APRIL 1990 £2.95

Amateur RADIO

For all two-way radio enthusiasts

QRP: The Other Option

An Unforgettable Journey: The Trusthorpe Saga

A User Review: The AT-300 HF Antenna Tuner

Amateur RADIO

Editorial:
Iain Mackenzie

Advertisement Manager:
Maria Smith

Subscriptions:
01-684 9542

Publisher:
Peter Williams

On sale:
Last Thursday of the month preceding cover date

Next issue:
Cover date May on sale 26 April 1990

Published by:
Amateur Radio Magazines,
Sovereign House,
Brentwood, Essex.
CM14 4SE, England
(0277) 219876

Printed: In England

ISSN: 0264-2557

News Trade Sales by:
S M Distribution,
6 Leigham Court Road,
Streatham, London.
SW16 2PG
Tel: 01-677 8111

Cover:
The Icom IC-R72 Communications Receiver

6 Straight & Level
The latest news, comments and developments on the amateur radio scene

7 The AT-300 HF Antenna Tuner
Ken Michaelson G3RDG takes a look at this tuner from Advanced Electronic Applications Inc

9 QRP: The Other Option
QRP operation represents a great challenge to radio amateurs, says Ian Pool G3YWX, and is helping to bring the spirit back into the hobby. Why not give it a go?

12 The World of Data
Don Field G3XTT with the latest news for datacomms enthusiasts

14 Second-hand
Hugh Allison G3XSE performs a few more successful bodges and shows why amateur radio equipment can be such good value for money

16 DX Diary
Don Field with this month's DX news for HF operators

18 Bits to Build
Rev George Dobbs G3RJV builds the Carlton Three-Band Direct Conversion Receiver, a new construction kit from Lake Electronics

25 Project Book
Martin Williams with a novel way of getting rid of excess voltage

26 The Trusthorpe Saga
Kevin Fox relives an unforgettable journey

29 Chain Home: Battle of Britain Radar
Part 2: From Conception to Maturity by Brian Kendal G3GDU

34 Short Wave Listener
Trevor Morgan GW4OXB exercises some brain power and then turns his thoughts to aerials.

36 The Software File
This month's program from Stephen Phillips designs yagi-type aerials for a frequency range of 40-600MHz

37 On the Beam
Glen Ross G8MWR with the latest news on VHF, UHF and microwaves

SERVICES

28 Subscription Order Form
39 Free Classified Ads
42 Advertising Rates and Information
42 Advertiser's Index

PHONE
0474 560521
FAX
0474 333762

P. M. COMPONENTS LTD

SELECTRON HOUSE, SPRINGHEAD ENTERPRISE PARK
SPRINGHEAD RD, GRAVESEND, KENT DA11 8HD

TELEX
966371
TOS—PM

Semiconductors

AC125	0.30	AU106	6.95	BC184LB	0.09	BD115	0.30	BD51B	0.75	BF259	0.28	BFY50	0.32	BUV41	2.50	R2008B	1.45	TIP125	0.65	2SA715	0.55
AC126	0.45	BC107A	0.11	BC204	0.25	BD124P	0.59	BD520	0.65	BF271	0.28	BFY51	0.32	GET111	2.50	R2009	2.50	TIO142	1.75	2SC495	0.80
AC127	0.20	BC107B	0.11	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	BC208B	0.20	BD132	0.42	BD535	0.45	BF273	0.18	BLY4B	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	BR100	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	BR101	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	BR103	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	BR303	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	BRC4443	1.15	MPSA13	0.29	RCA161B1	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	BRY39	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	BSW64	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	BDX32	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	BDX53B	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	BF115	0.35	BF422	0.32	BT106	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	BF119	0.65	BF423	0.25	BT116	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	BF127	0.39	BF457	0.32	BT119	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	BF154	0.20	BF458	0.36	BT120	1.65	MRF477	14.95	T6029V	0.45	2N3054	0.59	2SC1364	0.50
AD162	0.50	BC147B	0.12	BC258A	0.39	BD1B2	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	BF17B	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	OC2B	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/B5	2.25	2N3733	9.50	2SC1969	2.95
AF124	0.65	BC171	0.09	BC337	0.10	BD232	0.35	BF1B2	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	BU2080	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	TIP3BC	0.43	2N4280	3.50	2SC2029	1.95
AF127	0.65	BC174	0.09	BC461	0.35	BD237	0.40	BF1B5	0.28	BFT43	0.35	BU326S	1.50	OC70	1.00	TIP31C	0.55	2N4427	1.95	2SC207B	1.45
AF139	0.40	BC177	0.15	BC47B	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	BF19B	0.16	BFW16A	1.15	BU426A	0.75	OC75	1.50	TIP34B	0.95	2N5296	0.48	2SC2166	1.95
AF239	0.42	BC1B2LB	0.10	BC548	0.10	BD379	0.45	BF199	0.14	BFW61	0.60	BU500L	2.25	OC81	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	OCB4	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	BFX29	0.30	BU526	1.90	OC139	12.50	TIP42C	0.47	2N5641	16.50	2SC931D	0.95
				BC557	0.08	BD436	0.60	BF245	0.30	BFX84	0.26	BU807	2.25	OC171	4.50	TIP47	0.65	2N5643	16.50	2SK19	0.55
				BC558	0.10	B0437	0.60	BF256LC	0.35	BFXB5	0.32	BUY20	2.15	OC200	4.50	TIP48	0.65	2SA329	0.95	2SK33	0.55
				BC639/10	0.30	B0438	0.75	BF257	0.28	BFXB6	0.25			OC201	5.50	TIP50	0.65			3SK88	0.45
				BCY33A	19.50	BD510	0.95			BFY18	1.35			OC205	10.00	TIP120	0.60				

Integrated Circuits

AN103	2.50	AN7145M	3.95	LA4102	1.50	MB3756	2.50	SAS590	2.75	STK437	7.95	TA7609P	3.95	TBA550Q	3.50	TDA1001	2.95	TOA2581	2.95	UPC11B1H	1.25
AN124	2.50	AN7150	2.95	LA4140	2.95	MC1307P	1.00	SL901B	7.95	STK439	7.95	TA7611AP	2.95	TBA560C	1.45	TDA1003A	3.95	TOA2582	2.95	UPC11B2H	1.50
AN214	2.50	AN7151	2.50	LA4031P	1.95	MC1310P	1.95	SL917B	6.65	STK461	11.50	TA7629	2.50	TBA560Q	1.45	TDA10005	2.25	TOA2593	2.95	UPC11B5H	3.95
AN214Q	2.50	BA521	1.50	LA4400	3.50	MC1327	1.70	SL1310	1.80	STK463	11.50	TAA310A	3.50	TBA570	1.00	TDA1035	2.50	TOA2600	6.50	UPC1191V	1.50
AN236	1.95	CA1352E	1.75	LA4420	3.50	MC1327Q	0.95	SL1327	1.10	STK0015	7.95	TAA320A	3.50	TBA651R	2.50	TDA1037	1.95	TOA2610	2.50	UPC1350C	2.95
AN239	2.50	CA3086	0.46	LA4422	1.50	MC1351P	1.75	SL1327Q	1.10	STK0029	7.95	TAA350A	2.95	TBA673	1.95	TDA1044	2.15	TOA2611A	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	TDA1170	1.95	TOA2640	3.50	UPC1360	2.95
AN247	2.50	CA3130E	2.50	LA4461	3.95	MC1357	2.35	SN7421	0.85	TA7061AP	1.50	TAA570	1.95	TBA750Q	2.65	TDA1180	2.18	TOA2655	4.50	UPC1365C	3.95
AN260	2.95	CA3140s	2.80	LC7120	3.25	MC1358	1.58	SN76110N	0.89	TA7072	2.65	TAA6320S	2.95	TBA800	0.89	TDA1270Q		TOA2680A	2.75	UPC2002H	1.95
AN262	1.95	CA3140T	1.15	LC7130	3.50	MC1496	1.75	SN76115N	1.25	TA7073	3.50	TAA661B	1.95	TBA810AS			3.95	TOA2690	2.45	UPO2114LC	2.50
AN264	2.50	ETT6016	2.80	LC7131	5.50	MC1723	0.50	SN76131N	1.30	TA7108P	1.50	TAA700	1.70		1.65	TDA1327	1.70	TOA3310	2.95	555	0.35
AN271	3.50	HA1137W	1.95	LC7137	5.50	MC3357	2.75	SN76226DN	2.95	TA7120P	1.65	TAA930	3.95	TBA810P	1.65	TDA2002	0.95	TOA3510	3.50	556	0.60
AN301	2.95	HA1156W	1.50	LM323K	4.95	MC3401L	2.50	SN76227N	1.05	TA7129P	2.50	TBA120AS/B/C	1.00	TBA820M	0.75	TDA2003	1.95	TOA3560	3.95	723	0.50
AN303	3.50	HA1306	1.80	LM324N	0.45	MC14106P	2.95	SN76228N	2.95	TA7130P	1.50			TBA820Q	1.45	TDA2010	1.95	TOA4050	2.95	741	0.35
AN313	2.95	HA1322	1.95	LM380N	1.50	MC14518CP	7.50	SN76533N	1.65	TA7137P	1.00	SA/SB/T/U		TBA920	1.65	TDA2020	2.95	TOA4600	2.50	747	0.50
AN315	2.95	HA1339A	2.95	LM380NB	2.95	ML231B	1.75	SN76550N	1.15	TA7146P	1.50	TBA395	1.50	TBA920/2X		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	TBA396	0.75		1.50	TDA2040	3.95	TEA1009	1.35	7808	0.50
AN331	3.95	HA1406	1.95	LM390N	3.50	ML239	2.95	STK011	7.95	TA7203	2.95	TBA440N	2.55	TBA990	1.49	TDA2050	3.15	UPC41C	3.50	7805	0.50
AN342	2.95	HA1551	2.95	LM1011	3.15	MSM5807	8.75	STK014	7.95	TA7204P	2.15	TBA480Q	1.95	TBA990Q	1.49	TEA1009	1.35	UPC566H	2.95	7812	0.50
AN362L	2.50	LA1201	0.95	M5155L	2.95	SAA500A	3.50	STK015	5.95	TA7205AP	1.15	TBA510	2.50	TCA270	2.80	UPC41C	3.50	UPC575C2	1.50	7815	0.50
AN6612	2.15	LA3201	0.95	M51513L	2.30	SAA1025	7.25	STK01B	7.95	TA7208	1.95	TBA520Q	1.10	TCA270SQ		UPC566H	2.95	UPC1001H	1.95		
AN6362	3.95	LA4101	0.95	M51521L	1.50	SAA1251	4.95	STK025	11.95	TA7222AP	1.80	TBA520	1.10		2.50	UPC575C2	1.50	UPC1020H	2.95		
AN7140	3.50			MB3705	1.50	SAA5010	5.35	STK032	7.95	TA7227P	4.25	TBA530Q	1.10	TCA650	2.50	UPC1001H	1.95	UPC1024H	1.50		
AN7145	3.50			MB3712	2.00	SAA5020	5.75	STK07B	11.95	TA722BP	1.95	TBA540	2.50	TCA760	2.50	UPC1020H	2.95	UPC1025H	1.95		
						SAS570S	1.75	STK085	8.95	TA7310P	1.80	TBA540Q	2.80	TCA800	5.95	UPC1024H	1.50	UPC102BH	1.95		
						SAS580	2.85	STK415	7.95	TA7314P	2.95			TCA830S	1.95	UPC1025H	1.95	UPC1032H	0.95		
								STK435	7.95	TA7321P	2.25			TCA900	2.50	UPC102BH	1.95	UPC1158H	0.75		
														TCA940	1.65	UPC1032H	0.95	UPC1167C2	1.95		
														TDA440	2.20	UPC1158H	0.75				
																UPC1167C2	1.95				

BELT KITS

Akai VS1-2-4-5	1.75
Amstrad 7000	1.80
Amstrad 4600-5200	2.95
Ferg 3V22 HR3360	2.75
Ferg 3V23 HR7700	0.95
Ferg 3V29 HR7200	1.80
Ferg 3V31 HR7650	1.80
Ferg 3V35-36 HRD120	1.25
Ferg 42-43-44-45	1.25
Fisher 710-716-722	1.80
Hitachi VT11-33	1.25
Hitachi VT5000	2.25
Hitachi VT8000	0.95
Hitachi VT9300	0.95
Panasonic NV300-333-366	2.25
Panasonic NV370-430	2.50
Panasonic NV777	1.75
Panasonic NV2000	2.15
Panasonic NV7000	1.85
Panasonic NV8600	2.95
Sanyo 11-13-1500	1.80
Sanyo VTC5000	0.75
Sanyo VTC5300-5350	1.80
Sanyo VTC5500	2.95
Sanyo VTC9300	3.80
Sharp 9300-9500	1.75
Sharp 8300	2.95
Sharp 7300	2.95
Sony SLC5-7	2.75
Sony 6C	2.25
Sony SLC9	3.25
Sony SL8000	3.25
Toshiba 9600	1.25

20% Discount on 10 or more mixed belt kits

VIDEO HEADS

3HSSH	25.50
3HSSHA	25.50
3HSSHB	25.50
3HSSN	18.95
3HSSSF	35.00
3HSSSP	27.50
3HSSUIN	26.99
3HSSU2N	37.50
3HSSU3N	35.00
3HSSV	18.95
3HSSVA	29.50

PS38S	24.50
PS38SF	35.00
PS38T	30.00
PS482S	29.95
PSB3S	45.00

10% Discount on Five Mixed Heads

EHT MULTIPLIERS

Universal Tripler	5.45
Decca 30	5.35
Decca 80	6.95
Decca 100	6.95
Decca 120	6.95
Decca 1730	6.35
GEC 2040	5.45
GEC 2110	6.95
ITT CVC1-9	6.35
ITT CVC20/25/30	6.35
ITT CVC45	6.95
Philips GB (550)	6.95
Philips G9	6.00
Pye 697	6.50
Pye 713 4 lead	6.50
Pye 713 5 lead	6.50
Pye 731/25	6.50
Rank A774	6.35
Rank A823	6.95
Rank T20A	6.95
Siemens TVK76/1	6.95
Siemens Europa	7.50
Thorn 1500	5.45
Thorn 1600	5.45
Thorn 3500	7.95
Thorn 8000	6.95
Thorn 8500	7.15
Thorn 9000	6.50
Thorn 9600	6.50
TV11 Stick	0.90
TV13 Stick	1.25
TV18 Stick	1.10
TV20 Stick	1.40

PYE 713 4 LEAD	8.50
PYE 713 5 LEAD	8.50
PYE 731/25	8.50
RANK A774	6.35
RANK A823	6.95
RANK T20A	6.95
SIEMENS TVK76/1	6.95
SIEMENS EUROPA	7.50
THORN 1500	5.45
THORN 1600	5.45
THORN 3500	7.95
THORN 8000	6.95
THORN B500	7.15
THORN 9000	8.50
THORN 9600	8.50
TV11 STICK	0.90
TV13 STICK	1.25
TV18 STICK	1.10
TV20 STICK	1.40

FUSES — SPECIAL OFFER 100 PER TYPE

2MM Q/QB @ 0 06 each £4.50
100MA 200MA 250MA 500MA
1Amp 1 25Amp 1 5Amp
1 6Amp
2Amp 2 5Amp 3 15Amp 4Amp

20MM A/S @ 0 15 each £11.50
100MA 150MA 160MA 250MA
500MA 800MA 1 25Amp
2Amp 3 15Amp 5Amp

1 25 inch Q/B @ 0 06 each £4.00
250MA 500MA 750MA 1Amp
1 5Amp 2Amp 3Amp 7Amp
10Amp

1 25 inch A/S @ 0 15 each £10.00
50MA 60MA 100MA 150MA
250MA 500MA 750MA 1 5Amp
3Amp 4Amp 5Amp

We have recently introduced a special [illegible] and can offer the following special[illegible]

Special Selection of [illegible] £1.00 per valve

Supply and fitting of [illegible] £1.00 per ring

Special selection and matching of [illegible] £1.00 per valve

Valve Hardware List

SOCKETS

A12	1.75
B4 CHASSIS	2.50
B5 CHASSIS	2.50
B5 FLOATING	2.50
B7 CHASSIS	1.75
B7A CHASSIS	8.50
B7G PCB	0.65
B7G PCB CERAMIC	0.95
B7G CHASSIS	0.65
B7G CHASSIS SHOCKPROOF	0.65
B7G SKIRTED CHASSIS	0.65
B7G SKIRTED PCB	0.95
B7G SKIRTED PTFE CHASSIS	0.95
B8A CHASSIS	0.85
B8G CHASSIS	0.85
8BH CRT	0.45
B9A PCB	0.45
B9A OCB THIN	0.95
B9A CHASSIS	0.95
B9A CHASSIS SHOCKPROOF	0.50
B9A SKIRTED CHASSIS	1.25
B9A SKIRTED CHASSIS CERAMIC PINCH	0.65

PLUGS

OCTAL	0.85
B7G	0.35
B9A	0.65

CANS

B7G	0.35
B9A	0.65
B9A SKIRTED PCB	1.25
B9D CERAMIC PCB	0.95
B9D CERAMIC CHASSIS	0.95
B9G CERAMIC CHASSIS	2.50
B10B CHASSIS	0.50
B13B CHASSIS	0.50
B14A CRT (3BP1)	1.95
OCTAL VINTAGE CHASSIS	0.35
OCTAL CHASSIS	0.65
OCTAL PCB	0.95
GIANT 7 PIN (813) SOCKET	8.50
JUMBO 4 PIN	13.95
GIANT 4 PIN (12 2PH)	25.00
NUVISTOR	4.50
SK406	9.50
SK410	35.00
SK410S	25.00
SK670A	35.00
CHIMNEY (SK410S)	
SK410A	3.50
UX4 CHASSIS	1.95
UX5 CHASSIS	1.95
UX7 CHASSIS	2.95
X9V CHASSIS	0.50
12PGF CHASSIS	0.50

TOP CAPS

NOVAL	0.75
OTHERS ON APPLICATION	

EX-EQUIPMENT

4CX250B AEI BASE	15.00
4CX250B MILITARY SOCKET	10.00
4CX300A CLAMPS	5.00

DIODES

AA119	0.10	BYX36 150R	0.20
BA115	0.13	BYX38 600R	0.60
BA145	0.16	BYX55 600	0.30
BA148	0.17	BYX71 600	1.75
BA154	0.06	BZX61	0.15
BA156	0.15	BZX88	0.10
BA157	0.30	BZY95C30	0.35
BA244	0.75	CS4B	8.00
BA301	0.75	CS10B	18.50
BA302	0.85	MR510	0.65
BA313	0.75	MR512	0.65
BA318	2.95	OA47	0.15
BA379	2.95	OA90	0.10
BA521	1.75	OA91	0.15
BAV21	0.30	OA95	0.10
BAW62	0.19	OA202	0.40
BAX13	0.04	IN21DR	5.00
BAX16	0.12	IN23B	2.95
BB151	0.79	IN23C	4.95
BY126	0.10	IN23ER	4.95
BY127	0.11	IN23WE	2.95
BY133	0.15	IN4001	0.04
BY164	0.45	IN4003	0.04
BY176	1.20	IN4004	0.05
BY179	0.63	IN4007	0.06
BT182	0.55	IN4148	0.02
BY184	0.35	IN4448	0.10
BY187	0.45	IN5401	0.12
BY199	0.40	IN5402	0.14
BY206	0.14	IN5403	0.12
BY208 800	0.33	IN5406	0.13
BY210 800	0.33	IN5407	0.16
BY223	0.90	IN5408	0.16
BY298 400	0.22	ITT44	0.10
BY299 800	0.22	ITT923	0.15
BYX10	0.50	ITT2002	0.10
BYX25 600	1.25		

ZENER DIODES

BZX61 Series	0.15
BZY88 Series	0.20

INDUSTRIAL AND SPECIAL QUALITY CATHODE RAY TUBES
A small selection from our stock of 10 000

Please add £3 additional carriage per tube

1CP1	29.50
12CSP4	35.00
1074H	45.00
307BQ	95.00
CME B22W	7.00
CME1523W	9.50
CRE1400	29.50
D9 110GH	45.00
D10 210GH	45.00
D10 230GM	45.00
D13 611GH	59.00
D13 630GH	59.00
D14 200GM	75.00
D16 100GH97	65.00
DH3 91	55.00
ECR35	39.50
F16 101GM	75.00
F21 130GR	75.00
F31 12LD	75.00
LF708	75.00
M7 120W	19.50
M14 100GM	35.00
M17 151GVR	175.00
M21 11W	55.00
M23 112GV	45.00
M24 121GH	55.00
M24 122WA	55.00
M28 13LG	45.00
M31 1B2GV	45.00
M31 1B4W	55.00
M31 190GR	45.00
M31 191W	55.00
M31 325GH	35.00
M38 100W	59.00
M40 120W	59.00
SE5FP31	45.00
T975D	75.00

APRIL '90 PRICE LIST

P. M. COMPONENTS LTD

SELECTRON HOUSE, SPRINGHEAD ENTERPRISE PARK
SPRINGHEAD RD, GRAVESEND, KENT DA11 8HD

APRIL '90 PRICE LIST

A1714 24.50
A1834 7.50
A2087 11.50
A2134 14.95
A2272 15.00
A2293 5.50
A2426 29.50
A2599 37.50
A2792 27.50
A2900 11.50
A3283 24.00
A3343 38.95
ACSP3A 4.95

AC/S2PEN 8.50
ACT22 59.75
AH221 39.00
AH238 39.00
AL60 6.00
AN1 14.00
ARP12 2.50
ARP34 1.25
ARP35 2.00
AZ11 4.50
BT5B 55.00
BT113 35.00
C1K 27.50
C3M 17.95
C1134 32.00
C1149/1 120.00
C1150/1 135.00
C1166 125.00
C1534 32.00
CCA 3.50
CD24 5.50
CK1006 3.50
CK5676 6.50
CV Nos prices on request
CX1140 495.00
CX1528 3250.00
D3A 27.50
D63 1.20
DA41 22.50
DA42 17.50
DA90 4.50
DAF91 0.95
DAF96 0.95
DC70 1.75
DC90 3.50
DCX-4-5000 25.00
DET16 28.50
DET18 28.50
DET20 2.50
DET22 29.50
DET23 35.00
DET24 27.50
DET25 22.00
DET29 32.00
DF61 3.50
DF91 1.50
DF92 1.50
DF96 1.25
DF97 1.25
DG10A 6.50
DH63 3.50
DH77 1.50
DK91 1.20
DK92 1.50
DL35 2.50
DL63 1.50
DL70 2.50
DL73 2.50
DL91 3.95
DL92 1.50
DL93 1.50
DLS10 13.50
DLS16 10.00
DM70 5.25
DM160 6.50
DOD-006 79.50
DY51 1.50
DY86/87 0.85
DY802 0.85
E55L 49.50
E80CC 25.00
E80CF 12.50
E80F 12.50
E80L 29.50
E81CC 5.50
E81L 12.00
E82CC 4.50
E83CC 4.50
E83F 5.50
E84L 6.50
E86C 9.50
E88C 7.95
E88CC 4.50
E88CC-01 6.95
E88CC Mullard 6.95
E90CC 7.95
E90F 7.95
E91H 4.50
E92CC 3.95
E99F 5.95
E130L 18.50
E180CC 10.50
E180F 4.50
E182CC 9.00
E186F 8.50
E188CC 7.50
E235L 12.50
E280F 19.50
E283CC 12.00
E288CC 17.50

