THE ICOM IC-781

HF ALL BAND TRANSCEIVER

by Ken Michaelson G3RDG

The IC-781 HF all band transceiver is one of the most advanced rigs of its kind. It weighs a hefty 23kg (50.7lb) and its features include: ninety-nine memory channels; high performance filters; a built-in antenna tuner; and a frequency coverage of 100kHz-30MHz. The specifications are shown in the Table.

But let's start at the beginning. The rig has its own multi-purpose meter which reads the signal strength in 'S' units, the current of the final transistors in amps, power out in watts, SWR ratio, speech compressor in dB and ALC level; the ALC scale displays the voltage of the final transistors. Interestingly, the SWR scale of the meter does not require calibrating, unlike meters on some other rigs, and the SWR is accurately displayed even during SSB operation. Excess current due to a change in the SWR is detected automatically in order to protect the PA circuit.

The Icom IC-781 HF all band transceiver

Starting out

To begin operating the rig, I had to preset the automatic ATU for the band I was going to use, in this case 80m, by turning a little knob under a small cover on the top panel. Since my own 80m dipole operates on all bands, the preset tuner had to be operated for each of the bands separately. This only has to be done once, provided the antenna is not changed. Thereafter, the ATU senses the band alteration and automatically alters the tuning for the change in bands with a quiet 'whirr'. The rig can be used independently of the automatic tuner by switching it off. When it is in circuit, a green LED lights up but while it is tuning, a red LED labelled WAIT is displayed until the match is satisfactory.

The screen

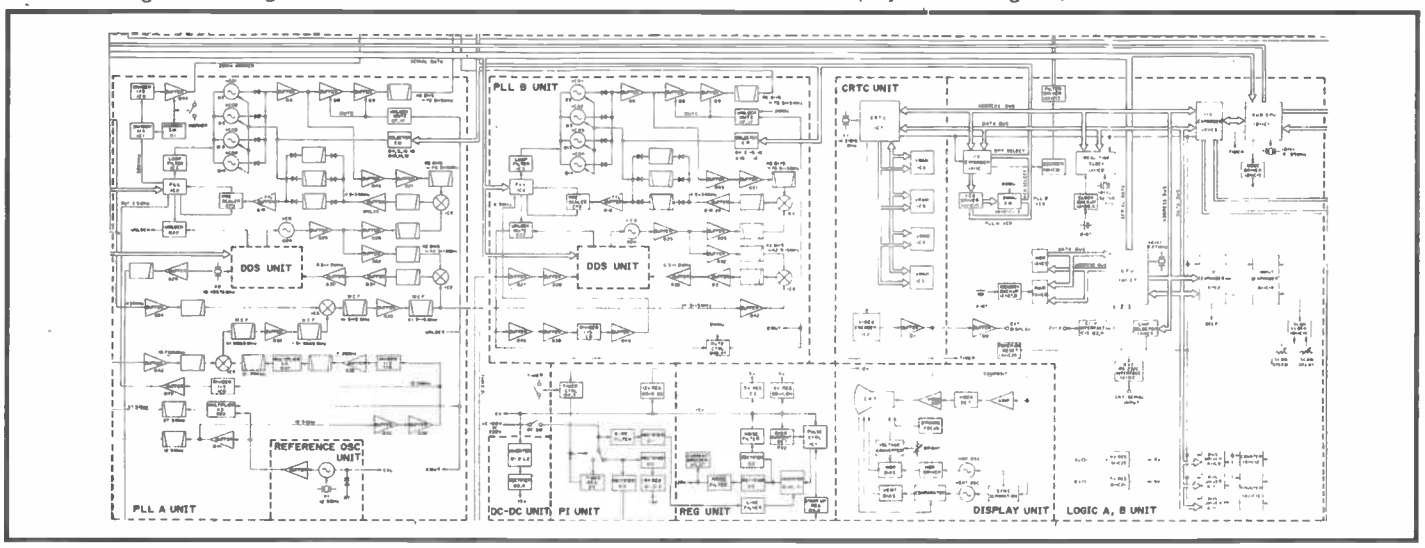
I will start with a short description of the screen's facilities, as without some sort of knowledge of what is shown, it would be difficult to use the rig.

There are two menus which can be displayed alternately by pressing button F6, one in a row of six under the screen. Both menus show the frequencies of VFO A and VFO B, together with the date, day and time. Two clocks are shown: one for local time and the sub clock, for UTC, or any other time. The latter can store a note of up to six characters. The display also shows the mode in use with whatever filter(s) are switched in circuit. The date shows the year first, followed by the month and then the day, the reverse of what we are used to. Menu 1 gives the choice of: SCAN OPERATIONS, MEMORY LIST, SPECTRUM SCOPE, or CLOCK and TIMER. Menu 2 shows: TERMINAL MONITOR, CI-V CONDITION (communications interface V allowing control of the external equipment with a personal computer), IF FILTER PRESET or BAND KEY PRESET. These functions are selected by pressing one or other of the F buttons below the screen. These buttons are labelled F1 to F6 and when pressed each one calls up different facilities on to the screen. In the top left-hand corner of the screen the word 'XMIT' is displayed. When going over to transmit, in addition to a red LED being illuminated to the left of a line of signals above the screen, the word 'XMIT' appears in reverse video.

Filters

Since the IC-781 has so many facilities, it is almost impossible to review all of them here. For example, nine filters are provided as standard in the 9MHz and 455kHz IFs which can be used separately or in tandem, with your choice being shown on the screen. My own rig is an Icom IC-751 and it is equipped with a very efficient PBT (passband tuning) facility

Schematic diagram showing the PLL A unit, reference osc unit, PLL B unit, CRT unit, display unit and logic A,B unit



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A User Review: The Icom IC-781 HF All Band Transceiver

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ICOM IC-R71E

0.1-30MHz RX, 32 mems, keypad entry, SSB/AM/RTTY/CW (FM option), DFM system, a classic receiver
IC-R71E ..... ~~£956.00~~

ICOM IC-3210E

Dual band mobile, 144-146MHz and 430-440MHz. 20 double memories, 25/5W on both bands, duplex capability
IC-3210E ..... ~~£499.00~~

ICOM IC-32E

Dual band HT, 144-146MHz and 430-440MHz. 20 mems. 5W on 2 and 70, duplex capacity, keypad entry
IC-32E ..... ~~£399.00~~

ICOM IC-2SE/4SE

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YAESU FT-23R/FT-73R

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YAESU FRG-8800

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FRG-8800 ..... ~~£649.00~~

YAESU FT-767GX

HF/VHF/UHF all mode 100W transceiver, 0.1-30MHz ham band TX, GCRX, 50/144/432 MHz option, built in ATU, digital SWR & power meter
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YAESU FT-736R

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NAVICO AMR1000/S

VHF 25W mobile, 144-146 MHz, 12.5/25 KHz steps, IARU channels, R0-R7, S8-S23, auto repeater shift/tone burst, digital S-meter
NAVICO AMR1000/S from ..... ~~£247.25~~

CHALLENGER BJ200

AM/FM scanning receiver, 26-520 MHz (with gaps) includes civil and most military bands, 16 mems, with free RAYCOM air band antenna (while stocks last)
CHALLENGER BJ200 ..... ~~£229.00~~

CTE 1600

VHF HT, (same as IC-2E), 144-148 MHz, 2.5W RF, nicad charger, complete with free 2m mag-mount antenna, while stocks last
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FT-711RH 70cm/35W	~~£249.00~~
FT-712RH 70cm/35W	~~£275.00~~
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ICOM

IC-228H 2m/45W	~~£385.00~~
IC-448E 70cm/25W	~~£429.00~~
IC-1200E 23cm/10W	~~£449.00~~
IC-900 multi-band bvr	~~£489.00~~
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NAVICO

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RAYCOM NEWS BOX

FOND

We have always been fond of scanners at Raycom, starting way back when with what seem today like the most ordinary receivers, but no range has found a place in our hearts like the Uniden/Bearcat range when it comes to handhelds.

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Over the past years, we have built up a close working relationship with Uniden UK, and as a result of this continuing and flourishing relationship we are able to bring to our customers some special deals and very special benefits which underline our confidence in the Uniden range of products.

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With effect from July 1st 1989 we are offering unbeatable deals on the following Uniden products. This is designed to clear out our stores for more of the current products and to make room for new and exciting products soon to come. *Call us for super special deals on the following rigs:*

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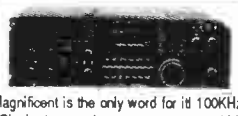
BC 100XL handheld scanner	~~£189.99~~
BC 175XL base scanner	~~£179.99~~

NO QUIBBLE

As continuing proof of our faith in the product and to provide even better levels of service we make the following promise: we will exchange on the spot without quibble any unit failing within 1 year of purchase due to component failure or manufacturing defect (nicad/helical excluded) - with effect from July 1st 1989 - *where will you find a better deal?* 73 es 88!

ICOM AT RAYCOM
ICOM IC-R9000



Magnificent is the only word for it! 100KHz-2Gigahertz continuous coverage, 1000 memories, multi-function CRT display and spectrum scope, send SAE for a fact sheet about this super new scanning receiver.
ICOM IC-R9000 ..... ~~£3995.00~~

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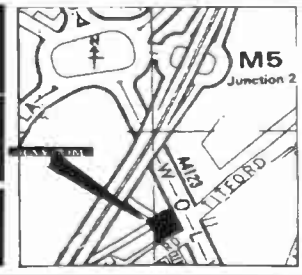

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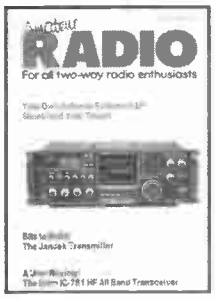

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AC127	0.20	BC108	0.10	BC207B	0.25	BD131	0.42	BD534	0.45	BF271	0.26	BFY90	0.77	GEX542	9.50	R2010B	1.45	TIP146	2.75	2SC496	0.80
AC128	0.28	BC108	0.10	8C208B	0.20	BD132	0.42	BD535	0.45	BF273	0.18	BLY48	1.75	MJ3000	1.98	R2322	0.58	TIP161	2.95	2SC784	0.75
AC128K	0.32	BC108B	0.12	BC212	0.09	BD133	0.50	BD575	0.95	BF335	0.35	8R100	0.45	MJE340	0.40	R323	0.66	TIP2955	0.80	2SC7B5	0.75
AC141	0.28	BC109	0.10	BC212L	0.09	BD135	0.30	BD587	0.95	BF336	0.34	8R101	0.49	MJE350	0.75	R2540	2.48	TIP3055	0.55	2SC789	0.55
AC141K	0.34	BC109B	0.12	BC213	0.09	BD136	0.30	BD588	0.95	BF337	0.29	8R103	0.55	MJE520	0.48	RCA16029	0.85	TIS91	0.20	2SC931D	0.95
AC142K	0.45	BC114A	0.09	BC213L	0.09	BD137	0.32	BD698	1.50	BF338	0.32	8R303	0.95	MJE2955	0.95	RCA16039	0.85	TV106	1.50	2SC937	1.95
AC176K	0.31	BC115	0.55	BC214	0.09	BD138	0.30	BD701	1.25	BF355	0.37	8RC4443	1.15	MPSA13	0.29	RCA16181	0.85	TV106/2	1.50	2SC1034	4.50
AC187	0.25	BC116A	0.50	BC214C	0.09	BD139	0.32	BD702	1.25	BF362	0.38	8RY39	0.45	MPSA92	0.30	RCA16334	0.90	ZRF0112	16.50	2SC1096	0.80
AC187K	0.28	BC117	0.19	BC214L	0.09	BD140	0.30	BD707	0.90	BF363	0.65	8SW64	0.95	MRF237	4.95	RCA16335	0.85	2N1308	1.35	2SC1106	2.50
AC188	0.25	BC119	0.24	BC237B	0.15	BD144	1.10	8DX32	1.50	BF371	0.25	BSX60	1.25	MRF450A	15.95	RCA16572	0.85	2N1711	0.30	2SC1124	0.95
AC188K	0.37	BC125	0.25	BC238	0.15	BD150C	0.29	8DX53B	1.65	BF394	0.19	BT100A/02	0.85	MRF453	17.50	S2060D	0.95	2N2219	0.28	2SC1162	0.95
ACY17	1.15	BC140	0.31	BC239	0.15	BD159	0.65	8F115	0.35	BF422	0.32	8T106	1.49	MRF454	26.50	SKE5F	1.45	2N2626	0.55	2SC1172Y	2.20
AD142	2.50	BC141	0.25	BC251A	0.15	BD160	1.50	8F119	0.65	BF423	0.25	8T116	1.20	MRF455	17.50	T6021V	0.45	2N2905	0.40	2SC1173	1.15
AD149	1.50	BC142	0.21	BC252A	0.15	BD166	0.50	8F127	0.39	BF457	0.32	8T119	3.15	MRF475	2.95	T6027V	0.45	2N3053	0.40	2SC1306	1.75
AD161	0.50	BC143	0.24	BC258	0.25	BD179	0.72	8F154	0.20	BF458	0.36	8T120	1.65	MRF477	14.95	T6029V	0.45	2N3054	0.59	2SC1364	0.50
AD162	0.50	BC147B	0.12	BC258A	0.39	BD182	0.70	BF158	0.22	BF467	0.68	BU105	1.95	MRF479	5.50	T6036V	0.55	2N3055	0.52	2SC1413A	2.50
AF106	0.50	BC148A	0.09	BC284	0.30	BD201	0.50	BF160	0.27	BF493	0.35	NU108	1.69	OC16W	2.50	T9002V	0.55	2N3702	0.12	2SC1449	0.50
AF114	2.50	BC149	0.09	BC300	0.30	BD202	0.50	BF173	0.22	Bf4995	0.23	BU124	1.25	OC23	9.50	T9011V	0.75	2N3703	0.12	2SC1628	0.75
AF115	1.95	BC153	0.30	BC301	0.30	BD203	0.50	BF177	0.38	Bf4997	0.25	BU125	1.25	OC25	1.50	T9015V	2.15	2N3704	0.12	2SC1678	1.50
AF116	2.50	BC157	0.12	BC303	0.26	BD204	0.70	BF178	0.26	BFR39	0.23	BU126	1.60	OC26	1.50	T9034V	2.15	2N3705	0.20	2SC1945	3.75
AF117	2.50	BC159	0.09	BC307B	0.09	BD222	0.46	BF179	0.34	BFR40	0.23	BU204	1.55	OC28	5.50	T9038V	3.95	2N3706	0.12	2SC1953	0.95
AF118	3.50	BC161	0.55	BC327	0.10	BD223	0.59	BF180	0.29	BFR81	0.25	BU205	1.30	OC29	4.50	THY15/80	2.25	2N3708	0.12	2SC1957	0.80
AF121	0.60	BC170B	0.15	BC328	0.10	BD225	0.48	BF181	0.29	BFR88	0.30	BU208	0.95	OC32	5.50	THY15/85	2.25	2N3733	9.50	2SC1969	2.95
AF124	0.65	BC171	0.09	BC337	0.10	BD232	0.35	BF182	0.29	BFR90	1.50	BU208A	1.15	OC42	1.50	TIP29	0.40	2N3773	2.75	2SC1985	1.50
AF125	0.65	BC172B	0.10	BC338	0.09	BD233	0.35	BF183	0.29	BFR91	1.75	BU208D	1.35	OC44	1.25	TIP29C	0.42	2N3792	1.35	2SC2028	1.15
AF126	0.45	BC173B	0.10	BC347A	0.13	BD236	0.49	BF184	0.35	BFT42	0.35	BU326	1.20	OC45	1.00	TIP30C	0.43	2N4280	3.50	2SC2029	1.95
AF127	0.65	BC174	0.09	BC461	0.35	BD237	0.40	BF185	0.28	BFT43	0.35	BU326S	1.50	OC70	1.00	TIP31C	0.55	2N4427	1.95	2SC2078	1.45
AF139	0.40	BC177	0.15	BC478	0.20	BD242	0.65	BF195	0.11	BFW10	0.55	BU407	1.24	OC71	0.75	TIP32C	0.42	2N4444	1.15	2SC2091	0.85
AF150	0.60	BC178	0.15	BC527	0.20	BD246	0.75	BF197	0.11	BFW11	0.75	BU408	1.50	OC72	2.50	TIP33C	0.95	2N5294	0.42	2SC2098	2.95
AF178	1.95	BC182	0.10	BC547	0.10	BD376	0.32	BF198	0.16	BFW16A	1.15	BU426A	0.75	OC75	1.50	TIP34B	0.95	2N5296	0.48	2SC2166	1.95
AF239	0.42	BC182LB	0.10	BC548	0.10	BD379	0.45	BF199	0.14	BFW61	0.60	BU500	2.25	OCB1	1.00	TIP41A	0.45	2N5298	0.60	2SC2314	0.80
ASY27	0.85	BC183	0.10	BC549A	0.10	BD410	0.65	BF240	0.20	BFW92	0.85	BU508A	1.95	OC84	1.50	TIP41C	0.45	2N5496	0.95	2SC2371	0.36
ASY77	1.50	BC183L	0.09	BC550	0.14	BD434	0.65	BF241	0.15	8FX29	0.30	BU526	1.90	OC139	12.50	TIP42C	0.47	2N564'	16.50	2SC931D	0.95
				BC557	0.08	BD436	0.60	BF245	0.30	8FXB4	0.26	BU807	2.25	OC171	4.50	TIP47	0.65	2N5643	16.50	2SK19	0.55
				BC558	0.10	8D437	0.60	BF256LC	0.35	8FX85	0.32	BUY20	2.15	OC200	4.50	TIP48	0.65	2SA329	0.95	2SK33	0.55
				BC639/10	0.30	BD438	0.75	BF257	0.28	BFX86	0.25			OC201	5.50	TIP50	0.65			3SK88	0.45
				BCY33A	19.50	BD510	0.95			BFY1B	1.35			OC205	10.00	TIP120	0.60				

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AN214Q	2.50	BA521	1.50	LA4400	3.50	MC1327	1.70	SL1310	1.80	STK463	11.50	TAA310A	3.50	TBA570	1.00	TDA1005	2.25	TDA2600	6.50	UPC1191V	1.50
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AN239	2.50	CA3086	0.46	LA4422	1.50	MC1351P	1.75	SL1327Q	1.10	STK0029	7.95	TAA350A	1.95	TBA673	1.95	TDA1037	1.95	TDA2611A	1.95	UPC1353C	2.45
AN240P	2.80	CA3123E	1.95	LA4430	2.50	MC1352P	1.00	SN7414	1.50	STK0039	7.95	TAA550B	0.95	TBA750	1.95	TDA1044	2.15	TDA2640	3.50	UPC1360	2.95
AN247	2.50	CA313EM	2.50	LA4461	3.95	MC1357	2.35	SN7421	0.85	TA7061AP	1.50	TAA570	1.95	TBA750Q	2.65	TDA1170	1.95	TDA2655	4.50	UPC1365C	3.95
AN260	2.95	CA3140S	2.50	LC7120	3.25	MC1358	1.58	SN76110N	0.89	TA7072	2.65	TAA621	3.95	T8A800	0.89	TDA1180	2.15	TDA2680A	2.75	UPC2002H	1.95
AN262	1.95	CA3140T	1.15	LC7130	3.50	MC1496	1.75	SN76115N	1.25	TA7073	3.50	TAA630S	2.95	T8AB10AS	1.65	TDA1270Q	3.95	TDA2690	2.45	UPD2114LC	2.50
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AN271	3.50	HA1137W	1.95	LC7137	5.50	MC3357	2.75	SN76226DN	2.95	TA7120P	1.65	TAA700	1.70	TBA820M	0.75	TDA2002	0.95	TDA3510	3.50	556	0.60
AN301	2.95	HA1156W	1.50	LM323K	4.95	MC3401L	2.50	SN76227N	1.05	TA7129P	2.50	TAA930	3.95	TBA820Q	1.45	TDA2003	1.95	TDA3560	3.95	723	0.50
AN303	3.50	HA1306	1.50	LM324N	0.45	MC14106P	2.95	SN76228N	2.35	TA7130P	1.50	T8A120AS/8/C		TBA890	2.50	TDA2010	1.95	TDA4050	2.95	741	0.35
AN313	2.95	HA1322	1.95	LM380N	1.50	MC14516CP	7.50	SN76533N	1.65	TA7137P	1.00		1.00	TBA920	1.65	TDA2020	2.95	TDA4600	2.50	747	0.50
AN315	2.95	HA1339A	2.95	LM380N8	2.95	ML231B	1.75	SN76650N	1.15	TA7146P	1.50	SA/S8/T/U		TBA950-2X	1.50	TDA2030	2.80	TDA9503	3.15	748	0.35
AN316	3.95	HA1366W	2.75	LM383T	2.95	ML232B	2.50	SN76660N	0.90	TA7176AP	2.95	TBA395	1.50	TBA990	1.49	TDA2140	3.95	TEA1009	1.35	7808	0.50
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AN342	2.95	HA1551	2.95	LM1011	3.15	MSM5807	8.75	STK014	7.95	TA7204P	2.15	TBA440N	2.55	TCA270	2.50	TDA2151	1.95	UPC566H	2.95	7812	0.50
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dip. Owing to the displacement of the magnetic poles, this line crosses the South Atlantic in a south-westerly direction, crosses South America well south of the geographic equator, then goes north-westerly across the Pacific until it is north of the equator again between Australia and Japan. Thereby the long path great circle route from Greece, Malta, Portugal and Ascension Island approximates to the same route.

It is interesting that Britain and Western Europe can at times gain access to this route by either Sporadic-E or one hop F-layer if the first MUF for the first hop rises high enough. In the case of Greece it is the late night persistence of high level densities in the tropical F-region that accounts for TEP, which enables access to the route after dark.

From the mailbag

Ted Collins G4UPS, from Hemyock in Devon, writes that the recent draft copy of the PA3EUI European activity list reveals that there are well over 1300 G stations active on 6m. Ted has another forty not on the list. His report also includes the following information.

New Beacon CX1CCC on 50.020, power 5W.

Little Cayman Island Harry Schools KA3B, who made a DXpedition to Cayman Island this June, left his equipment with Ron Sefton ZF8AA. Grid locator FK09.

Greece The SV1SIX beacon, 50.040, is now on the air.

Hungary A new crossband station represented by Zoli HA1AG, is a welcome addition to the growing list of European stations.

Sierra Leone Steve 9LSB is active on 6m.

Liberia EL2MR will be active on 6m soon.

Tanzania The first QSOs with 5H1HK were made on 16 May from around 1745hrs, with quite a wide spread around the UK. QSL via JH4RHF.

Canary Islands Bob G0KPW/EA8 made his first crossband into Europe on 20 May with G4UPS at 1457hrs.

Pirates Several Italian stations have been operating on 6m; none of them has a 6m permit. SV5TS is in the same category. One puzzling one is IR5ITU testing on 50.072. When he was called, he replied that he was only testing! Many G stations worked what they thought was Tony T77C on 30 May. At one time when the station was contacted, he started by using the callsign T77C, then changed to T77A – all on SSB. Tony, the genuine T77C, says that the only callsigns from T7 are T70A, T77C and T77F, and they are only permitted to use CW. Tony believes that the pirate is an Italian station, so G stations are warned to beware of any T7 stations using SSB.

Cyprus During the past few days several 5B4 stations have been heard on 6m. None of them is legal, which is very frustrating for the many Gs struggling through the pile-ups to work a country that cannot be claimed.

Market Reef QSL information for OH2BOZ/OH0M is via OH2AP, Jarvenpaan Radio Amatoorit, Box 90, SF-04401, Jarvenpaa, Finland.

Algeria A pleasant surprise on 13 June was FC1EAN/7X who worked many G stations. On 17th at 1900hrs SV1AN/7X also gave many a QSO from Algeria.

Geoff Brown, from St Helier, reports a first GJ-5H1 on 15 May with a QSO with 5H1HK. He has also had QSOs with SM6PU and LU2DEK, and heard the FY7THF beacon.

Steve G4JCC's report has 135 entries – mainly stations heard in accordance with his sensible policy of only working stations he has not contacted before. DX stations worked included: LU7DZ, 5H1HK, LU9AEA, T77C (the real one), and SV1EN.

Once again, a very interesting month and, with the solar flux rising each day, better things to come. Until next month, 73 and good DX on 6m from Ken Ellis, 18 Joyes Road, Folkestone, Kent CT19 6NX.

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■ Linear Zatagi 3-30MHz B300P 400W. Never used, £90.00. Tektronic 'scope, type 533. Perfect working order, with probes, offers? Model EH1221 timing unit, offers? Racal TM4 security tester, £20.00 ono. Lambda bench PSU, 12 to 15V, £20.00. JEP terminal unit and decoder, programs for Morse and RTTY for Spectrum computer, offers? Tel: (0698) 357869

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■ Racal RA117E receiver. Good condition and working order. With 100, 300Hz; 1.2, 3, 6.5, 13kHz filters installed. Complete manual, £150.00. Tel: 01-570 5603

■ Trio TS120S five band transceiver, with PSU, 100W output, £400.00. Also Trio 2000, plus VHF converter, £350.00. Tom Lorimer, 443 Delgatie Court, Glenrothes, Fife, Scotland KY7 4RW. Tel: (0592) 771583

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■ Exchange Yaesu FT747GX, mint cond with FM and extras, for any 26-30MHz multimode tcvr with digital display and an AOR 2002 scanner, or similar with same coverage to 1300MHz will do. Both items must be in good condition. Tel: 01-501 2807 evenings or weekends (Hainault, Essex)

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■ Vibroplex Champion model, mint condition. Exchange good CB/27/81 or communications receiver. Disabled so cannot deliver or collect. Would prefer valve type communications receiver ex-WD etc. Winchester, 50 Asten Fields, Battle, Sussex TN33 0HR

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STRAIGHT & LEVEL

SURFACE MOUNT REED RELAY

Hamlin have recently launched their surface mount series of 3800 Reed Relays.

The series 3800 is designed to be used with vapour phase, infrared or wave-soldering systems; the relay is fitted with a single form A (N/O) dry contact with a 10W rating.

The device features an extremely low profile, 5mm, and a footprint of just 0.70 × 0.75in, and offers a maximum soldering temperature of 340°C. The series 3800 is available with standard coil voltages: 5V, 12V and 24V dc.

Shock tested to 50g and vibration tested to 20g (non-operative), the range has a maximum initial contact resistance of 200m ohms and a minimum insulation resistance of 1×10^{10} ohms.

The relay is available with 'J' feet and the moulding has castellations at both ends to facilitate butt mounting of adjacent relays.

For further information and free samples, contact *Hamlin, Park Road, Diss, Norfolk IP22 3AY. Tel: (0379) 644411.*

BENCH POWER SUPPLY

STC Instrument Services have introduced the 5075 power supply to their Prism range of high-precision, programmable bench power supplies. The 5075 delivers up to 250W as a dc constant current or constant voltage source.

Maximum current delivery is 20A at 10V, the maximum voltage is 32V at 18A.

The unit is fully programmable, either from its integral keyboard or remotely via its IEEE-488 GPIB bus interface. Indicators provide full reporting on the instrument's status.

A built-in digital voltammeter shows separate four-digit displays of voltage and current for continuous monitoring of output parameters. An internal digital control loop maintains accuracy to within 0.075% for voltage and 0.25% for current.

A full 'talk and listen' capability is provided by the IEEE-488 interface which recognises standard uniline and multiline commands. A 'nudge' facility enables the voltage or current setpoint to be incremented or decreased. The GPIB response time is 20ms. A five-way switch mounted on the rear panel is used for GPIB address selection.

Overload protection is provided to guard against accidental damage, while a tracking crow-bar protects the load. The latching voltage is set at 115% of the programmed voltage. It also has a limited internal sink capability to improve response performance, providing a transient recovery time to 98% of 100μs.

Other performance parameters include: resolution of 10mV and 2mA; ninety day drift of 50ppm; temperature coefficients of 50ppm°C for voltage and 150ppm°C for current; and rms ripple and noise of 5mV and 5mA. Constant voltage output impedance is 50μ ohms and 10μH in a constant current mode 250μ ohms. The operating temperature range is 0°C to 50°C.

