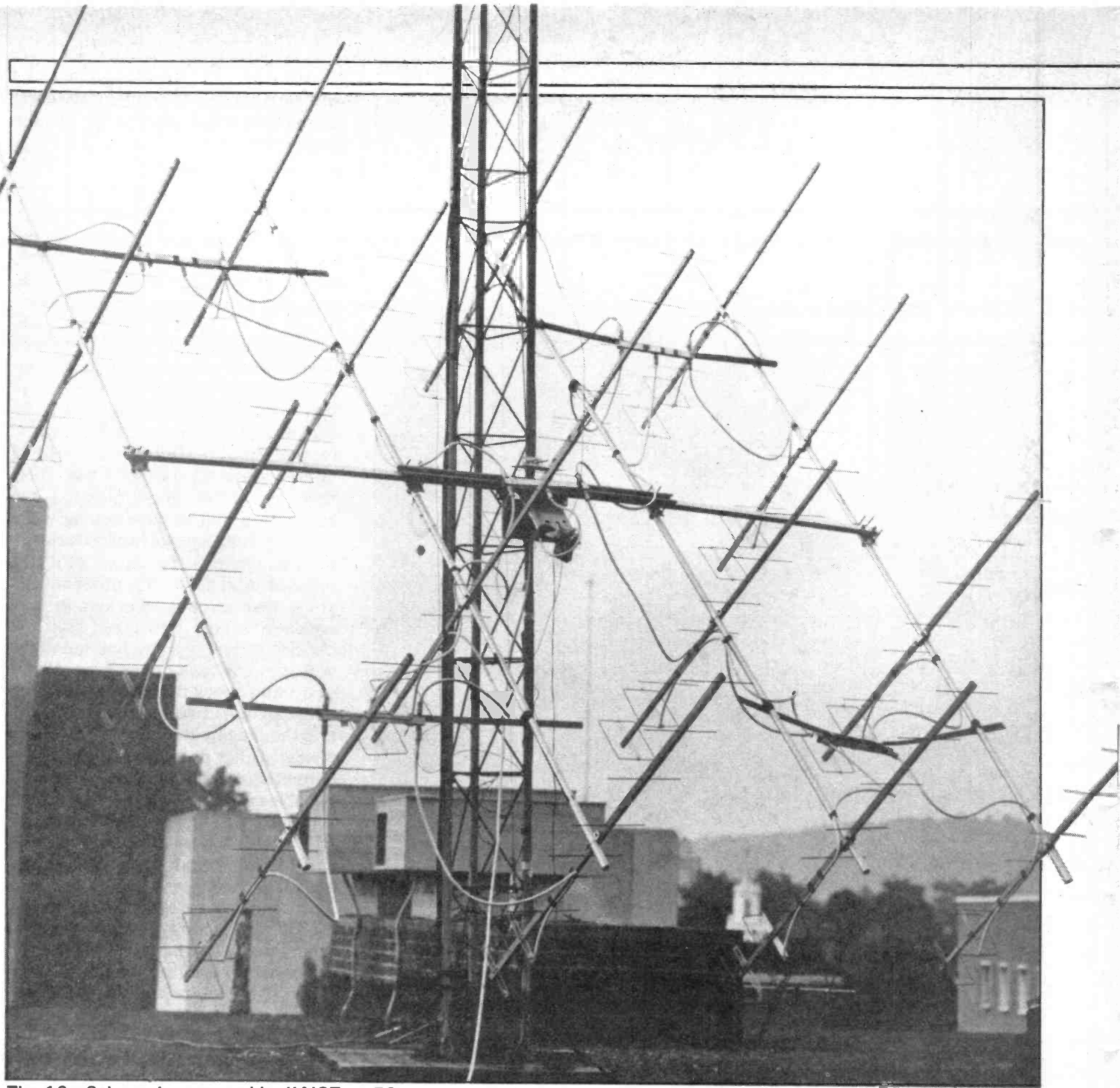
2. Equipment Checking

An EME station is a fairly complex assembly of equipment, all of which must be working at peak performance if you are going to be successful. A certain amount of test equipment is very useful, but much can be done without any. In this section I will outline a number of procedures which will enable the system to be given a good check-out.

Using The Sun

Nature has provided us with an excellent extra-terrestrial beacon, the sun. The such can be used as the basis for two checks on the performance of an EME system. Firstly, we can make use of the fact that the sun emits noise in the radio spectrum, the strength of which is reasonably constant with time. A 4 yagi array on 70cm, with a good receiver, should receive about 8-10dB of sun noise. If your system registers less than this, then you have good grounds for suspecting that all may not be well. Unfortunately low sun noise does not tell you whether the antenna or the receiver is at fault, but at least you know that something is wrong and needs attention. You could start by checking that no water has found its way into the coax connectors. Next, you might check that the changeover relays are not unduly lossy by connecting the preamp directly to the power divider. Other possibilities include incorrect phasing of the antennas, faulty cables etc. Any improvements you can make will show up as increased sun noise. One warning though: the sun's noise output does sometimes increase if the sun is active, and it is worth making a number of measurements on different days to see whether any apparent improvements are genuine. Another way of getting round this uncertainty is to compare notes with someone else whose system has not been changed.

The procedure for measuring sun noise is as follows. Choose a time when the sun is visible to your antenna, with no obstructions in the way. Point the antenna to a part of the sky well away from the sun, and which is also unobstructed. Then bring the antenna on to the sun, and measure the amount by which the noise level increases. This is then your sun noise figure. There are several ways of measuring the amount by which the noise level increases with reasonable accuracy. The most accurate way is to use a switched attenuator, which can be home made (**Ref. 7**). Connect the attenuator between the converter/transverter and the main receiver, with a fixed attenuator between the switched annenuator and the receiver. Do not omit the fixed attenuator, as its function is



The 16 × 8el quagi array used by KAIGT on 70cms

to define the impedance which the switched attenuator sees. Without it, the fixed attenuator may not read correctly. This fixed attenuator can also be home made (**Ref. 8**). The value of the fixed attenuator should be chosen so that the S-meter reads a small value (say S1-2), with the antenna pointing skywards and the fixed attenuator set to 0dB. The antenna is then pointed at the sun, and the switched attenuator set to bring the S-meter back to the same level as it was when the antenna was pointing skywards. When this has been done, try moving the antenna to see whether any more sun noise can be obtained. If an increase is obtained, switch in extra attenuation to bring the S-meter back to the reference level. The sun noise figure for your system is then equal to the total amount of switched attenuation introduced. For this method to work properly, the S-meter has to be capable of resolving small changes in noise level, eg 0.5dB. If yours does not, then some other way of displaying the receiver noise level must be used, for example by connecting an AC voltmeter to the audio output. It is possible to measure sun noise without the complexity of an attenuator, by measuring the change in audio noise from the receiver directly with a meter. This method is notoriously inaccurate and I do not recommend it.

The second useful function that the sun has in helping to check out an EME system is for calibrating antenna readouts and checking their accuracy. The elevation and azimuth of the sun can be calculated, and by peaking your antenna up on sun noise you can calibrate your antenna readouts with very high accuracy. Then, by following the sun as it moves in the sky you can ensure that the readouts remain correct at different positions. The presence of any accumulating errors means that your antenna mount is not set-up correctly (eg the main mast may not be exactly vertical). I have written a BASIC pro-

```
95   REM   SUN LOCATION PROGRAM
100 E =  - 1
110  DEF  FN A(X) =  INT (X * 10 +
.5) / 10
120  INPUT "DAY, MONTH, YEAR
";D,M,Y
125  REM  CALCULATION OF JULIAN
DATE
130 Y1 = Y - ( INT (Y / 100) *
100)
140 I1 = 2
150  IF M >  = 3 THEN 230
160  IF  INT ((Y - 1853) / 4) < 11
THEN 190
170 C1 =  - 1
180  GOTO 200
190 C1 = 0
200 J1 = 365 * (Y - 1853) + D + 30
* (M + 9) +  INT ((M + 10) / 2)
210 J2 =  INT ((Y - 1853) / 4) + 1
+ C1
220  GOTO 340
230  IF  INT ((Y - 1852) / 4) < 11
THEN  GOTO 260
240 C1 =  - 1
250  GOTO 270
260 C1 = 0
270  IF M = 9 THEN 310
280  IF M = 11 THEN 310
290 C2 = 0
300  GOTO 320
310 C2 = 1
320 J1 = 365 * (Y - 1852) + D + 30
* (M - 3) +  INT ((M + 2) / 2)
330 J2 =  INT ((Y - 1852) / 4) +
C1 + C2
340 J = J1 + J2
345  REM  END OF JULIAN DATE
CALCULATION
350 DY = J - 44865
360 PI = 3.1415926
370 C = PI / 180
380  INPUT "LATITUDE= (DD,MM)
";L1,L2
390  INPUT "LONGITUDE= (DD,MM)
";L3,L4
400  INPUT "START TIME (GMT) ";T
410  INPUT "INTERVAL (MINS) ";XX
420  PRINT
430  PRINT
440 LA = L1 + L2 / 60
450 LO = L3 + L4 / 60
460 NS$ = "N"
470  IF LA < 0 THEN NS$ = "S"
480 EW$ = "W"
490  IF LO < 0 THEN EW$ = "E"
500  PRINT "SUN ";D;"/";M;"/";Y;"
FROM LAT= "; INT (LA * 100 + .5) /
100 *  SGN (LA);NS$;" LONG="; INT
(LO * 100 + .5) / 100 *  SGN
(LO);EW$
510  PRINT
520  PRINT " GMT    AZ     EL
GHA    DEC"
530  PRINT " ---    --     --
---    ---"
540 TH =  INT (T / 100) + ((T /
100) -  INT (T / 100)) * 1.666666
550 E1 = E
555  REM  CALCULATION OF NUMBER OF
DAYS SINCE EPOCH 1975.0
560 DZ = DY + (TH / 24)
565  REM  CALCULATION OF SUN'S
ECLIPTIC LONGITUDE
570 N = 360 * DZ / 365.25
580 N = N -  INT (N / 360) * 360
590 M1 = N - 3.438926
600  IF M1 < 0 THEN M1 = M1 + 360
610 EC = (2 / C) * .01672 *  SIN
(M1 * C)
620 L = EC + N + 279.04147
630  IF L > 360 THEN L = L - 360
635  REM  CONVERSION OF ECLIPTIC
LONGITUDE TO DEC AND RA
640 SD = .397628 *  SIN (L * C)
650 DE = ( ATN (SD /  SQR (1 - SD
* SD))) / C
660 TA =  TAN (L * C) * .917547
670 A =  ATN (TA) / C
680 Q =  INT (L / 90)
690  IF Q = 1 THEN A = A + 180
700  IF Q = 2 THEN A = A + 180
710  IF Q = 3 THEN A = A + 360
715  REM  CONVERSION OF RA TO GHA
720 DD = ((DY -  INT ( INT (DY /
365.25) * 365.25)) * .065709) -
17.393506
730 DD = DD + (TH * 1.002743)
740  IF DD > 24 THEN DD = DD - 24
750  IF DD < 0 THEN DD = DD + 24
760 GH = (DD * 15) - A
770  IF GH < 0 THEN GH = GH + 360
775  REM  CONVERSION OF GHA TO LHA
780 LH = GH - LO
785  REM  CALCULATION OF ELEVATION
790 SE =  SIN (DE * C) *  SIN (LA
* C) +  COS (DE * C) *  COS (LA *
C) *  COS (LH * C)
800 E = ( ATN (SE /  SQR (1 - SE *
SE))) / C
805  REM  JUMP TO TIME INCREMENT
ROUTINE OR RE-RUN ROUTINE IF SUN
IS BELOW HORIZON
810  IF E < 0 THEN  GOTO 830
820  GOTO 850
830  IF E1 < 0 THEN  GOTO 1110
840  GOTO 1130
845  REM  CALCULATION OF AZIMUTH
850 CA = ( SIN (DE * C) -  SIN (LA
* C) *  SIN (E * C)) / ( COS (LA *
C) *  COS (E * C))
860 A = (1.5708 - ( ATN (CA /  SQR
(1 - CA * CA)))) / C
870  IF  SIN (LH * C) > 0 THEN A =
360 - A
880 GH =  FN A(GH)
890 DE =  FN A(DE)
900 E =  FN A(E)
910 A =  FN A(A)
915  REM  CONVERSION OF TIME TO
24H CLOCK
920 HR =  INT (TH)
930 MN =  INT (((TH - HR) * 60) +
.5)
940 T = 100 * HR + MN
950  IF MN = 60 THEN T = T + 40
955  REM  ROUTINE FOR PUTTING
LEADING ZEROS IN FRONT OF TIME
960 T$ =  STR$ (T)
970 I =  LEN (T$)
980  IF I = 4 THEN  GOTO 1020
990  FOR X = 1 TO 4 - I
1000  PRINT "0";
1010  NEXT X
1015  REM  PRINTING OF FINAL
RESULTS
1020  PRINT T;
1030  HTAB 7
1040  PRINT A;
1050  HTAB 14
1060  PRINT E;
1070  HTAB 21
1080  PRINT GH;
1090  HTAB 28
1100  PRINT DE
1105  REM  INCREMENT TIME
1110 TH = TH + XX / 60
1120  GOTO 550
1130  PRINT
1140  INPUT "RE-RUN PROGRAM? (Y/N)
";A$
1150  IF A$ = "Y" THEN  GOTO 100
```

BASIC program for determing the position of the sun to enable calibration of antenna readouts

gram, reproduced here, which calculates the position of the sun at any location given the date, time, latitude and longitude. For example, if the sun's position is required on 25 May 1984 starting at 0700gmt from a location with a latitude of 52 deg 20min North, and a longtitude of 1deg 15min West at time intervals of 60minutes, the following parameters would be entered:

```
DAY, MONTH, YEAR 25,5,1984
LATITUDE= (DD,MM) 52,20
LONGITUDE= (DD,MM) 1,15
START TIME (GMT) 0700
INTERVAL (MINS) 60
```

The output from the program is as follows:

SUN 25/5/1984 FROM LAT= 52.33N LONG=1.25W

GMT	AZ	EL	GHA	DEC
0700	88.1	25.4	286.1	21
0800	100.4	34.6	301.1	21
0900	114.5	43.3	316.1	21
1000	131.8	51	331.1	21
1100	153.7	56.5	346.1	21
1200	179.7	58.7	1.1	21
1300	205.7	56.7	16.1	21
1400	227.7	51.2	31.1	21
1500	245.1	43.5	46.1	21
1600	259.3	34.8	61.1	21
1700	271.6	25.7	76.1	21.1
1800	283.1	16.6	91.1	21.1
1900	294.4	8	106.1	21.1
2000	305.9	.1	121.1	21.1

The first three columns contain the required information. The columns GHA and DEC give the astronomical co-ordinates of the sun (Greenwich Hour Angle and Declination) which allow the program to be checked against almanac data (for those who are interested). *Note: if your site is south of the equator, or east of Greenwich, then the latitude and longitude have to be entered as negative numbers (both the degrees and the minutes).* There is one final point concerning the use of the sun for antenna checking. When you have the antenna peaked up for maximum sun noise, check that it is visually lined up also. Any significant 'squint' should be noted, as it indicates the presence of a fault, such as incorrect phasing, or a poor connection somewhere.

VSWR And Power Measurement

Provided that good sun noise can be obtained from the system, one can be fairly sure that the antenna and receiver are working well. It is, however, worth checking that the antenna has a good VSWR, otherwise the transmitter may not load properly and the preamp may not give its best performance. If commercial antennas are being used, the VSWR should be quite low. A high VSWR in this case is most likely to be caused by a cable or connector fault. An SWR bridge rated for use at 70cm should be used for measuring the VSWR, or alternatively a Bird Throughline. The latter instrument is also useful for checking the power output of the PA. Make sure that you have the correct element though (1000W 200-500MHz type), or the readings may be inaccurate.

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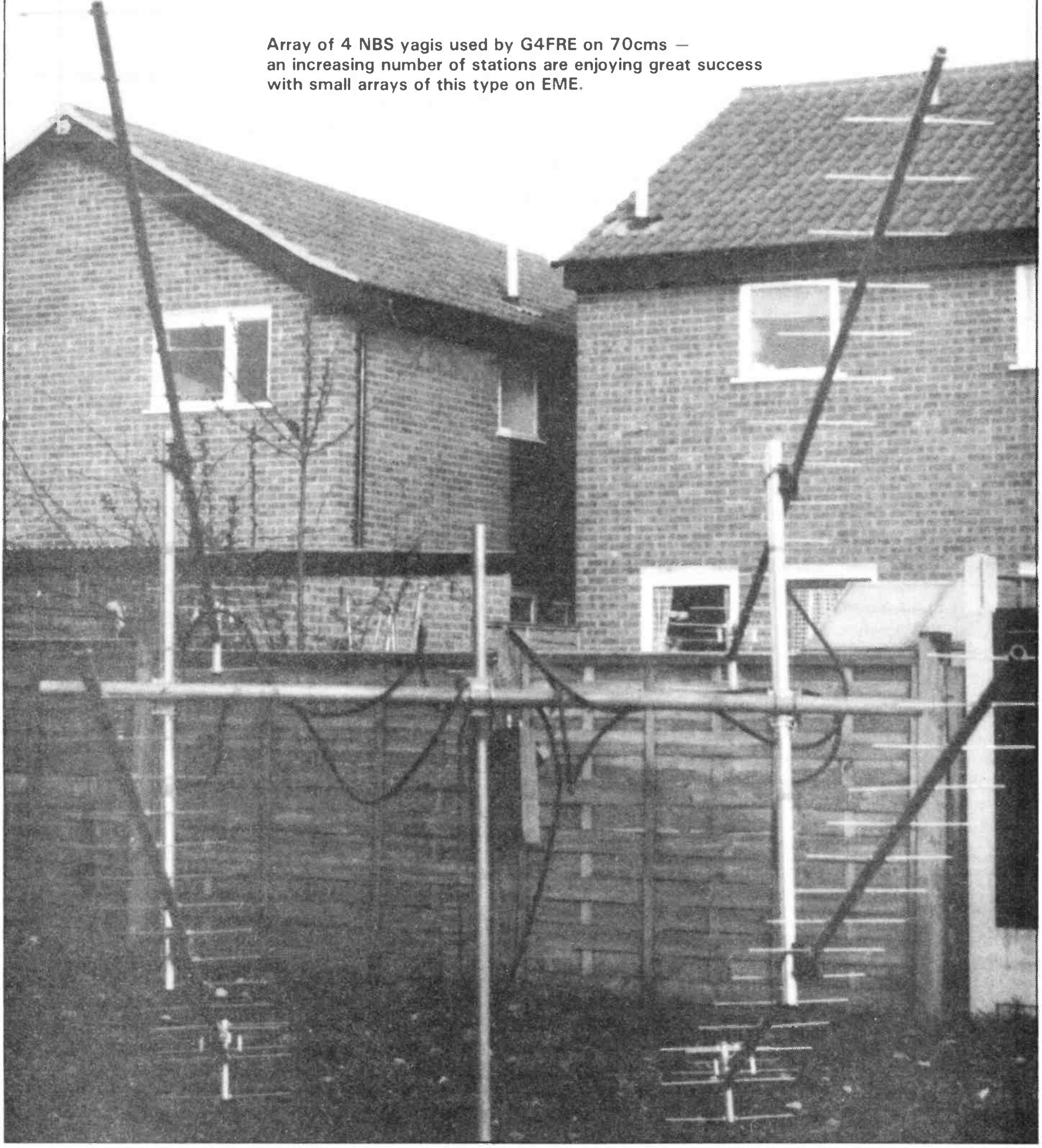
Due to a lack of space in this months HRT, there will be a further instalment next month in which Charles will describe EME operational procedure and give a BASIC program for predicting the position of the moon.



Array of 4 NBS yagis used by G4FRE on 70cms — an increasing number of stations are enjoying great success with small arrays of this type on EME.

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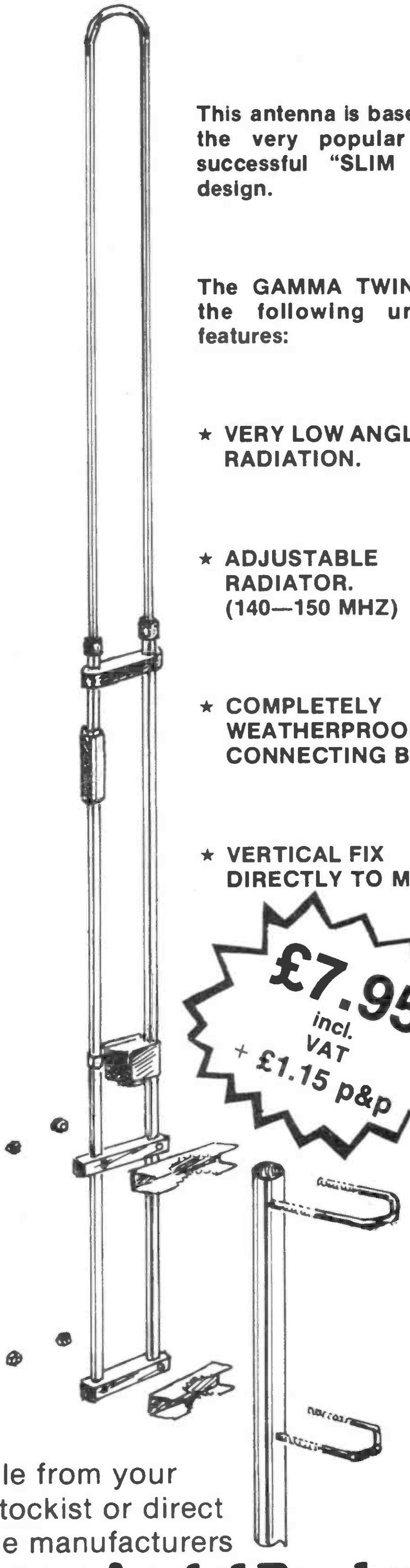

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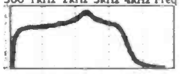

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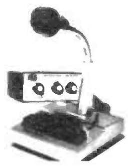

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An ACTIVE AERIAL for Receivers

This article describes the development of an active aerial for use where a general coverage receiver is to be used portable or where the more usual ATU and long-wire or tuned aerials might not be desired or are not possible. This aerial was developed as a speedy solution for an aerial when the author acquired an FRG7700 and wished to listen on the amateur bands but also to the rest of the spectrum. It may be used to provide a remotely mountable broadband aerial with co-ax feed to the receiver, or it may be used adjacent to the receiver. However, it is not a comparable substitute for a properly matched wire aerial, particularly an external one, and is, of course, receive only. This design is in day-to-day use in the shadow of a strong MF broadcast transmitter and should be satisfactory for most locations.

No room for outside antennas? Does your partner hate wires around the curtain rail too? Brian Frost, G6UTN, has the answer,

Development

In principle the active aerial is very simple. When my receiver arrived I effectively made one in two minutes by merely inserting a 2m length of wire into the rear socket. The first stage of the receiver is a dual-gate MOSFET preceeded by band-switched filters and the length of wire showed its shortcomings only by its *varying impedance with frequency* and thus the degree of mismatch to the 50 ohms input to the filters. One of the reasons the length of wire apparently works well is because at the lower frequencies, where the aerial impedance is quite high and hence the mismatch is most severe, the loss of signal is *least* noticed because the broadcast transmissions are so strong. As the frequency inceases a short length of wire shows a steady fall in impedance and the match improves until the length is around one-quarter wavelength. The short-comings of just a length of wire show themselves most when low level signals on 'top-band' or in the marine band are required to be received. The quality of reception of Radio 4 on 200KHz is a good guide to the aerial performance since the mismatch at this frequency is so considerable that despite the strong transmission the signal can sound weak enough to provide a poor signal-to-noise ratio. Matching to the receiver is very desirable for another reason beside signal attenuation; modern general-coverage receivers mostly adopt the technique of up-conversion to a frequency in excess of 40MHz to eliminate the need for track-tuned 'front-ends', but most designers insert sub-octave filters prior to the first stage to raise front-end performance to an acceptable level. These same filters should be correctly source matched to return their designed frequency characteristics and the responsibility for this rests with the connection made to the aerial socket.

The Active Aerial perched on the author's FRG7700

I wished to develop an aerial unit that would turn any short length of wire or telescopic aerial into a *matched signal source* for my receiver to allow me to investigate the whole HF spectrum without the need for any tuning adjustment and which would be a useful accessory for the receiver when used portable or taken travelling.

Principles

In principle an active aerial is very simple and is shown in **Fig. 1**. The 'active' ingredient being a buffer stage designed to accommodate the wide variation of impedance with frequen-

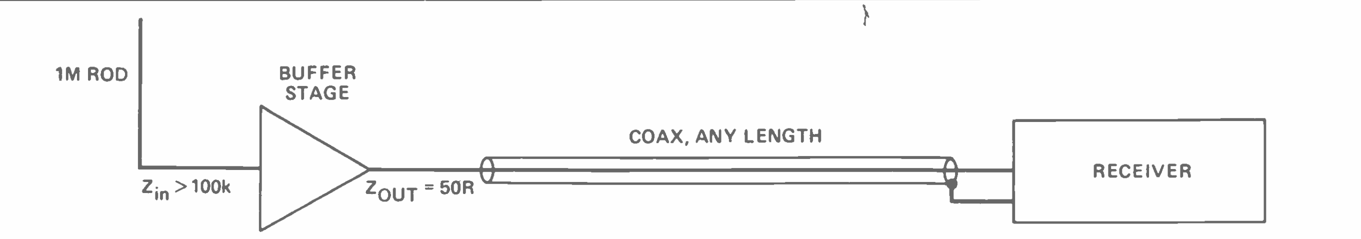


Fig. 1 Basic Active Aerial

cy exhibited by (say) a telescopic aerial and transform it into a low output impedance for transmission via co-ax to the receiver. Simply, if the circuit can provide an input impedance that is much higher than that which the aerial provides, the voltage produced from the aerial is not attenuated and variation of aerial impedance has no effect. Exact impedance matching to the aerial by the circuit is not required since at HF frequencies *aerial noise* is the factor which determines S/N ratio and not front-end noise figure. However, in practice this still places fairly stringent performance requirements on the circuitry. It must have a wide frequency response of some 100kHz to in excess of 30MHz, exhibit low harmonic distortion, and be capable of handling strong signals without intermodulation affecting the weak signals. For some time now, the front-ends of receivers have been dominated by FET devices and they are attractive for an active aerial for the same reasons of low noise and good cross-modulation performance. One of the first circuits I tried used a new FET as is shown in **Fig. 2**. This is unbeatable for simplicity and is a tribute to the characteristics of the new generation of power-MOSFETs. The device used is the VN10 manufactured by Siliconix in a simple source follower configuration. It may best be described as a small power-MOSFET, but presented in a plastic package and providing a linearity at low impedances unattaintable with a single small signal device. Although the MOSFET returns higher gate capacitances than small signal FETs the 10pF capacitance seen by the aerial is still acceptable at the upper frequencies of use. The low channel resistance and the insulated gate make the device almost a perfect 'source-follower' buffer amplifier where the 10pF input capacitance can be tolerated.