A SELECTION FROM OUR STOCK OF BRANDED VALVES

E810F 25.00
E1148 1.00
EA50 1.00
EA52 75.00
EA76 1.95
EA79 1.95
EABC80 1.95
EAC91 2.50
EAF42 1.20
EB34 1.50
EB41 3.95
EB91 0.85
EBC33 2.50
EBC41 3.50
EBC81 1.50
EBC90 1.95
EBC91 1.95
EBF80 0.95
EBF83 0.95
EBF89 0.95
EBF93 0.95
EBL21 4.50
EC52 0.75
EC53 1.50
EC70 1.75
EC81 7.95
EC86 1.95
EC88 1.95
EC90 1.95
EC91 5.50
EC93 1.50
EC95 7.00
EC97 1.10
EC8010 12.00
ECC32 3.50
ECC33 3.50
ECC35 3.50
ECC81 1.95
ECC82 0.95
ECC82 Philips 1.95
ECC83 1.50
ECC83 Brimar 2.15
ECC83 Philips 1.95
ECC83 Siemens 2.50
ECC83 Super.... 3.50
ECC85 1.50
ECC86 2.75
ECC88 1.50
ECC89 1.50
ECC91 2.00
ECC189 2.50
ECC801S 5.95
ECC803S 6.95
ECC804 0.50
ECC2000 7.95
ECF80 1.15
ECF82 1.50
ECF86 1.70
ECF200 1.85
ECF202 1.85
ECF801 0.85
ECF804 6.50
ECF805 2.50
ECH35 3.50
ECH42 1.50
ECH81 1.75
ECH83 1.50
ECH84 1.50
ECH200 1.50
ECL80 1.00
ECL82 1.50
ECL83 2.50
ECL84 1.00
ECL85 0.95
ECL86 1.50
ECL805 0.95
ECLL800 22.50
EF37A 2.50
EF39 1.50
EF40 4.50
EF42 3.50
EF50 2.50
EF54 4.50
EF55 4.95
EF70 1.20
EF72 3.50
EF73 3.50
EF80 0.65
EF83 3.95
EF85 0.85
EF86 3.50
EF86/CV4085- 7.50
EF89 1.95
EF91 1.50
EF92 2.15
EF93 1.50
EF94 1.50
EF95 1.95
EF97 0.90
EF98 0.90
EF183 0.75
EF184 0.85
EF731 4.50
EF800 11.00
EF804S 19.50
EF805S 25.00
EF806S 25.00
EF812 0.65
EFL200 1.50
EFP60 3.50
EH90 0.72
EK90 1.50
EL32 0.95
EL34 Siemans 3.95
EL34 Super 5.50
EL36 2.50
EL38 4.50
EL41 3.50
EL42 2.00
EL71 4.50
EL81 5.95
EL83 7.50
EL84 1.50
EL84 Mullard 4.50
EL84 Siemans 2.50
EL84 Super 3.50
EL85 4.50
EL86 1.75
EL90 1.75
EL91 4.50
EL95 1.75
EL152 15.00
EL360 5.75
EL500 1.95
EL504 1.95
EL509 5.95
EL519 6.95
EL802 3.65
EL821 6.95
EL822 12.95
ELL80 22.50
EM34 12.50
EM81 2.50
EM81 3.50
EM83 1.65
EM84 1.65
EM85 3.95
EM87 2.50
EN32 15.00
EN91 2.25
EN92 4.50
EY51 0.80
EY70 7.50
EY81 2.95
EY82 1.15
EY83 1.50
EY84 5.95
EY86/87 0.65
EY88 1.50
EY91 5.50
EY500A 2.95
EY802 0.70
EZ35 1.00
EZ40 3.50
EZ41 3.50
EZ80 0.75
EZ81 1.50
EZ90 1.50
FW4-800 4.50
FX2535 195.00
G55/1K 9.00
G180/2M 6.95
G240/2D 9.00
GC10B 17.50
GC10D 17.50
GN10 15.00
GS10H 12.00
GS12D 12.00
GT1C 9.50
GU20 35.00
GU50 17.50
GXU1 13.50
GXU3 24.00
GXU50SS 14.50
GY501 1.50
GY802 1.50
GZ32 4.50
GZ33 4.50
GZ34 4.50
GZ37 4.50
HBC90 1.95
HL41 3.50
HL90 3.50
KT8C 7.00
KT33C 3.50
KT36 2.95
KT44 5.95
KT45 5.95
KT61 5.00
KT63 2.95
KT66 USA 11.95
KT66 GEC 25.00
KT66 TEON-EX 5.00
KT67 9.00
KT77 Gold lion 11.95
KT81 7.00
KT88 USA 12.95
KT88 Selectron 15.00
KTW61 2.50
KTW62 2.50
KTW63 2.00
KTZ63 2.50
LB7-20 95.00
LS9B 6.95
M508 195.00
M5143 155.00
M5199 295.00
M8079 6.00
M8082 7.50
M8083 3.25
M8091 7.50
M8096 3.00
M8098 5.50
M8099 5.00
M8136 7.00
M8137 7.95
M8161 5.50
M8162 5.50
M8163 5.50
M8190 4.50
M8195 5.50
M8196 5.50
M8204 5.50
M8223 4.50
M8224 2.00
M8225 3.95
ME1400 3.50
ME1401 9.50
ME1402 29.50
MHLD6 4.00
MP25 195.00
MS4B 5.50
MU14 3.50
N37 12.50
N78 9.65
OA2 1.50
OA2WA 2.50
OA3 2.50
OB2 1.50
OB2WA 2.50
OC3 2.50
OD3 2.50
OM4 2.50
OM5B 3.00
OM6 1.75
ORP43 2.50
ORP50 3.95
P61 2.50
P41 2.50
PABC80 0.95
PC86 0.75
PC88 0.75
PC97 1.10
PC900 1.25
PCC84 0.40
PCC85 0.55
PCC88 0.95
PCC89 0.70
PCC189 0.70
PCC805 0.70
PCC806 0.80
PCE82 0.80
PCF80 0.65
PCF82 0.50
PCF84 0.65
PCF86 1.20
PCF87 1.25
PCF200 1.80
PCF201 1.80
PCF801 1.35
PCF802 0.85
PCF805 1.25
PCF806 1.00
PCF808 1.25
PCH200 1.50
PCL82 0.95
PCL83 2.50
PCL84 0.75
PCL85 0.95
PCL86 0.95
PCL805 0.95
PD500 5.95
PEN25 2.00
PEN40D 3.00
PEN45 3.00
PEN45DD 3.00
PEN46 2.00
PFL200 0.95
PL36 1.75
PL38 1.50
PL81 1.50
PL82 0.60
PL83 0.85
PL84 0.85
PL500 1.50
PL504 1.50
PL508 1.50
PL509 4.95
PL519 4.95
PL802 6.00
PL802T 3.50
PL820 2.95
PY32 0.60
PY33 0.60
PY81 0.85
PY82 0.85
PY83 0.85
PY88 0.95
PY500A 1.95
PY800 0.95
PY801 0.95
QB3-300 72.00
QB3-1750 139.50
QB5-3500 595.00
QQE02-5 19.50
QQE03-12 7.95
QQE03-20 35.00
QQE06-40 45.00
QQV02-6 19.50
QQV03-10 8.50
QQV03-10 Mullard 15.00
QQV03-20 25.00
QQV06-40A 27.50
QQV06-40A Mullard 39.50
QQV07-50 Mullard 55.00
QQZ03-20 Mullard 42.50
QQZ06.40 Mullard 45.00
QS75/20 1.50
QS95/10 4.85
QS108/45 4.00
QS150/15 5.95
QS150/30 1.15
QS150/40 7.00
QS1205 3.95
QS1213 5.00
QU37 9.50
QV03-12 5.50
QV05-25 3.50
QV06-20 29.50
QV08-100B 145.00
QY3-125 85.00
QY4-250 105.00
QY4-400 110.00
R10 4.00
R18 2.50
RG1-240A 14.50
RG3-250A 6.50
RG3-1250A 35.00
RR3-250 15.00
RR3-1250 35.00
S11E12 38.00
S104/2K 10.00
SC1/1300 5.00
SP61 3.50
STV280/40 11.95
TB2-5/300 95.00
TB2-300 195.00
TB3-750 115.00
TB3-2000 450.00
TBL2-300 395.00
TBL2-500 495.00
TD03-10/D/E/F 35.00
TT15 45.00
TT21 45.00
TT22 39.50
TT100 69.00
TY6800 125.00
TY2-125A 105.00
TY8-600W 365.00
U19 6.50
U26 0.90
U35 3.50
U37 9.00
U41 5.95
U50 3.00
U82 3.00
U191 0.70
U192 1.00
U193 1.00
U251 2.50
U801 3.50
UABC80 1.00
UAF42 1.95
UBC41 3.95
UBC81 1.50
UBF80 0.95
UBF89 1.00
UBL21 2.95
UC92 2.50
UCC84 0.70
UCC85 1.00
UCF80 1.00
UCH21 2.50
UCH41 2.50
UCH42 3.95
UCH81 1.95
UCL81 1.00
UCL82 1.75
UCL83 2.50
UF41 2.25
UF42 2.25
UF80 1.75
UF85 1.20
UF89 2.00
UL44 3.50
UL84 1.95
UL85 0.85
UM80 1.65
UM85 1.65
UU5 3.50
UU6 6.00
UU7 5.00
UU8 9.00
UY41 3.50
UY85 0.70
V235A/1K 250.00
V238A/1K 295.00
V246A/1K 250.00
V246A/2K 315.00
V241C/1K 195.00
V453 12.00
VLS631 10.95
VP4B 9.50
VP41 4.95
VR101 2.50
VR105/30 2.50
VR150/30 2.50
VU39 2.50
W21 4.50
W61 4.50
W77 5.00
W81M 4.50
W739 1.50
X24 4.50
X41 4.50
X66/X65 3.50
X76M 1.95
XC23 3.50
XC24 1.50
XC25 0.50
XFW47 1.50
XFW50 1.50
XG1-2500 75.00
XL628FT 7.50
XNP12 2.50
XR1-1600 25.00
XR1-3200A 79.50
XR1-6400A 149.50
Y65 6.95
YD1100 75.00
YL1020 42.50
YJ1060 265.00
YL1060 195.00
YL1070 195.00
YL1071 195.00
YL1290 65.00
Z77 1.20
Z300T 5.00
Z302C 12.00
Z359 9.00
Z700U 9.50
Z759 15.00
Z803U 16.95
ZM1020 8.50
ZM1021 6.00
ZM1023 7.95
ZM1082 9.00
ZM1084 10.00
ZM1162 9.00
ZM1175 6.50
ZM1177 9.00
1A3 4.50
1AE4 3.50
1AX2 3.50
1B22 10.00
1B27 55.00
IB3GY 1.95
1B35A 45.00
1K3 2.50
IL4 2.50
1N5GT 2.50
1P28 25.00
1R5 1.50
1S5 1.50
1T4 1.50
1U4 1.75
1U5 1.50
1X25 2.50
2A3 12.15
2AS15A 11.50
2B7 4.50
2B22 69.50
2C36 70.00
2C39A 25.00
2C39BA 39.50
2C40 37.00
2C42 29.50
2C43 50.00
2C51 2.50
2CY5 1.50
2D21 2.25
2D21W 3.15
2E22 49.00
2E26 7.95
2J55 295.00
2K25 59.00
2K26 95.00
2K29 250.00
2K48 140.00
2K56 250.00
2X2A 5.00
3A/107B 12.00
3A/108A 9.00
3A/109B 11.00
3A/110B 12.00
3A/141K 11.50
3A/146J 7.50
3A/147J 7.50
3A167M 10.00
3A3A 3.95
3A4 1.50
3A5 4.50
3AT2 3.35
3B22 25.00
3B26 24.00
3B28 15.00
3BZ8 1.50
3C45 39.50
3CX3000A7 650.00
3CYS 1.50
3D21A 29.50
3E22 49.50
3E29 39.50
3EJ7 1.95
3H 0.40
3J.170E 1450.00
3L 0.40
3Q4 2.50
3V4 3.50
4-65A 85.00
4-250A 105.00
4-400C 95.00
4-1000A 495.00
4B32 35.00
4BQ7A 1.75
4BZ6 1.95
4C28 25.00
4C35 95.00
4C250R 265.00
4CV35,000 1650.00
4CV100,000 2950.00
4CX125C Eimac 150.00
4CX250B 65.00
4CX250BM 85.00
4CX250K EIMAC 115.00
4CX250R 115.00
4CX350A 100.00
4CX1000A 425.00
4CX1500B 475.00
4CX5000A 1000.00
4D21/4-125A 85.00
4D32 125.00
4E27A 125.00
4GS7 2.25
4GV7 2.25
4JC6A 2.95
4KT6 1.50
4T85P 150.00
4X150A 35.00
4X150D 55.00
4X500A 350.00
5A/102D 9.50
5A152M 9.00
5A163K 10.00
5A170K 6.25
5A-180M 9.00
5A-206K 10.00
5B-110M 10.00
5B-254M 11.50
5B-255M 11.50
5B-256M 15.00
5B-257M 15.00
5B-258M 14.50
5C22 125.00
5CL8A 2.50
5J180E 1950.00
5LJ8 2.95
5R4GY 4.95
5R4WGY 5.95
5T4 5.95
5T8A 1.95
5U4G 2.95
5U4GB 4.50
5V4G 2.50
5W4 4.95
5X4 4.95
5Y3GT 3.50
5Z3 4.50
5Z4G 2.50
6/30L2 0.70
6A203K 9.00
6A7 4.95
6A8 2.50
6AB4 3.50
6AB7 4.50
6AC7WA 2.00
6AG5 2.50
6AG7 2.50
6AH6 3.50
6AJ4 3.50
6AJ7 2.00
6AK5 1.95
6AK6 2.50
6AL5 0.85
6AM4 3.25
6AM5 4.50
6AM6 1.95
6AN5 4.50
6AN8A 4.50
6AQ5 1.75
6AQ8 1.50
6AS5 1.50
6AS6 2.50
6AS7G 4.50
6AT6 1.95
6AT8 1.75
6AU4GT 2.95
6AU5GT 4.50
6AU6 1.50
6AV6 1.95
6AW6A 3.50
6AX4GT 1.95
6AY3B 1.95
6AZ8 4.50
6B4G 10.50
6B8G 2.50
6B10 1.95
6BA6 1.50
6BA7 4.50
6BA8A 3.50
6BC8 1.50
6BR3 2.95
6BE6 1.50
6BG6G 3.00
6BH6 1.95
6BH8 1.50
6BJ6 1.50
6BK4 6.50
6BL6 85.00
6BL8 1.15
6BM6 115.00
6BN6 1.65
6BN8 3.95
6BQ5 1.50
6BQ7A 1.50
6BR7 4.95
6BS7 5.50
6BW6 3.95
6BW7 1.50
6BZ6 2.50
6BZ7 2.95
6C4 1.95
6C5 2.50
6C6 3.5
6C8G 2.50
6C9 4.95
6CA4 4.95
6CA7 3.50
6CB5 3.95
6CD6GA 4.50
6CF6 1.95
6CG7 3.50
6CG7GE 5.25
6CH6 6.95
6CL6 3.25
6CL8A 2.95
6CM7 2.95
6CS6 0.75
6CS7 0.95
6CW4 8.00
6CX8 3.95
6DC6 2.35
6DJ8 1.50
6DJ8 Special 3.50
6DK6 1.50
6DQ5 11.95
6DQ6B 2.50
6DT6A 1.50
6DW4B 3.50
6E5 3.95
6EA7GE 4.50
6EA8 2.50
6EB8 3.50
6EJ7 0.85
6EM5 2.50
6EM7GE 4.50
6EU8 1.75
6EV7 2.95
6EW6 1.50
6EW7 4.50
6F1 2.00
6F5 5.50
6F7 5.50
6F13 3.00
6F14 1.00
6F17 2.75
6F23 0.50
6F24 1.25
6F25 1.25
6F28 1.25
6F32 1.25
6F33 7.50
6FH5 8.50
6FH8 15.00
6FL2 4.50
6FQ7 3.50
6FQ7GE 5.25
6GE5 3.95
6GH8A 2.50
6GJ7 0.85
6GK6 3.95
6GM6 2.65
6GS7 2.15
6GV8 0.95
6GW8 2.50
6GY5 4.95
6GY6 2.50
6H1 9.50
6H6GT 2.50
6HB7 1.95
6HF5 12.50
6HF8 3.50
6HM5 2.50
6HQ5 3.50
6HS6 4.95
6HS8 2.95
6HZ6 3.50
6J4 2.15
6J5GT 2.50
6J6 2.00
6J7G 4.15
6JB6A GE 9.50
6JE6C GE 12.50
6JM6 9.50
6JU8A 2.50
6JS6C GE 10.95
6JZ8 5.95
6K7G 2.00
6K8G 3.00
6KD6 GE 11.95
6KG6A 6.95
6L1 2.50
6L6GC 3.50
GL6GC USA 9.50
6L6GT 3.50
6L7 3.50
6L15 3.15
6L19 3.95
6LJ8 2.50
6LD20 2.50
6LF6 GE 12.50
6LU8 9.25
6LQ6 GE 12.50
6P28 2.00
6Q7GT 2.50
6R7 3.15
6S4A 1.95
6SA7 1.95
6SC7 1.95
6SH7 1.95
6SJ7GT 1.95
6SK7 1.95
6SL7GT 2.50
6SN7GT 3.15
6SQ7GT 1.50
6SS7 1.95
6T8 1.50
6U6GT 3.50
6U7G 3.50
6U8A 1.50
6V6G 1.45
6V6GT 2.50
6W4GT 1.95
6Y6G 3.95
6X2N 1.00
6X4 1.50
6X5GT 1.00
6X8A 2.25
7A6 4.50
7AU7 1.50
7B6 3.50
7B7 2.50
7D8 4.50
7J7 5.50
7K7 7.50
7L 1.50
7Q7 4.50
7Y4 2.50
8B8 2.50
8B10 2.50
8BQ5 1.95
8CW5 1.50
8EB8B 1.50
8FQ7 1.95
10D2 1.25
10DE7 2.50
10DX8 2.50
10EB8 1.95
10EW7 2.95
10F1 1.95
10GK6 1.95
10P14 2.50
11E3 55.00
11R3 5.50
12A6 3.95
12AD6 2.50
12AE6 5.50
12AH7GT 4.95
12AL5 1.00
12AT6 1.75
12AT7 1.95
12AT7WA 3.50
12AU6 1.50
12AU7 0.95
12AV6 1.95
12AV7 2.50
12AX4GTB 2.50
12AX7 1.50
12AX7WA 2.50
12AX7S 7.95
12AY7 3.95
12B4A 4.50
12BA6 2.50
12BE6 1.95
12BH7A GE 6.50
12BL6 1.75
12BR3 1.95
12BY7A GE 6.95
12C8 2.50
12CA5 1.95
12CX6 1.95
12DQ6B 3.50
12DW4A 3.50
12DZ6 3.95
12E1 19.50
12E14 38.00
12FX5 1.95
12FX5GE 1.95
12GN7A 5.95
12J5GT 3.95
12J7GT 3.50
12JZ8 2.95
12K7GT 1.50
12K8Y 1.95
12KU7 1.95
12S7GT 1.50
12SA7GT 1.95
12SG7 4.75
12SK7 1.95
12SJ7 1.50
12SN7GT 1.85
12SW7 3.50
12SY7 4.50
12X4 1.95
13D7 3.20
13DE7 2.50
13DR7 2.95
13E1 145.00
13EM7 3.50
14B6 4.50
14R7 3.50
15E 5.50
16AQ3 1.95
16GY5 2.95
16H 0.40
16L 0.40
17A8 3.50
17AX4GTA 1.95
17BE3 2.50
17DW4A 2.95
17EW8 1.50
17JZ8 5.50
18D3 6.00
18GB5 3.50
19AQ5 3.50
19AU4GT 2.50
19BG6 3.50
19G3 19.50
19G6 9.00
19H4 35.00
19H5 33.50
20CV 9.50
20D1 2.50
20LF6 7.95
20L1 0.95
20P1 0.55
20P4 1.95
20P5 1.15
21JZ6 10.50
21KQ6 4.95
21LU8 3.75
24B1 39.50
25BQ6 1.75
25DQ6B 2.95
25L6GT 1.75
29C1 19.50
29KQ6 6.50
30C15 0.50
30C17 0.40
30C18 1.45
30FL2 1.35
30FL12 0.95
30FL13 1.10
30FL14 1.25
30L1 0.45
30L15 0.60
30L17 0.50
30P4MR 1.00
30P12 1.00
30P18 0.60
30P19 1.00
30PL1 2.50
30PL13 0.50
30PL14 1.75
31JS6C 7.50
33A/158M 19.50
35A3 3.95
35A5 4.50
35C5 4.50
35L6GT 2.00
35Z3 1.95
35Z5GT 3.50
38HE7 10.95
40KD6 6.50
40KG6A 4.95
47 6.00
50A5 1.50
50B5 1.95
50C5 0.95
50CD6G 1.95
50EH5 1.50
50JY6 2.95
53KU 4.50
75B1 3.50
75C1 4.50
80 4.50
83 6.50
83A1 7.50
85A1 6.50
85A2 2.95
90AV 17.50
90C1 3.50
90CG 17.50
90CV 17.50
91AG 9.00
92AG 25.00
92AV 25.00
95A1 6.50
100E1 10.00
108C1 2.50
150B2 6.50
150C1K 9.00
150D2 2.50
150C4 2.50
185BT 1.50
211 14.95
230D 15.00
231D 15.00
250TH 150.00
307 5.00
328A 15.00
572B 59.00
705A 12.50
713A 25.00
723A/B 75.00
724A 275.00
725A 275.00
726A 75.00
801A 15.00
803 14.95
805 15.95
807 5.50
811A 6.95
812A 12.50
813 Philips 35.00
813 19.50
829B 22.50
833A 65.00
845 23.00
866A 6.50
872A 20.00
873 50.00
954 1.00
955 1.00
1802 1950.00
1849 315.00
1927 25.00
2040 25.00
2050A GE 9.95
4212H 250.00
4471 35.00
4687A 9.50
5544 79.50
5559 55.00
5636 6.50
5642 9.50
5643 9.50
5651 2.50
5654 1.95
5670 3.25
5672 4.50
5675 28.00
5678 7.50
5687 4.50
5696 4.50
5702 3.50
5704 3.50
5718 3.50
5725 2.50
5726 2.50
5727 2.50
5749 2.50
5750 1.85
5751 2.95
5763 6.50
5814A 3.25
5823 9.50
5829WA 6.50
5840 3.50
5842 11.00
5847 10.95
5863 95.00
5879 9.50
5886 13.95
5894 39.50
5899 4.50
5963 1.75
5965 2.15
6057 3.75
6058 2.50
6060 2.25
6072 6.95
6080 6.50
6080WA 9.50
6132 10.50
6136 2.50
6146B 9.50
6146B GE 15.00
6146W 12.50
6155 72.00
6156 125.00
6157 2.50
6158 3.20
6166 650.00
6189 4.50
6201 6.45
6350 3.50
6360 4.50
6386 14.50
6442 75.00
6463 7.50
6550A 9.95
6550A GE 13.95
6870 11.50
6883B GE 14.95
6973 10.50
7025 2.50
7025S 6.95
7027A GE 12.50
7092 125.00
7119 9.00
7189 6.50
7199 10.50
7247 6.50
7475 6.00
7486 155.00
7527 125.00
7551 6.50
7581A 11.95
7586 15.00
7587 19.50
7591A 10.50
7815 59.50
7868 6.50
7895 17.50
8156 9.95
8950 10.50
18042 10.50
9002 6.50
9003 6.50
6CB6 2.50
8417 6.95

CALLERS WELCOME

OPEN MON-THUR 9AM-5.30PM
FRI 9AM-5.00PM
24-HOUR ANSWERPHONE SERVICE
ACCESS & BARCLAYCARD PHONE ORDERS WELCOME
UK ORDERS P&P £1
PLEASE ADD 15% VAT
EXPORT ORDERS WELCOME
CARRIAGE AT COST
PLEASE SEND YOUR ENQUIRIES FOR SPECIAL QUOTATIONS FOR LARGE REQUIREMENTS.

STRAIGHT & LEVEL

ON THE COVER

On the cover this month is the new IC-R72 budget HF receiver, available from Icom (UK) Limited.

The IC-R72 measures 24mm × 94mm × 239mm (WHD) and is similar to the IC-725 and 726.

Multi-scan functions include: program, memory, select memory and auto-memory write scan.

Other features include: ninety-nine memory channels; 10dB preamplifier and 10dB, 20dB and 30dB attenuator; direct digital synthesiser; built-in tuning indicator for AM/FM, and a 10GHz digital display. The IC-R72 budget HF receiver is expected to retail at £599.00 including VAT.

For further information contact *Icom (UK) Limited, Sea Street, Herne Bay, Kent CT6 8LD. Tel: (0227) 363859.*

SPACERS

Richco International have extended their product range to include a new series of hexagonal threaded metal spacers, offering their customers a choice of over 240 different parts as standard.

The spacers are produced in nickel-plated brass (type HTSB) and zinc-plated mild steel (type HTSM). Spacing distances from 5mm up to 60mm are available, and can be supplied with tap/tap or tap/stud terminations. All threads are metric and range from M2 up to M6. The threaded spacers are supplied in packs of 100.

For further information contact *Richco International Company, Richco House, Springhead Enterprise Park, Springhead Road, Gravesend, Kent DA11 8HE. Tel: (0474) 327527.*

GROUND ANCHOR

Holtwood Engineering have introduced the Holtwood ground anchor. This provides a strong anchorage point for equipment, such as antenna masts, which are vulnerable in high winds.

The anchor comprises a hardened steel tube and ring which can be driven 600mm into either hard or soft ground. Inside the steel tube, three thin steel rods, curled like pigtails, extend and take a firm grip of the subsoil. The anchor costs £7.47 including VAT.

For further information contact *Holtwood Engineering Limited, 11 Brassey Drive, Holtwood, Aylesford, Kent ME20 7QL. Tel: (0622) 710921.*

DIGITAL CLAMP METER

Electronic and Computer Workshop Limited have introduced the CT4200 digital clamp meter, which gives flexibility when taking readings from awkward places.

The clamp meter measures to 200A ac (50-60Hz) from a jaw opening up to 23mm diameter. A 3½ digit LCD with a maximum reading of 1,999 features automatic indication of symbols and functions, overrange indication and battery warning indication. Accuracy is ± 1.5% reading ± four digits and the battery gives 100 hours of continuous operation.

This meter measures 175mm × 41mm × 27mm and weighs 135 grams. It is supplied with a flexible rubber carrying case, two 1.5V batteries and an instruction manual.

For further information contact *Electronic and Computer Workshop Limited, Unit 1, Cromwell Centre, Stepfield, Witham, Essex CM8 3TH. Tel: (0376) 517413.*

CLUB NEWS

The Bury Radio Society will hold its Annual Hamfeast on 29 April at the Castle Leisure Centre, Bolton Street, Bury. Doors open at 11.00am. Blind or disabled visitors will be admitted from 10.30am.

There will be a talk-in on S22 and SU8, as well as a giant bring and buy sale. Other facilities include a licensed bar.

For further information contact *C Marcroft G4JAG, Mosses Community Centre, Cecil Street, Bury.*

The Southgate Amateur Radio Club have brought forward their club meeting from 12 April to 5 April.

The club meets at the Holy Trinity Church Hall, Winchmore Hill, London N21.

For further information contact *Brian Shelton G0MEE. Tel: 01-360 2453.*

The Galway Amateur Radio Experimenters' Club meets on the first Monday of every month at Richardsons Bar, Eyre Square, Galway. The session begins at 8.30pm.

For further information contact *Ciaran McCarthy, 35 Dun Na Mara Drive, Renmore, Republic of Ireland.*

Spen Valley Amateur Radio Society's annual DXpedition to Pen-y-Ghent will be held on Saturday 19 May.

The Special Event callsign GB2PYG will be used, and operation will be on all bands from 160m to 10m, mainly SSB with some CW, 10m and 4m FM and 2m SSB and FM. As usual, WABers who require SD87 square are invited to call in. Operation will be from 1100-1700hrs.

For further information contact *the club secretary, J Wilde. Tel: (0274) 875038.*

ERRATUM

The following corrections are for Stan White's article, The MF10 Audio Filter, which was published in the June 1989 issue of this magazine.

1. The R3, shown connected to pin 18 of IC3, should be designated R30.

2. The resistor R33 is shown connected to the wrong end of R35. It is shown connected to IC3 pin 4, but should be connected to IC2b pin 1.

Errors 1 and 2 apply to the CCT diagram only.

3. On the vero layout, the legend (top right-hand side) is wrong; X = veropin, O = Track Cut.

THE AT-300

HF ANTENNA TUNER

by Ken Michaelson G3RDG

I have reviewed several HF antenna tuners in the past, but the AT-300 antenna tuner, manufactured by Advanced Electronic Applications Inc, is the largest I have had to evaluate.

It is solidly made, having a steel case which is divided into two parts. The top section is 'U'-shaped, with the two 'limbs' forming the sides of the case. The bottom section is also 'U'-shaped, with the two limbs forming the front and rear panels. The top 'U' incorporating the sides is finished in dark grey and the lower 'U', forming the front, bottom and back of the case, is painted in black with white lettering.

The front panel

On the left-hand side of the front panel is the transmitter tuning knob, which is a rotary switch with eighteen positions. The antenna tuning switch, also with eighteen positions, is located on the right of the panel. Both of these double-pole type switches operate with a very satisfactory clunk when turned.

The antenna switch is connected to the switch mechanism by a fibre rod to insulate it from ground.

The twin needle meter is calibrated to show forward and reflected power in watts. The swr reading, calibrated in red on the dial, is measured where the two needles intersect on the red scale.

Below the meter position are two rocker-type switches; the left-hand one controls the power handling capacity of the unit, 30W or 300W, and the right-hand one switches the dial lamp illumination on and off. The power for the dial lamp is taken from a separate supply, and there's a female 2.1mm socket on the rear panel for this purpose.

The antenna selector switch is on the top right-hand side of the front panel and has six positions, which are: dummy load, antenna 1 direct, antenna 1 tuned, antenna 2 tuned, antenna 2 direct and balanced antenna. Below this switch is the reactance control with markings from 1 to 10.

The rear panel

The rear panel is well laid out, having four SO239 coaxial sockets for the transmitter, antenna 1, antenna 2 and dummy load. Also on the left-hand side are two ceramic feed-through post connectors for the output to the RF balanced twin-lead antennas, the upper one connects to an endfed wire. A very substantial post/wing nut ground connector is also provided.

The unit is opened up by removing ten fixing screws. They are provided with nylon washers, which protect the paintwork from being damaged when they are screwed in or unscrewed. A very good touch. The interior contains two large coils, a twelve plate large-spaced variable capacitor with ceramic supports (the reactance control), two PCBs, a balun, the twin needle meter and all the necessary SO239 coaxial sockets.

The coils measure 80mm in diameter and 110mm long, being wound with a very substantial gauge wire. The tapping off of the various turns is achieved by supporting the coils on two sections of PCB; the turns are held by slots running along the edges of the PCBs. Each slot has a track along the PCB leading to the operating switch. Therefore the coils are rigidly held in place, and there is no loss in the leads.

The interior is also painted black, except where bare metal is necessary to have a ground connection, for example, fixing the reactance capacitor.

RG 58A/U coaxial cable is used throughout to link the antenna selector switch to the SO239 coaxial sockets and the ceramic feed-through post connectors on the rear panel.

In operation

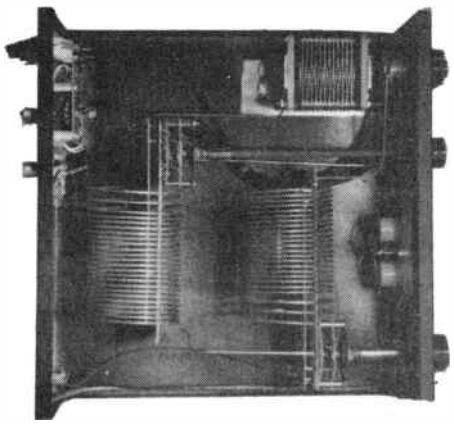
Using the AT-300 is quite straightforward, provided that the owner's manual is read and understood. Having set up the transmitter to the chosen band and frequency, the transmitter, antenna and reactance controls of the AT-300 need to be adjusted. To give the new owner a chance, the owner's manual suggests settings for these three controls for eight amateur bands, with space alongside to insert the actual readings relative to one's own antenna.

The AT-300 provides adjustable impedance matching and also measures power and swr, which enabled me to match a much wider range of antenna impedances than usual. Since I have only one antenna it did not matter whether I used antenna 1 tuned or antenna 2 tuned, so long as my antenna was connected to the correct SO239 socket on the rear panel; my feedline was coaxial cable.

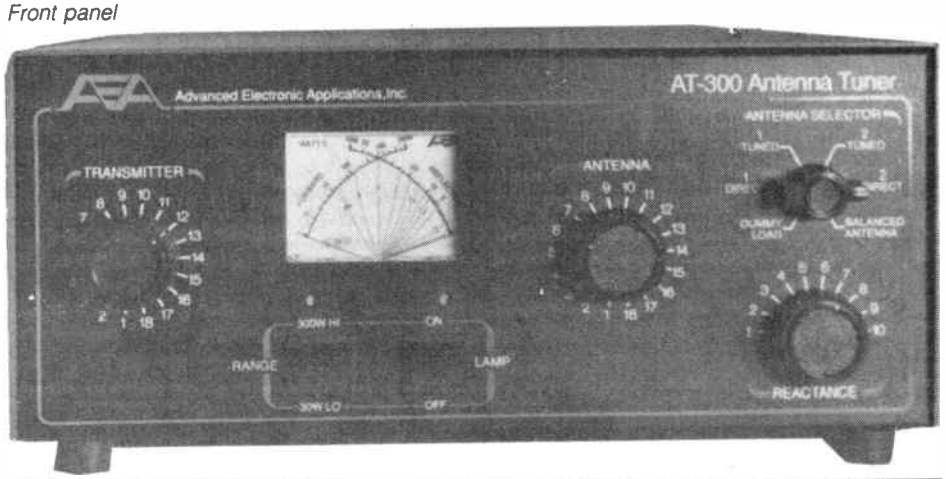
The rig will transmit on low power with the power switch set to 30W LO. The transmitter and antenna switches are then adjusted left and right for maximum forward power reading, whilst watching for dips in the reflected power readings. The next step is to adjust the reactance control, whilst also tuning for maximum forward power and minimum reflected power.

This should be carried out at about

Interior view



Front panel



3.600MHz and repeated several times to ensure that the lowest swr reading is obtained. In fact, the tuning readings did not differ too greatly from the positions given in the owner's manual. After a little practice, I was able to get my antenna tuned to a reasonable swr reading on 80, 40, 20 and 15m.

Conclusion

The AT-300 is a well-built unit with all the facilities required by the amateur who does not wish to be tied to one type of aerial. However, it is unable to cover tuning for 160m, although a reasonable swr is obtainable with practice.

I have only one gripe to make. There is a switch position labelled dummy load, and one would have thought that this facility was built in. But no, an external dummy load must be connected to its SO239 socket on the rear panel. I think that the dummy load could be mounted in the case with only a slight increase in cost.

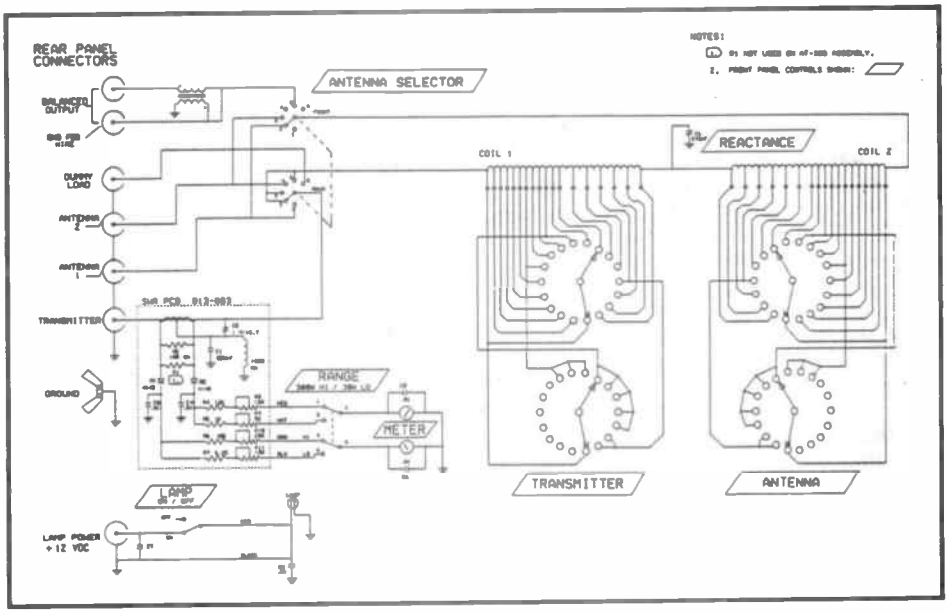
The owner's manual states, 'Do not operate the AT-300 with the cover removed,' and 'Do not change transmitter, antenna or antenna selector switches with more than 30 watts of applied power.'

Seems reasonable to me, but I would put a sticker on the front as a reminder. Not that I would be likely to operate it with the cover off, but I might inadvertently alter one of the switches.

The AEA AT-300 is capable of squeezing the greatest power out of your rig with the least possible TVI and, as such, I can thoroughly recommend it.

The AT-300 HF antenna tuner costs £209.95 including VAT. My thanks to ICS Electronics Ltd, Unit V, Rudford Industrial Estate, Ford, Arundel, West Sussex BN18 0BD, telephone: (0903) 731101, for the loan of the equipment for this review.

Schematic diagram of the AT-300 antenna tuner



QRP

THE OTHER OPTION

by Ian Poole G3YWX

It must be the ambition of most radio amateurs to be one of the loudest signals on the band. However, all too often this is not the case and contacts are difficult to make or pile-ups almost impossible to break through. And there is always the station who comes into the largest pile-up ever heard on the bands and gets through first time. It is infuriating.

Some years ago I had the good fortune to operate a local amateur's well-stocked station. The triband beam was at 60ft, the take-off superb, the linear could run the full legal power and the rest of the station was equally impressive. On the occasions I went round there it always seemed that DX was freely available, and what I considered to be DX was quite run-of-the-mill. I remember that stations from countries I had never heard of came back to CQ calls. This was my dream of a complete station.

The low power option

While I enjoyed operating this station, it was something that I could never afford for myself, particularly as I was a rather poor schoolboy at the time. I had to make do with a lesser station.