For further information contact *STC Instrument Services. Tel: 0279 641641.*

MX51 MULTIMETER

ITT Instruments have introduced the MX51 handheld digital multimeter, a high-performance instrument which incorporates a number of different measuring functions, including 5,000 counts and an LCD bar-graph display.

In normal mode, the display functions as a fifty-point, linear trend-indicating bar-graph. In zero mode, it is used like a centre-zero galvanometer, and is ideal for rapid polarity detection, making circuit adjustments for FM detection, or as a bridge-circuit null detector.

The zoom or magnify mode gives five times magnification of the input variation, and increases the resolution to 0.4%. This magnified presentation automatically tracks any shift of the input level within the span of the selected digital range.

Also included is a feature known as 'Live Trend Mode'. In this mode, the bar-graph indicates the instantaneous value, while the digital display follows whichever measurement mode has been selected.

A relative mode allows the multimeter to display the difference from a prerecorded reference. The surveillance mode memorises the measured maximum or minimum limits while the displays show the current value. Store mode records the values of up to five measurements for subsequent comparison or analysis.

For further information contact *ITT Instruments, 344 Edinburgh Avenue, Slough, Berkshire SL1 4TH. Tel: (0753) 824131.*

CMOS TIMER

STC Electronic Services have announced a new Philips general-purpose CMOS timer, the ICM7555, with improved performance over the standard NE/SE555 timer.

The enhanced parameters include: a lower supply current (80uA); wider operating voltage supply range (2-18V); lower threshold, trigger and reset currents (20pA); the elimination of crow-barring of the supply current during output transitions; and a higher frequency performance without having to decouple the control voltage for stable operation. A high-speed operation of 500kHz is guaranteed.

For further information contact *The Integrated Circuit Product Group, STC Electronic Services, Edinburgh Way, Harlow, Essex CM20 2DF. Tel: (0279) 626777.*

STC MERCATOR

The new STC Mercator catalogue is fully illustrated with numerous diagrams, offering the designer substantial technical information, general guidance notes, glossaries and product handling advice.

All the latest news, views, comment and developments on the amateur radio scene

There are fourteen sections which cover capacitors, resistors, inductors, EMI filters, varistors, resonators, audible products (buzzers and sounducers), counters, switches, LEDs, LCDs, vacuum fluorescent displays, soldering systems and speech systems. Copies are available free.

For further information, *tel: (0493) 844911.*

TANTALUM CAPACITOR

Unitel have introduced the Kemet Series T110 metal-cased solid tantalum capacitor. An Axial product, it is both compact, rugged and ideal for miniaturised circuits in, for example, coupling, bypass, filtering and RC timing applications.

Features include very high stability and extremely low dc leakage current, as well as dissipation factor and impedance over a wide temperature and frequency range. Supplied on tape, the capacitance tolerance is ±10%.

For further information contact *Unitel Ltd, Unitel House, Fishers Green Road, Stevenage, Herts SG1 2PT. Tel: (0433) 312393.*

DTI NEWS

Radio amateurs wishing to know the broad geographical location of all other enthusiasts will soon be able to find this information in amateur radio callbooks. The DTI recently announced that it will provide publishers of callbooks with the first two letters of the postcode of those amateurs whose full details are not known.

About 60,000 radio amateurs each have their own unique callsign which they must use to identify themselves when they transmit. The majority of radio amateurs give permission for their names and addresses to be released for publication, but a minority wish their details to be withheld. Their privacy is protected since the information released will indicate only a broad area equivalent to a county or major city.

These changes do not affect CB licensees since they do not have official callsigns, or callbooks.

CEPT NEWS

A European broadband interconnection trial (EBIT) has been agreed by members of the CEPT (European Conference of Postal and Telecommunications Authorities).

The decision to go ahead with the trial has been formulated in a Memorandum of Understanding (MOU), and has been agreed by seventeen telecommunications operators from fourteen countries.

The MOU provides a framework for collaboration between signatories to introduce switched digital services at a rate of 2 Mbits on a trial basis. The trial is intended to form the basis of a network which will support pilot application services developed under the collaborative programme RACE.

It is hoped that future commercial services will benefit from the results and experience gained by users of the pilot applications provided under the auspices of the EBIT MOU.

IAVF BERLIN 1989

The 1989 International Audio and Video Fair, Berlin, takes place from 25 August to 3 September at the Berlin Exhibition Grounds.

The Audio and Video Fair, the world's leading trade fair for consumer electronics, expects to attract more than 400,000 visitors world-wide. Over 350 exhibitors and 400 additionally represented companies from Europe, Asia and the USA will be displaying their products on an area measuring 81,000 square metres.

BEN NEVIS VIDEO

On 2 June, an expedition to Ben Nevis successfully operated a 40m SSB station from the summit under the callsign, GB5BN. This is believed to be the first time that 40m operation has taken place from the summit, and possibly the first SSB activity ever. In freezing snow bound conditions, the three operators: Richard G3XWH, Robin G3YHC and Simon G4KCR, managed to make forty contacts in just over two hours of operation using 2W output from battery equipment.

Waters and Stanton Electronics from Hockley, Essex, sponsored the team by donating HF equipment and, in return, obtained a video of the entire expedition. The ninety-minute video contains many scenic shots, showing the problems and terrain encountered by the three amateurs.

Waters and. Stanton will loan a free copy of the video to any club, who should find it both entertaining and instructive. Any club interested should contact Peter Waters, tel: (0702) 204965, between 9.00am and 5.00pm.

CLUB NEWS

The Derby and District Amateur Radio Society have recently announced the results of their Third Annual 144-146MHz Contest, held on Sunday 12 March 1989.

Anyone wishing to obtain a copy of these results can do so by contacting the club's chairman, Mike Sharp G4XPE.

On 13 August the Annual Derby Radio Rally will take place at the Lower Bemrose School, St Albans Road, Derby.

All the usual attractions, including the famous monster junk sale, will be there.

For further information about the 144-146MHz Contest and this year's rally, contact *Mike Sharp G4XPE, 119 Green Lane, Derby DE1 1RZ, or Martin Shardlow G3SZJ. Tel: (0332) 558875.*

The Barking Radio and Electronics Society 144MHz Contest takes place on Sunday 13 August from 13.00 to 17.00GMT at The Westbury Recreation Centre, Ripple Road, Barking, Essex.

The rules for this event are as follows:

1. High power section – full legal limit

Low power section – 20W PEP output SWL.

2. Any exchange will consist of the report, serial number (starting at 001) and county. Continental stations should give thir QRA locator.

3. Each contact scores one point, and contacts with Club Stations, ten points. The multiplier will be the number of counties plus overseas locator scores. The final total: points × multipliers.

4. Certificates will be awarded to the winner and runner-up in each section and leading Essex entrant.

5. Entries to be sent to: BRS31976, 32 Wellington Road, Rayleigh, Essex SS6 8EZ.

The Torbay Amateur Radio Society will hold their twenty-fifth Annual Rally on 27 August at the STC Social Club, Brixham Road, Paignton, beginning at 10.00am.

There will be the usual attractions including a talk-in on S22.

For further information contact *Andy Stafford, ECC Social Club, Highweek, Newton Abbot.*

The Ripon and District Amateur Radio Society meets every Thursday evening at 8.00pm in the bunker behind the Town Hall.

Members hope to take part in VHF/HF and QRP contests throughout the year. Foxhunts on VHF and top band are also planned.

A warm welcome awaits those interested in radio and electronics, especially those outwith the Ripon area.

For further information contact *John G4LGX. Tel: (0423) 567390.*

ADDENDUM

In the July issue of ***Amateur Radio***, we published 'A Trapped Dipole for the DX Bands', by David Taylor G4EBT.

An error appeared on page forty-one, second column, second line down. It should read, 'Are 55mm in diameter', *not* 15mm.

which I thought was excellent until I tried the IC-781, which has *twin* PBT! In effect, with the 455kHz and 9MHz IF filters able to be adjusted separately, *any* interference can be cancelled out. 7MHz is a case in point, as any powerful commercial operating on the band can be silenced so that only the required signal is heard. In addition to the twin PBT, the notch filter has an attenuation of more than 45dB. You can imagine that with all this filtering available, it is more likely to be the other end who will complain about interference from the adjacent CW station, or someone tuning up on the frequency you are using.

Voice synthesiser

This particular IC-781 was fitted with the optional UT-36 voice synthesiser unit, which means that in addition to the frequency being spoken, each time any one of the seven mode buttons are pressed a charming female voice says, 'Upper Sideband', 'RTTY', or whatever. I used menu 1, mostly, which showed my frequency using VFO A, the dual watch frequency on VFO B, and the spectrum scope. The spectrum scope is similar to a panadaptor. It displays the relative strengths of signals around a centre frequency and allows you to see what is going on adjacent to the frequency you are using.

Dual watch

There are three different bandwidths available: ±25kHz, ±50kHz and ±100kHz, giving you whatever spread you require. In addition, the display can be frozen to enable close analysis. If required, the scope will show the 9MHz IF of the transmitted signal. The dual watch simultaneously monitors two frequencies and incorporates two first mixers and a phase-locked loop frequency synthesiser, so that a signal on either or both frequencies can be heard through the speaker.

A balance control is provided which adjusts the level required. This is very similar to that of the Kenwood TM-721E 2m 70cm mobile transceiver which has two separate transceivers, the output of either or both being available at the speaker, and the level being adjusted by a balance control.

The manual mentions that the IC-781 has excellent reverse isolation, ensuring that signals from the mixer do not affect each other. This, of course, I could neither prove nor disprove, but suffice to say, I could not detect any interaction between the two signals.

DDS

The rig has a Direct Digital Synthesiser (DDS), applicable to the PLL circuitry, which is a new development for Icom. I won't go into the theory of it, but the result from an operating point of view is a very fast lock-up time between receive and transmit, typically 10msecs. This means, of course, that there is no trouble in operating AMTOR or CW for full break-in. Incidentally, there is a DATA switch on the mode line of buttons which, when pressed, inhibits the microphone input line when AFSK is used.

One of the most impressive parts of the rig is, of course, the CRT display. This important breakthrough for amateur equipment can be used to display packet, AMTOR or RTTY. There is also a standard RS232 socket on the rear panel which takes the video display to any other monitor. Just in passing, all of the frequencies are derived from a reference crystal oscillator. A constant temperature oven crystal is used which is stable to within ±15kHz between a range of −10°C to +60°C. Consequently, during the time I was using the rig, no drift could be discerned.

Something for all

This rig caters for everybody's taste. For CW addicts, there is both semi and full break-in; the usual socket on the rear panel is for those who prefer a straight key. A built-in iambic keyer with variable weight and speed adjustments is also provided. The variable keying speed is controlled from the front panel, and is

Specifications of the Icom IC-781

Frequency coverage: 100kHz - 30MHz
(Transmitting frequencies cover all nine amateur bands)
Modes: SSB, CW, FM, RTTY and AM
Frequency step (with TS off): 10Hz
(with TS on: 1kHz
Antenna impedance (with Tuner off): 50 ohms unbalanced
Power supply requirements
receiving (maximum audio): 150VA
(standby): 140VA
transmitting (maximum): 760VA
(minimum): 325VA
Frequency stability: ±15Hz between −10° and +60°C
Dimensions (projections not included): 425mm × 149mm × 411mm (WHD)
Weight: 23kg (50.7lb)

TRANSMITTER

Maximum output power

SSB:	150PEP
CW, RTTY and FM:	150W
AM:	75W

Modulation
SSB: Balanced modulation
FM and RTTY: Reactance modulation
AM: Low level modulation
Maximum frequency deviation: ±5kHz
RTTY shift width: 170Hz, 425Hz and 850Hz selectable

RECEIVER

Receiving system
SSB, CW, RTTY and AM: Quadruple conversion superheterodyne
FM: Triple conversion superheterodyne
Sensitivity (with preamp on)
SSB, CW and RTTY (for 10dB S/N): 0.1 - 0.5MHz less than 0.5μV
0.5 - 1.8MHz less than 1.0μV
1.8MHz - 30MHz less than 0.16μV
AM (for 10dB S/N): 0.1 - 0.5MHz less than 3.2μV
0.5 - 1.8MHz less than 6.3μV
1.8MHz - 30MHz less than 1.0μV
FM (for 12dB SINAD): 28-30MHz less than 0.23μV
Selectivity: Varies with the choice of filter.
Audio output: More than 2.6W at 10% distortion with an 8 ohm load
RIT variable range: ±9.99kHz
Notch filter attenuation: More than 45dB

ANTENNA TUNER (built in)

Output matching range: 16.7 - 150 ohms unbalanced
Minimum input power: 15W
Auto tuning accuracy: VSWR less than 1.2:1
Insertion loss: Less than 0.5dB (after tuning)
Band switching time: Less than 3 seconds

adjustable from 5 to 45wpm.

In addition to the normal 'tuned receive offset', there is an audio peak filter (APF) which maintains the best AF frequency characteristics of a CW signal, having a centre frequency of 700Hz which is variable between ±300Hz. In use, the benefit of this filter when listening to CW stations is quite incredible. On the SSB side there is a built-in RF speech compressor, which is adjusted from the front panel.

There is, of course, VOX availability but, in addition, a microphone tone control moves the frequency response of the microphone amplifier to suit the operator's voice. This is made up of two controls concentrically mounted, the inner attending to the treble and the outer to the bass, giving a large range of adjustment. You can also monitor the 9MHz IF of the transmitted signal in all modes at a touch of a button. This is of great help when experimenting with the microphone tone control. In the FM mode, the operator can use 10m to access the repeaters, taking advantage of the in-built programmable sub-audible tone encoder which covers thirty-eight different tone frequencies.

For those of you who are AMTOR or RTTY buffs, the RTTY circuitry uses a crystal oscillator as its tone generator; three shift widths are available, 170Hz, 425Hz and 850Hz – these are selected using an internal jumper plug.

After setting the rig to 170Hz, which is the most popular setting for amateur operation, a number of RTTY and AMTOR contacts were made on the 3.5MHz, 7MHz and 14MHz bands, all with complete success. SSB contacts were also completed on these bands, as well as on the 21MHz band. No great DX was worked, but all the reports gave excellent speech quality. While listening on the 10MHz band I put out some CQ calls, but I received no replies. 28MHz was alive during this period and a couple of transatlantic QSOs were successfully made. All this with my 80m dipole!

Memories

Ninety-nine memories are provided in addition to the six different scanning facilities. All the memories can be called up for inspection and the readout shows the frequency, mode, and degree of filtering (wide, narrow etc). A selected memory scan number will accept a note of up to ten characters. The channels can be rolled up on the screen to see what they contain by using the main tuning knob. This knob has a standard 'drag' adjustment which is designed to suit any operator's requirements. One particular method of scanning which appeals to me is called 'fine scan' because it slowly tunes through a signal and tunes rapidly through frequencies without signals. This facility is most intriguing to use, since it is quite different from the normal scanning operation. There are separate RIT/XIT controls for the two VFOs.

Conclusion

The general-coverage receiver section is very easy to use, and I was impressed with the 'businesslike' operation of the controls. The various filtering arrangements mean that, when using the general-coverage section annoying QRM can be cut out by pressing one or other of the filter switch buttons and/or the PBT controls. The audio quality is clear when listening to normal broadcast stations, whether on frequencies around 1MHz or short wave stations in the various short wave segments. The rig connects up to the Icom SP-20 speaker assembly, which incorporates still further filtering positions.

The IC-781 has every conceivable facility that the amateur could possibly require. After my experience in the driving seat, I found it to be the most fantastic rig I have ever operated.

The Icom IC-781 HF all band transceiver costs £4,500. The SP-20 loudspeaker costs £104.00 and the UT-36 voice synthesiser is £28.00. All prices are inclusive of VAT. Thanks to: Icom (UK) Ltd, Sea Street, Herne Bay, Kent CT6 8LD, tel: (0227) 363859, for the loan of the rig for this review.

SHUNT-FEED YOUR TOWER!

by Don Field G3XTT

Many times I have heard amateurs lamenting the fact that they don't have room for LF antennas and have to limit their operating to the higher bands. Often it turns out that they are using an HF beam or mini-beam mounted on some sort of metallic tower. If so, the solution is staring them in the face – use their present antenna system on LF. The basic arrangement is shown in **Fig 1.** The idea is to gamma feed the tower in much the same way that many HF and VHF beams have a gamma feed. The reason a gamma feed system is used is that the base of the tower will be earthed (not many towers are mounted on an insulator!), so you cannot feed it directly with coax.

A typical triband beam will add 40-60ft to the electrical height of a tower. In other words, a typical 40ft tower would look, electrically speaking, more like a 90ft tower; the beam acting as a giant-sized capacity hat. What more could the budding LF DXer want?

So surely there must be a snag? Well, yes, of course, there are several. But none that can't be overcome with a bit of effort. One of the reasons why shunt-feeding is less popular here than in the USA for example, is that the tendency in the US is to use fixed towers, whereas here it is more common to use tilt-over telescopic towers. This has two disadvantages where shunt-feeding is concerned. The first is that the gamma wire which you will use to feed the tower cannot be permanently fixed in place, and the second is that it is harder to achieve and maintain good electrical continuity between the tower sections. However, nothing ventured, nothing gained. So how can you give shunt-feeding a try?

For successful operation from a shunt-fed tower, you are aiming to couple as much power as possible into the tower and to radiate this at a suitable angle to the horizon. This has various implications.

Firstly, the system as a whole should exhibit an electrical height great enough to present a reasonable feed impedance (to reduce earth losses), while not so high as to start exhibiting high angle lobes which will result in most of your signal disappearing into the ionosphere rather than off towards the horizon and hence the DX. Basically this means aiming for something approaching a quarter of a wavelength as a minimum and not much more than five-eighths wave maximum. Secondly, you will need the best earth system you can achieve. If you have only a small garden, get lots of short radials down on as many sides of the mast as possible. If you can also run a few longer radials along boundary lines, under a nearby footpath, or whatever, then so much the better. Thirdly, the aim is to use the tower itself, and not the gamma wire, as the radiator. This demands that the gamma wire has as great a diameter as possible and is not too far from the tower. One of the mistakes amateurs often make is to take the gamma wire something like 5ft from the tower. This makes it easier to match the system to the feeder, but will result in the gamma wire doing most of the radiating.

Back to square one

So let's go back to square one, and look at the various stages in getting a working system. Firstly, it helps (though is not essential) to have an idea of the electrical height of the system as a whole. To do this you need to connect a temporary gamma wire to the tower, preferably just below the beam. Also, use a multimeter to ensure that there is good electrical continuity through the whole system. This may mean cleaning up the surfaces between the tower sections or, if physically possible, actually connecting some heavy braid between the tower sections (not usually possible with a wind-up tower). Without good electrical continuity the system will never work well for you. Now determine the resonant frequency of the tower using either a grid-dip meter (see **Fig 2a**) or a noise bridge (see **Fig 2b**). This is the frequency at which the tower looks like an electrical quarter-wave, so now you can easily calculate the electrical height of the tower.

Once you have an idea of the electrical height, then determine from Table 1 at what point on the tower you need to connect your permanent gamma wire. If you haven't made the measurement, then as a rule of thumb assume that a

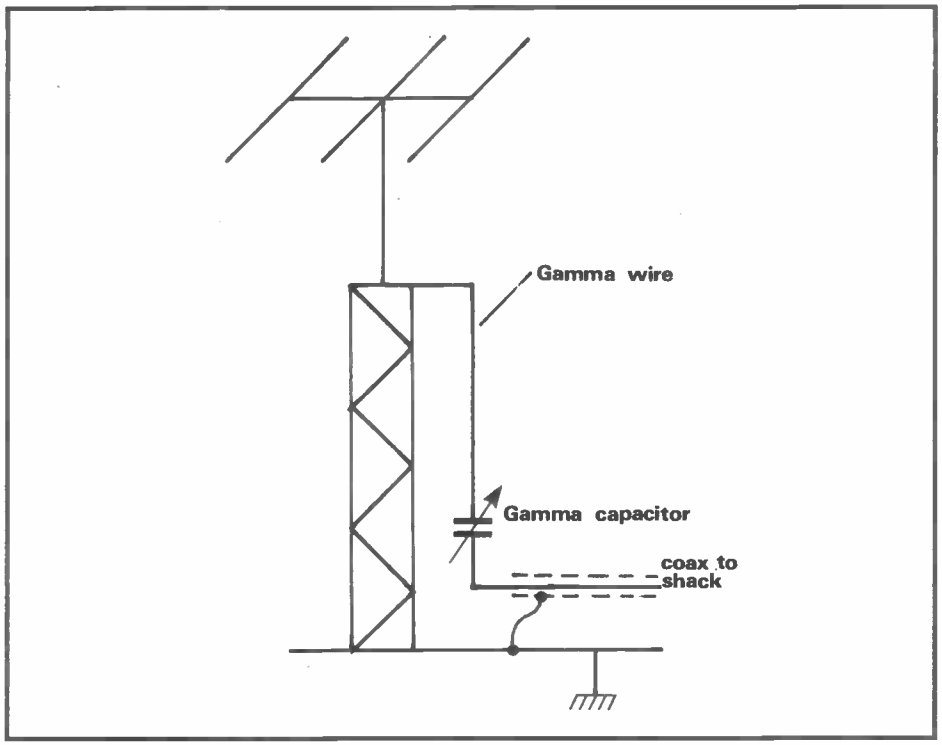
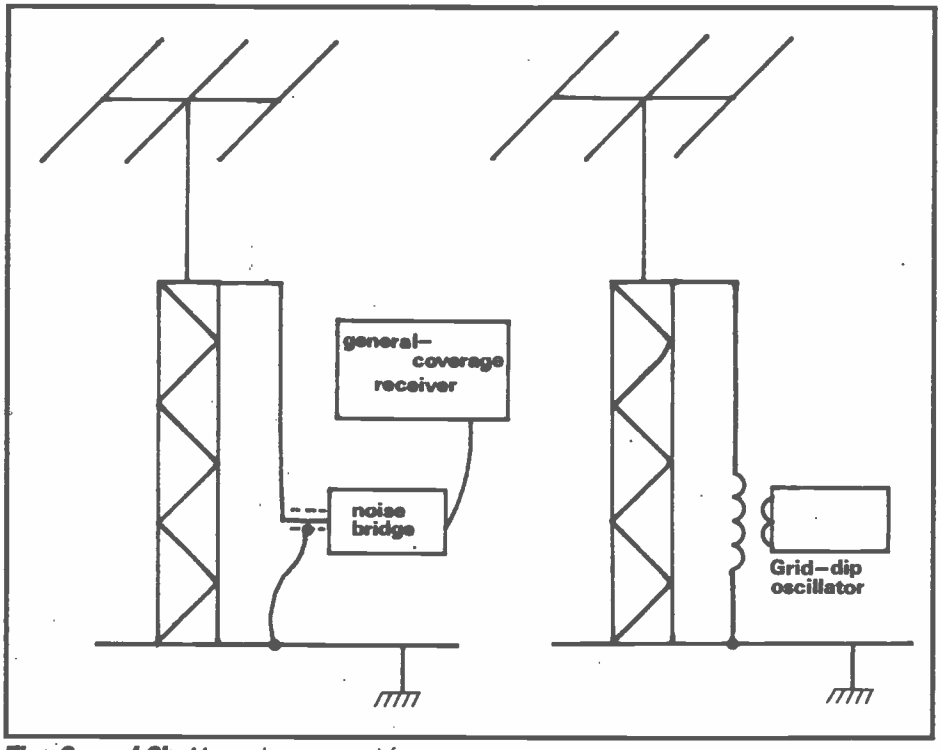


Fig 1: *Basic arrangement*

Table 1

Electrical Height (ft)	Gamma Wire (ft)		
60	Tower too low for effective results	30	20
70		30	20
80	70	30	20
90	60	30	20
100	50	30	Tower too high for effective results
110	40	30	
120	35	30	
130	30	30	



Figs 2a and 2b: *Measuring resonant frequency*

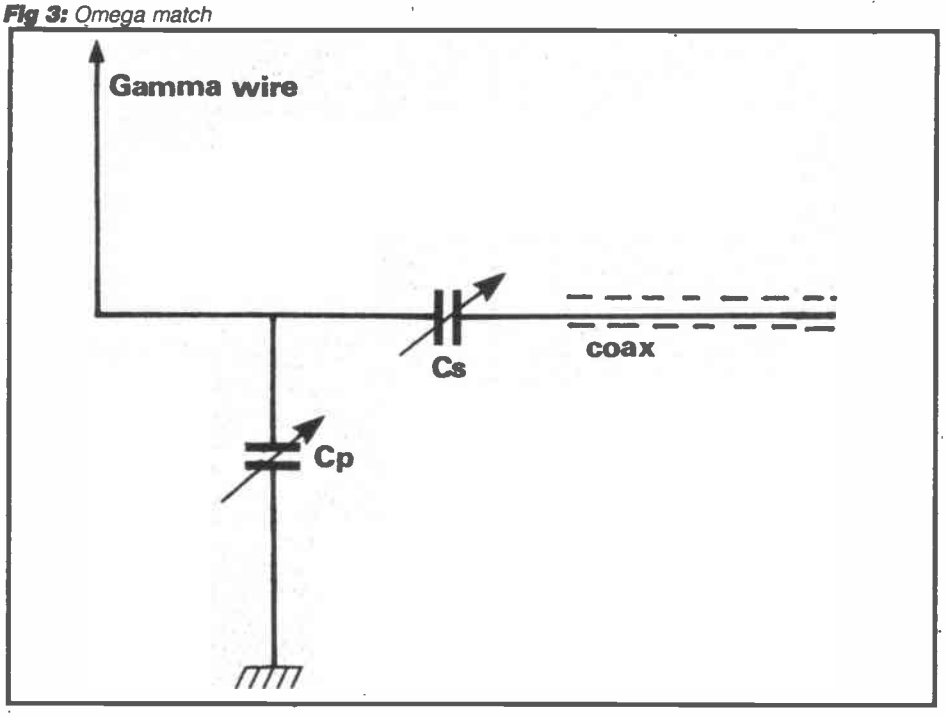
typical tribander adds about 30-50ft over and above the actual physical height of the tower. A quad will be rather less effective as a capacity hat, as will a VHF beam.

Table 1 can only provide a starting point and, in any case, in practice the height of the gamma wire will be determined by sheer practicality. On 160m, with a typical 50-60ft tower plus tribander, you will need to connect the gamma wire as close to the beam as possible. I have even taken a short cut and clamped it to the boom of the beam itself. This prevents you from rotating the beam when the tower is at full height, but can be a useful expedient for, say, a top band contest where the beam is not going to be used.

On 80 and 40m the gamma wire will normally need to be connected lower down the tower for ease of matching. With a wind-up tower this probably restricts you to connecting it at the top of one of the sections. In any case, even with the 160m wire, you will need stand-off insulators at the top of each section to maintain a constant spacing between the gamma wire and tower, otherwise you will find the SWR changing as the gamma wire sways in the breeze! As I said earlier, the gamma wire should be as substantial as possible – some old coax would do nicely, the outer braid acting as a large-diameter conductor – and spaced about 2ft from the tower to achieve a high level of coupling. Of course, if you are fortunate enough to have a fixed (as against wind-up) tower, you can install a rigid gamma wire permanently in place. One US writer recommends surplus cable TV coax which is ideal if you can get your hands on it.

Having installed the gamma wire (or wires, as there is no reason to limit yourself to shunt-feeding on just one band) in place, you will also need to ensure that any existing wires running down the tower (feeder for the beam, rotator cable etc) are lashed close to the tower and brought down to ground level before being led away at right angles to the tower. You may also find you need to earth them at the foot of the tower to prevent RF getting back into the shack.

Fig 3: *Omega match*



Matching

Now we come to the point where we match the whole arrangement to our feedline. The impedance at the bottom of the gamma wire will depend on a number of factors, such as the electrical height of the tower, the diameter of the gamma wire and its distance from the tower, the quality of the earth system, and the height at which you connected the gamma wire to the tower. There will be a resistive component which the matching network needs to transform to 50 ohms, and an inductive component which will be cancelled out with a capacitor. In the case of top band, the resistive element is likely to be very low (assuming that you do not have a 100ft tower plus 40m beam!), and you may well need to go to an Omega match (see **Fig 3**) rather than the more straightforward Gamma match.

