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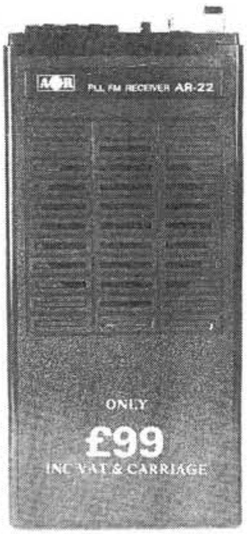

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BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

SEPTEMBER 1980
VOLUME 56
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ISSUE 882

Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG

QUERIES

While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the Editor, *Practical Wireless,* at the above address, giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components are usually available from advertisers. A source will be suggested for difficult items.

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☐ NEWS & VIEWS

☐ FOR OUR CONSTRUCTORS

☐ GENERAL INTEREST

Our October issue will be published about 5 September
(for details see page 43)

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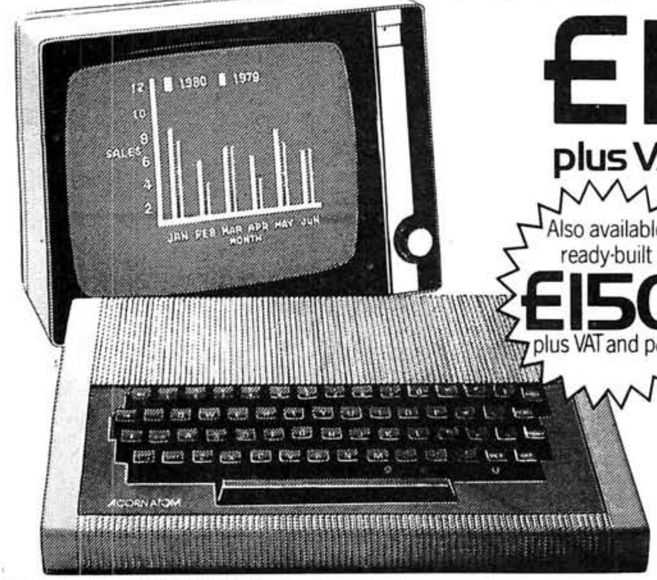

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*The picture shown demonstrates mixed graphics and characters in three shades of grey provided by the Standard Atom.

The standard ATOM kit includes:
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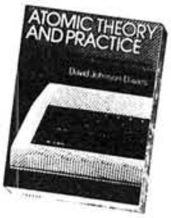

The ATOM concept
Adding chips into sockets on the PCB allows you to progress in affordable steps to large-scale expansion. You can see from the specifications that the RAM can be increased to 12K allowing high resolution (256 x 192) graphics. Two further ROM chips, e.g. maths functions, can be added directly to the board giving a 16K capacity. In addition to 5 I/O lines partly used by the cassette interface, an optional VIA device can provide varied I/O and timer functions and via a buffer device allow direct printer drive. An optional module provides red, green and blue signals for colour. An in-board connector strip takes the ATOM communications loop interface. Any number of ATOMs may be linked to each other – or to a master system with mass storage/hard copy facility. Interface with other ACORN cards is simplicity itself. Any one ACORN card may be fitted internally.
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● Memory from 2K to 12K RAM on board (up to 35K in case) ● 8K to 16K ROM (two 4K additions) ● 6502 processor ● Video Display allows high resolution (256 x 192) graphics and red, green and blue output ● Cassette Interface – CUTS 300 baud ● Loudspeaker allows tone generation of any frequency ● Channel 36 UHF Modulator Output ● Bus output includes internal connections for Acorn Eurocard.

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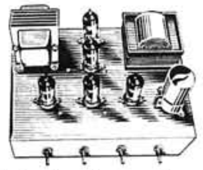

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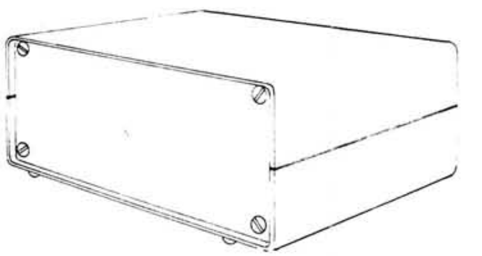

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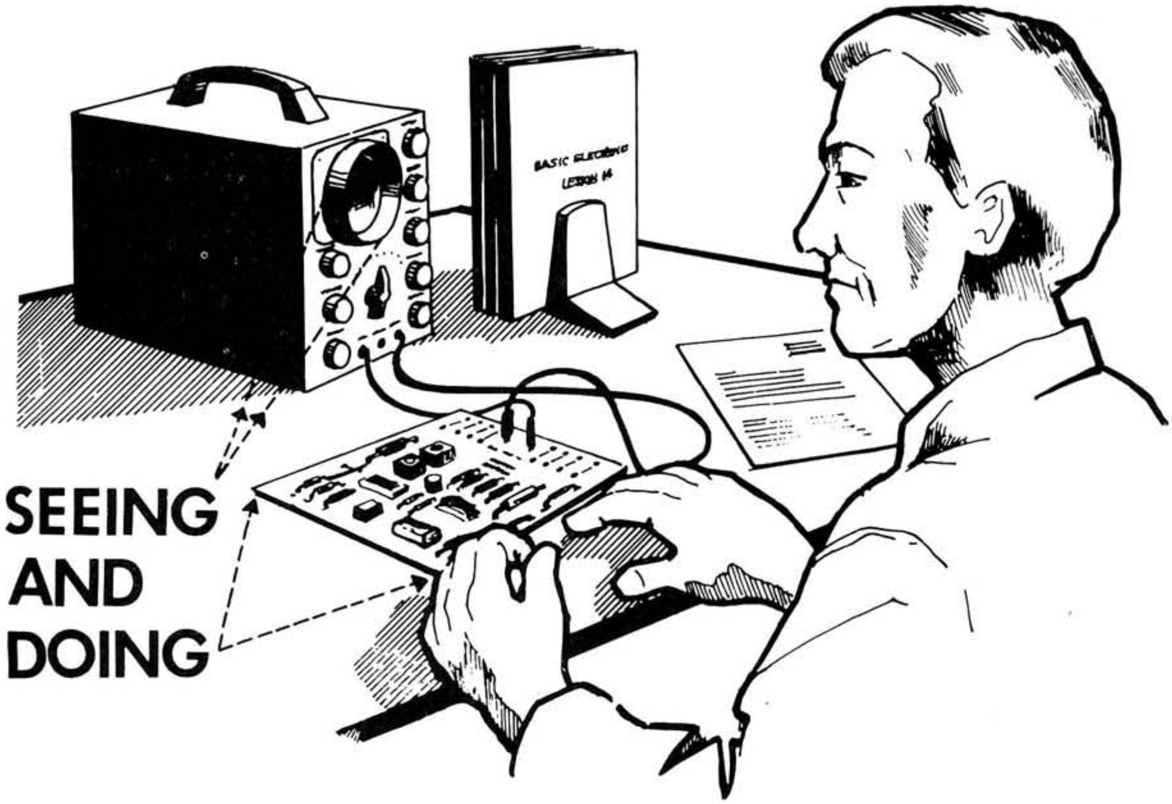

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7443	112p	74160	100p
7444	112p	74161	100p
7445	100p	74162	100p
7446A	93p	74163	100p
7447A	70p	74164	100p
7448	80p	74165	130p
7450	17p	74166	100p
7451	17p	74167	200p
7453	17p	74170	240p
7454	17p	74172	720p
7460	17p	74173	120p
7470	38p	74174	93p
7472	30p	74175	85p
7473	34p	74176	90p
7474	30p	74177	90p
7475	30p	74178	160p
7476	35p	74180	90p
7480	50p	74181	200p
7481	100p	74182	90p
7482	84p	74184A	150p
7483A	90p	74185	150p
7484	100p	74186	600p
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7490A	30p	74193	100p
7491	36p	74194	100p
7492A	46p	74195	95p
7493A	36p	74196	95p
7494	36p	74197	80p
7495A	70p	74198	150p
7496	65p	74199	150p

74221	160p
74251	140p
74259	250p
74265	90p
74278	290p
74279	140p
74283	190p
74284	400p
74285	400p
74290	150p
74293	150p
74294	200p
74298	200p
74365	150p
74366	150p
74367	150p
74368	150p
74390	200p
74393	200p
74490	225p

74 LS SERIES

74LS00	14p
74LS02	18p
74LS04	14p
74LS08	22p
74LS10	20p
74LS13	38p
74LS14	78p
74LS20	22p
74LS22	28p
74LS27	38p
74LS30	22p
74LS47	90p
74LS55	30p
74LS73	50p
74LS74	40p
74LS75	50p
74LS83	110p
74LS85	100p
74LS86	40p
74LS90	60p
74LS93	60p
74LS107	45p
74LS112	100p
74LS123	75p
74LS132	900p
74LS133	60p
74LS138	60p
74LS139	60p
74LS151	100p
74LS153	60p
74LS157	60p
74LS158	120p
74LS160	100p
74LS161	100p
74LS162	140p
74LS163	100p
74LS164	120p
74LS165	80p
74LS173	110p
74LS174	110p
74LS175	110p
74LS181	320p
74LS190	100p
74LS191	100p
74LS192	140p
74LS193	140p
74LS195	140p
74LS196	120p
74LS221	100p
74LS240	175p
74LS241	175p
74LS242	175p
74LS243	175p
74LS244	195p
74LS245	250p
74LS251	200p
74LS257	120p
74LS259	175p
74LS298	249p
74LS373	200p
74LS374	195p
81LS95	140p
81LS96	140p
81LS97	140p
81LS98	140p
8T28	230p
9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9322	150p
9368	200p
9370	200p
9374	200p
9601	100p
9602	228p

INTERFACE I.C.s

MC1488	100p
MC1489	100p
75107	160p
75182	230p
75450	120p
75451/2	72p
75491/2	96p

C-MOS I.C.s

74C00	25p
74C02	25p
74C04	27p
74C08	27p
74C10	27p
74C14	90p
74C20	27p
74C30	27p
74C32	38p
74C42	110p
74C48	250p
74C73	75p
74C74	70p
74C85	200p
74C86	65p
74C90	95p
74C95	130p
74C107	125p
74C150	250p
74C151	260p
74C157	250p
74C160	155p
74C161	155p
74C162	155p
74C163	155p
74C164	120p
74C173	120p
74C174	160p
74C175	210p
74C192	150p
74C193	150p
74C194	220p
74C195	110p
74C221	175p

4000 SERIES

4000	15p	4028	84p
4001	25p	4029	100p
4002	20p	4030	55p
4006	95p	4031	200p
4007	25p	4033	180p
4008	80p	4034	200p
4009	40p	4035	110p
4010	50p	4040	100p
4011	25p	4041	80p
4012	18p	4042	80p
4013	50p	4043	90p
4014	84p	4044	90p
4015	84p	4046	110p
4016	45p	4047	100p
4017	80p	4048	55p
4018	89p	4049	40p
4019	45p	4050	49p
4020	100p	4051	80p
4021	110p	4052	80p
4022	100p	4053	80p
4023	22p	4055	125p
4024	50p	4056	135p
4025	20p	4059	600p
4026	130p	4060	115p
4027	50p	4063	120p
		4066	55p

LINEAR I.C.s

AY1-0212	600p	MC1496	100p
AY1-1313	668p	MC3340	120p
AY1-5050	212p	MC3360	120p
AY5-1224A	225p	MK50398	750p
AY5-1315	600p	NE531	100p
AY5-1317	780p	NE543K	225p
AY5-1320	320p	NE555	25p
CA5019	80p	NE556	70p
CA3046	70p	NE561B	425p
CA3048	225p	NE562B	425p
CA3080E	72p	NE565	130p
CA3089E	225p	NE566	155p
CA3090AQ	375p	NE567	175p
CA3130E	100p	RC4151	400p
CA3140E	70p	SP8515	750p
CA3160E	75p	TBA641B11	225p
FX209	750p	TBA800	90p
ICL7106	925p	TBA810	100p
ICL8038	340p	TBA820	90p
LM301A	36p	TCA940	175p
LM311	190p	TDA4500	280p
LM318	200p	TDA1004	328p
LM324	70p	TDA1008	300p
LM339	90p	TDA1022	600p
LM348	95p	XR2206	400p
LM377	175p	XR2207	400p
LM380	75p	XR2216	675p
LM381AN	150p	XR2240	400p
LM389N	140p	ZN414	90p
LM709	36p	ZN424E	135p
LM710	50p	ZN425E	400p
LM733	100p	ZN1034E	200p
LM741	29p	95H90	800p
LM747	70p		
LM748	35p		
LM3900	70p		
LM3911	130p		
LM4136	120p		
MC1310P	150p		
MC1458	48p		
MC1495	400p		

VOLTAGE REGULATORS
Fixed Plastic TO-220

1A	+ve		1A	−ve	
5V	7805	60p	5V	7905	70p
12V	7812	60p	12V	7912	70p
15V	7815	60p	15V	7915	90p
18V	7818	90p	18V	7918	90p
24V	7824	90p	24V	7924	90p
100mA	**TO-92**		**100mA**	**TO-92**	
5V	78L05	35p	5V	79L05	80p
12V	78L12	35p	12V	79L12	80p
15V	78L15	35p	15V	79L15	80p

OTHER REGULATORS

LM309K	135p	TBA625B	120p
LM317T	200p	TL430	65p
LM323K	625p	78HO5KC	678p
LM723	37p	78MGT2C	140p

OPTO-ELECTRONICS

2N5777	45p	ORP12	90p	ORP61	90p
OCP71	130p	ORP60	90p	TIL78	70p

TRANSISTORS

AC127/8	20p	BFY51/2	22p
AD149	70p	BFY56	33p
AD161/2	45p	BFY90	90p
BC107/8	11p	BRY39	45p
BC109	11p	BSX19/20	20p
BC147/8	9p	BU105	190p
BC149	10p	BU108	250p
BC157/8	10p	BU205	220p
BC159	11p	BU208	240p
BC169C	12p	BU406	145p
BC172	12p	MJ2501	225p
BC177/8	17p	MJ2955	100p
BC179	18p	MJ3001	225p
BC182/3	10p	MJE340	65p
BC184	11p	MJE2955	100p
BC187	30p	MJE3055	70p
BC212/3	11p	MPF102	45p
BC214	12p	MPF103/4	40p
BC461	36p	MPF105/6	40p
BC477/8	30p	MPSA06	30p
BC516/7	50p	MPSA12	50p
BC547B	16p	MPSA56	32p
BC549C	18p	MPSU06	63p
BC557B	16p	MPSU56	78p
BC559C	18p	OC28	130p
BCY70	18p	OC35	130p
BCY71/2	22p	R2008B	200p
BD131/2	50p	R2010B	200p
BDY56	200p	TIP29A	40p
BF200	32p	TIP29C	55p
BF244B	35p	TIP30A	48p
BF256B	70p	TIP30C	60p
BF257/8	32p	TIP31A	58p
BF259	36p	TIP31C	62p
BFR39	27p	TIP32A	68p
BFR40	27p	TIP32C	82p
BFR41	27p	TIP33A	90p
BFR79	27p	TIP33C	114p
BFR80	27p	TIP34A	115p
BFR81	27p	TIP34C	160p
BFX29	30p	TIP35A	225p
BFX30	34p	TIP35C	290p
BFX84/5	30p	TIP36A	270p
BFX86/7	30p	TIP36C	340p
BFX38	30p	TIP41A	65p
BFW10	90p		
BFY50	22p		