Fortunately I enjoyed experimenting with low power transmitters – ones which I could build in an evening or so. I had a considerable sense of achievement when they were built, working and making contacts. Because the transmitters were fairly low power and simple in their design, there was a fighting chance of getting them to work satisfactorily with a minimum of test equipment. There was also the advantage of the project being easy enough to complete before my enthusiasm ran out. It is a fact of life that all too often a new project gets started in a burst of enthusiasm and before it is finished enthusiasm wanes and the project joins the other half-finished relics in the cupboard.

How low is low power?

It is surprising just what can be done with a relatively small amount of power. Obviously it is not possible to get through the big pile-ups on flea power but a lot can be done on a watt or so. There are plenty of stories around about people reducing their power from 100W or more to a matter of a few milliwatts and still managing to maintain contact.

Alternatively many people have made the whole contact at low power. I still consider one of my best achievements to be making a contact on 2m over a distance of more than fifty miles using just 10mW and an indoor quad. This is equivalent to making a contact of more than a thousand miles per watt. But even this is nothing special and many people have done far better.

With this in mind it is worth calculating how weak a low power station will be in comparison with a high-powered one. Take as an example a station running 100W. If he reduced his power to 10W, his signal strength would fall by 10dB or nearly two 'S' points (assuming 6dB per 'S' point). If the power was then reduced to just 1W his power would have fallen ultimately by 20dB or just over three 'S' points. So if the 100W signal had been S9 the 1W signal would be S6 and still be perfectly readable if there was not too much interference.

Cheap and easy

Apart from the surprisingly small reduction in signal strength, other advantages of QRP equipment are the cost and ease of building it. One of the ideas of QRP is to use relatively simple equipment. In fact most QRP operators will use crystal-controlled transmitters, or possibly ones which use ordinary variable frequency oscillators. There are very few QRP rigs which use synthesisers and have dozens of memories together with computer control etc. **Fig 1** is an example of a typically simple QRP transmitter.

In order to keep the circuits to an absolute minimum, most QRP operation takes place on CW. This also means that advantage can be taken of the fact that CW can be copied at much lower signal strengths. I always find it much easier to get contacts on CW than SSB, even when operating at normal power.

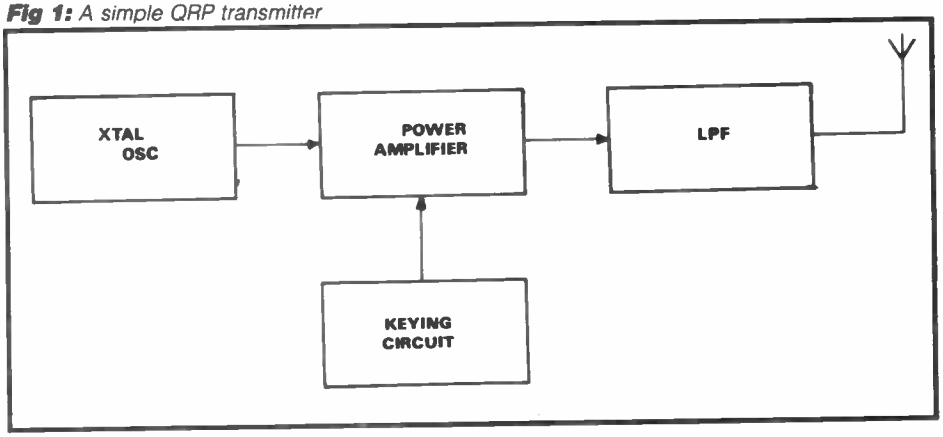
Build your own

The average QRP operator will usually build much of his equipment. There are plenty of designs around in the magazines, and a book called **The G-QRP Club Circuit Book**, available from the RSGB, is a veritable gold mine of circuits. The circuits available range from the very simple transmitters using just two or three transistors upwards. It is often a matter of honour among QRP operators to see just how much can be done with as few devices as possible.

Usually circuits will use one transistor or FET for the oscillator, another for the power amplifier and possibly a third for keying. This last transistor is needed to prevent the key from taking the full emitter current of the PA. If the extra transistor were not used, the current would pit the contacts on the key quite quickly. However, some people manage to key the oscillator quite satisfactorily to reduce the transistor count to just two.

The oscillator is one area which is very

Fig 1: *A simple QRP transmitter*



important. A crystal oscillator is probably one of the most popular because it is stable and gives a high output. The problem is obviously one of tuning. Fortunately it is possible to 'pull' the oscillator frequency by up to 10kHz or so quite easily.

This is done by placing a capacitor and coil in series with the crystal as shown in **Fig 2.** If the capacitor and coil combination resonates around the frequency of operation then it will become capacitive one side and inductive the other. Accordingly it will be able to change the frequency of oscillation slightly. Don't be too greedy and try to get too much pull from the circuit, because either the oscillator output will fall or it will not be controlled by the crystal.

By using a simple transmitter it is possible to generate quite significant levels of power. QRP, though, is generally accepted as being anything below 5W output or 10W input. However there are many designs which can deliver 3W or so using the very simplest of circuits. Often these transmitters are very small in size and can even be built into an old tobacco tin, for example.

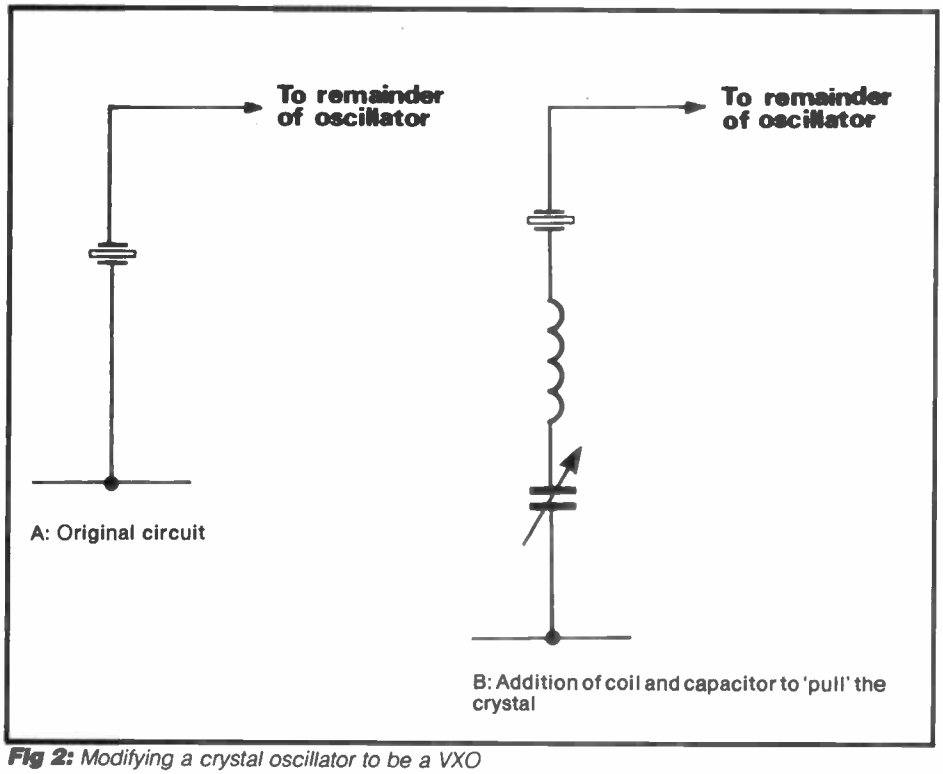


Fig 2: *Modifying a crystal oscillator to be a VXO*

How about a kit?

Instead of building from scratch, you can construct a kit. There are several manufacturers of QRP transmitter kits; CM Howes does a good line in transmitters and receivers, and Lake Electronics have a number of kits well worth considering.

These kits are a very good idea because they take some of the uncertainty out of home construction. All the kits I have seen are built up on a printed circuit board. This not only gives a much better look to the finished item but it makes the circuit more rugged and helps it to work better. All the kits I have built have given very satisfactory results.

With some kits it is possible to buy ready-drilled cases. These add the finishing touch to the project, and can also improve the performance.

Receivers

Many people use their normal station receiver, but a growing number are finding that building a simple QRP-style receiver completes the station. As the task of building a superhet can be rather daunting, most people opt for a direct conversion type of circuit (as shown in **Fig 3**).

Basically this type of receiver operates by converting the incoming signals directly down to audio frequencies. This simplifies the design considerably and means that it is possible to build a complete receiver with a few transistors and ICs. Again, there is a number of kits around which can be built up very easily and quickly.

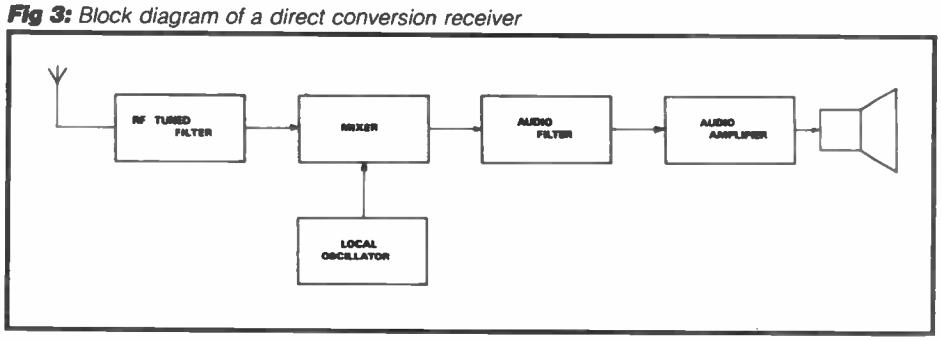
The main advantages of the direct conversion receiver or DCRX are its simplicity and the performance which can be achieved with very few components. However, there are some drawbacks to it. The main one is the audio image. This occurs because a beat note will be heard with the incoming signal when the local oscillator is either side of the signal. If you can tolerate this, the direct conversion receiver is ideal for a QRP station.

A good aerial

It is always a good idea to make the most of any station by putting up the best aerial possible. It is no use going to great lengths to set up an amateur radio station and then ruining it all by using a poor aerial. It is even more important with a QRP station to have a good aerial because it is necessary to make the most of every milliwatt of power available.

Most QRP operators will use home-made wire aerials but they will take every care to ensure the aerial performs to its best ability. This often means that people use a lot of ingenuity when they are designing their aerial systems.

Fig 3: *Block diagram of a direct conversion receiver*



ATUs

Aerial tuning units are also very important. It is necessary to ensure that the antenna is correctly matched, and of course an ATU is mandatory for an end-fed wire. However an ATU should not be used to mask a poor SWR in the coaxial feeder. Although a lot of today's commercial rigs need an ATU in the coax line near the transmitter, this does nothing to improve the match between the aerial itself and the feeder. If a high SWR exists on the coax this needs to be corrected by properly matching the aerial to the feeder. This can be done either by cutting the aerial to the correct length or by having an ATU actually at the aerial itself.

Unfortunately it is not always possible to put up the aerial you want. Even so it will still be possible to make contacts, although it will be much harder work. I have managed to get a number of contacts into Europe on 20m using just about 1W fed into a 10ft piece of wire draped across the rafters in the loft!

Operating QRP

In many respects there is little difference between operating a QRP station and an ordinary one. The same abbreviations are used and contacts proceed in the same basic manner. However, here are a few hints and tips which might make things a little easier.

The first of these is that there are frequencies set aside in most of the HF bands specifically for QRP operation. High power stations are asked to keep away from them so that the low power stations are given a chance. It is quite normal to hear a number of QRP contacts going on around these frequencies, and in fact most QRP stations will have their crystals on or around them.

Generally these frequencies are 60kHz above the bottom end of the band. The two exceptions to this are on 40 and 30m, where the size of the band means that this cannot be done.

Probably the most popular band for QRP is 80m. During the day the band is relatively free from interference and consequently the chances of a contact are increased.

It is not necessary to stick to the QRP frequencies. It is often fun to look around the band for a likely station to call and see if a contact is possible. It is then very gratifying to hear their reaction to the fact that you are running a mere watt or so in comparison with their kilowatts!

In order to do this you must pick the station carefully. Obviously he must be reasonably strong. It's worth working out how much weaker than him you would be. Obviously if he is running a kilowatt and you are running a watt then you will be 30dB or five 'S' points down on him. If he is only coming through at S6 then you are probably about S1 with him and unlikely to make contact. Alternatively if he is S9 + 40dB then it is quite possible you will make contact.

Finally, there is virtually no use in calling CQ unless you are on a QRP frequency or you have an exceptionally good aerial. All the other stations around you will be much stronger, and in my experience people come back to only strong stations.

QRP clubs

There are a number of QRP clubs around the world which have done a lot to encourage those interested in QRP operation. Most of the larger countries have their own clubs. In the UK the national QRP club is called the G-QRP Club.

This was founded in 1975 and the number of members rose rapidly. Today it is very active and has more than 4,000 members world-wide. It publishes its own magazine called **Sprat** which gives a whole range of circuits and useful ideas about QRP operation. In addition to this it offers awards, and members can obtain discounts from some suppliers of QRP components.

For anyone interested in joining the G-QRP club, the person to contact is Rev George Dobbs G3RJV, St Aidans Vicarage, 498 Manchester Road, Rochdale, Lancashire OL11 3HE.

Have a go!

QRP operation represents a great challenge to all radio amateurs. In a world which is constantly striving for higher powers and more complicated equipment, it is refreshing to see people using simple, low power equipment and showing everybody what can be achieved. On top of this it is helping to bring the spirit back into amateur radio by enabling people to construct their own equipment, and experience the thrill of making contacts on something they have constructed themselves.

Why don't you give it a go and join the ever increasing band of QRP enthusiasts?

The World of D | A | T | A

BY DON FIELD G3XTT

The packet network suffered severe disruption in the January and February storms, with many nodes and mailboxes going down because of storm damage to aerials and/or loss of electricity. Let's hope the damage is repaired soon.

The various new satellites that I have mentioned previously finally took to the air on 22 January and, apart from a few minor problems, have been working well. Although some need special equipment to copy, the Dove satellite has a 2m downlink on 145.825MHz, and has been transmitting packet-radio telemetry on that frequency.

You can copy it with your existing 2m radio and TNC, though do switch off your beacon to avoid causing problems to others. Eventually this frequency will carry a synthesised voice transmission.

While on the subject of outer space, the crew of the space shuttle Columbia, due to launch on 26 April, will include Dr Ron Parise WA4SIR, who has been authorised to operate voice and packet radio during his ten-day mission. The frequencies are not known to me.

Packet radio will also feature in a later shuttle mission, when KB5AWP takes Atlantis into space from 4 June. Ken is authorised to use voice, packet, slow scan TV and ATV.

Conference time

The IARU Region I Conference will be in full swing in Torremolinos in early April as you read this. Among other matters, delegates will be discussing a number of papers relating to band-planning for packet, RTTY, fax and other specialist modes.

As I have mentioned before, the biggest area of contention is that of packet allocations on 20m. Interestingly, although the ARRL (American Radio Relay League) have previously supported the use of frequencies above 14.1MHz for mail forwarding, they are now taking the view that such activities should take place below 14.1MHz to leave 14.1 to 14.15MHz free for SSB operation by stations outside the USA.

This is in line with what IARU Region I has advocated all along. Although, in my role as a corresponding member of the RSGB Packet Working Group, I have received several vociferous letters arguing for packet allocations above 14.1MHz, these still represent a very small proportion of the total users of the 20m band.

Perhaps as data enthusiasts we should phase out conventional RTTY which, because it uses continuous carrier, is very wasteful of precious bandwidth (this would be akin to AM giving way to SSB in days gone by). However, I realise that there are many amateurs world-wide who have no access to personal computers, and still have to make do with mechanical teleprinters.

The other development which could help enormously is the introduction of terminal units designed specifically for HF use, with suitable narrowband filters. This would allow many more packet, RTTY and AMTOR stations to share the same band allocation. Multi-function TNCs designed primarily for VHF packet are a downright liability on the HF bands.

You can go some way by using the filters in your HF radio to best effect. One suggested modification, if you are prepared to dedicate a radio wholly to datacomms, is to install a CW filter in the SSB IF. Pity that very few radios let you select this combination from the front panel.

SYSOPS conference

The (often unsung) heroes of the packet network are the SYSOPS. These stalwart folk dedicate expensive hardware plus lots of their time to provide a service for those of us who use the network. What is more, from time to time, they leave family and friends to get together to discuss ways in which the service they provide can be improved.

The most recent of these meetings, the ninth to date, took place on 11 February near Wolverhampton. G8TIC and G8VPQ presented a paper about a new 3,000 baud modem which offers speed improvements over the 1,200 baud modems used by most of us but which, unlike the 9,600 baud modems that are slowly coming into use, doesn't require major surgery on your expensive radio set. I suspect this is one piece of hardware which may well catch on quite quickly, if only for inter-BBS forwarding.

G8TIC, whose address is: 42 Peterborough Close, Worcester WR5 1PW, will supply copies of his paper in return for a large (A4 size) sae.

G8AMD suggested a number of ideas for discussion at the meeting. His view is that much can be done to improve our network by greater co-operation between the many SYSOPS. This is by no means a novel theme. However, one idea of his which I had not heard of before is to modify the way in which the AX25 protocol works between two network nodes.

Currently our network works via the CSMA/CD (Carrier Sense Multiple Access, with Collision Detect) method, whereby a TNC puts out a packet when it thinks a channel is clear. If two (or more) packets 'collide', then the various TNCs each try again after a random time delay. Hopefully, the random element means that next time there will be no collision. This is all very well but there are problems, especially when some stations in the network cannot hear each other.

The other option is a polling system, where a master node polls each of the others in turn. This avoids the collision problems inherent in CSMA/CD, resulting in better channel utilisation. However, it does require a lot of co-operation between the stations concerned. Nevertheless, it may offer a worthwhile way forward for inter-BBS forwarding.

Network design

The concept of network design is an interesting one, yet many packet users never stop to think about what is involved. Over the last year or so software has been introduced which provides both BBS and network node capabilities whereas, in many ways, this is not what is required.

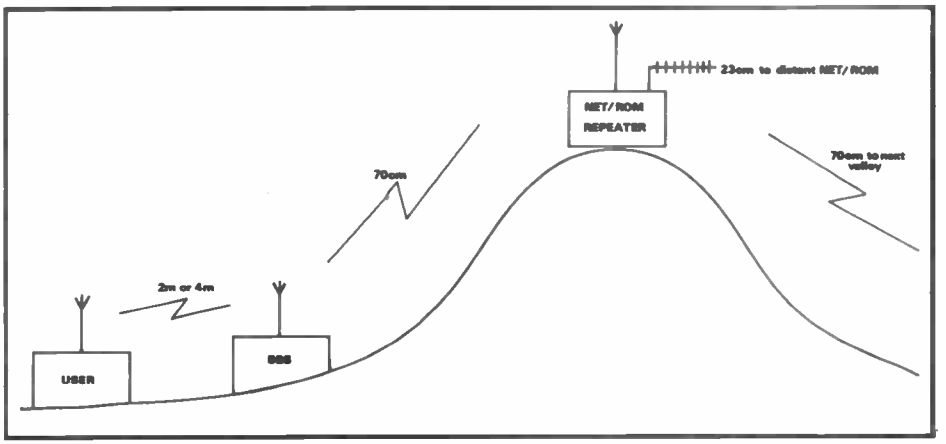
In an ideal situation, a BBS would be sited in a valley near to one, or more, major centres of population, and would serve users who lived in those centres. Power would be kept as low as possible, and users would have directional aerials pointed towards the BBS to avoid causing unnecessary QRM to adjacent BBS sites.

Network nodes are very different. Their role is to provide links between stations where no direct path exists. Ideally, therefore, they should be located on a hilltop. Also, they would work on a different frequency to the BBS, eg, on 70cm, where local BBS access was on 4m or 2m.

Of course, a number of well-sited network nodes on hilltops will not only allow long-distance communication by going through several hops, but they will also interfere with one another if they are on the same frequency.

Therefore, we can argue that these nodes should have only enough power and hence range to overcome any local obstacles such as hills, but should be linked to each other via dedicated UHF or microwave links with directional aerials, so that the same frequency can be reused without leading to lots of channel congestion.

It is also arguable that when end-users access the repeater, they should use a different channel to that used for BBS forwarding, because the nature of the traffic is very different. When an end-user is using the repeater it is usually for a realtime contact with a distant station, and the network should introduce a minimum of delays. When a BBS does its forwarding there is a sudden high throughput of traffic, but there is no urgency for this traffic to get through. The alternative, of course, is to insist that all BBS forwarding takes place at night.



The 'ideal' networking solution

Of course, not everybody lives in a valley, and there isn't always a convenient hill nearby. Also, while there is a certain amount of kudos in running a bulletin board, those who run network nodes rarely get any recognition, though this hasn't stopped clubs setting up well-sited voice repeaters in the past.

It is this kind of network planning which keeps many highly paid professionals busy in the context of cellular telephone networks, the siting of broadcast transmitters, and so on, so we can't expect a bunch of unpaid enthusiasts to get it right overnight.

Nevertheless, there are many professional engineers in the ranks of amateur radio, so let's hope that our SYSOPS can work together and draw upon the skills available in order to improve the service for us all.

SECOND-HAND

by HUGH ALLISON G3XSE

Nuts and bolts

A friend's rig had 'burnt out' its mains transformer. Coincidentally an acquaintance had recently dropped his rig, which was the same type. A small amount of money changed hands and my friend prepared to undertake major surgery to transplant the transformers. The problem was, he was nervous and asked me if I would oversee the operation.

I rolled up on the appointed day to find that my friend had already taken the covers off and the rigs were indeed identical. Every wire was the same colour and he had drawn it out very neatly – the creep. He had also checked for obvious shorts on rails etc, to see if there was a good reason for the old transformer burning out. There wasn't, which was what I'd suspected 'cos the old transformer had just stopped working, open circuit mains winding, not a 'flamer' which indicates very bad news downstream.

My friend was doing a good, careful job, and all I was doing was emptying out a four-pack he had thoughtfully provided for my entertainment. What got me was what he did with the nuts and bolts he'd removed. Like most of us he has an old shoe box full of fixing gubbins – screws, stand-offs, studding and the like. As he removed a nut and bolt from the scrap rig, he did the nut back up on the bolt *then* tossed it into the shoe box. When I asked why, he said it halved the time searching for a nut and bolt in the future, and meant that you didn't have to spend half an hour looking for the right sized bolt and then a further half-hour looking for the one nut that fits it. A simple but clever idea; I do it myself now.

On to the transceiver. Well, I'm of a nervous disposition where mains are involved. Thus, the said rig was connected to the mains via a variac and gently brought up to 110V (rig selector on 240V). All rails out of the transformer were about half their correct flavour, ditto dc levels after rectifiers. My friend flicked the variac round to full bore, and the rig ran A1.

He gave his rig a drink . . .

I opened the door to find this forlorn-looking bloke standing there with a Kenpro KT200EE 2m FM hand-portable – a Korean licensed and built Icom IC2 thing with slightly different styling. 'I've accidentally spilt coffee into the top and now it sounds all weird,' the chap wailed. It was actually working 10kHz high every other channel.

Well, for him I was worried. The rig had got your actual TC9122 chip in and they can piss you about at the best of times, never mind if you provoke 'em. Sure enough one pin of it was a half, ie, 2½V. The final check was to unsolder the flexible PCB over the TC9122 – you've got to unsolder this anyway to change the chip. Surprise, surprise, the pin had dropped to a zero – did I mention it's the tens of kilohertz switch we are talking about? I tuned the signal generator to 140MHz, and the Kenpro sang as sweet as a nut. I looked at the output of the flexible PCB – the least significant bit was a one when zero would have been more like it.

It was obvious really. Coffee had seeped into the end thumbwheel and it was now conducting. Avo'd 20k to rail. No end of washing out with solvent would shift it.

Now, as the chap needed the rig for a Raynet exercise, and I didn't have a spare thumbwheel which would fit, there was only one way out. Megabodge, a 20k fixed resistor from a half rail pin (ie, the least significant bit) to earth. The pin now sat at half a volt instead of the '0' where it should be, but that sure beat the 2½V we had previously. The rig now worked. I told the bloke to get the rig repaired properly. Bet he never does.

Prices. Genuine Icom IC2s have started to drop from their standard £100.00 – the price a 'bare' one sells at, ie, with a Ni-Cad pack but no other accessories like mobile aerial, extension mic, linear etc. With some or all of these, think £125.00. Put it this way, the last two I came across went at £90.00. A Kenpro equivalent, which is just as good, is a tenner or so cheaper – you've done well at £70.00.

Vacuum fluorescent displays

Vacuum fluorescent displays, or VFDs, are the bluish greenish displays found on some rigs. They are sometimes other colours if filtered. Not many people realise that these things have a heater in them. If you get a reasonably strong light behind you and look carefully it is sometimes possible to see in front of the characters two parallel lines about 3/16in apart running the length of the display. This is your heater and, should it have snapped, it's time to change the tube.

VFDs need a relatively high voltage – normally off an inverter in 12V powered rigs. The good news is that a couple of traders around the rallies are flogging new little inverter boards that fit straight into rigs, or are close enough if you are keen. At 15p the boards are worth buying just to keep for a rainy day.

The main problem with VFDs is when you lose all the characters. This could be because of an open circuit heater or no high volts out of your inverter. Failing that, the display information may be out of the micro so check the rig does all its tricks, repeat shift etc, as well as tunes all right. Any misbehaviour may be a clue that all is not well in the micro.

Some rigs have their VFDs driven by a specialist chip and breakdown here is common. Sometimes the chip is totally obsolete. Once, and only once, and I ain't doing it again, I made up a chip using a dozen transistors. The higher voltages these chips are handling mean that you cannot use just any transistor to hand. Not a job for the faint-hearted.

Having dealt with the totally dead display, let's turn to the 'one-segment-up-all-the-time' syndrome – be it one segment in one display or all of one segment on all displays. Incidentally, the following also applies to one segment out all the time.

Firstly, take a good look round the tracks, we are looking for shorts, also in the lead-outs of the display itself. A lump of solder or swarf can cause havoc. Upending the rig with it turned on and a gentle tap may dislodge any bits of junk *inside* the tube (take great care here); muck in the tube is not unknown.

Now we come to the deeply ashamed, I-shouldn't-be-telling-you-this bit. A lot of displays have the anode all up to rail and the turn on bits come out separately, each via a resistor, then 'turn on' the transistor to earth. Find a resistor of double the value already fitted and run it along the VFD lead-outs to deck. Each part will light up in turn, or light up a little brighter if already driven on. You can quickly give the lead-out of the affected bit much greater loving attention when you know which pin is causing the aggro.

If you cannot find the cause of the fault, unsolder (or cut, I've got some disgusting habits) the VFD lead and see if the trouble changes. Don't forget that driving transistors might be open or a short. I've had several displays where the decimal point is internally shorted to a segment, giving a row of little 1s on the display. Unsoldering the drive to the decimal point cleared the fault and the owner was far happier with the point missing than he was with the grotty figures (VFD unobtainable). I'm still not quite sure why this bodge works . . .

Now some good news. There aren't that many different styles of VFD. They were quite common in calculators several years ago, especially top-of-the-range models such as Scientifics. I've fixed a few rigs using second-hand VFDs out of old non-working calculators bought for pence. Not an ideal solution but at least a repair to a rig with an otherwise irreplaceable display. Quite often the 'new' display goes straight in, pin for pin.

Depreciation

If you had bought a Sony C5 Betamax video in 1982 it would have cost you £400.00. Its value today is about £25.00. The first legal CB sets hit the market at £70.00, now they're worth £10.00-£20.00. How about your average home computer? A £200.00 to £25.00 crash? From this it's clear to see that domestic or consumer electronic goods have little residual value after eight or ten years.

It's pleasing to notice the difference when you turn to amateur radio equipment. In 1982 a TS830S was nigh on £700.00. I've seen recent adverts, and I stress adverts, selling them second-hand at £725.00. I've seen some sell at between £500.00 and £600.00. Sure, a good example, but pick something at random, say an IC24G, which cost £170.00 eight years ago; last week I saw one for sale at £90.00. Here are a few more. TR2300, £166.00 new, now £80.00-£90.00; FRG7, £200.00 new, now about the ton; FDK700EX, £200.00 new, now £125.00; FT290R, £250.00 new, now £150.00 to £200.00.

There can't be that many hobbies where you can buy your equipment new from a trader, have years of, hopefully, trouble-free fun, then reasonably expect to see more than half your money back.

What if you bought second-hand in the first place? Well, the picture is rosier still. An HRO ten years ago would have cost you £25.00, nowadays it's worth £45.00. The AR88, including free hernia, would have cost you a bit more, maybe £35.00-£40.00, nowadays, double that. I bought a TR2200G second-hand ten years ago for £40.00 and would expect to see £50.00 for it now – OK, £45.00 after a haggle.

Now, I'm not suggesting for a moment that you should run down to your next local rally and buy everything on the bring and buy stall, hoping to make a fortune when you flog it in the year 2000. What I am saying is that you can reasonably expect to see most of your money back after a good long play – unless in that time the rig has been modified, caught fire or stopped working. It's an argument worth presenting to your loved one when he/she is squawking about the price you're thinking of paying for your next wonderbox.

'Cub' colour monitors

These things are often found hanging on the end of BBC 'B's. Quite a lot of schools have them, so there is a good chance of you ending up having to repair one. Like anything to do with the Beeb they hold their value well – a bit under the ton seems to be the going rate for a decent worker with reasonable definition, say £20.00 to £25.00 for a non-worker. Please believe me when I say that these are dead reliable monitors, it's just the sheer number of them in the field that produces a number of failures.

First, a warning. Part of the printed circuit board is live. It's well shaded on the top, but if you're like me and get engrossed in fault-finding, it's all too easy to forget the safety aspect. Personally I run 'em up on an isolating transformer.

I've repaired quite a few of these monitors, and most are doing the 'bright-line-across-the-middle' act, ie, no frame drive. This is, surprisingly, not the frame output chip, a TDA 1170. What happens is that the rail smoothing capacitor, C224, goes about 5 ohms, which is not a good thing. By the way it's 1000μF at 40V. There is a low value surge limiting resistor in series, R235, which burns out and will also need replacing.

Anyway, two keen young engineers were working away on a 'cub' which had the classic bright line, and my interest was caught by the query: 'Anyone got a TDA 1170?'

I decided to keep quiet – I'm a rotten sod at times – and throw over the requested chip. The next five minutes were accompanied by the noise of a solder sucker as the perfectly good chip got changed. They switched on and of course the bright line was still there. They looked a bit blank, and I softened: 'Check the chip's supply rail,' I advised. A couple of minutes later came the cry 'Cheers mate, R235 is open circuit.'

Now here is the dilemma. Do I advise them that this has occurred owing to the capacitor being a short, or not? In the end I decided that experience is the best teacher and let them proceed. Any burnt-out surge resistor should make you realise that all is not well downstream – they had to learn.

In went the new resistor. In their enthusiasm the engineers didn't notice the gathering crowd come to watch the fun. The cub got plugged in. With lots of volts across a low ohm resistor into a short the inevitable happened, clouds of smoke. Startled, the said young engineers whipped out the plug as the assembled crowd burst into spontaneous applause.

Since there was no chance of any more fun being milked out of the situation I told them about C224 and explained that resistors don't usually burn out for no good reason. Well, it livened up the afternoon.