Table 2 gives typical values for the components, but some experimentation may be required to get a good match (low SWR). The Gamma capacitor will need to be of the transmitting type, often obtainable at rallies for modest prices. Either or both of the capacitors could be replaced in whole or in part with fixed capacitors, once you know what value of capacitance is needed to achieve a match. Again, though, they must be of a suitable high current, transmitting variety. Adjustment of the Gamma match is relatively straightforward, since you are simply looking for minimum SWR. If this is still too high for your liking, then try adjusting the distance of the gamma wire from the tower, although bear in mind what I said earlier about this. To adjust the Omega match, start with the parallel capacitor (Cp) set to the minimum value and adjust the series capacitor to obtain

Table 2

BAND	C_s	C_p
40	200pF	
80	250pF	1000pF
160	500pF	2000pF

the best match. Increase Cp a little and readjust, and so on until you are happy with the match. At all times while making these adjustments ensure that you keep your output power at a minimum, both to avoid damage to the rig and to minimise QRM to other band users.

Naturally, the whole matching network must be enclosed in a suitable weatherproof enclosure. Bear in mind, though, that the bandwidth of the whole arrangement will be quite low (this is a high Q system, assuming you have managed to keep earth losses to a minimum), so any major changes in frequency (for example, from the CW to the SSB end of 80m) will require some retuning. One way to achieve this is to switch in suitable fixed capacitors using a relay controlled remotely from the shack. Another way is to go out in the rain and retune the capacitor (or is it only me who finds that it is always raining when adjustments to antennas become necessary?).

The above approach to feeding your shunt-fed tower is very much of the 'cut and try' variety but only has to be done once. Although if you are shunt-feeding on more than one band there may well be interactions which make the initial adjustments rather less straightforward than you might hope. Even better, if possible, measure the impedance of the system at the frequency of interest. For this you will need to acquire an impedance bridge and signal generator, but it will certainly make the job easier. If you know the feedpoint impedance of the system, then it is a relatively simple matter to calculate component values for a matching network. I haven't included details here; you will find them in the standard reference books.

Testing

So now you have a working system, and can begin to evaluate it. Like any antenna, don't expect to know instantly how well it is working. You will want to make a number of tests over a period of time, under varying propagation conditions, and over different paths. Some amateurs report excellent results with shunt-fed towers, while others fail to achieve success. The failures may in some cases be due to physical problems, such as the proximity of buildings, other metalwork, and the like. In other cases, they will be due to lack of attention to the various points I have mentioned in this article – good earthing, good electrical continuity throughout the system, good coupling between gamma wire and tower etc. If you pay attention to all of these points, you should end up with a system which works well for you. Of course, like any vertical antenna, it will often appear to be noisy on receive, since verticals tend to be more susceptible than horizontal antennas to electrical noise but, if the worst comes to the worst, you can always build a small loop antenna for receiving.

For my own part, my first attempt at shunt-feeding was for a top band contest when I didn't want to take down the beam. For such events, I had previously removed the beam from the tower, extended the tower by 20ft with thick-walled aluminium tube, and used this to support a quarter-wave inverted-L at 80ft. The shunt-fed 60ft tower, on top of which was an HF tribander and a four-element 6m beam, gave every indication of working at least as well as the inverted-L had previously done, and with a lot less hassle. I leave it to readers to try shunt-feeding for themselves, and would be interested to know how they get on.

Further reading

1 **Shunt-Fed Towers, Some Practical Aspects**: **QST,** October 1982.
2 **Build a High-Performance, Extended Bandwidth, Shunt Fed, 160 Meter Vertical**: **CQ,** December 1986.
3 **Gamma Matching Towers and Masts at Lower Frequencies**: **RadCom,** March 1986.
4 **Shunt-Feeding Towers for Operation on the Lower Amateur Frequencies**: **ARRL Antenna Anthology.**

BITS TO BUILD

THE JANDEK TRANSMITTER PART ONE

In ***Amateur Radio*** for June, July and August 1988, I described the Jandek receiver, which is an easy to build direct conversion receiver available in kit form. Jandek, a relative newcomer to the amateur radio market, offered the receiver kit in modular form with a choice of bands. An interesting concept because the constructor is able to build the receiver a module at a time, test, get each module working, and then combine them to produce a complete receiver for the chosen band. It is also possible to build a receiver using only some of the modules and combining them with the constructor's own favourite circuits, existing modules or boards. The whole kit represents quite a flexible arrangement.

Jandek have now added to this range by producing kits for QRP CW transmitters. These transmitters can be combined with the receiver modules to make a direct conversion transceiver or built alone to use alongside an existing station receiver. In fact, the latter offers a cheap and easy way to attempt two of the most enjoyable aspects of amateur radio: putting a home-made signal on the air and trying QRP on the HF bands.

The transmit package consists of four modules: the VFO (JD004), the QRP CW transmitter (JD009), the half-wave filter (JD005) and the CW T/R switch (JD010). The VFO is the same board as used in the direct conversion receiver; hence, the possibility of a direct conversion transceiver. The modules are available in five bands: 160m, 80m, 40m, 30m and 20m. In kit form, each module is supplied with a PCB and all the electronic components. **Fig 1** shows, in block form, how the modules can be used to make a single band transmitter. The dotted lines suggest how these modules can be used with the Jandek receiver modules to make a single band direct conversion receiver.

The VFO

The VFO is identical to that used in the Jandek receiver (a full description can be found in the July 1988 issue of ***Amateur Radio***). Table 1 shows the VFO parts list. It is based on the popular Colpitts design, which so many radio constructors know and love. The FET oscillator is followed by two stages of buffering: an FET and a bipolar transistor. The output is filtered by the lowpass filter circuit around L2 which has an output of 300mV into a 50 ohm load.

Exact figures for frequency stability are not given but obviously the lower the chosen band, the better the frequency stability. I have built versions of this VFO for 160 and 80m and found them very stable over long term use. The secret of obtaining good stability in a VFO circuit depends almost entirely on the method of construction. In this case, if the kit is used, nothing can be done about the component layout. However the board is widely spaced, which is good for the VFO circuitry, and the components are of high quality. The board and the frequency determining components must be rigidly mounted. And I would suggest that the VFO is mounted in its own screened box. Nothing must move if the case is shaken or knocked. I usually secure the windings on the VFO tuning inductor (L1). Some constructors use modelling cement but I prefer beeswax, melted on

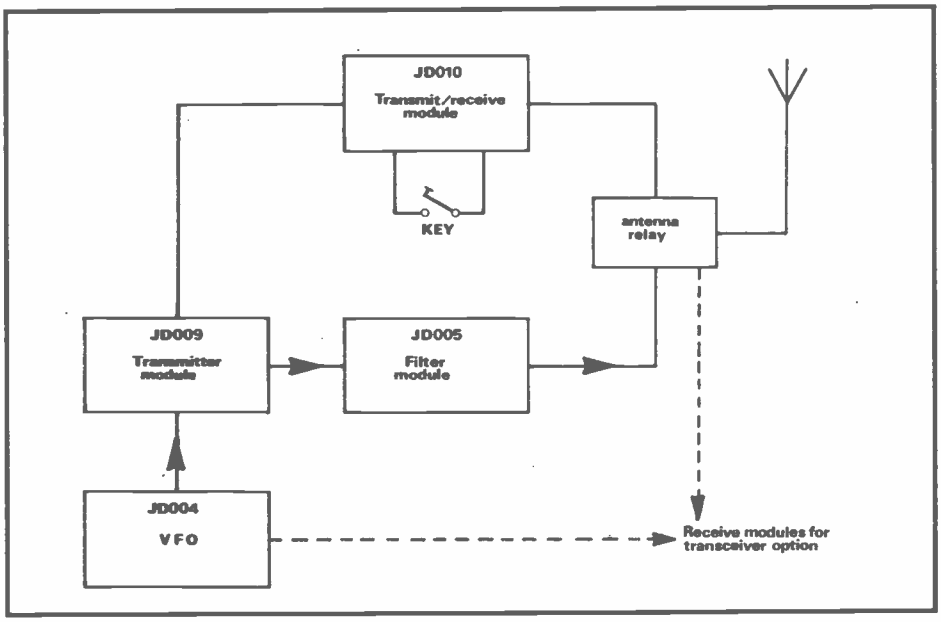


Fig 1: *Block diagram of the Jandek transmitter modules*

Table 1

VFO Parts List

Resistors (all in 0.25W)

R1 22k	R2 100k	R3 link	R4 100R	R5 100k
R6 330R	R7 100R	R8 18k	R9 39k	R10 100R
R11 100R	R12 3k0			

Capacitors

C9 to C16 inclusive: 100nF ceramic
C17: 100µF 25V electrolytic

Semiconductors

D1	1N4148
Q1, Q2	BF256C FET
Q3	2N2222
IC1	78L08 voltage-regulator

Miscellaneous

C1 to C8 inclusive and TC1 (see additional notes)
RFC1 to RFC3 inclusive (see additional notes)
L1 and L2 (see Table 2) (see additional notes)

Ten 1mm terminal pins
PCB

the edge of the soldering iron and dripped along the windings.

The values for the frequency determining components, according to the band used, are shown in Table 2. The PCB allows for variable capacitor or varicap diode tuning. Perhaps the simplest method – though the most expensive – is to use a good-quality airspaced variable capacitor, of appropriate value, between points 1 and 2, as shown in **Fig 2.** The other termination points: 3, X, Y and Z refer to the use of varicap tuning and additional RIT (Receiver Incremental Tuning). Their applications are discussed fully in the July article and in the Jandek literature. Using the varicap tuning method, it is only possible to get adequate coverage of the 40, 30 and 20m bands.

The layout of the VFO module board (see **Fig 3**) shows a top view (component side) of the circuit built on the Jandek kit's PCB. The two inductors (L1 and L2) must be made secure; they can be laid flush with the top of the board and fixed using nylon bolts and washers. In my case, I mounted the inductors vertically and enclosed them in beeswax which held the turns securely and the cores rigidly.

When the board has been assembled and the wiring checked against the layout and circuit diagrams, a low ripple 12V power supply can be connected. Check the output from the VFO by connecting a 56 ohm resistor across the output connections using a 'scope or diode probe and meter. A simple diode probe connected to an appropriate scale on a multimeter is the simplest way to do this test.

The frequency of the VFO can be checked with a frequency counter. The cheaper alternative is to listen for the signal on a receiver tuned to the correct band. At this stage, adjustments to the values of the tuning capacitor or varicap arrangement can be made. It is possible to add or remove turns from L1 to obtain the correct frequency coverage. In my prototype, built for 80m, I used a high-quality trimmer (35pF) across L2, adjusted in conjunction with a 25pF airspaced variable capacitor to give the correct band coverage. Since this is a CW only transmitter, only the bottom 100kHz of the band requires tuning.

When the correct frequency coverage has been obtained, monitor the RF output voltage again via the diode probe. The lowpass filter can now be adjusted using TC1. This trimmer capacitor is then adjusted to provide for maximum output in the centre of the required frequency range. I peaked my output at 3560kHz: the international QRP calling frequency.

The transmitter module

Fig 4 shows the circuit diagram of the JD009 transmitter module. This module is designed to be driven by the JD004

VFO Band Tuning Component Values

Component	Band				
	160m	80m	40m	30m	20m
C1	60-180 (56)	60-120 (56)	47-53 (39)	33-35 (22)	18-23 (10)
C2	1000	560	220	150	120
C3	2200	1000	470	330	270
C4	2200	1000	470	330	270
C5	82	39	22	15	10
C6	22	22	22	47	68
C7	150	82	56	39	33
C8	2200	1800	1200	820	680
TC1	5-65	5-65	6-25	6-25	6-25
RFC1	1mH	470uH	220uH	100uH	100uH
RFC2	1mH	470uH	220uH	100uH	100uH
RFC3	100uH	47uH	27uH	27uH	27uH
L1	fifty-two turns 30swg T50-6	thirty-seven turns 26swg T50-6	twenty-seven turns 24swg T50-6	twenty-two turns 22swg T50-6	eighteen turns 20swg T50-6
L2	ninety turns 36swg T50-2	fifty-nine turns 30swg T50-2	thirty-six turns 26swg T50-2	thirty turns 26swg T50-2	twenty-six turns 24swg T50-6

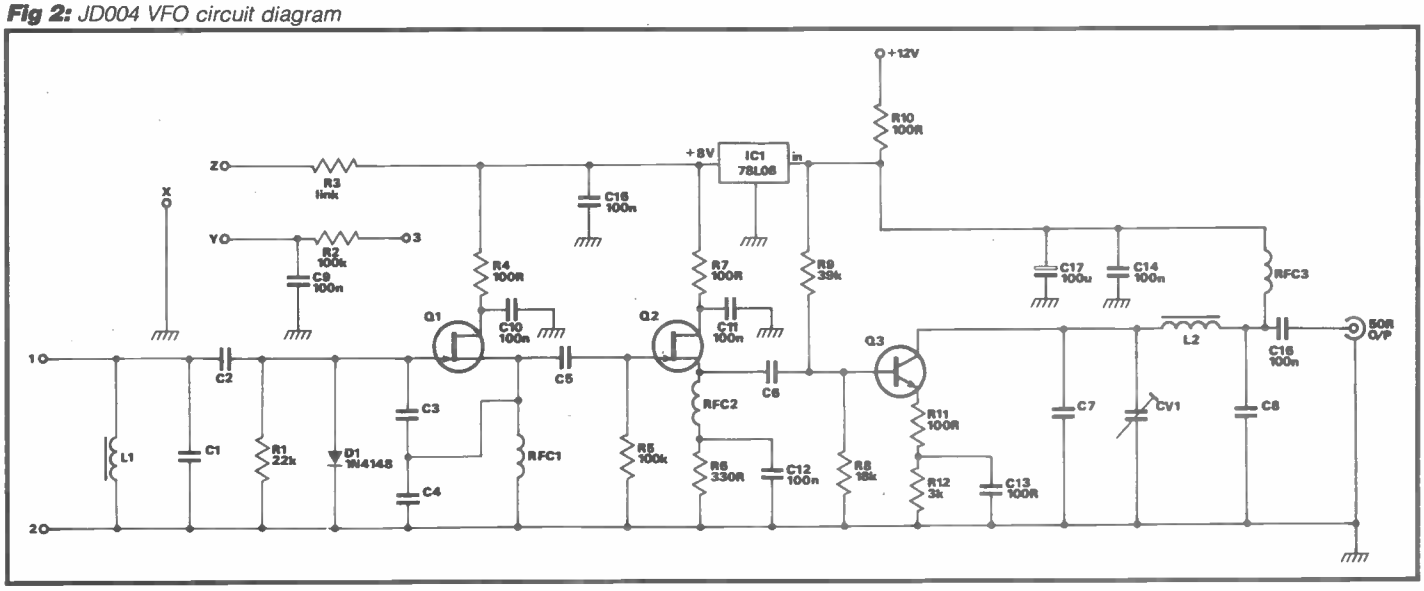
Note: T50-2 is red, T50-6 is yellow

Frequency coverage

Table 2 gives the values of the components required for various amateur bands. The values given for C1 are approximate only and depend upon the exact coverage required (a nominal value is included in each kit, shown in brackets).

Table 2

Fig 2: *JD004 VFO circuit diagram*



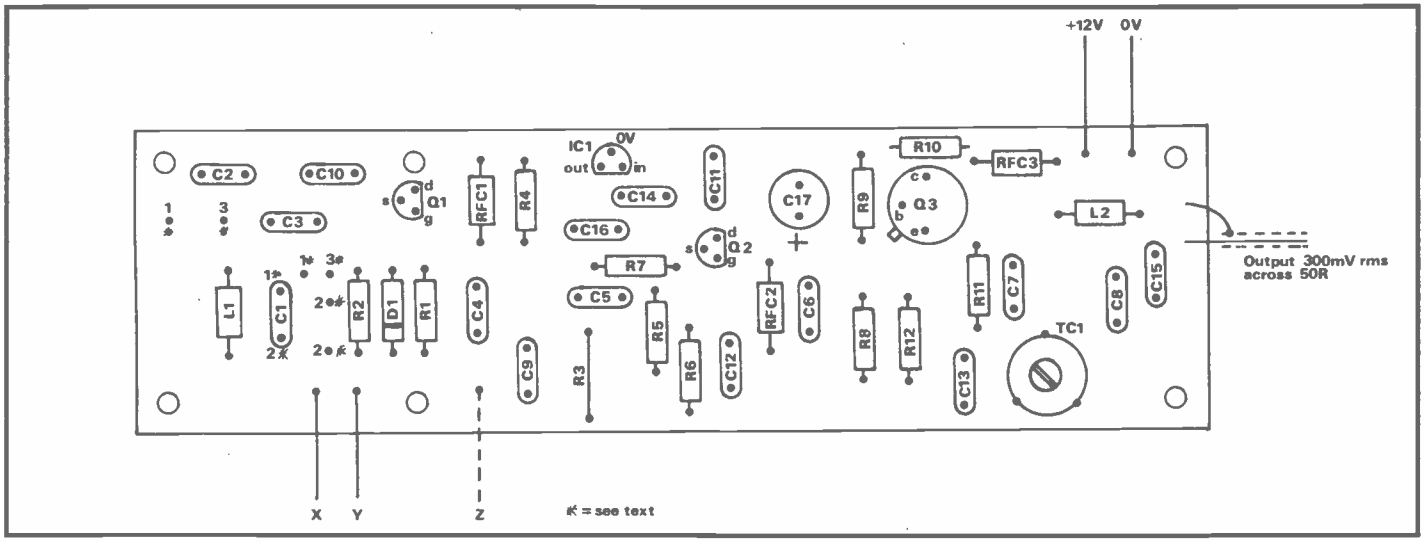


Fig 3: *JD004 VFO layout diagram*

VFO module. Since it is a broadband circuit, it can be used on any band from 160 to 20m with a suitable harmonic filter on the output. It is also a QRP transmitter and will give between 1.5 and 0.5W of RF output, depending upon the band in use. This may seem only a small signal to disturb the ether! But QRP operators will tell you how much can be worked with such power levels. I have a miniature 0.5W transmitter for 20m, and have worked most of Europe using a simple dipole antenna. Later, I will describe how the power output may be increased for those wanting a little more 'smoke up the stack'.

The first stage operates in Class A, and provides an input impedance suitable for the JD004 VFO and clean signal handling. A different VFO or even a crystal oscillator could be used to feed this board, but it should be capable of delivering 300mV across a 50 ohm load. The driver stage (Q1) feeds a Class C output stage (Q2). As this stage operates in Class C, it will produce harmonics of the required output signal frequency. It is therefore essential that filtering is included between the output and the antenna. The non-linear operation of the output stage also makes the transmitter module unsuitable for working AM, DSB or SSB.

The keying arrangement is a matter of choice. The board can be keyed in the 12V line to the driver, the power amplifier, or both. Keying the driver stage only is the most problematic alternative, as RF bleedthrough may cause a low RF output in the key-up position. Ideally, both the driver and power amplifier ought to be keyed. However the board is keyed, some form of key shaping ought to be used. The obvious method is keying through a series transistor dc switch; this is the method adopted in the Jandek T/R switch module. If so, the keying transistor must be able to handle the total current required by the keyed circuit.

The layout for the JD009 transmitter module is shown in **Fig 5.** Again, this follows the layout of the Jandek kit's

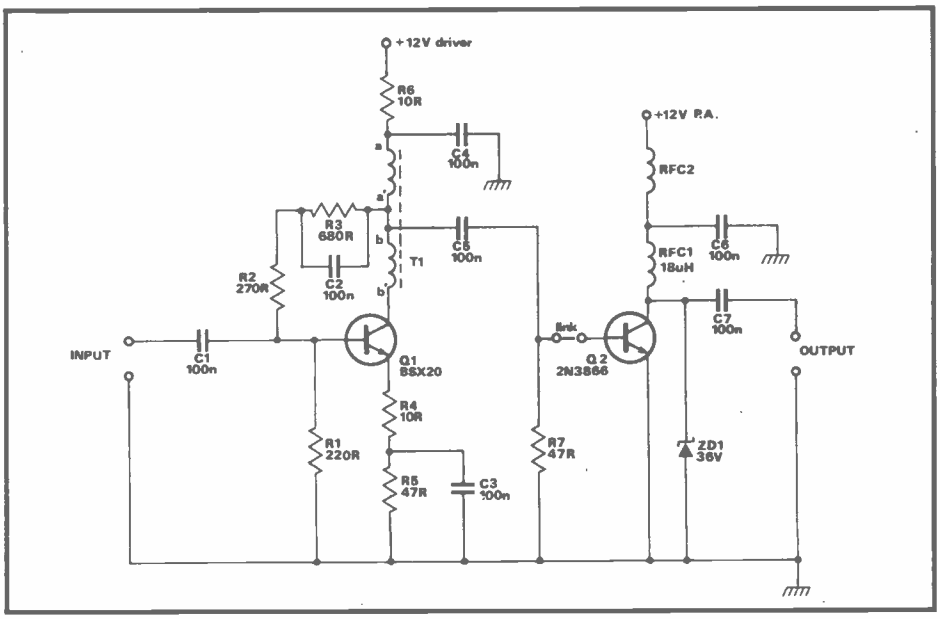


Fig 4: *QRP CW transmitter module circuit diagram*

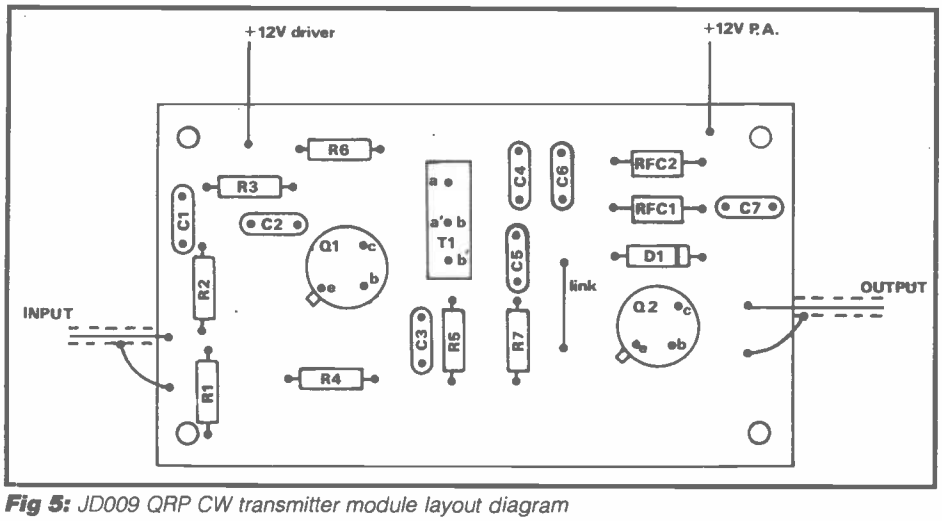


Fig 5: *JD009 QRP CW transmitter module layout diagram*

PCB. The board is simple to build, although less experienced constructors may need help with the inductor windings for RFC2 and T1. The exact way to wind these inductors is shown in **Fig 6.**

RFC (Radio Frequency Choke) 2 is a simple inductor made by winding ten turns of 32swg enamelled wire on to a ferrite bead. Each time the wire passes through the bead counts as one turn. The main problem with such a winding, apart from requiring nimble fingers, is scratch-

Transmitter Board Parts List

Resistors (all 0.25W):

R1 220R	R2 270R	R3 680R	R4 10R
R5 47R	R6 10R	R6 47R	

Capacitors

C1 to C7 inclusive: 100n ceramic

Semiconductors

Q1 BSX20 (replacement types)
Q2 2N3866 (may be supplied)
ZD1 36V zener diode

Inductors

T1 ten turns bifilar wound on ferrite toroid
RFC1 18uH
RFC2 ten turns on ferrite bead

Miscellaneous

TO18 push-on heatsink
TO5 push-on heatsink
Six 1mm terminal pins
PCB

Table 3

Filter Parts List

Capacitors and inductors

Component	Band				
	160m	80m	40m	30m	20m
C1a	1500	1500	820	560	390
C1b	n/a	1500	820	560	390
C2a	1500	1500	820	560	390
C2b	1500	n/a	n/a	n/a	n/a
C3a	1500	1500	820	560	390
C3b	n/a	1500	820	560	390
L1 & L2	twenty-seven turns 26swg T50-2	nineteen turns 24swg T50-2	fourteen turns 22swg T50-2	twelve turns 22swg T50-2	eleven turns 22swg T50-6

Note: T50-2 is red, T50-6 is yellow. Capacitor values are in pF. Polystyrene or ceramic types may be used.

Table 4

ing the enamel coating off the wire on the sharp edges of the ferrite bead hole. Carry out the winding slowly with plenty of spare wire, taking large 'sweeps' between each turn and laying the turns gently and neatly side by side.

T1 is a bifilar winding, ie, a split winding which lies side by side on the core. It is wound using two lengths of wire lightly twisted together; about five to eight twists per inch is ideal. Take two lengths of wire and secure one end of the pair. The twists can be added from the free ends by attaching them to a pencil or rod and slowly twisting, or by the very careful use of a small hand-operated drill. It is essential to connect the ends of the coil to the correct places in the circuit. The two wires are shown as a and b in **Fig 6**: the beginning of the windings being a and b, the end being a' and b'. The ends of the two wires, a and b can be identified using the ohms range on a multimeter. When these have been determined, connect a' to b; this gives the correct phase of winding to connect the wires, as shown in **Fig 6.**

When the board is completed and the wiring checked over, the transmitter can be tested. Begin testing with the link wire on the board removed and apply 12V to the Class A driver stage. The supply current should be in the order of 35 to 45mA. Connect the VFO to the input using a short length of 50 ohm miniature coaxial cable. Using a diode probe and meter, monitor the RF voltage across R7; this should be in the order of 1.2V RMS. Remember that some simple diode probes read peak-to-peak voltage. Connecting the 12V supply to the PA stage should show that this stage draws no current before the link is added.

Remove the power to both stages and add the link on to the board. For the remaining tests, a 50 ohm dummy load capable of handling around 2W should be added across the output of the transmitter board. Connect the 12V supply to both stages and monitor the current drawn by the PA stage; this should be in the order of 160mA. The output of the board can be measured using an RF output meter. The parts for the transmitter board are shown in Table 3.

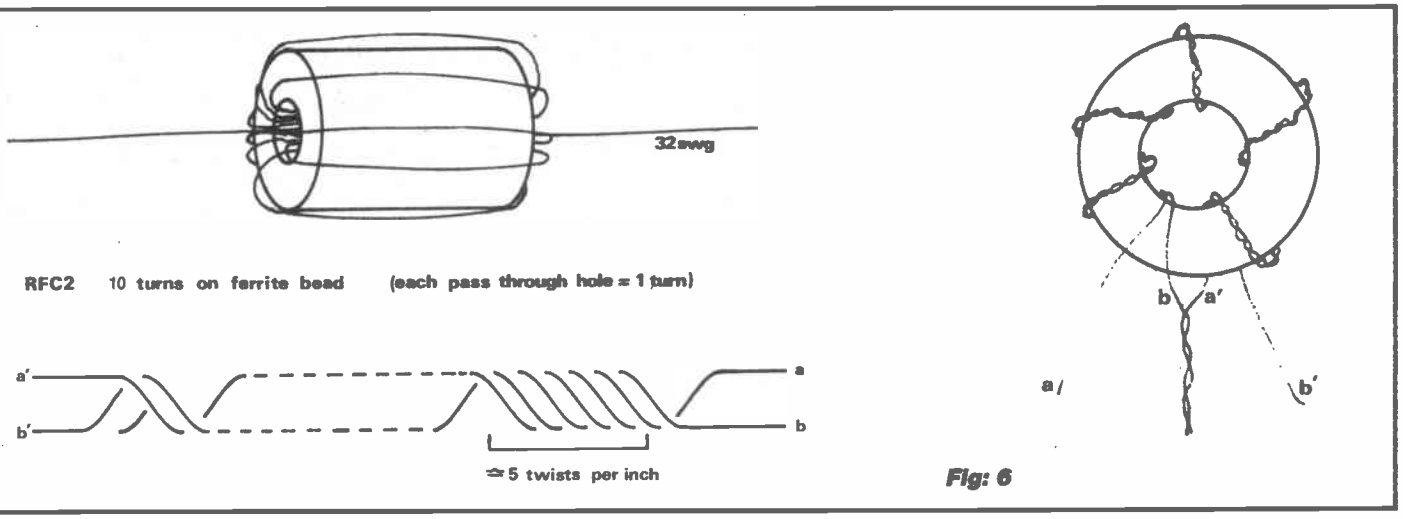


Fig: 6

The half-wave filter module

The half-wave filter supplied by Jandek in kit form is a five-element lowpass filter, as shown in **Fig 7a.** The filter provides harmonic suppression between the output of the transmitter and a 50 ohm antenna.