TIP41C	78p	2N3866	90p
TIP42A	70p	2N3903/4	18p
TIP42C	82p	2N3905/6	20p
TIP2955	78p	2N4036	65p
TIP3055	70p	2N4058/9	12p
TIS43	34p	2N4060	12p
TIS93	30p	2N4061/2	18p
ZTX108	12p	2N4123/4	22p
ZTX300	11p	2N4125/6	22p
ZTX500	15p	2N4289	20p
ZTX502	18p	2N4401/3	27p
ZTX504	30p	2N4427	90p
2N457A	250p	2N4871	60p
2N696	35p	2N5087	27p
2N697	25p	2N5089	27p
2N697	45p	2N5172	27p
2N706A	20p	2N5179	27p
2N708A	20p	2N5191	83p
2N918	30p	2N5194	90p
2N930	18p	2N5245	40p
2N1131/2	20p	2N5296	55p
2N1613	25p	2N5401	50p
2N1711	25p	2N5457/8	40p
2N2102	60p	2N5459	40p
2N2160	120p	2N5460	40p
2N2219A	30p	2N5485	44p
2N2222A	20p	2N6027	48p
2N2369A	30p	2N6247	190p
2N2484	30p	2N6254	130p
2N2646	50p	2N6290	65p
2N2904/5A	30p	2N6292	65p
2N2906A	24p	2N128	120p
2N2907A	30p	3N140	100p
2N2926	9p	3N201	110p
2N3053	30p	3N204	120p
2N3054	65p	40290	250p
2N3055	48p	40360	40p
2N3442	140p	40361/2	45p
2N3553	240p	40364	120p
2N3565	30p	40408	70p
2N3643/4	48p	40409	65p
2N3702/3	12p	40410	65p
2N3704/5	12p	40411	300p
2N3706/7	12p	40594	97p
2N3708/9	12p	40595	105p
2N3773	300p	40673	75p
2N3819	25p	40841	90p
2N3820	50p	40871/2	90p
2N3823	70p		

DIODES

BY127	12p
OA47	9p
OA81	15p
OA85	15p
OA90	9p
OA91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p

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1 W 15p

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100+ RCA 2N3055 **£36**

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1A 100V	22p
1A 400V	30p
2A 50V	30p
2A 100V	35p
2A 400V	45p
3A 200V	60p
3A 600V	72p
4A 100V	95p
4A 400V	100p
6A 50V	90p
6A 100V	100p
6A 400V	120p
10A 400V	200p
25A 400V	400p

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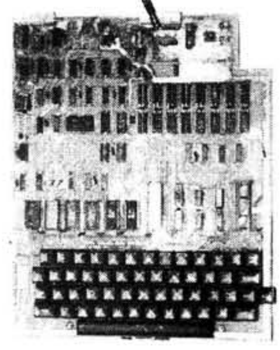

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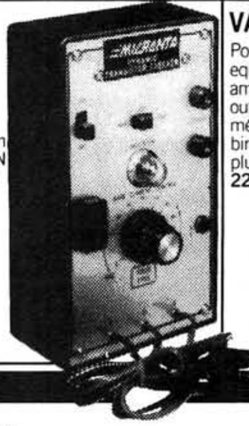

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ML 81 MUSICAL CLOCK CALCULATOR. 2 musical alarms, countdown timer, stopwatch from 1/10 second to 12 hours. Net lap, 1st and 2nd place. Calculator with full memory +/−/×/÷ % √. 1 year batteries. R.R.P. (£25.95) **£22.45**

ML 71 as above with one melody alarm mini-card. R.R.P. (£25.95) **£22.45**

ML 82 MUSICAL CLOCK CALCULATOR with alarm, calendar, stopwatch. R.R.P. (£22.95) **£19.95**

AQ2200 permanent display of full month calendar, clock, alarm, hourly chimes, stopwatch from 1/10 second to 10 hours; net, lap 1st and 2nd place times. Calculator with full memory % √. One year battery. R.R.P. (£21.95) **£19.45**

AQ1500 similar to above without month display. No alarms. R.R.P. (£17.95) **£14.45**

CASIO'S LATEST SCIENTIFIC CALCULATORS

FX8100 Hours, mins, secs, AM/PM, day. Calendar pre-programmed to 1999. 24 hour alarm. Alarm timer, interval timer, or 1/100 sec. Stopwatch: net lap and 1st, 2nd place times. Fractions, % cube roots, 5 levels of parenthesis, hyperbolics, standard deviations, co-ordinates, conversions. 46 scientific functions. 1 year batteries. R.R.P. (£27.95) **£24.45**

FX7100 as FX8100 only 30 scientific functions, 8 digits, 1 alarm. No hyperbolics, fractions, or calendar. 1 countdown alarm or 24 hour alarm. Hourly chimes. Mini card size. Complete with leatherette wallet. R.R.P. (£27.95) **£24.45**

FX501P 11 memories and 128 programming steps. 10 digit. R.R.P. (£64.95) **£52.95**

FX502P 22 memories and 256 programming steps. 10 digit. R.R.P. (£84.95) **£72.95**

FA1 adaptor for 501P and 502P programme on to cassete tape. R.R.P. (£24.95) **£18.95**

ALL OTHER CASIO CALCULATORS EX. STOCK MOST MODELS

CASIO Details. Send 20p for full details of Watches and Calculators. TERMS OF BUSINESS: Please note all CASIO items **PRICE INCLUDES** VAT, P&P and Insurance. Please send cheques or P.O.s or quote Access or Barclaycard No. to: B. BAMBER ELECTRONICS. 24 hour phone service. **(0353) 860185. Callers welcome Tues–Sat 9.30–5.30 pm.**

TRIO CS1566 20MHz triggered sweep oscilloscope. **£339.00 + VAT**

TRIO CS1562A 10MHz triggered sweep oscilloscope. **£259.00 + VAT**

HAMEG oscilloscope HM307 LPS triggering bandwitdh d.c. to 10MHz. Component tester. Timebase 0, 2 us–0, 2 s/cm. **£149.00 + VAT**

HAMEG HZ36 switchable probe for HM307. **£11.00 + VAT**

DACTRON PX40Z 13.8 DC 3 amp continuous 4 amp max. Fully stabilised power supply with overload protection. **£19.95 + VAT**

DACTRON PH 5000 13.8 DC 5 amp continuous. **£39.50 + VAT**

DIN PANEL METERS DIN 75: 0–5 amps DIN 715: 0–150 volts DIN 730: 0–300 volts DIN 750: 0–500 volts 72 × 72 mm range. **£8.00 + VAT**

EAGLE DD7 paging microphone impedance 600 ohm or 50K ohms sensitivity 2.25mV at 50K ohms. Frequency response 300–900Hz. Desk or wall mounted. **£14.85 + VAT**

EAGLE MULTI-METER. EM50 50,000 DPV DC volts: 0–1200 volts AC volts 0–1200 volts. DC current 0–6A resistance 0–10 Meg ohms. **£19.95 + VAT**

DRAPER SUPER CHROME ¼" sq drive socket sets. 33 piece 9 AF hexagon 3 AF Bl-sq sockets. 11 mm hexagon sockets 9 BA hexagon sockets 6 Access. **£12.75 + VAT**

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WELLER TCP3 irons 24 volt series 3 wire power units. For application requiring earthed tip. Also PU3D power units. **TCP3 £13.84 + VAT** **PU3D £24.12 + VAT**

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ORYX DE-SOLDER TOOLS Model SR3A desoldering pump with built in safety guard **Price £6.50 + VAT**

I.C. TEST CLIPS Clip over IC while still soldering to PCB or in sock. Gold plated pins. Ideal for experiments of service engineers. 28 pin DIL **£1.75** 40 pin DIL **£2.00** or save buy one of each ***For £3.50 + VAT***

I.C. AUDIO AMP P.C.B. Output 2 watts into 3 ohm speaker. 12V DC supply. Size approx. $5\frac{1}{2}$ in × $1\frac{1}{2}$ in × 1" high with integral heatsink complete with circuits **£2.00 each + VAT**

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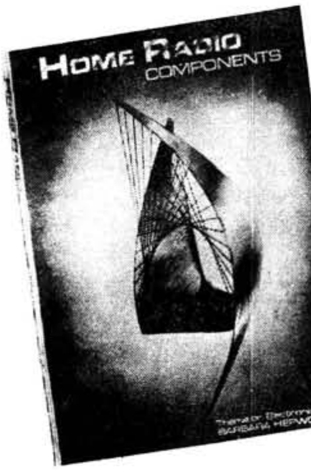

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(Nov. 75 article by A. C. Ainslie) ***Copy of original article supplied on request***

IF Sub-Assembly (G8) **£7·82.** P&P 85p.
Mullard ELC1043 V'cap UHF Tuner **£6·33.** P&P 40p.
3-way Station Control Unit **£1·38.** P&P 30p.
6-way Station Control Unit (Special Offer) **£1·15.** P&P 35p.
Power Supply Prtd Circuit Board **£1·15.** P&P 35p.
Res, Caps, Semiconds, etc. for above **£6·67.** P&P 45p.
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P&P all items £1.00.
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Callers welcome at shop premises.

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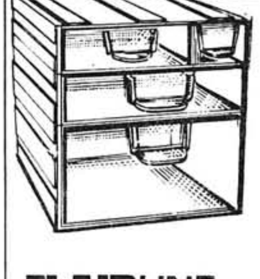
INTERLOCKING PLASTIC STORAGE DRAWERS

1D 2D 3D 6D



AS SUPPLIED: TO POST OFFICE & GOVT DEPTS

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. 1D and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

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SINGLE UNITS *(1D) (5in × $2\frac{1}{2}$in × $2\frac{1}{4}$in)* **£3.90** DOZEN
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TREBLE (3D) **£5.90** for 8.
DOUBLE TREBLE 2 drawers, in one outer case (6D2) **£8.90** for 8.
EXTRA LARGE SIZE (6D1) **£7.90** for 8.

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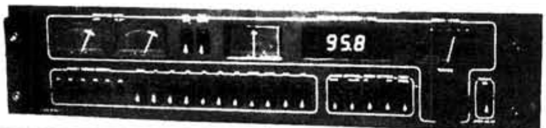
Complete Audio/Tuner Kits



Mk III FM Tuner series

Carriage for Mk III tuner £3 inc

The Mark III series FM tuner has been updated, and now includes a centre zero tuning meter as standard. The instruction manual has been meticulously revised, enabling easy assembly by constructors of various levels of experience - a preview copy may be purchased for £1.00.

Mark III A series	'Reference series' tuner modules	........£171.35 inc.
Mark III B series	'Hyperfi' modules, with switched IF BW, pilot cancel decoder	........£198.95 inc.

A matching synthesiser unit will be made available later this year, and can be retrofitted to either version. All versions include digital frequency readout/clock, VU deviation meters, 6 preset stations, 10 turn pot manual tuning, toroidal PSU, output level adjustment, 110/240v AC input. Full alignment service available.

Power Amplifier

Style and performance - with a real 'belt and braces' PSU design.

After a couple of preview comments, it seems that many of you are waiting to hear about the matching HMOSFET power amplifier for the Mk III tuner. Well, it's out at last - complete with twin toroidal PSUs for comfortable 80W RMS per channel, over 100W peak, but limited by thermal shutdown of the HMOS. 10W-100W log LED output peak indicator, DC offset protection and switch-on pause relay. AC or DC input coupling, direct or relay protected output terminals. The works.

Only one version of this item: Complete kit ....£178.25 inc. Carr. £5.

Preamplifier

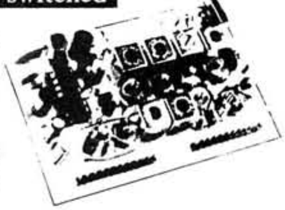
More features and facilities, thanks to DC switching and control design

Previewing the most comprehensive audio preamplifier yet...... DC switching of 7 inputs, plus two tape in/outs. 2 low pass, 2 high pass active filters, genuine volume related loudness, 1dB channel matching, with DC volume, balance, bass and treble controls. Suitable for bus/remote control, tape dubbing, switched monitor etc. 80dB S/N+, THD -75dB or better. Pluggable PU equalization boards, tone control override. Price for complete unit about £149 ex VAT.

Radio/Audio/Communications Modules

LW-MW-SW-SW DC tuned and switched

91072- All switching of bands by a single pin to gnd. Varicap tuned, with LO output for synth. MW/LW version or MW/LW plus 1 or 2 SW bands MW/LW: £15.58 +1SW £16.73



VHF Tunerheads

Europes largest stock range for broadcast and communications. Probably also the world's – details in the catalogues and PL. Specials are also supplied in the region 30-220MHz.

Pilot Cancel PLL Stereo decoders

944378-2 £26.45

Again, Europe's widest range of stereo decoders including pilot cancel PLL types. The pic shows the 944378 - pilot cancel including post decoder 26/38kHz filtering and muting preamp output

Switched bandwidth FM IF strips

Broadcast FM IF strips for all occasions, including the new 911225 - with diode switched narrow filter option, ultra linear phase ceramic filters, 84dB S/N, and 0.04% THD (40kHz deviation). Plus usual things like AGC, AFC, dev. mute, level meter drive. £23.95 (supplied in screen can with 0.1 edge connection system) Also the 7230 hyperfi series - as the 911225, but with slope controlled AFC that operates in conjunction with signal level - and an extra IF amp stage for DXing.

Various digital frequency displays

The World's largest range of receiver DFMs is now joined by the DFM7 (shown) - and L shaped version of the DFM3 with remote display mount connector possibility. 1kHz SW resolution with 455kHz or 10.7MHz offsets, 100Hz res up to 3.9999MHz, and VHF to 299.99 MHz in 10kHz steps : £41.75

Semiconductors

Radio/Communications ICs

FOR COMPLETE LISTINGS – SEE OUR NEW PRICELIST

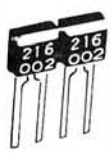
CA3089E	2.11	HA1197	1.61	SD6000	4.31
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38
HA11225	2.47	TBA651	2.53	MC1350P	1.38
HA12412	2.81	TDA1090	3.51	KB4412	2.24
KB4420	1.95	TDA1220	1.61	KB4413	2.24
TBA120S	1.15	TDA1083	2.24	KB4417	2.53
KB4406	0.80	TDA1062	2.24	MC3357P	3.16

SL1610	1.84	SL1626	2.80
SL1611	1.84	SL1630	1.86
SL1612	1.84	SL1640	2.17
SL1613	2.17	SL1641	2.17
SL1620	2.50	SL6600	4.31
SL1623	2.80	SL6640	3.16
SL1624	3.77	SL6690	3.68
SL1625	2.50	MC1496	1.44

VARICAP DIODES........

A section from our PL:

BA102	0.35	16:1 ratio AM tuning	
BB204	0.41	KV1215 9v triple	2.93
BB105	0.41	KV1211 9v dual	2.01
BB109	0.31	KV1225 25v triple	3.16
MVAM2	1.93	BB212 9v dual	2.25



POWER MOSFETS

100W PA's made simple

Since pioneering the 100W complementary MOSFET technique - Hitachi have developed a range of output devices and drivers that ought to revolutionise opinions and attitudes towards the design of all LF amplification systems. We have a new 48 page application note (£1.50 inc) and complete sets of parts, modules and now the new complete PA system (see above).

2SK133	120v N-ch 100W MOSFET £6.33	2SJ48 Pch complement	£6.33
2SK135	160v N-ch 100W MOSFET £7.29	2SJ50 Pch complement	£7.39
PA101B	Kit for 100W MOSFET PA less Heatsink £16.10. (£23 inc heatsink/bkt)		

ULTRA LOW NOISE PU PREAMPLIFIER

The HA12017 is the last word in PU preamps, and general low noise audio design. It is an SIL IC, with 86dB S/N in RIAA configuration, 10v RMS output capability, 0.002% typ THD at 10v RMS output (imagine the overload margin !!). It comfortably supercedes discrete circuit designs in terms of price/performance, and takes the art beyond the TDA1042's capabilities. (Replaces HA1457) £1.80 each - or an RIAA applications PCB with two ICs for £5.75. Complete with Rs&Cs £9.95.