Old Warden/Shuttleworth

Regular readers of this column will know that the National Amateur Radio Car Boot Sale, until now held at the Old Warden airfield, is *the* radio event of the year. Well, it is in my books; acres of bargains at reasonable prices, a radio heaven on earth.

I was extremely upset at last year's excellent do to learn that the Old Warden site owners were not happy about the sheer numbers of people that the event attracts – the sale is so successful it had outgrown a huge site. Life without Old Warden once a year would mean a bleaker world!

Well, the good news is that a new site has been found, Stockwood Park, Luton. Just off junction 10 of the M1. If the wife/husband/offspring are reluctant to go, there's a large fair in the next field. 20 May is the date. If you are thinking of going only to buy up the bargains, I'd prefer you not to go – all the more for me to snap up!

Daiwa RM940 mic systems

These are rather grandly named 'infra red ray mic systems' and are a short range (couple of metres or so) infra red speech link. You get a control box a bit bigger than a fag packet and a detachable mike about the size of an old-fashioned fountain pen.

The control box is amazingly complicated, with several transistors in it and four integrated circuits. When not in use you wop the detachable mike into the control box and it charges up the mike's internal Ni-Cad. There is a red LED that glows while charging and flashes when charging is complete. It is worth noting that this charging will take place regardless of the position of the line on/off switch – ie, the control box may be off but it's still charging if the mike is in place.

The system is intended for use in the car, or 'hands free' in the shack. There is a locking transmit/receive switch on the mike that causes a pair of wires to short out on the control box – ie, this makes and breaks your push to talk line.

The other output is obviously the speech. Range is five or six feet, which is adequate for the front two seats of a car but not to do reliable linking from the back in your average sized car. To this end there are two sensor sockets on the back of the control box, so you can have two infra red detectors, one in the front of the car, the other in the back, and overcome the range problem. Speech recovered by the system is punchy and normally receives favourable comments from the station you are talking to, who, until you mention the infra red link, are normally unaware that one is in use.

Problems. Yes, one. Many people soon encounter the range problem and decide to add another infra red detector. Beware. It looks like a standard 3.5mm jack socket, it ain't. It's a *stereo* 3.5mm jack, and the end pin has 12V on it. The middle 'ring' carries the detector output. One amateur tried to mount an additional detector in the back of his car and plugged it in on a normal mono 3.5 jack. It was a tribute to the rugged reliability of the detector he used that it was able to withstand the massive overload (and resulting heat) from the 12V straight across it. Use the right plug.

Prices. Second-hand only now – I don't think they are still available new – £15.00 seems about right.

DX DIARY

News for HF operators compiled by Don Field G3XTT

I hope your antennas are still up following the January gales. Several friends of mine lost both their antennas *and* towers. For one of them it was a repeat of what had happened in 1987.

If major storms are to be a regular occurrence, then we shall have to start paying much more attention to the physical design of our antenna installations. The wind load on an HF beam can be very considerable, and so can the torque generated by an antenna that is not balanced in terms of wind loading.

One tower that was lost in January, even though it was well-guyed, failed because of twisting as a result of uneven wind loads on the antennas (in this case, a tribander plus three-element 40m beam).

The benefit of a wind-up tower, as used by many UK amateurs, is that it can be wound down when there is a gale warning, provided the forecasters get it right, of course.

For those whose antennas did stay up, propagation was fair during the rest of January and February, though by no means spectacular.

There was some Pacific DX to be worked on 10m, for example P29KGW, YJ8SHD (Shepherd Island, OC111 for IOTA) and VR200PI (for the two hundredth anniversary celebrations on Pitcairn Island). However, most activity took place on the lower bands.

The Colvins wrapped up their operation in Bahrein as A92QL (where they made over 5,000 QSOs with 126 countries) and moved from there to Australia (as VK2GDD) and New Zealand (as ZL0AKH).

3W3RR was on regularly from Vietnam (this is UB5JRR, who is there until the end of June), ON7TK showed up as promised from A61AC with a good signal on the LF bands and, generally, there was plenty to keep everyone amused.

Light at the end of the tunnel

Most remarkable of all, though, I1RBJ put in a brief appearance from Yemen as 7O0A during the last weekend of January. Paul made 414 contacts, though only thirty-five of these were with Europe as his operations were restricted to the night hours. However, there is obviously light at the end of the tunnel. Let's hope this short operation is a prelude to a major effort later in the year.

In fact, it is beginning to look as though some other very rare ones might reappear on the bands. At the time of writing, Jim Smith VK9NS is reasonably confident of getting to operate from Bhutan, although I remain sceptical. I also hear rumours of possible activity from one or two more extremely rare ones, such as Burma, XZ.

'Inside DX', one of the US DX bulletins, reports that the Hungarian group responsible for the successful operations from Vietnam and Laos have made progress in getting a licence, though I wouldn't hold your breath.

Reflections

With the euphoria of the Bouvet Island and Laos operations now well behind us and with no immediate prospect of Burma or Albania reappearing on the bands, now may be a good time for a little reflection.

I know that many DX Diary readers may find much of the DX in this column rather esoteric, and about as far removed from their own HF band operations as if it took place on the moon. Mind you, although I know of many UK amateurs who never did manage a two-way contact with Bouvet, I am also aware that many QRP operators did make it.

Even on the LF bands a contact was not necessarily too hard. One friend worked 3Y5X on 80m CW using just a Butternut two-band vertical antenna. In fact, LF propagation definitely favoured northern parts, both of Europe and the USA, and some of the Italian 'big guns' could be heard calling away, even when UK amateurs with modest stations had been able to get through.

DXing secrets

Much of the secret to successful DXing lies in operating skill, knowledge of propagation, teamwork (for example, getting advice from more experienced friends on where the DX station is listening etc), and a hundred and one other factors which are not directly related to having the biggest signal on the band.

After all, signal strengths from a distant station can easily vary by several tens of decibels during a single band opening, or certainly from one day to the next. This effect swamps the relatively few decibels' advantage that can be gained from a directional antenna and linear amplifier. Of course, you may have to wait longer for the right moment to arrive, but that's the fun of the chase.

One problem is that many newly licensed HF operators have little or no idea of DX-chasing technique. It's one thing to be able to answer a CQ call and ragchew with an amateur in the US or Australia, but quite another to cope with a major expedition where split-frequency techniques may be used, where the timing of your calls is crucial, and knowing when and where to find the DX (preferably before everyone else) is of vital importance.

Surprisingly, there has been very little in print in the UK to help you with this. I have elaborated on the various techniques in this column in the past (back in 1974 in fact; how time flies). I have also mentioned a number of helpful books (almost all from the US, as it happens).

When I first started on the HF bands it was normal to have had an apprenticeship as a short wave listener. Nowadays, the route to HF is more likely to be via a Class B licence and, from what I hear in the pile-ups when a rare one appears on 6m, this is by no means an effective grounding in good DX-chasing technique. On 6m I have often been able to beat a much bigger UK signal through the pile-up simply by applying the techniques of timing, clear phonetics etc, learned in twenty years of HF operation.

How to improve your technique

If you wish to enjoy HF DXing, I would urge you to dig out what little literature there is and to put it into practice, starting with the more modest DX, such as the frequent expeditions to the Caribbean or to the various Mediterranean islands.

Try to find a mentor in your local area, an experienced HF operator who will share his knowledge with you and be prepared to pass information to you on VHF when a rare one appears (in many parts of the country Chiltern DX Club members are to be found on 144.525MHz, for example, and will willingly help out the newcomer).

If you can't find a mentor, let me know and I will try to locate someone in your area who is willing to help out. HF DXers can appear to be very secretive, staying by their rigs and not venturing out to the local radio club, but almost always will respond with enthusiasm to a newcomer who wants to join the ranks.

Of course, DX means different things to different people. My first non-UK contact was with OK1ATP on 160m CW. I

was running a Codar AT5 transmitter and Lafayette nine-valve receiver, which I had built from a kit, and I was over the moon. That contact meant more to me than many of the supposed rare ones I have worked since.

As time goes on your horizons change. When I first worked the US on 20m AM, having graduated to a Heathkit DX-100U transmitter, I was equally delighted, though now I can work over 1,000 US stations in a single contest and think nothing of it.

Some HF operators will be more than content to maintain regular skeds with friends in Australia and North America. Others like to chart their progress by achieving ever more difficult and specialist awards, just as a stamp collector might move on from collecting everything that comes his way to specialising in a particular theme, country or period.

Given that HF operating can be so diverse, I can never please all of you all of the time as I write this column. I hope what I do provide is of interest, and the letters I get from readers support me in this belief.

Pitcairn

In this anniversary year (see February DX Diary), Jim Russell G3OKQ has travelled back to Pitcairn and will be especially active during the celebrations in April. Last time he was on Pitcairn he worked the UK on all five main HF bands. Let's hope he can do the same again on this visit. I have already worked him on 10m with good signals.

Other Pacific

OH2BH and others were due to start a two week operation from Christmas Island (T32) around 21 March, to be followed around 4 April by a two week operation from Jarvis Island (KH5).

There is a possibility that some of the operators will go on to Palmyra Island and Kingman Reef.

They will be seeking separate DXCC status for Jarvis Island (which currently counts the same as Palmyra, though it is a separate one for Islands on the Air).

There was some confusion as to whether this information relates to one group or a number of groups of operators, though it seems certain that there was to have been a big effort as T32T in the CQ WPX SSB Contest at the end of March.

VK3OT was due to sign VK9LE until 8 April on all bands, both CW and SSB. This is Lord Howe Island, off the east coast of Australia. The club station on the Marshall Islands, formerly KX6BU, now has the callsign V73AX.

Elsewhere

There are now four amateurs on Kerguelen Island, which must represent a major proportion of the total population! The calls to look out for are FT4XG, FT4XI, FT5XA and FT5XH. In addition, FT4WB is active from Crozet Island.

The best place to look for these and other French possessions is in the French-speaking part of 20m (especially on and around 14115kHz), though you may need to polish up your French first.

SP9JLD will lead a climbing expedition to the Himalayas from 10-31 May. He will sign 9N5CW on CW and RTTY and 9N5DX on SSB.

Much nearer to home, the Northants Expedition Group will operate from the Channel Island of Herm from 1-8 May, using the callsign GB2HI. Look for them on all the HF bands. Individual members of the group may also use their own callsigns, albeit with the GU prefix. Unless you are in a big hurry for the QSL, send your cards via the bureau and save the cost of direct postage.

G0MGM hopes to put on WAB square NB00 in the Outer Hebrides from 7-21 April. The operation will be SSB only, using a Butternut HF6V vertical antenna.

Happy birthday to you

The San Marino Radio Club celebrate their tenth anniversary in April, and the special station T70A/10 will be QRV on 21-22 April. A special QSL card will be available. Also, an award will be issued for those working ten San Marino stations (you can work one station on more than one band to count towards this total) between 15 April this year and 14 April 1991.

To claim the award, send a list of QSOs, certified by two other amateurs or a recognised Club official to ARRSM, Box 77, San Marino 47031, Republic of San Marino, along with the fee of $10.00.

G0GWA and G0KPH have been invited to participate in a multi-national, Russian-sponsored expedition to the North Pole using off-road vehicles. The expedition will commemorate the fortieth anniversary of the founding of the United Nations.

Overseas visitors will be flown to the North Pole for the period 15-20 April, and it is hoped to put on an amateur radio station with the callsign EK0AA from the Pole for three days during this period.

5R8JL is currently active from the Malagasy Republic, a country which has become increasingly rare on the bands in recent years. Jean-Noel is a resident of the island, but as yet has no official paperwork authorising his operation. Work first, worry later!

ZS8MI goes QRT in mid-April and Marion Island may well be off the air once again for several years (let's hope not). The moral is to catch Peter before he leaves.

Marconi Day

Once again a number of special stations will be active to celebrate International Marconi Day. The event will take place on 21 April, from 0001hrs to 2359hrs GMT. Look out for K1VV/IMD, VE1IMD, VO1IMD, EI2IMD, IY4FGM, GB0IMD, GB4IMD, GB2IMD, IY0TCI, IY1TTM, ZS6RSA, DA0IMD, GB2MDI and F?IMD (full call not yet known).

Last year I was able to work eight of these special stations to gain the very attractive award issued by the Cornish Radio Amateur Club. This year, however, you need to work ten of them to qualify as there are more stations active.

The fee for the award is £2.00, which should be sent, along with details of the QSOs, to CRAC, PO Box 100, Truro TR1 1RX.

DXCC

It looks as though Walvis Bay has made it on to the DXCC list, so we now have 324 countries to chase. This decision has to be ratified by the ARRL Awards Committee. Meanwhile, it has been announced that QSLs for XW8KPL, XW8KPV, XW8DX, XW8CW and LU6ELF/D2 will all be acceptable for DXCC Awards credit.

The December issue of **QST** shows G3XMZ as a new holder of the Mixed DXCC Award, while G3XON gains an RTTY DXCC, not an easy achievement. The January issue lists GM0DBW as a new holder of Phone DXCC and G4WVX the CW Award. Congratulations all.

Contests

April is relatively quiet on the contests front, much to the relief of those among you who find contests an intrusion. The only events of note are the SP-DX CW Contest on 7-8 April and the Helvetia Contest (both SSB and CW) on 28-29 April.

Having said this, I believe the so-called Yuri Gagarin Contest, which is held every third year, will be on 14-15 April.

The new 1990 edition of DX Nets Around the World (List Nine) is now available from OE2DYL. The list contains data about more than 100 active DX Nets. The price is $3.00. Package price for all editions (one to nine) is $12.00. ($1.00 = three IRCs, cheques are not acceptable). Order your copy (enclose an sae) from Dieter Konrad, Rosengasse 1, 5020 Salzburg, Austria.

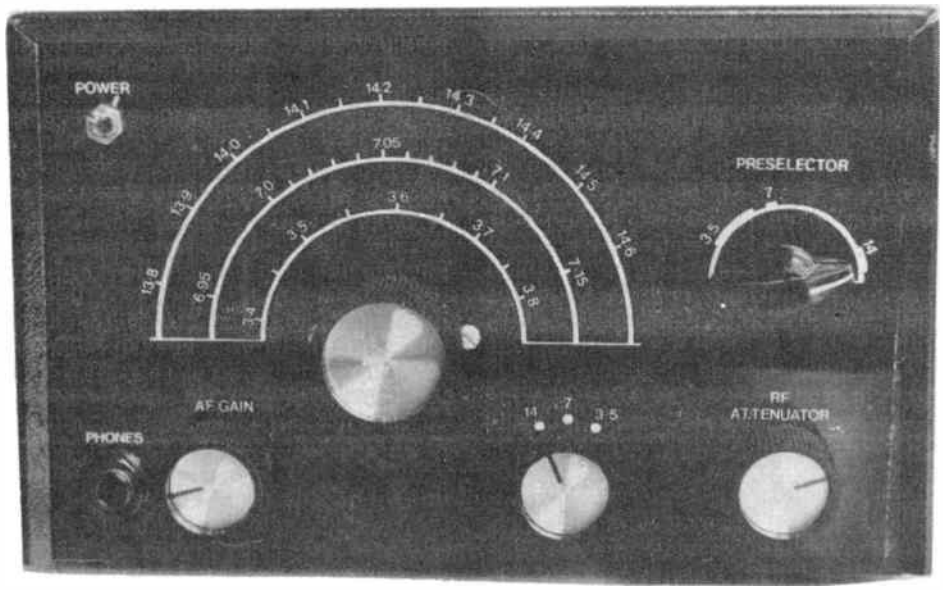
DX lies

DXers can be like fishermen in some of their tales, so I was amused recently to see a compilation in **QST** of the Ten Biggest DX Lies. Here they are:

1. I didn't need it;
2. I got him on the first call;
3. I worked him before;
4. The card is in the mail;
5. He answered my CQ;
6. I'll call you just as soon as he comes on;
7. Two more and I make the Honor Roll;
8. He QSL'ed direct;
9. Sure, I've got them all. I just don't bother to turn the cards in;
10. I'm a DXer and my wife just loves it.

BITS TO BUILD

THE CARLTON THREE-BAND RECEIVER



One of the advantages of living in a fair-sized house is that I can collect unusual amateur radio items, such as my collection of early Ten Tec QRP equipment. Did you know that Ten Tec began by producing modules for simple QRP equipment?

Amongst these early items I have a pristine example of the Ten Tec RX10. It is, I believe, the only example of a commercial direct conversion amateur bands receiver in the UK. It covers the 80, 40, 20 and 15m bands, uses very simple circuitry, looks ugly, and does not perform very well! Nevertheless, it is a very interesting piece of equipment and I have had a lot of fun using it from time to time. Attempting to obtain good results from the RX10 gives one an appreciation of the lost skills of our amateur radio forefathers.

I was, therefore, interested when Lake Electronics of Nottingham announced that they had produced a kit for a three-band direct conversion receiver. I have built many direct conversion receivers, but have usually played safe and made them single banders.

It is my view that the problems associated with getting such a receiver to cover more than one or two bands could mean that the band selection circuitry might be more complex than the rest of the receiver.

What were Lake Electronics going to do in this three-band kit? The answer proved to be that they kept it simple.

Direct conversion receivers

Quite simply, direct conversion receivers are those in which the incoming signal, at RF, is converted to an AF signal in 'one go'. **Fig 1** shows the block diagram of the Carlton receiver and illustrates this technique very well. There are other more complex techniques, but the block diagram shows the common, basic direct conversion receiver.

The signal from the antenna is selected (tuned) by the preselector stage and passes to the product detector. The product detector is a mixer circuit which also receives the signal from the VFO (Variable Frequency Oscillator). The two signals mix to produce an audio product. The VFO is tuned to almost the same frequency as the required radio signal. I say 'almost' because if the required radio signal and VFO are at the same frequency, mixing would produce no audio signal. If the VFO is, say, 1kHz away from the required radio signal, then mixing produces a difference of 1kHz which emerges as an audio signal from the mixer.

Any method of communication which requires a carrier insertion oscillator for reception, eg, the most common amateur radio modes of CW and SSB, can be received via direct conversion.

One of the problems with this technique is that only very limited selectivity and sensitivity can be achieved at the front end of the receiver. In the more conventional superhet receiver, amplification and filtering can be carried in the IF stages. But in most simple direct conversion receivers, this part of the signal processing is often carried out at the AF stages. Not the best place to carry out most of the hard work of the receiving process but, with care, acceptable results can be achieved.

The Carlton follows this convention and the weak audio signals from the product detector are amplified by a low noise IC preamp, the TL071CP, and a low noise audio power amplifier, the LM386. The receiver employs a sharply tuned lowpass filter before the PA stage to improve the selectivity. This is tailored to give a compromise between SSB and CW reception.

Practical circuits

As the Carlton three-band receiver is a multimodule project, it is only necessary to describe the two main sections which are of special interest to the constructor of a multiband direct conversion receiver, the VFO and product detector.

The circuit of the FET VFO and the two-stage buffer amplifier are shown in **Fig 2**. The oscillator is a Hartley circuit which uses a tap on the tuned circuit inductor (L) to provide the feedback needed to maintain oscillation. The Hartley has a very stable oscillator configuration if the feedback tapping point is correct: usually just above the point where oscillation occurs.

The buffer is well known to many home constructors of amateur radio equipment, as it is an RF buffer using shunt feedback. This is a neat little circuit which has the advantage that, in signal excursions of TR2 and TR3, the potential on the base of TR2 remains constant. Therefore the amplifier does not offer a changing load to the oscillator.

The interesting section of this VFO is the circuitry used to select the three bands. Conventionally, these days, synthesised multiband amateur radio equipment does not select the various bands by mixing a free-running VFO with a series of crystal oscillators. Accumulated wisdom suggests that bandswitching a VFO is bad practice. This must be done in the tuned circuit and HF tuned circuits are best left simple... and alone.

A glance at the circuit of the VFO shows that Lake Electronics have thrown caution to the wind and switched the inductor and capacitor values in the tuned circuit. A double pole, three-way switch selects individual inductors and parallel capacitors for the three bands. A main tuning capacitor (VC) provides the tuning control for all three bands. The bandedge is set by switching in a trimmer capacitor (TC1, TC2 or TC3) for each band.

Do Lake Electronics get away with this

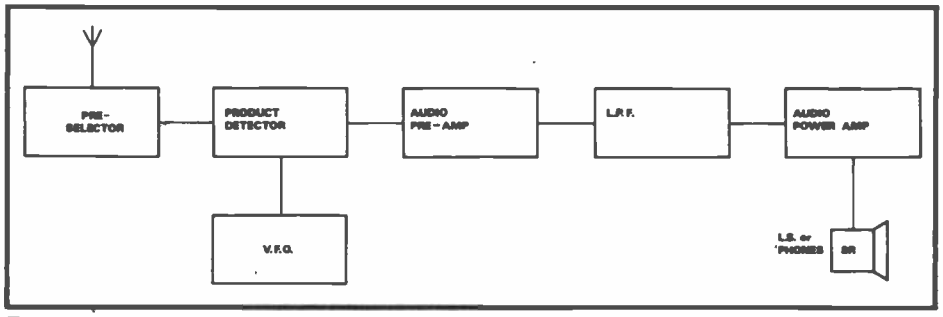


Fig 1: *Layout*

Specifications

Circuitry	Direct conversion
Coverage	3.5-3.8MHz 7.0-7.1MHz 14.00-14.35MHz
Modes	CW, USB, LSB
Selectivity	2000Hz @ 6dB
Output	Up to ½W to low impedance (8 ohms) Headphones or loudspeaker
Power requirement	12-15V dc (13.8V recommended)
Power consumption	Approximately 50-100mA, depending upon the audio output
Overall size	210mm × 180mm × 135mm (WHD)
Weight	1kg

approach in the Carlton? The answer, by and large, is yes. In use, the receiver stability seems more than adequate. On switch on some initial drift is present, but that is common. The Carlton resolved SSB signals on the highest frequency band (14MHz) without the need for constant retuning.

When putting the VFO on a frequency counter on the 14MHz band, I noted a little long-term drift, but this was not noticeable in use. I was surprised. I am not sure how well this VFO would cope in a transmitter circuit, perhaps I should try it one day?

The product detector

Lake Electronics claim in the Carlton receiver handbook that the VFO is the heart of the receiver. My contention is that the product detector is the heart of the circuit. My dreadful simile might be that the VFO is the lungs of the receiver.

Many direct conversion receivers succeed or fail on the strength of the product detector circuit. This is where the chief signal processing takes place and where most 'nasties' appear. A badly balanced mixer can let through broadcast stations, eg, pop music in the middle of an amateur band. The product detector should be able to cope with a wide range of input signal levels, even with cross-modulation, blocking or intermodulation distortion present. If you really want to frighten yourself, do some textbook reading on the design of RF mixers!

The circuit shown in **Fig 3** shows the product detector and also the input tuning preselector and audio preamplifier. The mixer circuit is based around the two FET devices, TR1 and TR2, which are used to form a balanced mixer. L1, C1, C2 and C3 form an input tuned circuit which feed the gates of TR1 and TR2 out of phase at either end of the tuned circuit. The VFO is injected at a capacitive tap formed by C2 and C3. The arrangement of R2, R3, R4 and R5 shows how TR1 and TR2 are balanced.

The balanced output from the drain leads of TR1 and TR2 is fed into two ports of the audio preamplifier, IC1. This gives a neater arrangement than the audio coupling transformer method often used in such circuits. It allows direct access to IC1 and retains the balance of the circuit.

The input circuit is very simple. L2 couples the antenna input and is designed for the common 50 ohm input impedance. This is a minimal preselector circuit, although extra tuned stages would obviously give greater selectivity.

An RF attenuator, VR1, is added to provide a basic RF gain control and to reduce the effects caused by overloading the front end of the receiver. The advantage of this simple input circuit is that bandswitching can be omitted from the input, because the single tuned circuit provides preselector tuning across the three bands.

The Carlton kit

The Carlton Receiver Kit is supplied complete by Lake Electronics, which is not so common for kit producers to do these days. This kit includes everything down to the last nut and bolt, including the case and facia for the front and back panels. The constructor requires only a soldering iron, solder and a few of the usual hand-tools used for radio construction. No extra parts have to be bought and the finished receiver needs simply 12V and a pair of headphones.

The handbook supplied with the Carlton makes the project very simple to understand and the layouts and interconnections are clearly illustrated. It describes how to build the receiver section by section, which is helpful for the less experienced constructor.

Even now, after many years' experience of construction, I would never build a multipart project all in one go and switch on.

The handbook also contains a useful section which is devoted to methods of construction. It even gives tips about successful soldering. 'Even gives' is perhaps an odd thing to say, because my experience is that 95% of problems which occur in home-built projects are because of poor or careless soldering. My guess is that if a would-be constructor can make good solder joints then he, or she, can build the Carlton receiver.

The Carlton in use

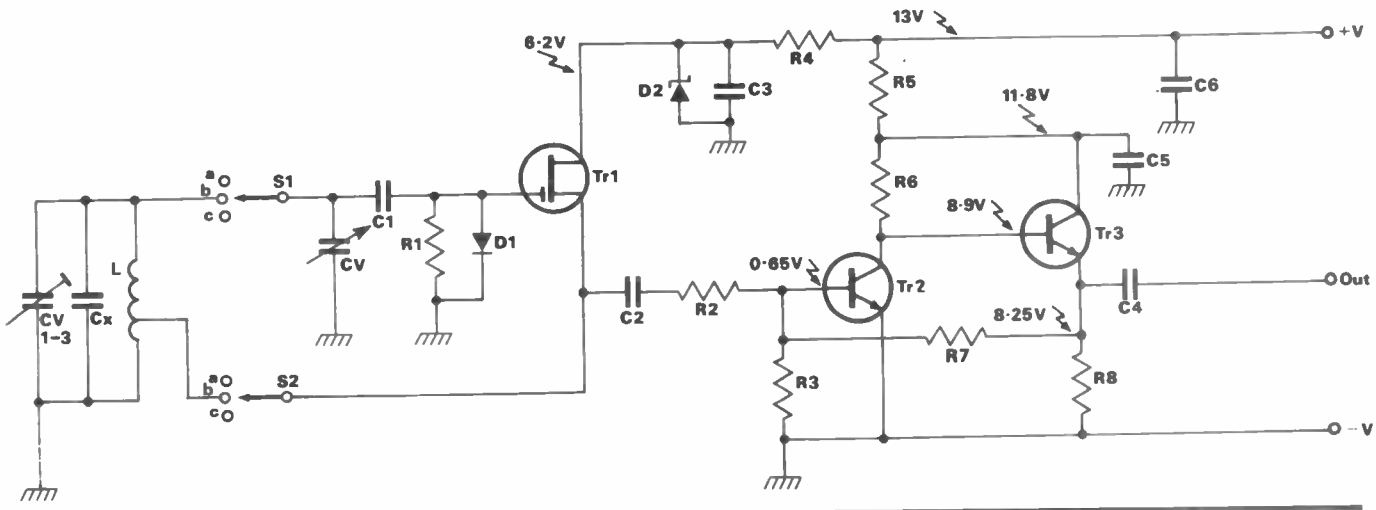
The Carlton requires a 12V supply and a pair of low impedance headphones. I used an ex-walkman pair of headphones wired for mono use.

Some care has to be taken with the choice of power source. Having so much audio gain, direct conversion receivers are prone to picking up mains hum from poor smoothed mains power supplies. The kit also includes a power line filter. The receiver worked on my 12V bench supply without any hum – better than many direct conversion receivers I have used. The current drain (100mA at maximum audio output) is such that a battery supply could be used.

The Carlton is a simple receiver but, like many simple receivers, if used with care, can give surprising results. The Carlton is stable enough for use on all three bands to resolve SSB or CW signals: the selectivity is good for SSB and adequate for CW. The sensitivity also seems adequate. I did not make any objective measurements, but I heard a wide range of DX stations on my example of the receiver.

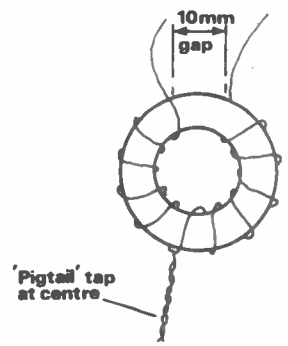
The weakest point of the Carlton, as with many more expensive receivers, is coping with cross-modulation. On 40m it struggles a little against the strong adjacent broadcast signals. Having said this, I have heard £1,000 transceivers struggle on 40m!

These drawbacks can be offset if a little care is taken. The antenna should have an impedance of 50 ohms. This can be obtained using an ATU (Antenna



Range	L	Tap	Wire	Core	Cx
1) 14MHz	Twelve turns	4T	0.4mm	T50-6	100pF
2) 7MHz	Sixteen turns	5T	0.4mm	T50-2	270pF
3) 3.5MHz	Fifty-eight turns	14T	0.3mm	T68-2	33pF

Fig 2: *The VFO*



Amidon T68-2 core

L_1 – 16 turns 0.6mm diameter enamelled copper wire. Spread turns to leave a gap between first and last turn as shown

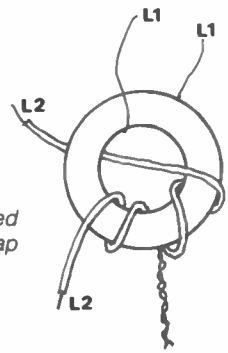
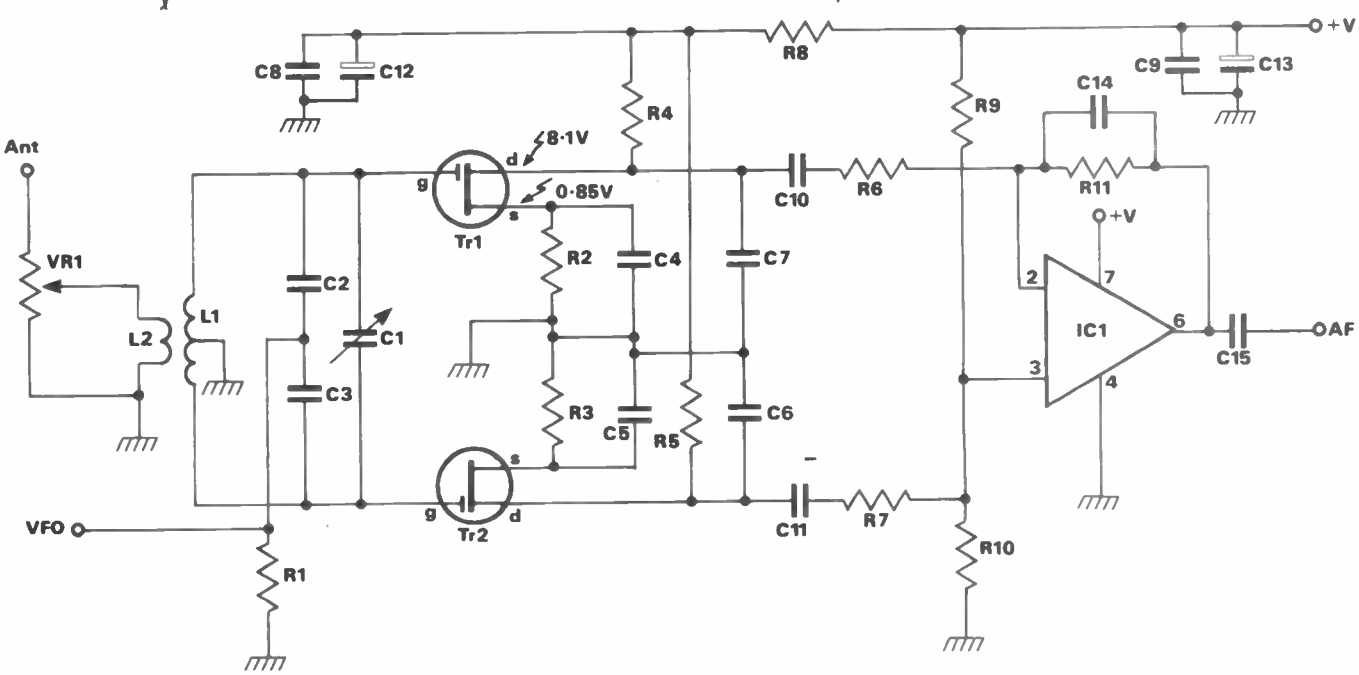


Fig 3: *Product detector*

L_2 – 4 turns 1/0.6mm PVC insulated wire wound over L_1 – 2 turns each side of the centre tap



Tuning Unit), which can improve the handling capacity of the front end enormously.