The layout for the filter is shown in **Fig 7b.** There are two versions of this diagram which depend upon the arrangement of capacitors to obtain the correct values for C1, C2 and C3. The parts list for the filter (Table 4) shows how, according to band, these capacitance values consist of one capacitor or two. Table 4 also shows that C2 can be one capacitor or two connected in parallel. Where only C2a is specified, connect as in **Fig 7b**(ii), and where C2a and C2b are specified, connect as in **Fig 7b**(i).

The circuit and layout are very simple to follow, and using the correct values for the chosen band produces a filter which is suitable for the JD009 transmitter module, or any other transmitter with a 50 ohm termination.

This completes the main PCBs of the Jandek transmitter. Part 2 of this article describes the automatic changeover transmit/receive module (JD010) and shows practical ways of using the modules, including the option of increasing the transmitter RF output.

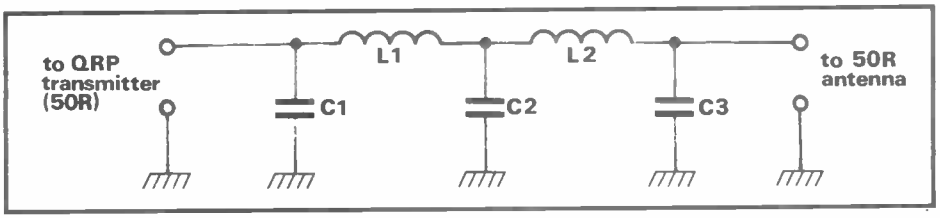


Fig 7a: *Circuit diagram*

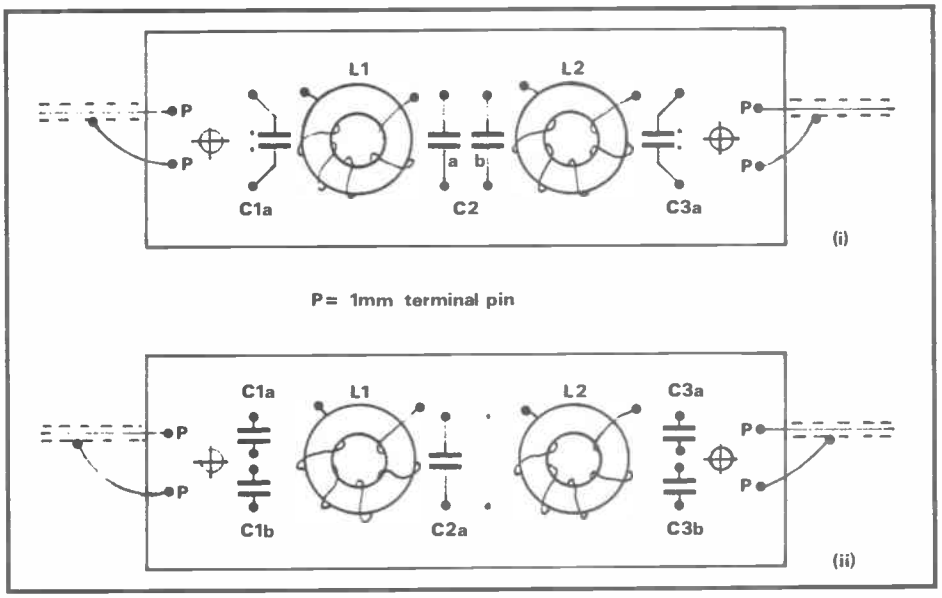


Fig 7b: *Layout diagram*

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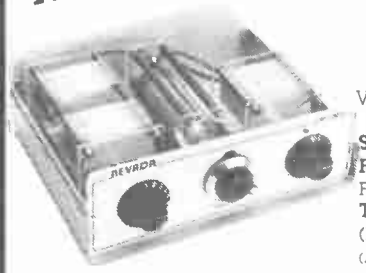

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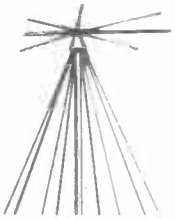

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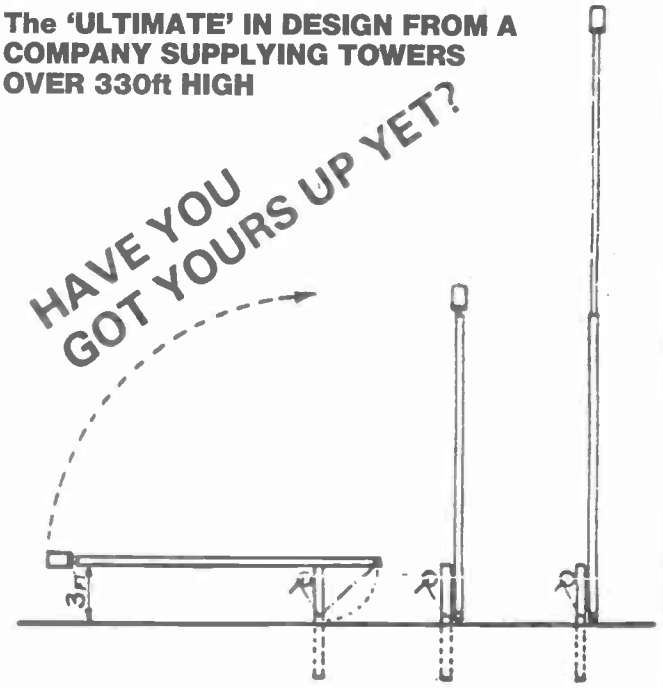

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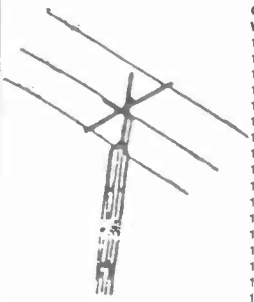

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The World of D | A | T | A

BY DON FIELD G3XTT

This month I want to return to packet radio and look beyond the basics. In particular, it is worth taking a look at networking because this is of great interest to many packet operators, and essential to those who live away from the main centres of population.

Networking

Most readers will be familiar with the idea of voice repeaters, which allow two stations who are out of range of each other to communicate via an intermediate, well-sited repeater station. This is the basic idea behind packet networking, but with packet you can do much more. Firstly, only one person can use a voice repeater at any one time, whereas the nature of packet transmissions means that a number of people can use a repeater, and each has the impression that he is an exclusive user (except that, as the level of use increases, congestion will start to occur, and the overall rate of transmission will fall).

The other interesting feature of packet repeaters is that, in theory at least, you can send a message via several repeaters so that, even on VHF, you can have a realtime QSO with someone hundreds of miles away. Because your data is reconstituted by each repeater it goes through, there is no deterioration of the signal en route. Even better, packet repeaters normally receive and transmit on the same frequency, rather than using a pair of valuable channels, as is the case with voice repeaters. I say normally because, in future, we may see the packet network evolving in a very similar way to the telephone network, with local access to your nearest network node on, say, 2m, and a 'trunk network' between nodes running on, say, 23cm. International connections might take place via satellite links or, perhaps, a microwave link across the Channel.

At its simplest level, packet networking can use an intermediate digipeater and, as I have said previously, every TNC has the capability of acting as a digipeater, so your own station can become part of the network. There are two disadvantages to this ad hoc approach.

Firstly, how do you keep track of whose digipeaters are active at any one time? Without knowing this, how can you route a signal effectively to where you want it to go? Of course, some kind souls could guarantee to keep their digipeaters on the air around the clock and, hey presto, you have the makings of a network. However, and this is the second disadvantage, the basic AX25 protocols do not lend themselves well to networking.

Suppose, for example, that G9AAA wants to communicate with G9ZZZ via digipeater GB9XX. The AX25 protocol demands that every packet sent by G9AAA gets safely to G9ZZZ, and that the acknowledgement from G9ZZZ gets safely back to G9AAA. This involves the sending of four packets in all: G9AAA to GB9XX, GB9XX to G9ZZZ, G9ZZZ to GB9XX, and GB9XX to G9AAA. If any one of these packets is corrupted, for example by 'colliding' with a packet sent by another station on the same frequency, then the whole process must be repeated.

In a busy part of the world such as the London area, getting even one packet through without the need for a retry can be quite an achievement. To expect four packets to go through without problems is asking too much. Of course, if you are trying to go through two or more intermediate digipeaters, the problems get rapidly worse!

The reason for these difficulties is that the AX25 is an end-to-end protocol, and the intermediate digipeaters do not get involved in the process other than in a 'dumb' way of retransmitting everything they receive.

The packet boffins realised these limitations early on, and have devised several new protocols to overcome the difficulties and make networking more efficient. The most common, at least at the moment, is NET/ROM. NET/ROM allows those network nodes, hopefully on the air around the clock, to behave more intelligently than they would purely as a digipeater. Let's go back to the example I gave earlier. If GB9XX were a digipeater, the connection would have been made to G9ZZZ by sending the command C G9ZZZ VIA GB9XX. The procedure with NET/ROM is rather different. If GB9XX were equipped with NET/ROM software, you would first connect to GB9XX, using either its full callsign or its networking 'alias', which would probably be XX2 (the '2' indicating that this is the 2m port on that particular network node). The command would be C XX2 or C GB9XX-2. You would get an acknowledgement:

***connected to XX2.**

You can then proceed by typing **C G9ZZZ**, when you should get the acknowledgement:

***connected to G9ZZZ.**

So far so good, but what's so clever about that? With NET/ROM, once you have made the connection, the NET/ROM node starts to play an intelligent role in the sending and receiving of data. If a packet you send to the NET/ROM is corrupted, it will ask your station to resend rather than passing the corrupted packet further down the line. This happens over each link. The result is a much higher throughput of packets from end to end.

One of the other clever features of a NET/ROM node is that it 'learns' over a period of time about those other NET/ROM nodes to which it can connect. So even without any formal organisation behind it, a long-distance network is falling into place gradually as new NET/ROM nodes open up around the country.

Impressed? Good. NET/ROM may seem a little off-putting at first because, unlike a mailbox, it doesn't present you with a menu of commands when you log on. As it happens, though, there are only five you need to know. I have already mentioned the CONNECT command, invoked by typing the letter **C** and the callsign of the station to which you want to connect. Then there is the CQ command. Type **CQ**, followed by a message of up to seventy-seven characters followed, as always, by a carriage return. The CQ command remains active for fifteen minutes and can be invoked on your own NET/ROM or a distant one to which you are networked. While it is active, stations who see your CQ are able to respond.

The USERS command is useful to see if anyone is calling CQ, and also lets you know who else is using the node and to whom they are connected. When you type **USERS** it will come up with a list. If you want to answer a CQ, then simply use the CONNECT command, followed by the callsign of the station concerned.

To find out which other nodes are accessible, use the Command NODES. Unfortunately, it will only list callsigns rather than locations, though the call-

sign or alias often gives a clue as to location. Otherwise you will need an up to date list of NET/ROM nodes. Such a list is often available as a file which you can download from your local mailbox.

Finally, the IDENT Command will return the sysop's call and SSID, and the alias of the node to which you are connected.

Many of the NET/ROM nodes on 2m have now moved from 144.650MHz (which is always busy with mailbox traffic) to 144.675MHz. On this frequency you may also run across people using another networking system known as TCP/IP, or Internet. The Internet protocols were developed by the University of Berkeley in California for ARPANET (the US Advanced Research Projects Agency) to enable files to be shipped around terrestrial data networks and, like X25, have been modified by amateurs to work in a packet radio environment.

TCP/IP is a much more sophisticated networking protocol than NET/ROM and is geared up for machine-to-machine communication, so that your PC actually becomes part of the network. (With NET/ROM you manually start the connection to your nearest NET/ROM node, and your PC is just acting as a dumb terminal.) For TCP/IP to work, therefore, your TNC has to be more or less invisible to the system, with the PC doing the work, which means you require a TNC with KISS (Keep It Simple Stupid) mode. TCP/IP is also a product of computer boffins and its instruction set is not very user friendly, so I wouldn't recommend it until you become a competent packet radio user and get to know how to drive your computer. TCP/IP software, to run on an IBM PC, is readily available in the UK.

Just to confuse matters, other networking software is also in use. The ROSE software is based on the international OSI (Open Systems Interconnect) standards, and amateurs are becoming involved in the same sort of debate which goes on in the professional data networking world as to whether so-called open standards will eventually win the day, or whether full international agreement will take so long that other standards will become establised in the meantime. And to add further fuel to the fire, users of KAM TNCs can use KAM/NODE networking, while you may also come across THENET. THENET is compatible with NET/ROM, but was written independently. You will come across other networking systems I have no doubt, but that is quite enough confusion for the time being!

Incidentally, when you have started to explore the wonders of networking there is often a tendency to feel 'I could help my fellow amateurs by putting a NET/ROM on the air from my QTH'. Beware! In some parts of the country, where NET/ROM coverage is thin on the ground, you may well be able to make a valuable contribution. Elsewhere, you will end up adding to the congestion and not helping anybody.

What is an SSID?

Earlier, I used the terminology SSID (Secondary Station Identifier) which is a phrase you may not be familiar with. SSIDs are used to avoid confusion with callsigns, especially those stations with several ports (such as mailboxes). The RSGB Packet Working Group recommends the use of SSIDs as follows.

For GB callsign stations:
GB . . . -0 (ie no SSID), not allocated;
GB . . . -1, microwave band port;
GB . . . -2, 144MHz band;
GB . . . -3, 3.5 or 7MHz;
GB . . . -4, 70MHz;
GB . . . -5, 14MHz;
GB . . . -6, 50MHz;
GB . . . -7, 430MHz.

For ordinary stations:
G . . . -0 (ie no SSID), a real, human operator at home;
G . . . -1, portable;
G . . . -3, mobile.

There are no recommendations about other SSIDs, but you will see a variety of SSIDs appearing when using NET/ROM (see above), because NET/ROM changes the SSID at each node in order to ensure that it doesn't confuse incoming with outgoing traffic (to avoid 'feedback' if you like, just like a conventional voice repeater changes the frequency).

Packet in the USSR

The January issue of **Radio**, a monthly magazine published by the Ministry of Communications of the USSR and the military training organisation DOSAAF, featured an article about last year's SKITREK expedition, written by Leonid Labutin UA3CR. The following excerpts describe packet radio's role in the expedition.

'It was with great difficulty that we received permission for packet radio communication from our official organisations. Foreseeing bureaucratic obstacles, we began to prepare the necessary equipment and got acquainted with the equipment in advance. We received assistance from colleagues in Hungary, US and Canada. As a result, we were successful in providing the following six stations with packet radio equipment: EX0KP, Sredniy Island, operators UA3CR, RA3AU and VO1SA/UAQ; 4K0DC, SP-28, operators UA2AOC and VE3CDX; EX0PM, Dikson Island, operators RW3DR and UA3-170-569; EX3HR, Moscow, expedition staff station, operator UA3HR; RA3APR, Moscow, reserve station; and UA9NS, Omsk, repeater station.

'Commercially made MFJ-1274 and PK-232 units were used as packet radio controllers. Radio-96PK and Robotron (on Sredniy) computers were used. Packet radio communications was used to the very end of the expedition and revealed all of its marvellous characteristics: 100% documentation, ability to prepare information in advance, high-speed exchange, and so on. Any packet radio station can serve as a repeater, which is extremely convenient. And no distortions. The central-newspaper correspondents, who came to our snowed-in station, were amazed by our electronic mailboxes.

'I would like to mention here an initiative of the University of Surrey. Michael Meerman G0/PA3BHF – with the approval of his "boss", Dr Martin Sweeting G3YJO – organised a special mailbox for the expedition. Only network stations could "deposit" letters. All interaction with the electronic mailboxes took place practically without operator intervention.

'We calculated that during the expedition, the base stations transmitted over 500kbytes of information.'

That's it for this month. Next month, a look at how to get started on AMTOR and, as promised, a further look at the papers presented to last year's ARRL Computer Networking Conference.

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PROJECT BOOK

by Martin Williams

There are few amateurs who have not considered the possibility of some of their gear being destroyed by a lightning strike. The big problem is to actually evaluate the risk of it ever happening to you. Many feel that it is so small that no precautions need to be taken. There is a lot of information available to help you decide but, unfortunately, the whole subject is usually shrouded in old wives' tales. You know the sort of thing: lightning can't go round corners; it always follows the shortest path; it will never strike twice in the same place. The weirdest advice I ever saw was not to play the piano in a storm because lightning is attracted to sound. If it is then it is the only thing that likes my piano playing!

Lightning is simply a gigantic spark between an electrically charged cloud and, usually, the earth, although it can be between clouds. The storms are of two types. In the convectional type, heated air rises into the cold air above it. The second type, known as frontal, is caused when a mass of cold air coming in on a weather front rides over the warmer air beneath it. Both these cases cause a very unstable condition to arise in which a large amount of condensation forms and finally a thunder cloud appears. This cloud usually has a large negative charge on the underside while the upper surface goes positive with respect to earth.

The flash

What you see as a single stroke is, in fact, a very complicated event. When the charge on the cloud has built up to a suitable level a pilot, or leader, stroke travels towards the ground at a speed of about 160km per second. The pilot stroke, which carries a current of only a few amps, is rapidly followed by more strokes of increasing current density. Once the pilot strokes reach the ground, the current increases enormously and the main stroke then flows from the ground *up* to the cloud. This upward stroke typically has a current of around 250,000 amps and is the one that does all the damage. After the main stroke comes what is known as the dart which finally drains all the available energy.

The risk factor

The chance of your mast getting struck obviously depends on the frequency of storms in your area and such figures are not readily available. Just to frighten you to death it is estimated that lightning strikes the earth nine million times a day! The statistics that are available suggest that in the United Kingdom there is an average of fifteen storms a year in any given locality. You can expect two strikes per thunderstorm in every 2.5 square kilometres of ground area although up to forty-five strikes have been recorded. The figures also show that a 15m tall tower in an area getting fifteen storms a year is likely to get hit once every eight years. A similar tower 30m high increases the risk to once every five years. In practice the times are probably longer than is suggested above because, if properly installed, the tower can offer itself a certain amount of protection. If you tell me that your tower has not been hit in twenty years my answer, based on the statistics, is simply 'aren't you lucky?'

Induced voltage

Not only is there the problem of a direct strike, there are also the effects of nearby storms to be considered. HF operators will know that a storm a couple of hundred miles away can cause severe noise problems. The electrical field surrounding a storm can produce some enormous voltages. A plastic-coated metal clothes line supported two metres above ground carried an induced charge of 15kV per metre from a lightning strike five miles away. If you do not have suitable protection installed this could easily blow the front end of your rig.

Protection

From here on we will assume that a metal pole and a tower are the same thing. The first thing in our favour is that a well-grounded mast will give a zone of protection and tests have shown that this zone extends to about three times the height of the structure. Assuming that it is the highest structure in the zone, a mast thirty feet high will give a protection zone extending for about a hundred feet around it. A tower that has been set in a concrete block is not effectively grounded and suitable earthing arrangements must be made.

Earthing

Ideally the earthing arrangements should have been installed before you had the concrete poured, but if your installation is already completed then they should be installed in a pit dug adjacent to the tower. You should dig down to below the permanent moisture level and then install a metal plate which should be at least three feet square, or an equivalent area.

Alternatives could include at least six metal rods of 12mm diameter and five feet long or, probably cheapest of all, a few scrap car wheels. The individual earthing units should be well-bonded together with heavy cable (perhaps all three cores of domestic 13A cable) and all joints should be protected with a water sealant of some type. At least two heavy cables, to ensure against one rotting through, should then connect the earth system to the tower. These joints should be well-made and sealed to stop moisture getting in.

Finishing off

All feeder and other cables should be run inside the mast as far as possible and should be fitted with a spark gap of some type. Before you spend money on these, just have a good look at an old car spark plug and use some imagination.

SECOND-HAND

by HUGH ALLISON G3XSE

Rotting transistor leads

I must admit the first time I came across this fault it really threw me – half an hour wasted before I sussed it. In comes an old Sony portable 405/625 telly with an excellent picture but no sound. Audio stage is go, so we have only the sound IF left. The whole IF board is encased in metal screens, so off comes the bottom one. Incidentally, the set is in pristine condition.

Now there are two transistors in the IF: on the base of No1 is a little bit of signal, collector lots; base of No2, lots of signal, collector nothing. Leaving him running, in with the AVO. In the case of dc, all the volts you would have expected in all the appropriate places. 'Transistor open circuit', thinks your hero. Up-end him, top cover off, unsolder base, then emitter. Clunk. Transistor falls out. Now here *is* a clue! It's fallen out and I've only unsoldered two out of three leads. The collector wire on the transistor is half as long as his friends on the other two pins and, still jutting out in the set, is the missing bit of the collector wire.

This particular style of transistor is very distinctive. They are a sort of brownish orange in colour (plastic cased), the lead-out wires are more of a tape than a wire, very thin but wide, and are gold-plated. Since Christmas I've had four more rot through, two in receivers and two in transceivers; always the collector (in the middle) so maybe there is an epidemic on the way. The sets have all been in reasonable condition with no other visible corrosion.

Rigs in the bath

This is not to be recommended; dropping hand-helds in the warm and wet. Amazingly, nearly all rigs seem to come out relatively unscathed; 90% of all rigs I've repaired where this has happened have had only duff mike inserts. They are nearly all electrofet nowadays, are shirt button size, and are expensive. Five to twelve quid seems the going rate, depending on supplier/manufacturer/importer. They are not too difficult to change; you will only require a small soldering iron. So, if your hand-held has inadvertently received a ducking and, after a dry out works but with no mod, you know what to do.

Salt (sea) water is much more serious, that stuff can ruin a set in minutes. I've heard that an immediate good wash in hot fresh water is the thing to do, but every set I've seen that has copped a dose of the brine has had useless green growths where the copper tracks should have been, and are write-offs.

From the post – GEC Worcesters

A few months ago I wrote a bit about a dirt cheap 2m FM box, the GEC Worcester, also known under many other names. Several letters have followed this piece along the lines of the receiver giving excellent quieting but poor recovered audio. The noise is really loud when no signal is present but there is not much sound when it gets a carrier and someone speaks. The problem here invariably lies with the discriminator coil. It is the biggest can on the top board, thus easy to find. It's in a roughly 1in cube. I think all the problems here arise from the fact that it is the only coil on the unit with two cores in it. Hence, it is the only coil that requires adjustment from top *and* bottom.

Our demon tweaker winds down the top core until it locks on the top of the bottom core. The whole former then turns and the lead-outs snap. The result? Recovered audio 20dB down. To prevent this happening to you, turn the cores here very gently. I prefer to tweak the bottom core first. To get to it you only have to hinge the bottom board out of the way – the hinge isn't too obvious if it's your first time inside one of these.

OK, so you've bust the coil. All is not lost. Unsolder him (if you are impatient, just unsolder the can and work on it in the set). It is normally possible to remove the coils from the former (I'm asuming the wires have snapped at the coil end, not the tag end). Use an eyeglass to locate the ends, then a pin to tease a turn off both inner and outer. Resolder the ends and secure the whole lot with candle wax or some such. Be more careful next time!

From the post – Diawa Search 9s

There seems to be a big crowd of people hell-bent on converting these fine 2m receivers to airband. Don't, for four good reasons.

– Airband communications is AM; it's going to sound awful through the FM system.

– Diawas tune a 2MHz span. Wind the oscillator down and it's probably not going to tune that far. Airband covers 118-135MHz. You're not going to cover it all by a long way.

– I wound one down and tweaked it carefully at 120MHz. The things I do for you lucky readers. Result; sensitivity 10μV for 15dB quieting. The set was previously giving a perfectly reasonable 1μV at 144. In other words it just doesn't want to do it. The cheapest airband sets are better than this.

– Diawas are lovely little sets and I hate to see them buggered up. Especially when, as in this case, it's pointless.

Realistic 'Patrolman'

This is a 'scanner' of the old school – ie, it isn't synthesised, it just clunks through the crystals that you have fitted. The amazing thing here is that the receiver is happy to work very well way beyond its stated frequency range at quite reasonable levels of sensitivity. I base this claim only on the few (five) that I've ever played with – if working outside supposed frequency limitations is important to you, obviously check it out before you buy. The receiver is supposed to cover 30 to 50, 144 to 174 and 450 to 512, but it will happily tune 26 to 55, 140 to 180 and 420 to 530MHz.

Mains power units are built in, and though the handbooks state 110V, all variants I've played with have obviously been supplied new for 240V. Best be careful here though – especially if the seller has an American accent! Talking of built in, there is a built in telescopic aerial that is usable for strong signal stuff.

On the subject of selling, they seem to sell in the £25.00 to £35.00 range with some crystals in, £20.00 if 'bare' and no handbook. Worth considering if you just want to cheaply monitor one or two channels in the shack, be they amateur or commercial frequencies.

KF430

This is an old (ten-years?) 70cm FM rig, crystal controlled with two crystals per channel. Very small; you could fit two, side by side, in the space of one 'normal' sized rig. Use the mike as a guide to size in the photo.

If memory serves me correctly, these are supposed to be 10W out – I normally see 7 or 8 out on 13.8V. Quite reliable. The PA transistor is a bit fragile, but replacement types (not the exact replacement) are available.

Faults? Well, sort of. There is an external speaker socket. Fine if you use the correct impedance speaker. Use a 16 or higher ohm speaker and it hoots or motorboats like a good 'un. No amount of decoupling will stop it. So, make sure you get the right speaker.

Prices? £55.00 to £65.00 if clean, with mike, mobile carrier and a moderate selection of usable channels. Remember, we are talking 70cm here, so the more expensive crystal cuts are required; they drift a bit if you use dodgy rocks. I've seen rough and rockless examples change hands at £35.00.

High band AM

There are an awful lot of high band AM rigs about at the moment at ludicrously low prices. As an example, I bought a bin liner full of various makes, GEC, Storno, Cossor, Pye etc, for a fiver the lot at Drayton. Of the ten, nine worked straight off, the other had a duff regulator.

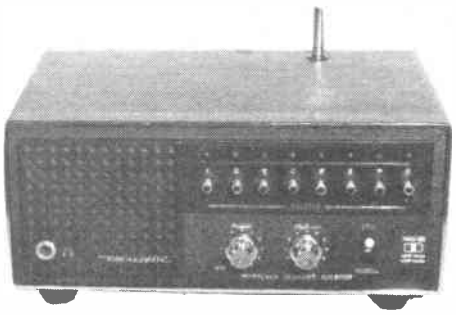
I've preached enough about cannibalising them for spares, but another use is a PA (linear) for your hand-portable. It doesn't matter that your 2m

rig is FM and the donor rig is AM. A moment's thought will show you that, say, for a 7W output, the AM rig PA will have been driven at a level of a watt or two, depending on the gain of the device. Isn't that just what your hand-portable wonderbox shoves out? Half the Tx/Rx switching is done for you (the donor had to have some sort of changeover relay), the other half may as well come from another commercial rig. Personally, I prefer to remove the PA stage from the old PMR rig and cobble it up neatly in a diecast box or something similar. It's amazing what some of these solid-state rigs used to chuck out; I've bought several fairly recent transceivers that have been about the 30W mark. A linear of this sort of power level for a couple of quid? Can't be bad.

I've seen a few enthusiastic amateurs try and make a mobile PA out of the old valve and inverter commercial stuff – high power, boot mount Westminsters and the like. I think this is a bit messy and unnecessary these days. One other thing against this approach is the 'quick-heat' valve. They are up and running in half a second or so, by which time your hand-portable toneburst has stopped, thus they are no good for repeater work. Not recommended.

Exploding counters

In the car boot sale area of a rally I espied a 500MHz mains powered counter. The seller says it's 50p but, and



Top: *the Realistic 'Patrolman'.* ***Bottom:*** *the KF430 70cm FM rig*

you've got to admire the man's honesty, he says it has scared the life out of him by exploding with a brilliant flash. Well, 50p seemed reasonable, and I didn't even haggle.