The strong signal performance of the circuit is very good since the low impedance nature of the source can drive the source resistance to hundreds of millivolts without loss of the required linearity. This kind of performance is not easily measurable, even with sophisticated equipment, since we may require to listen to a weak signal at, say, 14.5 MHz and may hear instead the second harmonic of strong broadcast signals in the 7MHz band at 7.25 MHz. This would mean hearing a second harmonic that is as low as 80dB down on the fundamental. This is commonly accepted as a very good figure and techniques for even measuring this sort of level are difficult. In practice, I have found that as long as signals anywhere in the receiver coverage are not allowed to exceed some S9 + 40dB (around the low tens of millivolts for the FRG7700) then the harmonics of these strong signals are only just audible. This characteristic is a good measure of the performance of an active aerial and has obviously caused some designers to opt for a tuned design. However, I considered an untuned design to be essential for users who desire to use this aerial mounted remotely from the receiver, perhaps to gain freedom from TV timebase harmonics, where the circuit would be unattended. Intermodulation is rather more difficult to measure than harmonic distortion; the circuit in use does not appear to audibly degrade a 'crowded' band as compared with a wire aerial, the receiver front-end performance still seeming to be the dominant factor.

Extra Capability

After using this circuit for a while it became evident that a useful additional capability would be to have a small amount of extra gain available at the upper frequencies above 20MHz; I found that about 10dB proved useful in improving the S/N ratio of weak signals. This gain was added to the previous single stage by taking the output from the drain and switching various source resistances as shown in **Fig.3**. This, however, did degrade the linearity of the device and the harmonics of strong out-of-band signals seemed more noticeable. In my application I wished for an aerial unit that could be used alongside the receiver so I decided to continue and develop a circuit that would possess this gain — but also provide attentuation — altogether on one 6-position switch. Armed with this switchable gain I was able to select the setting that gave optimum front-end performance.

To achieve the best linearity I realised that the feedback configuration of **Fig.4** would provide the best results when encountering strong signals. This is the classic 'virtual earth' inverting configuration with the gain directly varied by the feedback

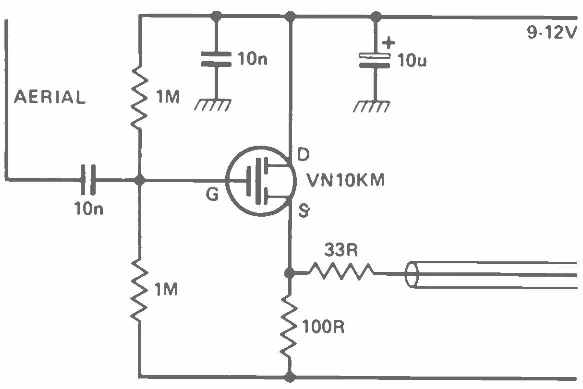


Fig. 2 'Good value' Active Aerial

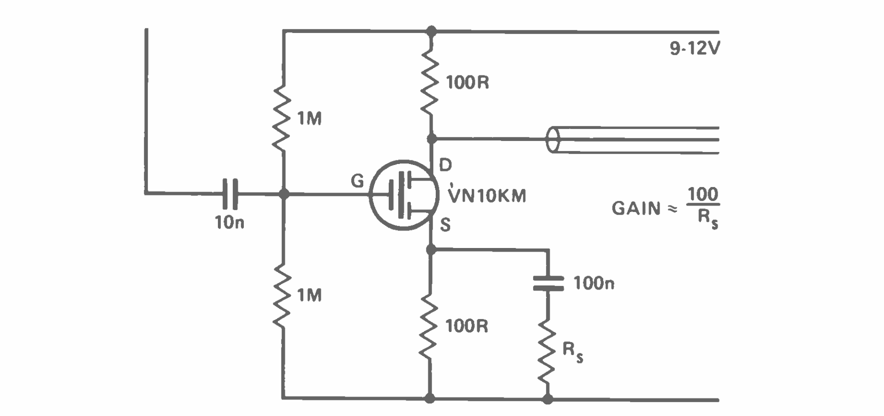


Fig. 3 Extra gain for upper frequencies

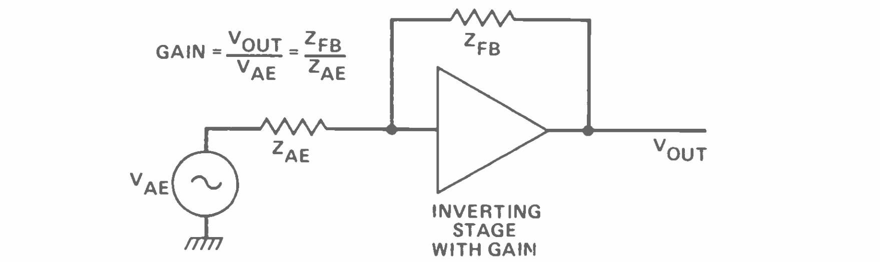


Fig. 4 Concept of variable gain Buffer

impedance Zfb. The performance of this configuration is better than the circuit in Fig.3 (where the feedback is effectively provided by the source resistor) because under strong signal conditions the feedback acts in Fig. 4 *directly* to negate the incoming signal — rather as in Fig. 3 where it acts always via the gate-source junction. The feedback situation of Fig. 4 shows the gain adjusted by the variation of the feedback impedance Zfb. When the aerial is connected to the amplifier we must understand the nature of its impedance before we can select that which is to be used for Zfb. We know that as long as our aerial is less than ¼ wavelength long at the highest frequency of interest, then, as the frequency falls from this point, the aerial impedance will *increase*. An increase in impedance with a falling off in frequency is the characteristic of a capacitor. In fact, an electrically short (with regard to a ¼ wavelength) rod has an equivalent capacitance of around 25pF per meter, and thus our impedance ZAE is around 20pF. Zfb must therefore be of this order to provide unity gain, lower than this to provide some gain, and higher in value to provide attenuation. In practice the gain equation shown in Fig. 4 only holds true for an amplifier with infinite stage gain. It is more practical to design our gain stage to provide the required gain of 10dB and to vary the feedback upwards from zero in order to achieve progressive attenuation. To maintain a low output impedance, and yet provide some gain and the inversion required for the feedback, two devices are necessary. Both are somewhat more readily available than the VN10 and the final circuit is shown in **Fig. 5**. The feedback must be capacitative; a 6-position switch was used with 5 fixed capacitors up to a maximum of 500pF. Use of a variable capacitor is possible here but generally inconvenient due to its size. Also, a 500pF variable is unable to be set below about 10pF.

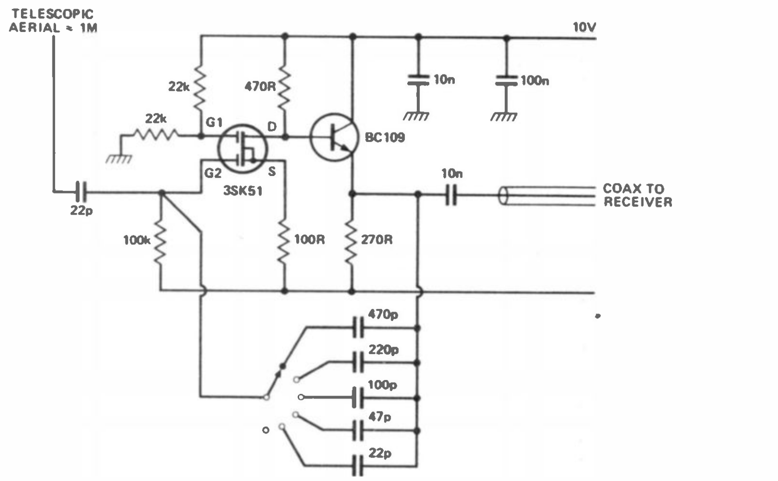
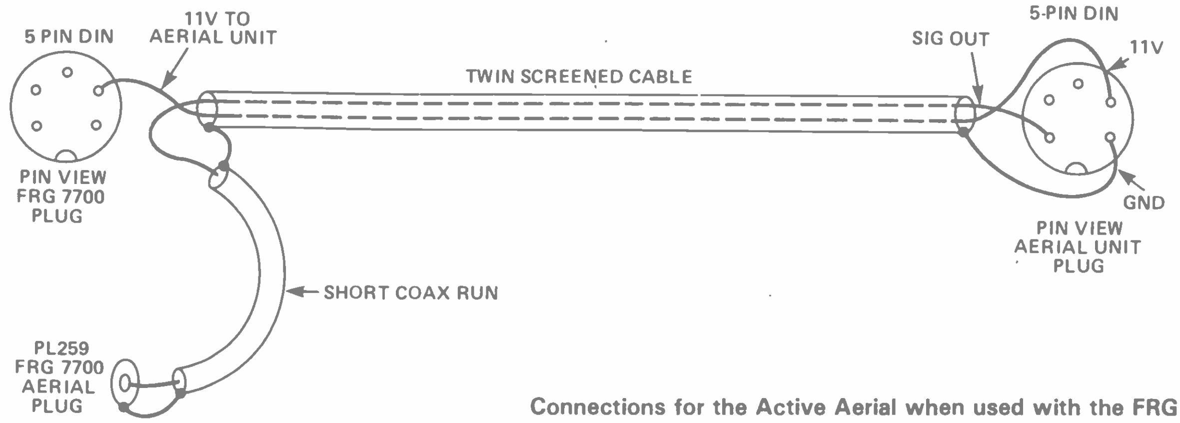


Fig. 5 Final Active Aerial circuit

Construction

Construction should take the form most appropriate to the positioning of the unit. My unit was required for use adjacent to the receiver, but other users may wish to take advantage of a broadband aerial mounted remotely from an interfering source — in which case the circuit can be mounted in a simple, perhaps weatherproofed, case. For this kind of use, use the circuit in Fig. 2 since this is ideal for this purpose: the simple unit gives a fixed gain of unity. For my unit the construction was kept as simple as possible. A telescopic aerial of about 1m was used mounted onto what is usually the base of a 4 × 2 die-cast box (see photo). This was in turn mounted upside down onto a scrap piece of ½" aluminium plate about 6 × 4, which provided the base and replaced and enlarged upon the original lid of the box (see photo). The 6-position switch was also let into the die-cast box together with an end-mounted 5-way socket which carried 10V into the unit and the signal out to the receiver. A test was done to check that the use of twin screened cable, with one core used for power into the unit and the other for signal out, did not cause problems with a 50ohm mismatch at 30MHz; in fact the mismatch results in about 1dB signal loss at 30MHz. This lead was then split at the rear of the receiver to provide power and connect with the aerial socket. (Pin connections of this lead are shown for users with the FRG7700 but any receiver can be used, especially those that provide a



Connections for the Active Aerial when used with the FRG7700

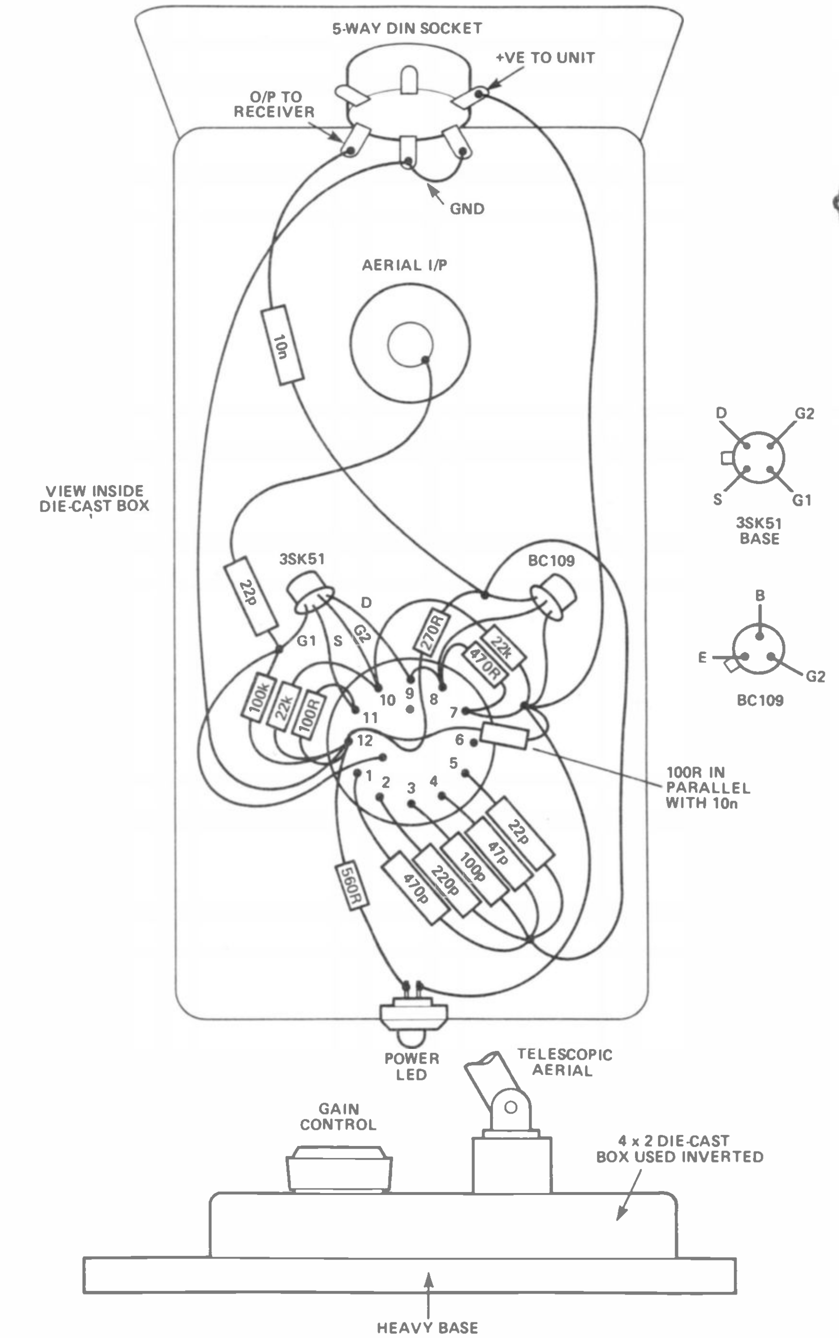
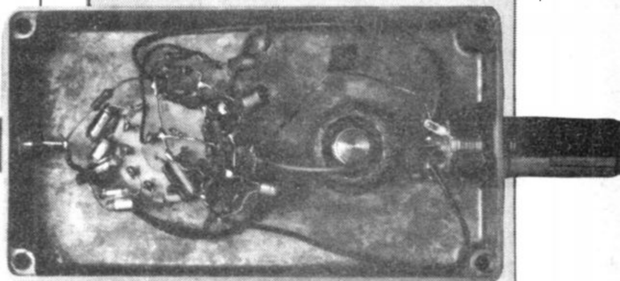


Fig. 6 Construction of Active Aerial by the author (Many of the multi-pole switch contacts are used as a 'tag strip' by the author — as only one pole of the switch is utilised)



power output of 9-12V. Cosmetics as such are an LED for power indication and some felt on the underside of the base.

In Use

Once the unit is connected to the receiver the only thing to adjust is the 6-position switch. This may be left at the 22pF position (2nd from right, position 5) which gives around unity gain. If a signal above about 20MHz is weak, try the 0pF (6th) position for extra gain. If this results in increase of signal but reduction in clarity, increase the capacitance by switching back down the positions until the best compromise is found. Generally the gain (6th position) is most often used at high frequencies or on 1.5 to 2MHz where the signals can also be weak. The use of the other, attenuating, positions is restricted to the very strong broadcast signals which may cause front-end problems and be more listenable at, say, S9 rather than S9 + 60dB because of receiver overloading. Some 2 miles away, I have a strong MF transmitter and this has been a good test of the performance of the aerial unit. It should therefore, be satisfactory in most other locations except perhaps Droitwich village!

Get the DX EDGE!

Improve your timing — on HF DX operation. Steve Ireland, G3ZZD, examines Xantek's DX Edge.

As a radio enthusiast who has been interested in LF DX operation since shortwave listening days (or, rather, nights!) I was very interested to get my hands on the DX Edge. In order to work DX over 15,000 miles distant — real DX — on the LF bands the *timing* of your operating periods is crucial. The best openings for this kind of DX occur in the main around the time when the desired country is experiencing sunrise at the same time your country is going through sunset, or vice versa. This kind of propagation is often referred to as 'Grey Line' propagation, because at both ends of the DX path a situation of *near* darkness persists.

In the past, operators had to rely on sunset and sunrise tables in order to consistently work 'Grey Line' DX, searching the tables to identify corresponding sunset and sunrise times. This, needless to say, was a somewhat tedious process. Many LF enthusiasts tended to give this up quite quickly, relying on their experience, built up through, often, many years of SWLing, of the timing of Grey Line openings, and long periods of listening. Consequently, quite a lot of time was wasted and openings missed, in particular when attempting communications with countries which were isolated and/or seldom activated.

All this was before the DX Edge (**Fig.1**) Consisting of a plastic 'double image' of the world and 12 perspex sliding overlays, one for each month, the DX Edge makes LF DX operation a snip, as well being a generally useful aid for HF operation. Forgive my raving, but I'm pretty impressed. Let me explain how the device works and perhaps my enthusiasm will become clearer. First, a slide is chosen for the desired month of operation and slid onto the map. We now find our current UTC (Universal Coordinated Time — the GMT that was) on the scale on the top of the slide. The DX Edge now indicates, for the current time of day, the areas of the world in **daylight** — the *unshaded* areas within the curve — and the areas in **darkness** — the *shaded* areas of the slide. The curve that separates the shaded from the unshaded is the Grey Line, sometimes called the 'terminator'.

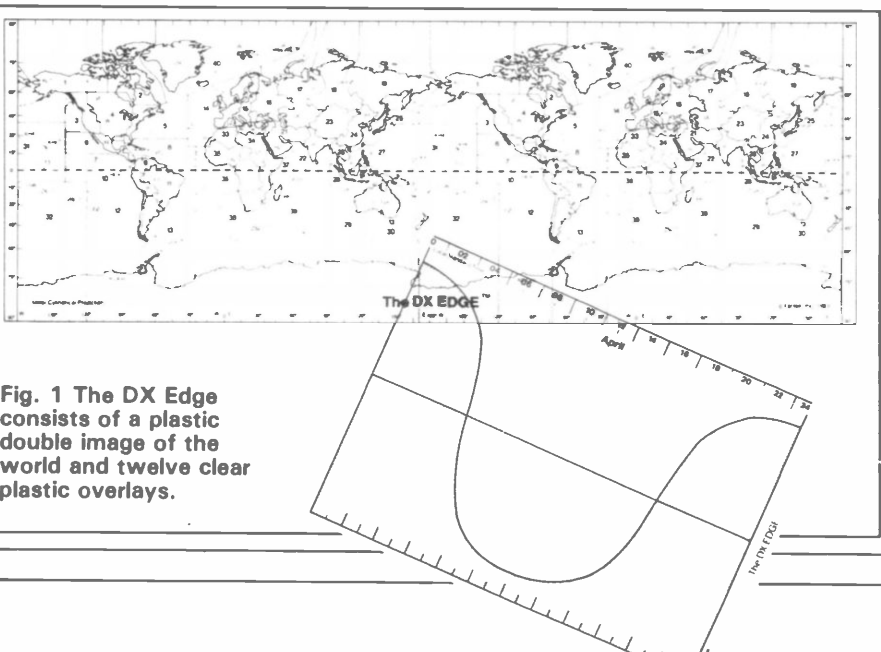


Fig. 1 The DX Edge consists of a plastic double image of the world and twelve clear plastic overlays.

Operation

If we move the slide toward the left ie Westward, we simulate the rotation of the Earth under the Sun. The appearance of the day and night portions of the Earth for any time of day during the current month may be seen. In order to see when the sun rises at any QTH anywhere in the world, we move the slide until the LHS of the Grey Line crosses the desired QTH. The sunset time is then read off the scale at the top of the slide — the local time in that particular QTH appears directly above that QTH and *our* local time at *his* sunset appears above our QTH.

To determine the time of sunset for any QTH in the world, we simply move the slide until the eastern (RHS) side of the Grey Line crosses that QTH. The sunset time is then read off the scale at the top of the slide, just as in the case of the sunrise time.

If we examine **Fig.2** below, which shows the DX Edge set up to indicate UK sunrise conditions for April (ie the western (RHS) of Grey Line crossing the UK) we can see that sunrise occurs around 0430, about which time a Grey Line QSO with Alaska (KL7) is possible on 80, 40 — and perhaps even 160m. As it is dark in North and South America and most of West Africa at this time, contact is theoretically possible with this medium distance DX, ionispheric conditions permitting.

Daylight Propagation

Where as on the LF bands, propagation usually occurs when the

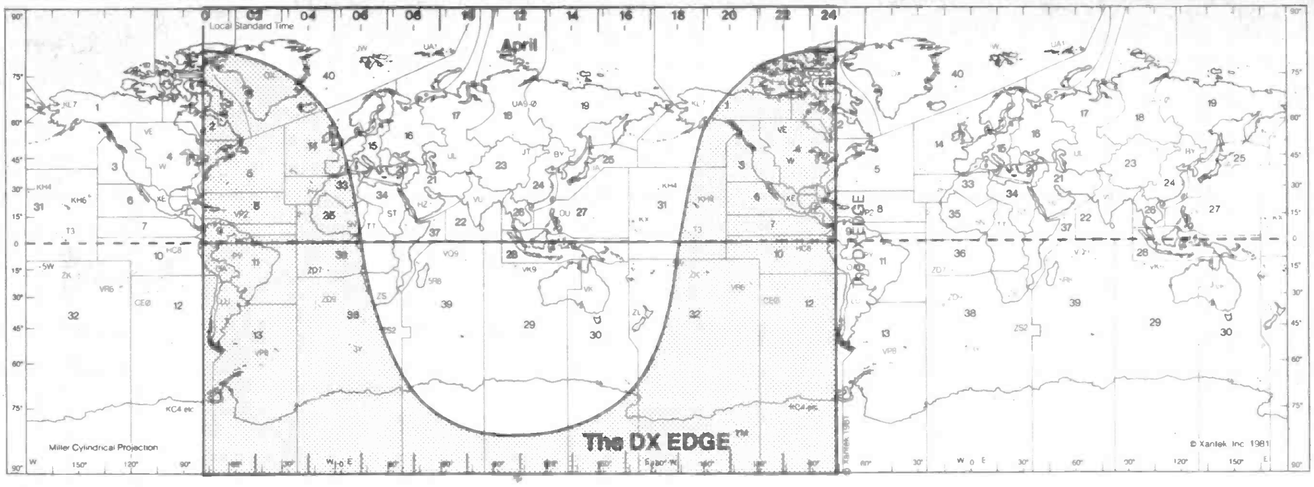


Fig. 2 DX Edge set up to indicate UK sunrise conditions for April

desired path is either very close to darkness (sunrise and sunset) or in darkness, on the higher bands, particularly 10 and 15m, the reverse is true, propagation generally occurring over a path that is in *daylight*, except in years of very high sunspot activity (ie very high ionisation of the Ionisphere). Thus, the DX Edge can also prove useful in predicting possible daylight propagation paths on these bands.

Sunrise and sunset times change by a minute or two daily and maximum deviation from the DX Edge curves will occur at the beginning and end of the month. However, if we take the example, given in the instruction sheet, of the variations occuring over the month of December occuring at a latitude of 40 degrees (we are about 50 degrees lat. in the UK — not substantially different) sunrise on Dec. 1 occurs at around 0703 and on Dec. 31 around 0722, the differences are not too substantial. . .

Available from the RSGB at Alma House, Cranbourne Road, Potters Bar, Herts, priced £11.10 for non-members and £9.99 for members, the price may seem somewhat steep for what is at face value "a few bits of plastic". As an operating tool, one that will not date and can be used anywhere you may go in the world, the DX Edge is cheap at the price! Next to a good Great Circle map, I reckon the DX Edge is *the* essential aid for the serious HF enthusiast, and can provide an awful lot of interest, education and DX. I wish I had had one years ago.

HAM RADIO TODAY NEXT MONTH

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Note that as of the 20th December 1983, we shall be moving the magazine QTH to No.1 Golden Square, London W1R 3AB, telephone 01-437 0626.

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REVIEW: Yaesu FT708R 70cm Handheld

The Yaesu FT708R is currently the cheapest available 70cm 'handheld'. Trevor Butler, G6LPZ, tried one out.

Having reviewed the Alinco 70cm linear Amplifier for an earlier edition of this magazine I have recently been looking again at suitable drive sources. One which stands out as being available at a reasonable (bargain?) price is the Yaesu FT708R hand-held transceiver. This rig is now considerably cheaper than it was when it started its life in the amateur radio market — importers SMC, who supplied the review sample, are currently selling it at £179. In fact, this makes 70cm equipment cheaper than some basic 2m hand-helds, a very encouraging sign indeed to see 70cm equipment falling in price, which should help to increase further the band's popularity.

First impressions of the FT708R are that it is an extremely compact unit, rather heavy yet with many sophisticated functions for a hand-held. Weighing in at 730g and measuring some 168(h) × 61(w) and 49mm(d) it has a generally squarish appearance, which is accentuated by the corner stitching on the black leatherette case. Hosting an impressive range of facilities including excellent scanning functions, with the majority of the controls easily accessible on the front and top panels, operating the rig was fairly straightforward. Fully synthesized and covering 430.000 to 439.975MHZ in either 25 or 50Hz steps, this equipment is designed to produced either 1 watt or 200mW of output in mode F3E. The unit includes a key-pad for entering frequencies and operation of the memories and scanning facilities — operation of these keys is displayed on the LCD panel which has a back-light for night-time operation.

The FT708R is supplied complete with a ¼ wave whip antenna, earphone for personal listening and a shoulder-strap. There is an impressive range of charging adaptor and base-station charging accessory units, together with the usual range of speaker-microphones etc. A 10.8V, 450mAH capacity NiCad battery pack is supplied (ref FNB-2) and is normally stored and charged in-situ, inside the equipment. Although first impression were that the pack was unusually large, in operation it's capacity was sufficient for even the heaviest user — like myself — which is just as well, as replacement of the pack is not something which should be undertaken whilst operating portable.