Radio Control ICs

We have various RC ICs, including NE544 NE5044, and two new ones from OKI

KB4445 - 4 channel dig.prop. FM TX IC. 30mW out (amplifyable) -£2.30 inc
KB4446 - 4/5 ch. dig. prop FM RX IC. Suits KB4445 or RCME syst. £2.65.
KB4445/6 pair: £4.75. New 8 page data sheet 35p + SAE. More RC ICs in list

CMOS, LPSNTTL, TTL, MPU: Listings in the new pricelist.

Most CMOS is available in low volume - also LPSN. Standard linears and TTL OK.

Things like ICM7216B, ICL8038, 8080A, 6800P, 2708, NE555,NE556, etc

Coming Soon..........

Contain yourselves, RF fans ! Not yet ready for a full launch until autumn, but previewed here:-

SSB transceiver system : 10kHz to 1000MHz !!

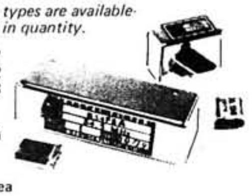
A modular VLF to UHF SSB TX/RX system at last. With the correct first mixer, the basic PCB covers 10kHz to 1000MHz - using LO fed from ext. source (Our 2 IC Mullard synth for instance) and RF PA for TX OP. 0.2uV basic sensitivity in HF, Typ cost for HF synth SSB RX will be less than £200. Add an RF PA for full TRX for another £50. See one in our foyer, and marvel.

Components

Crystal Filters

Most popular types are available ex-stock, and in quantity.

10.7MHz	25kHz Channel spacing 8pole	£16.67
	12½kHz ..	£17.82
	2.4kHz SSB	£19.78
	Monolithic dual roofing filter	£2.30
34.5MHz	1.3dB loss, 80dB stopband HF first filter in synth. RX	£36.80
RC XTALS	FM pairs (no spilts)	£3.74
	AM pairs ..	£3.57
USB/LSB	Xtals for 10.7SSB filter	£2.88 ea



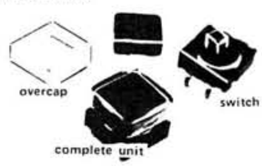
Piezo Sounders

The most efficient warning sounders yet

The latest thing in electro-acoustic efficiency. 1mA of drive from CMOS will give an SPL of 83dB - 10v RMS drive from CMOS uses 3mA for 100dB SPL at 4.8kHz (88dB at 1.65kHz)
The data sheets shows various drive circuits, and give full specifications with regard to broadband responses and power consumption etc. 1 off 44p inc. 100 off 28.75p (25p ex vat)

Keyboard switches and caps

From the world's most widely used switch manufacturers - ALPS - come the biggest and best range of keyswitches, and data entry keyboard switches. The SCM81101 is shown here, with the KT5 2-part cap (with clear top, to enable easy fitting of your chosen legend. Other types are available with built in LED, 90° mounting etc.
SCM81101 : 17p, KT5 : 16p - or 29p/pair



LCD CLOCKS

LCD DVM

Clocks use 1.5v at 15uA only DVM 9v/1mA

CM161: 7mm LCD 12/24hr, alarms etc £11.44 each
CM172: 13mm, 12hr, alarms,timer etc £14.32 each
CM174: 13mm, 12hr, min/sec stopwatch £14.32 ea
DVM 176: ICM7106 based LCD 3½digit £22.36 each

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If you still need convincing to invest £1.60 in the cats, be mean and get this first.

POWER MOSFET APPLICATIONS HANDBOOK by HITACHI :

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Everything you should know about HMOSFET devices theory and applications.

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You will not be too late

For most of the bargains listed in the newsletter reprinted below, even though it is our June/July issue, because the part of the newsletter with the items in short supply is not reprinted. However, you will receive the **whole** or our Aug/Sept newsletter if you send us an order this month and as an extra inducement we will send you our Oct/Nov newsletter directly it is printed, which is usually about two months before it can appear in this magazine.

FOUR NEW KITS THIS MONTH

One is an anti-mugging device which you can carry in your pocket or handbag. Secondly we have a morse practice outfit. Thirdly we have a surveillance transmitter which can be made in a matchbox and fourthly a radio mike. The last two are given for interest purposes as at present it is illegal to use this type of equipment but in view of the fact that legislation due to come into Parliament shortly may legalise these or similar transmitters, we are making the kits available. It is of course not illegal to own them.

MORSE TRAINER KIT

This kit consists of 5 items, morse tone module, morse key, battery connector, case and instructions. Price **£2·60 + 39p.**

MUG STOP

With mugging on the increase we think more and more of our customers will want their womenfolk to carry a deterrent, hence this kit. Very easy to make up, only 4 items. Alarm, push on push off switch, battery connector and case. **£2·00+ 30p.**

TRANSMITTER SURVEILLANCE

Tiny but easily hidden but which will enable conversations to be picked up with FM radio. Can be made in a matchbox—all electronic parts and circuit **£2·00 + 30p.**

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. All parts, mike and case **£6·00 + 90p.**

PHILIPS ELECTRONIC KITS

Despite the fact that these were very fine kits they have been discontinued by Philips Electric. We have purchased the unsold stock and these are available *now* at very reasonable prices. A double page is devoted to them but in all cases stocks are limited so prompt action on your part is essential.

WORKSHOP HINT

If you have to work on a mains operated device which has a metal case or chassis then do not connect the earth wire until you have found and repaired the fault. You will save yourself lots of fuses, shocks and damaged tools. Of course a final test should always be with earth connected and in fact with a neon tester to ensure that the earth is properly connected. Note: our *mains quick connector* is a real time saver, if you do repairs you will find that it will save its cost in no time at all and it's cheap at only **£1·95.**

THIS MONTH'S SNIP

is a *Bush* mains, battery, portable radio offered at a very low price but with full maker's guarantee. Bush Radio Model No. BW5776 is a medium sized radio covering the FM, Medium and Long Wavebands. A portable so of course it is battery operated (four SP11) but with the ever increasing cost of batteries the makers wisely built a power pack into the radio. You will use it from the mains whenever possible thus saving the batteries for when you go camping or picnicking etc. Price **£13·25 + £1·99** post £1·00.

VERSATILE PLIERS

Insulated handles. Long nose, serrated jaws. With side cutter **£1·50 + 22p.**

ALWAYS USEFUL CUTTERS

Insulated handles. Ideal for electronics. Approx. 5½" **£1·60 + 25p.**

NEON SCREWDRIVERS

Large, **60p + 8p,** medium sized **50p + 7p.**

MAINS TRANSFORMERS MORE TYPES THIS MONTH

500 WATT TYPE

18v-0-18v at 15 amp or 36v at 15 amp or 18v at 30v. This big transformer has a double wound primary so can be used as 500 watt auto as well. There is also a second secondary 24v tapped at 6v but of course any load you put on this should not be allowed to take the total beyond 500 watt. Upright mounting with fixing lugs, ex-equipment but fully guaranteed **£10 + £1·50** each postage £2·00. Note: our stock is approx. 200. *6V-0-6V* @ 100 mA. This will be a regular stock line, miniature with feet and flying leads. **£1·00 + 15p.**

12V 1 AMP

Primary and secondary are on separate bobbins with feet and tag connections. **£1·80 + 28p.**

POWER MOTORS

Most of our motors come from or were intended for computers, many have had little or no use, most are American makes and all are excellent quality and test before despatch. Most are capacitor run and reversible, prices depend on the actual motor but price for standard models ¼ h.p. **£7·50,** ⅓ h.p. **£12·50,** ¾ h.p. **£17·50** plus 15% VAT and 25% carriage.

SERVICEMAN'S SNIP—10 POTS IN ONE ONLY 20p

Four gang pots 4 × 50k log; miniature types with ¼ spindle. By combining the sections in series or parallel at least 10 types and values can be substituted i.e. singles:— 0-12k, 0-18k, 0-25k, 0-50k, 0-100k, 0-150k and 0-200k. Stereos 0-50k & 0-100k. It will definitely be worth you having a few of these in stock. Price 10 for **£2·00 + 30p.**

THIS MONTH'S ELECTRICIAN'S SNIP

is still the M.E.M. parcel but what a bargain this is you will soon realise at current prices its value is over £60. You get for only **£28 + £4·20p** white accessories:— 10 double 13 amp sockets and 5 single 13 Sw sockets with neons, 15 power (20 amp dpt switches and spurs some with neons) 10 single—one way, two way and intermediate switches and super free gift (worth £3). If not collecting please add £2·00.

FLUORESCENT LANTERN

Hand held or free standing for car, boat, caravan or home use, gives excellent non-directional light, operates from its internal batteries or through its cable from car cigar socket. Price **£5·60 + 84p** post £1

FLUORESCENT LIGHT

12v inverter with tube holders attached and lead for batteries which can be HP2s or a car battery complete with 12" fluorescent tube **£4·60 + 69p** post 60p. Plastic holder for 8 HP2s **60p + 9p.**

EXTRACTOR FANS

Mains operated ex-computer. 5" Woods extractor **£5 + 75p** post 70p. 6" Woods extractor **£6 + 90p** post 80p. 6" Plannair extractor **£6·50 + 97p** post 90p. 4" × 4" Muffin 115v **£4·00 + 60p.** 230v **£5·00 + 75p.**

BLOWERS

Mains operated, mostly new, we still have large stocks prices from **£3·00.** Note the Torrin Price **£4·50 + 67p** + £1·00 postage, makes a good desk fan (beat the heat-wave).

TOGGLE SWITCHES

250v 2 amp chrome *toggle*—S.P.S.T. **30p** + 5p dpdt **45p + 7p.**

SUB MIN TOGGLES

250v 2 amp S.P.S.T. **40p + 6p** dpdt **60p + 9p.**

PHILIPS ELECTRONIC KITS

All kits have a properly prepared printed circuit board and this with all the other parts is nicely packaged in printed presentation boxes and are complete with ample data.

1000Hz GENERATOR

Gives a pure sine shaped signal and is ideal for Morse Code trainer, balance control in stereo chain, 'whistling' of amplifiers, modulation of signal-generator signals, audible zero-point indication, in bridging-circuits, summoning signals, etc. The size of the load does not affect the operation of the generator. The output is provided with an 'emitter follower'. Complete factory packed kit **£2·00 + 30p.** Ref. R6830.

R & C MEASURING BRIDGE

Has built-in standard resistors and capacitors and is capable of measuring resistances valued 10 Ohms to 10M Ohms and capacitances from 10pF to 10uF in a simple but accurate manner. It is also suitable for the comparison of inductances. Complete factory packed kit **£3·00 + 45p.** Ref. R6516.

ELECTRONIC TRANSISTOR AND DIODE TESTER

All types of transistors can be tested dynamically under operating conditions in an earthed emitter circuit at a collector DC current of 1mA and the small signal gain is determined. The method compares two signals originating from the same oscillator and consequently the measurement is independent of oscillator frequency or voltage and the supply voltage and ambient temperature over the temperature range −5° to +70° C. Diodes can be checked for good or faulty operation. Complete factory packed kit **£3·00 + 45p.** Ref. R6831.

ELECTRONIC SWITCH

Is very versatile and suitable for switching, with changing temperatures, light, darkness, humidty, dryness, etc. A signal lamp, an electric buzzer and an electric motor, for example, can be connected directly with the switch. Extension with a holding circuit is possible in a very simple way. A simple time switch also requires only an extra capacitor and push-button. Complete factory packed kit **£2·50 + 37p.** Ref. H6715.

ELECTRONIC BUZZER

Generates an alternating voltage which is converted into sound by a loudspeaker. The alternating voltage consists of several frequencies, from which a penetrating tone is produced. The buzzer can be used in the same manner, for example, as an electric doorbell and thus be operated by means of a push-button switch. There are many possibilities if the buzzer is combined with an electronic switch type H6715. Switch ON and OFF will be possible by means of temperature, light, darkness, moisture, drought etc. It is also possible to use the electronic switch as a time-switch, so that the buzzer will continue to operate for some time. The buzzer can also be switched directly with light, darkness or temperature. The switching point is not adjustable, but in many applications this will not matter. Complete factory boxed kit **£2·00 + 30p.** Ref. H6714.

STEREO CARTRIDGE PRE-AMPLIFIER

Is designed to use a modern stereo cartridge with an ordinary amplifier. Magneto-dynamic, electro-dynamic or Hi-Fi ceramic are all suitable cartridges. The response from the record will be corrected according to RIAA standards. As the distortion is very low, this pre-amplifier is ideal for Hi-Fi equipment. Complete factory packed kit **£3·00 + 45p.** Ref. NL3403.

2 × 40 WATT HI-FI STEREO POWER AMPLIFIER

Will supply high power over a broad frequency range at very low distortion. The output stages are safeguarded in such a way that the use of a too low load impedance and short-circuits in the loudspeaker leads cannot cause the amplifier to break down. The four output transistors are mounted on two heat sinks. Complete factory packed kit **£10·00 + £1·50p.** Ref. NL6920.

60 WATT HI-FI POWER AMPLIFIER

This amplifier is specially designed to perform at high power over a broad frequency range with low distortion. A modern component line-up is incorporated in the circuit configuration, including Darlington transistors. A double protection circuit is built-in using five transistors, to guard against accidental over-loading or short-circuiting of the amplifier. With the exception of the two power transistors and an NTC resistor, all the components are mounted on the printed circuit board. The heat sinks should be positioned as close as possible to the p.c.b. For stereo applications two units are, of course, necessary. Complete factory packed kit **£8·00 + £1·20p.** Ref. NL3606.

STABILISED POWER SUPPLY UNIT

For the 2 × 40 watt stereo-amplifier NL6920 supplies a current of 1A continuous (peak 2·2A) at an output voltage of 60V. The output is protected against short-circuits. Bewteen the primary and secondary windings of the transformer, a screening (extra winding) has been applied which can also serve for the supply of an indicator lamp. Factory packed kit **£10·00 + £1·50p.** Ref. NL6924 (This will only be supplied if the amp is ordered)

UNIVERSAL TRANSISTORISED PRE-AMPLIFIER

Can be used for many purposes, because the amplification and the input impedance can be adjusted within wide limits and you can select between amplification with RIAA correction (for pick-up elements) and 'straight' amplification (for microphones and other signal sources). Two different supply voltages can be used (9V and 18V) and the output impedance is low. A few examples of applications are: a) pre-amplifier for microphone and/or Hi-Fi pick-up elements for use with power amplifiers which are not designed for that purpose. b) complete Hi-Fi preamplifier in combination with tone control unit R6903 and noise and rumble filter NL6913. c) mixer-preamplifier, with tone-control unit R6903 and noise and rumble filter NL6913. d) baby-phone or intercom installation (with loudspeaker functioning as a microphone). Complete factory packed kit **£2·50 + 37p.** Ref. R6905.

PLEASE NOTE: The "+" sign after the amount shows the amount V.A.T. The postage, if quoted, is based upon the amount the article costs to send if it forms part of a larger parcel. Should your order be less than £10·00 however, please send an additional 50p. BARCLAYCARD & ACCESS WELCOMED. Phone 01-688 1833.

J. BULL (ELECTRICAL) LTD

34-36 AMERICA LANE,
NEW ENGLAND ROAD,
HAYWARDS HEATH,
SUSSEX.

PHILIPS ELECTRONIC KITS

2 WATT I.C. AMPLIFIER KIT

A small amplifier, with a proportionally large power output, is suitable for many purposes. As an A.F. amplifier in a radio combined with a tuner unit for example, or as an amplifier for a record-player with a crystal ceramic pick-up head. All semi-conductors (transistors and diodes) and many resistors have been incorporated into one single integrated circuit (IC) TCA100C. The other components on the printed circuit board are mainly for the alignment of the I.C. and alignment of the pick-up element, the tuner and the loudspeaker. Complete factory boxed kit **£3·00 + 45p.**

1WATT IC AMPLIFIER KIT

Similar to NL3402 but smaller output. Complete factory boxed kit **£2·00 + 30p.** Ref. NL6833.