Next day, on the way to the bench with it, I give it a shake (there's high technology testing techniques for you)! The thing rattles. Covers off, there is a blackened, battle scarred 4BA nut rolling about in the innards. Further investigation reveals a similar blackened area around the mains voltage selector. Obviously the nut has come undone, and, as is the way of these things, it's headed straight for the area where it can do the most damage.

A good clean up is followed by remating the nut with his friend on a heatsink and securing it with a dab of Tipp-Ex (it was the first thing that came to hand). The fuse is in a sorry state, with shattered glass and mangled metal end caps. I dig him out and stuff in a replacement – 250mA. Feeling well pleased I plug him in, and *Woof*. Brilliant flash and bench trips. 'Gosh', I say.

AVO out. Mains plug shows 500 ohms earth to live; it still does with the counter switched off; it still does with the fuse out (curiously still intact).

Showing amazing stupidity I assume the mains lead is faulty and unsolder it. AVO the mains lead; it's open circuit, as it should be between wires. All that's left is the fuse holder. He is 500 ohms to earth. Presumably when the fuse ruptured the wire in it vapourised and reformed on the surface of the holder. In with a new fuse holder, solder mains lead back in and bring up counter, extremely cautiously, on a variac. It all works. It also runs to 650MHz at 5mV input. Great.

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BP-81	7.2V, 110mAh
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BP-86	Case for six R6 (AA) size batteries

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Carrying Case	Battery Packs, Battery Case
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Power Saver for longer operating time.
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Built-in Clock with timer functions.
The IC-2SE is equipped with an advanced 24-hour system clock with timer function. The transceiver automatically turns on when real time matches a pre-programmed time. This is perfect for scheduling QSO's. Auto power-off timers and other settings can be made in clock mode.

Convenient Scan Functions.
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- **Memory Scan.** Memory scan repeatedly scans memory channels.

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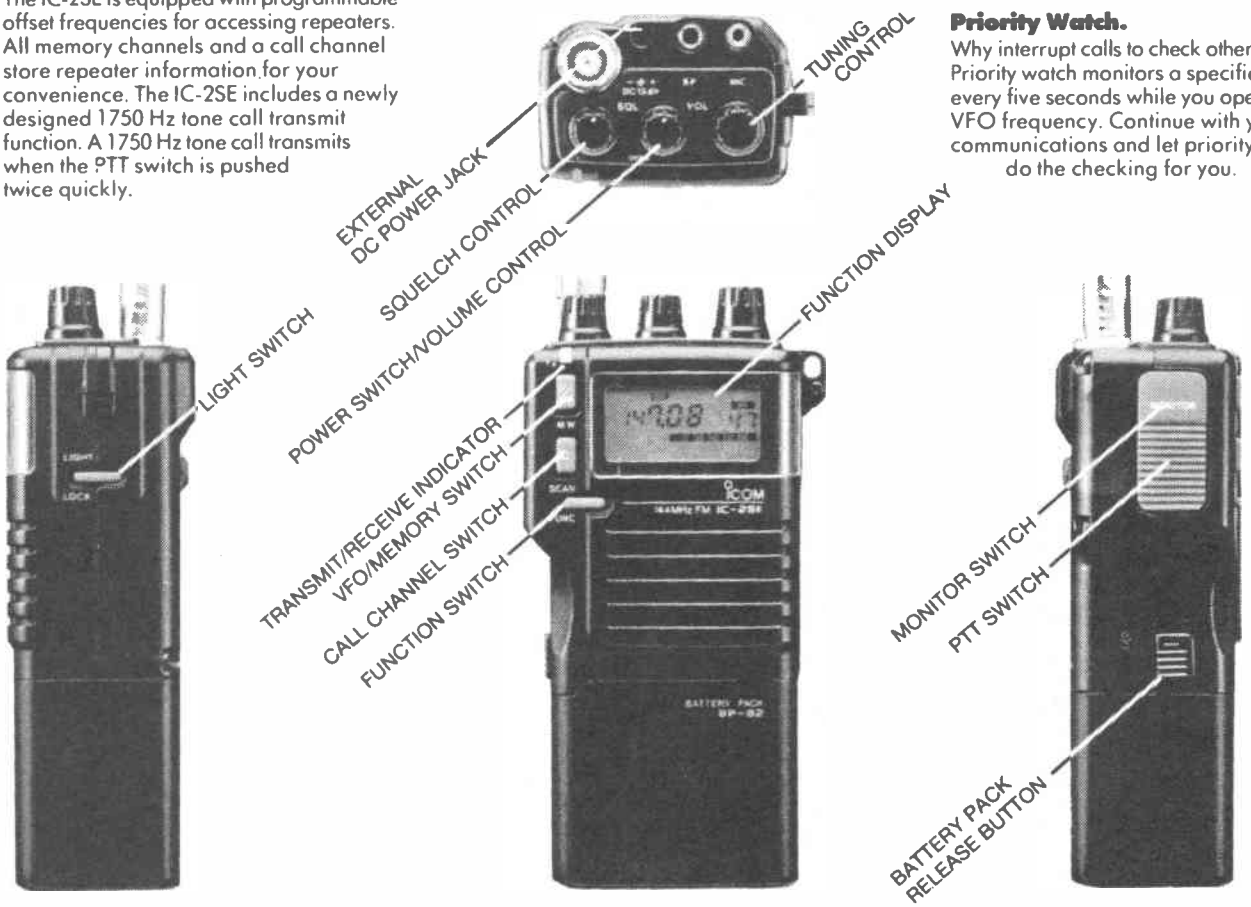
Priority Watch.
Why interrupt calls to check other stations? Priority watch monitors a specified station every five seconds while you operate on a VFO frequency. Continue with your communications and let priority watch do the checking for you.



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MEDIUM WAVE DXING

by Steve Whitt G8KDL

As I mentioned last month, the medium wave band at first sight seems to consist of local broadcasters during the day and a jumble of foreign stations fading in and out at night. Of course, there is more to it than meets the eye, and one of the peculiarities of the band is the continued presence of 'utility' stations.

Utilities

If you carefully tune around the medium wave band you may hear signals that sound like intermittent bleeping, though perhaps you've not paid much attention to them. On the other hand, depending on where you live, you may find such signals a painful source of interference to normal reception. The majority of these signals are radio beacons for aircraft – think of them as the radio equivalent of a lighthouse guiding a ship. World-wide, most navigational beacons (marine and aeronautical) are found on frequencies between 280 and 490kHz, ie, between the long wave and medium wave broadcast bands. There are, however, several exceptions to the rule, and over 100 beacons actually operate in the medium wave band. The vast majority are in the USSR but a few can be found in the UK.

The stations shown in Table 1 (except those on 518kHz) are aeronautical non-directional beacons (NDB) which transmit a continuous carrier, audio modulated, with their callsign in Morse code. If you are learning CW, you can use beacons to check how your skills are coming on. The figure given in brackets is the operational range in nautical miles over which a pilot will be able to use the signal for accurate navigation. The DXer, on the other hand, can hear these signals over much greater distances, especially at night. The three stations listed on 518kHz are part of a world-wide network known as NAVTEX, a system designed to transmit navigational and meteorological warnings and other urgent messages to shipping. These messages are carried by a network comprising many stations operating on one frequency, but using synchronised time windows to avoid mutual interference. The UK stations have a fifteen-minute time slot, starting at the allocated times shown in Table 1.

A radio teletype system known as NBDPT SITOR-B is employed, which sounds like warbling audio tones on an ordinary radio. However, if you have a home computer and an interest in experimenting, it may be possible to link it to your receiver to decode these messages.

Propagation news

For many years radio listeners and communicators have relied on information transmitted by station WWV in the USA as a guide to what the ionosphere held in store. The information provided over the short wave transmitters of WWV is also available by telephone, but both methods are less than ideal, owing to radio information only being aired hourly because of the prohibitive cost of making regular transatlantic phone calls.

It is therefore good news to hear that a new geophysical broadcasting service for Europe may well start in 1989. The RSGB's Propagation Studies Committee discussed the possibility of starting such a service with the IARU and professional bodies, such as the Rutherford Appleton Laboratory, who would be the likely source of the information to be broadcast. The Marconi Company donated a 1kW transmitter for the service, which could operate from a University of Sheffield site near Buxton, Derbyshire.

The plan has the backing of the propagation staff at the DTI, so much so that they may support an application for a fixed service licence to allow the station to operate on a frequency just outside the 80m amateur band (3, 5-3 and 8MHz in the UK). Such a service would be of great use to all DXers and would certainly benefit the keen MW listener.

Book corner

Although most DXers agree that the **World Radio TV Handbook** is the most wide-ranging radio annual around, there is still a need for more specialised information. One such book that is just out is the **Blue Book of British Broadcasting**, published by Tellex Monitors Ltd of London. The 1989 edition contains over 500 pages of station programming,

Frequency	Call	Station	Location and Time (UTC)
518kHz	GCC	Cullercoats R	(0048, 0448, 0848, 1248, 1648, 2048)
518 "	GLD	Land's End R	(0018, 0418, 0818, 1218, 1618, 2018)
518 "	GPK	Portpatrick R	(0130, 0530, 0930, 1330, 1730, 2130)
545 "	LIC	Lichfield (50nm)24hrs	52° 44′ 47″N, 01° 43′ 03″W
669.5kHz	BTN	Barton (25nm) 24hrs	53° 27′ 31″N, 02° 27′ 22″W
669.5 "	STN	Stornoway (60nm) 24hrs	58°17′12″N, 06° 20′ 35″W
734 "	WCO	Westcott (30nm) 24hrs	51° 51′ 09″N, 00° 57′ 38″W
850 "	CFD	Cranfield (15nm) Mon-Fri 0800-2000hrs in summer and Mon, Wed, Sun 0900-1800hrs in winter	52° 07′ 45″N, 00° 33′ 20″W

Table 1

Table 2

Middle East Stations

621kHz	Egypt	2000kW
702kHz	Oman (BBC)	1500kW
900kHz	Saudi Arabia	1000kW
1134kHz	Kuwait	1500kW
1413kHz	Oman (BBC relay)	1500kW
1449kHz	JRT Jordan	1000kW
1481kHz	Dubai VAE	1500kW
1512kHz	Saudi Arabia	1000kW
1521kHz	Saudi Arabia	2000kW

together with presenters, addresses and phone numbers of all TV, radio, cable and satellite broadcasters in Britain. Priced at £21.00 this book is not particularly cheap, but there is a good chance that your local library will have a copy.

Summertime DX

As I write this column, we have been enjoying the most intense heat wave since 1976. It takes great willpower to stay indoors in the shack and even more to stay on the low frequencies, since VHF enthusiasts will be chasing excellent tropo and Sporadic-E DX conditions. The long days certainly do not favour the more northerly propagation paths – remember the north pole is in permanent sunshine at this time of year. Two areas of the world which do feature during the summer are Latin America and the Middle East, though the latter is less reliant on good low frequency propagation conditions.

The Middle East encompasses a number of neighbouring countries and societies closely linked by historical tradition and modern allegiances. The common denominators linking many middle eastern countries are a belief in Islam and a common language, Arabic, of which several dialects exist. Another common factor is their oil-generated wealth, which has enabled radio stations to be set up to proclaim Islam to the rest of the world.

Over the years, as more and more stations have appeared on the MW band competing for a limited number of frequencies, the average power of transmitters has steadily increased in an attempt to override interference. Today, looking at a list of stations on the MW band reveals that the vast majority of super-power stations are in the Middle East; indeed, there are around eighteen stations in this area using 1000kW or more. Just compare this with the maximum power of 500kW used in the UK (by the BBC World Service on 648 and 1296kHz) or even the 50kW upper limit in North America and, of course, the 400-1000W used by amateurs. Some of the more readily heard Middle East stations are shown in Table 2.

At first sight, much middle eastern broadcasting seems to be influenced by the local dominance of Islam. However, the Koran is not the basis for all programming, and you may well be surprised as to the extent to which English programmes are aired. The stations shown in Table 3 should make good hunting for the DXer.

Table 3

Middle East Stations with English Programmes

Bahrain	Bahrain Broadcasting Station	0300-2100hrs on 1584kHz
Egypt	ERTVU	0500-0700hrs and 1000-2200hrs on 558kHz (foreign language channel includes English)
Iran	IRIB	1400-1500hrs on 702kHz and 1930-2030hrs on 1404kHz
Israel	IBA	0500-0515, 1100-1130, 1500-1505hrs, and 1800-1815hrs on 576 and 1458kHz
Jordan	R Jordan	0500-2200hrs daily on 855kHz + local FM stereo
Kuwait	R Kuwait	0500-0800hrs and 1800-2100hrs on 1341kHz
Lebanon	V o Free Lebanon R V o Lebanon	0830, 1230, 1530 and 1700hrs on 963kHz 0900, 1315 and 1815hrs on 872kHz
Qatar	QBS Doha	0300-1100hrs and 1400-1830hrs on 1233kHz
Saudi Arabia	BSKSA Jeddah	1000-1300hrs and 1600-2100hrs on 1485kHz
UAE	V o United Arab Emirates	0800-1100hrs on 810kHz

(all times are UTC)

DX file

After a very depressing period on the medium wave band stretching from last November through to February, which might be attributed to the so-called mid-winter anomaly, things began to pick up in late February. In fact, the first half of January saw some of the largest jumps in solar activity (measured in terms of 10cm radio flux) recorded in over thirty years. This led to disturbed medium wave propagation and fuelled speculation that the current solar cycle might peak as early as the end of 1989.

Towards the end of February, propagation conditions had stabilised and medium wave signals started to reappear with some rather good DX being logged. I heard many of the regular east coast stations from the USA and Canada, with many at very good strength. I was particularly pleased to hear CFDR on 680kHz in Dartmouth, Nova Scotia, since this was one station that had consistently evaded me in the past. Indeed, conditions were good enough for reader Derek Taylor, from Preston, to log a few rare stations from across the pond. The cream of his crop was a UK first WAGE contact on 1200kHz from Leesburg, Virginia, with just 1kW of power. Unfortunately, solar activity resumed its inexorable rise, and conditions deteriorated in March as massive auroral conditions prevailed in the ionosphere.

Even though we are rapidly heading for a solar maximum there is no need to put the medium wave equipment away in the loft, since good DX is still possible. In fact, my records show that during the 1980 spring equinox KEX, on 1190kHz, from Portland, Oregon, and CJVB, on 1470kHz, from Vancouver, British Columbia, were both logged in Britain; reception of stations from the west coast of North America is generally a reliable indicator of excellent medium wave DX conditions.

Until next time, I look forward to your 'listeners' tips' and loggings of stations you've recently heard on the medium wave band and, of course, feel free to drop me a line c/o the editor.

TUNE INTO RUSSIAN NEWSPAPERS BY RADIO

by Andy Thomas

You are a deck-hand on a Soviet fishing trawler, weeks away from your home port of Murmansk. As evening falls over the cold Barents Sea you ask yourself, what is happening at home? Yes, Radio Moscow does transmit a special bulletin for seamen, but what you yearn for is a newspaper pinned up on the wall, like they do with **Pravda** at home.

Inside the radio room, the ship's radio operator tunes to 12828kHz and connects his weather fax equipment. As the transmission starts, the fax prints the callsign of UDK Murmansk. No weather chart follows – the fleet newspaper is printed here, 'live' from Murmansk via short wave. Today's issue of **Murmansk Fisherman** has arrived.

Radio newspaper

From the Arctic to the Antarctic, the same events are repeated several times every day, so cruise ships and fishing factories of the Soviet merchant marine tune into Kiev, Kaliningrad, Odessa and Murmansk. These radio newspapers are easily received in the UK on simple equipment compatible with weather facsimile (fax) transmissions.

But surprisingly, the BBC monitoring service at Caversham, whose job it is to report on Soviet transmissions to government and intelligence organisations world-wide, do not monitor them. 'We don't have the equipment,' one official told me. Another, rather curtly, said, 'We're not interested in that sort of thing.' However, the BBC do monitor the Moscow service for seamen and similar RTTY broadcasts from Kaliningrad.

The Royal Navy, who publish a great deal of information about maritime fax transmissions in the 'Admiralty List of Radio Stations', is also rather coy about these broadcasts. 'We are aware of these transmissions,' one official wrote. But they are not included in the published list 'since they are intended primarily for the use of Russian fishing fleets and as such are of little interest to general merchant shipping. In addition, even if we wanted to include these broadcasts in our book, we would be confronted with the problem of keeping the information updated, since we do not receive any correctional information from official Russian sources.'

The amateur DXer can expect no help from official Russian sources either. So, in the spirit of 'glasnost', Table 1 gives the approximate schedule, based on observation of all four stations.

*The **Fedor Dostoevsky** in Funchal harbour*

Schedule

	UJY Kaliningrad	UFB Odessa	UJQ Kiev	UDK Murmansk
Mon-Fri	1000 1400	1100	1200	
Saturday	1300		1700 1200	
Sunday		1100		1700

All times GMT/UTC

Frequency: 12828kHz
Fax mode: 120/576

Table 1

The newspapers are (in translation): **Soviet Mariner**, from Odessa and Kaliningrad; **Southern Fisherman**, from Kiev; and **Murmansk Fisherman**, from Murmansk. The transmissions begin with an identification sheet giving the callsign, location and the word for 'tuning', and Odessa adds the explanation 'photo-radio material' from the gazette **Soviet Mariner**.

What news will the bulletin hold for the deck-hand on a factory ship or cruise liner? The Soviet authorities are very concerned about the rapid turnover of labour and the low morale of crews in Soviet ships. There is also a lot of gossip among the ranks of the fishing industry about lack of discipline, and the men blame the poor fishing harvest this year on the party committee.

Propaganda

Although the bulletins include information from Tass, they are produced editorially by the ministry responsible for the merchant marine. A lot of editorial space is devoted to the workers' committees and screaming headlines report their good work; sometimes inspiring line drawings of seamen, together with official announcements.

So if you're a Russian student or spy, tune into the Soviet merchant fleet and read what Soviet seamen read, but remember to chip the ice off your aerial first!

FIELD EFFECT TRANSISTORS

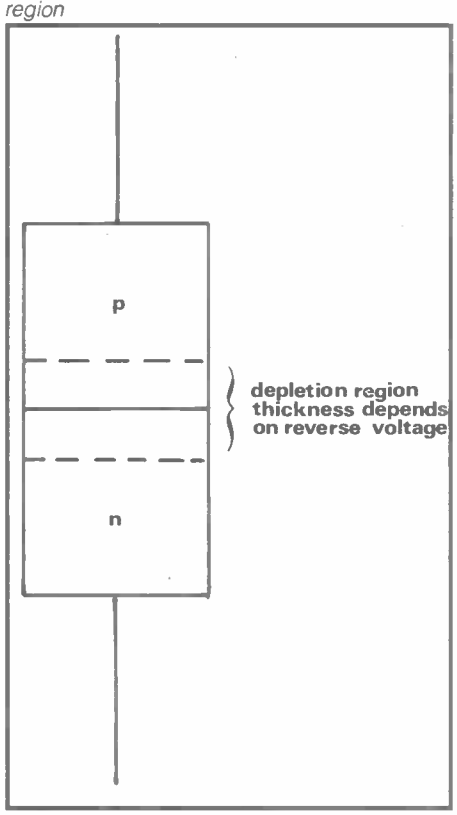
by Ian Poole G3YWX

Over the past years, the importance of field effect transistors has risen dramatically. Not only have they found uses in an increasing number of areas because of their high power performance, but they are also being used extensively within integrated circuits because of their lower power consumption than that of bipolar technologies. Most microprocessors use a form of field effect transistor technology known as MOS and, likewise, so do the peripheral integrated circuits. This, of course, represents a vast and growing area.

History

The idea of a field effect transistor is not new. The original patent for the idea was taken out in 1933, but it was not until 1952 that W Shockley gave the first details of it in a practical form. It took about eight years before they were commercially available, but by 1963 ten companies were manufacturing them. The performance of these early devices was somewhat unpredictable, and it was not until 1966 that improved techniques enabled generally acceptable devices to be manufactured. One of the major problems which had to be overcome was that field effect transistors required silicon, which was considerably better refined than that used in bipolar transistors. This is the reason why bipolar transistors were used well before field effect transistors.

Fig 1: *Standard diode showing the depletion region*



FET basics

Basically, a field effect transistor is a voltage-controlled semiconductor device. It has a very high input impedance, especially at low frequencies where any capacitive effects can be ignored.

Its operation depends on controlling the number of charge carriers; hence, the current which passes along a length of silicon (called the channel) between two electrodes is known as the source and drain.

Charge carriers can either be electrons or holes, a hole being a space for an electron in the crystal lattice.

The current flow is controlled by the voltage on a third electrode known as the gate. The fact that the current flow is controlled by a voltage on the control electrode makes the field effect transistor very similar to the thermionic valve, giving it many applications in areas where the bipolar transistor is not so suitable.

There are several different types of field effect transistor, depending on the way in which the gate is separated from the channel, the type of material used, the mode of operation of the device, and the number of gates it possesses.

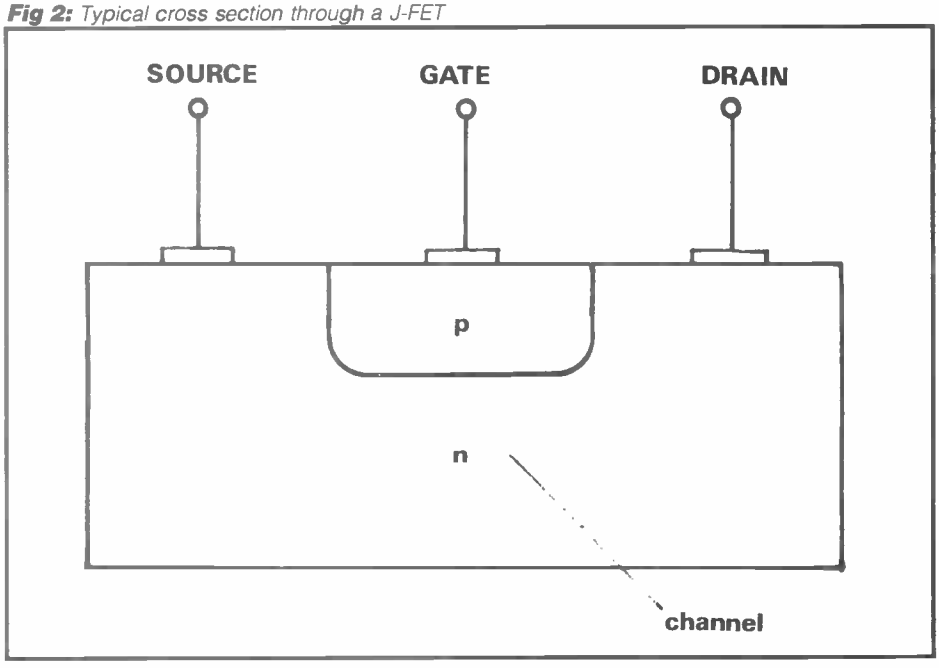
The gate can be separated from the channel in several different ways. Early devices were mainly junction gate FETs or JUGFETs, where the gate was separated by a reverse biased PN junction. These devices are still very much in use today; the 2N3819 family is an example of this type of FET.

MOSFETs

There are also MOSFETs, where the gate is formed by depositing an oxide layer on to the channel and then a conducting layer on to the oxide, hence, giving a metal-oxide-silicon build up. The gate is then physically insulated from the channel, ensuring that this type of device has an exceedingly high input impedance. So high in fact, that static charges break down the oxide layer, rendering the device useless. To overcome this, back-to-back protection diodes are usually integrated on to the device between the gate and source. Despite this, these devices are often supplied with shorting links around their leads for further protection.

FETs can also be divided into two categories, depending on the type of material used for the channel. If the substrate, and hence the channel, is doped to give an N-type material, then the FET will be known as an N channel

Fig 2: *Typical cross section through a J-FET*



FET and the majority of carriers will be electrons. Conversely, if the substrate is doped to give a P-type material, then the FET will be known as a P channel FET and the majority carriers will be holes. Most modern FETs are of the N channel variety because the mobility of electrons is greater than that of holes, resulting in a superior performance being obtained. However, many integrated circuits use both types together to give complementary pairs.

One further type of category which FETs can be divided into depends on their mode of operation: they can be either depletion mode or enhancement mode. As their name implies, depletion mode operation depends on depleting the channel of majority carriers and reducing the conductance. Alternatively, the enhancement mode FETs operate by enhancing the number of available carriers and increasing the conductance. The majority of discreet FETs are of the depletion mode variety.

Silicon is usually used as the semiconductor material. However, using gallium arsenide, although more expensive, improves the performance of the FET. Germanium is not used because of its higher reverse currents. One result of this is that the input impedance of a Germanium FET would be less than a megohm, whereas the input impedance of a silicon device is many megohms.

FET operation

Before explaining the mode of operation of a FET, it is useful to understand the meaning of a depletion layer and depletion. Take, for example, an ordinary PN junction, as shown in **Fig 1**. On one side of the junction there is material with electrons freely wandering through the lattice, and on the other side there are holes. Some of these charge carriers near the junction wander across and naturally combine with each other. In other words, some of the free electrons go into the p material and fill holes, and vice versa, with the holes wandering into the n material. Thus, a region is formed around the junction which is depleted of charge carriers. This depletion region or layer can be widened by applying a reverse bias or narrowed by applying a forward bias.