The RF attenuation control can also be used to advantage. It is common bad practice in receiver technique to turn up the front end gain and turn down the audio gain. The reverse approach is much better and will certainly give the best results when using a simple receiver.

The audio stages have a relatively low inherent noise level, and the audio gain can be used at high settings, with the RF attenuator regarded as the main usable gain control. This approach dramatically improves the performance of the receiver.

Conclusion

The Carlton is fun, easy to build and gives acceptable results for such a simple receiver. It is a good way of enjoying the satisfaction of listening to the amateur bands with equipment which is home-made. The Carlton is a good receiver for the young newcomer to amateur radio. I enjoyed playing with my sample as it reminded me of the old Ten Tec RX10, except that it gave a better performance!

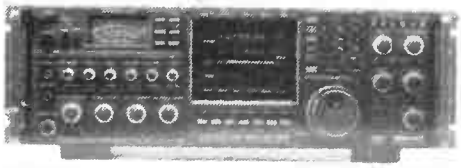
Sources

The Carlton receiver kit costs £66.50 including VAT and is available from: Lake Electronics, 7 Middleton Close, Nuthall, Nottingham NG16 1BX, tel: (0602) 382509. Enclose a stamped addressed envelope for details.

ICOM

ICOM ON STAND

HF TRANSCEIVERS



IC-781 **£4,500**
HF. SSB. CW. RTTY. AM. FM. 150W.

IC-765 **£2,499**
HF. SSB. CW. RTTY. AM. FM. 100W.

IC-726 **£989**
HF/50MHz. SSB. CW. AM. FM. 100W.

IC-725 **£759**
HF. SSB. CW (AM.FM). 100W.

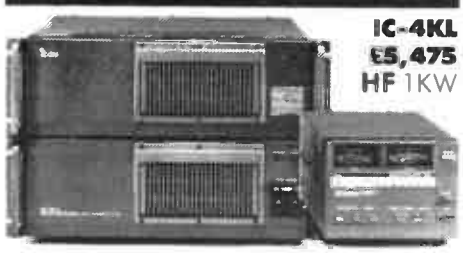
COMMUNICATIONS RECEIVERS

IC-R9000 **£3,995**
30KHz – 1999.99999MHz.

IC-R7000 **£989**
25-1000MHz. 1025-2000M

IC-R71E **£855**
100KHz – 30MHz.

LINEAR AMPLIFIER



IC-4KL
£5,475
HF 1KW

VHF-UHF TRANSCEIVERS

IC-505 **£529**
50MHz. SSB. CW (FM) 3W/10W.

IC-575 10W **£1,042**
IC-575H 100W **£1,199**
28/50MHz. SSB. CW. AM. FM.

IC-275E 25W **£1,069**
IC-275H 100W **£1,039**
144MHz SSB. CW. FM.

IC-475E 25W **£1,185**
IC-475H 75W **£1,250**
430MHz SSB. CW. FM.

HALL 7. RSGB CONVENTION. N.E

Icom (UK) Ltd.
Dept AR , Sea Street, Herne Bay, Kent CT6 8LD. Tel: 0227 363859. 24 Hour.

Count on us!

A1... WHERE ELSE!

MOBILE TRANSCEIVERS

IC-2400E FM 144/430MHz **£635**

IC-2500E **£675**
FM 430/1200MHz

IC-3210E FM 144/430MHz **£499**

IC-901 MULTIBAND **£799**
FM (SSB) 144/430MHz
VARIOUS OPTIONAL FREQUENCY
UX UNITS INCLUDE ▶

IC-228E 25W **£365**
IC-228H 45W **£385**
FM 144MHz

IC-448E 25W **£429**
FM 430MHz

IC-290D 25W **£559**
144MHz SSB. CW. FM.

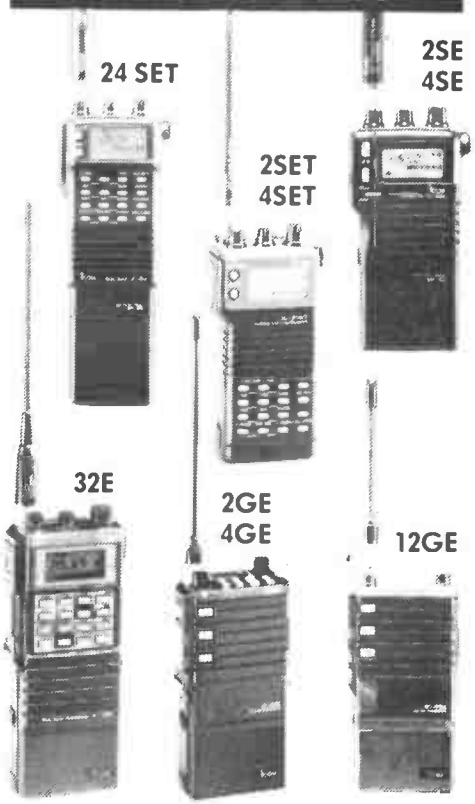
IC-490E 10W **£625**
430MHz SSB. CW. FM.

IC-1201 FM 1200MHz **£520**

PRICES AVAILABLE UPON REQUEST

IC-UX19	28MHz	FM
IC-UX59	50MHz	FM
IC-UX129	1200MHz	FM
IC-UXS92	144MHz	SSB.CW
IC-UXR91	RX Unit	FM.AM

HANDHELD TRANSCEIVERS



IC-24SET	FM 144/430MHz	**£385**
IC-2SET	FM 144MHz	**£295**
IC-4SET	FM 430MHz	**£310**
IC-2GE	FM 144MHz	**£265**
IC-4GE	FM 430MHz	**£299**
IC-32E	FM 144/430MHz	**£399**
IC-2SE	FM 144MHz	**£275**
IC-4SE	FM 430MHz	**£310**
IC-12GE	FM 1200MHz	**£365**

.C. BIRMINGHAM 21 & 22 APRIL.

Icom (UK) Ltd.
Dept AR, Sea Street, Herne Bay, Kent CT6 8LD. Tel: 0227 363859. 24 Hour. Fax: 0227 360155.
Visa & Mastercards: Telephone orders taken by mail order, instant credit & interest-free HP.
Despatch on same day whenever possible.

VISA RSGB MasterCard

DEPARTMENT OF TRADE AND INDUSTRY

OPPORTUNITIES IN TELECOMMUNICATIONS

BALDOCK INTERNATIONAL MONITORING STATION
BALDOCK, HERTS

TELECOMMUNICATIONS TECHNICAL OFFICERS

ASSISTANT TELECOMMUNICATIONS TECHNICAL OFFICERS

Up to £14,905

Challenging and interesting opportunities have arisen at this modern well equipped radio station which is part of the Radiocommunications Division of the DTI.

You will join a technical team working in the frequency range 9kHz to 18 GHz for fixed, mobile and satellite service, maintaining systems and using them for measuring and monitoring. One post will involve travel throughout the UK.

You will need 2 years' radio/telecommunications experience and be qualified to BTEC standard or have an equivalent qualification.

Salary up to £14,905 with further increments, depending on performance, up to £16,125. 20% extra where shift work is involved.

RELOCATION ASSISTANCE UP TO £5000 MAY BE AVAILABLE.

The Station is set in the North Hertfordshire countryside with easy access to Cambridge, Peterborough and London to give a wide range of housing and leisure choices.

For further details and an application form (to be returned by 20 April 1990) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 468551 (answering service operates outside office hours).
Please quote ref: T/8305.

The Civil Service is an equal opportunity employer

dti

the department for Enterprise

PROJECT BOOK

by Martin Williams

We start this month with a novel way of getting rid of excess voltage. The simple answer of course is to use a resistor, but this method does have its own problems. Firstly, the voltage drop across the resistor will vary according to the amount of current which is being drawn by the load. The second drawback is that if the supply is providing several amps, then you will need a heavy resistor to handle the current. This poses a subsidiary problem in that you will have to get rid of a lot of excess heat.

Simple

The resistor method works well if, for example, you want to run a 6V dial lamp from a nominal 9V supply. A bit of Ohms Law and you are in business. The load is fairly constant and you have no problems. What happens, though, if you want to run a transistorised audio amp from a higher supply rail than it was intended for? The main problem is that as the audio output from the amp varies so will the current it takes. If you use a simple dropping resistor the supply voltage will vary in sympathy with the audio, being least when the audio output is greatest. This is exactly the opposite of what you want and can only lead to increased distortion.

The answer

The simple way of rectifying this type of problem is to use a series-connected zener diode. The circuit is shown in **Fig 1.** Let us assume that you have an 18V supply and you want to run some 12V equipment from it. The zener diode has to drop the excess voltage and so should be a 6V type. Remember that it must have a suitable wattage rating to handle the current passed to the load. You may need to fit a small heatsink to it to get rid of the heat. The capacitor C1 should always be fitted across a zener diode whatever the circuit. Its purpose is to suppress the tremendous amount of RF noise that the diode generates.

Safety

The resistor R1 is included to ensure that the zener does not drop out of regulation at very low currents. It should be chosen so that around 10mA flows through the diode. With 12V on the output line a value of one thousand ohms would suit this purpose as it would ensure a current of 12mA in the zener.

This very simple circuit provides a suitable output at reasonable stability, certainly within ±1/10V, which is adequate for many purposes.

Noise

It has already been mentioned that zener diodes are inherently noisy. Why not put this to good use? One of the best ways to optimise the performance of any receiver is to use a noise generator. Because these are expensive, they are rarely found in the average shack. Fortunately for our purposes we do not need the device to be accurately calibrated, since we use it as simply a comparative test set. This means that if you have made some adjustment to improve the performance of the receiver, then you will need less output from the noise generator to reach your reference reading on the test meter.

Circuitry

The very simple circuit is shown in **Fig 2** and is an example of the only circuit in which you do not fit a capacitor across the diode. The components should be mounted in a small die-cast box. Both the .01µF capacitors are disc ceramic types. The one across the supply line ensures that there is no radiation from these connections. The second capacitor provides a dc block so that the connected receiver does not short circuit the diode.

The three components which are shown mounted on the output socket should be fitted using the shortest possible leads. If this is done, the unit will perform well up to several hundred MHz, although, if this is where the unit is most frequently used, reduce the value of the output capacitor to .001µF. If the unit is being built to work at an impedance other than 50 ohms, it is a matter of changing the value of the 50 ohm load resistor to the required value.

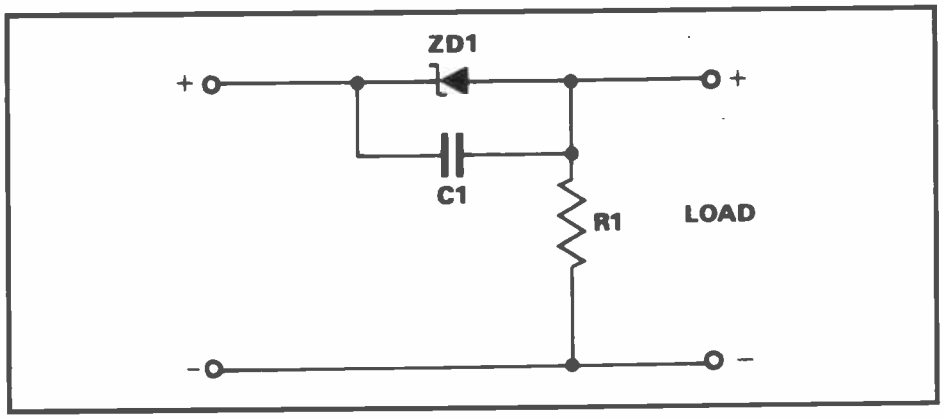


Fig 1: *Series dropper circuit*

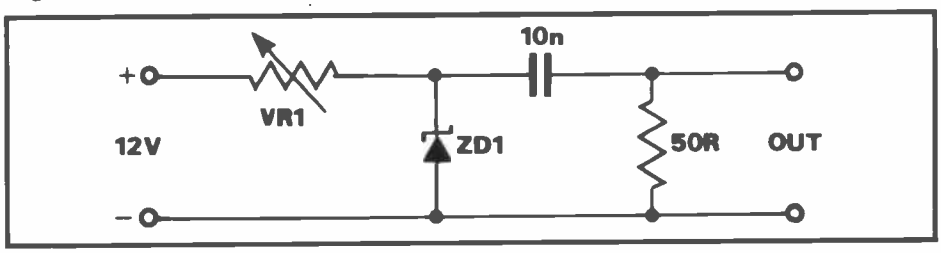
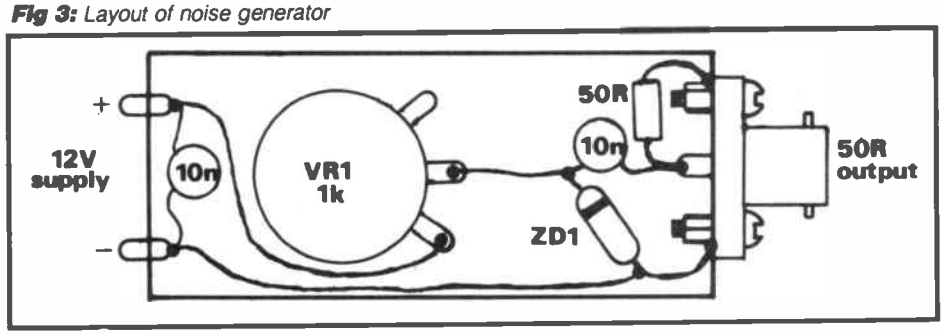


Fig 2: *Zener noise generator*

Fig 3: *Layout of noise generator*



THE TRUSTHORPE SAGA

by Kevin Fox

Over the years the story of my Morse test has made me famous (or infamous) and earned me many a free pint for the relating of it. However, you can only have so much of a good thing and no matter how gratifying the audience's response, I do get tired of telling the story. So, now I am preserving it for posterity within the pages of this magazine.

Perhaps the strangest thing about *The Trusthorpe Saga* is that it is true, no matter how improbable you may think it.

There were several of us living in Radio City at the time (that's North Anston to you; a small place with an incredible amateur density – some thirty-six licences in the village). Although there was a crowd of us listening to RSGB slow Morse transmissions and playing about with computers and Datong Morse Tutors, there were only two of us doing it for real, John G4MRB (neé G8VFK) and myself (neé G8YYK). Boy! Was I glad to lose that.

John told me that he was about to put in for the test, and asked me if I wanted to put in for mine so we could go together. Like a fool I agreed, so plans were laid and arrangements made. I well remember licking eighty-eight 9p stamps for the test fee, nobody having told me about one pound stamps!

The great day dawned, and I dashed over to John's house to be confronted with Selwyn.

Almost a motor caravan

Selwyn was John's means of locomotion. It was (almost) a motor caravan; a very old Bedford van converted to a motor home by a team of homicidal maniacs with a warped sense of humour. It had a lift-up roof which to my certain knowledge had already lifted up, over and off twice! The paint job was custom; dirt and rust. Underneath the bonnet lay a mass of hoses which apparently led nowhere, one end of them being attached to the engine and the other end suspended in mid-air. Selwyn just about had four wheels and sometimes they even rotated together.

Put it this way, if Selwyn had been a horse, he would've been shot. However, this was to be our transport for a round trip of some 150 miles. Perhaps I could get used to G8YYK after all?

I filled the glove compartment (posh name for the hole in the dash) with essential supplies like Mars Bars, crisps and Coke then, when John had finished winding the elastic band, Selwyn spluttered into pseudo life; we were off!

To my utter amazement Selwyn performed faultlessly throughout the whole journey. That's if you discount the 150dB roar of the engine which reduced my hearing by at least 40dB, the freezing cold air whistling in under the roof and out of my right ear, and the rattles and bangs which loosened two of my fillings. But we arrived at Trusthorpe, safe and (almost) sound. And also three hours too early, thanks to my lack of faith in Selwyn.

You're absolutely right

What exactly can you do on a Thursday afternoon in the middle of winter at Trusthorpe, Lincolnshire? Oh! You've been there too? Yep, you're absolutely right, not a lot! We checked out Humber Radio where we were due to take our tests at 3.00pm. After a quick nosey at the aerials, we had really seen all there is to see. So, being famished, the Mars Bars long since consumed, we set off in search of sustenance.

I caught the faint aroma of fish and chips wafting down the promenade on a salty breeze. I followed my nose but when the water lapped over my shoes, John pointed out that the shop was probably inland anyway. We waded back to shore and trudged off towards Mablethorpe.

When we finally discovered the chip shop it was on the verge of closing. I pushed the proprietor away from the door, rushed up to the counter and slapped down a pound.

'Fish 'n' chips please!' I yelled before he could object. He sighed deeply and retreated behind the counter. As he lifted the chrome cover of the chip box I began to regret my haste. In one corner huddled a congealed mass of black-spotted greasy chips, and as far away from the chips as it could get lay a lonely piece of cod.

'You have the chips John,' I urged.

'No thanks, old chap. After all, you *were* first!'

Thanks a bunch, pal, I thought.

He's thoughtless like that

It was beginning to rain outside, so we tried to stay in the chip shop. However, there's only so much salt and vinegar you can put on to fish and chips before they're inedible. We trudged through the pouring rain, eating our cold and wet chips. I gave John his coat back; he's thoughtless like that. Still having over two hours to kill, we sat in a sea-front shelter, firing practice Morse at each other.

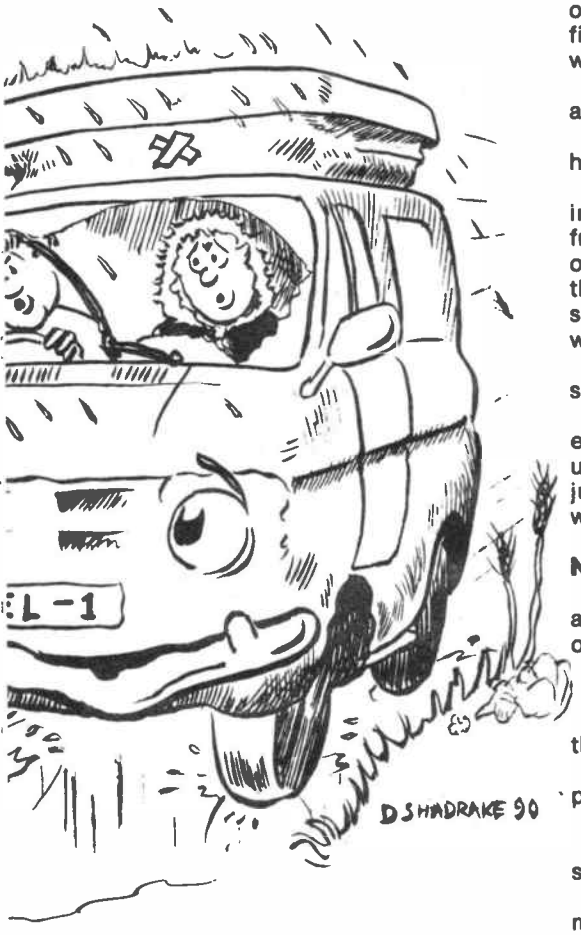
'Di da di dit,' I fired at him.

'Pardon?' said an elderly lady carrying a poodle.

'Who knitted yer dog missus?' I asked her conversationally.

The lady moved to another shelter and I continued with the practice session. I suddenly began to feel very ill, my stomach churning. John decided I needed a toilet, although I would have liked to go back to the chip shop and deposit my multi-coloured protest outside his front door.

We eventually found a toilet that wasn't locked, but there was still a problem. There was no indication of which toilet was for which sex. I wanted John to try one, and me the other.



'I'm not the one who's feeling sick,' he reminded me.

The way I was feeling by this time, it hardly mattered anyway. I dashed in and emerged ten minutes later, looking very green. We watched as a police car pulled up and a policeman got out and went into the toilet I didn't. We left, smartly.

We decided to play safe

A quick tour around Mablethorpe confirmed that it had little to offer in the way of pleasant diversions. As a thick mist began to roll in from the sea, we decided to play safe, and set off along the sea-wall back to Trusthorpe.

After we'd been walking for over thirty minutes John asked:

'Shouldn't we be there by now?'

The sea-mist had quickly developed into a sea-fog and we were hopelessly lost.

Coming towards us I saw a figure in a bright yellow oilskin and sou'wester, towing a dog on a lead. (It's a great place for dogs, is Mablethorpe!)

'Er, excuse me, Captain,' I ventured, 'Can you tell me if we're anywhere near Humber Radio?'

The dog started woofing and snapping at me, straining on its lead. I gave a short growl Sgt Belker of Hill Street would have been proud of, and the dog ran behind its master whimpering. The oilskinned figure stuck out a gnarled finger, pointing in the direction from which we'd just come.

Turning round we trudged along for another half-hour.

'We're going to be late,' said John helpfully.

For a second I thought I was hallucinating; appearing out of the fog, directly in front of us, was the same bright yellow oilskin, towing the same dog. This time the man didn't wait to be asked, merely stuck out his finger in the direction from which we had just come.

'At least we're narrowing it down,' I said optimistically.

We walked back a short way, and eventually the fog relented and opened up a narrow slit through which I could just see the towers of Humber Radio. We were inside within a couple of minutes.

No time to be nervous

A man taking off bright yellow oilskins and releasing his dog from a lead, took our papers from us.

'You're late,' he said.

'We got lost in the fog,' I crawled.

Before we had time to become nervous the chap who was to test us came over.

'Who's going first then?' he asked pleasantly.

'After you, old boy,' said John.

I marched after the fellow and into a small office.

'Try the headphones on for size,' said my tester chappie affably. 'And adjust the volume and pitch of the buzzer.'

I slipped on the cans, and my tester gave the key a few blips. I winced, some nutter had the volume full on... So I failed. To give the Humber Radio guys their due, they did everything short of actually doing the test for me. I could feel my chap literally willing me to pass! Trouble was, I wasn't ready, so I deservedly failed.

I returned to the waiting room dejected. John didn't have to ask, my face told the story. He went in for his test and was soon back again. He wasn't ready either. We said our farewells and thanks to the guys at Humber Radio and left.

The last thing I needed

On leaving the building I saw Selwyn leaning even more drunkenly than normal. After a really disastrous day, a day in which I had been poisoned by the local chippy, got lost in the fog, been in the sea *and* failed the Morse test, the last thing I needed was hassle getting back home.

Walking over to Selwyn I kicked the flat tyre in disgust.

'Pass me the jack and I'll give you a hand,' I said to John resignedly.

Silence from John. I looked over at him.

'You do *have* a jack?'

John looked down at his shuffling feet.

'Er... Well... er.. We don't actually have a jack-type thingy,' he said in embarrassment.

I sighed deeply, recognising all the omens of a major disaster hurtling over the horizon straight for me. But even I couldn't have guessed at the magnitude of the disaster about to engulf us.

John returned from Humber Radio with a borrowed jack. As he came out of the door he waved the jack above his head, signifying that he'd managed to borrow one. The handle slipped out and hit him on the head.

I knelt down at the side of Selwyn, pumping the jack handle. Selwyn lifted up, then crashed back down again. The jack had made a neat round hole in the floor.

I eventually found a solid bit of chassis to fix the jack to, and we replaced the flat tyre with the spare. Although why we bothered I don't know, the spare didn't look in any better condition than the tyre it had replaced!

The dog supervised

John returned the jack, and then he jumped into the cab and hit the starter. There was the faint suggestion of a whimper from the engine. Flat battery, we concluded together. John returned to Humber Radio and arrived back with two bodies and a dog to help push-start Selwyn. The three of us (the dog was supervising) pushed Selwyn up and down Humber Radio's carpark.

On the third circuit, John removed the hand-brake and Selwyn choked into life with an almighty back-fire which sent the dog running straight into a chain-link fence. The day did have its bright spots!

I got the distinct impression that the people at Humber Radio were pleased to see us go. They continued pushing Selwyn out of the carpark even though the engine was running.

Selwyn seemed far from happy; there was an horrendous grinding crash from the gear box.

'What was that?' I asked John, grinning weakly.

'We've just lost third gear,' he replied grimly.

'I didn't know Selwyn had three gears,' I said, surprised.

The temperature gauge climbed as the petrol gauge sank. I had a little bet with myself that the petrol would run out before the engine boiled over. I lost, but it was close. Clouds of steam streamed back along the road. We pulled over. John lifted Selwyn's bonnet, rummaged around and reappeared clutching an armful of hoses.

Things fell off thick and fast

Again, we were mobile. It started to rain, and John flicked on the windscreen wipers. Wipe... wipe... whoosh! A passing motor-cyclist copped an offside wiper arm in his ear.

John wound down his window to adjust the door mirror; it came off in his hand. He brought it back into the cab with him. On attempting to wind up the window, the handle came off. He slung it into the back of Selwyn, along with all the other bits and pieces which had fallen off since leaving Humber Radio.

There was yet another horrendous grinding crash from the gear box. I looked over at John.

'Fourth?'

He nodded. 'Yep! Fourth.'

We were down to two gears and twenty miles an hour. As it was getting quite dark by this time, John flipped the headlights on. The engine all but stopped. Hastily he switched to sidelights. I asked John if we could stop and purchase sustenance (I always eat when I'm depressed). He looked at me as if I were crazy.

'Can't stop,' he muttered through clenched teeth, 'never get started again.'

We tootled along at a steady fifteen miles an hour. People out walking dogs, old men using walking frames sped past us. I felt as if I should be walking in front with a red flag. Little wisps of steam were once more beginning to appear from Selwyn's bonnet, like froth around a rabid dog's mouth.

The thought cheered me

Then I suddenly remembered Dunham Bridge, where you have to stop and pay a toll for the privilege of crossing the Trent. The thought cheered me enormously; I couldn't wait for John to get there. I was dying to see what he would do.

John read the road sign, 'Dunham Bridge – 1 mile'. It appeared to jog his memory. It was quite comical watching the various emotions flicker across his face as he formed plans in his mind and then rejected each one.

'Got 20p?' he asked at last.

Holding out his left hand I carefully counted 20p in pennies into it.

'Thanks,' he snorted, struggling to close his hand over the coins.

As we approached the bridge John was still in an agony of indecision. As he sank down into his seat and transferred the coins into his right hand, I thought, my God! He's really going for it! John picked up a little speed as we approached the toll booth, and the attendant stuck his head through the booth window, the better to see this fleet of tanks approaching his bridge.

His eyes registered amazement on seeing Selwyn, then fear as doubt began to go through his mind, then blind terror as his eyes confirmed his worst fears. He realised we weren't going to stop.

Leaning through the open window of Selwyn, John hurled the fistful of coins into the hastily vacated toll-booth window. He yelled, 'Sorry old chap. Can't stop. Engine trouble.'

I grinned in delight. The attendant just made it to the traffic barrier in time.

He was open-mouthed

My last memory of Dunham Bridge is of the attendant framed in the toll-booth window, standing open-mouthed, with coins trickling off him.

It took only another three hours to cover the remaining twenty miles. Poor Selwyn, you could see him making the effort once he could see the finishing line. We arrived at last, Selwyn gave a last asthmatic wheeze, coughed and died.

'How did the test go, love?' asked my beloved on my return. Test? Test? Hadn't I taken that weeks ago?

Postscript: I returned to Trusthorpe (making my own travelling arrangements) within a couple of months with a usable speed of twenty-five. I passed. John returned a couple of months after me; he passed too, although he complained of an uneventful journey. (But he didn't dare go via Dunham Bridge!)

CHAIN HOME:

BATTLE OF BRITAIN RADAR

by Brian Kendal G3GDU

Part 2: From Conception to Maturity

Orfordness

Within a few days of the Daventry Experiment it was decided that, on grounds of secrecy, the initial experiments should take place at a remote site at Orfordness, some ninety miles north-east of London. This comprised a long spit of salt marsh and shingle extending some fifteen miles down the coast from Aldeburgh which could only be reached by boat from the village of Orford.

The site was already owned by the Air Ministry and had been a busy establishment during the First World War. Subsequently it had been almost abandoned, although in 1926 a rotating radio beacon had been installed there by Marconi.

In preparation for the Slough team, several huts were reroofed and power was laid on from the mainland.

The radar group left Slough for Orfordness on 13 May 1935. This comprised four scientists: Arnold Wilkins, L H Bainbridge-Bell, George Willis and E G (Taffy) Bowen plus a number of workshop personnel.

Once installed in their new location, work proceeded rapidly. Under Wilkins' direction the aerials were rapidly erected while he and Bainbridge-Bell assembled the receivers and cathode ray indicator, Bowen taking responsibility for the transmitter.

Of these, the transmitter had previously been neither tested nor even put together. Many of the components had been rescued from discarded equipment at Slough and Teddington, while the high voltage transformers and rectifiers had previously been used in X-ray experiments.

These Bowen combined with a pair of Naval silica valves type NT46 which were the most powerful transmitting valves currently used by the Royal Navy and, by happy accident, ideally suited to pulsed operation. The valve envelope was of tough silica and the filaments drew about twenty amperes at twenty volts, thus ensuring adequate emission for the service which they were being called to perform.

On completing the transmitter, Bowen first ran the valves at 5,000 volts, their maximum rated voltage, obtaining a peak envelope power in the order of 25kW. During the next few weeks, however, Bowen gradually increased this voltage while carefully observing the valves for distress. By mid-May he had managed to double the applied voltage and increase the transmitter power to a very creditable 100kW peak on a wavelength of about 50m.

By this time no aircraft echoes had been identified but they were already receiving an impressive display of returns from the ionosphere and other echoes stretching out to several thousand miles.

After a little thought it was realised that these were land returns from central Europe, reflected on a grazing incidence from the ionosphere – the first example of over-the-horizon radar. However, with the broad beam in use at the time and the lack of signal processing methods, there was no way in which these could be identified.

On the morning of 16 June the equipment was again run up and immediately a clear echo was received at a distance of seventeen miles. This turned out to be a Scapa flying boat from Felixstowe Air Station.

Good echoes were received as the aircraft flew up and down the coast and when it eventually landed, Watson-Watt telephoned the Commanding Officer and asked if the aircraft could repeat the flight. This was agreed and the scientists at Orfordness had another hour of pleasure viewing the aircraft as they followed its passage up and down the coast.