NOISE AND RUMBLE FILTER

This Filter Circuit contains two transistors which are used in such a way that the input impedance is high, the output impedance low and the input voltage is equal to the output voltage (amplification 1x). This applies in the 'flat' position for the whole frequency range. In this position there is no amplification or attenuation. If, however, the 'noise' and/or 'rumble' position be selected, the amplification between the adjusted 'noise' and 'rumble' points is still 1x, but the attenuation after the cross-over point(s) will be 12dB per octave. Because of the sharp cut off, the medium range is not affected, making it possible to reproduce well, for example, old gramophone records with a poor high and/or low registration. If the filter R6913 is combined with tone-control unit R6903, it is possible to obtain a gradual amplification or attenuation from 1,000Hx onwards both for 'high' and for 'low' independent of the adjustment of the filter. With this combination it is possible to adjust the most divergent frequency characteristics. Complete factory boxed kit **£3·00 + 45p.** Ref. R6913.

TRANSISTORISED TONE CONTROL

Permits adjustment with very wide frequency limits. Complete factory boxed kit **£2·50 + 37p.** Ref. 6903.

ELECTRONICALLY CONTROLLED STEREO PRESENCE UNIT

Attenuates or increases the tonal range to which the human ear is most sensitive (optimum speech range). This is achieved by one potentiometer applying a d.c. voltage on one point of an integrated circuit (i.c.) TCA740 both channels being controlled at the same time. The connections between the printed circuit board (p.c.b.) and the potentiometer can be fairly long as only d.c. voltage is used. This gives the constructor freedom in cabinet design of this unit or the complete set by being able to position the potentiometer freely. Complete factory packed kit **£3·50 + 52p.** Ref. NL3415.

STEREO PRE-AMPLIFIER KIT WITH ELECTRONICALLY CONTROLLED VOLUME AND BALANCE

This unit can be fed from a tuner, or a record player, with a crystal or 'ordinary' ceramic cartridge having an output level of approximately 100mV. Volume and balance are d.c. voltage controlled these voltages being connected to an i.c. TCA 730 and then adjusted by single slider potentiometers supplied with the kit. The amplification factor is a maximum of six times the input. The volume control circuit contains a physiology control which can be switched on or off by a push-button linking the i.c. to earth via a resistor. Considerable flexibility in assembly of the unit into a stereo system is achieved because only a c.d. voltage is used for control, thus enabling leads between the p.c.b. and controls to be as long as required. This allows the potentiometers and switches to be placed in the most convenient positions, enabling the system combined with the pick-up amplifier kit NL3403 the tone control kit NL3406 and the stereo presence unit NL3415, all units being electronically controlled. Complete factory packed kit **£3·00 + 45p.** Ref. NL3405.

ELECTRONICALLY CONTROLLED STEREO TONE CONTROL UNIT

In this stereo tone control unit the low and high tones are controlled by a d.c. voltage. the d.c. voltage is connected to an integrated circuit TCA 740 to vary the d.c. voltage, slide potentiometers are supplied which are effective on both channels simultaneously. This unit can be combined with the NL3405 preamplifier where volume and balance are controlled electronically and with the NL3415 stereo presence control. Complete factory packed kit **£2·50 + 37p.** Ref. NL3406.

PUSH SWITCH

250v 2 amp push to make, release to break, standard size **40p + 6p** miniature **25p + 4p.** Push to make push to break **30p + 4p.**

TV TURRET TUNER

A two transistor (BF180 & 181) continuous, capacitively tuned U.H.F. tuner, designed to receive television signals. It is operated by four push pubttons which are fully adjustable. Millions of these were used mainly in black and white but also in colour. It was very extensively used by set makers and it would probably still be used to-day were it not for the fact that the Varicap tuner is so much easier and cheaper to make. Philips referenced the tuner U5, GEC gave it several numbers, M95928 M (5932 etc. BR called it AT6382/15. We have acquired a large quantity of these and offer them at only a fraction of their original cost. **£1·50 + 22p** + 50p postage less quantity discounts.

TV SOUND ONLY RECEIVER

We believe there is a demand for this and think the UHF tuner could be used for this. If any reader has already done work on this please let us know we will pay £100 for a good design. The same applies to any other device which could be made using the TV Turret tuner described above.

PRECISION MAINS OPERATED CLOCK

For only **£1·50 + 22p.** Sounds unbelievable but that's what you can have if you send your order right away. The clocks which have large clear dials were made by the famous Smiths Company for use with their domestic cooker switch and are brand new and guaranteed and this batch have the 25 amp switches as well.

LOW VOLTAGE THERMOSTAT

With remote sensor joined to approx. 36" of capillary. Dial calibrated 10—0+20 degrees c, change over contacts so it can be used to switch on or off **£3·00 + 45p.**

CAMBRIDGE INSTRUMENTS

This Company as many of you will know is famous for large dial remote operating temperature indicators. We have just received a small batch of these, assorted types covering temps such as 0-200c, 100°-500°f etc., some have 6" dials others have 3" dials. Most have a thermostatic switch incorporated. If you are looking for something like this please let us know. The price will be reasonable.

LOW VOLTAGE REED RELAY

Normal 40 watt glass reed switch encased in metal tube which also holds the solenoid. 1½ volt or 100mA will operate it. Ex G.P.O. equipment but unused **75p + 12p.**

34 OHM 8·5A POWER RESISTOR

Slider type variable, made by Burco for machine control but also suitable for lamp dimming etc. ex-equipment but in very good order **£4·00 + 60p** post £2·00.

Britain's first complete computer kit.

The Sinclair ZX80.

£79.95

Price breakdown
ZX80 and manual: £69.52
VAT: £10.43
Post and packing FREE

Please note: many kit makers quote VAT-exclusive prices.

You've seen the reviews...you've heard the excitement...now make the kit!

This is the ZX80. 'Personal Computer World' gave it 5 stars for 'excellent value.' Benchmark tests say it's faster than all previous personal computers. And the response from kit enthusiasts has been tremendous.

To help you appreciate its value, the price is shown above with and without VAT. This is so you can compare the ZX80 with competitive kits that don't appear with inclusive prices.

'Excellent value' indeed!

For just £79.95 (*including* VAT and p&p) you get everything you need to build a personal computer at home...PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or colour); *everything!*

Yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The ZX80 is programmed in BASIC, and you can use it to do quite literally anything from playing chess to managing a business.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done: connect it to your TV...link it to an appropriate power source*...and you're ready to go.

Your ZX80 kit contains...
- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs–all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to a portable cassette recorder.)
- FREE course in BASIC programming and user manual.

Optional extras
- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately–see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available–see coupon).

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

The unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:
- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability–takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input–to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions. USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

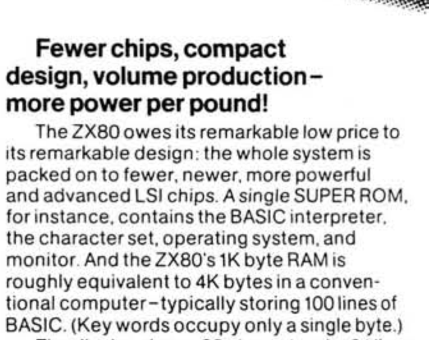
Fewer chips, compact design, volume production–more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer–typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.



plete

ZX80 software – now available!

See advertisements in Personal Computer World, Electronics Today International, and other journals.

New dedicated software – developed independently of Science of Cambridge – reflects the enormous interest in the ZX80. More software available soon – from leading consultancies and software houses.

The Sinclair teach-yourself BASIC manual.

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.) A hardware manual is also included with every kit.

The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

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Demand for the ZX80 is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

sinclair ZX80

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	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	£79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	£99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes).	12.00	
	RAM Memory chips – standard 1K bytes capacity	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		TOTAL	£

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EDITOR
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ASSISTANT EDITOR
Dick Ganderton
C.Eng., MIERE, G8VFH

ART EDITOR
Peter Metalli

NEWS & PRODUCTION EDITOR
Alan Martin

TECHNICAL ARTIST
Rob Mackie

ASSISTANT ART EDITOR
Keith Woodruff

SECRETARIAL
Sylvia Barrett
Sharron Breeze

EDITORIAL OFFICES
Westover House,
West Quay Road,
POOLE, Dorset BH15 1JG
Telephone: Poole 71191

ADVERTISEMENT MANAGER
Telephone: 01-261 6636
Dennis Brough

SECRETARY
Telephone: 01-261 6636
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Making Haste Slowly

As I write this leader, we are awaiting expectantly the publication of the Government discussion paper on the introduction in the UK of a Citizens' Band, or Open Channel as they plan to call it. Anyone who has carefully analysed the statement made on the subject in Parliament in May, will have realised that, apart from the announcement of the name and the discussion paper "to appear within a few weeks", this statement was merely a cunningly re-worded version of that given last November. I wonder just how long we are going to have to wait for some more positive action.

I get the impression, from snippets heard and read in various places, that the authorities are having much greater success than is realised, against the illegal users of 27MHz CB sets in the UK. Even so, it seems impossible that such use can be contained, when national economic pressures prevent the Home Office from deploying more effort towards tracking down the pirates. Every day that a decision on the format of the service to be introduced is delayed, makes it more certain that we shall eventually finish up with two services, one legal and one illegal, running in parallel.

A favourite suggestion for a suitable frequency for CB in the UK is some part of the present v.h.f. TV Bands I and III. It was announced in May that the close-down of the existing 405-line stations would begin in the Autumn of 1982, and be completed within "about four years". Unless it is arranged that one TV channel is completely vacated in one of the early batches (and this is not the case in the list for 1982), we would have to wait until 1987 at least for CB in these bands. And that's too long.

To those radio enthusiasts, licensed amateurs among them, who are against CB or are just not interested, and who wish that we, and everyone else would stop talking about it, I would point out that we are all having to live with the effects of illegal operation now. Certainly any amateur who operates mobile should know that he is liable to be stopped and questioned very closely about any "unusual" aerials and radio equipment fitted to his car. Policemen who may stop you initially under the "Prevention of Terrorism Act" cannot be expected to recognise the difference between illegal CB gear and legal PMR, radiotelephone or amateur sets, and could well delay your journey while they check it out. The present Amateur Licence does not have a very official air about it, being entirely a duplicated document, apart from the holder's name, callsign and address and dates of first issue and renewal on page 1. The Home Office have plans to introduce a new Amateur Licence format when all their records are computerised in a few years' time, and in the meantime, the RSGB (with the approval of the authorities) has instituted its identity card system for members, in an effort to produce a document more secure and more easily recognised by Police and other officials. It should be remembered, however, that no matter how recognisable and authoritative the licence document, it is no proof that you do not have illegal CB equipment in your car, and we understand that two licensed amateurs have recently been prosecuted for doing just that.

One thing that puzzles me is what is behind the decision to adopt the name Open Channel in the UK, instead of Citizens' Band, as used in just about every other English-speaking country, regardless of the official title there—Open Channel doesn't have the sound of an official title. Is it because the authorities want to set it apart by name from other systems? Is there anything sinister in the use of the word "Channel" instead of "Band"—they're surely not thinking of confining it to one channel? Perhaps the problem of confusion of abbreviations has something to do with it. Some-one connecting his new mobile transceiver to the electrical terminal marked "CB" in his car should get some interesting results! But Open Channel as "OC" could be even more confusing, as it means not only "open circuit", but also "ondes cortes" (short waves) in Spanish, which used to be, and maybe still is, marked on quite a few radio set dials.

*   *   *   *   *

I wonder if one of our readers, somewhere, has a complete list of the phonetic spelling table used for telephone communications during the 1914-18 war. In researching an article on the subject, I have been unable to find a list earlier than 1924, by which time there had been several changes, for example, "Toc" had become "Tommy". Any assistance will be gratefully acknowledged.

Geoff Arnold

NEWS... NEWS... NEWS...

RAE Courses

Classes to prepare students for the City and Guilds Radio Amateurs Examination, Course No. 765-02 are offered at the following locations:

Mid-Warwickshire College of Further Education, Department of Engineering, Warwick New Road, Leamington Spa CV32 5JE. Tel: (0926) 311711. Enrolment; 4 and 5 September, between 09.00 and 12.00hrs, 14.00 and 16.00hrs, and 18.30 and 20.00hrs. Commencing Thursday, 18 September, for approximately 30 weeks.

Bracknell College, Church Road, Bracknell RG12 1DJ. Tel: (0344) 20411. Enrolment; 11, 12 and 15 September. Commencing 29 September.

Bournville Institute, Selly Park Centre, Pershore Road, Selly Park, Birmingham B29 7PL. To be held on Thursday evenings between 19.15 and 21.00hrs. Enrolment as for other Adult Education Centres in Birmingham and will also be announced in the local press.

North Wirral College of Technology, Borough Road, Birkenhead. Enrolment; between 8 and 10 September. Commencing during the week beginning 15 September. Senior Lecturer; D. E. Owen G4GGB.

College of Technology, College Square East, Belfast BT1 6DJ. Tel: 27244. Enrolment; early September. Commencing Tuesday, 16 September, between 17.30 and 20.30hrs. A further class for Morse code instruction and practice for those intending to obtain a class A licence will be held on Thursdays between 18.00 and 20.00hrs. Lecturer; J. E. Wilson.

Brooklands Technical College, Heath Road, Weybridge KT13 8TT. Tel: (0932) 53300. Enrolment; 8, 9 and 10 September between 18.00 and 20.00hrs. Classes will be held on Wednesdays between 18.30 and 20.30hrs. Lecturer; Chris Roberts G4EVA.

Melton Mowbray College of Further Education, Ashfordby Road, Melton Mowbray, Leics. Enrolment early September. Details from the college or the Course Tutor G3WKM, Tel: Melton Mowbray (0664) 68810.

Newport Amateur Radio Society, Brynglas House, Brynglas Hill, Newport. Commencing: Monday, 8 September at 1850hrs. Lecturers: GW4YTJ, GW4HYZ, GW3NWS and T. J. Wynn.

Duston Upper School, Duston, Northampton. Enrolment: 3, 4 and 8, 9 September. Commencing: Tuesday, 23 September between 1900 and 2100hrs. Lecturer: D. F. Watton G4AYZ. Fee for 30 lectures £15. Further information: Tel: Northampton (0604) 33834.

Pendlebury High School, Cromwell Road, Swinton, Manchester. Registration prior to first class. Commencing late September on Thursdays at 1930hrs. Details from course instructor: P. Whatmough G4HYE. Tel: 061 794 3706.

Gosforth Adult Association, Gosforth Secondary School, Gosforth, Newcastle upon Tyne. Commencing: September on Tuesdays between 1900 and 2100hrs. Lecturer: D. R. Loveday G3FPE. Further details from: The Principal, Gosforth Adult Association. Tel: (0632) 668439.

The Great Barr Institute, Church Lane, Birmingham B20 2HH. Two courses are available, the first, a revision class for candidates required to re-take Part 2 only will be held on Wednesday evenings from September until December. The second course for beginners will be held on Tuesday evenings. Further details are available from the course lecturer: F. G. Fear G8CVR. Tel: Aldridge (0922) 52706.

RAE Reprint

A reprint of the complete *PW* series—So You Want to Pass the RAE?—including details of the new examination format introduced in 1979, is now available.

Please note that the prices for the RSGB publications mentioned in the reprint have recently been changed. You should check with the RSGB for the latest information.

Order your copy by completing and returning the coupon on page 69.

RCI Meets the Listener

Ian McFarland, host of Radio Canada International's weekly programme for short-wave listeners "DX Digest" recently visited Britain to meet some of the UK audience. A total of three meetings were held in London, Newark and Durham, and well over one hundred listeners travelled to the venues to find out more about Radio Canada and short-wave broadcasting in general. Each meeting took the form of a slide presentation of some of the studios and transmitters used by the station, a film covering various aspects of life in Canada, a general discussion on various aspects of programmes and the technical side of SW Broadcasting. A competition was also held with Canadian records given as attractive prizes.