Controls

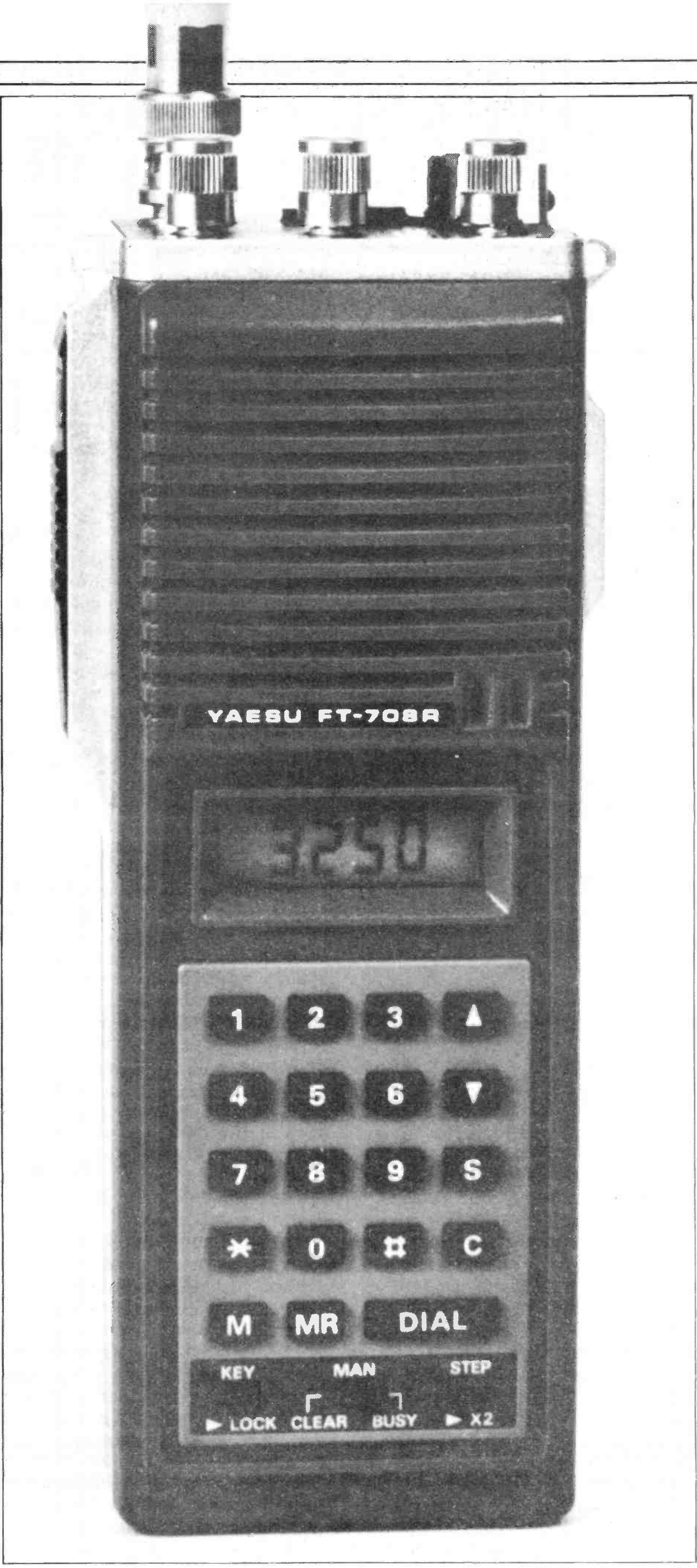
The central feature of the controls is the nineteen button key-pad on the front panel: controlling frequency input, operation of the ten memories, scanning facilities and the optional two-tone DTMF function. Below this key-pad are three switches, the first to lock the key-pad to prevent accidental re-writing, the second to select the mode of the scanner, either busy, clear of manual (ie scans continuously until stopped manually) operation and a third to select either 25 or 50 kHz stepping. Both the 'Busy' and 'Clear' modes are dependent on squelch setting; if the squelch is reduced so that the quiescent noise of a clear channel is audible (ie the noise breaks squelch) the channel is classed as 'Busy' by the scanner.

The top panel contains the majority of the remaining controls — a BNC socket for either the quarter-wave whip supplied or any other 50 ohm antenna system; a 3.5 mm socket providing audio output (on insertion of a plug the internal speaker is muted) and, next to this, an interesting six-pin microphone socket with mic, PTT, speaker and 10.8V DC lines fed to it.

The Volume and Squelch controls are on independent rotary potentiometers with smart, spun-aluminium knobs. The on-off switch is incorporated with the volume control. The function selection switch is a rotary six-position switch, again with a stylish spun aluminium knob. The hi-lo power output switch, to select either one watt or two hundred mW or RF output, is located next to the antenna socket. The PTT switch is mounted on the LHS of the rig and has a second, smaller, inset switch which will, when pressed in conjunction with the PTT switch produce a 1750Hz tone burst on the signal.

Power

Power to the FT 708R can be supplied via a socket in the base, which will automatically switch the internal NiCad battery pack out of circuit when a plug is inserted. A supply of no more than 10.8V DC is quoted, so beware if trying to use a 12V power supply or operating directly from a car battery. Yaesu do produce an adaptor to regulate the voltage from a 13.8V supply, although this is at an additional cost. Charging of the internal battery pack is achieved through a 3.5mm socket adjacent to the external DC supply socket. In addition,



there are two metal studs on the base which are for use with one of the optional base-charging units. These studs are well shrouded and there is little likelihood of them shorting against a metallic surface, even though some circuit protection has been built-in; it is *never* wise practice to short circuit NiCads! I found it a little inconvenient to have the DC supply and charging sockets in the base. Although obviously designed with the mobile operator in mind or for someone who can afford the extra base charger, standard upright use of the unit from an external supply or whilst charging is not easy — as the unit cannot stand on its base.

There is one control actually *inside* the equipment: the memory back-up switch. The internal lithium cell, supplied, is in fact switchable out of circuit, although it is quoted in the unit handbook that it should last for more than five years with the memory current consumption of around 1uA. Why provide a switch at all then, for a further passage in the instruction manual reads: "the life of the battery is not exceeded significantly by keeping the back-up switched off"?

Functions In Detail

Repeater-shift controls do not normally warrant an in-depth investigation, except, that is, on the FT708R. The unit has obviously not been primarily designed for UK usage, since the repeater shift as standard is +/− 7.6MHz. To overcome this difficulty and to provide the needed +/− 1.6MHz shift in the UK, Yaesu have cleverly incorporated a second, user-selective repeater shift which must be initially programmed in through the main key paid. Once in, the back-up battery will ensure the retention of the repeater shift.

There is, a little surprisingly, no provision made for any means of listen-on-input. Perhaps Yaesu felt that this facility would not be useful on a hand-held, for which simplex contacts are essentially limited to short distances. However, if the unit were to be used as a base station, say, driving a small linear. . .

The LCD read-out will display the last four digits of the operational frequency, whether transmit or receive. In addition, two LED-type indicators show that the key-

lock memory operation, scanning or 'priority' functions are in operation. The frequency input, via the keys, must be divisible by 25kHz, otherwise an 'E' will appear indicating the error status. The operation of the key-pad is rather similar to that of an electronic calculator, except that the *layout* of the key-pad is that of a standard push-button telephone. One must remember to press the 'Dial' key to actually put the dialled frequency into the unit's operational memory, and this is indicated by a full-stop which appears on the LCD display. Failure to do this, simply puts the unit back onto the previous working frequency.

A useful feature on this piece of equipment, something common to the range of Yaesu UHF and VHF equipment, is the priority channel operation. The rig can be set to monitor the frequency recorded on the main dial and every five seconds a memory frequency, also which has been selected, will be checked. Depending upon the setting of the scanning control switch, the unit will search for either a busy or clear memory frequency. 'Split' operation, other than the standard or selected repeater shifts, is possible — by transmitting on the dial frequency and receiving on a pre-chosen memory. This may be accomplished by operation of the mode switch and suitable key-pad programming.

The scanning operations available are versatile but rather complex, and I am not sure that I have mastered them to their fullest possible extent (*my fault for setting impossible deadlines! — Editor*). It should be possible to scan the whole 70cm band, or a selected part of it in either 50 or 25 kHz steps — the scan can be *programmed* to miss out a selected part of the band. In addition to this, the memory frequencies stored can be scanned — for either squelch-breaking or clear frequencies. After stopping on a frequency for some five seconds, the scanner will automatically continue — unless manually stopped by either pressing the up/down control keys or by a press to the PTT switch. Initially rather complicated, the instruction book should be read several times to fully master the scanning operations. I came across an FT708R owner who admitted that he did not use the scanner because he could not remember the *correct order* in which to operate the controls, vital in this operation to prevent an error condition occurring. The clear button will allow any error to be erased and the entry re-punched correctly — a very useful function since at first I found the 'E' status was appearing quite a lot!

An optional tone-squelch unit is available, although selective access is of more use elsewhere, since under the terms of our licence it is necessary for each transmission to be accompanied by the user's call-sign, and this rather defeats, the object of, or more aptly, makes illegal, any tone-calling system.

Circuitry

Whilst it is not possible here due to lack of space to include a detailed explanation of the operation of the circuitry, a glance at the FT708R Block Diagram will indicate the various receive and transmit paths as well as elucidate some of the intricate control systems of this equipment.

The receiver is of the conventional double conversion super hetrodyne type with a first IF at 46.225 MHz and the second IF on 455kHz. The quoted sensitivity of the unit is said to be better than 0.4uV for 12dB SINAD and better than 1uV for S/N at 30dB. Selectivity is measured at +/−6kHz at −6dB and +/−15kHz at −60dB. Transmitter deviation is specified at +/−5kHz and spurious radiations are said to be −50dB or better which is all relatively standard. It can be seen from the block diagram that the RF circuitry is of a good, straightforward and basic design, with more circuitry employed for the PLL and control unit than for the purposes of receiving and transmitting RF — obviously a sign of the times. The first RF (receive) Amplifier transistor is of the bi-polar type which seems to be favoured over other types, currently for this purpose at UHF.

It was encouraging to see that Yaesu have employed a change-over relay in place of the now, more popular, diode switching. Whilst the relay may not do good things to the current consumption figures, it is a good feature as far as the RF circuitry is concerned. There is a strip-line on the output (very good!) after a three-staged power amplifier which follows a multiplier and band-pass filter. The phase-lock-loop control unit employs a four-bit microprocessor chip — a HD 44820A07, which provides information for the display, transmit disable DTMF encoder etc.

In Operation

Thorough field trials were made using the equipment, primarily with regard to its intended use as a hand-held transceiver, although some operation was managed both 'mobile' and as a base station (without either the mobile or base accessory units though).

Audio reports obtained from other stations, through repeaters and from extensive simplex contacts, were excellent: "clear and crisp"; "very pleasant to the ear"; "good armchair copy" and "well-balanced" were just some of them. The audio produced, however, through the internal speaker was not so favourable. This tended to be rather coarse, raspy and generally lacking in audio bandwidth, particulary at the top end of the spectrum. Full volume did not seem to produce any distortion on the received signals, but was insufficient to overcome high background noise such as road traffic. There was, nevertheless, a great improvement in quality and audibility when using either headphones or the earpiece supplied.

The sensitivity of the unit was as good as other 70cm hand portables I've used and certainly sufficient for use with the transmitter power. There were no adverse reports of either under or over deviation, even through the more critical repeaters.

It is a pity that there is no plastic cover combined with the black leatherette pouch to protect the key panel from dirt and moisture — otherwise the case added to the overall appearance of the rig as well as providing basic protection of the equipment from grime*. For the left-handed operator holding the rig in the right hand, the positioning of the PTT switch is not at a convenient pressure-point although it affords little difficulty for the right-hand operator. A simple but effective improvement would be the replacement of the tone burst switch with a DPST type to allow it to activate the transmit rail at the same time as producing tone. The metal belt-clip to the rear of the FT708R was effective and gave a tight grip. The shoulder strap was less successful and in the end a wrist-strap was preferred by yours truly.

Whilst portable, I found it difficult under night-time conditions to press the correct keys in the right order. There is a raised 'dimple' on the '5' key which is intended to aid the night-time or blind operator — although this 'dimple' was not felt to be pronounced enough and was on a non-central key. Under these conditions a number of the functions became rather superfluous for the operator — it simply was not possible to utilise the "frills" whilst on-the-move.

Little time was available for testing as a FM base station. Certainly the 708 was as sensitive as my present base station set-up and worked very well with the current linear amplifier.

Inside

A look inside any piece of equipment is always interesting, and it is good to know what you get for your money. By removing the NiCad battery pack and a further four screws the whole rig literally falls apart in the hand revealing the interior. Based around a central metal framework with moulded vacuum-coated plastic front and back panels in Yaesu's house-grey, the metalwork seems to provide a sufficient ground-plane for the ¼ wave antenna.

The layout of the rig consists of the main RF, the PLL unit in a screened box, the keyboard assembly and the control unit. The screened PLL unit and the main RF unit are housed in the body with the control and keyboard assemblies under the front panel. The AF unit is located under the top panel and houses the Tx/Rx change-over relay. Construction is to the usual Yaesu standard; generally well made with good soldering joints. Hot wax has been poured over some of the components to prevent accidental dislodgement and to provide extra stability.

Recommended cleaning procedure should be periodic and, according to the manual, "a vacuum cleaner (should be used to ?!) to remove loose dirt while a small brush will help in dislodging caked dirt". This is not a practice I would recommend — not that the rig should be allowed to get into this state anyway!

Conclusion

Definitely a value-for-money piece of equipment at current prices (which is good to see these days) hosting an impressive range of features normally associated with more expensive equipment, although tending to be a little complicated in use, particularly initially. Key-pad entry is a good feature over thumbwheel switches, but does increase the size of the rig which is all important in the portable application, as, too, is weight, and for my liking the FT708R is just a fraction too heavy. An ideal companion for the FT208R, the accessories for the two being conveniently interchangeable. To be considered primarily for portable and occasional mobile operation it does of course lack any SSB facilities. The rig is solidly constructed and has my overall seal of approval.

*A leather case with key-pad flap is available from SMC for £25.

Specification

RF OUTPUT (FT708R driven with a 10.8V DC supply)

Hi	(Specification 1W): 1·45W
10	(Specification 200mW): 340MW

CURRENT DRAIN (driven with a 10·8V DC supply)

RX	(Specification 150mA): 45mA
RX	Squelched (Specification 20mA): 19·5mA
TX	Hi Power (Specification 500mA): 496mA
TX	Lo Power (Specification 300mA): 325mA

RF measurements made with a Hewlett Packard 435A UHF I owermeter with 20dB pad.

NEWCOMERS FORUM

By Tony Bailey, G3WPO

Our subject this month is the art of operating CW, and what I hope are some helpful notes on this (sometimes controversial) aspect of our hobby. I expect quite a few of you out there have just obtained your class A licence and will be venturing on the air for the first time using the key soon. CW isn't merely a boring subject that you have to pass to get on the HF bands, and then forget. It is simply another language, just as you would learn French or German (or Latin if you were going to converse with Romans). However, it is a universal language – you can have a QSO with another station who doesn't know a word of English and yet understand each other perfectly and in a concise manner. CW may be your only means of making contact under such conditions with a prize DX station, whether it be on HF, VHF or UHF.

Be a CW hotshot! Well, even if you think you don't want to be, you may change your mind after Tony Bailey, G3WPO, gives you the lowdown...

CW Is Best . . .

I don't think that anyone who has tried operating under difficult conditions will dispute that CW has by far the best chance of getting through, and often is the *only* means of getting a contact when the signal is weak and QRM bad. There was quite a good article in QST many years ago which set out to determine the dB advantage of CW over SSB under such conditions. The answer was equivalent to 20dB of power gain! Not bad for just plugging a key in and using it. There are now other modes which may compete with CW for DX-effectiveness; AMTOR is probably the best known, and probably some of the computer-enhanced straight RTTY systems have a good chance, but 'the key' is much cheaper!

The first problem likely to be facing you when you intially try to use CW on-the-air is what to do first. You have the choice of either calling another station or putting out a CQ call. Which you do is debatable – I personally would favour calling another station. This way you can pick someone who appears to be sending at a speed *which will suit you*, and also you may be lucky and find a station who is a little DX'y rather than go for a rubber stamp QSO.

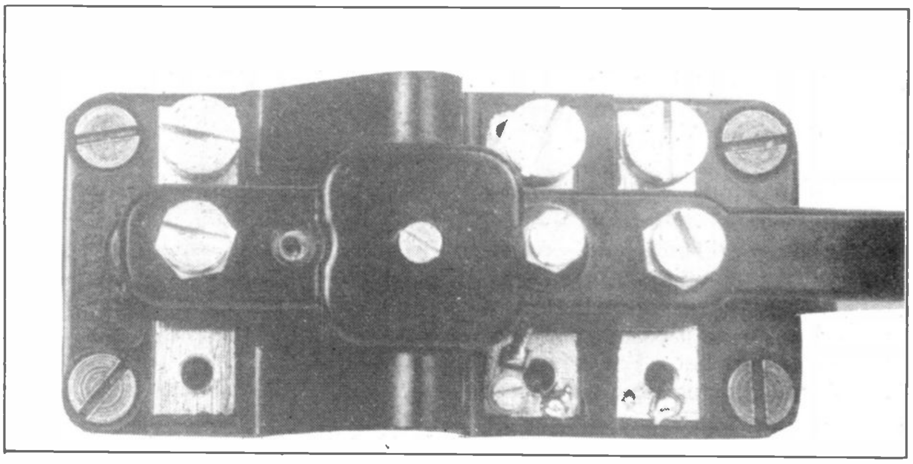
In theory, another station should respond to you at the same speed at which you are sending (if he is good operator), but in practice, this is hardly ever the case. There are two cures for this – a) forget the QSO and look for someone else or b) tell him to **QRS**. This is another of the many 'Q Codes' used in CW operating which save an awful lot of time. They replace a particular sentence or question (when a question is desired to be *asked* the three letter code is followed by a question mark). QRS means 'Please send more slowly' – if you added a ? it would mean 'Shall I send more slowly'.

It isn't a bad idea to try to work a station who is sending a little faster than you can really *easily* copy – it will help you to get your speed up more quickly. One thing you will soon find is that operating in contests gives you a false sense of security about your receiving speed – because you virtually know what is coming each transmission and can almost guess it accurately 9 times out of 10. Also, don't forget that the number 9 tends to get abbreviated to 'dash-dot', and zero to just a dash in contests. (5NN is much quicker to send than 599!). This is also the reason why everyone gets 599 in contests!!

If you want the other station to speed up then the code is QRQ. Don't worry if you forget these codes at first – no-one will worry too much if you have to send the full message, although it does slow things down a bit. When you get familiar with all the 'Q codes' you will be surprised at the speed at which you can send a lot of information within a fairly short time using the key.

Pse snd wid ur crd

The other way in which QSOs are speeded up is by the use of abbreviations for everyday expressions or words. Even if you have had little experience of CW you will probably have come across 'tks' or 'tnx' in place of 'thanks' – *where the vowels are left out*. This latter trick is possible with almost any word and still leaves it recognisable. Other common ab-



breviations are 'stn' for 'station', 'gd' for 'good', 'hrd' for 'heard', and 'condx' for 'conditions'. You do get variations on the above, but there are a set of International recognised abbreviations, the aforementioned 'Q codes', which do not have ambiguous meanings (providing you use them correctly) – although they don't always have strictly the same meaning in Amateur radio use as in Commercial radio.

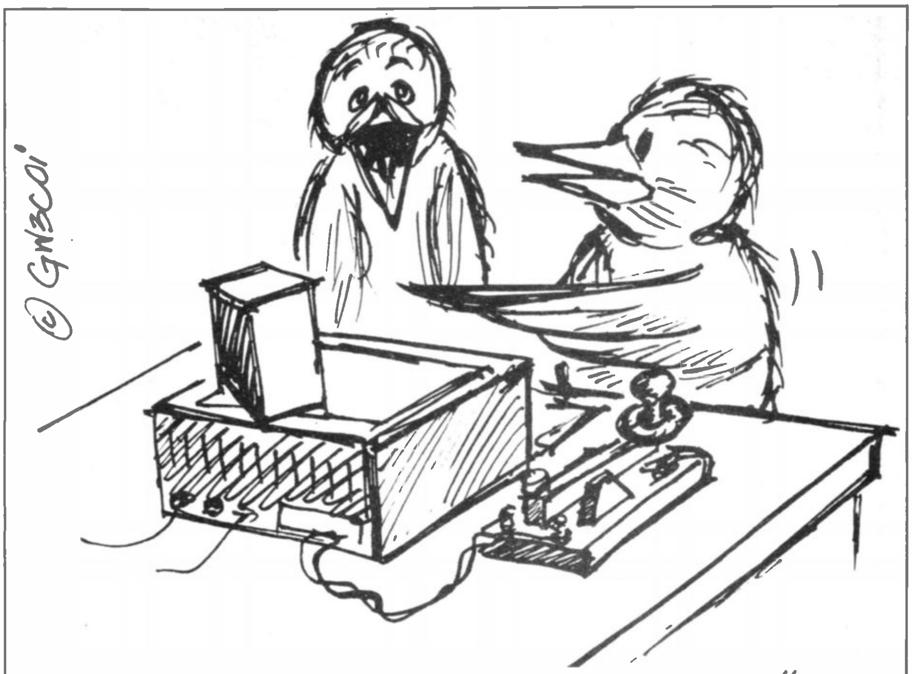
Diddity-dah-de-dah

A lot of first-timers don't understand the 'ending' codes used for QSOs. When sending 'CQ', the end code is 'K' – this tells anyone listening that you are happy to get a reply from anyone (even if they missed the actual CQ part). Ending with 'KN' is an indication that you were calling a specific station (or area) and that you only want replies from the specified station. It is normal to use this ending during a QSO so that people just catching your call only realise that you are in QSO, and don't try to break in. *(People often forget to use this one, particularly in contests, and the result can be havoc! - Ed.)* When the QSO is actually finished, the end code is 'SK' or 'VA' but sent without a space between the two characters (thus both codes sound the same in practice). If you are actually closing the station down, then send 'C L' to show that there is no point in anyone calling you now.

Another code used near the end of a transmission is 'AR' (again sent without a space), which means "end of message". 'AR' was usually sent before the 'K' by many stations, but over the past few years seems to have come into use as a replacement for the 'K'. I don't think it matters much – out of habit, I still use both like many people. You may also find some European stations ending with TU – another way of signing off meaning 'to you'.

Calling CQ

Call for a short time and often. So may times you can hear a station calling CQ for what seems hours on end, and after the 20th repeat of his callsign, you give up and listen for something else. Does he wonder why no-one comes back to him half the time? You probably know the standardised format for CQ – three CQs followed by three callsigns (and, when on VHF, add your QRA locator as well), and then maybe a repeat. Not a repeat of the 3 x 3 ten times as in the case above. If nobody comes back then try again – you are far more likely to get replies this way than by boring everyone to death with long CQs.



"... LISTEN TO THAT TERRIBLE CHIRP...."

The most common procedural abuse on CW is the use of QRZ instead of CQ, not *so* much on *CW* but more on phone. 'QRZ?' means 'Who is calling me', and therefore implies that someone has actually called you but you couldn't tell who this was. It is not a substitute for CQ – unless you have just called CQ!

Sending CW

'The Maryland Stroll', 'The Swinger', 'The Twitch' and others are not dances but names coined up to describe the sound of some people's *CW* sending (or 'fist'). During the last War, many of the monitor stations could tell which operator they were listening to purely by the characteristics of the transmission, and if you do a lot of CW work, you will probably be able to do the same. This 'fingerprint' isn't quite as noticeable these days due to the increasing use of electronic keys, all of which send perfect CW – or should I say, send perfect CW when the operator uses them properly. In the hands of an idiot, they will send total rubbish! The usual problem is that people try to send too quickly, possibly to impress. The classic demonstration is the 40 wpm QSO where one station says 'Ur sigs 599 – pse rpt QTH, name and rprt'.

How to send CW is outside the scope of this piece, and we are assuming that you have got up a fair old lick of speed or perhaps have passed your test by now, anyway. Some advice on electronic keyers (el-bugs) may be useful. I suppose the first keyer was the 'Vibroplex' type, still made and in everyday use. These are not electronic, but mechanical, using a rigid but slightly flexible bar and a system of sliding weights to generate a string of dots automatically, but leaving the dashes to be made manually. This tends to make transmissions using these devices fairly recognisable, as the majority of stations seem to accent the dashes heavily, possibly without realising it. *(Oops! - Ed.)*

There are two types of paddle-controlled electronic keys available. The first is the single paddle type where one side contact sends dots (the right) and the other, the dashes. These are fairly easy to get used to, and if you use them carefully at first you can get to send very good CW. The other is the twin paddle or 'IAMBIC' type, sometimes called 'squeeze keys'. *Iambic* comes from the Greek 'Iambikos', and indicates a 'short followed by a long' (as in Iambic Verse). When both paddles of such a keyer are squeezed together, the keyer will send an alternating series of dots and dashes – hence the derivation. Now you know.

Only a personal feeling, but if you

are going to use a keyer, then start with an lambic type. They are very easy to use after a bit of practice, and send accurate CW *with less paddle movements* than the single paddle type. What I don't recommend is to start with a single paddle type, and then change to lambic – because of the different movements your hand has to make, your brain gets very confused for a long time. 'Weighting' controls are often seen on some keyers – these adjust the dot-to-dash ratio from the ideal 3:1. At high speeds changing the ratio can improve the 'copyability' of a signal. For another look at electronic keyers, see Ian Poole's review of the Samson ETM5C.

Break-in Keying

This is the CW equivalent of VOX on phone, and means that your rig allows you to actually listen to signals between the elements of your CW sending. By elements is meant the dots and dashes! With a good system you should be able to hear whether anything has come onto the frequency in the spaces you're sending, or whether the station you are working wants to 'break-in' and say something. This does prevent you carrying on sending while an S9 UA station calls CQ on top of you. 'Semi-break-in' is more often found on modern transceivers however, but is purely an operating convenience, and bears no comparison with true 'break-in' (or QSK).

With this, the rig goes to transmit as soon as you touch the key, and returns to receive after a short gap. This allows you to continue sending fluently without a lot of relay chattering, and also gives you the opportunity to listen on the frequency occasionally. If you set the gap too short, you can listen more frequently, but will almost certainly clip the first dash or dot you send each time. To changeover at the speeds required for break-in, in a silent fashion, with no clicks, needs special circuits, not needed for SSB VOX, hence the reason why this feature is only seen on the higher priced rigs such as the FT–ONE.

A full list of the 'Q codes' and commonly used abbreviations may be found in the 'Amateur Radio Operating Manual' available from the RSGB Publications, Alma House, Cranborne Road, Potters Bar, Herts EN6 3JW.

'Q' Codes – all in their Question form (followed by ?). Leaving out the ? gives the direct statement version. These are as commonly used by Amateurs – the meanings are often slightly different to the original Commercial codes.