Rapid progress was made

From that time on progress was rapid. The Royal Air Force Station at Martlesham Heath assumed responsibility for test flights of the new radar equipment and a series of flights was made by aircraft flying on the landward side from Orfordness to Bircham Newton and back.

With such flights occurring daily, the performance of the equipment improved rapidly and the maximum range of detection increased from forty miles in September to eighty miles by the end of the year and to more than a hundred miles in early 1936.

All the original results had been achieved on a wavelength of about 50m. This wavelength had been chosen because many bombers of the period had a wingspan of 75ft and would thus act as a halfwave aerial at this wavelength. Unfortunately, it was also heavily used by commercial traffic to a degree which rapidly became untenable. Initially a move to 26m was made until this too became unusable and a final shift was made to 10-13m which then remained as the British early warning wavelength until well after the end of the war.

All work to this time had concentrated on detecting and determining the range of aircraft targets. However, for a complete early warning system it was also necessary to determine the height and bearing of the target aircraft.

The first of these was addressed by Arnold Wilkins who adopted a system which had been pioneered at Slough for the measurement of the downcoming angle of transatlantic signals. From the angle of incidence of the returning echo and the range of the target, it was possible to calculate the height of the observed aircraft.

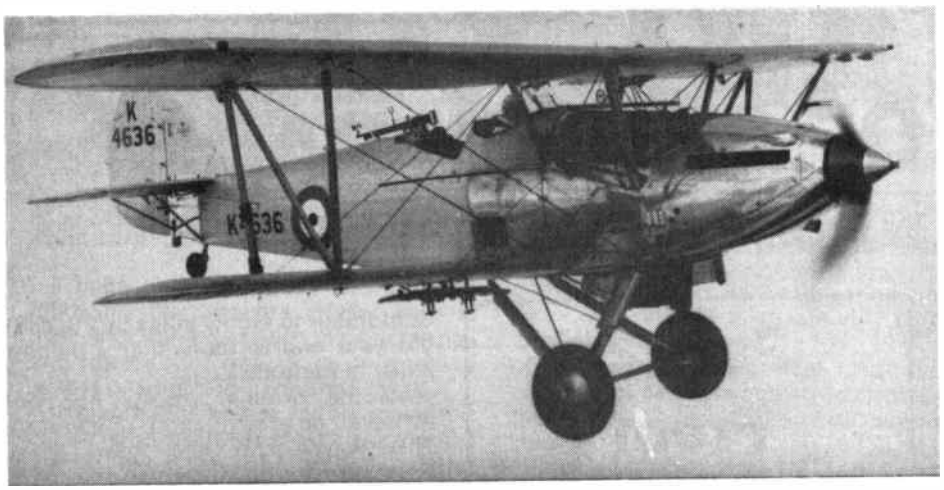
This was achieved by switching the receiver between two separate aerial arrays, one higher than the other. As the vertical polar diagram of any aerial is a function of its height, with a knowledge of the aerial characteristics, by comparing the signal strength received on each aerial, the angle of incidence of the incoming signal could be measured. By combining this with the measured range, the height of the target could be calculated.

A little later an accurate method of direction finding using crossed dipoles was added, thus completing what, in modern parlance, would be called a complete 3-D radar system.

The success of this development prompted the air staff to ask for the construction of five stations to provide air warning over the approaches to the Thames estuary for which the Treasury allocated £1,000,000.

It was immediately realised that the small development staff at Orfordness had neither the resources nor the manpower to tackle such a project. Thought was therefore given to increasing the staff and finding an alternative,

CHAIN HOME: BATTLE OF BRITAIN RADAR



A Hawker Hind bomber similar to those used as targets for the 'Biggin Hill Experiment'.

more convenient site from where the project could be attempted. The staff therefore initiated a search, finally locating a large house located on the coast just a few miles south of Orfordness.

This was Bawdsey Manor which was located on a 180 acre estate at the mouth of the River Deben and was owned by Sir Cuthbert Quilter. Within a short period the sale was arranged and in March 1936 the move from Orfordness was commenced. The establishment was named the Bawdsey Research Station with Watson-Watt appointed as the first superintendent.

The laboratories were quickly set up and 240ft aerial towers were erected on a hill behind the manor. Within a very short space of time the manor became an extremely busy place with a rapidly increasing staff. It was to remain the focus of the United Kingdom's radar research for many years to come.

Biggin Hill

By the early summer of 1936, Tizard had become optimistic that the experimental equipment operating at Bawdsey could give the ground controllers a continuous stream of information indicating the bearing, distance and height of any aircraft approaching the coast from which it would be possible to determine the aircraft speed and track.

This was immeasurably better than any method used previously, but Tizard realised that as far as the defence of the United Kingdom was concerned, this only addressed half of the problem.

The immediate operational advantage of an early warning and tracking system was that the costly 'standing patrols' of aircraft could be eliminated. These comprised small flights of fighter aircraft patrolling allocated stretches of the British coastline in order to observe and report the approach of any hostile aircraft.

Unless the sighting occurred during the early part of the patrol, interception would not be possible because of the lack of sufficient fuel reserves for combat. The policy was therefore to transmit the sighting report to enable fresh aircraft to take off and perform the interception.

The maintenance of standing patrols was extremely expensive in men and machines as, for every aircraft and crew in the air there had to be four or more aircraft and crews on the ground: refuelling; under maintenance; resting; training; on leave etc. Thus by eliminating standing patrols, the numbers of aircraft and crews available for combat would be multiplied by five.

Tizard realised, however, that such advantages could only be exploited to the full if a completely new technique for interception were employed – and that such a technique could never be adequately developed in the early stages of a war. The development had therefore to be achieved in the peacetime environment, and, in view of the international situation at that time, as a matter of urgent necessity.

On 13 July 1936, Tizard approached the Air Ministry and outlined his proposals for the necessary experimental work to a number of senior RAF officers.

As a result of this it was agreed that an experiment should start on 4 August 1936 and last for a period of two months. In the event it lasted for over a year and laid the principles for radar-controlled interception.

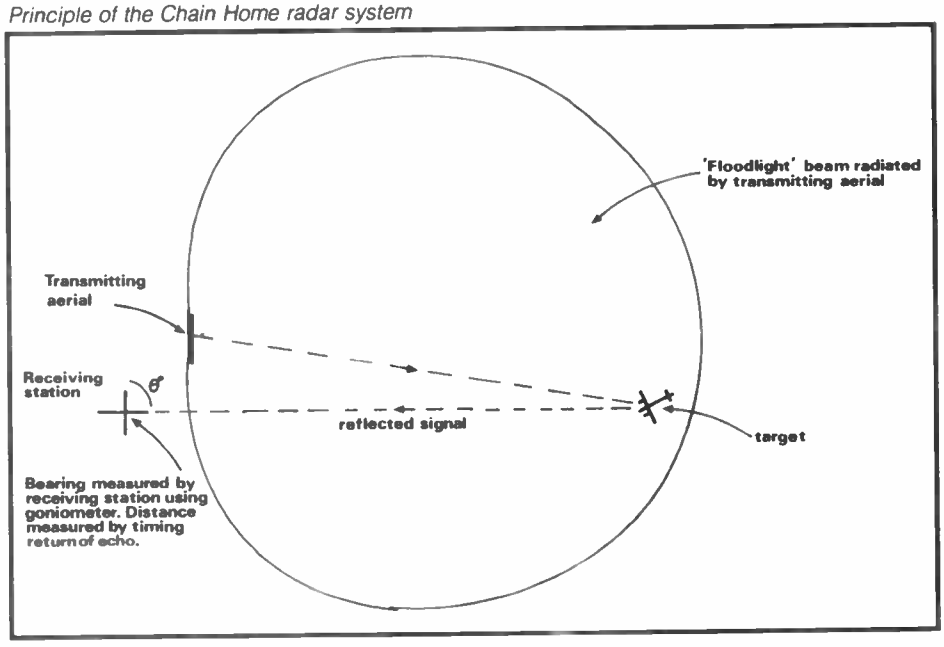
The RAF station chosen for the experiment was Biggin Hill, some twenty-five miles to the east of London and also directly below one of the main air routes between the Continent and London. From here interceptions would be flown by a flight from 32 Squadron. This was equipped with Gloster Gauntlet biplane fighters and led by Sqdn Ldr Arthur McDonald. The 'hostile' aircraft were to be represented by Hawker 'Hind' light bombers from various squadrons.

The selection of 32 Squadron was not completely random for, under their previous and present leaders, great efforts had been made to extract maximum performance from their TR9 air to ground R/T equipment, with the consequence that they were regularly achieving an air to ground range of fifty to sixty miles compared with the five to ten miles of most other squadrons.

At first, to avoid divulging the full capabilities of the system, the crews were informed that updates of the enemy aircraft position were only available at five minute intervals. Even with this limitation, interception of the Hawker Hind hostiles was soon being achieved. To avoid any suggestion of collusion, the pilots of 32 Sqdn were informed of neither the squadron nor the base from which their targets originated.

Most interesting of all was the fact that

Principle of the Chain Home radar system



most of the techniques for radar interception were developed without the use of radar, for the only station which could give guidance, Bawdsey, was more concerned with developing the equipment and installing new stations.

The experiment was made possible by two devices, the filter table and the pip-squeak.

The intended system of control was to pass all information, whether radar, observer corps or other sightings, to a central point where each threat could be assessed and appropriate response initiated. Provided, therefore, that information arrived at the table, as far as the fighter controller was concerned it did not really matter where it came from. From the moment that the information was plotted on the table, his action was the same.

As radar was not available, the position of the hostiles was provided from several sources including the bombers themselves, whilst the position of the fighter aircraft was determined by the RAF direction finder chain in conjunction with the pip-squeak.

The pip-squeak was a very accurate time switch which caused an aircraft transmitter to transmit for fifteen seconds in each minute, thus allowing the aircraft position to be determined by the direction finding network.

As the transmitter only operated for fifteen seconds, it was possible for the first aircraft to transmit for the first part of the minute, the second aircraft for the next fifteen seconds, etc. Thus the position of all aircraft of a flight could be determined within one minute. This system was used for many years including throughout the Battle of Britain.

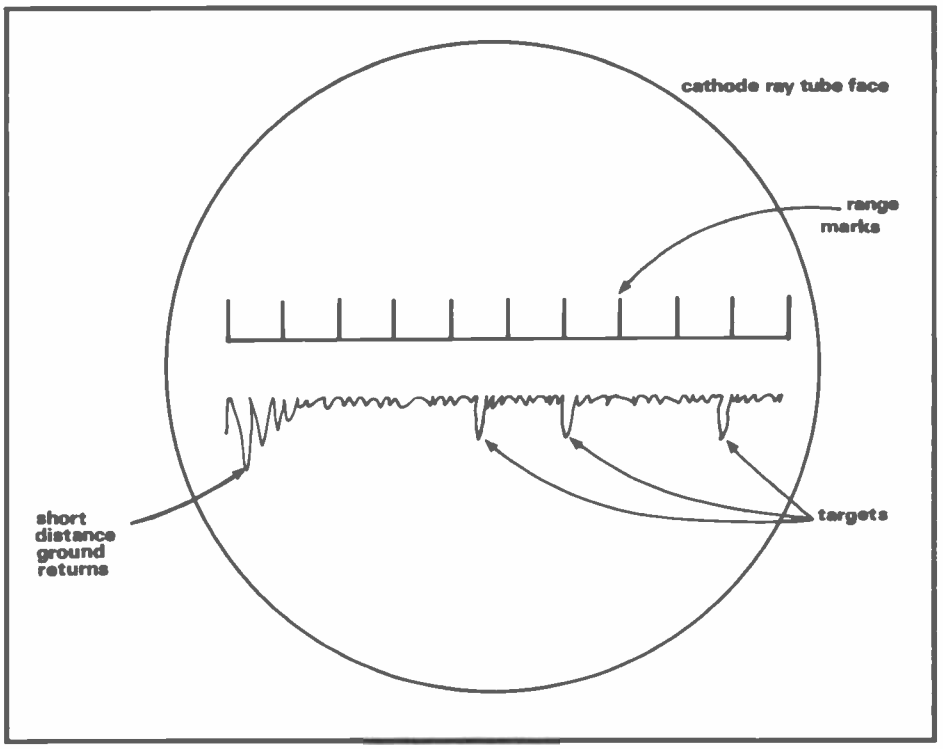
On the morning of 13 August 1936 Sqdn Ldr McDonald received a telephone call from Bawdsey asking whether he would like to try a 'real' radar interception. He replied to the affirmative and patched the telephone through to the filter room.

Taking off, he climbed through cloud until he passed into the clear air above. He followed the instructions of the controller until within a few minutes he saw his target approaching on an opposing track – a KLM DC2 aircraft – en route from Holland to Croydon.

Obviously no simulated attack was made, but the first attempt at radar control interception had been successful. Such was the secrecy of the work that the interception was recorded in the pilot's log book only as 'interception above cloud'.

On one of his visits to 32 Squadron, Dowding had suggested that the current procedure for giving instructions to aircraft was rather clumsy and if a code were developed it would not only streamline R/T procedure, but also provide some degree of security.

Little was done about this until one wet day when flying was impossible. During the afternoon, the pilots started chatting in the crew room and within a few hours the language of interception had been developed: 'angels' for height; 'pancake' for landing; 'bandits' for hostile aircraft and many others.



The Chain Home radar display. The CRT was approximately twelve inches in diameter

Disaster

From the very beginning, the radar experiments had proved remarkably successful – so much so that it was decided to mount an ambitious defence exercise in early September.

About a hundred aircraft were involved over a three day period, of which about half were bombers. These were directed to make raids on Bawdsey from a point about 100 miles to the seaward.

Disaster struck on the first day, when, for reasons which were not immediately apparent, the Bawdsey station failed to receive any returns at a range sufficient for interceptions to be made.

This was doubly embarrassing, for the proceedings were being observed from the receiver room by Air Vice Marshal Sir Hugh Dowding. Checks soon proved that the transmitter was failing to produce its normal power for reasons which were not immediately apparent.

As an interim measure a small party hurriedly returned to Orfordness where the original experimental transmitter was returned to health, which enabled the exercise to resume the following morning. Later that day the problems on the Bawdsey transmitter were resolved and the honour of the Bawdsey team had been restored.

The disaster had a profound effect on Tizard who later said that if the rapid recovery had not been achieved, he was considering applying all his considerable influence to have the radar development abandoned.

Expansion

In the meantime, work was proceeding on the chain of five stations intended to cover the Thames estuary. These were rapidly completed and by the time of the next major air exercise in the autumn of 1937, all were operational and the exercise was a resounding success. This was in no small measure also due to the interception techniques developed, and the work of the filter rooms where the plots from all stations were assessed and suitable response to all threats initiated.

The performance of the radar stations was so good that, even before the end of 1936, plans were made to expand the radar cover to the whole of the east and south coasts of England.

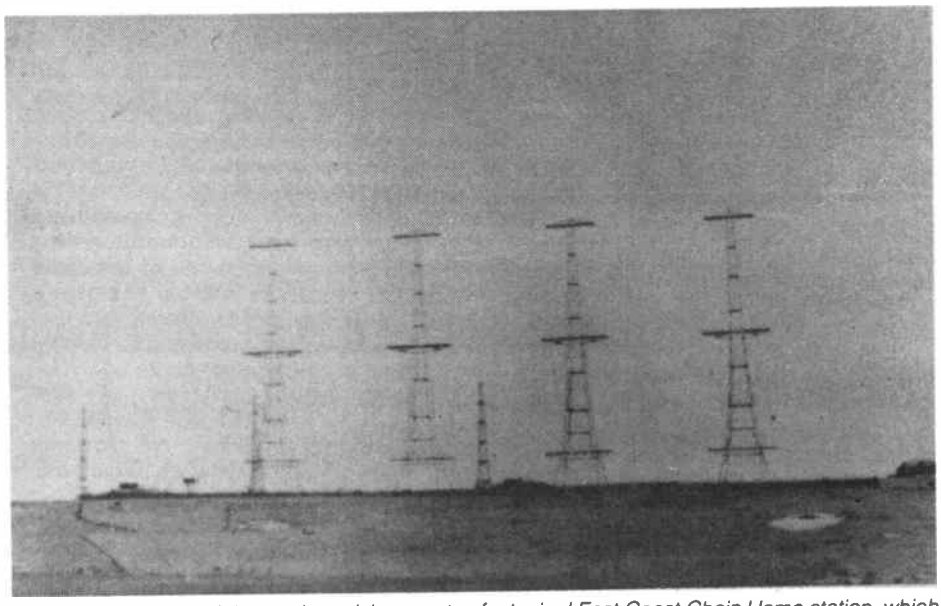
Arnold Wilkins was in charge of site selection which had to be made to an Air Ministry specification. This included: 'It is essential that the installation should not gravely interfere with grouse shooting'. As stations were being surveyed on the Yorkshire moors and in Scotland, as always, the right priorities had to be observed!

By the outbreak of war in September 1939, Britain had a chain of nineteen Chain Home stations which gave continuous cover out to 100 miles from the coast, from the Isle of Wight to Scotland.

The CH equipment

By the end of the war there were several variations of the basic equip-

CHAIN HOME: BATTLE OF BRITAIN RADAR



The distinctive transmitting and receiving masts of a typical East Coast Chain Home station, which played an important role in the Battle of Britain

ment in operation. Of these, the East Coast version is probably the best known because of the distinctive design of the transmitter masts and the vital role it played in the Battle of Britain.

Each Chain Home station employed four 360ft transmitter towers between which were strung 'curtain' arrays fed by 600 ohm balanced feeder.

Two identical transmitters (type T3026) were provided for each station, each of which was capable of operating in the main or standby role.

The typical operating conditions for these transmitters were:

Frequency: 20-30MHz

Peak Power: 350kW (later increased to 700kW)

PRF (Pulse Recurrence Frequency): 25 or 12.5pps

Pulse Length: 20 microseconds.

The very low pulse recurrence frequency (modern radars use 250 to 1000pps) was determined by the need for a long period to allow long range returns from the ionosphere to die down before the next pulse was transmitted. At times this was severe and there are also many authenticated observations of the pulse on its second, third and fourth circuit of the earth.

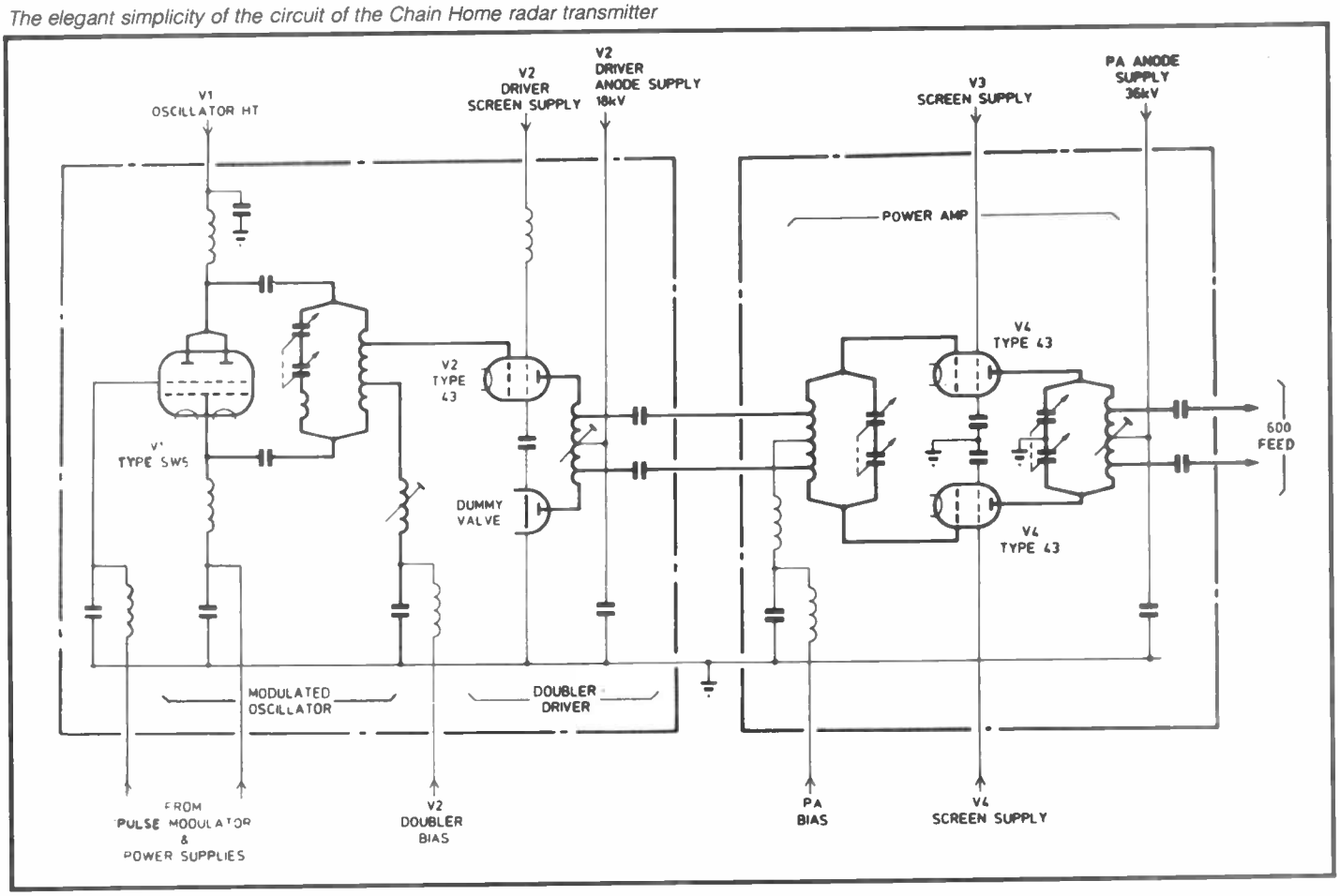
Another requirement was for all CH stations to be synchronised so that no station interfered with others in the chain.

The receiver system

Four 240ft wooden masts, each equipped with two sets of receiver aerials, were located some distance from the transmitter site. Each set of aerials comprised two dipoles mounted at right angles together with switchable reflectors.

From the aerial systems, the incoming signals were routed via high grade coaxial cables to goniometer stator coils. Manually positioning the rotor coil of the goniometer enabled an accurate comparison of the signal from each

The elegant simplicity of the circuit of the Chain Home radar transmitter



Inside the receiver room of an East Coast Chain Home station. The WAAF at the left rear can be seen operating the goniometer while observing the display tube

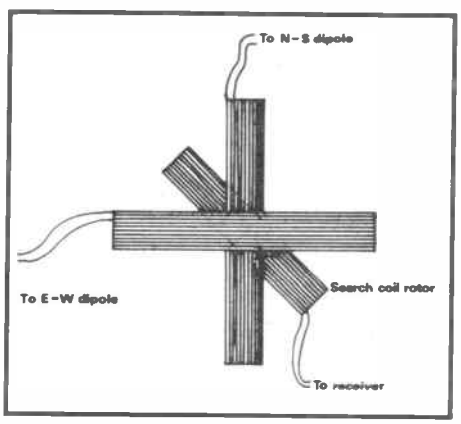
dipole and thus the bearing of the incoming signal was determined. The output of the rotor coil was passed to the receiver.

These were designed and built by Cossor to a TRE specification.

The RF stage comprised push-pull EF8 'aligned grid' pentode valves which fed to a push-pull mixer using a pair of triode hexodes. This converted the signal to 2MHz where it was amplified by a five-stage amplifier. This also gave the choice of three bandwidths: 500kHz, 200kHz and 50kHz. After full wave detection, the video signal passed via a pair of push-pull deflection amplifiers to the Y plates of the cathode ray tube.

A second goniometer was also fitted to allow comparison of the signal from upper and lower sets of aerials and enable the angle of incidence of the incoming signal, and thus the target height, to be determined. At first calculations were performed manually, but later in the war an electro-mechanical computer, commonly called the 'Fruit Machine', was developed for the purpose.

CH was a remarkable achievement for the times. Based on a simple proving experiment at Daventry, the system was conceived by Watson-Watt and taken through to fruition by the genius of Wilkins, Bowen and many others. Tizard realised the practical necessity of developing completely new control and flying techniques which were developed by scientific staff and 32 Squadron at Biggin Hill commanded by Sqdn Ldr Arthur McDonald. The timescale from concept to operational service was just over two years.



Principle of inductive goniometer. In practice the connections to the rotor would be made via the spindle and sliprings

Overall, it was a superb example of the right men being in the right place, thinking the right thoughts at the right time. The result was the CH radar and ground controlled interception system.

By modern standards, the CH system was crude, slow and inaccurate, but when combined with the skills of the operators, many of them WAAFs, and the fighter controllers operating the filter tables, it provided the tool which enabled Fighter Command to maintain control of the skies over southern England during that critical period in the autumn of 1940.

Had the Battle of Britain not been won, there is no doubt that within a few months the German Army would have successfully invaded the British Isles and subsequently won the war. For that, if for no other reason, the Chain Home system deserves to be remembered with reverence and pride.

ACKNOWLEDGEMENT

I should like to thank Air Marshal Sir Arthur McDonald, who as a Squadron Leader led 32 Squadron in 1936, for providing much of the information on the Biggin Hill Experiment.

SHORT WAVE LISTENER

TREVOR MORGAN GW4OXB

This month I would like to look at one of those unusual signals that we often come across when tuning the bands. In this case, it is a Morse transmission on around 1.490MHz on the 160m band. It is similar to many transmissions found throughout the bands as it consists of groups of letters and numbers, usually in sets of five. However, although PC users or code readers will be able to resolve the signals, it is doubtful if you will understand the 'script', as it is in Czech.

Brain power

The signal emanates from the Department of Psychic Studies at the University of Prague, in Czechoslovakia, where experiments have been taking place since 1965, in parallel with similar experiments in the Soviet Union, on psycho-kinetics and deep thought transference.

Under the control of the Czech scientist, Professor Karel Vosnovski BDP Sc, AFA (Hons), founder of the study group set up in 1965, a number of dedicated scientists have been studying the electrical impulses transmitted by the brain during concentrated mental activity and how they can be used.

Although these experiments and studies gave few conclusions in the early days, the development of the micro chip and computer has enabled some startling results to be obtained.

The electrical activity of the brain has been studied in many quarters for different purposes. Purely by accident, during studies of brain stem audiometry and cerebral electrophysics, Professor Vosnovski discovered that an electrical impulse is created by the deep brain cells during concentrated thought processes, and that this impulse could be charted using a standard electro-encephelograph (as used to detect brain damage after head injuries).

However, it was not until the 1980s that Professor Vosnovski made the discovery that was to gain him his country's highest award for technical achievement.

Recording signals

During 1982 his team made the startling discovery that, not only could brain impulses be charted, but they could be amplified using digital techniques then being developed for space research, to produce a signal which could be recorded. This was only the beginning of Professor Vosnovski's development of the process. In 1985 he announced that he had recorded discernible signals from a hypnotised subject which could be translated.

Further experiments took place at the Department of Science in Brno, which proved that a subject could consciously control his own brain impulses, under strictly controlled conditions, and cause visible oscillations on a chart recorder that could be predetermined.

The most recent experiments began in 1987 using a highly trained Czech radio operator, who actually managed to use his brain impulses to 'send' Morse code. As Soviet scientists were still experimenting with psycho-kinetics, both countries co-operated with each other with this discovery.

It appears, though I have not received a firm response to my questions, that the electrical impulse is set up when the subject concentrates on a predetermined Morse 'form'. This is amplified and the minute current is used to operate sensitive relays in the equipment, resulting in the Morse 'form' being produced.

As a result of these experiments, a radio link was set up between Brno and Novosibirsk using 1kW transmitters on 1.490MHz, and transmissions are exchanged on a daily basis.

This is experimental stuff, but very interesting to the listener and worth tuning in to.

Checking for safety's sake

Traditionally, spring is the time when a young man's thoughts turn to... aerials. And with the contest season getting into full swing, there's just time to get into the garden and check your wires, beams and feeders for any damage caused by the ravages of winter.

Although our licensed friends may be all too aware of any major problems with their aerial system by constantly monitoring it with an SWR meter, the listener may not know that a problem exists until the aerial or feeder hits the deck with a thud. Although it may be pretty obvious when the final crunch does come, it is those unseen and undetected problems that you should be looking for.

Such faults usually show up as intermittent losses or reduction of signals. One of the main causes is the deterioration of soldered joints where feeders join the main antenna wires.

Soldering feeders to transmission lines needs more constant heat than most simple soldering irons produce, since the copper wire forming the transmission line acts as a heat dissipator and draws the heat away from the joint. As a result, although the solder may flow into the wrapped joint, there may not necessarily be a good bond between the feeder and the transmission line.

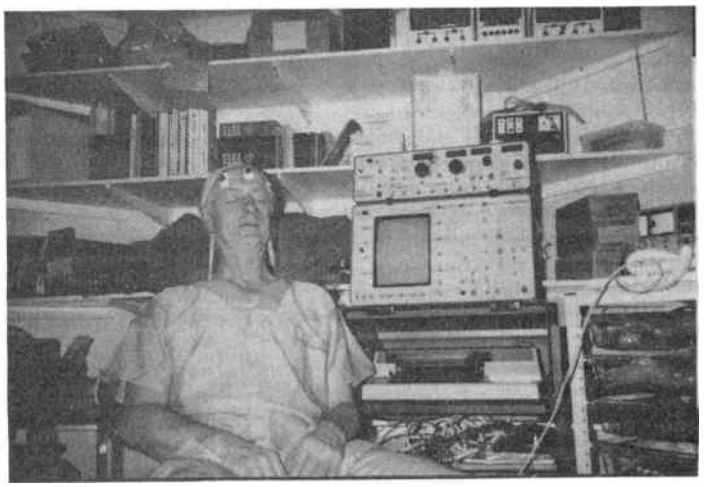
It is easy to be fooled by this as the flux may give a temporary tension joint; even testing with a meter will give a 'positive' reading due to surface contact. It is only when the weather destroys the flux 'joint' that problems arise.