Ian McFarland RCI hands a collection of LP's to competition prize winner Michael Burden at one of the RCI Listener meetings.

Radio Canada International has also been holding phone-ins recently where UK listeners can phone a number in Britain to report on reception and leave a music request. This has proved popular and it has been interesting to note how reception varies on the different frequencies used in different parts of the United Kingdom.

The success of the recent meetings means that a further series are being considered for next year and advance details will appear in *Practical Wireless.* Programme schedules are available from the station by writing to *Radio Canada International, PO Box 6000, Montreal, Quebec, Canada H3C 3A8.*

RCI broadcasts to Europe in English with the following schedule: 1900hrs GMT: 7130, 9555, 15 325 and 17 875kHz; 2000hrs GMT: 7295, 9555, 15 325, 17 820 and 17 875kHz. Note: The above frequencies are valid until 7 September. After this date: 1900hrs GMT: 5995, 7130, 15 325, 17 875 and 21 695kHz; 2000hrs GMT: 5995, 15 325, 17 820, 17 875 and 21 695kHz. The DX programme "DX Digest" is heard in each Sunday broadcast.

On the Move

Studio 99 Video, the video recording and c.c.t.v. specialists, announce the opening of their new Headquarters at Cricklewood Broadway.

An entire floor of 8000 sq ft will now house this fast expanding company. After twenty-one years of development in Fairfax Road, Swiss Cottage, the company is now able to offer greatly increased levels of professional service in systems design and engineering. Hardware and tape stocks have been substantially improved to meet escalating demand by clients at home and overseas.

Callers will be welcome at the Cricklewood Showrooms and offices at: *249 Cricklewood Broadway, Edgware Road, London NW2 6NX. Tel: 01-450 1313.*

Video disc Information

Thorn EMI Ltd,confirms the announcement made on 5 June, in New York, in which it was stated that discussions are being held by Thorn EMI, Matsushita Electrical Industrial Co. Ltd. (MEI) of Japan, Victor Company of Japan (JVC) and General Electric Company (GE) of USA to form three jointly-owned companies to support the introduction of the Video High Density (VHD) video disc system in the US market by the end of 1981.

The proposed joint ventures will consist of a hardware manufacturing company, a software management company, and a software manufacturing company.

Thorn EMI, MEI, JVC and GE believe that other hardware manufacturers and software companies will adopt the VHD system and that it will be accepted in the market as the best consumer choice.

Thorn EMI Ltd., Thorn House, Upper Saint Martin's Lane, London WC2H 9ED.

Rallies and Events

The Peterborough Radio and Electronics Society will be holding its annual rally on Sunday, 21 September at Walton School, Mountsteven Avenue, Peterborough. All the usual attractions including talk-in on S22, SU8 and via GB3PB on RB10. Further details from: *G8OUU, QTHR. Tel: Stamford, Lincs. (0780) 740456.*

Telford Amateur Radio Rally Group hold their rally at Telford New Town Centre Malls, Telford, Shropshire on Sunday, 7 September, commencing 1100hrs. There will be full catering and licensed premises plus talk-in via GB3TRG on S22, SU8 and a free coach service to the famous Iron Gorge Open Air Museum nearby. Further details from: *G8DIR (Tel: Shrewsbury 64273), G8UGL (Tel: Telford 584173) or G3UKV (Tel: Telford 55416). All QTHR.*

Pembroke and District Amateur Radio Club has decided, after an absence of four years, to reinstate their "Bucket and Spade Party." The event will be held on Sunday, 14 September at The Regency Hall, Saundersfoot, commencing 1100hrs. There will be talk-in on S22, R7 and RB4 plus refreshments and licensed bar. Further details from: *GW3XJQ. Tel: Carew (06467) 610.*

The Girl Technician Engineer of the Year

The search is now on to find the Girl Technician Engineer of the Year 1980. Nominations for this electrical and electronic engineering Award, and the accompanying £250 prize, are required by the closing date of 1 October 1980; and the winner will be announced at a ceremony in London during November.

Sponsored by the Caroline Haslett Memorial Trust and the Institution of Electrical and Electronics Technician Engineers, the Girl Technician Engineer of the Year has already established itself as a worthwhile and successful competition and is increasingly well recognised by the electrical and electronics industries.

The aim of the Award—in the realisation that the engineering industry needs to attract more young people of the highest calibre—is to focus attention on electrical and electronic engineering as a worthwhile professional career for women. By selecting the most outstanding Girl Technician Engineer—who will have successfully undertaken the necessary education and training, and have proved herself capable of holding a responsible job—it is the Award sponsors' express hope that she will, by her example encourage more girls to enter the electrical and electronic engineering profession. Naturally it is also to be hoped that it will enhance the winner's own career prospects.

For further details, and copies of the 1980 Award nomination form, please apply to: *Mrs Eileen Sheldon, IEETE, 2 Savoy Hill, London WC2R 0BS. Tel: 01-836 3357.*

23rd Queen's Award

A GEC-Marconi Electronics company has won the group's twenty-third Queen's Award.

This year's winner, Marconi Radar, has very nearly trebled its export sales over the past three years, increasing by 68% during the last year alone. Overseas business now represents some 48% of that company's total sales.

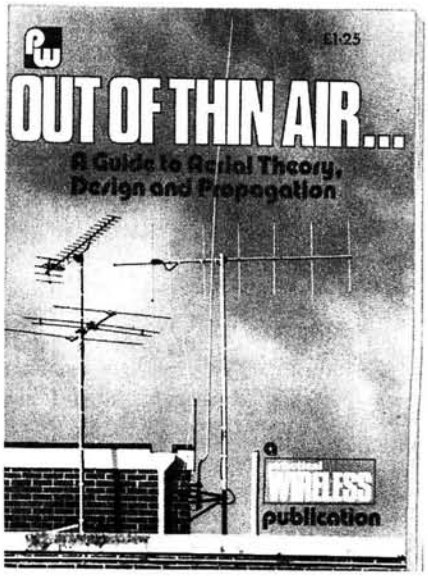
With the exception of 1974, the group has won at least one Queen's Award every year since the scheme's inception in 1966.

Out of Thin Air

In response to the enormous interest shown in articles on aerials and associated subjects, the staff of *Practical Wireless* have compiled an 80-page book entitled "Out of Thin Air—A Guide to Aerial Theory, Design and Propagation".

The book consists of articles extracted from *PW*, new material and a directory of aerial suppliers.

"Out of Thin Air" is available from leading newsagents, priced £1.25 or by post. See page 69 for details.



PW 'TAMAR' Part 2

28 MHz TRANSVERTER DRIVER

R.S.HEWES FSERT G3TDR

Readers who intend to operate the *PW* Tamar should be in possession of the appropriate licence issued by the Home Office to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Home Office, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

In this issue the circuit description is continued, dealing with the transmitter section first, and finishing with the mechanical features.

Microphone Amplifier

The integrated circuit IC4, a TDA1054, is primarily designed for use as a record/playback amplifier in cassette recorders, with d.r.c. (dynamic range compression) for high average level recording. The i.c. has four sections; a low-noise preamplifier, an operational amplifier with a high open loop gain of approximately 60dB, a linear d.r.c. (a.l.c.) generator and a supply ripple rejection circuit. The d.r.c. facility is used in this transceiver to produce a high average level of s.s.b. talk power.

With S2 set to "Mic", the input is routed to pin 11 of IC4c via SK4, R57, C63, and C64. Ferrite bead FB2 and capacitor C65 provide filtering of any r.f. signals present on the microphone cable. Capacitor C69 initiates the h.f. roll-off at 1·5kHz. Amplified signals at pin 13, across R65, are routed via R63 and C70 to the input of the d.r.c. circuit, pin 15, this circuit forming a feedback loop via S2b back to the input of the operational amplifier. The feedback transforms the output signal level information by means of the d.r.c. circuit peak-to-peak detector into a continuous voltage. Two perfectly matched internal transistors are driven by the detector.

A dynamic resistance is formed by these transistors which varies the d.c. voltage level at pin 16 and is seen at pin 1. This d.c. level is inversely proportional to the op. amp. output signal and symmetrical compression is obtained with minimal introduction of even order harmonic distortion. The system therefore allows wide control range, adjustable recovery times and a good signal-to-noise ratio to be obtained under varying operating conditions, therefore dispensing with the need for a manual microphone gain control.

Under controlled conditions the d.r.c. circuit produces a constant 1V r.m.s. across R65. Typically, the d.r.c. range is 46dB change in input for a 0dB change in output, thus it is not possible to overdrive the balanced modulator. The recovery time is 5 seconds and the s.v.r.f. section (IC4b) offers a high level of rejection to supply interference with associated components R56, C61 and C62.

Balanced Modulator

A potential divider formed by R64 and R69 sets the audio level from the microphone amplifier to 300mV maximum at pin 4 of IC5 (an MC1496), via C72. The carrier signal (approximately 60mV r.m.s.), from the c.i.o. running at 8998·5kHz is injected on pin 10 via C73. The resultant output at pins 6 and 12 is a d.s.b. signal with even order harmonic rejection due to the use of a centre tap on T5 primary, carrier rejection of approximately 50dB being optimised by adjustment of VR5. The signal is then routed to CF1 via T6 secondary, C81 and switching diode D9, a 1N4148, CF1 suppressing the lower sideband.

Operation On CW

The low-noise preamplifier in this circuit (IC4a) functions as an audio phase shift oscillator producing a tone of approximately 1kHz. With S2 switched to "CW" this tone is routed to IC4c via RLD1, the reed relay, S2b disconnecting IC4d from the input to IC4c preventing d.r.c. on the output. When the key is depressed, the reed relay is actuated, the tone then modulates IC5, the level being preset by VR12 to about 300mV r.m.s. thus producing A2 output from IC5. The 1kHz tone is also routed via R53 and VR4 to IC3, preset by VR4 to a suitable level to give sidetone for monitoring the keyed output.

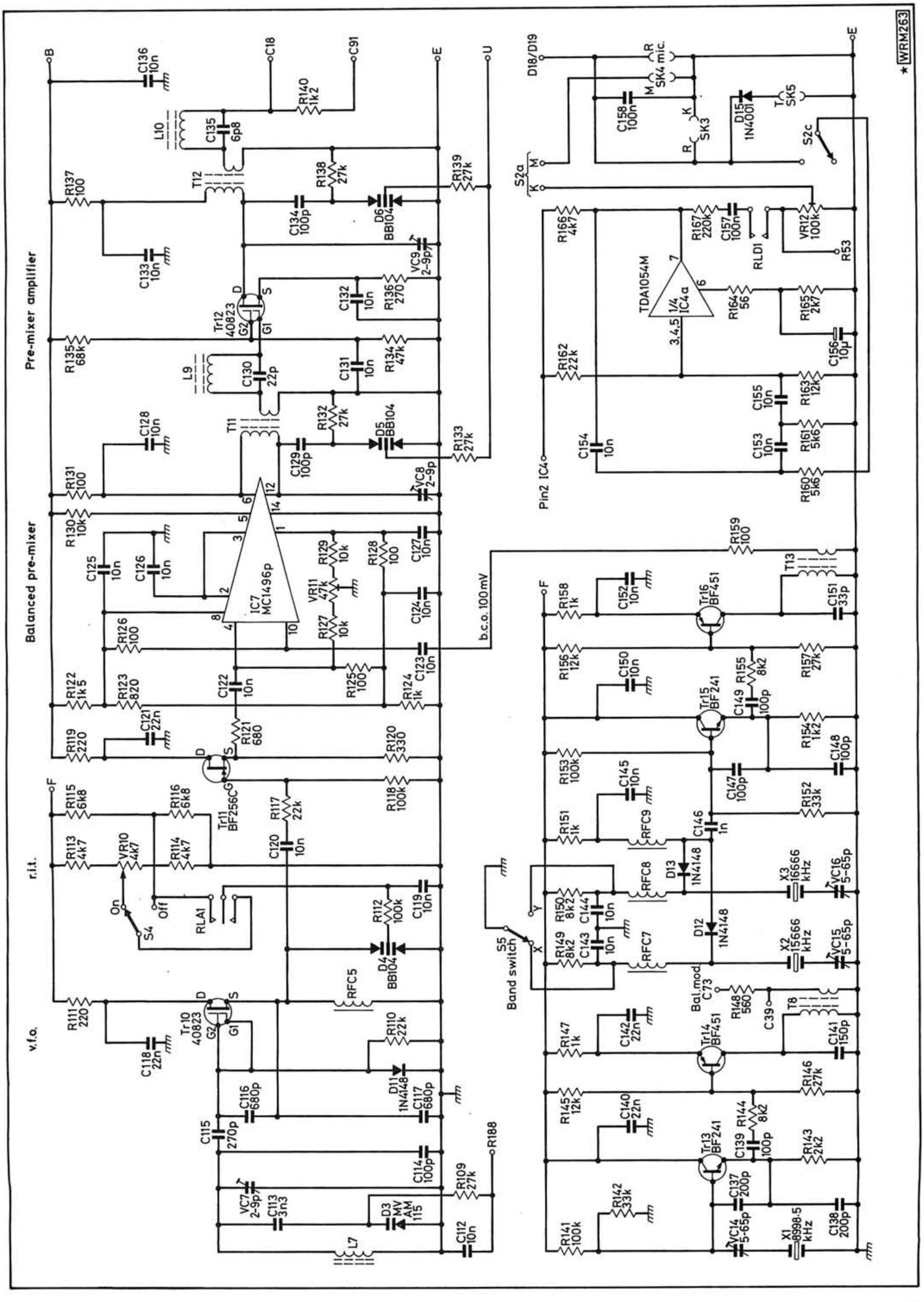
Semi "break-in" is provided for c.w. operation as follows. Switch S2d connects R189 and C171 in parallel with RLA, B and C. When the key is released, the one second time constant provided by R189 and C171 holds these relays in the transmit position for this period of time. After one second has elapsed the relays return the transceiver to receive and "break-in" and keying speeds down to six w.p.m. will hold the transceiver in the transmit condition. Diode D18 prevents "hold-in" on RLD allowing this relay to operate in synchronism with operation of the key.

The IF Amplifier

The u.s.b. output from CF1 is routed via C85 to the gate of Tr7, a BF256C, which is the transmitter i.f. amplifier. Amplified signals at the drain of Tr7 appear across T7 primary which is tuned by C86.

The Mixer

A low impedance winding on T7 couples the signal to pin 4 of the double balanced mixer IC6, an MC1496, via


WRM263
Pre-mixer amplifier
Balanced pre-mixer
r.i.t.
v.f.o.
b.c.o. 100mV
Band switch
Bal.mod.
IC7 MC1496p
TDA1054M
1/4 IC4a
Pin2 IC4
Tr10 40823
Tr11 BF256C
Tr12 40823
Tr13 BF241
Tr14 BF451
Tr15 BF241
Tr16 BF451
X1 8998·5 kHz
X2 15666 kHz
X3 16666 kHz
SK4 mic.
SK3
SK5
S2a
S2c
S4
S5
RLA1
RLD1
On
Off
D18/D19

R85 and C90. Local oscillator voltage of about 100mV at 19 to 21MHz from the pre-mixer is injected into pin 10 of IC6 via C91. The added resultant output of 28 to 30MHz at pin 12 appears across T9 primary, the local oscillator rejection at the output being optimised by adjustment of VR6.

Class A Amplifier

The low impedance secondary on T9 couples the signal via C97 to gate 1 of class A amplifier Tr8, a 40822, and amplified signals at the drain of Tr8 appear across T10 primary. Variable capacitors VC1 and VC2 tune T9 and T10 respectively. This type of miniature capacitor being primarily intended for tuning Band II v.h.f. f.m. receivers, has a 20pF swing and is ideally suited for use in this transceiver for peaking the r.f. output power.