The mode of operation of a FET is more easily understood than that of the more well-known bipolar transistor. For the purposes of explanation, a junction FET is used. **Fig 2** shows the PN junction formed between the gate and the channel which is reverse biased, and the field effect generated by this potential depletes an area of the channel of its free charge carriers. Voltage applied to the drain causes a greater reverse bias from drain to gate than from source to gate as there is a potential gradient from

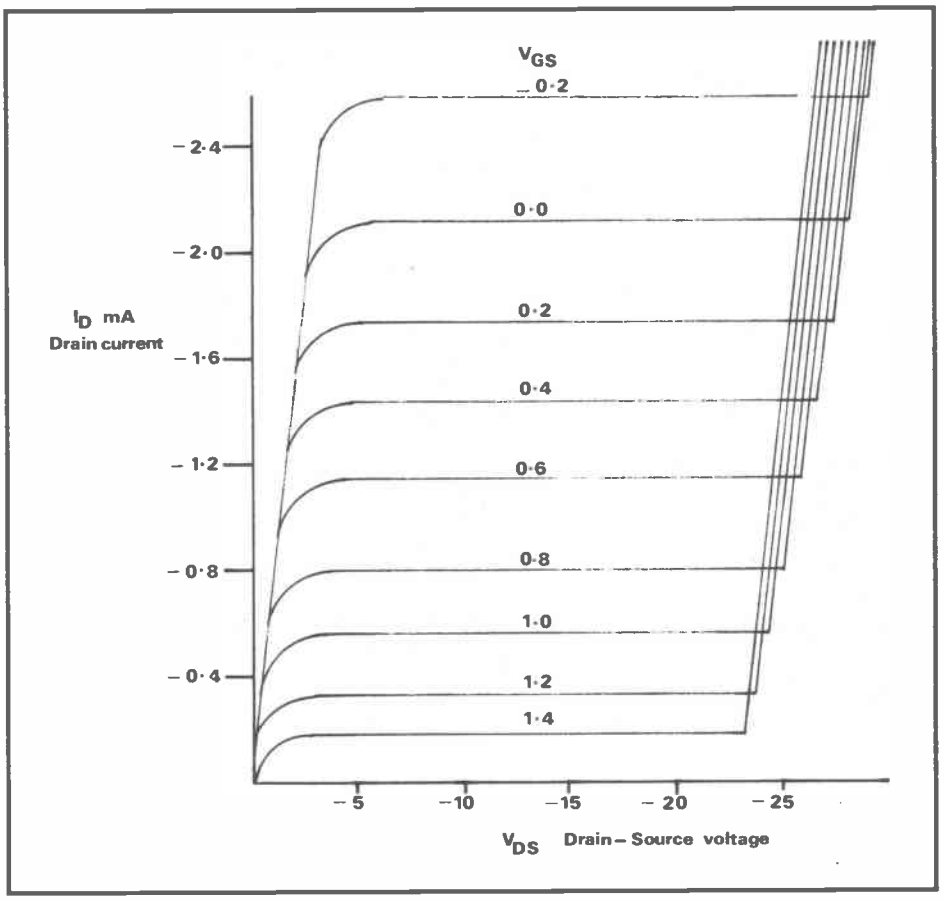
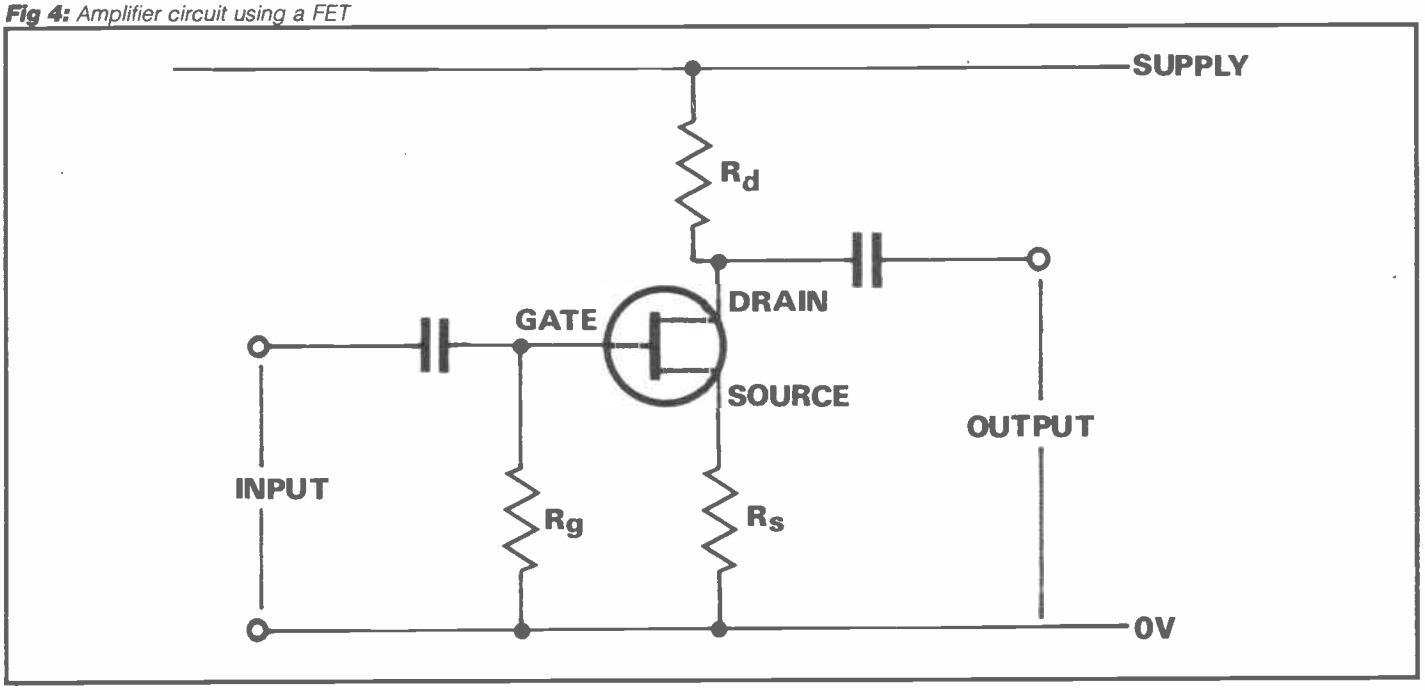


Fig 3: *Typical common source drain characteristics of a FET*

Fig 4: *Amplifier circuit using a FET*



drain to source, as shown in **Fig 2**.

As the channel width decreases, it reaches a point where the change in conductance resulting from a change in voltage is large, and the current flowing through the channel will no longer increase with drain voltage. This is the edge of what is known as the pinch off region, which is reached when the width of the non-depleted area of the channel is zero. Thus the pinch off voltage Vp is the gate voltage required to stop channel conduction with the drain to source voltage Vds being non-zero. After pinch off has occurred there is very little increase in drain current Id for increasing drain source voltage Vds. Thus a graph can be drawn of Id against Vds, as shown in **Fig 3**.

Field effect transistors normally operate with the drain voltage beyond the pinch off voltage Vp and a reverse bias between the gate and source. Thus the drain current is controlled by the gate voltage Vgs. The action of the gate is similar to that of the control grid of a valve on the anode current by altering the electric field between the grid and cathode.

The circuit diagram of a typical N channel FET amplifier is shown in **Fig 4**. This circuit uses a resistor Rs in the source circuit to provide the reverse bias for the transistor. The gate resistor Rg provides the saturation current which flows across the reverse biased junction to flow to ground, thus maintaining the gate at approximately ground potential for dc. In practice, no more than about 0.1V should be developed across Rg.

Current developments

There are many developments of the FET which have occurred over the past few years, but most of these have applications within integrated circuits. Probably one of the most well-known is CMOS, which stands for Complementary MOS, and gives its name to an entire series of logic integrated circuits. These have a high input impedance and very low power consumption, but their operating speed is not as high as the more common 74 families of logic. There are, of course, CMOS versions of the popular 74 series logic ICs. They are designated by the numbers 74HCxx or 74HCTxx and are very popular due to their low power consumption and compatibility with the other 74 logic families.

There are several further types of FET technology. One type of FET which is of great interest to the radio amateur is VMOS. Its name is derived from the fact that there is a V-groove structure which allows high currents to pass more easily, thus vastly increasing the power handling capacity. VMOS devices fall into the category of enhancement mode MOSFETs. These enhancement mode devices remain off when no bias or drive is applied, which is a very useful feature when dealing with high powers. They only start conducting above a certain threshold, which is normally between 0.6 and 2V. Once a certain quiescent current is reached, any further increase in gate voltage results in a linear increase in drain current. VMOS devices are probably most useful in amateur radio as RF amplifiers, providing a few watts of power. They can be easily run in parallel to increase the power output, making them ideal for low power transmitters or as drivers for a high power output device.

The future

Enormous sums of money are still being spent on the development of various FET technologies. Some of the latest types of FETs, such as HEMT (High Electron Mobility Transist) and MESFETs (Metal Silicon Field Effect Transistors) are pushing up the power and frequency limits to well beyond what was previously possible. As research and development are still continuing, it will be interesting to see what can be done. Then, as they enter production and prices fall they will find their place in amateur radio projects, just as transistors did in the late 1950s and early 1960s.

DX DIARY

News for HF operators compiled by Don Field G3XTT

After the excitement of May, June was relatively quiet on the HF bands, which at least gave us the opportunity to enjoy the long spell of hot weather. Nevertheless, there were a few interesting stations to be worked. T26LP and T28RW appeared from Tuvalu, with good signals on 15 and 20m. ZS1IS was on from Walvis Bay which, as I mentioned last time, may end up counting for a new one. ZS8MI on Marion Island started to explore the lower bands and was worked in the UK on 40 and 80m. FR5AI/G operated from Glorioso Island, and was worked in the UK on 15 and 20m, but he was not especially active. TT8CW was busy handing out a rare one, though work responsibilities limited his operating hours. He is there until September. Finally, there was an operation from Tunisia under the callsign 3V8AZ. However, this ended tragically when the operators, F2SA and F1HJW, were killed when their light aircraft crashed in the Pyrenees on the way home.

At the end of May, John PA3CXC operated briefly from southern Sudan, CW only. John hoped to get back to ST0 at some stage, and TZ6MG, currently back in Holland, was also expecting to go out there for a twelve-month tour of duty. However, at the time of writing, there was a problem in that the only way into southern Sudan was by light aircraft from Kenya or Uganda, and two of the three aircraft involved had recently been shot down in the fighting.

PA3CXC also told DX News Sheet that he had applied for a permit to operate from Ethiopia and, if successful, would operate for two weeks, CW only, so keep a look out for this one. He was also exploring the possibility of licences for other semi-rare countries, such as 5R and 8R. Finally, John reports that a Dutch amateur was issued recently with an Albanian callsign by the telecommunications authorities in Albania, but had been unable to get the additional authority needed from the state security police who, apparently, have said they are getting rather fed up with applications from radio amateurs hoping to operate from Albania. Looks as though a ZA operation could still be a long time coming.

Marion Island

I said in my introduction that ZS8MI had been busy from Marion Island. He has now said that he will operate CW and SSB on alternate weeks. This practice was due to start with SSB from 5-11 June and CW from 12-18 June. I leave readers to make their own projections. Peter works 14145kHz (both modes) from 1600 to 1800GMT, 21300kHz (both modes) from 1500GMT, and 28100kHz CW or 28400kHz SSB at 1000 or 1300GMT. He uses the big rhombic antennas on the island, and has been putting an excellent signal into Europe on all bands.

Bermuda Contest

The results of this year's Bermuda Contest have now been published and the country winners are N2NT, VE3XN, G4OSY, DK8FD and VP9LR. All win a free holiday in Bermuda. Congratulations!

DX operations

A group of Canadian and US amateurs plan to sign CY0DXX from Sable Island from 5-12 August. SV1AEU will sign /5 from Kassos Island in the Dodecanese, from 28 July to 10 August; mainly on CW, 10kHz from the bandedges. The Nanticoke ARC will sign KW3Z from 11 to 13 August on 80 through 10m. This one is NA-83 for the IOTA awards.

Prefixes

PT2BW reports that he has a list of unusual prefixes lined up for his operations in this year's contests. Calls include: PR2A, PS2A, PT2A, PV2A, PW2A, ZV2A, ZW2A and ZX2A. Unfortunately, he is taking the line that only direct QSLs will receive replies.

The long path

Most active DXers will be familiar with the fact that Australian and New Zealand stations are loudest in the mornings on 20m when beaming 180° away from the direct beam heading; in other words, via the long path. The serious DXer, though, recognises that there are many occasions when long path openings can be important, and can help him to catch that rare station. Just to take a few examples. The west coast of the US, as well as parts of the Pacific, such as Tahiti, can often be heard long path on 20m in the afternoons. This opening sometimes extends up to 15m – the Marquesas and Austral Island operations were workable long path on 15m a few months back. Japanese, Australian and Far East stations are often loudest long path on 15m in the morning. And long path openings occasionally occur on 10m, and will become more common over the sunspot peak. In a recent article by N6AV in **The DX Magazine**, Jerry gave some helpful tips regarding the 10m long path.

1. Most contacts made this way are with stations in a time zone which is eight to ten hours ahead.
2. The beam headings tend to be due south rather than on a directly reciprocal bearing.
3. An evening long path opening is often preceded by a strong short path opening to (in our case) the Pacific between about 1000-1200GMT
4. The time of day at the DX location is usually about ninety minutes after sunrise.

Recent long path openings on 10m from the UK have included Hawaii and Japan, plus occasional signals from New Zealand. Stations in the south of England seem to encounter these openings more frequently than those in the north.

The moral of the story is that it is often worth checking for long path openings rather than just relying on short path. In the case of 10m openings signals are likely to be quite weak, and a decent beam antenna will help a lot. And bear in mind with both long and short path propagation that it doesn't always follow the rules. Quite frequently paths are skewed away from the direct great circle bearings, especially at the beginning and end of an opening. Too many DXers nowadays become lazy and expect DX to be fed to them on cue via a list or net, but attention to propagation, as well as being a fascinating study in its own right, can often deliver those extra goodies that you would otherwise miss.

Miniprop 3.0

Finally, while on the subject of propagation, there has been a lot of recent excitement in the US over a new computer program, Miniprop 3.0, from W6EL Software, which runs on IBM-compatible PCs. The program uses a much more complex mathematical model than the more familiar Minimuf program to generate both long and short path propagation predictions between two specified locations. The printout, by time of day, gives MUF (Maximum Useable Frequency) as well as the predicted signal levels on each of the main amateur bands. Without a maths co-processor in the PC the calculations can take rather a long time, but apparently the results obtained are excellent. The program costs $49.95, and is available from W6EL Software. I understand that at least one other similar program, T-MUF, is also being developed in the US at the moment, so there may soon be several to choose from.

Contests

August brings the YO-DX Contest on 5-6th, the Worked All Europe CW on 12-13th, the SEAnet (South East Asia Net) Contest on 19-20th, and the All Asia CW Contest on 26-27th. The YO Contest is both SSB and CW. The last three events are all forty-eight hour affairs; the YO Contest runs from 2000hrs on the Saturday until 1600hrs on the Sunday. On Sunday 3 September there is the LZ-DX contest, followed a week later by the SSB leg of the Worked All Europe event. After the CQWW and the ARRL contests, the Worked All Europe (WAE) contests are probably the most popular in the HF contester's calendar. The rules are quite complex, with extra points scored for QTC traffic. I won't reproduce them in full here but, thanks to help from a DX Diary reader, I can supply photocopies of the rules and official log sheets in return for an SAE.

Awards

The major awards in the world of HF DXing all originate from the USA. I suppose all DXers are aware of the ARRL DXCC awards programme, for confirmed contacts with 100 countries, and endorseable as extra countries are confirmed. DXCC is available for mixed mode or for phone, CW or RTTY operation. There are also single band versions for 160, 80, 40 and 10m. Other awards are available for the VHF fraternity. Finally, the five-band DXCC is available for confirmed contacts with 100 countries on each of the main HF bands, 80 through 10m. I suppose what really gives spice to DXCC are the listings in **QST**, the ARRL's monthly magazine, which mean that not only can recipients look at the certificate on their shack wall, but they can also compare their achievement with others in the published league tables. The ARRL countries list also has wider applications, being used as a basis for many other awards and for multiplier purposes in many contests.

The ARRL also sponsors the Worked All States awards programme, which should be self-explanatory. A five-band version is also available. One restriction, which has always caused me problems with my frequent moves of QTH, is that all contacts must be made from the same location (defined as being within a radius of twenty-five miles of the original location).

CQ Magazine sponsors the popular Worked All Zones awards. These can be endorsed for single mode operation, and are also available for single band single mode operation (eg, all on 40m CW). The ultimate WAZ award is the five-band WAZ. I recently became only the seventh English station to gain this award, despite the fact that it has been in existence for ten years. The most recent introduction to the WAZ awards family is 160m WAZ. G3RBP was the first UK station to qualify with all forty zones worked on top band.

The American **CQ Magazine** runs a similar award to DXCC, the CQ DX Award. Unlike DXCC, 'deleted' countries do not count and there is no mixed mode version. An Honour Roll of those with more than 275 countries confirmed on either phone or CW is run bimonthly in **CQ.**

In terms of UK-sponsored awards, the Islands on the Air Award now has worldwide recognition, no doubt because there is an ongoing element of competition through a six-monthly Honour Roll listing in the RSGB's DX News Sheet. There is a number of IOTA awards, based on continents, geographical groupings (eg, the West Indies Award), and total number of islands worked.

The RSGB sponsors a number of other awards, those based on Commonwealth Call areas and on ITU zones being the most prestigious. And, as I mentioned earlier, the Worked All Britain awards programme, though not under the auspices of the RSGB, has achieved popularity in many parts of the world. WAB is based on the National Grid Reference Squares found on OS maps, but the programme also includes awards for working Book Holders, UK offshore islands, counties and rateable districts. WAB seems to be as much a way of life as an awards programme. Many friendships have grown up through the WAB nets on 80 and 40m, and many miles have been travelled by mobile stations helping to put rare squares on the air.

SHORT WAVE LISTENER

TREVOR MORGAN GW4OXB

At the time of writing, the weather is nowt short of fantastic. This is something we're not used to but I'm sure we could get used to it . . . in time! Pity is, the bands have not been complementary and even the Stateside boys have been difficult to find at times, especially on 10m. For the most part, 80m has been extremely noisy with a lot of fading present.

Nevertheless, there are some good things to be heard on the amateur bands, especially during the various contests.

Contests

It doesn't matter how you feel about contests as such since they attract a lot of DX stations, so they are worth listening to, even if only for short spells.

Philip Davies ILA023, of Market Drayton, has been doing just that with great success.

The ARRL contest on 4-5 March was the first with YI0ACC (Baghdad), TA5C (Turkey), JY4YJ (Jordan), V31C (Belize), KD0HY (Arkansas), XE0DX (Mexico), ZV5A (Brazil) and CE6JOE (Chile) on 10m; 6D2DX (Mexico), FG5/KA3DSW (Guadeloupe), VP5V (Turks and Caicos), J6LSN (St Lucia), W0GAA (Colorado), NU0P (Iowa), ZV9ZZ (Brazil), 4M1G (Venezuela) were found on 15m; and RH4E (Tukomen Republic), 9Q5NW (Zaire), K3ZJ (District of Columbia), NF0N (Nebraska) and AK6T (California) were on 20m.

Mississippi was the best catch on 20m via KB5MZ, while 75m revealed XE2FU (Mexico) which shows that these WARC bands are occasionally being used. Top band even came up with RB4IGN (Ukraine) and W3LPL!

The Russian MIR (Peace) contest on 13-14 May was also fruitful for the oblast (districts) hunters. As you know, the Soviet Union is divided into some 200 oblasts and there are awards available for logging them.

The Heard 100 Oblasts award is issued by the Central Radio Club, PO Box 88, Moscow (the fee is fourteen IRCs) and is available for 3.5MHz, 7MHz and all bands. Just submit the usual duplicate log sheets with the date, time, frequency and mode details and get the claim signed by a licensed amateur. In this contest, the suffix 'WA' was used frequently, so it was necessary to listen carefully for the correct callsign. Phil managed seventy-four oblasts (forty-eight European and twenty-six Asian), filling *ten pages* in his log!

Included were: RG8GWS (004 Armenia), UM8MDX (036 Kighiz), UI9BWE (053 Uzbek), UJ8XDH (192 Tadzhik), UL8BWN (016 Kazakh), UA0ABK (103 Krasnoyarsk) and RD8D/UZ3QWX (001 Azerbaijan) on 15m; UA1OT (113 Franz Josef), UZ1N (088 Karelia), UZ0QWA (098 Yakutsk), UZ0WWA (104 Abakan), UZ9KWA (163 Salekhard), and UZ6WWA (086 Dagestan) on 20m; UZ1TWB (144 Novgorod), UO4OXR (039 Moldavia) and UQ0GZW (039 Latvia, special call) on 40m.

As luck would have it, Phil finally logged VK1WW. He's not heard a VK1 in forty years of radio and it was nice to get him in the log during his 'anniversary' year. Well done, Philip!

Stuart Wilson ILA580, of St Andrews, erected a triband dipole for 20/15/10 in place of his endfed wires and has had a lot of success so far with 3C1MB, ZS8MI (information is that he was on Marion Island in April) and S01A on 10m; BY7HY, 5H3RB, YB0FS, HZ1AB, JA8CAR, 4S7PK, FH8DFT, VK3AMB, 6W1NQ, 9V1XB, TL8NS, VK9LA, 5N7DH, DU9CU, 9M2ZZ and TZ6MG all on 15m with CE3OV, PJ9JT, A92BE, 7X4LX, 9K2JS, P2PIK, VK6RU, ZP5HF, KG4FB (Guantanamo Bay naval base), AP2ZA and 4X6SJ (Judy), who sent a QSL and postcards of her QTH which were received within *ten days* of the report!

Some news of another award comes from Pierra Fournier F11ADB, in France. The TV-FV Award is based on the special callsigns with the TV and FV prefixes and is in two grades. Grade A requires confirmed loggings of fifteen different TV/FV stations with at least one TV6/TV7/FV6/FV8 prefix. Alternatively, one station with TO, TW, TX or HW can be used to replace one TV/FV. Grade B requires confirmation of twenty-five TV/FV stations in any mix. Endorsements can be claimed for single modes or bands as separate awards. Lists must contain all relevant information as usual, and should be signed by two licensed amateurs. QSL cards are *not* required but should be available. The fee for the awards is FF30.00, ten IRCs or $5.00. Claims should be sent to Pierre Fournier F11ADB, 3 bis rue Pasteur, 78000 Versailles, France.

Another award from the same source is for logging stations in the CQ/WAZ zones. Class 1 requires confirmed loggings of stations in forty zones; Class 2 requires confirmed loggings of stations in thirty zones; and Class 3 requires confirmed loggings of stations in twenty zones. The usual rules apply and the fee is FF25.00, ten IRCs or $5.00.

Transmitting aerials

A letter from one reader asks 'Can I use a transmitting aerial for short wave listening?'. Apparently, he was offered a triband vertical for nowt! The answer is certainly YES! Although listeners tend to go for endfed or 'long' wires more than other aerials, this is principally because they are cheap, easy to erect and can be bent to fit any available space. Used through an aerial tuner unit, they can be extremely effective if the old adage of 'the higher the better' is taken.

Transmitting aerials, especially triband verticals, are usually pretuned to certain bands and operate best at the design frequencies. However, there's nothing to stop you using a 20/15/10 aerial on 80m or any other band. If you use an ATU, it will help to get the best results from the aerial outside the design frequencies.

Also remember that vertical aerials really work best when tuned against a very good earth, or if the radials are cut to a quarter wavelength of the bands in use. The radials should be attached to the earth terminal at the base of the aerial. Although it has been accepted that 'the more radials the better', recent experiments and tests have questioned this theory and two radials per band, it seems, are quite sufficient.

Recent computer-aided experiments by Bill Bringler K5CSJ, revealed that two-radial operation differed little from four radials, and a ground-mounted vertical was even less effective than either ('Technical Topics', **RadCom**, May 1989). This experiment seems to verify what many operators and listeners have been saying among themselves for as long as I can remember – an ounce of practice is worth a ton of theory.

Many operators have found that aerials do not always behave as the textbooks or designers would have us believe. Theoretical gain and performance figures may well be matched under perfect conditions, but it is a very lucky chap who has anything like a perfect site; indeed, most of us live in a location that is very far from ideal. Theoretically, terrain should not affect HF signals to any great extent, but when an operator lives in an area surrounded by hills containing a good proportion of iron and copper ores, over ground that has virtually no water table and is surrounded by steel-framed buildings, is it feasible to expect *any* aerial to operate as it was designed to? (As a matter of interest, those are *my* conditions!)

Aerials are a matter of trial and error. What works for you may well be useless to some-

one else, as has been proved time and again, despite the theorists and designers. So, if you have a chance to try something different, go ahead. You may be lucky and find something that really does pull in the DX!

Awards

Malcolm Gregg G0KNN, of Spennymoor, has sent in his claim for the Silver Award for 500 prefixes logged. It's three years since Mal claimed his Bronze as a 'G6 and listening', but he has been using his ICF-7600D and endfed to good effect while studying the dots and dashes.

Among the listings were AP2JZB, BA0DDD, BY2HY, HK1LDG, HL1AYK, J52US, JS8DN, KL7KHO, KS9Y, KZ1J, S0RASD, S01A, VU2SBN, WU5F, ZS6OT, 5W1FT, 9K2FN, 9L1WS, 9X5NH, and many other nice ones. Just shows, you don't need a big rig for a good catch. Well done, Mal!

Stuart Wilson, of St Andrews, also claimed a Silver Award with: AZ4F, AG8Z/P/4, AJ9C, C45A, HK1LDG, KP4KC, LU3MCJ, P40U, PS8ET, P33ES, SW2XR, SM2/PL5AZ, VU2DUP, VP9KG, VU7APR, YC7BS and YC5NST.

Dave Davidson ILA320, of Newmilns, has claimed the Oceania Continental award with: FO0SSJ, P23UKK, KH6VX, F08MM, H44RO, ZK1KK, P29VU, AH6HY and FO4LU hidden amongst the VKs and ZLs. This was his 'final' claim for the amateurs in the series, so now he's looking for another ladder to climb to keep him out of mischief!

Ian Armstrong ILA601, of Millom, in Cumbria, put in a claim for his first award. Claiming the Continental European award, he submitted LX1KN, 4U4ITV, TF3CW, EP2HZ, AA4AH, HB0/DL2MEH/P, OD5RA, and many other more common ones. Nevertheless, a very good effort for a first-timer. David used a Panasonic DR49 receiver with an endfed wire antenna.

Rules

Some new readers may not know the rules for the awards, so let's give you a quick rundown.

The Prefix Awards are available for logging amateur prefixes and can be claimed for 250, 500, 1000 and 2000. The prefix is the first part of a callsign, ie, that part which denotes the location, such as G, GW, GM etc. Some prefixes consist of number/letter mixes such as 6W (Senegal) or 4X4 (Israel). The suffix is the personal callsign of the operator, so, in my case, GW4 is the prefix and OXB is my callsign in that series. The claim should consist of a list of the stations heard, the frequency heard on, time and date. There is no need for QSL cards. There is no fee for the awards and they can be endorsed for any single mode or band.

The Continental Awards are offered for logging stations in different areas. These areas are: Europe, Asia, North America, South America, Africa and Oceania. They can be claimed for amateur or broadcast stations and endorsed for any mode or band. Once again, there is no fee and the rules are the same.

You may remember my comments in the May column which referred to listeners as 'second class citizens'. I had a number of responses from this (mostly agreeing, I might add). One was from a licensed amateur who said, 'You may also have mentioned the A/B class distinction too... but what gets me mad is that "old timers" – who should know better – are often the worst offenders. One of whom was on 40m when a newly licensed amateur called on "his" frequency and asked for a report on a new antenna. The newcomer was told exactly what he could do with his antenna! If this is the way newcomers are treated, no wonder we can't get youngsters to take up the hobby.'

Hardly encouraging

Why not explain procedures to a new chap and give him the report he wants? We all go on the air for the first time with our hearts in our mouths, not knowing what to expect. This is hardly encouraging!

Well, that's all for this month. I hope the conditions improve soon. Meanwhile, keep those reports and claims coming in to me at 1 Jersey Street, Hafod, Swansea SA1 2HF.

News and comment from Glen Ross G8MWR

First of all this month, here is an address for your little black book. Those of you who have already worked the MIR space station should send their QSL card to Boris Stepanov UW3AX, PO Box 679, Moscow, 10727, USSR. Well, it makes a change from the usual Box 88.

Microwave survey

The RSGB microwave committee recently sent out a questionnnaire to their readers, and now that all the results are in it provides some very interesting information. The following information is given with acknowledgement to the Microwave Newsletter, which is available from the RSGB.

In terms of percentage of returns, the usage of the various bands comes out at: 1.2GHz, 68%; 2.3GHz, 37%; 3.4GHz, 22%; and 5.7GHz, 10%. On 10GHz FM the figure leaps up to 63%, and for SSB it is 29%. Moving up to 24GHz, the figure is 20% and at 47GHz we get 1.25%. There are several noteworthy points here. One is the growing popularity of operating on 10GHz and, particularly, the dramatic increase in the use of SSB on the band. Another point of interest is the explosion of interest in 24GHz which, until a couple of years ago, was hardly ever used. Perhaps it is time you thought of moving up a band or two?

The gear

To give you a better idea of what you may be letting yourself in for, the following information might be of interest. The power levels shown are the maximum used by over 50% of operators, and the aerials are typical of those most often used.

Starting at the low frequency end on 1.2GHz, the typical station runs less than 10W to a twenty-three-element aerial. The average longest contact is about 700km, with the best stretching out to 1350km. On 2.3GHz most operators use less than 5W for average DX of 550km; the best being only a little short of the 1.2GHz figure at 1260km. On 2.3GHz most people move up to a dish aerial, the most common being about 3ft in diameter, although yagis with up to sixty-six elements are still fairly common.

Moving up

The next band up is 3.4GHz where the average operator runs less than 5W to a 30in diameter dish, giving a best DX of 903km. On 5.6GHz, average powers of about 4W feed a 3ft diameter dish. Most contacts are out to 250km, with the best DX at 971km. 10GHz is treated as two sections: one for wideband FM and the other for SSB or narrowband modes generally. On the FM side, most people run less than 10mW of RF to a 2ft diameter dish aerial. The average DX is up to 150km, with the best contact stretching to 256km. On SSB the same aerial size is used, with 75% of operators running less than 250mW (many operators run well under 1mW from the usual G3JVL-type of transvertor). This gives average distances of 200km, with the best contacts going to about 500km. On 24GHz the usual power is less than 8mW to an 18in diameter dish, giving paths up to about 125km. The same for 47GHz is too small to give any useful data.