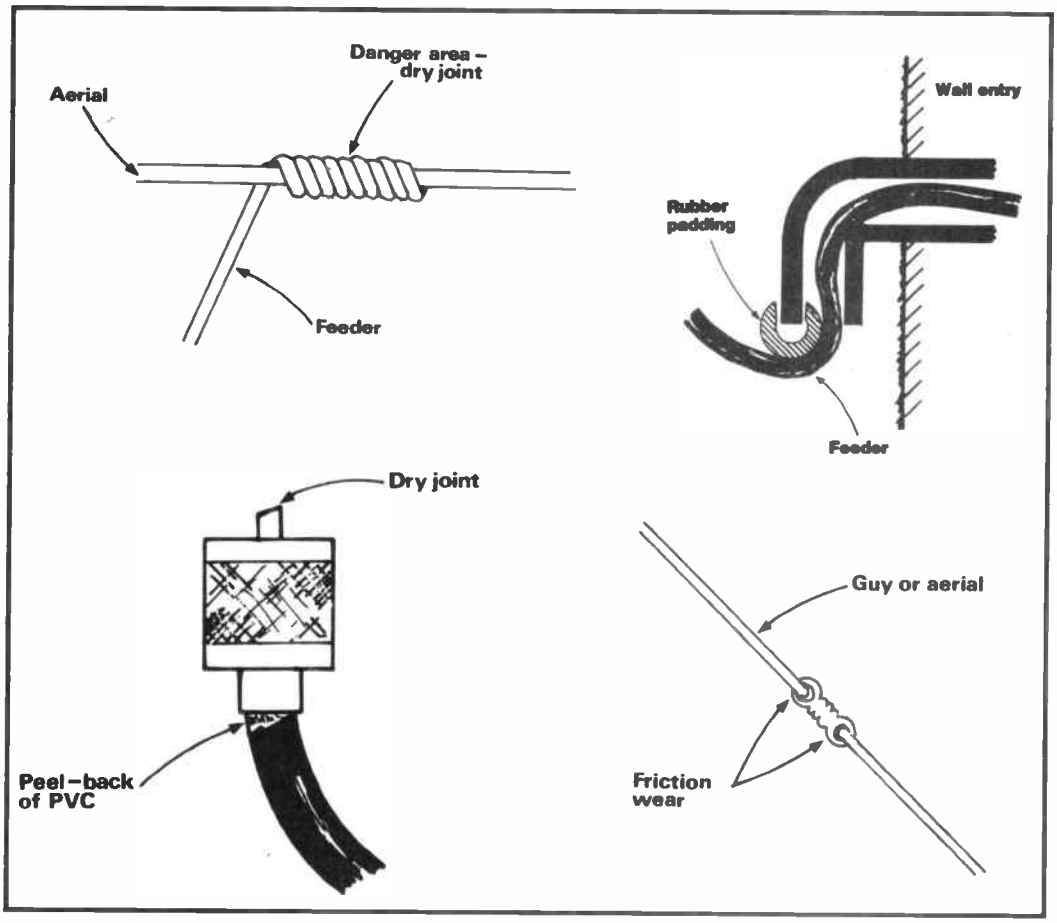
Other problems

Feeders can become weather worn, particularly where the feeder enters the shack. An aerial constantly swaying in the wind will rub the feeder against an entry point until it starts giving interference by shorting out or actually failing completely.

Coaxial cables used as feeders are commonplace, but they have their own problems. The worst and most destructive of these is the ingress of water between the outer PVC sleeve and the copper-mesh screen. This rapidly destroys the screen but can be undetected until you need to cut the feeder or suddenly find a small pool of water behind your receiver.

'Subject' during trials at the State University of Prague, Czechoslovakia





Repairing dry joints and friction wear

Although multi-element beams are not as common amongst listeners, they have their problems as do trapped vertical antennas.

That neat plastic moulded terminal housing labelled '100% waterproof' has a nasty habit of becoming rather less so after a hot summer and a cold, frosty winter. Water can also find its way through microscopic gaps and quickly disposes of copper and alloy terminals. Traps, of course, are aptly named as they act as perfect traps for water.

Hands up those who have a wall-mounted, sealed terminal box for multi or single feeders? I have never found out how spiders manage to do it, but you can bet that one of the blighters has woven a neat web in the corner of the terminal box!

Repairs

So, what about repairs? To 'dry' joints use one of those miniature gas welding units. These operate at very high temperatures and give a first-class solder joint. Alternatively, a standard blowlamp will do the trick.

Friction wear on feeders can be repaired by using old rubber motor-cycle or car tyres to line the inlet points. Always thoroughly seal the ends of feeders, single line or coax, with self-amalgamating tape, covering even the plugs and sockets.

Terminal boxes should also be thoroughly sealed after squeezing Mastic around the inside and outside of the inlet and outlet points.

Traps should be sealed with tape at both ends, and any 'sleeve' joints in beam elements should be treated with conductive grease before assembly and sealed afterwards.

Although your aerial and feeder might now be pretty safe, check your insulators and halyards. Constant swaying can cause the loop of wire at the end of the aerial or halyard to wear thin. A half decent gale and . . !

The same goes for guy ropes or wires. They are under constant tension but can still become worn or corroded with the same disastrous results. So play safe and check them regularly!

From the mailbag

Getting down to the mailbag, we find Peter Bowles ILA 039, of Newhaven, still in there filling the log.

Some nice stuff can still be found on 10m including VS6BS, 5B4ES, 9Y4TAM, C56/G3RZ, 5N6YBC, A47RS, A92FB, VU2RX, D44BS, KH0AC, 9H4L and 9K2IC. 15m produced C31LHK, 9K2RA, 9K2DB and 3B9FR. Pete says the rest of the bands were quiet with plenty of the run-of-the-mill but nothing extraordinary.

QSL information starts with VS6BH via K9EL; C56/G3RZ via home call, QTHR; A92FB to PO Box 22394 Bahrein; and KH0AC via K7ZA.

Pete's first award arrived this month from Cyprus, being the ZC4 Award (Class 3). Congratulations, Peter.

BARTG have been having their share of problems lately with changes in their committee. Previous news quoted that G6ZTF would be holding the membership secretary's seat. Unfortunately G6ZTF has personal problems, so GW6MOJ and GW6MOK will be standing in until the next AGM in November.

Full details about the group can be obtained from Ffynnonlas, Salem, Llandeilo SA19 7NP for an sae.

Forthcoming events

The RSGB National Convention will be held at the NEC in Birmingham on 21/22 April in Hall Seven. The RSGB inform me that there has been a lot of interest shown by traders and societies, so it looks like it will be worth a visit.

The Swansea Annual Rally will be held on 8 April at the Leisure Centre, the same venue as last year. It is sure to attract another huge crowd, but there's plenty of parking space! Doors open at 10.00hrs. I hope to be there with the ILA stand, so pop over for a chat.

A must for award hunters

Ted Melinosky tells me that the new edition of his **K1BV Directory of Awards** is now available. The 1990 edition features no less than 1,380 awards from 113 countries! This directory is a must for award hunters and I thoroughly recommend it. It is supplied unbound but ready for insertion into a suitable ring binder (easier to add sheets, if you wish) and is very well presented.

The directory costs $18.00 (£10.00) and is available from: K1BV, 525 Foster Street, South Windsor, CT 06074-2936, USA.

The weekend of 10-11 February heralded the first ILA Contest. Being the first, it was a 'testbed' for members, but we hope to make it an open contest in future. This time the aim was to log as many callsigns as possible in any three-hour period. I am still waiting for a few entries but the best score so far is tremendous!

Well, that's about it for this issue. I hope you have all recovered from the storms by now and wish you all the best of DX for the coming month. Cheers!

THE SOFTWARE FILE

by Stephen Phillips

This month's program will design yagi-type aerials for a frequency range of 40-600MHz and will produce designs using between four and twelve elements. The program assumes that the elements will have a 3-9mm diameter, since their length to diameter ratio makes a difference to the computed lengths. To allow for other L/D ratios would involve complications which should be avoided.

The listing

The program contains notes which will enable you to tailor it to your own requirements. Note that there are unlimited combinations of element lengths and spacings which will work.

Lines 190-200 ask for the frequency and check the validity of the input. Lines 200-230 check the input for the number of elements. The section between lines 250 and 370 calculate all the required dimensions for the array, including the total boom length.

Clever

Line 360 is a useful dodge if your computer does not support the PRINT USING ####.## type statement. In the form shown it forces the printout to one decimal place. If you use (X★100+.5)★.01 it would force two places. The BEEP statement in line 230 is not available on the Amstrad PCW series, so use PRINT CHR$(7) instead of BEEP.

Display

Lines 390 to 550 display the computed data for the array. An interesting dodge here is to use the variable L in the LOCATE statements. This is set to ten in line 490 and then is incremented by one (in the loop between lines 510 and 540) for every additional director printed. By doing this the display length is automatically set no matter how many directors are involved.

If you want to send the data to a printer you can simply use the PRINT SCREEN (shift ★) command from the keyboard.

It is possible to rewrite the display section using LPRINT commands and deleting the LOCATE statements.

Length

The total boom length is displayed using line 550. Before you complain that this figure is not the total of the element spacings, let me tell you that three inches have been added to the boom length so that you will have some metal to fix the end elements to!

Lines 560 to 600 ask if you want to change the input data or end the program.

```
10 '                    COPYRIGHT AMSOFT 1989
20 '
30 '
40 ' This program calculates the dimensions of a VHF Yagi
50 ' ------------------------------------------------------------------------
60 '
70 ' 1. The dipole element length is 5600/MHZ inches.
80 ' 2. Reflector length is 5% longer than the dipole.
90 ' 3. Reflector spacing is 0.2 wavelengths from dipole.
100 ' 4. The first director is 5% shorter than the dipole.
110 ' 5. Director spacing is 0.2 wavelengths from dipole.
120 ' 6. Subsequent director spacings increase by 10%.
130 ' 7. Subsequent director lengths decrease by 1%.
140 ' 8. Any of the above criteria may be easily changed.
150 ' ------------------------------------------------------------------------
160 '
170 CLS:DEFINT A
180 LOCATE 15,20
190 INPUT "Enter frequency in MHz.... (40-600)..";MHZ
200 IF MHZ<40 OR MHZ>600 THEN BEEP:RUN
210 LOCATE 17,20
220 INPUT "Number of elements ..... (3-12)....";EL
230 IF EL<3 OR EL>12 THEN BEEP:LOCATE 17,62:PRINT " ":GOTO 210
240 ' ------------------------------------------------------------------------
250 WL = 11810/MHZ '                    Free space wavelength in inches.
260 DP = 5600/MHz '                     Dipole length in inches.
270 RF = DP ★ 1.05 '                    Length of reflector in inches.
280 SPC = WL ★ .2 '                     Dipole to reflector spacing.
290 FDL(1) = DP ★ .95 '                 Length of first director.
300 SPP(1) = WL ★ .2 '                  Dipole to director spacing.
310 FOR A = 2 TO (EL-2) '               Start director calc loop.
320 SPP(A) = SPP(A-1) ★ 1.1 '           Increase director spacing.
330 FDL(A) = DP★(100-(4+A))★.01 '       Decrease director length.
340 LNG1 = LNG1 + SPP(A) '              Increment boom length.
350 NEXT A '                            End director calc loop.
360 DEF FNX(X)=INT(X★10+.5)★.1 '        Round printing to 1 decimal.
370 LNT=SPC+SPP(1)+LNG1 '               Total beam length.
380 ' ------------------------------------------------------------------------
390 CLS
400 LOCATE 1,23:PRINT "DESIGN DATA FOR VHF YAGI BEAM ANTENNA."
410 LOCATE 3,23:PRINT "A design using";EL; "elements at";MHZ; "MHz."
420 LOCATE 5,27:PRINT "All dimensions are in inches."
430 LOCATE 7,13:PRINT "Element.";TAB(30); "length."
440 LOCATE 7,45:PRINT "spaced";TAB(60); "from"
450 LOCATE 9,13:PRINT "REFLECTOR";TAB(30);FNX(RF)
460 LOCATE 9,45:PRINT FNX(SPC);TAB(60);"dipole."
470 LOCATE 10,13:PRINT "DIPOLE";TAB(30);FNX(DP)
480 LOCATE 11,13:PRINT "Director 1.";TAB(30);FNX(FDL(1))
490 LOCATE 11,45:PRINT FNX(SPC);TAB(60); "dipole.":L=10
500 IF EL<4 THEN L=11 ELSE L=10
510 FOR A = 2 TO (EL-2):L=L+1
520 LOCATE L,13:PRINT "DIRECTOR";A;TAB(30);FNX(FDL(A))
530 LOCATE L,45:PRINT FNX(SPP(A));TAB(60); "director";A-1
540 LNT=LNT+SPP:NEXT
550 LOCATE L+2,25:PRINT "Boom length is";INT(LNT)+3; "INCHES."
560 LOCATE L+4,20:PRINT "CHANGE the data or END .. (C/E)...."
570 IN$=INKEY$
580 IF IN$= "C" OR IN$= "c" THEN RUN
590 IF IN$= "E" OR IN$= "e" THEN STOP
600 GOTO 570
```

News and comment from Glen Ross G8MWR

You may remember that a month or two ago I mentioned that it was hoped that the Belgian authorities would issue some permits for 50MHz operation. Sure enough, these were duly issued and on 9 February what is believed to be the first G to ON contact took place. The participants were ON4PS and G3KOX. Things have been very interesting on the band, because a few days before the ON contact the first contacts were made into Austria.

Into HB land

To cap it all, some Swiss amateurs have been issued with permits. The first contact to Switzerland was made via meteor scatter between G4VXE and HB9XAJ. Operation is only allowed outside TV hours, so this limits things somewhat.

If you want to get a contact into Switzerland, then the place to look is 50.27MHz. Remember that this is MS territory, so brush up on your procedures first. If you start playing around up there without knowing what you are doing, you are in danger of receiving serious damage to your equipment: and you can read that any way you like!

Repeater abuse

Recent comments about repeater abuse have brought in a lot of letters from you, and they make interesting reading. The vast majority of people condemn this activity and feel that standards in amateur radio are rapidly declining.

The one point on which there is no general agreement is about how this aspect of our hobby should be cleaned up. This is hardly surprising, since everyone has their own local problem and these all need local solutions.

Governmental

The RSGB, as we know, have the power to do something about it but seem very reluctant to do anything. This prompted one well-known northern amateur to visit the House of Commons and get his MP to ask questions in the House.

Seems a long way to go to crack a nut, you may say, mixing your metaphors slightly, but it is one man's answer to the problem. At least he is trying to get some results, while most of us sit back and keep muttering, 'Why don't they do something?'

Alternative

There is a second avenue open to you and that is to write to the DTI RIS enforcement section. The man to address your complaints to is Paul Chapman, who is the head of the department.

An interesting point here is that the department has decided to send copies of all the letters received to David Evans at the RSGB. Perhaps the DTI feels that if the RSGB will not move when the information and complaints come direct from members, they might shift a bit if they are aware that the DTI has been informed.

Mole report

Yes, the little fellow has been at it again. This time he has turned up a threat to our 23cm band. This stretches from 1240 to 1300MHz (who says we are short of space?), and we enjoy secondary user status. The cause for concern is some devices which are known as WVCS (Wireless Video Camera Systems).

In a recent letter from the DTI to a company involved in this area, it says, 'In order to progress ... the allocation of frequencies ... to the primary user (in) the 1.2 to 1.4GHz band.... the frequency bands we are seeking access to (are) 1260 to 1285MHz and 1300 to 1325MHz.'

Problems

Now the second band of frequencies is of little interest to us because it is just outside the amateur band. The first one is a different kettle of fish because this covers precisely our satellite area and also the whole of the ATV sub-band.

In fairness the DTI has warned the new industry of our presence in the area. The letter continues, 'There is secondary use by radio amateurs with very high powers permitted. Although they are not heavily used at the moment (use it or lose it, lads), it is expected that the use of these bands by amateurs will increase.'

The DTI also goes on to say that interference would have to be 'expected and tolerated by both WVCS operators and amateurs'. Well, we have been warned.

The mole also asks if I have any idea as to what the RSGB are going to do about this particular intrusion into our air-space. Will you tell him or shall I?

Space news

Last month we mentioned the launch of the six Microsats. The one that has caused the greatest amount of interest is Dove. This is in a low orbit and sends all its data down via packet radio. The signal is very strong and is easily received on a hand-held with the usual rubber duck aerial.

Hot on the heels of these six birds comes news of the launch of the new Japanese satellite FO-12. At least, that is what it was supposed to be called but the Japanese have either changed their minds or, at least, have become rather confused, as they are now talking about it as FUJI-2.

The details

Our JA friends are rather backward at coming forward with details on this one. The following is a combination of previously issued specifications, inspired guesswork and some hard graft at the maths.

The one thing we can be certain of is that the launch took place on time with lift-off on 7 February at 01.33hrs UTC. You will need Kepler elements to get your tracking program running, and the list shown in the Table below will get you started. At the moment there are at least three different sets in circulation, which shows how little agreement there is on the subject.

Remember that the figures in the table are only tentative and will require adjustment as information becomes available. At least they provide some starter data to play with.

Keplers

SAT	FO-20
EPOC	90038.106750
INCL	99.2178
RAAN	109.167
ECCN	0.05378
ARGP	344.1275
MA	5.3579
DECY	1.0e-06
REVN	1
PERIGEE	940
APOGEE	1700

Transponders

The satellite carries two transponders, known as JA and JD. The JA unit is a linear system transponder, which means that whatever mode you throw at the input, you get the same thing on the output frequency.

I might mention at this point that using FM or other wideband modes is considered very antisocial. The uplink passband, which is the one you use for transmitting, is from 145.9 to 146MHz. The downlink, or receiving section, is from 435.8 to 435.9MHz. Do not forget that the signal is inverted as it passes through the satellite, so if you use upper sideband on transmit you get lower sideband on receive.

Doppler shift

This may sound rather confusing but, in fact, it's very simple. It is all to do with reducing the effects of Doppler frequency shift. This shifting of signals is demonstrated by reference to the change in frequency of a fire engine siren as it passes you. Imagine having that sort of shift on the downlink and you can see what fun it would be trying to keep a single sideband station tuned in to give normal sounding speech.

The inversion idea means that as Doppler shift increases in frequency on the uplink, it will reduce on the downlink and so minimise the problem. Without it the Doppler shift could go to as much as 10kHz; try coping with that.

Digital

The second transponder is the digital or JD unit. This uses four uplink channels on 2m, but these are spaced in American rather than the usual British 25kHz. The frequencies are 145.850, .870, .890 and .910MHz. All these channels are sent down on 435.91MHz. There is no inversion on this channel, so watch out for that 10kHz Doppler shift.

This transponder uses standard AX25 packets for communication which are sent at a rate of 1200 baud.

Power

Both transponders have 1W power output and, in the case of the linear unit, this is spread over all the activity in a 100kHz passband. This means that if there are a lot of QSOs going on at the same time, each person gets only a fraction of that power. It also means that the loudest signals on the input get the lion's share of the output power. The JA unit also has a beacon on 435.795MHz, plus or minus Doppler shift, and this runs 100mW output.

Aerials

The satellite carries three aerial systems. The 2m one is a simple quarter-wave monopole, which has a loss of about 1dB compared to that of a dipole. There are two 70cm aerials. The one used by JA is a turnstyle using left-hand circular polarisation and the JD is the same, but with right-hand polarisation.

The output powers you need to run on the uplink will depend on your aerial system, but if you work with about 100W radiated power you should get a decent signal through the transponder.

Polarisation

If you use a normal beam on the downlink you will suffer a loss of about 3dB, compared with that of a correctly handed circular beam. If you get the handing wrong, you will suffer a loss of 30dB or more.

Use it

The JA transponder is on and there has been no instruction not to use it, so the answer is get going and enjoy it. You will find at first that the signal will suffer from some fairly severe deep fading. This is caused by the satellite spinning and so the aerial regularly rotates, facing away from and then towards you in a rhythmic pattern.

This rotational effect will gradually be stabilised as an onboard magnet slowly pulls the satellite into line with the earth's magnetic field. Do not hold your breath waiting for this to happen, since it will take several weeks before a stable condition is reached.

Sign-off

That's all for this month. Keep your news coming to me at: 81 Ringwood Highway, Coventry, or on packet at GB7NUN.

FREE CLASSIFIED ADS

FREE CLASSIFIED ADS CAN WORK FOR YOU
We are pleased to be able to offer you the opportunity to sell your unwanted equipment or advertise your 'wants'.

Simply complete the order form at the end of these ads. Feel free to use an extra sheet of paper if there is not enough space. We will accept ads not on our order form.

Send to: ***Amateur Radio Classified Ads***, Sovereign House, Brentwood, Essex CM14 4SE.

DEADLINE AND CONDITIONS
Advertisements will be published in the first available issue on a first come first served basis. We reserve the right to edit or exclude any ad. Trade advertisements are not accepted.

FOR SALE

■ ICF 7600 Sony radio, FM 876kHz-108kHz, LW 153kHz-282kHz, MW 531kHz-1611kHz, SW 1615kHz-26100kHz, £50.00. Tel: 091-438 1903

■ Cobra 148 GTL-DX, AM/FM/SSB/CW, 26.570-28.060, handbook, £110.00. Tel: (0373) 66369

■ Yaesu 757GX, can be seen working, £575.00 ovno. Bremi power pack, B35, 7A, offers? Discone, cost £75.00, offers? Power unit, 80W, offers? Sirtel power mic, offers? Concord II, will convert to 10MHz, £65.00. Tel: (0283) 221870

■ Breaking up collection owing to lack of space: SR88/31, B44, A40, CPRC26, A41, C11/R210, B47 – all complete stations and in working order. Realistic offers for quick sale, please. Tel: 01-654 2582

■ Yaesu FT-7700 with memories, good condition, boxed, complete with instruction manuals, £200.00. Tel: (0965) 44446

■ Kenwood RZ-1 wideband receiver, 500kHz-905MHz, as new, £395.00. Tel: (042 873) 7202

■ Sony CRF-220 world-zone Rx FM/MW/LW/SW, twenty-two bands, CW/SSB, £130.00. Satellit 1400-SL digital Rx, £80.00. Sony CRF-5090, world-zone Rx, AIR/FM/MW/LW/SW, 16-26MHz, nine bands, CW/SSB, will exchange for Grundig 3100 Party Centre CD/stereo cassette recorder or £120.00. Tel: 061-743 1570, buyer collects

■ Wind-up, tilt-down tower, 80ft, £500.00. 204BA 20m Yagi, £165.00. 402BA 40m Yagi, £175.00. K2RIW 70cm amp heavy-duty power supply, 500W output, £650.00. 40cm x 250cm base, £10.00. Tel: (084421) 3381

■ AR40 rotator, £60.00 ono. Icom 1050, 10FM, with Nevada power amp, 29MHz, 25-30W FM, RF. Tel: (0532) 524222, ask for John

■ Eddystone 940 Rx, 480kHz-30MHz, plus Eddystone 935 speaker and photocopy of manual, all in original box, £150.00. SX200 scanner, 26MHz-88MHz, 108MHz-180MHz, 380MHz-514MHz, FM/AM, plus PSU and manual, £125.00. Tel: (0253) 35764

■ Ham multimode 2, Lo/Mid/Hi/Hi-Hi, alphas, no legal board, bracket, £120.00 ono. Swap for Grant or other President. Also Harrier CBX LM/Hi, legals, £50.00. Tel: (0296) 433405 anytime

■ Oric Atmos personal computer with disc drive, tape deck, printer, speech synthesiser, thirty-five-plus discs, 100-plus tapes, approximately 400 programs with extras and three spare computers (working), all leads, etc, £250.00, no offers. Also Kenwood ATU model AT230, six months old, £75.00 ono. Spectrum 48K computer with 100 programs, joystick and interface, £50.00. Tel: (0604) 412690 evenings

■ MFJ de luxe Versatuner 2, with SWR/PWR meter, dummy load and balum bult in, plus manual, £100.00. Welz SP225 HF 2m SWR/PWR meter, with remote head, boxed with manual, £70.00. Maplin 600MHz frequency counter, £70.00. All items as new. Tel: 01-390 2650, ask for Norman

■ Yaesu FT101ZD, nine bands, fan, FM, FV, 901DM, ext VFO, FC902 ATU, SP901 speaker, mic, manuals, new tubes, plus spares, all boxed. Exchange for Yaesu FT1. Also Icom IC-245 2m multimode, mic, mobile mount, boxed. Exchange for Belcom LS-102L or Uniden 2830. Write to: Ian Duffin, The Dormouse, 5 Sunset Walk, Bush Estate, Eccles-on-Sea, Norfolk NR12 0SX

■ Yaesu FT-767GX with 2m and 6m modules and MD-1 mic, mint condition with latest mods, manuals and boxes, £1,600 ono, carriage extra, going QRP. Tel: (0491) 36873

WANTED

■ Kenwood R5000, preferably with VC20 VHF module. Ham International Jumbo base station. Tel: (0373) 66369

■ Cobra GTL 148, must be in good condition. Tel: (0283) 221870

■ AR88D, WS19, R107, R206, R109, R209 (6V), R1155, T1154, WS22 etc. Tel: (0908) 373114 till 10.00pm

■ International Jumbo, must be in excellent condition, good price paid. Tel: (0633) 842729

■ Scrap Ham International Jumbo, cash waiting. Tel: (0422) 368817

■ Valves, vintage radios including broadcast and amateur books on theory/repair, magazines, test gear, owner's manual and/or complete Star SR550 receiver. Someone to do conscientious repairs. Tel: 01-870 6316

■ VHF/UHF discone antenna, also lightweight rotator. Information on ten-channel national car telephone network radio, as supplied by Luton Communications, including manual, frequencies etc. Tel: (0426) 22649 after 6.00pm

■ Solid-state GDO/dip meter for HF bands. Maplin, Trio and Heathkit models acceptable. Write to: N Cameron, 16 St Mary's Crescent, Westport, Co Mayo, Eire

FREE CLASSIFIED AD FORM

Send to: Amateur Radio Classified Ads · Sovereign House · Brentwood · Essex CM14 4SE,

Classification: (tick appropriate box) If you want to insert ads under more than one classification use separate sheets for second and subsequent ads

For Sale ..... ☐ Wanted ..... ☐

USE BLOCK CAPITALS (One word per box)

To avoid mistakes please write clearly and punctuate your ad

Name/Address Postcode/Telephone							

USE SEPARATE SHEET FOR MORE WORDS

Ensure that you have included your name and address, and/or telephone number

CONDITIONS: Ads will be published in the first available issue on a first come first served basis. We reserve the right to edit or exclude any ad. Trade advertisements are not accepted

Amateur RADIO SMALL ADS

★ PC COMPATIBLE SOFTWARE by G4BMK ★
RRRY: £15 – AMTOR: £30 – AMTOR+RTTY: £40

Split screen, screen colours selectable, fast synchronizing, superb auto-print, clock, disk logging, file send mode, printing, etc. Use with any T.U. such as ST5, or our own: Grosvenor Multimode Modem, built, boxed: **£68** AM7911 Modem Clip – special price – **£11.**

DRAGON 32/64 AND CBM 64/128 – PLEASE ENQUIRE

GROSVENOR SOFTWARE (AR)
2 Beacon Close, Seaford, E Sussex BN25 2JZ
Tel: (0323) 893378

MRZ COMMUNICATIONS LTD
NEWCASTLE UNDER LYME

ICOM
RADIO EQUIPMENT

BUSINESS **AIR**
MARINE **AMATEUR**

VISA **TEL: (0782) 619658**
7 DAY SERVICE

Sample our Quality With
A FREE
PRINTED CIRCUIT BOARD
Single-Double Sided Circuits
or Plated Through Hole
Write to: **Dept A**
PAYNE ELECTROPRINT LTD
Marcus Road, Dunkeswell
Nr Honiton, Devon EX14 0RA

TURN YOUR SURPLUS
IC's TRANSISTORS etc, into cash, immediate settlement. We also welcome the opportunity to quote for complete factory clearance.
CONTACT:
COLES-HARDING & CO
103 South Brink, Wisbech, Cambs
TEL: 0945 584188/Fax. No. 0945-588844
Est Over 15 years

T. POWELL
Electronic Components
16 Paddington Green
London W2 1LG
Tel: 01-723 9246
Mon-Dri 10am-5pm Sat 9am-12 noon
Specialist Audio-Video Spares

JAYCEE ELECTRONICS LTD
20 Woodside Way, Glenrothes
Fife KY7 5DF
Tel: 0592 756962 (Day or Night)
Open: Tues-Fri 9-5; Sat 9-4; Sunday by appointment
Good range **Kenwood & Yaesu** etc, plus
Quality Secondhand Equipment

IAN FISHER COMMUNICATIONS OF STANHOPE
CB Works, The Market Shop, Market Place, Stanhope, County Durham
☎ (0388) 528464

Main Distributors of 27MHz CB radios and the NEW CEPT models including UNIDEN and DNT.
Including U.K. and CEPT walkie talkies from £45.00 each.
Rather good ½ mile radius 2 channel walkie talkies £22.50 each
Large stocks of coaxial cable, plugs, sockets and adaptors.
Jupiter MVT/5000 Scanner receiver covering 25 MHZ to 1300 MHZ. Price on request

AIRBAND RADIO
Very latest sonic 4=8342 multiband radio receiver airband +PMR from 54MHz to 176MHz two aerials £21.00
All available via mail order. Retail/Wholesale

OPEN: MON-SAT 10.30am-6.00pm SUN 2.30 - 4.30
RING FOR DETAILS (0388) 528464

Amateur RADIO **SMALL ADS**

This method of advertising is available in multiples of a single column centimetres — (minimum 2cms). Copy can be changed every month.

RATES
per single column centimetre:
1 insertion £7.00, 3 — £6.60, 6 — £6.30, 12 — £5.60.

ASHTON-U-LYNE **MAIL ORDER AND RETAIL**
PROCOM Electronics

ELECTRONIC DISTRIBUTORS
Specialising in Electronic Components and Surplus
Open Mon to Sat
G7ARR
13 Clarence Arcade
Stamford Street, Ashton-U-Lyne, Lancashire
OL6 7PT **Tel: 061 343 2782**

ETESON ELECTRONICS
E•E
15B Lower Green,
Poulton-le-Fylde, Blackpool
Tel: (0253) 885107

Open: 9.30am - 12.30, 1.30 - 5.30. Closed Wed & Sun.
Electronic Component Specialists.
A wide range of electronic components, IC's, capacitors, transistors, resistors, plugs and sockets etc.

AMATEUR RADIO SMALL AD ORDER FORM

TO: **Amateur Radio · Sovereign House**
Brentwood · Essex CM14 4SE · England · (0277) 219876

PLEASE RESERVE.....centimetres by.....columns

FOR A PERIOD OF 1 issue.....☐ 3 issues.....☐ 6 issues.....☐ 12 issues.....☐

COPY enclosed.....☐ to follow.....☐

PAYMENT ENCLOSED: (Add 15%VAT).... £ — Cheques should be made payable to Amateur Radio. Overseas payments by International Money Order and Credit Card

CHARGE TO MY ACCOUNT.....☐ CREDIT CARD EXPIRY DATE ☐☐ / ☐☐

COMPANY .....

ADDRESS .....

SIGNATURE ..... TELEPHONE.....

.....

C P I

Amateur RADIO

ADVERTISING RATES & INFORMATION

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
61 x 90	⅛ page	£86.00	£82.00	£59.00	£53.00
128 x 90 or 61 x 186	¼ page	£115.00	£110.00	£105.00	£92.00
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
May 1990	28 Mar 90	29 Mar 90	4 Apr 90	6 Apr 90	26 Apr 90
June 1990	2 May 90	3 May 90	9 May 90	11 May 90	31 May 90
Jul 1990	30 May 90	31 May 90	6 Jun 90	8 Jun 90	28 Jun 90
Aug 1990	27 Jun 90	28 Jun 90	4 Jul 90	6 Jul 90	26 Jul 90

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.

ADVERTISERS' INDEX

Air Supply 21

Brian J Reed 11
J & N Bull Electrical 44

Candy Club 21
P M Components 4,5

Department of Trade and Industry 24
Display Electronics 43

G C H Q 13
L F Hanney 13

ICOM 22,23

Lake Electronics 8

W P Publications 11

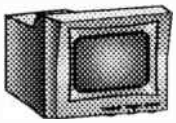
Radio & Telecommunications Correspondence School 21

Syon Trding 13

Technical Software 21
Total Communications 2

THE *ORIGINAL* SURPLUS WONDERLAND!