QRA	What is the name of your station
QRB	How far are you from my station
QRG	What is my frequency (exact)
QRH	Does my frequency vary
QRI	What is the tone of my transmission (1-9)
QRK	What is the readability of my signals (or 'how much does it cost)
QRL	Are you busy
QRM	Is there interference at your end (manmade)
QRN	Is there static at your end
QRO	Shall I run more power
QRP	Shall I run less power (opp: I am running low power)
QRQ	Shall I send faster
QRS	Shall I send more slowly
QRT	Shall I stop sending
QRU	Have you any traffic for me (opp: I have no more traffic)
QRV	Are you ready (or Are you equipped for . . .)
QRW	Shall I tell . . . you are calling him on . . . kHz
QRX	Shall I call you again (opp: I will call you again – or 'stand-by)
QRY	When is my turn
QRZ	Who is calling me
QSA	What is the strength of my signals
QSB	Are my signals fading
QSD	Is something wrong with my keying
QSK	Can you hear me between your signals
QSL	Can you acknowledge receipt (or send a QSL card)
QSN	Did you hear me on . . . kHz
QSO	Can you contact . . .
QSP	Will you pass a message
QSS	What working frequency will you use
QSU	Shall I send on this frequency
QSV	Please send a series of V's (for tuning)
QSX	Will you listen to . . . on . . . kHz
QSY	Shall I change frequency to . . . kHz
QSZ	Shall I repeat everything
QTH	What is your position
QTR	What is the time
QTX	Please keep your station open for me (until . . .)
QUA	Have you any news of . . .
and	
QLF	Are you sending with your left-foot . . . (or sometimes QAH – you can work that out!).

COMMON ABBREVIATIONS

AA	repeat all after . . .
ABT	about
ADR	address
AGN	again
ANT	antenna
ANI	any
BCNU	be seeing you
BD	bad
BLV	believe
CFM	confirm
CK	check
CLD	called
CNT	can't
CONDX	conditions
CUD	could
CUL	see you later
CUAGN	see you again
DE	from
DR	dear
DX	long-distance
ES	and
FB	fine business
FER	for
FONE	speech
FREQ	frequency
GA	good afternoon
GB	goodbye
GD	good day
GE	good evening
GLD	glad
GM	good morning
GN	good night
GND	ground
GUD	good
HI	laugh
HPE	hope
HR	here
HRD	heard
HV	have
HVY	heavy
HW	how
INP	input
LID	lousy operator
LSN	listen
MNI	many
MSG	message
ND	nothing doing
NR	number
OM	old man
OP	operator
OT	old timer
PA	power amplifier
PSE	please (or PSED pleased)
PWR	power
RX	receiver
SA	say
SED	said
SIGS	signals
SKED	pre-arranged contact
SLD	solid
SN	soon
SRI	sorry
STN	station
SUM	some
SWL	short wave listener
TKS	thanks
TMW	tomorrow
TNX	thanks
TRX	transceiver
TU	to you
TX	transmitter
U	you
UR	your
VY	very
WID	with
WKD	worked
WKG	working
WL	will
WUD	would
WX	weather
XYL	wife
YL	young lady/girl friend
73	best wishes
88	love and kisses

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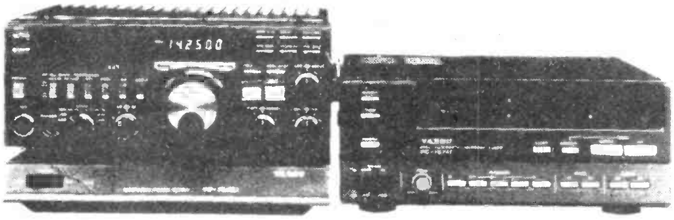

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MOD SHEET: Totsuku TR2100M

Priced at around £115 and giving some 10W PEP of SSB output, the Totsuku TR2100M 2m transceiver has become quite popular with both newly licensed and experienced radio amateurs. Robert Parry, G4VCL, suggests two simple but effective modifcations.

Modification To Stop Assymetrical Clipping By Microphone Amplifier

Change R16, 220 ohm resistor, for a 1k or 2k miniature cermet or turret potentiometer (see **Fig .1**). With an oscilloscope connected between Q7 collector and earth and with audio input to the transmitter from an audio oscillator, adjust the audio oscillator level until the waveform displayed begins to clip at the bottom (or top) — see **Fig.2**. R16 is then adjusted so that the output of Q7 clips at both the top and bottom — of the waveform — at the same time (see also **Fig.2**). This modification should considerably improve the quality of the transmitted audio.

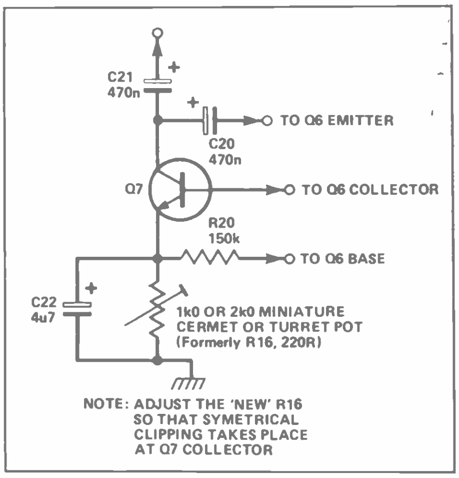


Fig. 1 Simple component change to mic. amp.

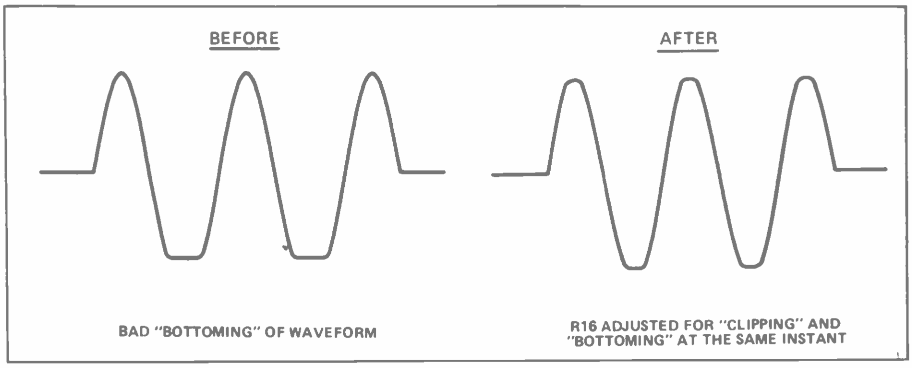


Fig. 2 Waveform at Q7 before and after mod.

Modification To Prevent 'Jitter' Or Frequency Modulation Of The Transceiver VXO

Extra stability is added to the VXO supply voltage, and thus to the frequency of the VXO, by the addition of capacitors Cc, Cd, and Ce (**Fig.3**). These are connected to pin 5 of the VXO unit connector.

The addition of resistor Rb (see **Fig.4**) provides a DC bleed to earth for diodes D14 and D15. These diodes are situated on the Main Unit Board and are part of the "OFFSET" voltage feed circuitry to the varicap diode D1 on the VXO Unit. The additional capacitor Cb, also shown in **Fig.4**, is provided to remove any ripple or 'jitter' on this voltage. Cb and Rb should be connected to pin 6 of the VXO unit connector. In tests I found that on transmit there was a small voltage jitter of quite a few millivolts on the supply to the varicap diode D1. This was reduced to almost nothing by the addition of Rb and Cb.

Fig. 3 (on RHS)

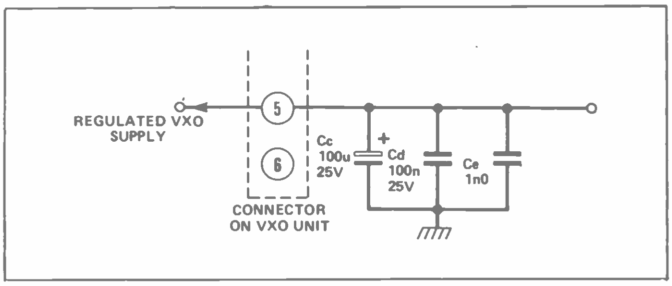
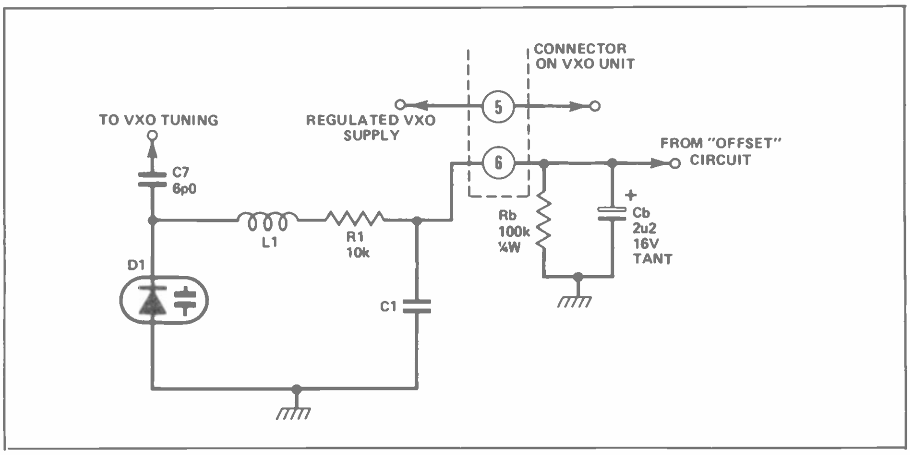


Fig. 4



FT101 + New Bands

The FT101 can be put on most frequencies between 1.8 and 30 MHz and fairly comprehensive instructions are included in the Yaesu workshop manual which is available for this series. The disadvantages of the official modifications is that they involve a fair amount of work, and entail removing some of the existing bands. The modification which follows is admittedly a compromise, but works well provided you do not try and run too much power, is quite simple and cheap to do and only looses you the CB band!!

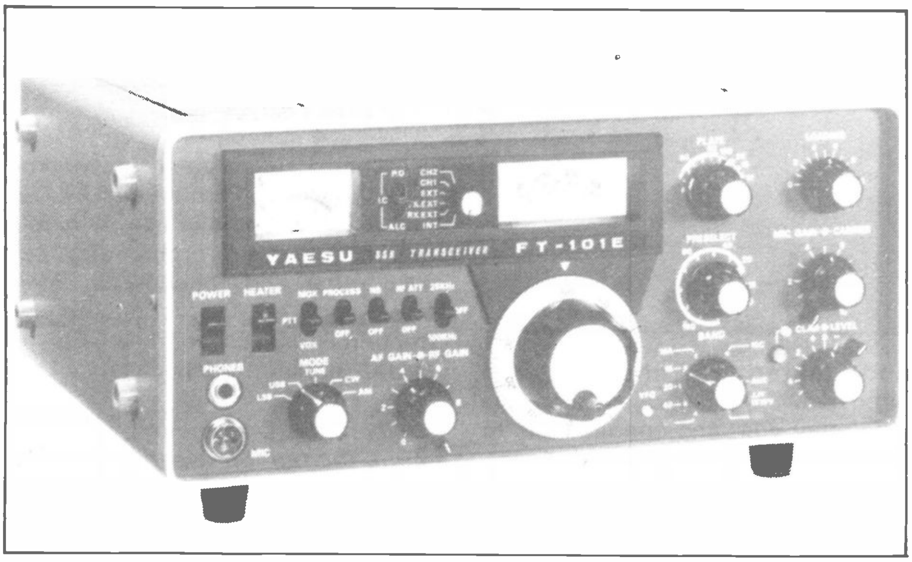
Want to work 10, 18 and 24MHz? If you have an FT101E or earlier marque, put that cheque book away and listen to Harry Leeming, G3LLL.

The FT101 MK1-E series is quite exceptional in its ease of new band convertability so please don't write asking if you can do the same to your FT101ZD or TS520 because I am afraid as far as the writer is concerned the answer is 'no'. If, however, *you* have a magic mod which puts the new bands on an existing popular rig for a few quid please don't keep it to yourself; if it really works the Editor will, no doubt, pay you to spill the beans *(I'll second that — Ed)*. The following instructions are part of the G3LLL Kit and whilst we have no objection to anyone 'rolling their own' they are copyright and must not be used commercially.

Parts Required

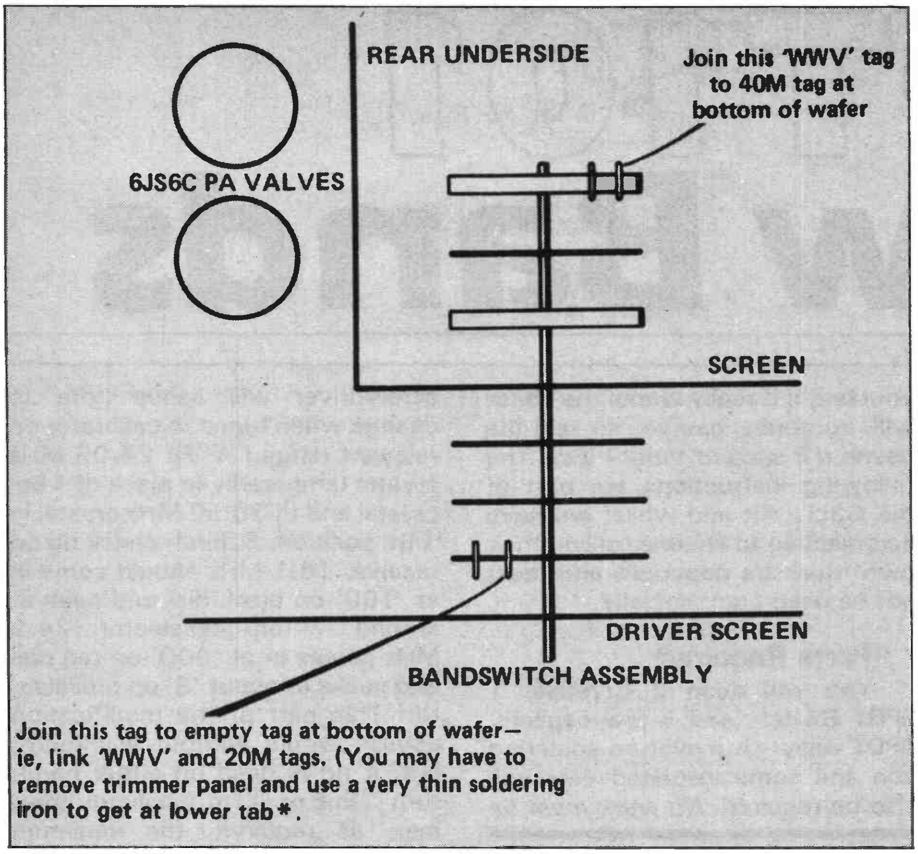
You will need 2 Crystals, 1 SPST Switch, and 1 low capacity SPDT relay. (A miniature soldering iron and some insulated wire will also be required. *No work must be carried out with AC mains supply connected,* and your soldering iron must be earthed to chassis or you may 'blow' an FET (or yourself). If you are not familiar with normal safety prodecures, get someone else who is to do the work.

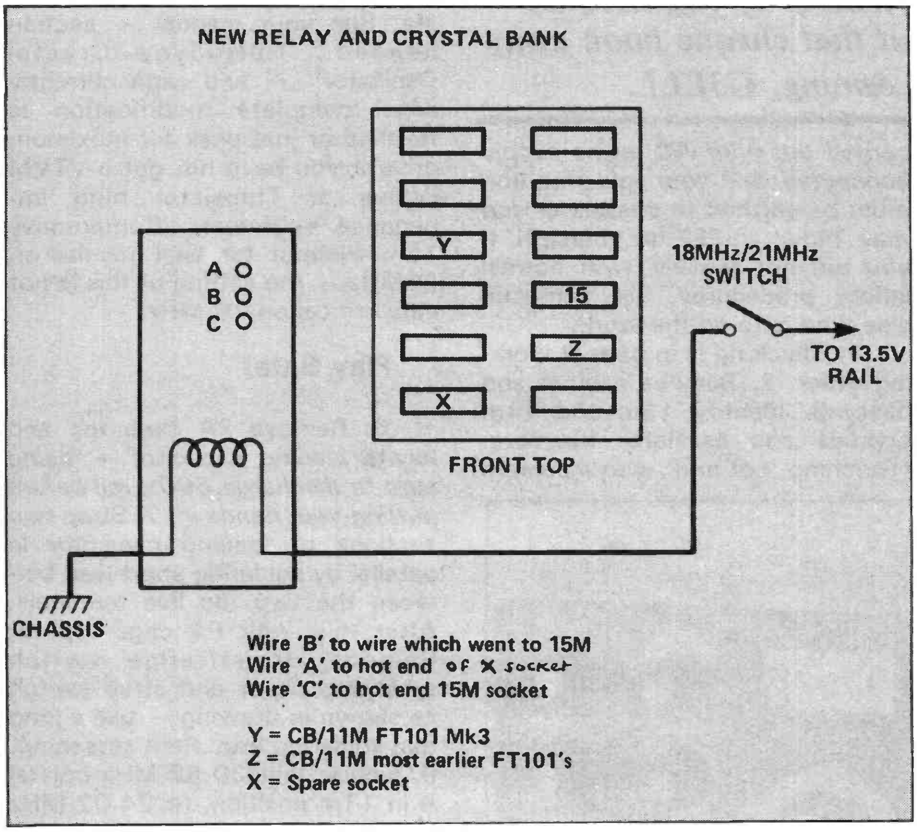
1. Check rig is in perfect working order. 2. Remove cabinet and base. 3. Identify 15m and 11m crystals and oscillator trimmers. (Touching 'hot end' with insulated screwdriver will cause note to change when tuned to calibrator on relevant range.) 4. Fit 24.02 MHz crystal temporarily in place of 15m crystal and fit 30.52 MHz crystal in 11m position. 5. First, check rig on receive. 18.1 MHz should come in at '100' on black dial and peak at around '7' on preselector. 24.9 MHz comes in at '900' on red dial and peaks at about '8' on preselector. This part of the modification usually works without alignment, but, if rig is dead on either band, turn 15m or 11m oscillator trimmer, as required, the minimum amount needed for rig to burst into life. See your manual — section headed "Hetrodyne Crystal Oscillator" — and align correctly *after* complete modification is finished or just peak for maximum drive if you have not got a VTVM (Valve or Transistor high impedance voltmeter). Compromise 15m trimmer for best results on 21MHz — the setting of this is not very critical on 18 MHz.



Play Safe!

6. Remove PA cage top and locate loading capacitor — *being sure to discharge 600V rail before putting your hands in!* 7. Strap two sections of loading capacitor in parallel by soldering short lead between the two top live terminals. After this, refit PA cage top. 8. Remove driver/range switch screening cover and strap switch as shown in drawing — use a long thin soldering iron. Refit screening. 9. Ensure that 30.52 MHz crystal is in 11m position, fit 24.02 MHz crystal in spare 'X' position and refit 15m crystal in its original position. 10. Remove two screws from crystal panel and withdraw it a little. Place FT101 on its side (watch you don't loose the spacers) and unsolder lead from 'hot end' of 15m crystal socket. ('Hot end' is





Top diag. View of bottom of FT101 chassis showing modifications to bandswitch.

Bottom diag. Modifications to crystal bank.

the end not common with the crystals.) 11. Wire two short insulated leads to hot ends of 'X' position and 15m crystal sockets and refit crystal panel. 12 Mount the relay in inverted position adjacent to 'X' position crystal socket and fasten to chassis with adhesive. Solder thick wire to one side relay coil, and connect this to chassis under crystal board screw, to earth the relay coil (and help hold relay in place). 13. Wire the centre contact of the relay (ie the pole) to the wire which originally went to 15m crystal socket, keeping this and all crystal/relay wiring *as short as possible.* 14. Wire the contact of the relay which is 'made' when th relay is energized, to the hot end of 'X' socket. 15. Wire the contact of the relay which is made when the relay is *not* energized, to the hot end of 15m crystal socket. 16. Wire the free end of relay coil to length of insulated wire going to the back of FTk101. 17. Fit 21/18 MHz switch by filing out hole that holds cabinet screw above 'IF' and 'AF' phone sockets are rear of FT101. 18. Wire one side of switch to 13.5V HT rail and other side to wire going to relay coil.

Modifications Complete

Check crystal oscillator trimming, see instruction 5.

Now 15m position of the bandswitch 'tunes' 21-21.5 or 18-18.5 (18/21 MHz switch), 11m 'tunes' 24.5-25MHz and WWV 'tunes' 10-10.5 MHz.

10 and 15m bands operate as before except PA loading is moved approx. 2 points clockwise. PA on new bands 'tunes' at around 15-20m point. We advise keeping power to a maximum of 50 watts and using an antenna tuner to ensure a clean signal. (Note, 10 watts is equivalent to about 100ma PA current and 200 ma gives around 50 watts CW, 130 ma peak approx. 50 watts PEP SSB).

Final Notes

The 11m crystal is marked 33.02 and the 15m crystal 27.02. If the 'X' socket is in use, wire in a crystal holder, one end to relay (see 14.) other end to common point "cold end" of 'X' crystal. Late production FT101Es label the CB band 'AUX', earlier models call it '11m'.

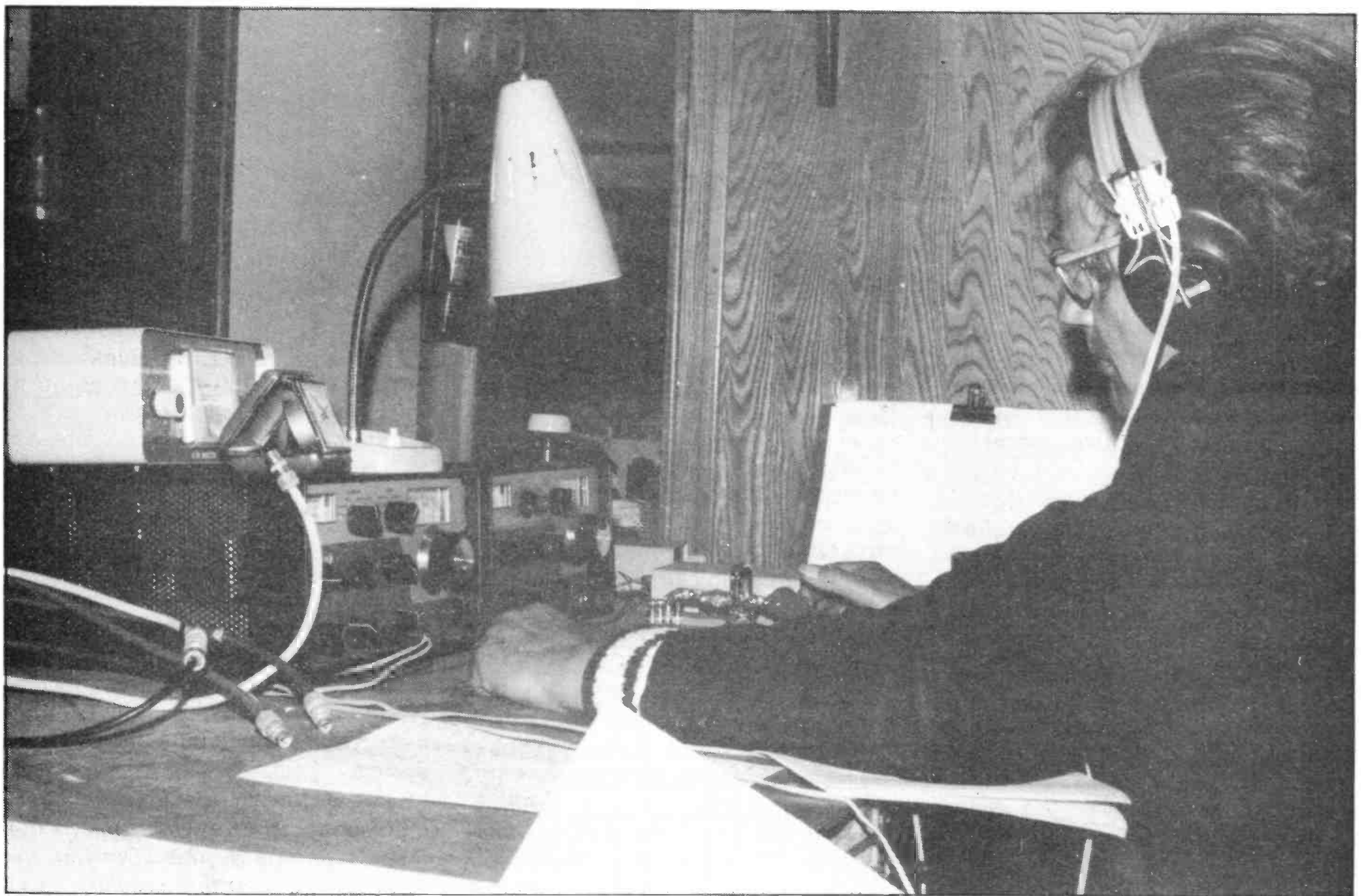
**When the bandswitch is set to 20m, the tag the wiper makes contact with will be the 20m tag. The WWV tag can be similarly identified.*

The Art of CONTEST OPERATION

Al Slater, G3FXB, is arguably the most successful HF contest operator in Great Britain — on both SSB and CW. Here he introduces the noble but much maligned art of contest operation.

"Not another contest again" is often the reaction of the average radio amateur when switching the receiver on during almost any weekend for a spot of casual operating. This state of affairs attracts plenty of comment from many others who are not interested in contest work and not aware of the pleasure and satisfaction that this activity can bring. Fortunately for the disinterested, contests are invariably either 'phone or CW only events and it is at least possible to escape them with a bit of flexibility in your mode of operating. Even at the present high level of amateur radio operation, contest activity tends to be concentrated in certain parts of the bands and hopefully the International Amateur Radio Union (IARU) will eventually recommend specific contest segments.