The r.f. drive to the linear class A amplifier is controlled by VR7. This control adjusts the voltage on gate 2 of Tr8 from −2V at minimum setting to +4V at maximum setting with respect to gate 1, varying the amplifier gain over a range of approximately 40dB. Control VR7 thus adjusts the output level on transmit for transverter and 10 metre linear power amplifier input drive requirements, with VR9 pre-setting transverter input levels to 500mW maximum at full setting of VR7.

Class B Linear

The r.f. drive at T10 secondary is applied via the impedance matching network VC10, C102, VC11 and L5 to the base of class B linear amplifier Tr9, a 2N4427. The requirements for a "stiff" bias supply for linear operation are provided by R103, R104, R105, VR8, C103 and D14 and is applied to Tr9 base via RFC2. Control VR8 presets Tr9 quiescent current to 10mA with D14 clamping the bias voltage to about 0·7V preventing variations in bias level under all drive conditions. Diode D14 is thermally connected to Tr9 heatsink to provide thermal tracking thus minimising changes in quiescent current.

The output network at the collector of Tr9 consists of VC12, VC13 and L6 which transform the output impedance back to 50Ω. The amplified signal is then routed via C108 to S3 which routes the signal to either the transverter drive via FL1a and b to SK2 or 10 metre drive output socket SK1.

The RF Output Meter

In the transmit mode, M1 is switched via RLB1/2 to monitor the collector current of Tr9 for setting quiescent current and indicating power output, the meter shunt R107 increasing the equivalent f.s.d. of M1 to 200mA, hence a meter calibrated for 200μA may be read by direct interpolation. Maximum p.e.p. from the 2N4427 corresponds to 200mA, the meter itself showing an average reading of 100mA collector current. Transistor Tr9 is not switched, therefore on receive the quiescent current of 10mA is maintained through Tr9 sustaining thermal stability.

Variable Frequency Oscillator

The v.f.o. employs a MOSFET (Tr10), as the active component in a modified Colpitts oscillator circuit. Because the circuit is designed for maximum stability, the gates are not connected to the top of L7 but via a capacitor, C115; C116 and C117 operating at a feedback level of approximately 35 per cent. The values of the divider capacitors C116 and C117 are made electrically large so that voltage division between gate and source and between source and ground is equal.

Gate resistor and forward diode biasing are utilised with advantage over source biasing for output voltage regulation and frequency stability. The v.f.o. covers 3·333MHz to 4·333MHz, L7 being tuned by D3, an MVAM115 variable capacity diode. An isolation amplifier incorporating a junction f.e.t. (Tr11) in grounded drain configuration, provides a low output impedance and eliminates all possibility of varying loads across R120 affecting the oscillator frequency. Diode D4, RLA1, S4 and associated components provide the "Receiver Incremental Tune" facility (r.i.t.), VR10 being the r.i.t. control on the front panel of the transceiver.

Band Control Oscillator

The b.c.o. employs a bipolar transistor Tr15, a BF241, as the active component in a modified Colpitts oscillator circuit. Two crystals X2 and X3, 15·666MHz and 16·666MHz respectively, are switched into Tr15 base circuit via diode switches D12 and D13 to cover the 10 metre band in two ranges, 28–29MHz and 29–30MHz. The oscillator output from the emitter of Tr15 is routed to the buffer amplifier Tr16, a BF451, via C149 and R155. The resistor prevents overdriving of Tr16 and the amplified output appears across T13 which is tuned to 16MHz by C151.

The Pre-mixer

This stage employs an integrated circuit double balanced mixer IC7, an MC1496P. The v.f.o. output, preset by R121, is injected via C122 to pin 4 and the b.c.o. output is routed via R159 and C123 to pin 10.

The injection levels are 20mV and 100mV respectively, r.m.s. The resultant sum output (19 to 21MHz) at pin 12 appears across T11 primary which is tuned by D5. Capacitor C129 limits the frequency coverage and R132 provides a d.c. return path for the top diode in D5. A low impedance secondary on T11 couples the pre-mixer output to gate 1 of MOSFET pre-mixer amplifier Tr12, a 40823.

The amplified output at the drain appears across T12 primary which is tuned by D6. Capacitor C134 and resistor R138 perform similar functions to C129 and R132. A total output level of about 1·5V r.m.s. is available across T12 secondary. This level is applied to gate 2 of the receiver mixer, Tr3. A level of about 100mV r.m.s. preset by the ratio of R140 and R90, is applied via C91 to pin 10 of transmit mixer IC6. Optimum b.c.o. rejection in the pre-mixer output is obtained by adjustment of VR11, with L9/C130 and L10/C135 providing optimum harmonic rejection.

Carrier Insertion Oscillator

The c.i.o. employs a h.f. transistor Tr13, a BF241, again in a modified Colpitts oscillator circuit. The 8998·5kHz crystal is a parallel mode crystal and is set exactly to this frequency by VC14. The oscillator output from the emitter of Tr13 is routed to the buffer amplifier Tr14, a BF451, via C139 and R144, the resistor preventing overdriving of Tr14 base. The amplified output appears across T8 primary which is tuned to about 9MHz by C141. The total output of approximately 500mV r.m.s. appears across T8 secondary, and is applied to pin 10 of the product detector IC2. A level of 60mV approximately is set by R148 and applied to pin 10 of the balanced modulator IC5 via C73.

Transceiver Tuning

Frequency setting of the v.f.o., tracking of the receiver aerial and r.f. circuits for maximum sensitivity, and tracking of the pre-mixer and p.m. amplifier for constant l.o. output is controlled by VR14. This control is a high grade 10 turn potentiometer with a circular calibrated scale fitted to the outer 1:1 driven spindle. Minimum reverse voltage (3V), is controlled by R183. Resistors R184, 185, 186 and 187 in conjunction with S5b set the reverse voltage on D1, 2, 5 and 6 to between 3–6V and 6–10V when S5 is set to 28–29MHz and 29–30MHz respectively, to maintain optimum *tracking*.

An extremely stable voltage is required for the varicap control line in terms of d.c. variations in p.s.u. output and in temperature changes. This stable voltage is provided by Tr21, Tr22, D27, D28 and associated components, being initially preset by VR13. The temperature coefficient of varicap diodes is such that an increase in temperature fractionally increases the varicap diode capacitance, i.e., giving a downward v.f.o. frequency shift and vice-versa.

The voltage stabiliser counteracts this effect by fractionally increasing the d.c. control line voltage with increasing temperature, decreasing varicap diode capacitance and hence negating any frequency changes. The full 10V rail supply is used for three oscillators and their amplifiers, i.e., Tr10, 13, 14, 15 and 16.

The Power Supply Unit

The transceiver will operate from a.c. mains or from 11–14V d.c. e.g., a 12V car battery. The mains p.s.u. consists of T14, bridge rectifier D20 to D23 and C173. The secondary of T14 supplies 20V a.c. to the bridge rectifier, the resultant 100Hz pulses charging C173 to give 24V unstabilised d.c. off load, with some a.c. ripple at S6b, the inverter on/off switch combined with S6a. When S6 is switched for mobile operation, S6a connects the battery to

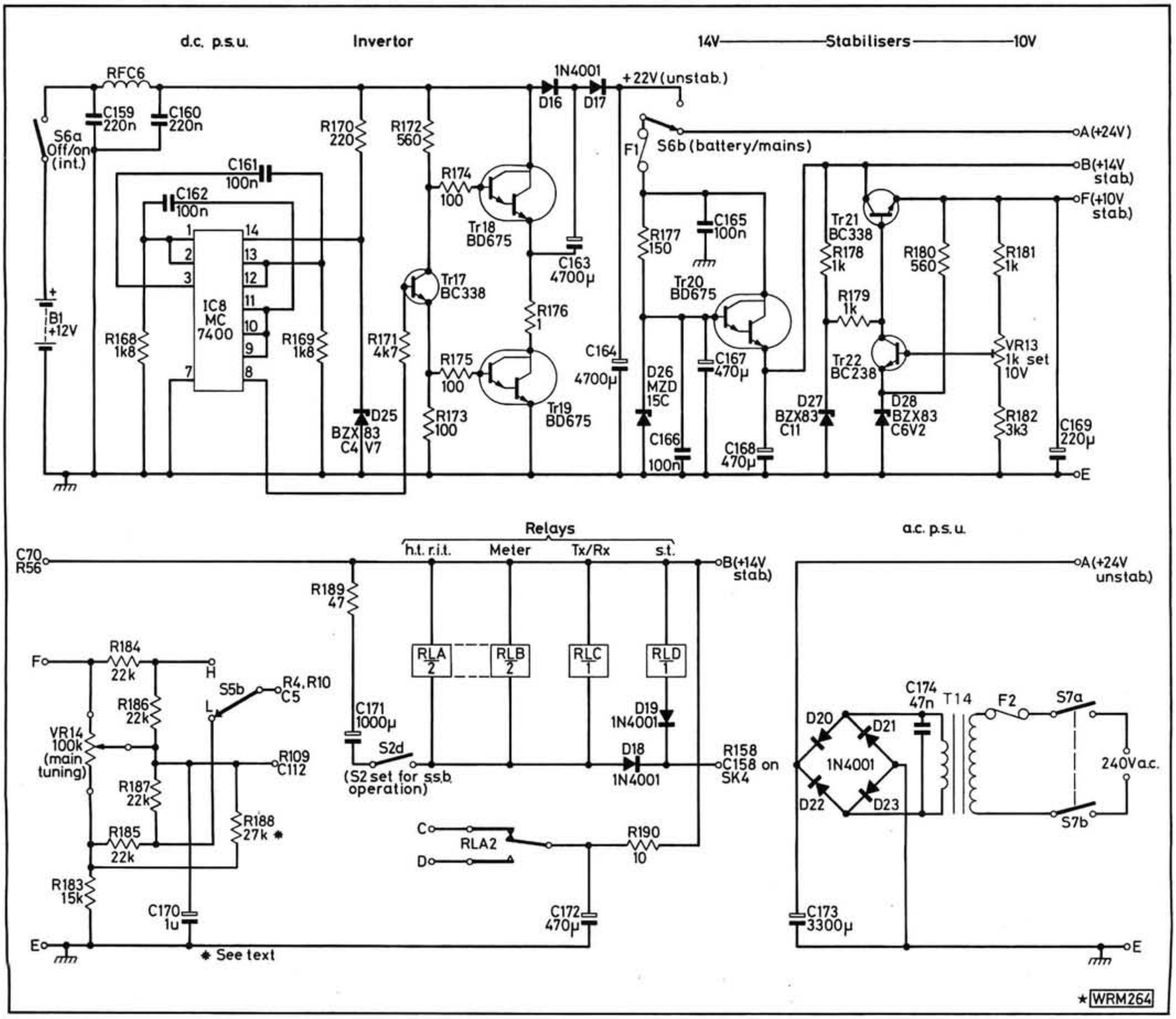


Fig. 5: Power supply, tuning and relay circuits. On the p.c.b. pattern shown in Fig. 7, RLA and RLB have been combined into a single 4-pole changeover relay

PRINTED CIRCUIT BOARDS

Full-size paper prints of all the "Tamar" p.c.b. track patterns are available from the Editorial offices at Poole. Please, a large (10 × 8in) stamped addressed envelope

the inverter. Device IC8 generates a 7kHz squarewave, the frequency being controlled by C161 and C162.

As IC8, a 7400, is a TTL i.c. it has its 5V supply rail stabilised by D25. The output at pin 8 is applied to phase splitter Tr17 via R171. The 180 degree out-of-phase outputs at Tr17 collector and emitter are applied via R174 and R175 respectively, to Tr18 and Tr19 (BD675) Darlington transistors with a minimum h_{FE} of 750 at 1A.

The amplified, square waveform at the junction of Tr18 emitter and Tr19 collector is applied to the Cockcroft-Walton voltage doubler consisting of D16 and D17, C163 and C164. The doubler delivers 22–24V d.c. depending on the d.c. input from the battery. Choke RFC6 with C159 and C160 prevent 7kHz pulses on the h.t. line radiating interference from the battery leads. Switch S6b selects either the mains or mobile p.s.u. output which is applied to the 14V regulator consisting of Tr20 (BD675), another Darlington transistor and associated components.

The resultant output across C168 is a fully stabilised and virtually ripple free 14V d.c. with F1 protecting the stabiliser should an h.t. short occur in the transceiver. The stabiliser output is routed to the transceiver circuits, relays and the 10V stabiliser. In the author's transceiver the mains p.s.u. is fitted externally in a separate box but it may, however, be mounted within the transceiver cabinet for "one unit" portability.

Mechanical Features

Six p.c.b.s carry all the transceiver circuitry including relays and are allocated as follows:

1. Mode switch (s.s.b., c.w., c.w. filter in/out).
2. Mobile p.s.u., 14V stabiliser and the h.t., r.i.t. and meter relay.
3. Linear amplifier, filter FL1 and transmit/receive relay bias network.
4. Transmit mixer and class A amplifier.
5. All receiver circuits, transmitter, balanced modulator and i.f. amplifier.
6. The v.f.o., relay RLD, c.i.o. and amplifier, b.c.o. and amplifier, pre-mixer and amplifier, mic. amplifier and sidetone generator and 10V stabiliser.

Boards 3–6 can be fitted in diecast boxes with lids or alternatively p.c.b.s 2–5 can be bolted to an aluminium sheet with vertical screens between p.c.b.s 3–6.

A further mounting configuration is to set p.c.b. 6 over p.c.b. 5 and p.c.b. 4 over p.c.b. 3 hence saving horizontal area although increasing the height of the transceiver.

Figures 6 to 11 show the component disposition on each of the p.c.b.s and terminal pins are fitted where external connections are made. All interconnecting wiring is carried out with pvc covered instrument wire except for the signal leads, where miniature coaxial cable should be used. The disposition of controls and dial assembly on the cabinet front panel may be varied to suit individual taste but the layout illustrated in the photo gives the best compromise between control positions and their connection points on the p.c.b.s.