Important

The information from this survey is very useful since, for the first time, it gives a fair idea of the equipment used and the results obtained by the average operator. There have been previous surveys, but this one is certainly the most important. It also brings up some interesting facts about the largest installations. For instance, on 1.2GHz the highest power used is 120W and the largest aerial is a 322-element array; makes my 90W to a 120-element array look like a starter system!

Owning up

I have, I think mainly because of the mole reports, received several letters accusing me of being against the RSGB; perhaps the time is right to put the matter straight. Far from being against the society I am very much in favour of it, to the point where I served with the society for several years as the regional representative for the Midlands. Frankly, if you are in the hobby and not a member, then you are getting your enjoyment without paying your bills. If it was not for the society you would have no class B licence structure. You would still need, and have to pay for, separate licences for mobile operating and ATV. There would be no repeater system and no 50MHz. You would still have to pull into the side of the road to log your mobile contacts at the time of the contact. Class Bs would not be on 70MHz and would not have the Morse facility. There would be no WARC bands and no easing of the regulations to allow packet operation. The list of things the RSGB have arranged for amateur radio is too long to print.

Why the mole?

So why do we have the mole report? The answer is simple, the RSGB is the best we have but they are not perfect, and they themselves would be the first to admit it. They do not always tell us, possibly for excellent reasons, what is going on. They often appear to cover up in some form or another and, if things go wrong, they close ranks. There is nothing unusual in this, as it happens in most large organisations. One does not help the organisation by pretending that everything is perfect when it obviously is not. In my opinion, instead of moaning about things in the back room of a pub, it is far better to openly criticise and report on what is going on, or at least to ask a few pertinent questions.

The mole report

The RSGB always tell us that there is little that they can do about unlicensed operators and other users abusing the bands. This, according to letters which have been leaked concerning responsibility for repeater abuse, is not strictly true. It seems as though the RSGB may be ducking out of its responsibilities, or perhaps they have managed to avoid them in the first place?

A 1984 report into the activities of the RIS and various other official departments contains some interesting points.

'The licensing section are already having discussions which should lead to RSGB members taking responsibility for monitoring their bands and identifying serious and persistent offenders and licence evaders. Responsibility should also be placed upon them (the RSGB) for issuing initial letters to alleged offenders, warning them that evidence will be laid before the RIS unless they mend their ways. The RIS should only take on a case where the RSGB has assembled clear evidence for a prosecution case with a very high probability of conviction.'

Revoking

The report continues, 'The Secretary of State has the power to revoke a licence without taking the case to court. Subject to the safeguards that the RSGB produce evidence of persistent abuse confirmed by RIS, that prior written notification is given to the offender, and

that any defence be properly investigated, it is recommended that this sanction be reintroduced as a method of dealing with abuse. RIS monitoring of the amateur bands should cease, except for the purpose of confirming evidence on cases which the RIS have accepted from RSGB.'

Responsible

Now, if these proposals were ever implemented, it seems that the RSGB not only has the power but also the moral responsibility to actively pursue offenders on our bands and to send out warning letters. If the proposals did not go through, then one wonders why the RSGB, who seem so keen to clean up the image of amateur radio, appear to have missed an excellent opportunity for amateur radio to become a self-policing hobby? Another interesting point is that if the proposals were ever put to the RSGB – and the wording of the report makes it pretty clear that they were – why was the membership not informed of the proposals? Just think about it, the membership polices the bands, the RSGB sends out warning notices, the RIS gives us official backing and the Secretary of State is prepared to revoke licences in proven cases without even going to court. What a wonderful world. Who blew it?

The awards

This month we have three rather special awards to report. The first one goes to Ian G4OUT, from Staffordshire, who claims a 144MHz Gold award. That is a good start, but what makes the award even more special is that it is endorsed for CW contacts only and is the first Gold certificate so marked. The icing on the cake is that Ian already has both the first Bronze and Silver CW only certificates, so he now has a full set to hang on the wall. Ian's claim and copy log entries were computer-generated and are the best yet received.

Going up

The second award goes to Dave GM3WIL in recognition of the first contact between GM and G on 24GHz. He also gets the third certificate this month to confirm the first ever GM and GI contact on 24GHz. Both of these contacts were made using about 8mW to (if my memory serves me correctly), a 12in diameter dish. Dave had been working on these contacts for a long time, so it's nice to see that his perseverance paid off in the end. What makes the contacts even more memorable is that they both included a lot of sea path. This is great on the lower bands, but at 24GHz there is a lot of loss due to water absorption. The GI contact was finally made after rebuilding the RX strip with a 50kHz filter. The stability problems then become enormous; try keeping a free running oscillator inside 50KHz at an operating frequency of 24000MHz.

In space

The satellite news featured in recent issues has brought a very favourable reponse, so regular information on this side of the hobby will be included in the future.

There are several new satellites expected soon and their provisional launch dates are: June 1989 for the new Russian RS11 and 12; and 9 November 1989 for PACSAT, LUSAT, DOVE, UoSat D and UoSat E. The new Japanese unit, JAS-2, is now scheduled for blast-off on 23 January 1990. Information on link frequencies and power budgets etc, will be published as soon as possible. Do not forget that the latest information can be obtained by listening to the AMSAT net on 80m on Sunday mornings. If you want to contact AMSAT direct, then G3AAJ (QTHR) is the man to send your SAE to.

Close-down

I doubt if it will surprise you to learn that in a recent contest a station was heard giving his contact a 59 report, then asking for a repeat on the callsign and the report! Keep the news coming to: 81 Ringwood Highway, Coventry, or on packet via GB7NUN.

The September 1989 issue of ***Amateur Radio*** will be on sale 31 August 1989

50MHz

by Ken Ellis G5KW

We start this month with a report from Smithy G8KG, comparing the progress of cycle 22 with cycles 19 and 21.

'As often happens, the very steep rise in solar activity which reached its highest point early in the year has been followed by what is hopefully no more than a minor trough. **Table 1** shows how similar minor peaks occurred in both cycles 19 and 21 when they were three months older than the present one.

'It can be seen that the three month average solar flux early in 1989 was higher than at the *peak* of cycle 21 and was 10% above the level of cycle 19 at the same age. At the present time the comparison between the cycles is complicated by the fact that 22 is in a minor trough when the others were at minor peaks. In mid-June there were early signs of the start of a further rise and the situation should be clarified during the next few months. SIDC Brussels predicts that the cycle peak could be as early as August of this year while the latest available prediction from NGDC Boulder favours early 1990. The most likely peak value seems to be midway between 19 and 21 – say a three month mean flux around 250sfu – but a steady climb from now into the new year could take us level with, if not above, the peak of 19.'

Since Smithy wrote this report the daily solar flux has started to climb again rapidly; on 15 June it was 314 and the following day it was 321, promising a very high three month mean. The highest daily figure for cycle 21 was 324/325 on 9-10 November 1979 during its peak.

50MHz Reporting Club

This summary of events from Ray Cracknell G2AHU covers the period from 1 September 1988 to 28 February 1989. The period has been momentous for several reasons, but chiefly because nearly all our expectations were exceeded when F-layer propagation opened up 50MHz for world-wide communications. The reasons are not hard to find. Firstly, solar sunspot activity exceeded most, if not all, predictions and secondly there was a marked absence of severe magnetic storms compared with similar stages in preceding solar cycles. Needless to say, these two factors led to some excellent conditions for 50MHz working. Just after the end of the period, the fine aurora of 13 March redressed the deficit somewhat and since the magnetic cycle lags on the sunspot activity, which has been steep, it is possible that many magnetic disturbances may be in store, which will be good news for auroral working.

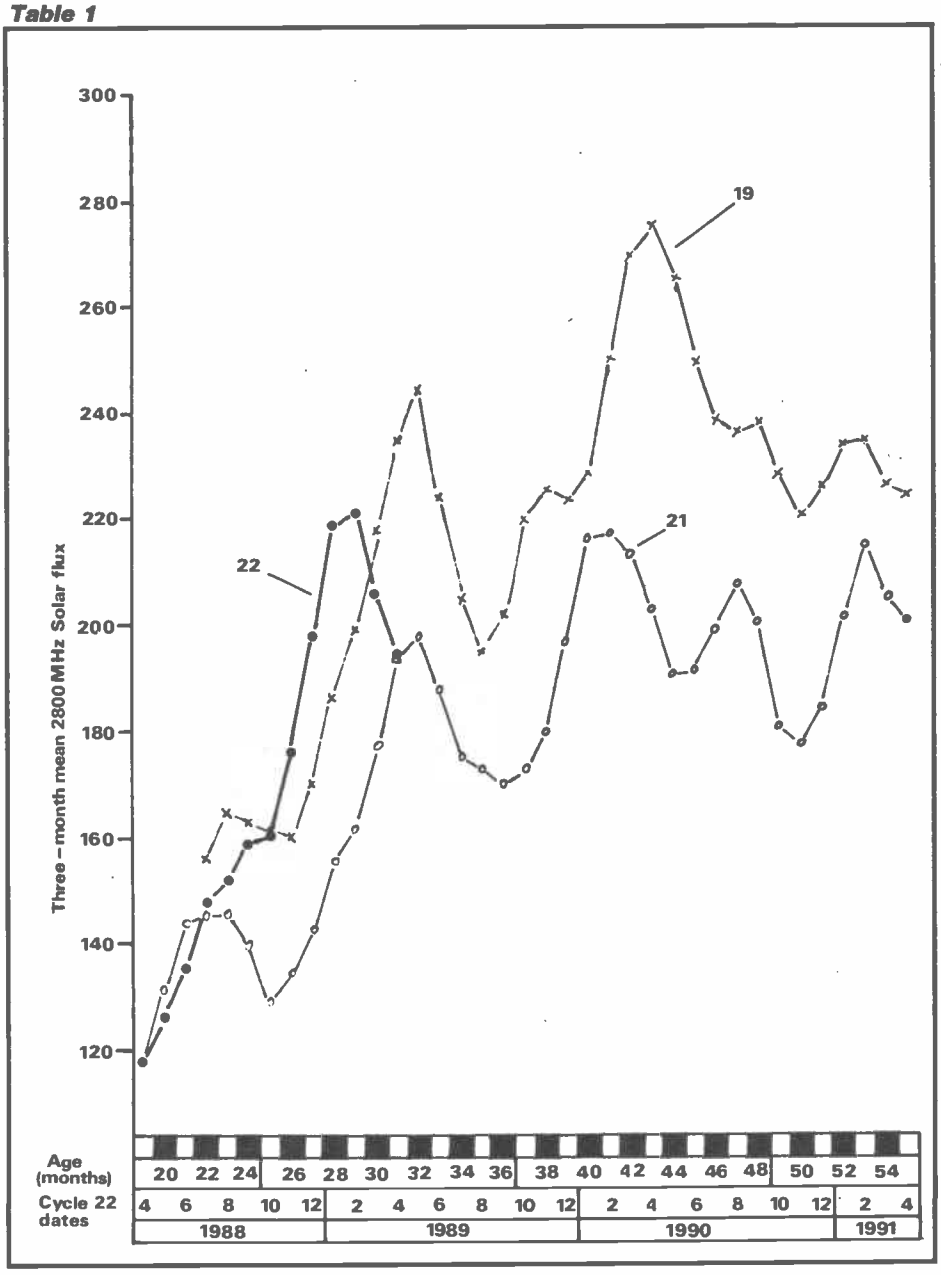
Since the period has been dominated by solar activity, it is logical to look first at what occurred as we began to approach the maximum of cycle 22 which is now predicted by Boulder for February 1990. The neat smooth curve obtained when the mean of all counts during a year is plotted, belies the variation which occurs from day to day and from month to month about the general trend. Boulder's prediction of the maximum in February 1990 is 195+ or −46 for a confidence level. It may be noted that in November 1988 Boulder predicted a count of 132+ or −22 for December 1988; it in fact registered 179.2, so too much reliance must not be placed on these predictions.

The dramatic spurt in December 1988 after a rather dull November took us by surprise and many of us with our antennas down for maintenance missed out on the DX.

Solar flux

Several members have tried to relate solar flux and the K and E magnetic indices to conditions, and report that best conditions tended to follow some days after the highest counts. This is probably owing to the flares associated with high solar flux projecting radiation other than ultra-violet (X-rays for example) in our direction, so that better

Table 1



conditions occur after they rotate beyond the meridian facing the earth. In a more normal period, with several magnetic storms, best conditions could be expected on the day before the storms. The relationship between the K index when it is 4 or below is complex and a rise within this range sometimes accompanied improved conditions. There is scope for much more research along these lines.

Outstanding achievements

Solar activity has remained high and solar flux figures were provisionally quoted at 286 on 16 March. The outstanding event was the intense aurora of the 13 March, which was visible over the British Isles, and in the southern hemisphere the Aurora Australis was reported as seen as far north as 20° over the Kalahari Desert. It provided excellent radio conditions on 28, 50, 144 and 432MHz, and the first authenticated auroral E QSO between KA1MFA and G4GLT at 2234hrs on 13 March, while VE1YX and VE1BPY were also heard in England and Scotland. During March the excellent F-layer transatlantic conditions died away but conditions on north-south paths improved considerably. The ZS3E and ZS3VHF beacons were received in Britain on twenty-three days and ZS4, 5 and 6 on nineteen days. In both cases reliability was highest during the noon period (1130-1430hrs). On 1 March OH worked VK8, and on the 2nd SZ heard VK4. On 20 March VK6KXW worked G4FJK at 0830hrs for the first two-way 50MHz QSO between Britain and Australia. On 23 March G4UPS reported hearing ZL3JVL.

During March auroral QSOs were reported on fourteen days and many major flares brought disturbed conditions as well as the excellent ones experienced between the outbursts of solar energy.

Northerly locations favoured

Comments were received about the apparent difference in conditions between the north and the south, and the south coast and the Channel Isles in particular. The difference was marked on signals from South Africa and Ascension Island on several occasions but not exclusively so; at times the skip favoured the Midlands or Scotland, an opening to GX and LU on 29 March was restricted to GM and GI, and transatlantic F-layer openings between December and February were evenly distributed and frequently covered the whole of the British Isles. Auroral openings strongly favoured more northerly locations as must be expected. The first QSO with Australia was made from the Midlands and the JAs were heard and worked in the Midlands and Scotland as well as in the south.

The first QSO with Hong Kong was between VS6UP and G4UPS at 0858hrs on 25 February, and was followed by contacts with six other Gs and four PAs. At 0909hrs the same morning JH4IUO and JA4MBM were being received over a wide area and by this time it seemed the telephone warning system had alerted every 50MHz operator in the British Isles. At G2AHU a JA CQ was heard followed by a solid blocking of the frequency with strong backscatter signals through which no one could hear a reply. JA4IOU sent QSL cards to several stations and it is very doubtful if any QSO was completed. Fortunately no real harm was done as a second opening occurred next day at 0914hrs when GJ4ICD worked JA4IOU followed by many other G-JA QSOs in the opening lasting until after 1100hrs.

It is not the purpose of these reports to be concerned with operating procedures but all are requested to suggest that short calls followed by a longer listening period should be mandatory for all. DX operators could take a leaf out of J52US's book, whose excellent operating procedure and disciplining of pile-ups have been much admired by many.

F-layer propagation

The optimum skip distance for F-layer propagation during this reporting period appeared to be greater than 4000km. This was well illustrated by the preference of Nova Scotia for one hop F-layer working (4500km from the centre of Britain) and the strong signals experienced from Guinea-Bissau at the same range. While both were highly competent operators using good equipment, had VE1YX been worked by two hop propagation it would have needed an elevation angle of 9° approximately and would have provided much more reliable signals further west in the Toronto area and in the more densely populated areas of the USA.

It is interesting too that ZS3 and ZS6 are at approximately double the distance, and during the noon period the best two hop F-layer signals can be anticipated (although afternoon and evening signals are more likely to have a TEP effect). While ordinary ray propagation via the ionosphere is normally limited to a maximum of 4000km, the extraordinary ray component which is often apparent on ionosonde traces but seldom considered as a means of propagation, provides a greater virtual height and an enhanced usable frequency, and may well account for a skip distance of 4000-5000km at 50MHz during this reporting period.

It is also interesting to note that three-hop ordinary ray propagation to Africa would almost certainly favour the Cape of Good Hope (ZS1) as happened at the peak of cycle 18 in 1947. It is probable that at the peak of the current cycle, ordinary ray propagation will again be possible and it would be unwise to assume that all F-layer propagation at 50MHz would use the extraordinary ray.

The openings to Japan were off the direct beam bearing of 30-40° and were variously reported between 70-90°. Similar off-path propagation is by no means uncommon, particularly in tropical areas, and can take place by deflection or scattering from the ground (or sea) as well as in the ionosphere. Since the JAs have not reported any abnormal beam headings, the deflection probably occurred in the last hop into Britain, possibly from the area to the north of the Caspian Sea, and thereby avoided using the ionosphere over Arctic regions. The path to VK6 (Perth) was anticipated as it avoided a great circle route, arriving here from north of east.

An alternative way of avoiding an Arctic or Antarctic route is to use the long path great circle route. 9H1BT's contacts with Japan at 2145hrs on 8 October 1988 have been repeated on several occasions by other Maltese stations, from Mediterranean and Portuguese locations and from Ascension Island. The greatest distance claimed was by SZ2DH in Athens for his contact with JG2BRI; a distance of 30,627km at 229°, or more than three-quarters of the way around the world if no off-line propagation occurred. Further openings from Greece to Japan have been worked during recent weeks, but since any deviation from the long path great circle would reduce the distance, these cannot be recognised for record purposes, except that 9H1BT's and SZ2DH's long path contacts with Japan are recorded as 'significant firsts'.

The unique natural propagation route followed by these contacts is associated with the equatorial high density belts which follow the line of zero magnetic

TODAY'S TECHNOLOGY

by Ian Poole G3YWX

It is surprising how wide a field amateur radio covers in terms of electronic development and innovation. One thinks first of new RF devices operating at higher frequencies, higher powers or lower noise figures. But there are of course other areas such as synthesiser technology, EMC and the like which are also of great interest. Even topics like superconductors are likely to have an impact on the hobby in years to come.

With this wide variety of topics, it is likely that radio communications involves more aspects of electronics than any other section of the industry.

New forms of synthesiser

There are many ways in which oscillator signals can be synthesised. Many early transmitters and receivers used various mixing techniques in what are called direct synthesisers. Now the phase locked loop is by far and away the most commonly used building block for frequency synthesisers. This form of synthesis is known as indirect.

Although indirect or phase locked loop synthesisers offer many advantages, they still have their drawbacks. The main one is phase noise, and most people will be well aware of it from either reading the technical magazines or just listening to sideband signals on 2m.

One of the reasons for the poor phase noise performance of many synthesisers is the very large division ratios which have to be used. These division ratios are made necessary because cost restraints dictate that only one loop can be used in the synthesiser. On top of this, small tuning steps are needed to give smooth tuning and this means that the phase comparator frequency must be very low (in fact it operates at a frequency equal to the step size).

Now there are new ways of overcoming the problem. With the latest technology it is becoming practicable to use a form of synthesis called Direct Digital Synthesis, or DDS for short. Essentially, this form of synthesis involves generating a digital representation for the waveform using either ordinary logic or a microprocessor. This is then converted into an analogue waveform by using a digital to analogue converter (DAC). Finally, the signal is filtered to remove any unwanted signals caused by the digital nature of the waveform.

The advantage of this form of synthesis is that it is very easy to change the frequency in small increments. If a processor is used it is simply a matter of changing the value of a variable in the processor program. In turn this can be brought about by someone turning a tuning dial, by an input from a remote computer port, or by any control stimulus linked to the processor.

The main drawbacks of this type of synthesiser used to be the phase noise and frequency limit. But now with the new technology which is freely available the phase noise has been reduced, and the upper frequency limits have been increased well in excess of the previous limits of 200kHz or so.

Although direct digital synthesisers are not the complete answer to all synthesiser problems, they can be used in conjunction with phase locked loops. Consequently, they can give a much more cost effective solution to many synthesiser applications. In fact, these hybrid synthesisers are beginning to appear in pieces of amateur equipment emanating from the land of the rising sun.

DTI Regulations change

It has recently been publicised that the DTI is to abolish licences for low power transmitters. Up until now it has been necessary to obtain licences for items like remote controlled garage doors, children's walkie talkies and the like. Now these will not have to be licensed.

Whether this will have a beneficial effect remains to be seen. The new legislation may mean that the standards of equipment fall and this could result in more cases of interference. Alternatively, the increase in the number of small transmitters could have spin-offs into amateur radio. For example, it could soon be possible to buy small units to remotely control the station.

MMICs

MMICs or Monolithic Microwave Integrated Circuits have been around for a few years now. Essentially they are ICs which operate right up to the microwave region of the frequency spectrum. They may be amplifiers, dividers, or in fact any type of circuit, but they all have one thing in common – the IC has microwave components on it. Often these components are only in the form of transistors or FETs, but they can also include capacitors or chokes.

Avantek, an American company, has an

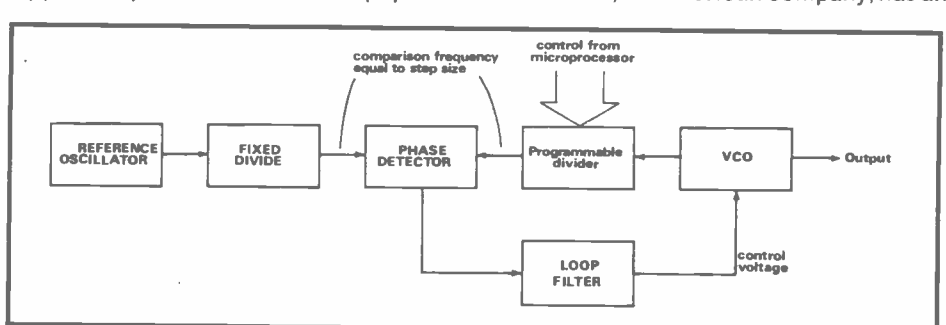
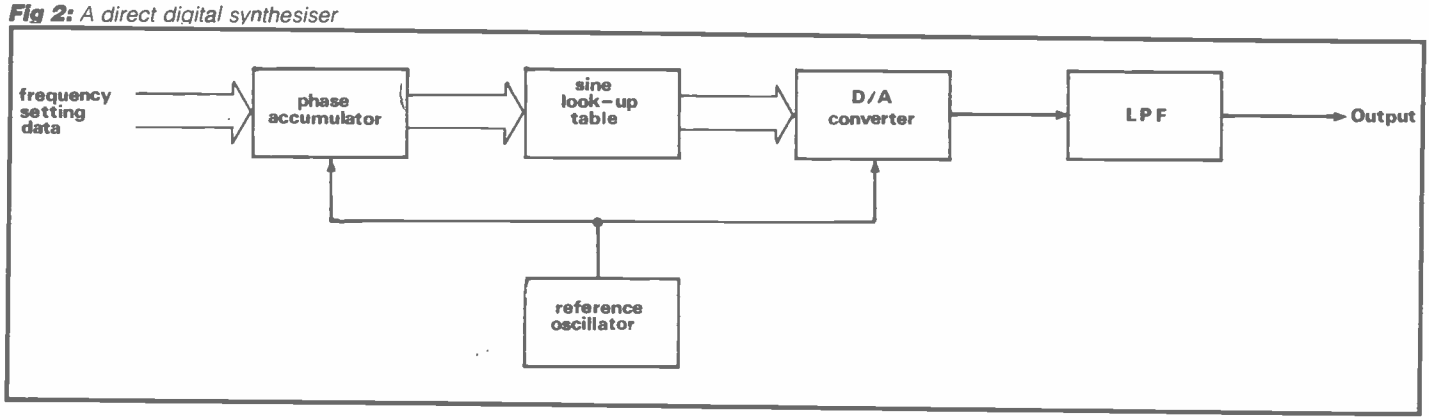


Fig 1: *A typical single loop synthesiser*

Fig 2: *A direct digital synthesiser*



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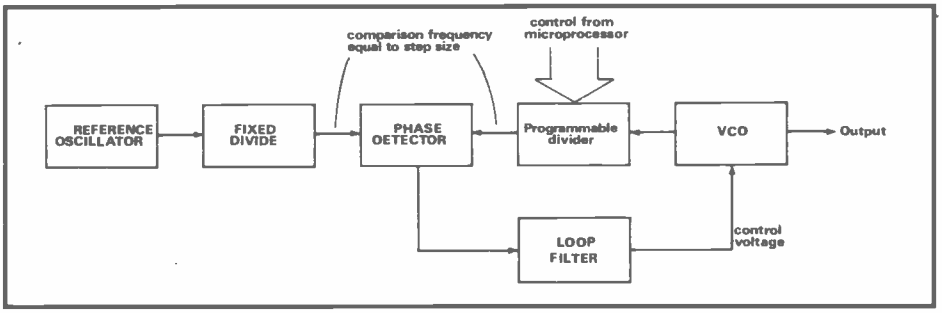

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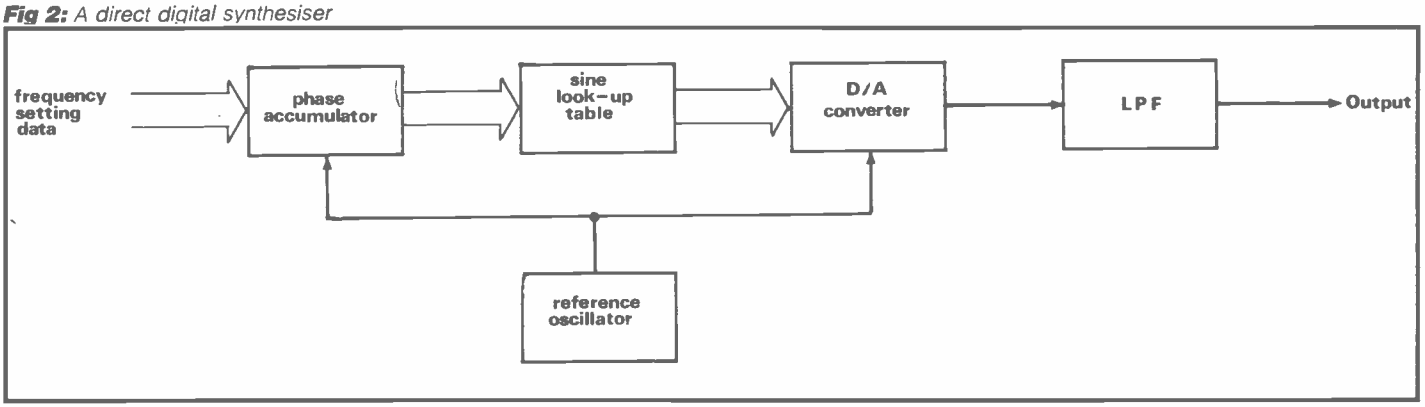


THE INTERNATIONAL TELECOMMUNICATION UNION

by Trevor Morgan GW4OXB

Most amateurs have heard of the ITU, but mostly in reference to the 'ITU zones' used as a reference medium in contests. But who are they? What do they do?

Let's start at the bottom of the ladder. The local club you belong to is, most likely, an associate member of the Radio Society of Great Britain. As you know, the RSGB takes care of the interests of radio amateurs in the UK, and negotiates with the Department of Trade and Industry on matters concerning licences and frequency usage, amongst other things.

The IARU

The International Amateur Radio Union consists of national societies in over 120 different countries and has official observer status at the International Telecommunication Union which is the branch of the United Nations in charge of world conferences and agreements concerning the radio spectrum. It represents the amateur radio fraternity at the World Administrative Radio Conference, the governing body for all radio spectrum usage.

The International Telegraph Union was founded in Paris in 1865 by twenty states, and their first convention led to the first telegraph regulations. This was followed in 1868 by the Bureau of the Union, founded in Berne, Switzerland.

In 1906, the first International Radio conference was held with twenty-seven states represented. This was to be an historic conference as, besides the convention and radio regulations being agreed, the SOS signal was adopted for emergency calls.

In 1927, the membership of the ITU had increased to eighty member states, and the allocation of radio frequencies to various radio user services was agreed. It was in 1932, at the Madrid conference, that the title was changed to the International Telecommunication Union. In 1947, the Administrative Council was formed and agreement with the United Nations approved.

In 1963, the first World Space Radiocommunication conference was held in Geneva, certainly an historic landmark for the ITU. From the first use of telegraph in 1837 to space communications in 1963, the ITU had been in the forefront of development, forging links between users of the radio spectrum and helping to further the knowledge and use of radio communications.