This apart, in view of the high levels of contest activity on the bands today some introduction to the world of contesting seems indicated not only for the newer licencee but for those who have always divorced themselves from this activity. Certainly, contesting

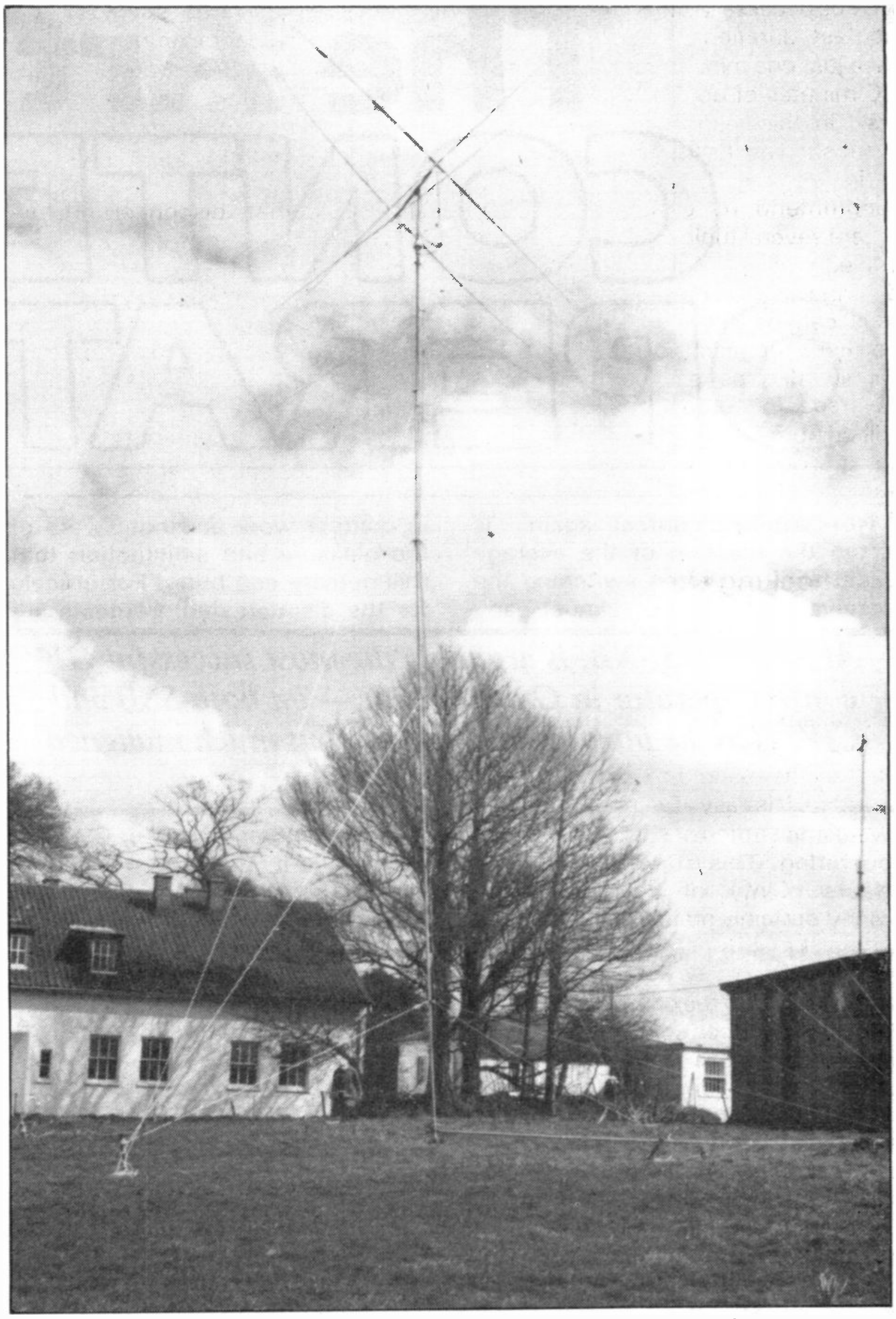


The writer operating in National Field Day with G4DAA, the Channel Contest Group brings out the best in us as far as perfecting station performance is concerned, although the cynics would point out that it also brings the worst out at times, with broad signals and marginal operating practices.

Receiver Requirements

One of the keys to the winning of contests is undoubtedly station performance and in particular the performance of the antenna system. In this connection only the competitive element could be the driving force behind the erection of no less than 24 towers at N5AU or the more modest 9 towers at N4AR. Much can be achieved by good operating practices but there really is no substitute for an effective antenna system. The competitive spirit often leads to the purchase or construction of good equipment which is properly maintained and coupled to a selection of antennas. Obviously such a station is equally effective for contesting and day-to-day routine operating activities, resulting in a performance considerably in excess of that of a more modestly equipped station. Serious contesting is not really for the 'piece-of-wire-out-of-the-window' type of installation.

If station performance is one of the keys to successful contesting, what should the UK operator be considering in the way of equipment?. As far as the actual gear is concerned I think it is fair to say that there is not too much to choose between what is available today. A prime factor is of course reliability, for, after all, contests are not won by being off the air with equipment failure for part of the event. This dictates the use of reliable equipment properly maintained. Good sensitivity and selectivity on the receiver are of course vital — remember the old adage "If you can't hear them you can't work them". Reasonable sensitivity is a common feature of all modern equipment, but selectivity in the 'front end' does sometimes leave something to be desired. For the CW operator there is often a fairly wide choice of IF filters available and these should be utilised fully. 500Hz is probably a reasonable compromise in CW bandwidth, providing as it does fair selectivity coupled with the ability to hear signals calling that are incorrectly 'netted' and thus slightly removed from your transmit frequency. There can be times when



The 2 element Quad antenna used by the Channel Contest Group as GU4DAA - the rare prefix and the antenna made a good contest combination!

sharper bandwidths such as 250Hz seem very desirable but anything sharper than 500Hz is generally not suited to contest work and really only applicable to routine QSOs under conditions of extreme QRM. A 'notch' filter is a useful feature and some "back-up" by an efficient tunable audio filter should also not be ruled out. Though all the modern "bells and whistles" are very nice, the prime receiver requirements, particularly for the CW contest operator, are versatile and effective IF selectivity free from filter leakage, coupled with good dynamic range in the front end.

Transmitter Tactics

It is fair comment that 100 watts of RF is the same regardless of how it is generated, but, in the selection and use of transmitting equipment, the contest operator should give consideration to a number of points. Whilst contest activity is at times restricted to one band or single band entries permitted, a lot of events are multi-band, a class of entry that often involves **rapid** band changes. In the RSGB Commonwealth Contest for example where activity is fairly thin, as many as thirty or so band changes may be necessary during the 24 hours contest duration. If these changes take just one minute, obviously some 30 minutes of operating time will be lost. In this respect modern equipment such as the TRIO TS 930s with its instant band change has much to recommend it. Other equipment where several tuning functions are involved can at least be simplified by drawing up a tuning chart so that controls can be set to pre-determined positions on each band. Attention should also be paid to frequency coverage, for, as an example, there is still equipment around that does not cover 160 metres and there are a number of interesting contests on that band during the year.

Checking Up

Some form of in-line power meter/SWR indication is desirable so that there is a visual check at all times of transmitter and antenna performance — and that the correct antenna for the band in use has been selected. It is easy after many hours of contest operation and lack of sleep to inadvertently select the wrong antenna! The CW contest operator will almost certainly make use of an electronic keyer, preferably of the memory type — so that paper work associated with the contest can be attended to between contacts when the keyer is calling CQ. SSB operators will also give consideration to speech processing, but a word of caution is indicated here. The writer still believes that under normal conditions a strong voice with good diction, employed in conjunction with a good quality microphone suitable to that voice, is superior to processed speech. It is mainly under marginal band conditions that the processor will show an advantage. In fact at other times the distortion introduced by processing, often giving the effect of alteration in the natural characteristics of the voice, can degrade readability. From the writer's own experience in "pile-ups" there have been many times when a station would have been copied much easier without processing. Another factor is that a processor incorrectly adjusted or abused can be a positive menace to those operating on adjacent frequencies, as witness the transmissions of some European stations.

The writer is a strong believer in VOX operation on SSB or semi-break-in on CW, as such techniques save valuable time and contribute to 'snappy' operating as well as permitting one to monitor the frequency during transmissions. However he does find the use of QSK or full break-in operation somewhat disconcerting on CW when trying to monitor one's own sending, often to the accompaniment of other signals on or near the frequency. Nevertheless for those accustomed to it, full QSK is the ultimate in efficient operating technique.

The prime transmitting requirements then are for a clean but well modulated signal on SSB, with a clean note and freedom from 'clicks' on CW, coupled with the ability to monitor output and also to make rapid band changes. The capability for split frequency operation, as provided by twin VFOs, is a necessity for pile-ups and working US stations on 80 and 40 metre 'phone.

Antenna and Site Requirements

As pointed out previously one of the keys to station performance is the antenna system and coupled to this are site considerations. As far as the latter are concerned, we are mostly not in a position where we can live in the ideal QTH, but we *can* make the most of what we have available. Almost anywhere we live we will be faced with the hazards of obtaining planning permission for our tower or of dealing with TVI/RFI problems. In this connection a rural location will almost certainly be best (!) and the more open terrain will assist antenna performance. Another advantage will be the relative freedom from RFI-in-reverse from neighbouring domestic equipment.

Ground conductivity is a very important factor in any location and apart from salt water (!) the best 'ground' is provided by clay soil. In any event a reasonable water table is indicated. The majority of locations will exhibit some enhancement in certain directions as a result of sloping ground. There is a fairly popular misconception that the best site for HF communication is on top of a hill and up to a point this may be true. But a location on sloping ground will give considerable enhancement of low angle radiation in the direction of the slope, with the rising ground in the reverse direction acting as a reflector and as a result giving an inferior perforance in this direction. The bulk of contest activity comes from a westerly direction (W, VE, VK/ZL long path etc.) and from a NE direction (JA), and anyone with sloping ground in these directions is indeed fortunate. Picking contests that enable one to exploit site enhancement is to be advocated and to some extent will make up for inadequacies in the antenna system, although this effect will be less pronounced on the lower frequencies. A site with sloping ground to the west and rising ground to the east would be a good choice for the ARRL DX contest where the object is to contact only US and Canadian stations, whilst sloping ground to the NE would suggest participation in the All Asian contest where the bulk of the QSOs will be with Japan.

Many Variables

The question of antenna choice is of course not easy and dictated by so many considerations. Readers are referred to a number of excellent publications on the subject, in particular the ARRL Antenna Book, HF Antennas for All Locations by Les Moxon, G6XN, All About Cubical Quad Antennas by W6SAI and the Beam Antenna Handbook by the same author. If space is at a premium and your interest centres on a particular band, specialising in an antenna system for that band could well be the best approach. As far as HF is concerned it is probably true that the mono-band full sized yagi is the best performer, excluding such specialised arrays as the rhombic. There are diminishing returns when the array is extended beyond 3 elements, after due allowance for the mechanical, structural and indeed ecological problems involved with large installations. Nevertheless, optimum performance is of course obtained with the larger arrays. Next in line after the 3 element mono-band yagi comes the basic 2 element cubical quad, which has the big advantage of a no-compromise performance with the possibility of simple multi-band construction matched only by the bigger tri-band yagis such as the TH6 DXX. If interest is limited to certain directions or a rotary array precluded, some form of fixed beam such as the rhombic, vee beam or wire yagi should not be ruled out. However, unless one is fortunate to have a selection of such antennas contest activity will be restricted to certain specialized events, as mentioned previously when discussing site considerations.

Next down the performance table come the smaller trap yagis that do undoubtedly compromise performance, followed by the multi-band single wire antenna which if fed with open wire line through an aerial tuning unit is still a surprisingly effective antenna, exhibiting useful gain on some bands. Finally come the compromise antennas such as the trap dipole and trap vertical which can best be described as convenience antennas, and certainly inadequate for serious contest work.

The position on the LF bands is somewhat different, for fortunate indeed are those that can accommodate rotary beams on 7 MHz. On these bands the vertical comes more into its own because of the lower angle of radiation over horizontal antennas at these frequencies, at least when the latter are used at conventional heights. The effectiveness of the vertical for DX work is more pronounced on 3.5 and 1.8 MHz, particularly if two or more can be phased to achieve directivity and gain. Another effective antenna on these frequencies is the sloping dipole or "sloper", particularly if several can be suspended from a central point and switched so as to give directivity, modest gain and low angle of radiation. As on the HF bands the multi-band single wire antenna with open wire feeders will perform reasonably well, as will the inverted V dipole with the apex as high as possible. As with the HF bands, coverage in specific directions can be obtained very effectively with wire arrays such as the rhombic but particularly on 7 MHz the use of a fixed, wire yagi beam should not be ruled out.

Contest Station N4AR, Kentucky USA

To sum up then, the requirements are for a reasonable site coupled with effective antennas which will give gain, directivity and low angle radiation on the bands and in the directions required.

Contest Strategy

Having hopefully equipped ourselves with reasonable facilities it is now necessary to consider the various contests on the calendar and the strategy to be employed to achieve a reasonable placing in the results. All the various contests are different in character but the majority have one thing in common in that there will be a *multiplier* or bonus system in the scoring, making it necessary not only to achieve a good QSO total but to ensure that in the total there are a reasonable number of contacts with rarer stations. In some events such as the IARU Radiosport contest there is less emphasis on this aspect, but, in our own RSGB Commonwealth Contest, for example, a good amount of bonus contacts is imperative. If one has a commanding signal on the bands there will be more emphasis on calling CQ and 'running' QSOs — as the QSO total resulting will largely compensate for the failure to contact some of the rarer stations. In any event I think it is also fair comment that a reasonable number of rarer stations will respond to CQ calls from a well equipped station.

Tactics to be employed then are dictated by the type of contest and the emphasis on those rarer QSOs, as well as by the class of signal that one can radiate on the bands. A rule of thumb that the writer employs is to call CQ at least during the initial stages of the vent and spend more time towards the end searching for multipliers or bonus contacts, and also for stations not previously worked.

Contest Calendar

This might be an opportune time to run through some of the major contests in the calendar and explain some of the objects as well as some of the tactics that might be employed. Propagation conditions tend to be rather depressed during the winter months, at least in the northern hemisphere, and the HF bands are closed for long periods. Most of the major European and American events therefore occur during the spring and autumn when conditons are optimum.

The first one of the year is the **CQ WW 160 metre** contest sponsored by CQ Magazine in the USA. The CW section is on the last full weekend of January and the 'phone the last full weekend of February. To some extent this is a contest for the 160 metre specialist but there is fun in it for all. Extra points are given for DX QSOs and the total of points is multiplied by the total of different countries, US states and Canadian provinces contacted. Obviously activity is minimal during the daylight hours, apart from the periods following sunrise and preceding sunset. The sunrise period indeed will often give the best openings for DX on 160. A reasonable balance must be struck between calling CQ and searching. Other points to remember are that although DX stations will reply to CQ calls on one's own frequency, that in the main, use should be made of the "DX Window" listening from 1800 to 1810 KHz and transmitting around 1825 to 1835 KHz. Remember also that certain countries have only limited allocations on 160. The bulk of the USSR activity for example is above 1850 and the JAs are at the high end of the band.

RSGB 1.8 MHz. Three short duration CW contests are held each year on 160 metres in February, June and November. Bonus points are scored for contacting different countries and also UK countries. Special awards are issued to new entrants and senior citizens. These events are not demanding in the amount of time involved and provide an excellent opportunity for aspiring contesters to "cut their teeth". UK stations are sought after and providing reasonable antenna facilities are available, the bulk of contacts will come from CQ calls with searching indicated when the scoring rate drops.

RSGB 7MHz Contest. This is held in February and has separate 'phone and CW weekends. It is a "G -- versus the rest" type of event so UK stations tend to be sought after. Extra points are given for DX QSOs so a reasonable ratio of DX to European contacts is required. The multiplier is based on the DXCC country list but in addition VE, VK, W and ZL call areas are also valid. CQ calls are the usual procedure for UK stations for much of the time but an occasional search for multipliers and stations not worked should be made, particularly when replies to CQ calls tend to fall off. Only a small percentage of UK amateurs possess rotary arrays for 7MHz and this is certainly a contest where the more modestly equipped station operated efficiently can do well.

ARRL DX Contest. In this event QSOs are only valid with the USA and Canada and the multiplier consists of the US states (excluding Hawaii and Alaska) and the Canadian provinces. There are single and multi-band classes of entry and in the case of the latter, multipliers count on each band — for example MASS (Massachusetts) would count six times if contacted on the six older bands from 1.8 to 28 MHz. The CW section is held in February and the 'phone in March. Handsome plaques are awarded to continental winners in each mode and class of entry. The fun of this contest is the fact that it is very well supported by W and VE stations and CQ calls from Europe will invariably produce long "runs" of North American QSOs. It is also interesting to contact those rarer western states and provinces on the different bands. In the main, searching for QSOs is restricted to the morning hours when propagation and activity is marginal. Log sheets and entry forms with a multiplier check list can be obtained from the ARRL, Newington, CT 06111, USA but, as in all such cases, return postage should be enclosed.

RSGB Commonwealth Contest. This is one of my favourites. Originally known as the BERU (British Empire Radio Union) it originated in the early 30s. It has only been won outright from the UK on three occasions and as such present a major challenge. It is a CW only event although there is a companion event run on 'phone by the Canadian CARF which does not attract much support. The duration is 24 hours and it is held in early March. There is no multiplier but the first three contacts on each band with each Commonwealth call area score bonus points. A good knowledge of propagation together with precision timing is necessary if a reasonable number of VK and ZL bonus contacts are to be obtained on the LF bands. Being restricted to 24 hours one has but one "shot" on the various paths. CQ calls do pay dividends when directed at high density areas such as VE and VK/ZL but to a large extent this is a contest that primarily involves searching for contacts. It is a contest not marked by some of the unsavoury practices found at times in some of the more major events and tends to take on the atmosphere of a QSO party to some extent, with the opportunity to contact a goodly number of old friends in the Commonwealth. Operation is restricted to the lower 30 kHz of each band but in practice tends to be concentrated in the lower 10 or 20 kHz.

CQ Magazine WPX Contest. The multiplier in this event takes the form of the prefix of the call sign. Unlike other major multi-band contests each prefix only counts once — however there is such a wide selection of prefixes available, particularly from the USA, that there is no shortage of multipliers. An incentive is provided for LF band operation as each QSO on those bands earns double points. Single operators are only permitted 30 hours of operation out of the 48 and the balance can be taken in up to five rest periods. This provides the additional challenge of knowing when to take time off without losing too many QSOs. In addition to multi-band entries, single band operation is also permitted. The SSB section is held at the end of March and the CW in May. These dates dictate that rest periods at least in the CW event be taken during the midday period when conditions are at their worst for DX working. Rules, log sheets and entry forms cn be obtained from CQ Magazine, 76 North Broadway, Hicksville, NY 11801, USA.

Radiosport. This activity is sponsored by the IARU through the auspices of the ARRL. It is scheduled in July and entries can be SSB only, CW only or mixed mode. There is no single band class of entry and single operators are restricted to 36 hours of operation. The multiplier is based on the ITU zone system which possibly does not provide as much fun as chasing countries. For further information contact IARU Hq, Box AAA, Newington, CT 06111, USA.

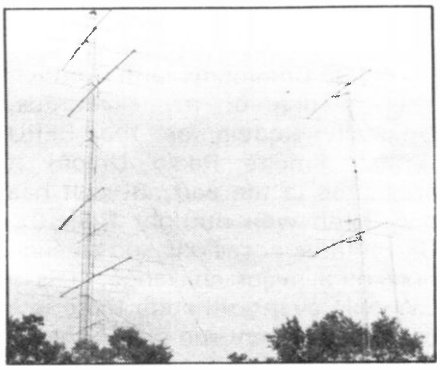
WAE Contest. This is another summertime event with the CW section in August and the 'phone in September. The object is for European stations to contact only those in other continents whilst the DX stations only work Europe. This contest is quite complex insofar that points are not only obtained from QSOs but also for QTCs, which consist of reporting back on-the-air details of previous contacts in the contest. These QTCs are transmitted by DX stations to European entrants and are worth points for both the orginating and the receiving station. Multipliers are DXCC countries as well as US states, along with certain call areas, with additional bonuses for those on the LF bands. Paper work is vital in the WAE, each competing station producing accurate check lists of stations contacted. Also QTCs received as there is a maximum 10 allowed from each station. The writer has always tried to strike a balance in securing roughly the same number of QSOs as QTCs and, of course, the multiplier aspect should not be overlooked. In view of the rather complex nature of the WAE it is strongly suggested that rules, log sheets and entry forms be obtained from the WAEDC Committee, Postbox 1328, D-895, Kaufbeuren, Germany.

RSGB 21/28 MHz Telephony and 21 MHz CW Contests. These events are both held in October, are in the ''G versus the rest'' category and are restricted to 12 hours on a Sunday. The multiplier consists of DXCC countries plus certain call areas and the comments made concerning the use of CQ calls in the RSGB 7MHz Contest information are applicable here also.

CQ Contest. This is probably the major event of the year in the contest calendar. The phone section is in October and the CW in November. All contacts count for points with the exception of those within your own country and the scoring system of 1 point for Europe, 3 points for DX, makes a high percentage of DX QSOs imperative. The multiplier consists of zones as in the WAZ award, plus countries. The DXCC listing is the basis for these but in the case of Europe the basis is the WAE list. This means that countries such as Orkney/Shetland, Sicily and the Karelo-Finnish Republic (UN1) are valid. There are single band and multi-band entries and world records are published in CQ Magazine, for each continent on each band, as well as the US records. Both weekends attract considerable DX-expedition activity as well as very high levels of 'normal' activity. In the phone event in 1979 the writer made almost 4000 QSOs from the UK which serves to illustrate the point. As with the WPX Contest log forms etc. are obtainable from CQ Magazine.

Multi Operator Contests

These events could really warrant an article all of their own. The major contests that I have mentioned all have sections for this type of operation where a team is employed to spread the operating and the search for multipliers. Where operation is limited to one transmitter apart from the contacting of multipliers, such activity is known as ''Multi Single''. In some cases however, several transmitters will be run on *simultaneously* on several bands. Such an activity is known as ''Multi Multi''(!) Some of the more popular contests that involve a team are the RSGB National Field Days which have a character all of their own. A CW event is held in June with SSB in



N4AR

September and those developing an interest in contest work would be well advised to gain some experience by involving themselves with a local Club in these activities.

Paperwork

Inevitably any contest entry should be of a high standard as far as accuracy is concerned and many an entrant has lost the coveted first place because of being lax with the paperwork. Most adjudicators penalize entrants who fail to remove duplicate contacts from their log and all entries should always be thoroughly and systematically ''duped''. Depending on the contest and the speed of operation, some form of ''dupe list'' should be maintained during the contest so that when searching for contacts one is aware of stations that have already been worked. This is not always possible in contests where scoring rates are very high as in the CQ Contests, but some form of check list for multipliers is absolutely essential in almost *any* event. At least on CW the use of a memory keyer will enable some of the paperwork to be kept under control.

It is a good idea in any contest to target a QSO total based on the previous years results. This target should be broken down to a projection of so many QSOs per hour and once the rate from CQ calls fall substantially below this projection, then is the time to change bands or go searching for elusive multipliers as the case maybe.

Accuracy is vitally important. The majority of adjudicators deduct points for incorrect call signs and serial number exchanges. One of the prime objects in contest operation is the maximum exchange of information with the highest level of accuracy achieved in the minimum of time. The use of such pleasantries as 73, TU, CUL and GOOD LUCK IN THE CONTEST are entirely superfluous and only waste valuable time. They should be reserved only for close friends.

In Conclusion

The subject of contest operating as you have seen is a complex one. Indeed it is a hobby in itself and 'dyed-in-the-wood' contesters have a language all of their own. It is a pity that there seems less competitive spirit here in the UK as opposed to the USA or Eastern Europe. If this article has kindled a little enthusiasm or taught a few tricks then it has not been in vain. Inevitably with a subject so complex there is much more that could be said and I trust that any of my omissions have not been serious ones.

As a follow up to this article, HRT will be shortly running an article on VHF contest operation by John Ridd, G8BQX, of G6HH and the Hastings Electronics and Radio Society. If you have worked in a 2m contest, you may have heard the G6HH signal from their four 16 element yagis — mounted on a 90 foot jib crane! John Ridd is a man who speaks his mind and he has been successfully competing in VHF contests for well over a decade. Pungent and highly informative are the adjectives that spring most easily to the Editor's mind as he reads the article through. . .

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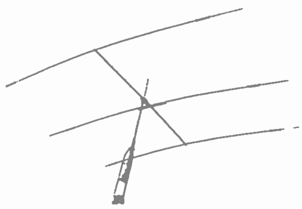

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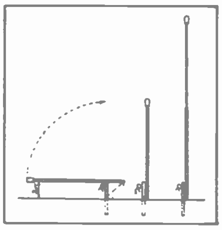

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Reviewing the FDK M-750XX — Budget 2m multimode

FDK's Multi 700 series of 2m rigs have been around for quite a while now. Introduced around 1980, the Multi 700 (FM) and 750E (multi-mode) soon carved a place for themselves in the market. The FM that I set about this review of the 750XX multi-mode version, which was kindly provided by Waters and Stanton of Hockley, Essex who are the UK importers for FDK equipment. The 750XX was introduced

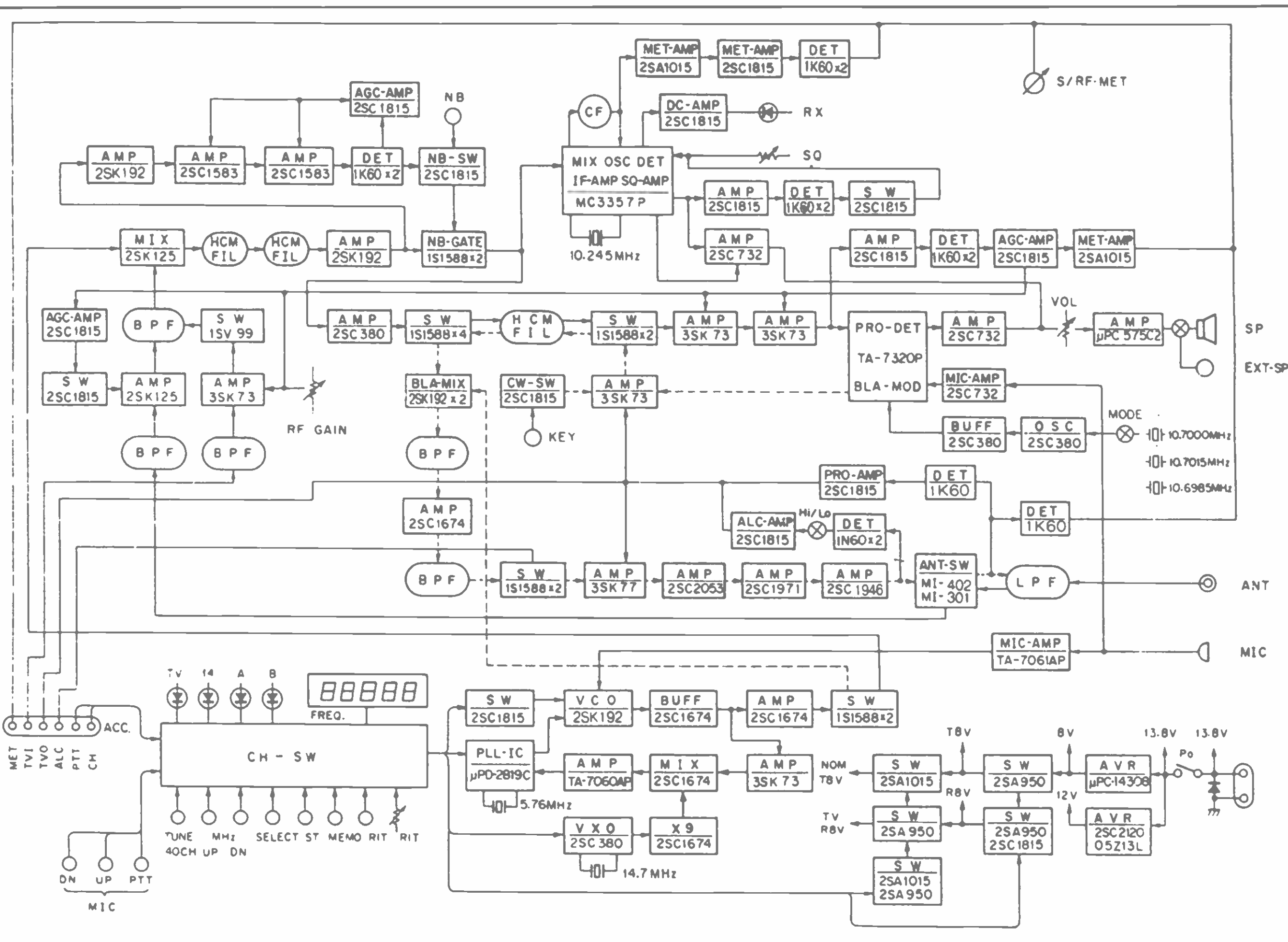
The word on the streets said the FDK Multi 750XX was the cheapest 2m multimode around and pretty hot stuff. HRT thought this needed further investigation and Peter Metcalfe, BSc, G8DCZ, was put on the case.

version seems to have become a very popular rig for mobile use and, as an owner of a 700EX for the past three years, I can see why. It's basic, unpretentious facilities make for simple and safe mobile operation while the signal handling properties and general ruggedness of the 700EX are as good as any of the more flashy models on sale. It was therefore with great interest

at the end of 1983 and the only outward difference from its predecessor is the blue display, whereas previously it was green. Looking a little closer at old and new adverts shows that the 10W output has now been raised to 20W. Little else appears to have changed but, if you're onto a winner, why change it!