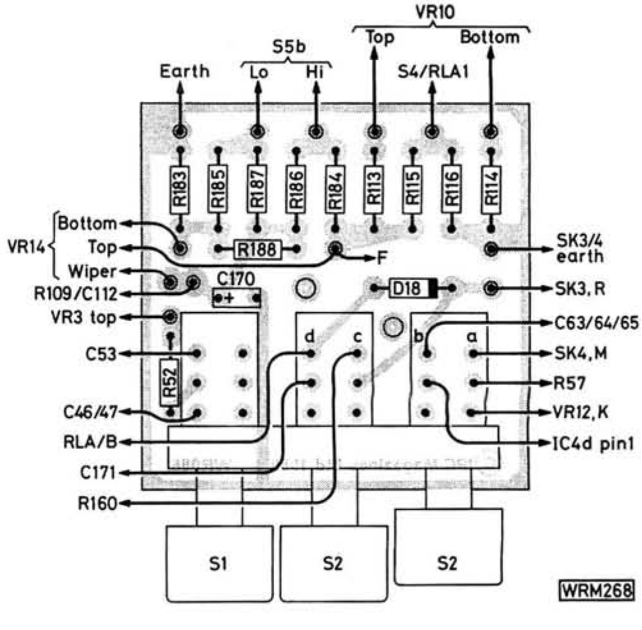


Fig. 6: Mode switch and bandswitch/r.i.t. component layout (Board 1)

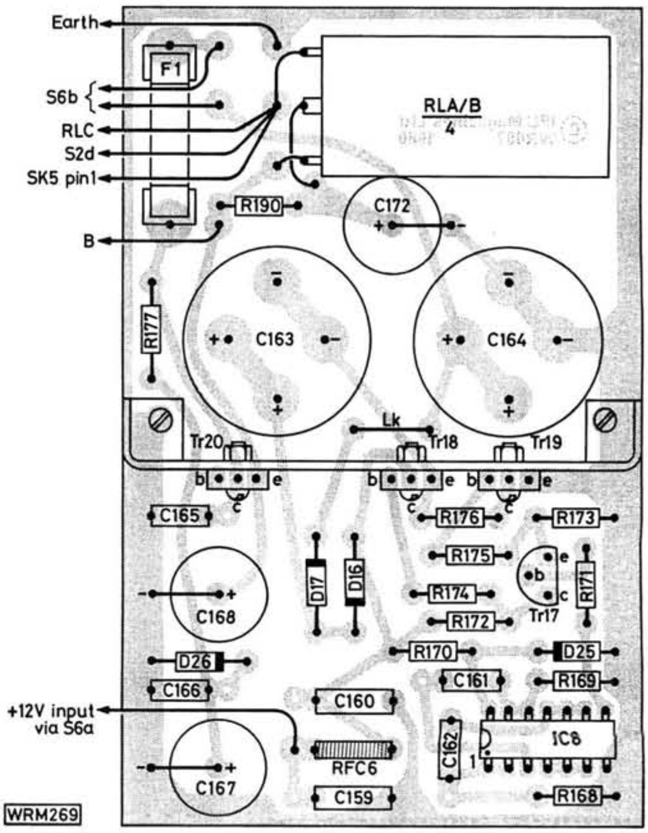


Fig. 7: The d.c./d.c. power supply unit, stabilisers and relay board layout (Board 2)

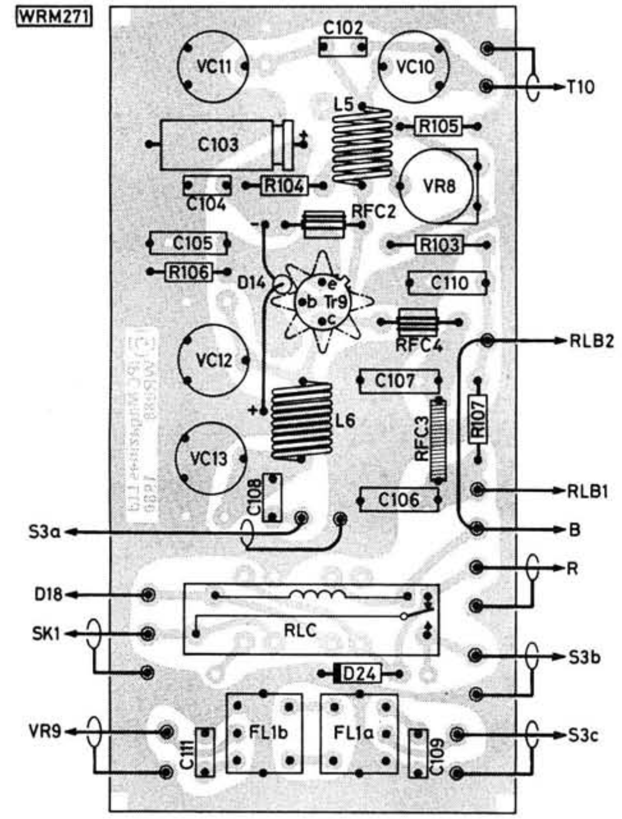


Fig. 8: The linear amplifier, T/R relay and 28MHz filter board layout (Board 3)

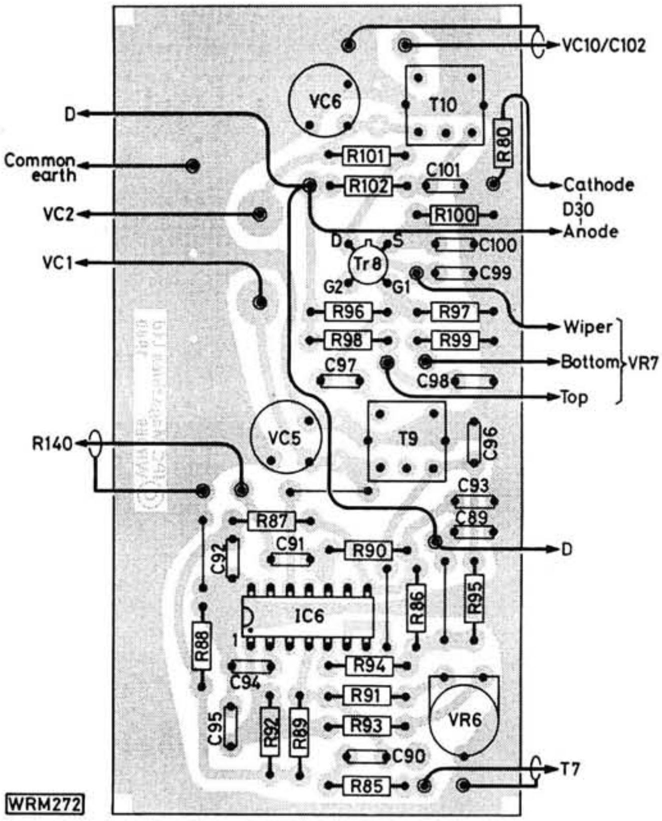


Fig. 9: Transmitter balanced mixer and class A amplifier board layout (Board 4)

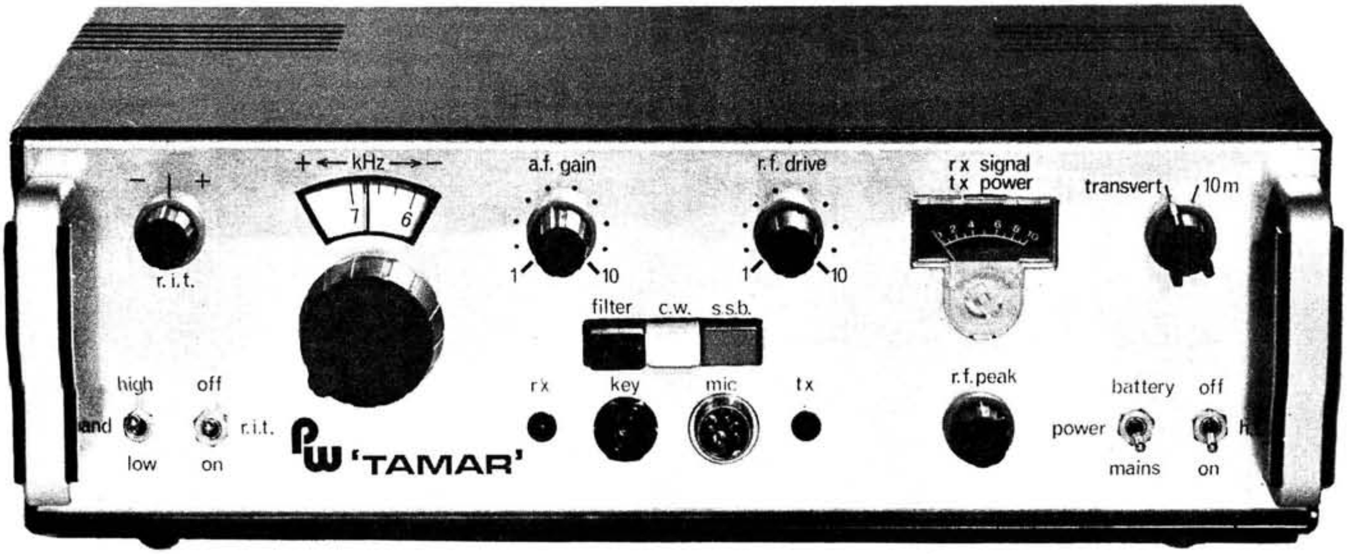
Table 1: Winding details of remaining inductors

Coil	Turns	Wire s.w.g.	Wire Type	Notes
L5	4	26	enam	6mm i.d. 12mm long
L6	7	26	enam	6mm i.d. 12mm long
RFC2	4	26	enam	on FX1115 ferrite bead
RFC3	2	26	enam	on FX1115 ferrite tube
RFC4	3	26	enam	on FX1115 ferrite bead

The brackets for mounting the tuning potentiometer and function switch were formed from aluminium sheet and are fixed to the front panel by the nuts and bushes of the r.i.t. and a.f. gain controls and also by the bushes of SK3 and 4 to avoid the use of untidy screws and nuts.

Next Issue

Component layouts for the two remaining p.c.b.s will be given in the final part of this series next month, together with full alignment details and instructions on driving transverters with the *PW* "Tamar" transceiver.



AUDIO POWER AMPLIFIERS

PART 1

M. J. DARBY

This short series of articles has been written to explain in fairly simple terms how conventional transformerless solid-state audio power amplifiers using bipolar transistors function. Although various circuits will be discussed, it is not intended to describe the detailed construction of any particular amplifier design. However, readers who study these articles should be able to look at most power amplifier circuits and understand the principles of their operation. Calculations have been simplified as far as possible to render the articles more easily readable.

When designing an audio amplifier, it is usually most convenient to start thinking about the type of output stage one requires to give the desired output, and to work back gradually towards the input. This is the basic pattern we shall follow before looking at some complete amplifier circuits.

Basic Output Circuit

Let us use the simple basic output circuit shown in Fig. 1 to understand how the amplifier controls the power being fed to the loudspeaker. The power transistors shown in Fig. 1 are a complementary pair (an *npn* and a *pnp* transistor), but the somewhat similar circuit of Fig. 2 using two *npn* transistors operates on generally similar principles. The load shown is a loudspeaker; for most purposes it can be treated as a purely resistive load, whilst in some applications it can be replaced by a resistor.

The circuits shown employ two balanced supply lines, one being positive and the other an equal amount negative with respect to 0V. As indicated by the dotted arrows in Figs. 1 and 2, each transistor passes a current in one direction only. This direction is shown by the arrow on the circuit symbol for the transistor concerned. During positive-going parts of the input waveform, a current passes from the positive power supply line through the *npn* transistor of Fig. 1 to the amplifier output and hence through the loudspeaker to 0V; the amplifier output voltage becomes positive at this time so that it can drive the current through the load. The current in the *pnp* transistor at this stage is quite small.

During the negative-going parts of the input waveform a current passes from 0V through the loudspeaker into the *pnp* transistor and hence to the negative power supply line. The amplifier output voltage is negative at this time and the current in the *npn* transistor is quite small.

The use of two output transistors in this basic circuit therefore allows the current to pass through the loudspeaker first in one direction and then in the opposite direction producing an alternating voltage across the loudspeaker. The control signals which must be applied to the transistor bases will be considered later, but it should be noted that it is these signals which control the flow of current from the power supply lines through the loudspeaker.

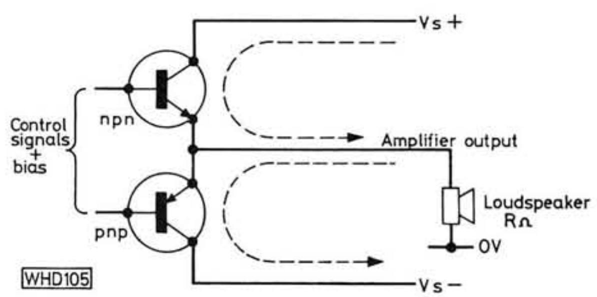


Fig. 1: A complementary transistor output stage showing current flow

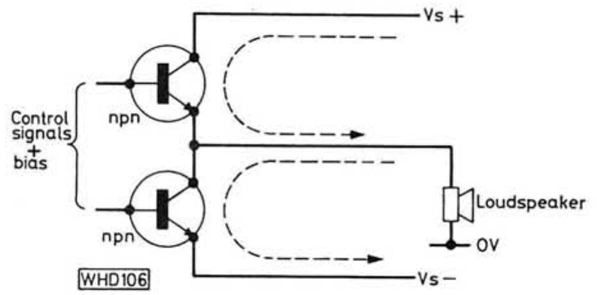


Fig. 2: An output stage using two *npn* transistors

Maximum Power Output

As the alternating input voltage applied to an amplifier is increased, the output power increases, since more power flows in the load as the amplifier output voltage swing increases. However, there is a fairly sharply defined point at which the distortion commences to rise very rapidly indeed with increasing input voltage; the power output at this point may be regarded as the maximum power output of the amplifier into the load concerned. This output power is very dependent on the power supply line voltages.

What causes this sudden increase in distortion? The maximum positive potential to which the amplifier output can rise is a little less than the positive supply voltage, V_s^+, because there must be a small voltage drop across each transistor to enable it to operate correctly. If this small voltage is v, then the maximum *positive output* voltage of the amplifier is $(V_s^+ - v)$, whilst the greatest negative voltage is $(V_s^- - v)$; the maximum positive and negative swings should be almost equal.

If a sinewave of gradually increasing amplitude is applied at the input, initially a similar but amplified sinewave will be present at the output as shown in Fig. 3(b). As the input voltage rises further, however, the peaks of the output voltage waveform will be clipped, as shown in Fig. 3(c), because the output potential cannot rise or fall beyond a certain value which can be denoted $V_{o(max)}$.

Any waveform which shows appreciable clipping on an oscilloscope, even if the clipping is far less than that shown in Fig. 3(c), will be badly distorted if used as an audio signal. Thus it is the onset of waveform clipping which limits the maximum output power obtainable from an audio amplifier feeding a specified load impedance.

The level at which clipping commences is determined by the power supply voltage. If the output transistors are not being operated at their maximum voltage, current and power, more output power can be obtained by increasing the power supply voltage somewhat. However, if an excessive voltage is employed in an attempt to obtain high power, the transistors may be damaged.

Similarly, one cannot reduce the loudspeaker impedance below a certain value with a specified power supply voltage in order to obtain more output power because the output current would then become large enough to damage the transistors. Thus the maximum output power supply is determined by the values of the loudspeaker impedance and the power supply voltage, but these values are in turn limited by the ratings of the particular output transistors employed.

What is the maximum output power developed in a loudspeaker? If the peak output voltage (positive or negative) is $V_{o(max)}$, the peak current passing through the loudspeaker will be $V_{o(max)}/R$ where R is the speaker

TABLE 1

Typical values of the maximum mean power output from amplifiers using various balanced supply voltages and speaker impedances. In all cases it has been assumed that the peak output voltage is 5V less than the power supply voltage

Power Supply ±V	Peak Output Voltage ±V_o	Peak Load Current (A)	Peak output power (W)	Maximum mean output/power (W)
	LOAD IMPEDANCE 16Ω			
55	50	3·125	156	78
45	40	2·5	100	50
35	30	1·875	56	28
25	20	1·25	25	12·5
15	10	0·625	6·2	3·1
	LOAD IMPEDANCE 8Ω			
55	50	6·25	312	156
45	40	5·0	200	100
35	30	3·75	112	56
25	20	2·5	50	25
15	10	1·25	12·5	6·2
	LOAD IMPEDANCE 4Ω			
55	50	12·5	625	312
45	40	10	400	200
35	30	7·5	225	112
25	20	5	100	50
15	10	2·5	25	12·5
	LOAD IMPEDANCE 2Ω			
55	50	25	1250	625
45	40	20	800	400
35	30	15	450	225
25	20	10	200	100
15	10	5	50	25

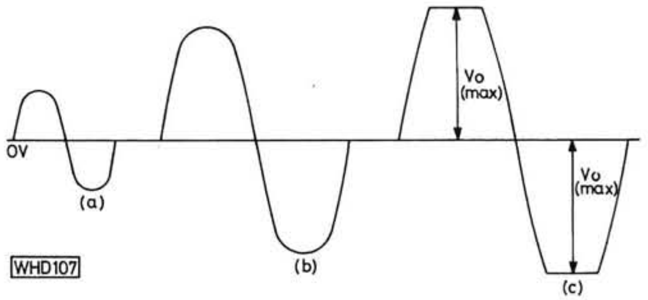


Fig. 3: (a) Amplifier input waveform (b) normal output and (c) clipped output waveform

impedance in ohms. The instantaneous maximum power is equal to the product of the peak voltage across the loudspeaker and the peak current passing through it, namely $V^2_{o(max)}/R$. As $V_{o(max)}$ is only a few volts less than the power supply line potential, the output power is approximately proportional to the square of the power supply voltage for any given speaker impedance.