THIS MONTH'S SPECIAL!



There has never been a deal like this one! **Brand spanking new & boxed** monitors from NEC, normally selling at about £140! These are over-engineered for ultra reliability. 9" green screen composite input with etched non-glare screen plus switchable high/low impedance input and output for daisy-chaining. 3 front controls and 6 at rear. Standard BNC sockets. Beautiful high contrast screen and attractive case with carrying ledge. Perfect as a main or backup monitor and for quantity users! **£39.95 each (D) or 5 for £185(G)**

CALL FOR DISCOUNTS ON HIGHER QUANTITIES!

COMPUTER SYSTEMS

TATUNG PC2000. Big brother of the famous Einstein. The TPC2000 Professional 3 piece system comprises: Quality high resolution Green 12" monitor. Sculptured 92 key keyboard and plinth unit containing Z80A CPU and all control circuits. PLUS 2 integral TEAC 5.25 80 track double sided disk drives. Generous other features include dual 8" IBM format disk drive support. Serial and parallel outputs, full expansion port, 64K ram and ready to run software. Supplied complete with CP/M, Wordstar and Basic. Brand new and covered by our famous 90 day guarantee and backup. Normal price of this unit is over £1400!

Our price .... only .....£299 (E)

SPECIAL PURCHASE
V22 1200 baud modems

We got a tremendous buy on further stocks of this popular **Master Systems 2/12** microprocessor controlled V22 full duplex 1200 baud modem - we can now bring them to you at ***half last advertised price!*** Fully **BT approved** unit, provides standard V22 high speed data comm, which at 120 cps, can save your phone bill and connect time by a staggering 75%! Ultra slim 45 mm high. Full featured with LED status indicators and remote error diagnostics. Sync or Async use; speech or data switching; built in 240v mains supply and 2 wire connection to BT. Units are in used but good condition. Fully tested prior despatch, with data and a full 90 day guarantee. What more can you ask for - and at this price!! **ONLY £69 (D)**

MONITORS

COLOUR MONITORS

Decca 16" 80 series budget range colour monitors. Features include PIL tube, housed in a beautiful teak style case and guaranteed 80 column resolution, features which are only normally seen on colour monitors costing 3 times our price! It is absolutely ready to connect to a host of computer or video outputs. Manufacturers fully tested surplus, sold in little or hardly used condition with 90 day full RTB guarantee. **Decca 80 COMPO** 75 ohm composite video input with integral audio amp & speaker. Ideal for use with video recorder or our Telebox ST, or any other audio visual use. **Only £99.00 (E)**

HI-DEFINITION COLOUR MONITORS

Brand new Centronic 14" monitor for IBM PC and compatibles at a lower than ever price! Completely CGA equivalent. Hi-res Mitsubushi 0.42 dot pitch giving 669 x 507 pixels. Big 28 Mhz bandwidth. A super monitor in attractive style moulded case. Full 90 day guarantee. **Only £149 (E)**

20",22" and 26" AV SPECIALS

Superbly made UK manufacture. PIL all solid state colour monitors, complete with composite video & sound inputs. Attractive teak style case. Perfect for Schools, Shops, Disco, Clubs. In EXCELLENT little used condition with full 90 day guarantee.

20"....£155 22"....£170 26"....£185 (F)

MONOCHROME MONITORS

Very high resolution, fully cased 14" green or amber screen monitor with non-glare screen and swivel/tilt base. The very latest technology at the very lowest price! Fully compatible and plug compatible with all IBM PCs and clones fitted with a high res Hercules or equivalent card! Enables superb graphics and resolution, all at a give away price. Has many extra features including aux +5 & 12v DC outputs to power at least 2 disk drives, if your PC power supply is getting hot! Supplied BRAND NEW and boxed. State whether amber or green screen required.

Amber .....£79 Green .....£69 (E)

Wang green screen 12" chassis monitor with composite video input. Adjustable for tilt. Requires 12 vdc. Brand new and boxed in perfect condition. **Only £39 each or 2 for £75 (F)**

Motorola M1000-100 5" black & white compact chassis measuring only 11.6H x 12W x 22D. Ideal for CCTV or computer applications. Accepts standard composite or individual H & V syncs. Needs 12vdc at only 0.8a. Some units may have minor screen blemishes. Fully tested with 30 day guarantee and full data. **£29.00(C)**

Fully cased as above in attractive moulded desk standing swivel. Dim 12 x 14.5 x 26cm. **£39.00(C)**

JVC 751 ultra compact chassis monitor for 12vdc 0.7a. Dim 11 x 14 x 18cm. Simple DIY data included to convert to composite video input. Full data. **BRAND NEW £65.00(B)**

20" Black & white monitors by Aztek, Cotron & National. All solid state, fully cased monitors ideal for all types of AV or CCTV applications. Standard composite video inputs with integral audio amp and speaker. Sold in good used condition - fully tested with 90 day guarantee. **£85.00(F)**

FLOPPY DISK DRIVES BARGAINS GALORE !

NEW 5¼ inch from £29.95!

Massive purchases of standard 5¼" drives enables us to present prime product at industry beating low prices! All units (unless stated) are removed from often brand new equipment and are fully tested, aligned and shipped to you with a 90 day guarantee and operate from +5 & +12vdc, are of standard size and accept the standard 34 way connector.

SHUGART SA405. BRAND NEW £29.95(B)
TANDON TM100-2A IBM compatible DS **£39.95(B)**
TANDON TM101-4 80 Track DS **£49.95(B)**
CANON,TEC etc. DS half height. State 40 or 80T **£75.00(B)**
TEAC FD-55-F. 40-80 DS half height. **BRAND NEW £99.00(B)**

3½ INCH BRAND NEW AT £19.95!!

Never before seen price for a 3½" drive. Standard size believed to be by Canon. Brand new and packaged - mint condition! 40 track SS, run from +5 & +12vdc with standard power connector.....Only..... **£19.95 or 2 for £34.50(B)**

CHOOSE YOUR 8 INCH!

Shugart 800/801 SS refurbished & tested **£125.00(E)**
Shugart 851 double sided refurbished & tested **£195.00(E)**
Mitsubishi M2894-63 double sided switchable hard or soft sectors- BRAND NEW **£250.00(E)**

SPECIAL OFFERS!!

Dual 8" drives with 2 megabyte capacity housed in a smart case with built in power supply! **Only £499.00 (F)**
Ideal as exterior drives!

End of line purchase scoop! Brand new **NEC D2246** 8" 85 megabyte of hard disk storage! Full CPU control and industry standard SMD interface. Ultra hi speed transfer and access time leaves the good old ST506 interface standing. In mint condition and comes complete with manual. Only.....**£399(E)**

MAINS SUPPRESSORS & FILTERS

The "Filtan" from Crotan is a British made high current mains spike suppressor and RF filter in one, capable of handling up to 10 amps! The attractive case has an integral 13 amp socket for your equipment plug and a flying lead terminates in a quality plug (to BS 1363A standard) to go to the mains socket. There is an internal fuse plus one in the plug. Two LED indicators, one for power on and the other lights if the internal fuse fails. Dims:6" x 3" x 2". Brand new. Distributor's price - £65.00! Continental plug version Filt-C. Either only **£15.95 each or 2 for £29.95 (B)**

Belling-Lee type L2127 mains RFI filters rated at 250 volts 3 amps maximum. Comes complete with a built in mains cable (English coding), and a three pin miniature non-reversible socket and a mating plug, to go to the equipment. Ideal for those who are bugged by RF interference. Very compact. Dims 3-1/8" x 2.5" x 1.5".....**£3.95 each or 3 for £10 (A)**

COOLING FANS

Please specify 110 or 240 volts for AC fans.

3 inch	AC. 1½" thick	**£ 8.50(B)**
3½ inch	AC ETRI slimline. Only 1" thick.	**£ 9.95(B)**
4 inch	AC 110/240v 1½" thick.	**£10.95(B)**
4 inch	AC 1½" thick	**£ 9.95(B)**
10 inch	Round. 3½ thick. Rotron 110v	**£10.95(B)**
62 mm	DC 1" thick. No.812 for 6/12v. 814 24v.	**£15.95(A)**
92 mm	DC 12v. 18 mm thick.	**£14.95(A)**
4 inch	DC 12v. 12w 1½" thick	**£12.50(B)**
4 inch	DC 24v 8w. 1" thick.	**£14.50(B)**

RECHARGEABLE BATTERIES

LEAD ACID

Maintenance free sealed long life. Type A300.

12 volts	12 volts 3 amp/hours	**£13.95(A)**
6 volts	6 volts 3 amp/hours	**£ 9.95(A)**
12 volts	Centre tapped 1.8 amp hours	**£ 5.95(A)**
12 volts	12 volts 24 amp hours. A200. RFE.	**£29.00(B)**

SPECIAL OFFER!

100 amp/hours at 6 volt! Brand new Chloride Powersafe 3VB11. Leakproof with additional snap-on security lid. Perfect for uninterruptable power supplies, portable power source, caravans etc. Normally costs £80! **£39 (E)**

NICKEL CADMIUM

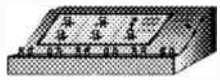
Quality 12v 4ah cell pack. Originally made for the Technicolor video company. Contains 10 GE top quality D nicad cells in a smart robust case with a DC output connector. Ideal for portable equipment. Brand new. **£19.95(B)**

Ex-equipment NICAD cells by GE. Removed from equipment and in good, used condition: D size 4ah **4 for £5(B)**; F size 7ah **6 for £8(B)**

SPECIAL INTEREST

Recal-Redac real time colour drafting PCB layout system. Includes furniture and huge monitor. Complete ready to go! **£3950**
DEC VAX11/750 inc. 2 Meg Ram DZ and full documentation, in brand new condition! **£3900**
Calcomp 1036 large drum 3 pen plotter **£ 650**
Thurlby LA 160A logic analyser **£ 275**
1.5kw 115v 60hz power source **£ 950**
Wayne Kerr RA200 audio real time freq.res.analyser. **£3000**
VG Electronics 1033 Teletext Bridge **£3750**
Tektronics R140 NTSC TV test signal standard. **£ 875**
Sony KTX 1000 Videotex system - **brand new** **£ 790**
DEC LS11/02 CPU board **£ 150**
ADDS 2020 VDU terminals - **brand new** **£ 225**

ANALOG to DIGITAL and DIGITAL to ANALOG CONVERTERS



Brand new and boxed Amdek ADA-200 analog to digital and digital to analog converter packed full of features: Interfaces to most popular PC's; 2 channel input & output by software selection; Integral input/output filters and address decoder; input pre-amp; over-level detecter; trigger signal detecter circuit; expansion availability and more. Input level 25mv to 50v p-p. Max. sampling frequency is 44khz and input gain variable to 200 times. Designed for use with almost any personal computer, allowing conversion of analog signals to digital data for processing by the computer plus conversion back to analog signals. The 26 page manual supplied includes data on the correct connection to various CPU's including the 8080, Z-80, 6800, 6502 and 6809 families plus data and schematics for user modification of I/O filter cut-off frequencies. Complete with 50 way ribbon cable and edge connector to go to the computer and power cable. All for a fraction of the regular price! **£49.95 (C)**

POWER SUPPLIES

All PSUs 220-240vac input and are BRAND NEW unless stated. Many types ranging from 3v to 10kv always in stock.

Fine OP-8619 20 watts switch mode. +5v @ 2a. +12v @ 1a, -12v @ 0.1a. 5" x 3" x 1-1/2". **£15.95(B)**
Astec AC-8151 40 watts. Switch mode. +5v @ 2.5a. +12v @ 2a. -12v @ 0.1a. 6-1/4" x 4" x 1-3/4". **£19.95(B)**
Greendale 19AB0E 60 watts switch mode. +5v @ 6a, ±12v @ 1a, ±15v @ 1a. RFE and fully tested. 11 x 20 x 5.5cms. **£24.95(C)**
Conver AC130. 130 watt hi-grade VDE spec. Switch mode. +5v @ 15a, -5v @ 1a, ±12v @ 6a. 27 x 12.5 x 6.5cms **£49.95(C)**
Boshert 13090. Switch mode. Ideal for drives & system. +5v @ 6a, +12v @ 2.5a, -12v @ 0.5a, -5v @ 0.5a. **£29.95(B)**
Farnell G6/40A. Switch mode. 5v @ 40a. Encased **£95.00(C)**
Farnell G24/5S. As above but 24v @ 5a. **£65.00(C)**

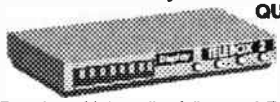
IBM KEYBOARD DEAL

A replacement or backup keyboard, switchable for IBM PC, PC-XT or PC-AT. LED's for Caps, Scroll & Num Locks. Standard 85 keyboard layout. Made by NCR for the English & US markets. Absolutely standard. Brand new & boxed with manual and key template for user slogans on the function keys. Attractive beige, grey and cream finish, with the usual retractable legs underneath. A generous length of curly cord, terminating in the standard 5 pin DIN plug. A beautiful clean piece of manufacturers surplus. What a deal!

BRAND NEW AND BOXED ONLY..... £49 (B)

THE *AMAZING* TELEBOX!

Converts your colour monitor into a QUALITY COLOUR TV!!



TV SOUND & VIDEO TUNER!

Brand new high quality, fully cased, 7 channel UHF PAL TV tuner system. Unit simply connects to your TV aerial socket and colour video monitor turning same into a fabulous colour TV. Dont worry if your monitor does'nt have sound, the TELEBOX even has an integral audio amp for driving a speaker plus an auxiliary output for Headphones or Hi Fi system etc. Many other features: LED Status indicator, Smart moulded case, Mains powered, Built to BS safety specs. Many other uses for TV sound or video etc. Supplied BRAND NEW with full 1 year guarantee.

Telebox ST for composite video input monitors.....**£29.95(B)**
Telebox STL as ST but with integral speaker.....**£34.95(B)**
Telebox RGB for analogue RGB monitors.....**£65.95(B)**

NOT suitable for IBM or Clone type colour monitors.
PAL overseas version please call. SECAM not available.

BRAND NEW PRINTERS

Epson MX-80 F/T One of the most popular printers around! Bi-directional printing with full logic seeking. 9 x 9 dot matrix for enlarged, bold, condensed etc. Standard parallel interface. Brand label removed from front. Handles tractor, fanfold and individual paper. OK with IBM PC and most others. A tremendous buy!
FOR A LIMITED TIME ONLY.....£129.00 (E)

DED DPG21 miniature ball point pen printer plotter mechanism with full 40 characters per line. Complete with data sheet which includes circuit diagrams for simple driver electronics.....**£49(B)**

Centronics 150 series. Always known for their reliability in continuous use - real workhorses in any environment. Fast 150 cps with 4 fonts and choice of interfaces.

150-SN up to 9.5" paper.....**£155.00(E)**
150-SW up to 14.5" paper.....**£199.00(E)**
Specify whether serial or parallel required.

CALL FOR THE MANY OTHERS IN STOCK INCLUDING DAISY WHEELS.

Visit our Shop - Technical help always on hand plus many un-advertised specials. You can buy a colour television for as little as £29! Come and join the gang at 215 Whitehorse Lane!

LARGE QUANTITIES OF OSCILLOSCOPES AND TEST GEAR ALWAYS AVAILABLE - CALL NOW!

DISPLAY
-Electronics-

MAIL ORDER & OFFICES
Open Mon-Fri 9.00-5.30
Dept AR, 32 Biggin Way,
Upper Norwood,
London SE19 3XF.

LONDON SHOP
100's of bargains!
Open Mon-Sat 9-5.30
215 Whitehorse Lane,
South Norwood,
London, SE25 6RB.

DISTEL © The Original Free dial-up database!
1000's of items+Info On Line
300 bd 01-679-1888,
1200/75 bd 01-679-6183,
1200/1200 bd 01-679-8769

ALL ENQUIRIES
01-679-4414
Fax- 01-679-1927
Telex- 894502

Access Visa

All prices for UK Mainland. UK customers add 15% VAT to TOTAL order amount. Minimum order £10. PO orders from Government, Universities, Schools & Local Authorities welcome-minimum account order £25. Carriage charges (A)=£2.00. (B)=£4.50. (C)=£8.50. (D)=£10.00. (E)=£12.00 (F)=£17.00 (G)=Call . All goods supplied subject to our standard Conditions of Sale and unless otherwise stated guaranteed for 90 days. All guarantees on a return to base basis. We reserve the right to change prices & specifications without prior notice. Orders accepted subject to stock. Quotations willingly given for higher quantities than those stated. Bulk surplus always required for cash.

BAKERS DOZEN PACKS

All packs are £1 each. 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.
BD9	2	6V 1A mains transformers upright mounting 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	BOAC 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-Elextricity 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.
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.
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.
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.
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.
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 to 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 footswitch 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.
BD305	1	Tubular dynamic mic with optional table rest.
BD653	2	Miniature driver transformers. Ref LT44. 20k to 1k centre tapped.
BD548	2	3.5V relays each with 2 pairs changeover contacts.
BD667	2	4.7μF non-polarised block capacitors, PCB mounting.

There are over 1,000 items in our Bakers Dozen List. If you want a complete copy, please request this when ordering.

GEIGER COUNTER KIT includes PCB loudspeaker etc to build a 9v Geiger counter only £39.00 Ref 39P1

ALKALINE PP3 BATTERIES These are past their sell-by date but test OK, only 2 for £1.00 Ref BD758

1¼ FUSE HOLDERS 5 for £1.00 Ref BD752

UNCASED KEYBOARDS Brand new mounted on PCB with components only £3.00 Ref 3P27

TOASTERS 2 slice with browning control, may need slight attention onlyu £3.00 Ref 3P84

MICROWAVE CONTROL PANEL Brand new, mains operated including digital clock 2 relay output, good for all sorts of timer applications. Good value at £6.00 Ref 6P18

EQUIPMENT WALL MOUNT Multi adjustable metal bracket for speakes etc. 2 for £5.00 Ref 5P152

SUB-MIN TOGGLE SWITCH Body size 8mm x 4mm x 7mm SBDT with chrome dolly fixing nuts. 3 for £1. Order ref BD649.

COPPER CLAD PANEL for making PCB. Size approx 12in long x 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 ET1 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**. Our ref 12P5/1.

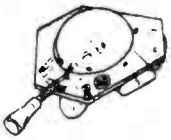
MAIL ORDER TERMS: Cash, PO or cheque with order. Please add £2.50 service charge. Monthly account orders accepted from schools and public companies. Access and B/Card orders accepted – minimum £5. Phone (0273) 734648 or 203500. Fax No 0273-23077

REAL POWER AMPLIFIER for your car, it has 150 watts output. Frequency response 20Hz to 20kHz and signal to noise ratio better than 60dB. Has built-in short circuit protection and adjustable input level to suit your existing car stereo, so needs no pre-amp. Works into speakers ref 30P7 described below. A real bargain at only £57.00. Order ref 57P1.

REAL POWER CAR SPEAKERS. Stereo pair output 100W each. 4 ohm impedance and consisting of 6½in woofer, 2in mid-range and 1in tweeter. Each set in a compact purpose-built shelf mounting unit. Ideal to work with the amplifier described above. Price per pair £30.00. Order ref 30P7.

STEREO CAR SPEAKERS. Not quite so powerful – 70W per channel. 3in woofer, 2in mid-range and 1in tweeter. Again, in a super purpose-built shelf mounting unit. Price per pair £28.00. Order ref 28P1.

VIDEO TAPES. These are three hour tapes of superior quality, made under licence from the famous JVC Company. Offered at only £3 each. Our ref 3P63. Or 5 for £11. Our ref 11P3. Or for the really big user 10 for £20. Our ref 20P20.



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 £10. Our ref 10P81.

12in HIGH RESOLUTION MONITOR. Amber screen, beautifully cased for free standing, needs only a 12V 1.5 amp supply. Supplied with connection data for H sync, V sync & Video. Brand new in maker's cartons. Price £22.00. Ref 22P2

COMPOSITE VIDEO KIT converts composite video to H sync, V sync & sep video. Price £8.00. Ref 8P39.

14in COLOUR MONITOR made by the American Display Tek Company. Uses high resolution tube made by the famous Japanese Toshiba Company. Beautifully made unit intended for console mounting, but top and sides adequately covered by plated metal panels. Full technical spec on its way to us. We have a limited number of these. All brand new still in maker's cartons. Price £89 each plus £6 insured carriage. Order ref 89P/1.

BUSH RADIO MIDI SPEAKERS. Stereo pair. BASS reflex system, using a full range 4in driver of 4 ohms 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. Our ref 5P141.

3½in FLOPPY DRIVES. We still have two models in stock: Single-sided, 80 track, by Chinon. This is in the manufacturer's metal case with leads and IDC connectors. Price £40, reference 40P1. Also a double-sided, 80 track, by NEC. This is uncased. Price £59.50, reference 60P2. Both are brand new. Insured delivery £3 on each or both.

REMOTE CONTROL FOR YOUR COMPUTER. With this outfit you can be as much as 20 feet away as you will have a joystick that can transmit and a receiver to plug into and operate your computer and TV. This is also just right if you want to use it with a big screen TV. The joystick has two fire buttons and is of a really superior quality, with four suction cups for additional control and one-handed play. Price £15 for the radio controlled pair. Our ref 15P27.

ASTEC PSU. Mains operated switch mode, so very compact. Outputs +12V 2.5A, +5V 6A, ±5V 6A, ±12V 5A. Size: 7½in long x 4¾in wide x 2¼in high. Cased ready for use. Brand new. Normal price £30+, our price only £13.00. Order ref 13P2.

VERY POWERFUL 12 VOLT MOTORS. ⅓ 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 £20 plus £2 postage. Our ref 20P22.

PHILIPS LASER

This is a helium-neon and has a power rating of 2mW. Completely safe as long as you do not look directly into the beam when eye damage could result. Brand new, full spec. £35.00. Mains operated power supply for this tube gives 8kV striking and 1.25kV at 5mA running. Complete kit with case £15. Complete kit with tube & power supply. £50.00.

ORGAN MASTER is a three octave musical keyboard. It is beautifully made, has full size (piano size) keys, has gold-plated contacts and is complete with ribbon cable and edge connector. Comes complete with Spectrum 128 software. Brand new only £22.00. Ref 22P1

FULL RANGE OF COMPONENTS at very keen prices are available from our associate company SCS COMPONENTS. You may already have their catalogue, if not request one and we will send it FOC with your goods.

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. £20.00. Ref 20P26.

12 VOLT BRUSHLESS FAN. Japanese made. The popular square shape (4½in x 4½in x 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.

MINI MONO AMP on PCB, size 4in x 2in (app). Fitted Volume Control. The amplifier has three transistors and we estimate the output to be 2W 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.**

SINCLAIR C5 WHEELS INC INNER TUBE & TYRES 13" & 16" DIAMETER SPOKED. POLYCARBONATE WHEELS FINISHED IN BLACK ONLY £6.00 EACH. 13" REF 6P10, 16" REF 6P11

NEW MAINS MOTORS 25 watt 3000 rpm made by Framco approx 6"x4"x3" priced at only £4.00 ref 4P54.

SHADED POLE MOTORS Approx 3" square available in 24v AC or 240v AC both with threaded output shaft and 2 fixing bolts. Price is £2.00 each. 24v ref 2P65, 240v ref 2P66.

MICROWAVE TURNTABLE MOTORS Complete with weight sensing electronics that would have varied the cooking time. Ideal for window displays etc. Only £5.00 ref 5P165.

SURFACE MOUNT KIT Makes a super high gain snooping amplifier on a PCB less than an inch square! £7.00 ref 7P15.

COMPUTER KEYBOARDS Brand new 100 keys, uncased only £3.00 ref 3P89.

PERSONAL STEREO INNARDS Complete with PCB and tape mech etc. 2 for £3.00 ref 3P94.

J & N BULL ELECTRICAL

Dept AR250 PORTLAND ROAD, HOVE BRIGHTON, SUSSEX BN3 5QT.

POPULAR ITEMS – MANY NEW THIS MONTH

JOYSTICKS for BBC Atari, Dragon Commodore, etc. All £5.00 each. All brand new, state which required.

TELEPHONE TYPE KEYPAD. Really first class rear mounting unit. White lettering on black buttons. Has conductive rubber contacts with soft click operation. Circuit arranged in telephone type array. Requires 70mm by 55mm cut-out and has a 10 IDC connector. Price £2.00. Ref 2P251.

SUB-MIN PUSH SWITCHES. Not much bigger than a plastic transistor but double pole PCB mounting. 3 for £1.00. Our ref BD688.

AA CELLS. Probably the most popular of the rechargeable NICAD types. 4 for £4.00. Our ref 4P44.

20 WATT 4 OHM SPEAKER. With built-in tweeter. Really well made unit which has the power and the quality for hi-fi 6½in dia. Price £5.00. Our ref 5P155, or 10 for £40.00, ref 40P7.

MINI RADIO MODULE. Only 2in square with ferrite aerial and solid dia tuner with own knob. It is superhet and operates from a PP3 battery and would drive a crystal headphone. Price £1.00. Our ref BD716.

BULGIN MAINS PLUG AND SOCKET. The old and faithful 3 pin with screw terminals. The plug is panel mounted and the socket is cable mounted. 2 pairs for £1.00 or 4 plugs or 4 sockets for £1.00. Our ref BD715, BD715P, or BD715S.

MICROPHONE. Low cost hand-held dynamic microphone with on/off switch in handle. Lead terminates in 1 3.5mm and 1 2.5mm plug. Only £1.00. Ref BD711.

MOSFETS FOR POWER AMPLIFIERS AND HIGH CURRENT DEVICES. 140V 100 watt pair made by Hitachi. Ref 2SK413 and its complement 2SJ118. Only £4.00 a pair. Our ref 4P42.
Also available in H pack Ref 2SJ99 and 2SK343 £4.00 a pair. Ref 4P51.

TIME AND TEMPERATURE LCD MODULE. A 12 hour clock, a Celsius and Fahrenheit thermometer, a too hot alarm and a too cold alarm. Approx 50 x 20mm with 12.7mm digits. Requires 1AA battery and a few switches. Comes with full data and diagram. Price £6.00. Our ref 6P12.

REMOTE TEMPERATURE PROBE FOR ABOVE. £3.00. Our ref 3P60.

A REAL AIR MOVER. Circular axial fan moves 205 cubic foot per min, which is about twice as much as our standard 4½in fans. Low noise mains operated, 6½in dia, brand new. Regular price, over £30.00. Our price only £10.00. Our ref 10P71.

600 WATT AIR OR LIQUID MAINS HEATER. Small coil heater made for heating air or liquids. Will not corrode, lasts for years. Coil size 3in x 2in, mounted on a metal plate for easy fixing. 4in dia. Price £3.00. Ref 3P78 or 4 for £10.00. Our ref 10P76.

EX-EQUIPMENT SWITCHED MODE POWER SUPPLIES. Various makes and specs but generally ±5, ±12V, ideal bench supply. Only £8.00. Our ref 8P36.

ACORN DATA RECORDER. Made for the Electron or BBC computers but suitable for others. Includes mains adapter, leads and book. £12.00. Ref 12P15.

STABILIZED POWER SUPPLY KIT 1-25v 2A adjustable, contains PCB transformer and components to build a bench supply only £20.00. Ref 20P25.

PTFE COATED SILVER PLATED CABLE. 19 strands of .45mm copper, will carry up to 30A and is virtually indestructible. Available in red or black. Regular price is over £120 per reel. Our price only £20.00 for 100m reel. Ref 20P21, or 1 of each for £35.00 Ref 35P2. Makes superb speaker or aerial cable!

NEW PIR SENSORS. Infra-red movement sensors will switch up to 500W mains. UK made, 12 months manufacturer's warranty. 15-20m range, with a 0-10min timer, daylight sensor, adjustable wall bracket. Only £20.00. Ref 20P24.

MITSUBISHI 3½in DISC DRIVES. Brand new drives, ½ height, double-sided, double density, warranted. Our price £60.00. Ref 60P5.

10 MEMORY PUSHBUTTON TELEPHONES. These are customer returns and sold such so may need slight attention. Price £6.00. Ref 6P16 or 2 for £10. Ref 10P77. BT approved.

NON-MEMORY PUSHBUTTON TELEPHONES. Same condition as above with redial £3.00. Our ref 3P79. BT approved.

SPECTRUM SOUND BOX. Add sound to your Spectrum with this device. Just plug in. Complete with speaker, volume control and nicely boxed. A snip at only £4.00. Our ref 4P53.

BBC JOYSTICK INTERFACE. Converts a BBC joystick port to an Atari type port. Price £2.00. Our ref 2P261.

TELEPHONE EXTENSION LEAD. 5m phone extension lead with plug on one end, socket on the other. White. Price £3.00. Our ref 3P70, or 10 leads for only £19.00! Ref 19P2.

LCD DISPLAY. 4½in digits supplied with connection data £3.00. Ref 3P77, or 5 for £10, ref 10P78.

CROSSOVER NETWORK. 8 ohm 3-way for tweeter mid-range and woofer, nicely cased with connections marked. Only £2.00. Our ref 2P255, or 10 for £15.00, ref 15P32.

BASE STATION MICROPHONE. Top quality uni-directional electret condenser mic 600r impedance sensitivity 16-18kHz – 68dB built-in chime, complete with mic stand bracket. £15.00. Ref 15P28.

MICROPHONE STAND. Very heavy chromed mic stand, magnetic base 4in high. £3.00 if ordered with above mic. Our ref 3P80.

SOLAR POWERED NICAD CHARGER. 4 Nicad AA battery charger. Charges 4 batteries in 8 hours. Price £6.00. Our ref 6P3.

MAINS SOLDERING IRON. Price £3.00. Our ref 3P65.

SOLDERING IRON STAND. Price £3.00. Our ref 3P66.

SHARP PLOTTER PRINTER. New 4 colour printer originally intended for Sharp computers but may be adaptable for other machines. Complete with pens, paper etc. Price £16.00. Our ref 16P3.

CENTRONICS CONVERSION KIT FOR ABOVE PLOTTER only £4.00. Ref 4P57.

CAR IONIZER KIT. Improve the air in your car, clears smoke and helps prevent fatigue. Case req. Price £12.00. Our ref 12P8.

NEW FM BUG KIT. New design with PCB embedded coil 9V operation. Priced at £5.00. Our ref 5P158.

NEW PANEL METERS 50UA movement with three different scales that are brought into view with a lever. Price only £3.00. Ref 3P81.

STROBE LIGHTS. Fit a standard Edison screw light fitting, 240V 40/min flash rate, available in yellow, blue, green and red. Complete with socket. Price £10 each. Ref 10P80 (state colour required).

ELECTRONIC SPEED CONTROL KIT. Suitable for controlling our powerful 12V motors. Price £17.00. Ref 17P3 (heatsink required).

EXTENSION CABLE WITH A DIFFERENCE. It is flat on one side, making it easy to fix and look tidy. 4 core, suitable for alarms, phones etc. Our price only £5.00 for 80m reel. Ref 5P153.

METAL PROJECT BOX. Ideal for battery charger, power supply etc. Sprayed grey, size 8in x 4in x 4½in. Louvred for ventilation. Price £3.00. Ref 3P75.