The most novel feature of the 750E was the announcement, in 1980, of a companion unit to expand the basic model to 70cm multi-mode. Funnily enough this unit did not make its appearance in this country until Spring 1981. However, the 'Expander' 430 is now readily available and FDK are still committed to their multi-mode/multi-band idea. When you think about it, the 750XX at £315 and its expander at £249 make a very favourable price comparison with, say, the TS780 at £795 or the FT726 at around £900. OK, so perhaps that's an unfair comparison considering the extra facilities offered by the other models, but if money is tight (when isn't it?) what better way is there of getting on 2m and 70cm (excluding homebrewing of course!).

On unpacking, the 750XX's ancestry is instantly obvious since it is housed in exactly the same case as the FM only version. The control layout is also similar to the 700EX with one or two additions and a few relocations. (Being used to the 700EX, this caused a couple of initial operating problems!) The manual describes the 750XX as having a "compact size compared to an ordinary FM transceiver". In fact, it is one of the larger multi-modes, being similar to the Trio 9130 but much bigger than the C5800 and many other presently available rigs. It's true that compared to the 700EX, FDK have packed multi-mode operation into



Block diagram of the FDK Multi-750XX

the same box as FM alone, but of course the latest FM rigs are much smaller (e.g. the Trio TM201A). I have found over the years that the very large front-to-back length makes the 700EX rather awkward to fit into many cars and, also, that a lot of vibration seens occur when the rig is in the mobile mount. The mount supplied with the 750XX is unfortunately the same awful design as the 700EX. One needs about four hands, good lighting and a lot of luck to fix the rig into the mount and it cannot by any stretch of the imagination be called 'quick-fit'. The power connector is also the same as on the 700EX and I have found that, unless the rig is a permanent fixture, the plug gradually wears and can cause intermittent connection problems. A few pence more on a screw-type connector here would have been well spent I feel.

Manual Error

Now onto my old hobby horse — the manual. Until recently Trio have had my prize for the least informative manual but now FDK take the wooden spoon! True, the booklet explains basic operation for the newcomer (just about) albeit with one or two errors/misleading areas (see later) but that is all. The review copy seemed incomplete with no diagram of the microprocessor section and an almost unreadable photocopy for the main circuit. FDK use the now 'standard' technique of labelling wires with incomprehensible codes (which seem to change along their length!) and have the inevitable single line representation of multi-wire cableforms with little indication as to what goes where. Because of this, one of the most attractive features of the 750XX, the accessory socket on the rear panel, is rendered almost useless. Concerning this socket, the manual issues a warning that it should only be used with the 430 Expander; however it would appear that some very useful features could be tapped into via this outlet. For example, PTT, some form of RF output, metering, display drive, RF input and a way to convert the normal 600KHz repeater shift to the UHF standard 1.6MHz. I know that FDK want you to buy their add-on unit but there must be someone out there dying to step into the homebrew linear/transverter field. Isn't that what amateur radio is all about? So please wake up manufacturers!

One area in which the manual is misleading is where it states that the PTT switch must be depressed when operating CW. This is not the case as merely pressing the Morse key will put the rig onto transmit when in the CW mode. It is unfortunate that, though there is a sidetone facility, there is no means by which one can practice CW 'off air' as, unlike many other rigs, the sidetone is only operative whilst transmitting. I also found that the tone is rather loud and could find no immediately obvious control to turn the level down.

Classic quote from the manual is: "It is good operating practice to use the minimum RF output power to secure good communication, according to the distance and band conditions. Output level, is controlled by the rear panel 'high/low' switch."

This is all very true, so why put the switch on the rear panel? If the rig is mounted on a shelf or in a car, this switch is practically inaccessible and would tend to discourage this laudable operating practice.

It's a shame that sticking to the same panel layout as the FM version has meant that the 700EX's variable power control (a unique and admirable feature to my mind) has had to be replaced by the RIT in the 750XX. One point in favour of the 750XX is that the high/low power (20W/1W) does operate on SSB, unlike many of it's contemporaries. Another potentially useful feature is that the mic. socket appears to have a +5V line along with the usual PTT, audio and up/down lines. This could be very useful for supplying power to a speech processor or boom mic preamp without having to use extra power leads (pity it's not +12V though!).

Opening Up

So what goes on inside? (You know it's surprising the large number of people who will go for months without peeking inside the box! I'm afraid that it's one of my first thoughts.) After the clean uncluttered lines of the 700EX, my first impression of the 750XX is that there are lots of add on boards. However, the whole interior is still quite well laid out with lots of room to wield a soldering iron!

The lower section reveals the main RF board containing, surprisingly, a bipolar (2SK125) grounded-based input stage. If one is using the 70cm add on unit then the input is routed to 3SK73 MOSFET. Also on this board is the now 'standard' integrated circuit for a dual conversion FM transceiver i.e. a MC3357 (FM detector, squelch, second IF etc.). This has proved it's worth in such rigs as the Icom IC290E. What is rather intriguing is a rather large, nay massive, diecast block which I can only assume is the helical bandpass filter. (Yes, the manual is terribly explicit here!) Practically all of the board connections are socketed which is rather nice, unlike for example the Standard C5800.

The upper portion of the rig houses the main microprocessor and the switching side of things. These are constructed on three circuit boards. The first of these houses the microprocessor channel switching using a UPD650, as in the IC290 and TR9130. The second has the PLL, VXO and VCO while the third has the usual mic amplifier integrated circuit, crystal filter, balanced modulator and product detector circuitry. Also in the top section are two 'add-on' boards which cater for the tone burst and scan functions. The main impression of these areas is of good quality, no-nonsense design and construction. My only gripe here is that in the logic section only three of the ICs are socketed (the expensive ones!) and I think it a shame that there is the chance of ruining an entire circuit board when replacing a 20p IC, when, for the sake of a few pence more, this danger could have been easily alleviated.

The final section of the rig is a most pleasant surprise. The rear section is devoted to the voltage regulator and RF power section. The surprise comes in finding that the final PA is discrete. Having blown two PA modules in the 700EX in three years, I am rather pleased to see a discrete output stage at last. (Never did trust those module things!) Considering the abundance of 10W multi-mode rigs using modules in the output stage, it would be interesting to see if the 750E (10W) version used one too. Perhaps this is the major difference between the two versions. Having said this however, there is one rather odd point in that the 750XX has a large heatsink bolted to the back of the case but the final transistor is attached to a relatively small extension of this. There is nothing bolted to the main heatsink at all! With this in mind I kept a careful eye on it's operating temperature and sure enough after about five minutes of transmitting on FM the rear panel was too hot to touch! However, the rig seemed to cope adequately with this but I do advise caution when mounting the rig in a car (not too near the hot air vents!).

Physical Problems

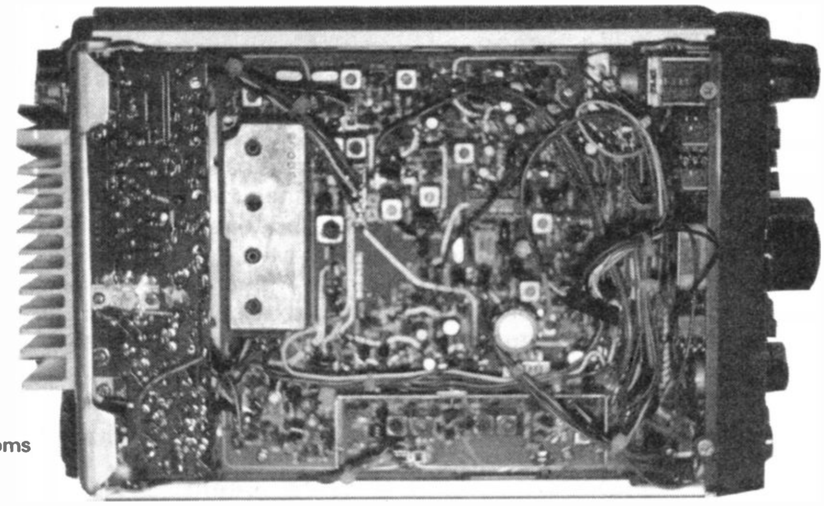
In operation the 750XX presents one or two physical problems to the operator. For example, the squelch control is difficult to use without simultaneously and unintentionally adjusting the audio output level. Similarly, the mode switch is very awkward to operate without turning the RF gain control. One of the main advantages of the 700EX was the simplicity of the control layout, making the rig ideally suited for mobile use. I fear that FDK have tried to cram many features into too few control knobs/buttons with the 750XX and they have failed to produce a 'safe' mobile rig in some respects. (I'm afraid that my vote must go to the TR9130 for being the 'safe' mobile multi-mode rig.).

Readout Roundup

FDK seem determined to perpetuate the age-old controversy about 'S' meter readings — as are many other manufacturers for that matter. Local contacts on both FM and SSB, which I would have considered to be 5/9+, barely registered on the LED display. On the positive side the frequency readout is provided by a blue five-digit display, the brightness and size of which should be adequate for even the sunniest day. There is also a rather nice touch in that when used as a 2m rig, a green '14' legend is illuminated, while when the 70cm Expander unit is connected this changes to '43', the ordinary display thus giving true 70cm frequencies.

The audio output is quoted as 1·2W with the inevitable 10% distortion. This seems rather low for all but the quietest of cars and I found this a bit of a problem! However, in the rig's favour, the speaker fitted is a reasonably large 3" type and gives very nice audio quality. It is particularly pleasant on SSB and makes DX chasing not too strenuous on the ears at least.

In operation the 750XX seems to have a very sensitive 'front end' and compared favourably with my main rig, which is fitted with a preamp. I have long been a fan of FDK's front end design and they seem to have got it right again with this model. Unfortunately, the operation of the review model was marred by a couple of 'dry joints'. One of these was in the squelch circuitry and occasionally caused the squelch to open when the rig was scanning, thus stopping the scanning. The other rather more serious dry joint was in the mic preamp section and resulted in practically zero modulation on FM (no wonder I couldn't raise the local repeater or get any reports initially!). I do hope



Bottoms up!

that this is not an indication that FDK are cutting costs at the expense of production control. Reports on SSB were of a "nice clean signal and audio", "perhaps a little flat but not bad audio" etc. One slightly worrying feature is that there appears to be no 'out of band' preventative switching and on a set which covers 144-148MHz this could cause embarrassment (to say the least!). A couple more criticisms were that the noise blanker seemed rather ineffectual, (it didn't pass the 'sewing machine in the next room' test as well as other rigs I've tried) and that the tone burst, like that on many current rigs, was far too long. On this point however, the tone burst section is readily accessible (a bolt-on board to the rear of the upper section) and should present little difficulty in changing a capacitor to alter the length of burst.

Taking Steps

The processor and PLL unit allows frequency steps of only 5KHz and 100Hz on all modes. The absence of a 25KHz step on FM made quick QSYing rather awkward. For SSB I found 5KHz steps a little coarse, especially under lift conditions with a crowded band, but, as the alternative is to tune in 100Hz steps, one has to get used to this I'm afraid. RIT is enabled by latching a push switch and covers +2·5KHz on SSB. While this shift seemed rather large at first and took a little time to get used to, it does mean that it covers the frequency range of the 'Step' control. Since the RIT range is so large it would have been nice if there was some form of LED indication when RIT was enabled. There is a further 'step' of 1MHz provided by a front panel push switch and, while this is very useful, I found it all too easy to knock under mobile conditions and found myself tuning to the 146-148MHz region!

A very nice feature of the 750XX is the totally independent A/B dual VFO. When used as a 2m only rig this gives great versatility in setting up QSY frequencies and for monitoring both SSB and FM calling channels etc. But FDK don't stop there — also available is the 'cross' facility which means that the currently selected VFO gives the receive frequency and the other VFO gives the transmit one. This facility means that if the Expander is fitted, cross band operation is possible. This offers many useful features to the 2m/70cm operator, for example, reverse repeater, listen on input, continental repeater shifts, satellite working, silly splits etc. Back up for the two VFOs is only provided while power is connected and then the current drain is around 1·5mA, perhaps a little too high for battery back-up and anyway, as there are no memories provided, perhaps this is not a bad omission. On the subject of memories, it does seem strange that FDK do not offer them on the 750XX. After all, Trio and Icom use the same processor and yet do have memories. I can only think that FDK couldn't find room for a switch to control this function!

Up/down tuning is accomplished by two buttons on the microphone; continuous pressing of either of these also sets off the up/down autoscan. This scanning can only be described as rudimentary, for it is only of the 'stop on a busy channel' variety and, once the rig has stopped there, scanning does not resume when the signal disappears. It is possible to scan when in SSB mode but the scanning will not stop until told to do so. Another annoying feature is that once the scanning facility is initiated, the rig scans the full 144-148MHz and there is no facility to scan, say, between VFO A and B frequencies. Consequently, on 2m this function is effectively useless for half the time. Selection of the step frequency of 5KHz provides a problem here and causes the scanning on FM to stop, as soon as it detects any signal, well away from the correct frequency!

My biggest gripe in the synthesiser department is with the repeater shift design. While the 750XX has the usual +600KHz shift (1·6MHz on 70cm) controlled by the offset switch, there is no indicator to tell you when this function has been selected. What is more, the display does *not* alter to show the Tx frequency! This seems rather odd considering that the display does change when using the A/B cross facility. (Perhaps a modification will be forthcoming to rectify this problem.) Also there is no immediately available 'listen on input' facility unless one goes through the procedure of setting up the A/B VFOs to give this. Finally since the repeater shift is not deactivated on SSB, and owing to the 144·000/147·995 wrap-around, one can easily find oneself transmitting on 147·700MHz instead of 144·300MHz!

Final Thoughts

Now I may have seemed to be running down FDK, *but far from it*. Most of my gripes are about minor details which should be relatively easy to modify. The main attraction of the 750XX is that it is a very well designed rig from the RF point of view with simple controls, few gimmicks and, from my point of view, there is plenty of space to get the soldering iron into! An excellent RF enthusiasts rig, but a shame about the manual. Probably of greater importance is that it's one of the cheapest units on the market. Couple this with FDK's commitment to 70cm transverter facilities and I feel that you have an excellent nucleus for a base/mobile set up. I wonder if FDK will swap it for my faithful old 700EX?

A Plain Man's Guide to 6m Reception

There is considerable and growing interest in the 6m band. With the accelerated closedown of VHF 405-line TV, from January 1984, licences may be widely granted to the UK amateur fraternity. In Part 1, Jack Hum, G5UM, sets the scene and describes the techniques for successful 6m reception. A simple, effective design for a 6m converter will follow.

In the past, there was traditionally an amateur frequency allocation in the UK around the five-metre area of the radio spectrum. Back in the 'Thirties', pioneer VHF men keen to try 'Five' would subject the valves of the day to a process known as debasing, which simply entailed removing them from the large bakelite bases, then common, and attaching signal frequency inductors to the actual valve lead-out pins in the interest of (it was fondly hoped), reducing losses.

All this was in the cause of building transmitters – self-excited modulated oscillators – and companion 'super-regenerative' receivers for the virtually uncharted territory of 56Mc/s – and please, Mr Editor, do not change that term "Mc/s" to "MHz": the word megahertz was unknown all those decades ago, and it was megacycles that ruled the waves.

Upon the resumption of amateur activity after World War Two, the S/E transmitters and 'super-regen' receivers of the 'Thirties proved obsolete in the face of the vastly improved VHF techniques of the 'Forties. There was only one place for them when they were returned from their impounding by Government agency, and that was straight into the garbage bin!

The post-war allocation in the five-metre area was, in the event, slightly higher in frequency than the pre-war one. It was 58.5 to 60MHz, and at once it attracted the attention of many operators whose interest in the "very highs" had been whetted during the war years. But it also had among its adherents many exploratory-minded amateurs ready to tackle anything that looked new and challenging, as 'Five' was then and 'Ten Gigs' is today.

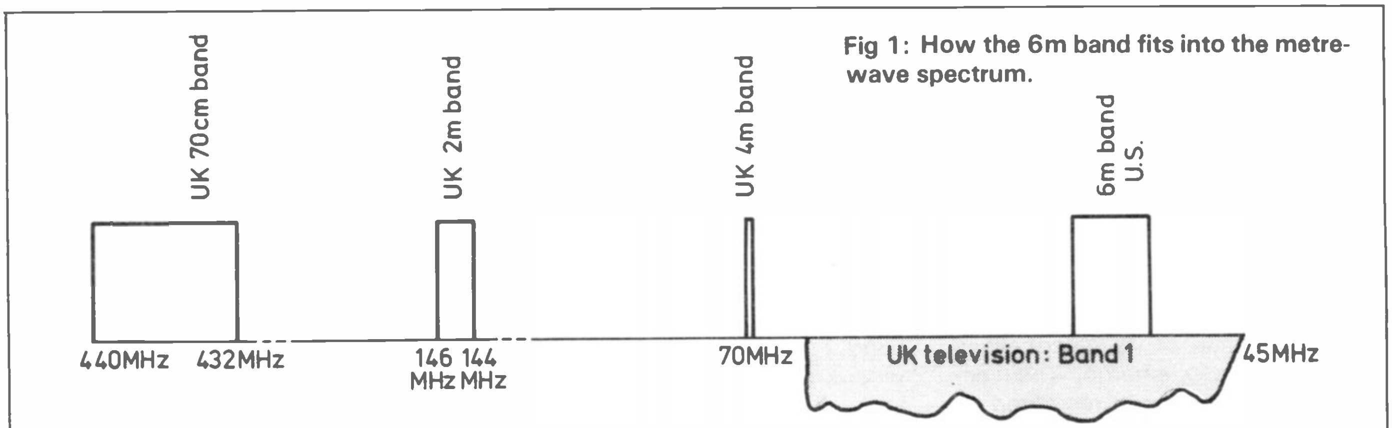
Sadly, theirs was to be but a brief flirtation with the new 5m band. The writing was on the wall and it was spelled 405-line television. The BBC's one existing television transmitter in North London was soon to be complemented by another, to serve Birmingham, just as soon as resources allowed – this would demand a takeover of the amateur 5m band. Only three years after the resumption of amateur radio transmission came the closedown of 5m on March 31, 1949.

Not many years later, 4m became available to the British amateur; initially little more than a spot frequency around 70.2MHz, later to be extended to today's generous width.

'Four' soon proved to be essentially a 'VHF' band in terms of radio propagation, with the limitations in range imposed by Nature that might be expected of it. Much more exciting was the prospect of a frequency allocation at 6m. Here, for many years, British amateurs had listened (through the 405-line TV interference!) for signals from those regions of the world, such as the USA, where, unlike Europe, 50MHz is an official amateur allocation. Of course, we were not allowed to transmit in it because of the presence of those 405-line television services.

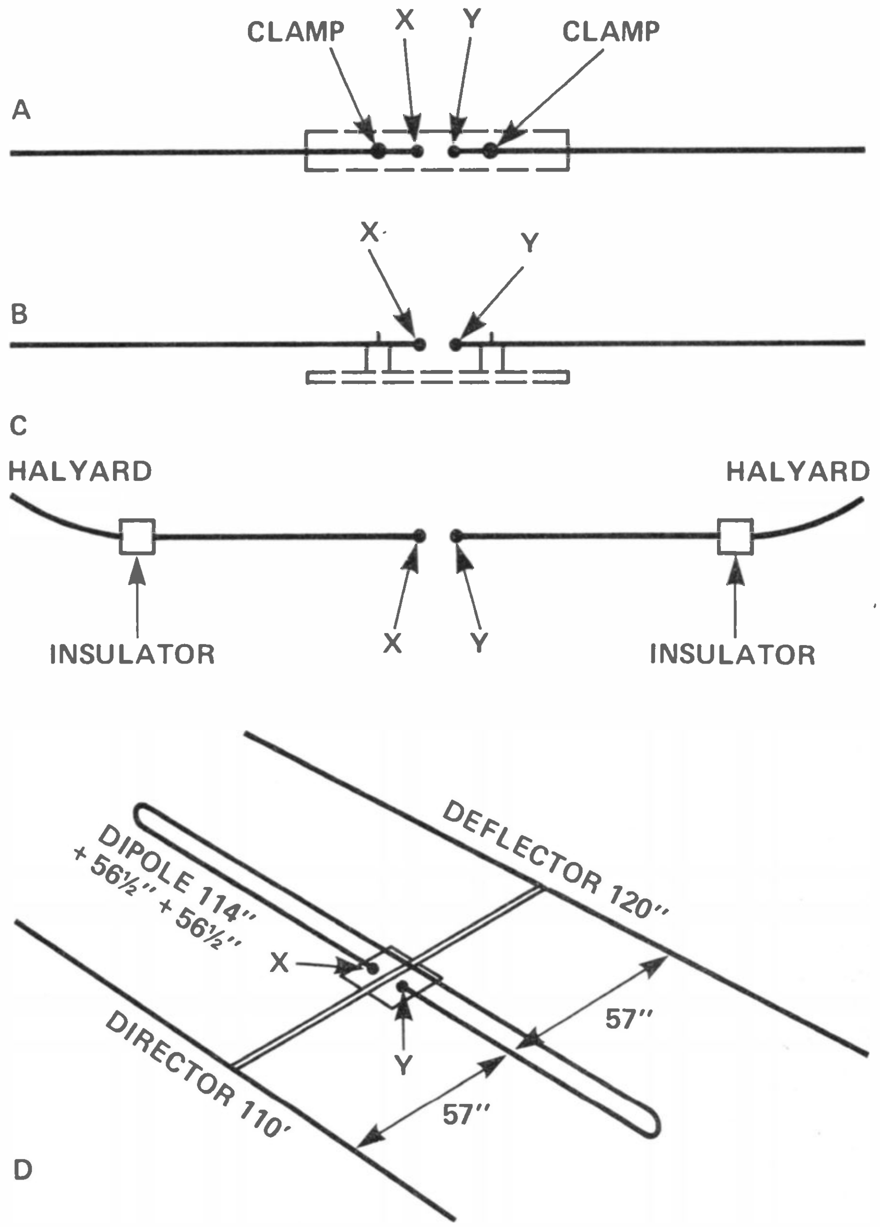
Very early on it became evident

Fig 1: How the 6m band fits into the metre-wave spectrum.



The position in the spectrum of the three lower-frequency vhf amateur bands is shown in this diagram. A UK allocation at 50MHz would be within the 4MHz area enjoyed by North American amateurs but at present--in Europe--occupied by Band 1 television.

Fig 2:
ANTENNAS FOR "SIX":
A: Simple dipole construction. Each arm is 57 inches long and may consist of ¼in or ⅜in aluminium tubing (or even Woolworth's curtain rail!). Each inner end is secured to a polythene or perspex mounting block. Feeder connections are at "X" and "Y". The feeder should be firmly secured to a nearby bracket or similar substantial object to avoid flexing and possible rupture of the connections.
B: Alternative construction for a 6m dipole on a timber batten with stand-off insulators to support the metal elements.
C: A perfectly adequate 6m dipole may be constructed of wire as shown here, each arm once again 57inches long. The feeder, connected to Points X and Y, should be securely dressed away from the line of the dipole because wind movement will be more evident on a flexible arrangement such as this one by comparison with the more rigid construction possible when metal elements are used.
D: Layout for a 3-element Yagi at 50MHz. The folded dipole section consists of an unbroken section of tube 114inches long bolted at its remote ends to the ends of each 56½inch dipole arm. The inner ends of the dipole arms accept the feeder connections, at X and Y. A centrally positioned polythene or perspex block is the anchor point for both arms of the dipole section. This aerial will match into a variety of coaxial cable impedances: the impedance may be varied by varying the distance between the two dipole elements.



that 6m had intercontinental potential, a fact demonstrated by such pioneers as the late G5BY and the still-with-us and very active G5KW when, for a brief period, a clutch of special licences was issued for 50MHz – before the heavy hand of television was laid, seemingly finally, upon it.

Now in the 'Eighties the British amateur is at last favoured by the reallocation of the 50MHz band, albeit to a limited number of operators in geographically selected areas from whom evidence of its potentialities will undoubtedly emerge. Their activities are necessarily restricted to outside-television-hours until the last vestige of 405-line video disappears – and as that is likely to be shortly after the end of 1984, the opportunities for much more extensive use of 'Six' seem an intriguing possibility.

How many students of 6m are there at present? Probably a few hundred, made up of the few dozen who actually have permits to transmit, plus the considerable number who do not, but listen to see what might turn up. These at present modest numbers could – and should – swell from hundreds to thousands if a large number of readers of *Ham Radio Today* decided to take an interest in the band. For it is a part of the spectrum where, rather like 70cm, you never know what's going to happen next. Its potential for surprise is likely to attract the curiosity of SWL, Class B and Class A people alike.

Initially, I think it might be no bad thing if 'Six watchers' restricted their investment in the band to facilities that would allow them to monitor it at a minimal cost. More sophisticated facilities can be developed if and when the opportunity to transmit is granted. In the meantime, the facilities necessary to sample 6m need be no more than a basic aerial and a simple converter. Let us take a closer look at each of these requirements.

Skyhook For Six

When the phrase 'basic aerial' is used the speaker often has in mind the common or garden ½ wave dipole – and the garden is indeed the best place in which to erect it rather than somewhere within the roof space, always a temptation when the erection of a simple, compact type of antenna is contemplated. Let us have no illusions: the dipole is an inferior antenna by comparison with a beam, and possesses no inherent gain of its own. Yet, when it is made resonant at a chosen operating frequency, it can give encouraging results.

The dipole should be given the best possible chance to produce results on 'Six' by being erected in as high and clear a position outdoors as the site allows. There will be time enough to invest in a beam antenna if the experimenter's initial explorations of the band persuade him to stay with it.

Another reason for suggesting that a dipole should be used initially is that a beam array for 50MHz is a structure of considerable size. A dipole for 6m is nine-and-a-quarter feet in length, or three times the dimensions of its 2m equivalent. Applying the G5UM maxim for beam dimensions, so often deployed in print and over the air these last thirty years, that familiar "36, 38 and 40 inches spaced 19 inches" for the 2m band translates to 110 by 114 by 120 inches spaced 57 inches" for a three element 6m beam. In other words, you are faced with the problem of building or buying and then installing an antenna of virtually 10ft boom length.