In the days of telegraphy, messengers crossed country boundaries by agreement. With radio communications, there are no physical boundaries, so agreement of the member states must be reached on the use of the radio spectrum. The use of satellite communications has made these agreements even more important.

The purposes of the ITU, as laid down in the convention, are to maintain international co-operation in the development and use of telecommunication; promote the development and efficient operation of technical facilities, thus improving efficiency in telecommunication services and making them available to the general public; and maintain agreement of the member nations to ensure these aims are met.

So, how does all this affect the radio amateur? There are three important groups within the ITU. The International Frequency Registration Board decides if radio frequencies assigned by countries to their radio stations are in accordance with the convention and regulations and do not cause harmful interference to other stations. All frequencies accepted by the board are registered and accorded recognition and protection.

Centralising agencies

The International Radio Consultative Committee (CCIR) and the International Telegraph and Telephone Consultative Committee (CCITT) work in conjunction, acting as centralising agencies for technical information which is assessed by study groups. The recommendations of these groups are presented to the ITU plenary assembly for adoption. Recommendations from the CCIR and CCITT have an important influence with scientists, technical experts, designers and manufacturers of communications equipment world-wide.

The amateur radio service is recognised by the ITU as being one of the oldest radio services in existence. It is defined in the radio regulations as 'a service of self-training, intercommunication and technical investigation, carried on by amateurs being authorised persons interested in radio technique solely with a personal aim and without pecunary interest'. In the ITU programme of international technical co-operation, the technical training of radio amateurs plays a very important part that is often underrated.

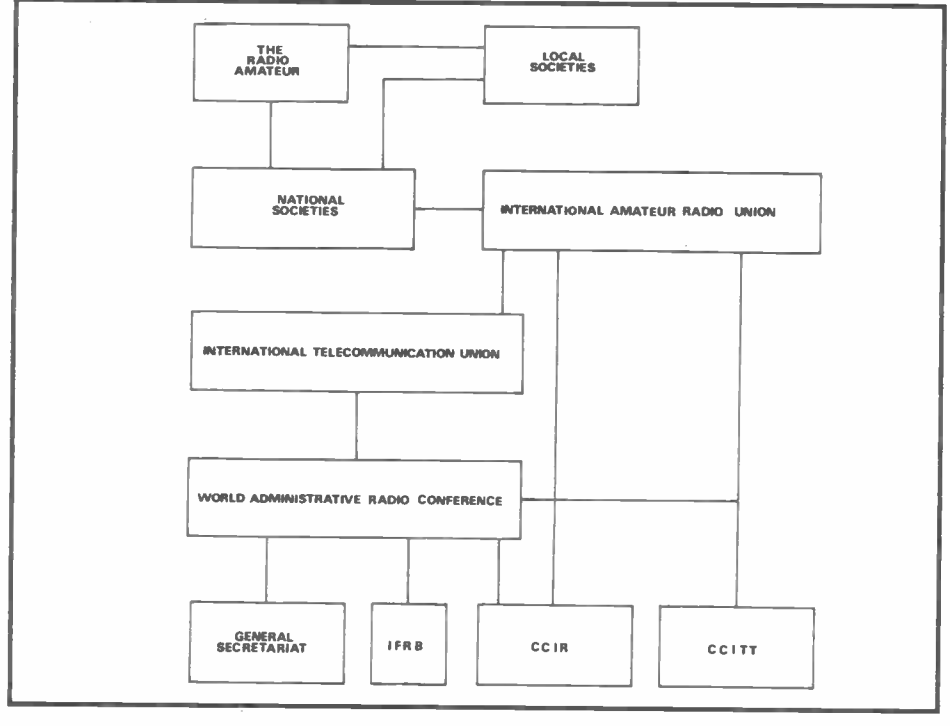
As the RSGB undertakes its obligations to its members by representing their interests at national level, so it is the IARU and the ITU that represent organisations at international level at the World Administrative Radio Conferences.

Amateur radio

Although amateur radio is taken as a hobby in itself, it has led to most of today's advances in communications, such as satellite and microwave communications, and will play an important part in future developments. The International Telecommunication Union plays a very large part in ensuring that the interests of the radio amateur are put forward at the World Administrative Radio Conference, and that amateur frequencies are protected and achievements recognised.

By supporting the Radio Society of Great Britain, we can ensure that our national interests are protected, as well as the future of amateur radio.

The communications chain



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128 x 186 or 263 x 90	½ page	£225.00	£210.00	£200.00	£180.00
263 x 186	1 page	£430.00	£405.00	£385.00	£345.00
263 x 394	double page	£830.00	£780.00	£740.00	£660.00

COLOUR AD RATES

colour rates exclude cost of separations

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
128 x 186 or 263 x 90	½ page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£550.00	£530.00	£470.00
263 x 394	double page	£1,130.00	£1,070.00	£1,010.00	£900.00

SPECIAL POSITIONS

Covers: Outside back cover 20% extra, inside covers 10% extra
Bleed: 10% extra [Bleed area = 307 x 220]
Facing Matter: 15% extra

DEADLINES

*Dates affected by public holidays

issue	colour ad	mono proof ad	mono no proof & small ad	mono artwork	on sale thurs
Sep 89	2 Aug 89	3 Aug 89	9 Aug 89	11 Aug 89	31 Aug 89
Oct 89	30 Aug 89	31 Aug 89	6 Sep 89	8 Sep 89	28 Sep 89
Nov 89	27 Sep 89	28 Sep 89	4 Oct 89	6 Oct 89	26 Oct 89
Dec 89	25 Oct 89	26 Oct 89	1 Nov 89	3 Nov 89	23 Nov 89

CONDITIONS & INFORMATION

SERIES RATES
Series rates also apply when larger or additional space to that initially booked is taken.
An ad of at least the minimum space must appear in consecutive issues to qualify for series rates.
Previous copy will automatically be repeated if no further copy is received.
A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received.
Display Ad and Small Ad series rate contracts are not interchangeable.

If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

COPY
Except for County Guides copy may be changed monthly.
No additional charges for typesetting or illustrations (except for colour separations).
For illustrations just send photograph or artwork.
Colour Ad rates do not include the cost of separations. Printed – web offset.

PAYMENT
Above rates exclude VAT.
All single insertion ads are accepted on a pre-payment basis only, unless an account is held.
Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by the publication date.
Overseas payments by International Money Order or credit card.

FOR FURTHER INFORMATION CONTACT
Amateur Radio, Sovereign House, Brentwood, Essex CM14 4SE.
(0277) 219876

Commission to approved advertising agencies is 10%.

CONDITIONS
10% discount if advertising in both Amateur Radio and Radio & Electronics World.
A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

No. 1 LIST BAKERS DOZEN PACKS

All packs are £1 each, if you order 12 then you are entitled to another free. Please state which one you want. Note the figure on the extreme left of the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

BD2 5 13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
BD7 4 In flex switches with neon on/off lights, saves leaving things switched on.
BD9 2 6V 1A mains transformers uorioht mountino with fixing clamps.
BD11 1 6½in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
BD13 12 30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
BD22 2 25 watt loudspeaker two unit crossovers.
BD29 1 B.O.A.C. stereo unit is wonderful breakdown value.
BD30 2 Nicad constant current chargers adapt to charge almost any nicad battery.
BD32 2 Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
BD42 5 13A rocker switch three tags so on/off, or change over with centre off.
BD45 1 24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day. original cost £40 each.
BD49 10 Neon valves, with series resistor, these make good night lights.
BD56 1 Mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
BD59 2 Flat solenoids—you could make your multi-tester read AC amps with this.
BD67 1 Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
BD91 1 Mains operated motors with gearbox. Final speed 16 rpm, 2 watt rated.
BD103A 1 6V 750mA power supply, nicely cased with mains input and 6V output leads.
BD120 2 Stripper boards, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc.
BD122 10m Twin screened flex with white pvc cover.
BD128 10 Very fine drills for pcb boards etc. Normal cost about 80p each.
BD132 2 Plastic boxes approx 3in cube with square hole through top so ideal for interrupted beam switch.
BD134 10 Motors for model aeroplanes, spin to start so needs no switch
BD139 6 Microphone inserts - magnetic 400 ohm also act as speakers.
BD148 4 Reed relay kits, you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets
BD149 6 Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
BD180 6 Neon indicators in panel mounting holders with lens
BD193 6 5 amp 3 pin flush mounting sockets make a low cost disco panel
BD196 1 in flex simmerstat - keeps your soldering iron etc. always at the ready.
BD199 1 Mains solenoid, very powerful, has 1in pull or could push if modified.
BD201 8 Keyboard switches—made for computers but have many other applications.
BD210 4 Transistors type 2N3055, probably the most useful power transistor.
BD211 1 Electric clock, mains operated, put this in a box and you need never be late.
BD221 5 12V alarms, make a noise about as loud as a car horn. Slightly soiled but OK.
BD242 2 6in x 4in speakers, 4 ohm made from Radiomobile so very good quality
BD252 1 Panostat, controls output of boiling ring from simmer up boil.
BD259 50 Leads with push-on ¼in tags—a must for hook-ups—mains connections etc.
BD263 2 Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress.
BD268 1 Mini 1 watt amp for record player. Will also change speed of record player motor.
BD283 3 Mild steel boxes approx 3in x 3in x 1in deep—standard electrical
BD293 50 Mixed silicon diodes.
BD305 1 Tubular dynamic mic with optional table rest.

CAMERAS. Three cameras, all by famous makers, Kodak, etc. One disc, one 35mm and one instamatic. All in first class condition, believed to be in perfect working order, but sold as untested. You can have the three for £10 including VAT, which must be a bargain—if only for the lenses, flash gear etc. Our ref 10P58

675 VOLT MAINS TRANSFORMER PCB mounting, 20VA. A very well made (British) transformer. Ideal for laser power supply, etc. Price £4. our ref 4P38.

EXTRA SPECIAL CROC CLIPS Medium size, just right for most hook-ups. Normally sell for around 10p to 15p each. These are insulated and have a length of spring rod connected to them but this is very easy to snip off if you do not need it. 20 for £1. Our ref BO117A,

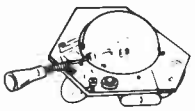
COPPER CLAD PANEL for making PCB. Size approx 12in long×8½in wide. Double-sided on fibreglass middle which is quite thick (about 1 16in) so this would support quite heavy components and could even form a chassis to hold a mains transformer, etc. Price £1 each. Our ref BD683.

POWERFUL IONISER

Generates approx 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, workroom etc. Makes you feel better and work harder—a complete mains operated kit, case included. **£12.50**+£2 P&P Our ref 12P5-1

MODERN TELEPHONES. Two-piece push-button desk or wall mounting telephone. Fitted with standard BT flat plug for immediate use. Standard model £8. Our ref 8P31. Or similar but with 10 memory feature £10. Our ref 10P68. If not collecting add £2 for special packing.

BUSH RADIO MIDI SPEAKERS Stereo pair. BASS reflex system, using a full range 4in driver of 4ohms impedance. Mounted in very nicely made black fronted walnut finish cabinets. Cabinet size approx 8½in wide, 14in high and 3½in deep. Fitted with a good length of speaker flex and terminating with a normal audio plug. Price £5 the pair plus £1 post. Our ref 5P141.



ELECTRONIC SPACESHIP. Sound and impact controlled, responds to claps and shouts and reverses when it hits anything. Kit with really detailed instructions. Ideal present for budding young electrician. A youngster should be able to assemble but you may have to help with the soldering of the components on the pcb. Complete kit £8. Our ref 8P30.

DATA RECORDER FOR COMPUTERS For playing games or for listening to music cassettes. It has a built-in condenser microphone and loudspeaker (muted if you use the extension socket). Has the following controls: pause, stop/eject, fast forward, rewind, play and record. Also has built-in tape counter, extension headphone and microphone socket and volume control. Built-in power supply enables it to run from the mains but provision also for battery operation. In 'as new' condition, but customer returns so may have fault. Price only £10 and if you order 4 you get a fifth one free. Our ref 10P65.

3½in FLOPPY DISC DRIVE—DOUBLE SIDED, DOUBLE DENSITY, 80 TRACK Shugart compatible, has 34 way IDC connector and will interface with almost any computer. Made by the famous Japanese NEC Company. Price £59.50 plus £3 insured post

ATARI 65XE COMPUTER At 64K this is most powerful and suitable for home and business. Complete with PSU, TV lead, owner's manual and six games. Can be yours for only £45 plus £3 insured delivery

65XE COMPENDIUM Contains 65XE Computer, its data recorder XC12 and its joystick with ten games for £62.50 plus £4 insured delivery

AGAIN AVAILABLE: ASTEC PSU. Mains operated switch mode, so very compact. Outputs - 12V 2.5A, +5V 6A, ±5V .5A, ±12V .5A. Size: 7¼in long x 4¾in wide x 2¾in high. Cased ready for use. Brand new. Normal price £30+, our price only £10. Our ref 10P34

VERY POWERFUL 12 VOLT MOTORS. ⅓rd Horsepower. Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £15 plus £2 postage. Our ref 15P8.

PHILIPS LASER

This is helium-neon and has a power rating of 2mW. Completely safe so long as you do not look directly into the beam when eye damage could result. Brand new, full spec, £30 plus £3 insured delivery. Mains operated power supply for this tube gives 8kv striking and 1.25kv at 5mA running. Complete kit with case £15. Battery operated P.S.U. now available at £15.

BATTERY DRIVEN LASER POWER SUPPLY This is available in three versions. **First:** is a cased unit which holds the power supply and is fed from a separate 12 volt battery and drives the laser through extension leads. Kit complete with ABS case. Price £15. Our ref 15P22. **Second:** is a metal cased unit which holds the power supply and the laser but is driven from an external 12 volt battery. This unit, in kit form, costs £18. Our ref 18P2. A conversion kit from 15P22 to 18P2 is £6. Our ref 6P14. **Third:** is a metal cased unit which holds the laser, its power supply and 2×6 volt rechargeable batteries which feed it, also the mains driven unit to recharge the batteries. Complete kit is £24. Our ref 24P2.

MONO RADIO CASSETTE RECORDER AM/FM with all the normal controls. In 'as new' condition but customer returns or shop rejects, so may need attention. Price £10. Order 5 of these and get a sixth one free. Our ref 10P66.

PRETTY CASSETTE PLAYER in handy carrying pouch with silk type shoulder cord. Ideal present for a young girl. New, tested and in perfect order. Just needs headphones and batteries. Price £4. Our ref 4P35.

HIGH RESOLUTION MONITOR. 9in black and white, used Philips tube M24 306W. Made up in a lacquered frame and has open sides. Made for use with OPD computer but suitable for most others. Brand new. **£16 plus £5 post.** Our ref 16P1.

12 VOLT BRUSHLESS FAN. Japanese made. The popular square shape (4½in×4½in×1¾in). The electronically run fans not only consume very little current but also they do not cause interference as the brush type motors do. Ideal for cooling computers, etc., or for a caravan. **£8 each.** Our ref 8P26.

FDD BARGAIN

3½in made by Chinon of Japan. Single sided, 80 track, Shugart compatible interface, interchangeable with most other 3½in and 5¼in drives. Completely cased with 4 pin power lead and 34 pin computer lead £40 plus £3 insured delivery. Our ref 40P1.

MINI MONO AMP on p.c.b. size 4" × 2" (app.) Fitted Volume control and a hole for a tone control should yopu require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of **£1.15** each, or **13** for **£12.00**.

J & N BULL ELECTRICAL

Dept AR, 250 PORTLAND ROAD, HOVE BRIGHTON, SUSSEX BN3 5QT

MAIL ORDER TERMS: Cash, PO or cheque with order. Orders under £20 add £1.50 service charge. Monthly account orders accepted from schools and public companies. Access and B/card orders accepted. –minimum £5. Phone (0273) 734648 or 203500.

POPULAR ITEMS

Some of the many items described in our current list which you will receive if you request it

BATTERY OPERATED TRAVEL MECHANISM. On a plastic panel measuring approx 9in x 3½in. Is driven by a reversible 12V battery motor, fitted with pulley and belt which rotates a threaded rod and causes a platform to travel backwards and forwards through a distance of approx 5in. Price £5. Our ref 5P140.

MAINS OPERATED WATER VALVE with hose connection for inlet and outlet suitable for low pressure. Auto plant watering, etc. Only £1 each. Our ref BD370.

20VOLT 4AMP MAINS TRANSFORMER. Upright mounting with fixing feet. Price £3. Our ref 3P59.

12VOLT SOLENOID. Has good ½in pull or could be made to push if fitted with a rod. Approx. 1½in long by 1in square. Price £1. Our ref BD232A.

16OHM PM SPEAKERS. Approx 7in x 4in. 5 watts. Offered at a very low price so you can use two in parallel to give you 10 watts at 8 ohms. £1 for the two. Our ref BD684.

EHT TRANSFORMER 4kv 2mA. Ex-unused equipment. £5. Our ref 5P139

FOIL CAPACITORS Axial ended .33uf 1 000v. 4 for £1. our ref BD672. Many other sizes in stock. send for May newsletter

4 CORE TINSEL COPPER LEAD As fitted to telephones terminating with flat BT plug. 2 for £1. Our ref BD639

EHT TRANSFORMER 8kv 3mA. £10. Our ref 10P56

DOUBLE MICRODRIVES. We are pleased to advise you that the Double Microdrives which we were offering at about this time last year as being suitable for the 'QL' OPD' and several other computers are again available, same price as before namely £5. Our ref 5P113

VERY USEFUL MAGNETS. Flat, about 1in long, ½in wide and ¼in thick. Very powerful. 6 for £1. Our ref BD247(a).

ACORN COMPUTER DATA RECORDER REF ALF03 Made for the Electron or BBC computers but suitable for most others. Complete with mains adaptor, leads and handbook £10. Our ref 10P44. Plus £2 special packing.

FREE POWER! Can be yours if you use our solar cells - sturdily made modules with new system bubble magnifiers to concentrate the light and so eliminate the need for actual sunshine—they work just as well in bright light. Voltage input is 45 - you join in series to get desired voltage - and in parallel for more amps. **Module A** gives 100mA, Price £1. Our ref. BO631. **Module C** gives 400mA, Price £2. Our ref. 2P199. **Module O** gives 700mA. Price £6. Our ref. 6P3

SOLAR POWERED NI-CAD CHARGER 4 Ni-Cad batteries AA (HP7) charged in eight hours or two in only 4 hours. It is a complete, boxed ready to use unit. Price £6. Our ref. 6P3

METAL PROJECT BOX Ideal size for battery charger, power supply etc.; sprayed grey, size 8in x 4¼in x 4in high, ends are louvred for ventilation other sides are flat and undrilled. Price £2. Order ref. 2P191

4-CORE FLEX CABLE. Cores separately insulated and grey PVC covered overall. Each copper core size 7/0.2mm. Ideal for long telephone runs or similar applications even at mains voltage. 20 metres **£2**. Our ref.2P196 or 100 metres coil **£8**. Order ref. 8P19

6-CORE FLEX CABLE. Description same as the 4-core above. Price 15 metres for **£2**. Our ref. 2P197 or 100 metres **£9**. Our ref. 9P1

13A PLUGS Pins sleeved for extra safety, parcel of 5 for £2. Order ref. 2P186.

13A ADAPTERS Takes 2 13A plugs, packet of 3 for £2. Order ref. 2P187

20V-0-20V Mains transformers 2½ amp (100 watt) loading, tapped primary 200-245 upright mountings £4. Order ref. 4P24.

BURGLAR ALARM BELL 6" gong. OK for outside use if protected from rain. 12V battery operated. Price £8. Ref. 8P2.

CAPACITOR BARGAIN axial ended 4700µF at 25V. Jap made, normally 50p each, you get 4 for £1. Our ref. 613.

SINGLE SCREENED FLEX 7/0.2 copper conductors, pvc insulated then with copper screen, finally outer insulation. In fact quite normal screened flex. 10m for £1. Our ref. BD668

M.E.S. BULB HOLDERS Circular base batten type fitting. 4 for £1. Our ref. BD127a.

SPRING LOADED TEST PROBS – Heavy duty, made by the famous Bulgin company, very good quality. Price 4 for £1. Ref. BO597

3-CORE FLEX BARGAIN No. 1 - Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm for £2. ref. 2P189

3-CORE FLEX BARGAIN No. 2—Core size 1.25mm so suitable for long extension leads carrying up to 13 amps, or short leads up to 25A. 10m for £2. Ref. 2P190

ALPHA-NUMERIC KEYBOARD – This keyboard has 73 keys giving trouble free life and no contact bounce. The keys are arranged in two groups, the main area is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13" x 4"—brand new but offered at only a fraction of its cost, namely £3, plus £1 post. Ref. 3P27

WIRE BARGAIN—500 metres 0.7mm solid copper tinned and p.v.c. covered. Only £3 plus £1 post. Ref. 3P31—that's well under 1p per metre, and this wire is ideal for push on connections.

1/8th HORSEPOWER 12 VOLT MOTOR Made by Smiths, the body length of this is approximately 3in, the diameter 3in and the spindle 5/16th of an inch diameter. It has a centre flange for fixing or can be fixed from the end by means of 2 nuts. A very powerful little motor which revs at 3,000rpm. We have a large quantity of them so if you have any projects in mind then you could rely on supplies for at least two years. Price £6. Our ref 6P1, discount for quantities of 10 or more.

3 VOLT MOTOR Very low current so should oe very suitable for working with solar cells. £1 each. Our ref BO681.

MINI SPEAKERS to use instead of headphones with your personal stereo—simply plug in to earphone socket. Excellent sound quality, only £4 per pair. Our ref 4P34.

INNER EAR STEREO HEADPHONES Ideal for lady listeners as they will not mess up your hair do! Come complete in a neat carrying case. Price £3. Our ref 3P56.

STEREO HEADPHONE AMPLIFIER Very sensitive. A magnetic cartridge or tape head will drive it. Has volume control and socket for stereo headphones. 3V battery operated. £1 each. Our ref BD680

FET CAPACITOR MICROPHONE EAGLE CI.200 Output equivalent to a high class dynamic microphone while retaining the characteristics of a capacitor microphone. Price £1. Our ref BO646

SUB-MIN TOGGLE SWITCH Body size 8mm×4mm×7mm SBOT with chrome dolly fixing nuts. 4 for £1. Our ref BD649.

SUB-MIN PUSH SWITCH DPDT. Single hole fixing by hexagonal nut. 3 for £1. Our ref BO650

DISPLAY 16 CHARACTER 2 LINE As used in telephone answering and similar machines. Screen size 85mm×36mm×9.3mm. Alpha-numeric, dot matrix module with integral CMOS micro processor. LCD display. Made by the EPSON Company, reference 16027AR. Price £10. Our ref 10P50.

WSE – HAM RADIO STORE

ALINCO 2M FM ALR22E

The budget 2m FM rig that is low on price but high on spec. 25 watts with an rx coverage that extends from 140-170MHz (optional). Hundreds in use. Send for full colour brochure.

£249

AZDEN PCS-6000 2M FM + AIRBAND!

This rig is unique. It provides 25 watts of FM on 144-146MHz plus full receive coverage from 108-180MHz AM/FM. 20 memories any duplex split in any memory, auto tone-burst, listen on input etc, etc. The airband section has been purpose designed for the job. Send today for colour brochure.

£329

ALINCO DJ-100E 2M FM

DJ-100 2M FM

NEW

IN STOCK

Latest rig from the ALINCO stable, this hand-held has been developed from the successful ALX-2E. Now incorporating LCD display and 10 memory channels it will fit into even small pockets! The extended receive range covers 140-170MHz and there are no extras to buy. Chris Lorek says in Ham Radio Today, "A lovely little transceiver with a very impressive technical performance".

£219

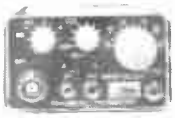
ALINCO ALD-24E Dual Bander

If you thought that duel band rigs were expensive, then look again at this one. It gives true duplex operation with a single antenna output. Basically 2 rigs in one box, it has a superb specification covering 2m & 70cm FM. Extended receive coverage is possible upon request. Probably the most cost effective rig on the market. Send for full details today.

£449

QRP HF TRANSCEIVERS

SSB/CW



Single banders for 80, 40 or 20m with 2 watts output SSB/CW. Fits into the pocket but can work the DX. These rigs have provided us with some fun recently, and they could do the same for you. Ideal for holidays, hotels or just a new challenge. Go anywhere, no TVI and beautifully eningeered. VXO control, IRT, and a host of other features. We got 569 from LA2 on 80m with an indoor wire and Ws on 20m! Send for specification.

£189

BOOKS & FREQUENCY LISTS

THE BOOKS THAT ARE USED BY THE PROFESSIONALS, NEWS AGENCIES, RADIO STATIONS, ETC.

UK Listeners' Confidential Frequency List 1.6 to 30MHz New 1989 Edition	£7.95
Complete Guide to VHF/UHF Frequencies 25 to 2GHz	£5.95
VHF/UHF Airband Guide to Commercial & Military	£5.95
HF Oceanic Airband Communications 1988	£3.50
The Secret of Learning Morse Code	£4.95
Pocket Guide to RTTY & FAX Stations	£2.95
Marine Radio Frequency Guide HF & VHF	£4.95
Airband Radio Handbook Second Edition	£5.95
Air Traffic Control by D Adair	£6.99

DIAMOND POWER METERS

A superb range of VSWR & Power meters from a very famous stable! All with new styling and RMS/PEP readings.

SX-100 1.6 to 60MHz up to 1kW	£95.00
SX-200 1.8 to 200MHz up to 200W	£65.00
SX-400 140-525MHz up to 200W	£79.00
SX-600 1.8 to 525MHz up to 200W	£119.00
SX-1000 1.8 to 1300MHz up to 200W	£159.00

Send for spec sheet

ADONIS MICROPHONES

£49.95

AM-303G Used by many stations to provide that distinctive voice quality on either FM or SSB. A switch selects the correct response for each mode. Touch buttons provide the PTT and the omni-directional microphone gives the distinctive quality that hand mics just can't match. Works with any rig and includes up/down controls.

AM-503G As above but with speech compressor £65.95

NEW! MARINE FREQUENCY GUIDE

This is the latest addition to our frequency guides. It covers LF, HF and VHF, and lists all the UK coastal and port stations, with simplex, duplex and channel numbers together with traffic list times, channel designations etc. Full editorial is included about the marine service including emergency channels, SSB/RTTY/CW. Also listed are the world phone channels normally receivable in the UK. Most HF coastal stations listen on quite separate frequencies to those that they use for transmit. It's all in the guide. Super value as ever!

Marine Radio Frequency Guide £4.95 + £1

NEW! 730V-1 HF ANTENNA

Designed for DX operation on 10, 15, 20 and 40 metres, this aerial is highly efficient and yet easy to install in most situations. Full 1kW rating on SSB and full bandwidth performance at the 2:1 VSR points. No radials and single pole support point makes it ideal for even small QTHs. The robust construction and simple assembly makes this antenna a delight to use. Dimensions: Each element = 5.8m; Total span = 8.3m; Total height = 4.1m from base point to element tip line. 2in mast mounting and full instructions **£149.00. Carriage £7.00 via Securicor**

SONY COMMUNICATIONS

ICF 2001D	150kHz-30MHz + Air	£297.00
ICF 7600DA	150kHz-30MHz AM + FM	£127.00
ICF 7600DS	150kHz-30MHz SSB/AM + FM	£157.00
ICF SW1	150kHz-30MHz AM Compact	£147.00
ICF SW1S	As above with full kit etc	£247.00

ICF PRO80	150kHz-225MHz SSB/FM	£297.00
ICF AIR7	108-174MHz + FM Broadcast	£227.00
AN1	Active short wave antenna	£49.00
ACD4M	Mains power supply charger	£19.95
BP23	Ni-Cad pack for AIR7/PRO80	£16.95
DCC 127A	12V PSU/charger	£24.95

WATERS & STANTON

RETAIL & MAIL ORDER: 18-20 Main Road, Hockley, Essex SS5 4QS
Tel: (0702) 206835/204965

RETAIL ONLY: 12 North Street, Hornchurch, Essex RM11 1QX
Tel: (04024) 44765

Visa and Access by telephone. 24hr Answerphone