Despite this, many of the small number of experimenters licensed to transmit on the band today have invested in antennas considerably more complex than the 3-element design described above – in their determination that 50MHz shall yield the maximum possible results.

Our nascent dipole need be no more than two lengths of aluminium tubing cut to the dimensions shown in **Fig. 2** and fed in the centre with 75ohm coaxial cable. The antenna could be constructed of thick wire, say 10SWG, rather than metal rod. Clearly, a wire antenna has greater propensities for movement in the wind than does one of rigid rod construction, which is a condition likely to induce fading of a distant signal, caused by the movement of the antenna in relation to solid objects within a quarter-wavelength's distance from it.

Another drawback to the use of a wire dipole at 50MHz is that you can't rotate it! Yet, this difficulty need not be an insuperable one so long a the aerial is positioned to favour reception of a signal source, such as the GB3SIX beacon in north Wales at XN49F (there is a 6m beacon proposed for RSGB Headquarters north of London), or an area of high population density where there is likely to be at least one amateur active on 6m.

On any band where the amateur population is not high beacons are invaluable as signal sources for the alignment of receiving equipment. On 70MHz newcomers to the band look to GB3BUX in north Derbyshire to provide them with a signal (audible nationwide) to permit the evaluation of their receiving equipment. On 50MHz constructors will undoubtedly look to GB3SIX to do the same, not forgetting that because its radiation pattern is directed westwards the signal level in much of the UK is low.

What To Hear?

The UK activity is presently a mixture of CW/SSB with many 'cross-mode' contacts taking place, as on 4m. Listeners will soon become aware that there is a considerable amount of cross-band working by the lucky 50MHz permit holders with other stations less fortunate than themselves, using 2m, 4m, 10m and sometimes 80 and 40m, depending upon the prevailing propagation conditions.

All of this could be said to presuppose that HRT readers are already in possession of equipment to enable them to listen on the band! Anyway, what follows should help readers to build something appropriate and understand the principles involved.

What To Build?

What I am proposing that we construct is a device referred to rather loosely in our hobby as a 'converter'. This is a device for receiving a signal on one frequency band and converting it to another frequency – where it is 'received' by a separate receiver. Why do we do this? Principally to avoid handling the signal directly at VHF which can prove difficult. We thus convert our VHF signal down to HF where we can receive it on our main station receiver.

I realise that a large number of new licencees do not possess a HF communications receiver. Of the ten thousand Class B licencees who have come into Amateur Radio in the last twelve months, probably a majority enjoy the hobby via the medium of a factory built VHF-only transceiver. Understandably, a 'black box' to get on-air directly is often the first priority but, close behind, at the least, should be an investment in a general coverage HF receiver – to provide a window on the world below 2m and to furnish the station with an 'intermediate frequency' or IF strip, into which various kinds of converters (for, say, 23cm, 70cm, 4m – and 6m of course!) may be fed.

The inter-relationship of converter with main station receiver is shown in **Fig. 3**. Operationally, this is what happens:

From one of the aerial systems described earlier the incoming 50MHz signal passes to the **RF** amplifier which is the first stage of the converter. After amplification the signal passes to the mixer stage. Here it meets the local oscillator signal presented to it – say at 45MHz for the sake of argument. The difference frequency – clearly 5MHz – appears at the output of the mixer, to be resonated by an inductor at 5MHz and passed along a short length of coaxial cable to the input of the station communications receiver.

By this technique the 6m band is tuned on the 60m band! The 50MHz band edge occurs at 5MHz on the receiver scale, the GB3SIX beacon on 50.02MHz is tuned in at 5.02MHz, the EI4RF beacon on 70.13MHz comes up at 5.13MHz and so on.

What IF?

The significance of that phrase a few lines earlier ". . . at 45MHz for the sake of argument" will not have been lost on the careful reader. Simply, the local oscillator does not need to be at 45MHz if you don't want it to be: a tenet of VHF converter design is that you can make the IF whatever you like, and you choose your I/o frequency accordingly.

However, in practical terms, the IF decided upon by the constructor will be dictated by the amount of space 'Six' is likely to take up on the tuning scale of his main station receiver. He will wish to be able to scan the full 2MHz area of the band from 50 to 52MHz. This will occur at 5 to 7MHz on his receiver when the converter oscillator is at 45MHz.

Certain communications receivers which are amateur-bands-only offer no facility for tuning a 2MHz span except at 28MHz: all other HF amateur bands are much less than 2MHz wide. The converter-builder possessing such a receiver will need to select his converter local oscillator frequency accordingly. The following table shows what local oscillator frequencies are required for which bandspreads:

Main Receiver	Converter LO
5 to 7MHz	45MHz
10 to 12MHz	40MHz
14 to 16MHz	36MHz
28 to 30MHz	22MHz

The practical convenience of the 5 to 7MHz area as a tunable IF is at once evident when the above figures are studied. It is very nice to have 5MHz representing 50MHz. It is less convenient, but not by much, if 50MHz is represented on the receiver dial by 10MHz, because 51MHz then becomes 11MHz, and 52MHz becomes 12MHz.

A modicum of mental arithmetic is called for on the listener's part if he goes for a 28MHz intermediate frequency out of his converter, for he is compelled to remind himself that "28MHz on my receiver dial means 50MHz on the 6m band". If the available bandspread compels the use of this IF the listener will find before many weeks of operation have passed that he recognises almost by instinct that "28 equals 50" and "30 equals 52".

Right, then: you can make the IF whatever you like. Watch out, though, for that bugbear of converter construction known as 'IF breakthrough'.

What Breakthrough?

In order to detect radio signals a HF communications receiver needs an aerial. Our converter output is going to be connected to the aerial input terminal of the receiver – and unfortunately, under the circumstances to be described, a converter can act as quite a good aerial!

Many constructors have reported to the writer how disappointed they were at ". . . the amount of morse and unwanted broadcast stations and lots else" that rode into the system when they attempted to commission a metre-wave converter for the first time. The answer to this lament is threefold:

"First, have you removed that metal input terminal from the receiver and replaced it with a coaxial socket?" And – "Have you kept the IF coaxial lead from your converter to the HF receiver input as short as possible? Then – "Thirdly, have you connected the converter case to the receiver earth terminal by means of a separate bonding lead?"

The constructor who completes these three essential jobs should be able to sit back and say with complete conviction: "What's IF breakthrough?" – as there should be none.

Proud owners of sleek communications receivers may harbour misgivings about 'butchering' them in order to substitute a coaxial input socket for the existing antenna terminal. They may be assured that no butchery is called for: most antenna terminals are easily removable, and in many cases the space left behind will exactly accommodate a standard TV coaxial socket into which the output of the converter is to be fed. Be sure to resolder the antenna terminal lead to the central spigot of the coaxial socket when you fit it! Apologies for stating the obvious: but it *has* happened!

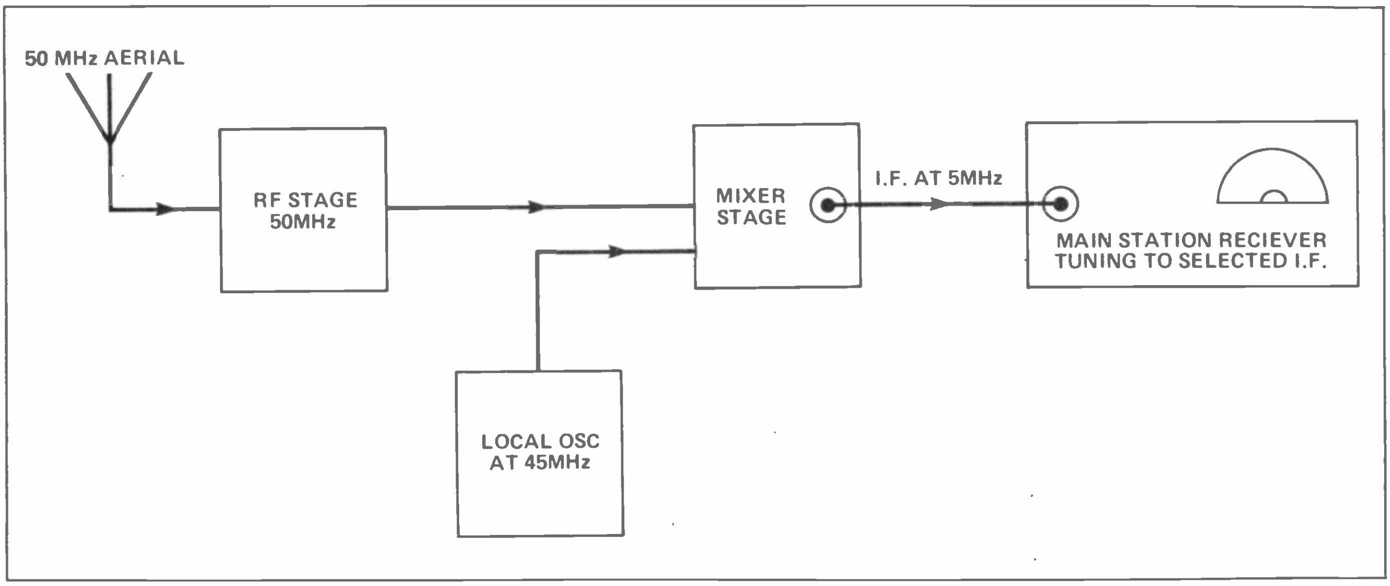
The first-time purchaser of a communications receiver should ask his supplier to fit an appropriate coaxial socket before delivery. If, as sometimes happens, there are dual aerial input sockets be sure to 'coaxify' them both – to inhibit IF breakthrough from either of them.

What Converter?

By now the intending 'seeker after Six' having decided what aerials he will erect and what intermediate frequency range he will select is in a position to ask the question: "What converter?"

The answer to it must wait until next time, when it is planned to offer HRT readers a simple but practical design of converter that will allow that first foray on 6m to be taken with confidence.

Fig 3: The converter principle. An incoming 50MHz signal is amplified and passed to the mixer stage. Also injected into the mixer is a local oscillator signal at 45MHz. The difference between the two, which is 5MHz, represents the intermediate frequency. It is fed to the aerial input socket of the main station receiver. Set the receiver scale to "5MHz" and you are receiving on 50MHz. Set it to 5.5 and you are receiving on 50.5MHz.



A Simple Iambic Keyer

''Thirty eight pounds; you must be joking'', I said. Unfortunately, he wasn't, adding that the price had gone up again. The local radio emporium was selling an iambic keyer

David Sylvester, G4TJG, shows how to build an iambic morse keyer which works well and looks good.

PCB, with some eight ICs on the board, and this was the price. . . I had decided to build a keyer for myself, rather than pay £100 for a commercial unit. Buying a ready completed Keyer PCB had seemed a nice compromise between homebrewing and commercial equipment. Leaving the emporium, I determined to build a keyer to my own design, starting from scratch. After some thought I reckoned I could build one, including a nice commercial paddle, case and power supply, and have change from £38.

Like most people who have recently passed the morse test, I was interested in improving the morse I was sending by letting electronics take over the timing work. The readability of a CW signal relies on the sender being able to keep to a constant pace. Listing logic circuitry, a multivibrator, with it's constant output pulse time, can be utilised to maintain rhythm; also, the dit-dah time ratio could be made exactly 1:3 rather than the variable ratio that hand keying can give, also substantially aiding the readability of the morse sent.

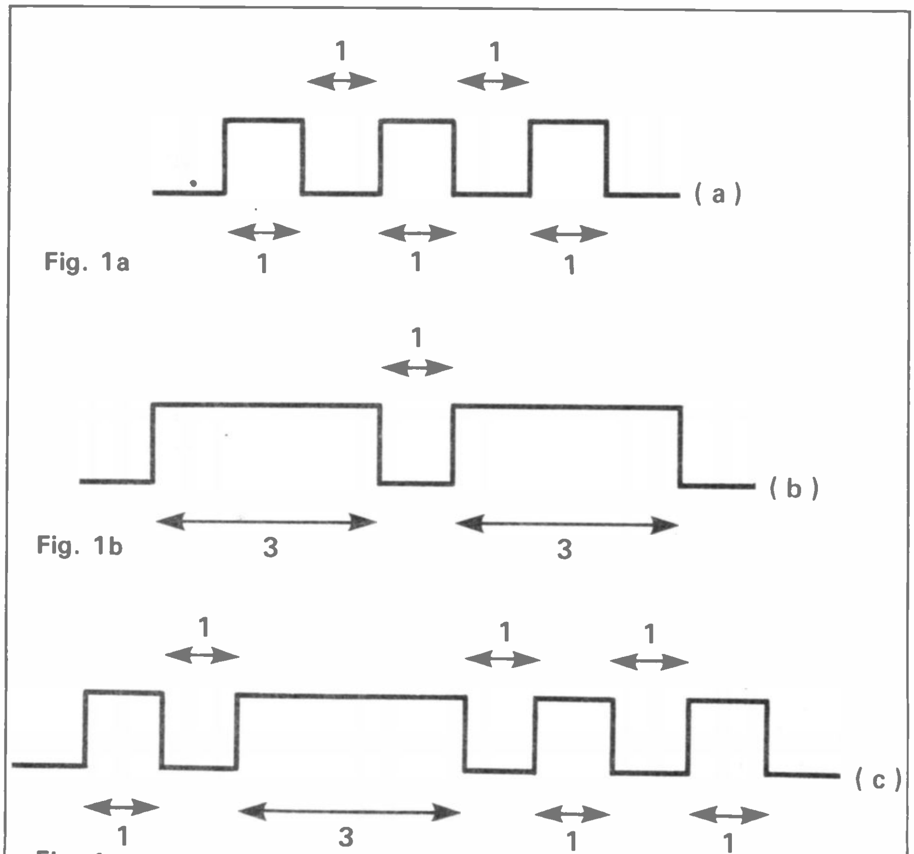


Fig. 1a

Fig. 1b

Fig. 1c

Design Considerations

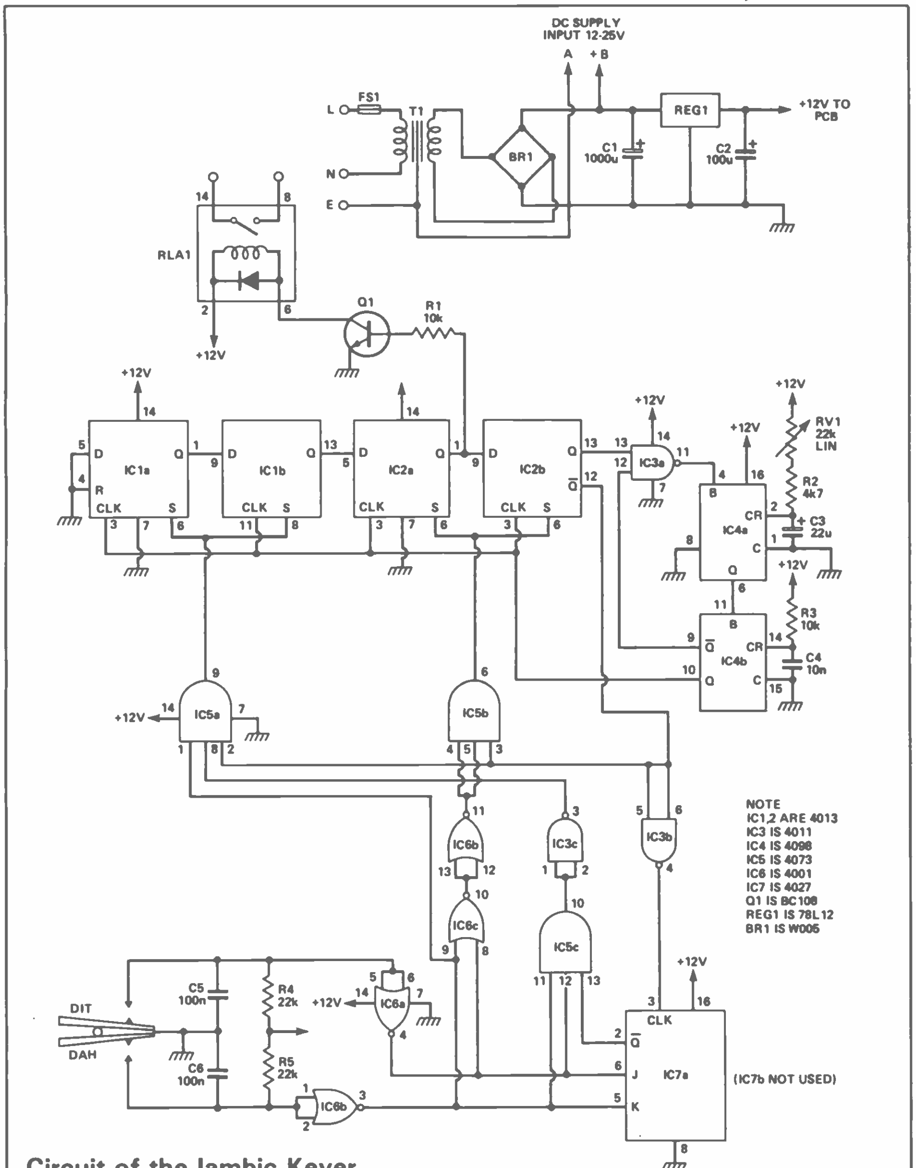
The difficult decision was what to include and what to leave out of the design. The keyer must have twin paddles, go dit-dit-dit when one paddle is pressed, dah-dah-dah with the other pressed and dit-dah-dit-dah when squeezed together, that is to say fully iambic. It also had to look good as well; a dirty box next to the rig ruins the station appearance and your pleasure in it, even if everything works perfectly. As to other options; power supply, well, both mains or DC options should be available, a rate control for sending speed, and, having seen other amateurs blow up the transistors used to switch the output of their keyers, a relay switched outut was decided upon so that the unit could be used safely with a variety of rigs. No tone generator was included as I already had a practice oscillator for training and most transceivers seem to contain their own tone generators when used on CW. Memory facility was not felt to be a necessity and, anyway, the idea was to produce a cheap keyer and memory would add considerably to the complexity and cost.

Getting The Timing

We should finally consider what CW actually is and how we can generate the necessary 'timing'. **Fig. 1a** shows the timing arrangement of a string of dits where the 'sound' is on for one time unit and off for one time unit before starting the next sequence. The string of dahs, **Fig. 1b**, has a sound-on time of three units and off for one unit. The letter L (.-..), **Fig. 1c**, only has one time unit gap between the dits and dahs so the keyer must be able to cope with this.

How It Works

Fig. 2 shows the complete circuit including the 240V mains and 12V DC power supply options. The heart of the system is the four D-type flip-



Circuit of the Iambic Keyer

flops in IC1 and IC2, the output of IC2a (Q) operating the relay whilst the output of IC2b (Q) controls the timing unit. These flip-flops are connected as shift register and each time the register is 'clocked', the information at the D input to each section will be transfered to the Q output. The set lines S are connected as two pairs and are asynchronous in that when the S input becomes high the corresponding Q output immediately becomes high, no clock pulse being needed.

The timer consists of two monostable multivibrators, IC4a and IC4b, and a NAND gate, IC3a, arranged so that whilst output Q of IC2b is high the timer will produce 100 micro-second positive-going pulses at a time interval controlled by the resistance of RV1 and R2 in series. The time between pulses can be varied with RV1 — allowing the selection of the morse speed most suited to the constructor. These pulses are used to clock the shift register, the Q of IC4b and IC3a are needed as feedback to keep the timer producing pulses while the output Q of IC2b is high.

The two set lines of the register are connected to the paddles via the logic circuitry consisting of IC5a, IC5b, and IC6 so that, from the rest condition, when the dit paddle is pressed, the set lines to IC2 only become high and when the dah paddle is pressed, the set lines to both IC1 and IC2 become high.

Let us consider what happens after the set line of, say, dit (IC2) becomes high. The output Q of CI2a will go high switching on the relay, and Q of IC2b will go high, initiating the pulse of 100 micro-seconds after a period of, say, 0.1 seconds. The Q of IC2b becomes low and forces the set lines low, via IC5a and IC5b, and holds them low irrespective of the position of the paddles, until the system returns to the rest state. In addition a signal at the output of IC3b is used to clock IC7a but we shall return to this later. After the clock pulse from IC4b, IC2a output becomes low and the relay opens, but the previous 'high' on the output of IC2a is transfered to the output of IC2b and this initiates a second clock sequence. After the second clock pulse all of the shift register Q outputs have become low and the keyer has returned to the rest state. The Q of IC2b becomes high and allows the set lines to take up more data from the paddles. We have now generated a dit by turning the relay on for one clock pulse and off for one clock pulse before returning to the rest state. Similarly for a dah where all the Q outputs of IC1 and IC2 become high. Four clock cycles will be needed to move the low input to D of IC1a to the output of IC2b and of these, three will turn on the relay and one will be with the relay off.

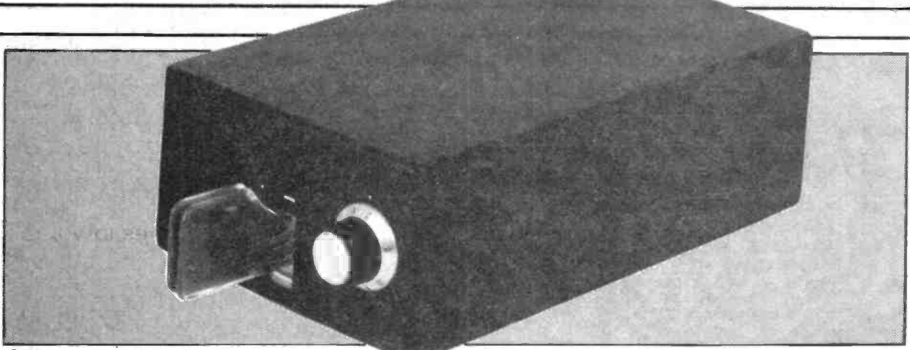
Dits And Dahs

We now have electronic generation of dit and dah and by holding one or other paddle on, we can generate a string of dits or dahs.

The difficult part is the generation of alternate dits and dahs with both paddles pressed, the iambic bit! Without IC7a, the JK flip-flop, the keyer would only produce dahs with the paddles squeezed together. IC7a receives positive clocking edges from IC3b at the same time as the rise in output Q of IC2b, caused by the acquisition of data from the position of the paddles. The output Q of IC7a is controlled by information derived from the paddles via their buffers IC6a and IC6b. The state of the paddles at the instant that the register receives data is recorded in the ZJK flip-flop. **Table 1** gives the truth table for a JK flip-flop. It can be seen that when the paddles are held together, the inputs to J and K are both 1 (high) and the output of IC7a will become high and low

Table 1

CLOCK	J	K	Q		$\bar{Q}$
↑	0	0	NO CHANGE FROM PREVIOUS STATE		
↑	1	0	1		0
↑	0	1	0		1
↑	1	1	$\bar{Q}$	TOGGLES	Q
↓	ANY INPUT			NO CHANGE	



The complete unit

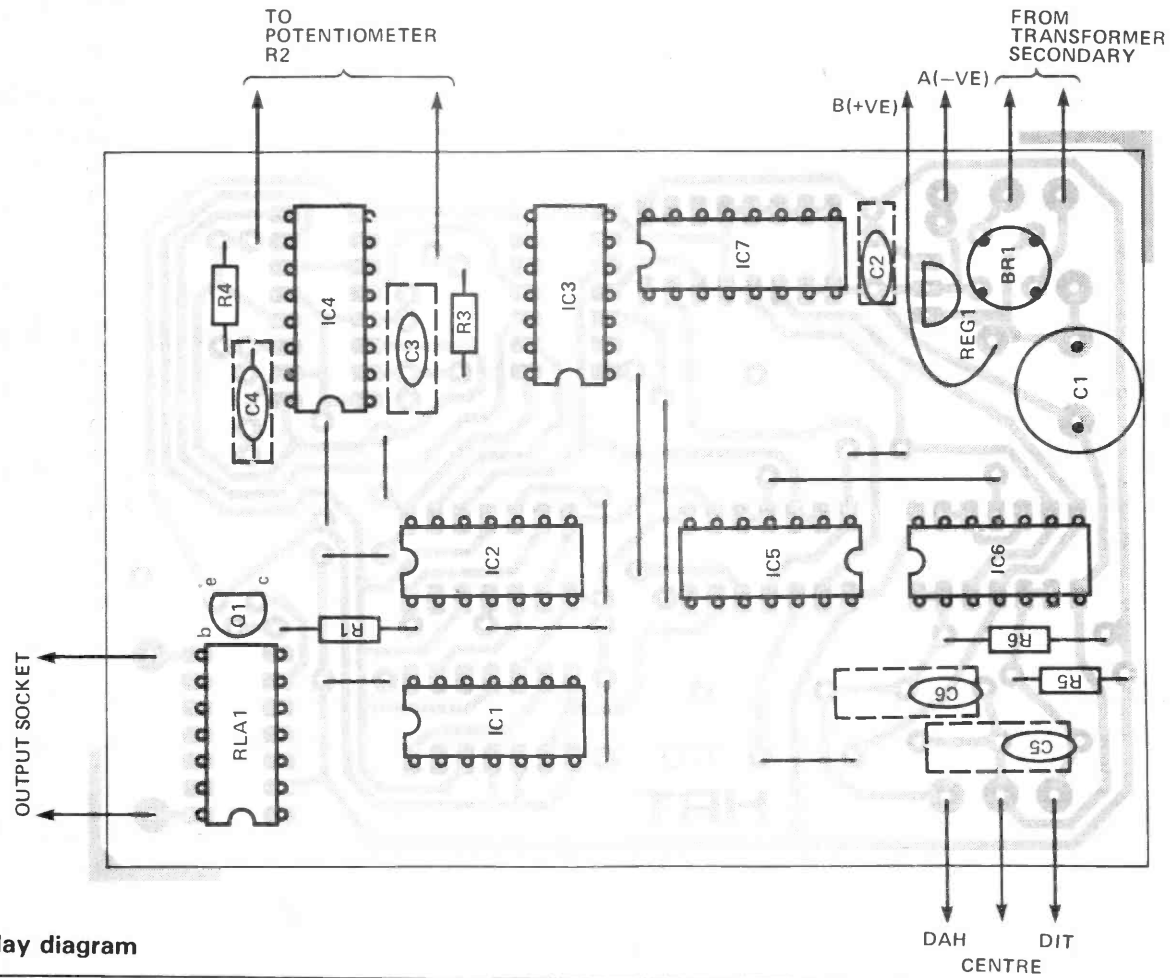
alternately as each morse digit is locked into the register. In this condition, the output of IC3c will be the opposite of IC7a's Q output as the other inputs to IC5c are high. This toggle action allows the dit-dah-dit sequence to take place by alternately turning the output of IC5a high and low. The state of the paddles is latched into IC7a every time a new timing sequence begins, but, to prevent the dah-dah-dah sequence being lost, IC5c disables the output from IC7a until such time as both paddles are pressed. In addition careful arrangement of the J and K inputs to IC7a allows the dit-dit-dah sequence of letter U to be achieved by pressing the dit paddle for two cycles and then both paddles together. The low on Q of IC7a produced when only dit is pressed (J input high, K input low) allows the last dah to be incorporated into the shift register with either both paddles, or only the dah padddle pressed.

IC6a and IC6b act as buffers/inverters for the signal from the paddles and although they are not Schmitt devices the inherent characteristic of CMOS devices is to provide a Schmitt acton for the input. Along with IC6c and IC6d these gates are arranged so that when dit only is pressed, the input to IC5b becomes high, whilst when dah is pressed, the inputs to both IC5a and IC5b become high, whilst when dah is pressed, the inputs to both IC5a and IC5b will also be high and the data will be transfered to the register.

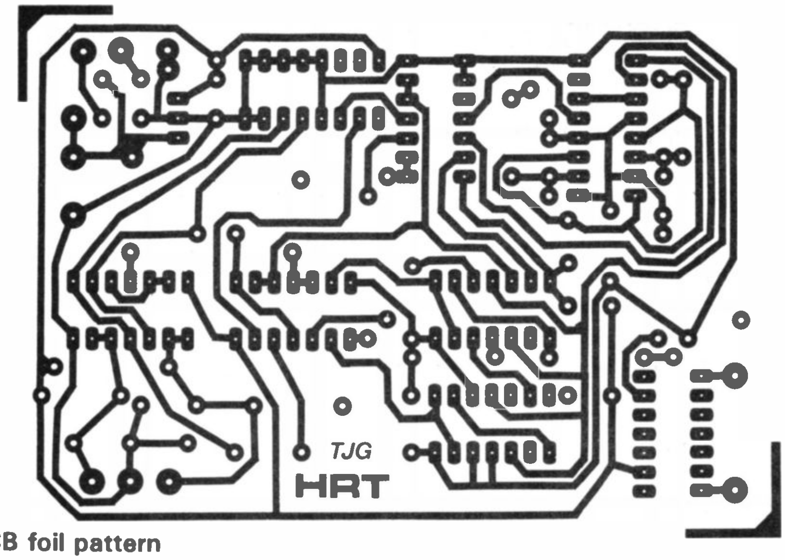
Construction

Firstly consideration must be given to the method of supplying power to the unit. The prototype used mains input via the low voltage AC input lines C and D (see **Fig. 2** and **Fig. 3**). As only low power is needed, a 12 volt 100 mA miniature transformer is suitable, the 16V DC that results after rectification and smoothing being satisfactory for driving the rest of the circuit via the 12V regulator. Alternatively if the constructor has a low voltage power supply or wants to use battery power, a supply of 13.6V to 26V can be connected using the A and B input lines.

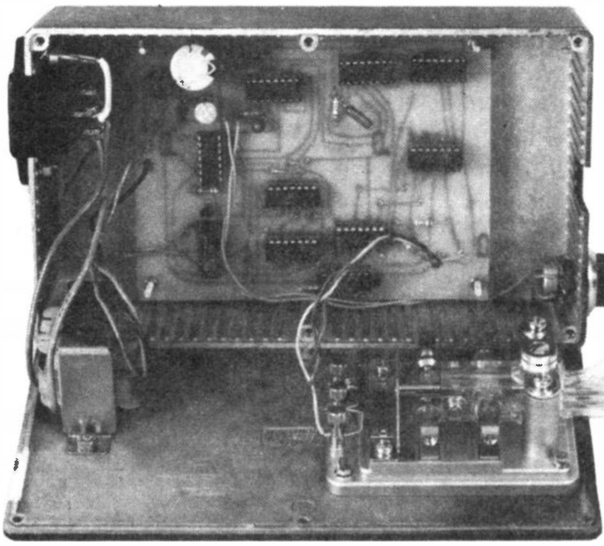
The PCB carries all of the components except the paddles, potentiometer RV1 and the transformer. To aid construction it is best to locate and solder the IC sockets into position ensuring that they are orientated in the



Overlay diagram



PCB foil pattern


Inside the box

correct directions, but do NOT insert the ICs. The relay also plugs into one of the IC sockets. Using these sockets as position locators it should now be easy to fix the wire links, resistors and capacitors. Ensure the C1 and C2 are connected with the correct polarity as they are electrolytic capacitors. Attach flying leads for the other connections, and having decided on whether mains or DC supply is to be used, connect leads to C and D or A and B respectively. Finally solder the bridge, transistor and voltage regulator to the PCB.

The die-cast box will now need to be cut. The prototype has the twin paddles projecting through the side of one end of the box with the box inverted, ie, the lid becomes the bottom and has the stick on feet. This means that a square piece can be simply cut out of the main box near the edge to accommodate the paddles.

Cut and drill the holes for the paddles and potentiometer in one end of the box and the holes for the ¼ inch output jack socket and power input (mains = euro socket/DC = 2.1mm power socket) in the other. Drill the holes to mount the paddles and the transformer, if used, in the inverted lid. To save having to screw the PCB into the top of the box and ruin the appearance of the finished keyer, the PCB is mounted in the box by flat head screws projecting from the PCB on short pillars, whose heads are then araldited into the box.

To match with the rest of the station the box can be thoroughly cleaned and de-greased and then spray painted. The author chose matt black to match some other commercial equipment in his station and used white 'letraset' lettering to identify the external connections.

Final assembly can then be carried out and all connections made. The ICs can be plugged into their respective sockets — *after first checking the 12V supply.*

Testing

On switch-on, check by touch that none of the components become hot as this will indicate a serious fault. On pressing one or other key, a string of dits or dahs should be produced and you should be able to hear the relay operating. Holding the two paddles together will achieve the dit-dah-dit action. The potentiometer RV1 should vary the rate of the morse digit chain.

If all is satisfactory, a number of practice sessions will be needed before going on the air(!) as it takes a little time to get used to the keyer and not to send *too* many incorrect letters!

Component Listing

Resistors (all ¼W 5%)

R1, 3	10K
R2	4k7
R4, 5	22k
RV1	22k lin potentiometer

Capacitors

C1	1000uF 25V electrolytic
C2	100uF 25V electrolytic
C3	22uF 16V tantalum bead
C4	10nF polyester C280
C5,6	100nF ceramic

Semiconductors

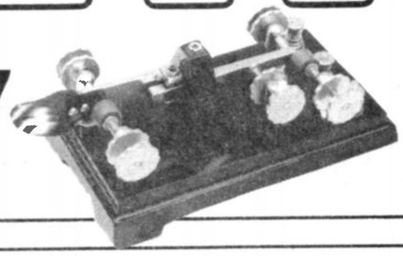
IC1, 2	4013
IC3	4011
IC4	4098
IC5	4073
IC6	4001
IC7	4027
Q1	BC108 or equivalent
REG1	uA78L12AWC (12V regulator)
BR1	w005 bridge rectifier (50 PIV min)

Miscellaneous

RLA1	DIL reed relay
T1	12V 100mA mains transformer

Die-cast aluminium box 184 × 106 × 56mm; Euro plug and socket; ⅛" jack socket and plug; 2.1mm power plug and socket; knob for potentiometer; stick-on feet for box; DIL sockets (6 off 14-pin, 2 off 16-pin) if preferred; twin paddle key Hi-Mound' Mk 704 (plastic base); mains fuse and holder; PCB, wire, etc.

REVIEW: Alpha Key



Here is something special for the person who requires high-speed CW capability (meteor scatter enthusiasts please note!) without the key becoming airborne. Tony Bailey plugs in.

Attention all CW addicts! Especially those who use electronic keyers and are fed up with the paddle wandering round the bench, or who have to find 12 copies of HRT to put on top of it to stabilise it. Seriously, if you have a straight keyer module which requires a separate paddle, then you should look closely at this design from a UK source against those from the Far East and elsewhere.

There are a number of paddles on the market, but the majority seem to have paid attention to the appearance, more than the essential functionality. The paddle itself is often so light that you have to make a heavy base yourself, or even screw it to the bench to stop the thing wandering. Also, the range of adjustments are limited – especially if you are a high-speed operator at, say, 50wpm+.

The Alpha Key is a UK product from an independent manufacturer, which, although maybe not up to the appearance of the shiny existing commercial paddles, has an engineer with CW experience as its designer. The result is an almost ideal paddle that stays where it is put and which you can adjust to suit any operating requirement. At the time of this review it is only available for non-iambic (squeeze) keyers, but we gather a squeeze version is imminent. Several types of finish are available, depending on what you want to pay.

The review model supplied was the middle of the range, with a cast iron base (the paddle weighs just over 2Kg) finished in black. Other versions finished in chrome, or with a cast aluminium base in either black or chrome are also available. Five adjustments are provided for setting the paddle up, each using a pair of 20mm diameter knurled adjusting discs, one acting as the lock. These are easy to adjust and leave you with a very smooth movement with no vertical play apparent – the paddle itself is pivoted on ball bearings. The return power for each side of the paddle is cleverly provided using polymer-bonded rear earth *magnets* rather than springs – giving a very pleasant feel to the whole unit.

The contacts are silver plated for efficient electrical contact, although the mechanical alignment of one of them on the review model was a little adrift. This did not affect the operation, but marred the appearance if nothing else. Connections to the outside world are via three substantial screw terminals on the rear of the base, two isolated and one earth.

In Use

The reviewer used the paddle for a number of normal 'rag-chew' contacts, and also for some high speed Contest operation over one weekend. It is very difficult to fault the operation of the unit once the adjustments to suit your own style are made. It does have one major advantage – very few of the paddles used in the past performed well at over 40wpm. The usual problem is that the return pull when you let go of the paddle is so weak that a small gap is difficult to set up properly without mis-keying. The Alpha Key wins hands down here and proved to be no problem. At slow speeds with the Alpha again there was no problem once adjusted to suit my operating style.

High Slung

From a personal point of view, the only niggling point was that the actual tortoiseshell style operating lever was located much too high above the bench for easy use. I could have done with it at least an inch lower – reversing the lever helped a lot. I suspect this may apply to many people and, if so, a simple redesign of the lever would overcome this.

A descriptive leaflet is supplied with each key, but no adjustment instructions. The latter is not a major omission, but newcomers could have some difficulty here, and the inclusion of simple adjustment details would be a useful addition.

Conclusion

If you want a paddle unit designed for ease of use then this is the answer. The paddle will especially appeal to the high speed operator due to its excellent performance at high speed, although it is equally well suited to the more casual user. Some thought has gone into the mechanical arrangements with excellent results. The review model is priced at £58 plus p&p. A Chrome version will set you back £68.50, with the cast aluminium versions priced at £50.45 and £56.60 for black and chrome respectively. An aluminium based version is also available with the owner's callsign engraved upon it. Further details from P Sergent, 6 Gurney Close, Costessey, Norwich NR5 0HB. (Tel 0603 74782).

Radio Building Blocks

In part three of this series, Frank Ogden, G4JST, looks at SSB IF strips.

The third part in this series — linear IF strips — come at a very appropriate time. For the past six weeks or so I have been developing a new single band HF transceiver for mobile use, the design of which will be appearing in HRT in the not too distant future. Watch this space. The development, although reasonably straightforward, has thrown up a number of interesting problems which would be encountered by most people proposing to build SSB radio gear.

How Much Gain?

Before looking at specific circuits the designer needs to sit back and think about what he is trying to achieve. Obviously the finished radio receiver needs to be sensitive but how much IF amplication does this actually mean? Does it need to have variable bandwidth? What should the AGC characteristics be? How necessary is an effective noise blanker? (This feature adds considerably to complexity if it is to work well) etc.

But first, the amount of gain. I have chosen a diode ring mixer circuit without RF amplifier for the following calculation. The finished set, a working example of which I have recently built, is mainly destined for mobile use (initially on 20m although the final version may be constructed for any band 160 through to 20m) thus the signal strengths are likely to be small and the interference high. The limiting sensitivity of the overall set should therefore be dictated by front end mixer losses and thermal noise of the first IF stage. The 3kHz bandwidth noise voltage of a 50 ohm resistor at normal room temperature is about 0.02uV. The preselector and mixer losses will amount to 9dB. The first IF stage will probably have a noise figure of 3dB or slightly better. This produces an effective input noise voltage at the beginning of the IF of around .08uV and a noise figure measured at the aerial socket of some 12dB. This means that the finished set will require about 0.15uV PD of aerial signal for a 12dB SINAD (SSB).

It follows from all this that the IF amplifier should boost the signal from 0.1uV to 100mV measured at the output of the product detector, a gain requirement of 120dB. To ensure that this highly sensitive amplifier doesn't overload, it will require an AGC range of some 110dB. To avoid intermod problems it should be able to handle up to 25mV at the IF input while hanging on to that 3dB IF noise figure at low level signals. Put like this, the task of designing an effective IF amplifier is not quite so straightforward.

Building a 10.7MHz amplifier with all that gain poses substantial problems with stability. There are two things which can be done. The first is to put more gain in the front end — say 20dB from an RF amplifier — but this will be at the expense of equipment dynamic range. A better way is to put more gain into the audio side following the product detector. Here, the only penalty will be slightly more background hiss at all signal strengths because it is difficult to auto-gain these sensitive audio stages as part of the AGC loop.

AGC Action

The most demanding aspect of any linear SSB IF system concerns the performance of the AGC system, the way in which the receiver can accept wide variations of input signal strengths with a relatively constant output at the detector. AGC stands for Automatic Gain Control which means automatically varying the

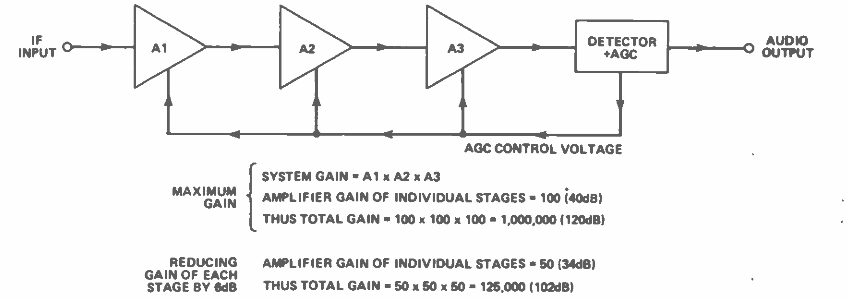


Fig. 1 AGC action of IF strip.

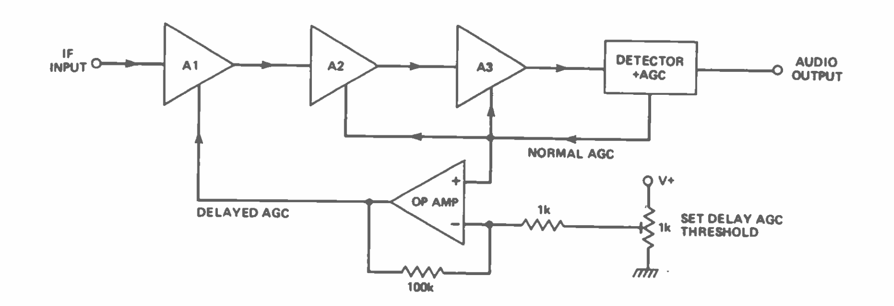


Fig. 2 Delayed AGC; see text for explanation.

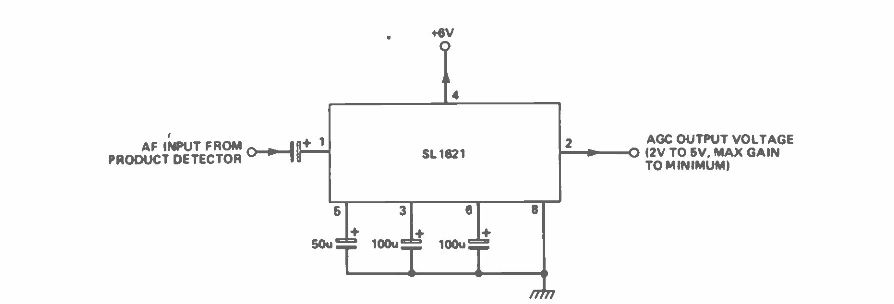


Fig. 3 AGC generator using SL1621

system amplification with signal strength. AGC action must always keep the individual IF stages working within a linear portion of their characteristics. The opposite to this is the limiting FM IF amplifier where everything runs flatout. **Fig. 1** shows AGC action on a three stage example IF. Individually, each stage has an individual gain of 40dB. If the gain of each stage is reduced by half (6dB) then the gain of the strip as a whole will fall by eight times. This is because each stage offers a reduction in amplitude on the signal passed on from the stage before. If the individual stage gain in dB = A, then the total IF strip gain will be A x N where N = number of identical stages.

Delayed AGC

It is not always a good idea to apply the same level of AGC voltage equally to all stages. Most types of amplifier circuitry tend to show a degraded signal-to-noise performance when operated at reduced gain. It is customary therefore to ensure that those stages near the front of a strip — where signal voltages are lowest — do not run with gain reduction until necessary to do so to prevent overload at the detector end of the strip. In an extreme example, if most of the gain reduction occurs at the first stage, then subsequent ones would always run 'flat out' producing audible noise even on strong signals. This is the reason for delaying the onset of AGC action at the RF stage of good VHF gear, and the first IF stages of high performance HF equipment where RF stages are not fitted. **Fig. 2** shows how this can be achieved. A2 and A3, the amplifiers nearest to the detector/AGC generator, are fed with the normal AGC control voltage. This voltage is also applied to an 'op amp' comparator circuit which produces no output until a threshold point, set by the potentiometer, is reached. The output then rises very rapidly applying control to the first stage.

AGC Generation

The AGC control voltage essentially derives by rectification of amplified signal passing through

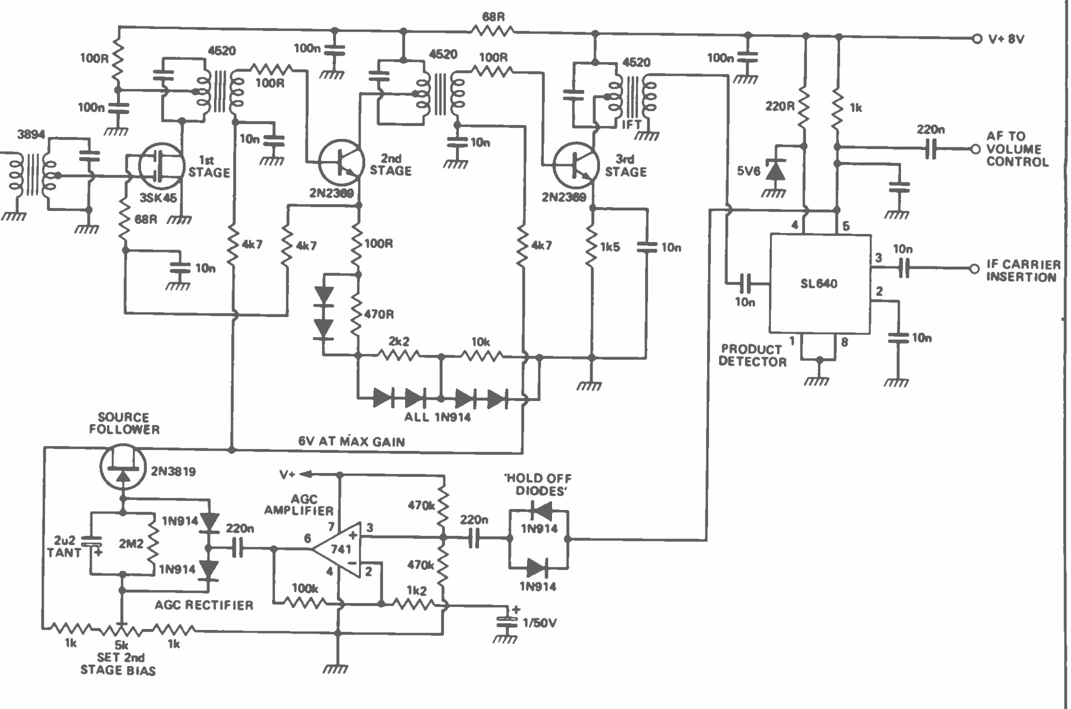


Fig. 4 A working IF strip in basic form. The diode chain in the emitter circuit provides a logarithmic AGC characteristic and feeds delayed AGC to the first MOSFET stage. The top to tail diodes before the op-amp hold off AGC until the recovered signal rises to 200 mV peak to peak.

the IF amplifier. The basic signal used to provide the control voltages can either be produced from the IF signal itself, or from the audio after detection. Unlike AM, SSB RF envelopes fall to zero in the absence of modulation. For satisfactory performance, the AGC system has to take account of this.

It is only proposed to deal with radio derived AGC here; carrier systems are susceptible to co-channel interference and are therefore less satisfactory. The main point about SSB AGC is that it has to remain in action during the normal pauses in speech. This 'overhang' is normally achieved by the use of long time constants in the rectifier circuitry. Sophisticated AGC generators such as the Plessey SL1621 chip incorporate a double time constant so that decay occurs very rapidly after a predetermined time. All circuits though must exhibit a very fast attack so that the first syllable does not distort. **Fig. 3** shows the SL1621 in use. **Fig. 4**, the principle IF strip circuit example incorporates an op amp generator circuit based on the ubiquitous 741.

Injection Leakage

IF strips, particularly those of the SL1612/SL1621 type, tend to suffer from distortion and instability on the AGC attack phase when rising from maximum gain state. This is due to carrier oscillator signal getting into the front end of the strip. This is of the same frequency but different phase, after amplification, to the injection signal present at the product detector. The two interact together to produce a DC offset which is proportional to IF gain. The fast attack AGC generator sees this rapidly changing offset as an envelope signal and thus reacts to it in an unstable way. The result is a series of gain 'hops' rather than a smooth slide from maximum to minimum gain.

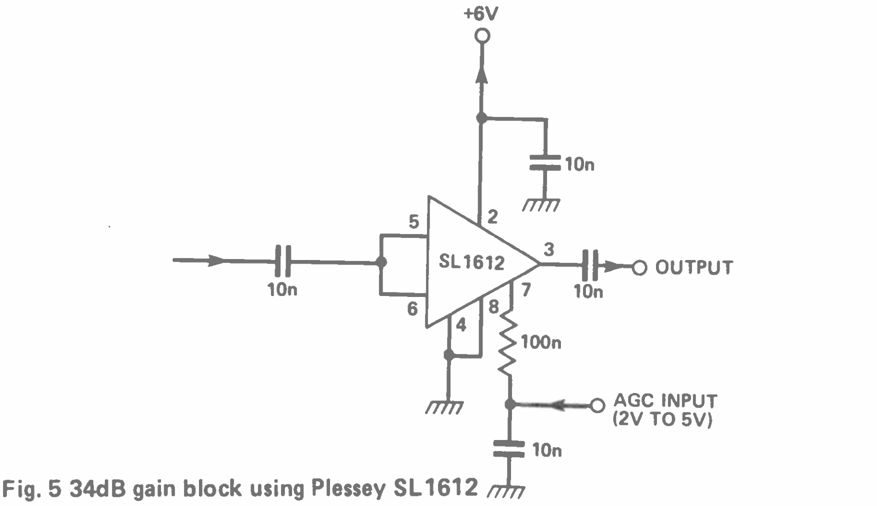


Fig. 5 34dB gain block using Plessey SL1612

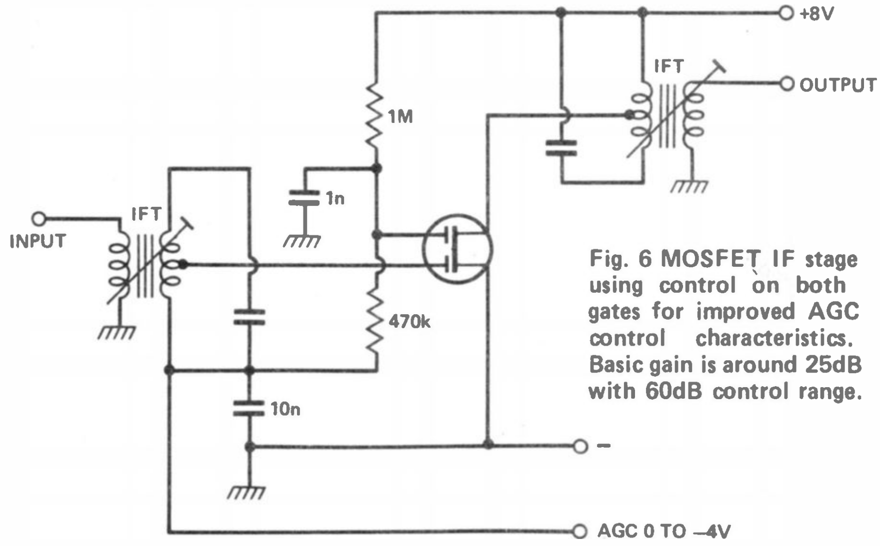
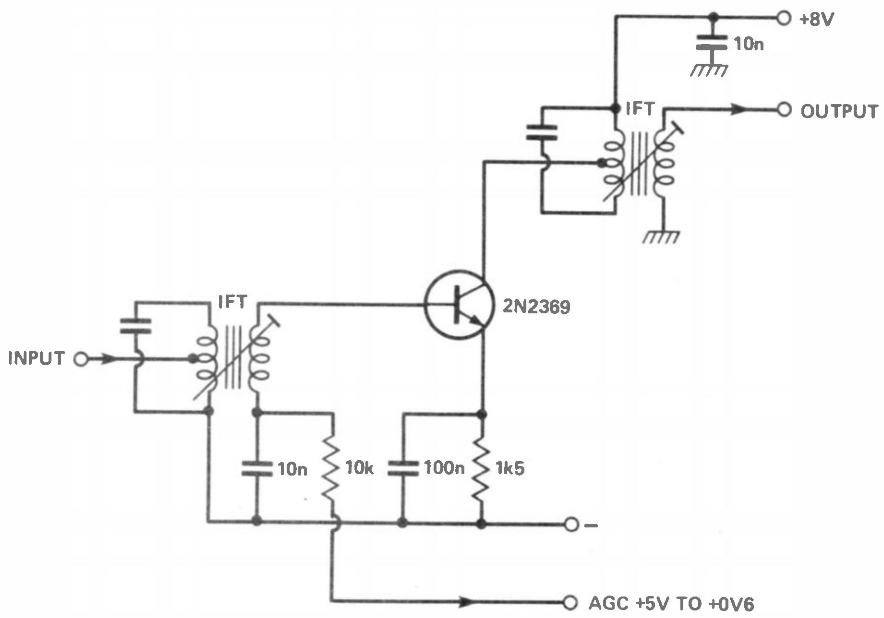


Fig. 6 MOSFET IF stage using control on both gates for improved AGC control characteristics. Basic gain is around 25dB with 60dB control range.

Fig. 7 Bipolar IF stage, 30dB gain.



The Cure

The cure, of course, is to prevent leakage getting into the front end by extra screening, decoupling and the use of double sided PCBs with groundplanes. *Next month — FM IF strips*

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