Mean Power

The instantaneous maximum power output at the peak of the waveform has the value we have just derived of $V^2_{o(max)}/R$, but during most of the waveform the power will be much less than this peak value. If the signal is a sinewave, it can be shown that the power averaged over a whole number of cycles is one half of the peak power.

This mean power is often referred to as the r.m.s. output power, because it is the product of the r.m.s. voltage and the r.m.s. current flowing through the load, but this use of the term "r.m.s. power" is actually incorrect. Audio equipment sold in Europe is rated on the maximum mean power output which it can deliver, namely $(V_{o(max)}/\sqrt{2})^2/R = V^2_{o(max)}/2R$.

Table 1 gives some general indication of the maximum mean power output levels one may expect to obtain using amplifiers with various values of balanced power supply voltages and various load impedances. It has been assumed that the output voltage, $V_{o(max)}$ can swing to within 5V of either supply line voltage. Low value current stabilising resistors are often employed in the emitter circuits of the output transistors and the voltage drop across these resistors can reduce the maximum value of the output voltage. Thus the power levels in Table 1 can be taken as being only very approximate values when the actual peak output voltage is not known.

Single Supply

Balanced power supplies are used in the circuits discussed, but some power amplifiers use only a single supply line. The output stage of a circuit of this type is shown in Fig. 4. The quiescent voltage at the junction of the two emitters is about half the positive supply potential, so a blocking capacitor, C is required to prevent a steady current from flowing through the speaker; such a current would heat the speaker coil and displace it in the magnet gap. The value of this capacitor must be large enough to ensure that its impedance is lower than that of the loudspeaker at the lowest frequency at which the circuit is likely to be used, otherwise the bass signals will be attenuated.

The circuits in Figs. 1 and 2 have the advantage over the circuit of Fig. 4 that their low frequency response is not limited by any coupling capacitor, so they can operate down to zero frequency if necessary. In addition, the circuit of Fig. 4 has the disadvantage that a high charging current flows into the coupling capacitor when the power is first applied and this causes a loud "plop" noise to be emitted from the loudspeaker. This noise can be greatly reduced by using the circuit of Fig. 5 at the expense of circuit complexity. Balanced power supplies are usually used at power levels over about 30W in high-quality amplifiers.

The maximum mean power output from the circuit of Fig. 4 or 5 is somewhat less than $V_s^2/8R$ where R is the loudspeaker impedance.

Transistor Ratings

When the *npn* transistor of Fig. 1 is heavily conducting, the output voltage will rise towards the V_s^+ level. Thus the voltage across the *pnp* transistor is almost equal to the sum of the two supply voltages, $2V_s$, but at this time the *pnp* transistor is taking little current. The transistor must therefore have a collector-emitter voltage rating at zero base current, V_{CEO} of not less than $2V_s$. The *npn* transistor should satisfy this same condition.

The output transistors must also have a maximum continuous current rating, I_c of not less than the peak output current from the amplifier (Table 1). If the manufacturer's recommended maximum current rating is exceeded, the bonding wire inside the transistor can fuse. This is likely to occur if the amplifier output is shorted to ground.

Power ratings for a transistor are a little more complex, since the quoted power rating is normally the maximum power which may be dissipated in the transistor when the case is at 25°C. As one operates power transistors with their cases at higher temperatures, one must reduce the internal power dissipation so that the device junctions are not damaged by overheating.

The maximum instantaneous power is fed to the load when the output voltage from the amplifier is a maximum. However, the voltage across the conducting output transistor is then quite small, so the internal power dissipation in this transistor is not the maximum value. It can be shown that the maximum internal dissipation occurs in the output transistors with a sinewave input when the peak output voltage is approximately equal to $2V_s/\pi$. For a sinewave input the maximum total dissipation in both transistors is approximately $4/\pi^2$ (or about 40%) of the maximum power which can be delivered to the load using a larger input amplitude.

Thus in a 100W amplifier, the maximum internal dissipation in the output transistors will be about 40W with pure sinewave inputs. However, odd harmonics increase the internal dissipation until one reaches the worst possible case of an internal dissipation of 50% of the rated power output when the input is a squarewave. Even harmonics normally lower the internal dissipation. Loud music can easily dissipate 25% of the rated output power in the output transistors even though the average output power is quite low. There is some variation from one amplifier circuit to another, but generally it is wise to allow an adequate margin of safety by assuming a maximum internal dissipation of some 60 to 70% of the rated power output, since it is not worth risking considerable damage to the amplifier by thermal runaway.

If one considers the MJ802 *npn* transistor and its complement, the *pnp* MJ4502, these have a 90V V_{CEO} rating and a 30A collector current rating. The maximum dissipation is 200W and the maximum junction temperature 200°C. The thermal resistance from the junction to the case is 0·875°C/W, so if the dissipation is 200W, the case temperature must not exceed 200 – (200 × 0·875) = 25°C.

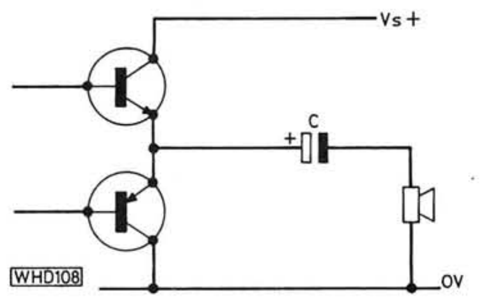


Fig. 4: Output stage fed from a single power supply line

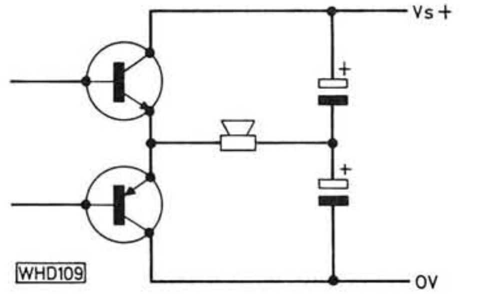


Fig. 5: A method of reducing the switch-on transient

It would be very difficult to maintain the case of the transistor at this temperature without cooling, so one normally uses a higher case temperature and reduces the internal dissipation. For example, a maximum dissipation of 80W will produce a junction-to-case temperature difference of 80 × 0·875 = 70°C. The maximum case temperature will then be 200 – 70 = 130°C. If the maximum ambient temperature is 30°C, the case to ambient thermal resistance will be (130 – 30)/80 = 1·25°C/W. Even if the output transistor is mounted directly onto the heat sink, the latter should have a thermal resistance to ambient of no more then 1·1°C/W so as to allow for the contact resistance.

In very high power amplifiers it is difficult to insulate the transistors from the heat sink, since a TO3 mica or polyester washer itself has a thermal resistance of about 0·8°C/W. Hard anodised aluminium washers have a value of about 0·4°C/W and aluminium oxide washers about 0·3C/W. Beryllium oxide washers are very expensive, but have a thermal resistance of about 0·1°C/W and ideal electrical properties. Note that, in common with all beryllium compounds, beryllium copper is **highly toxic** if ground, drilled or filed.

Driver Stages

The circuit of Fig. 1 is often fed by driver transistors as shown in Fig. 6. The base current required by each output transistor, Tr2 and Tr4, is quite large—perhaps about 300mA when the output transistor is passing 10A. The current amplifier transistors Tr1 and Tr3 are therefore used before each output transistor, these additional transistors being connected to the output transistors so that two Darlington pairs are formed.

The *npn* and *pnp* Darlington pairs are fed from an amplifier, but the bases of Tr1 and Tr3 cannot be connected directly together and to the output of the amplifier shown in Fig. 6, since a positive quiescent bias voltage is required at the input to the *pnp* Darlington pair, but a negative bias is required at the input to the *npn* Darlington pair. The load resistor R and the components in the block marked "bias" provide the required bias difference to the two driver transistors.

Each of the four transistors requires a base-emitter voltage of about 0·6V before it commences to conduct, that is, $V_{BE} = 0{\cdot}6V$. The V_{BE} of Tr1 is effectively added to that of Tr2, so the total voltage between the base of Tr1 and the emitter of Tr2 is $2V_{BE}$. Similarly, the base of Tr3 is at a potential of $-2V_{BE}$ relative to the emitter of Tr4. This means that a bias voltage of about $4V_{BE}$ will be required to ensure both Darlington pairs are conducting in the quiescent state.

In principle it would be possible to provide a suitable bias voltage by using a resistor between the base of Tr1 and the base of Tr3 in Fig. 6. However, a resistor would not provide the required variation of bias voltage with temperature. This variation is required because it follows from the band-gap theory of semiconductor materials that V_{BE} varies with temperature. As the transistors in Fig. 6 become hotter, V_{BE} becomes smaller and a constant bias would result in an increased output transistor current; this would cause the transistors to become hotter still and give rise to the possibility of thermal runaway.

In small amplifiers the bias network may consist of series-connected silicon diodes which are kept at about the same temperature as the power transistors. When the diodes become hot, their forward voltage falls (and hence the bias also) with the same temperature coefficient as the V_{BE} of the transistors. Thus the collector current of the transistors remains fairly constant with temperature. The only disadvantage with this form of biasing is that the bias cannot be varied with a preset resistor; such variation is desirable so that one can set the quiescent current for minimum distortion.

V_{BE} Multiplier

A better solution is the use of the simple transistor circuit of Fig. 7 as the bias network in Fig. 6. This single transistor circuit is known as a "V_{BE} multiplier", since the V_{BE} of the transistor is effectively multiplied by a variable factor to provide the bias. The temperature coefficient matches that of the power transistors.

In the circuit of Fig. 7, the bias voltage across the whole circuit is equal to $(I + I_b)R1 + IR2$, whilst the V_{BE} of the transistor is equal to IR2.

$$\frac{\text{Bias}}{V_{BE}} = \frac{(I + I_b)R1 + IR2}{IR2} = \frac{R1 + R2}{R2}$$

provided that I is much greater than I_b. Thus the bias voltage provided by this circuit is approximately equal to $V_{BE}(R1 + R2)/R2$ and is thus directly proportional to V_{BE}. Any transistor with a gain of 10 or more is satisfactory for use in the Fig. 7 circuit, the collector emitter voltage being quite small.

If R2 in Fig. 7 is increased, the bias (and hence the power transistor current) will be reduced and vice-versa. It is normally better to make R2 variable rather than R1, since there is always a chance of a variable resistor becoming open circuit and, if this happened in the R1 position, a huge increase in the bias and therefore in the power transistor current would occur with possible damage.

Optimum temperature stabilisation of the circuit will be obtained only if the multiplier transistor of Fig. 7 is mounted near the power transistor heat sinks so that the temperature of this transistor is kept near to that of the power transistors. This may not be very convenient, but in some designs it can allow a smaller heat sink to be used with safety. Perfect thermal compensation with the power transistor quiescent current remaining constant with temperature variation will never be obtained, but the Fig. 7 circuit can greatly reduce changes with temperature.

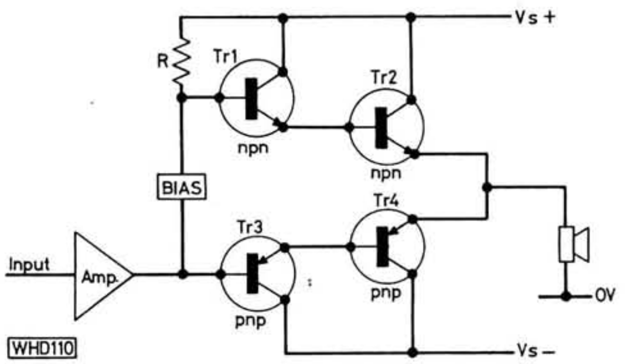


Fig. 6: A basic amplifier circuit

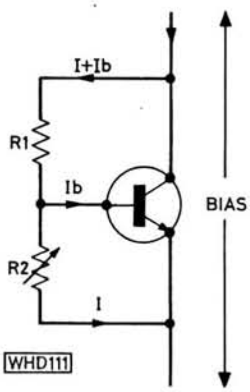
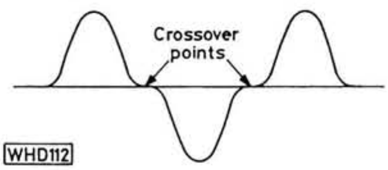


Fig. 7: (left) A V_{BE} multiplier circuit for providing suitable bias for an amplifier output stage

Fig. 8: (below) A waveform with crossover distortion



Various minor variations of the Fig. 7 circuit are possible. For example, it is a good idea to replace R2 with a fixed resistor in series with a variable resistor. This will be to prevent the bias from becoming excessive if the value of the variable resistor is set near to zero. A capacitor may be connected across R2; its value is effectively multiplied by the transistor gain so that it reduces the impedance of the bias circuit at audio frequencies.

Crossover Distortion

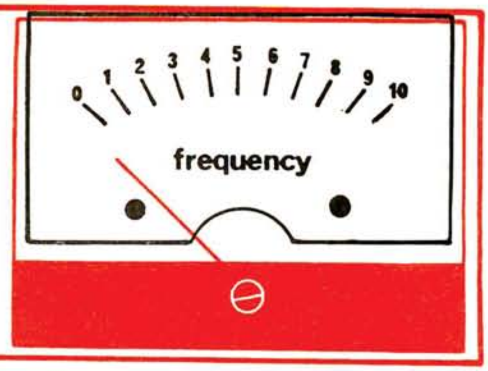
If the bias voltage is too small, a particularly objectionable form of distortion known as crossover distortion becomes noticeable. It occurs when one of the output Darlington circuits of Fig. 6 does not take over smoothly from the other Darlington as the input voltage passes through the zero point. On an oscilloscope the waveform with crossover distortion appears as in Fig. 8 at low signal amplitudes; at high amplitudes the effect tends to be masked by the height of the peaks.

When setting the bias of an amplifier (R2 of Fig. 7), a low amplitude signal should be applied to the amplifier at a high frequency—perhaps 10kHz. Under these conditions any crossover distortion shows up more clearly. When adjusting the bias, it is almost essential to monitor the power transistor current so as to ensure this does not become excessive at any time.

In Part 2 of this series, we shall be looking at quasi-complementary output stages, input amplifier circuits and power supply requirements.

LINEAR FREQUENCY METER

J. P. Macauley



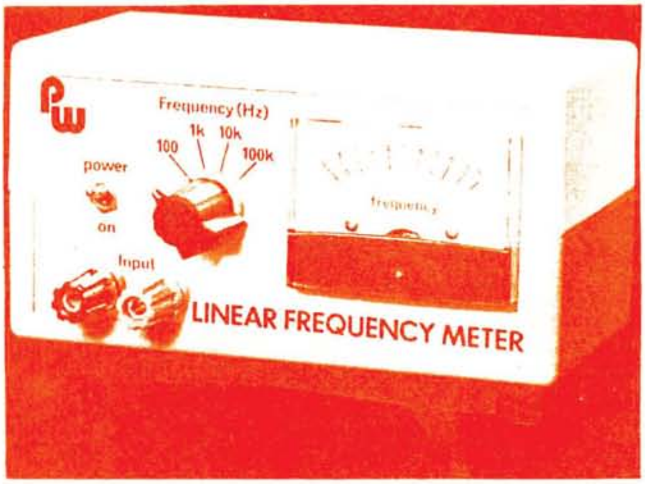
There is no doubt that digital frequency meters have become commonplace nowadays and very much the accepted method of accurate frequency measurement. But, for the home constructor, building a full-blown d.f.m. does have disadvantages and the most significant snag for most people is that old bogey, cost.

A good digital display is not cheap at £40 or so and, considering the amount of use that the instrument will have in the average amateur's workshop, such an outlay can hardly be justified. As an economical alternative, why not consider an analogue design and build *PW*'s Linear Frequency Meter? This design is cheaply and simply made, with its electronics mounted on Veroboard and has a frequency range of 10Hz–100kHz (suitable for a.f. and logic applications, etc.) in four ranges; it is accurate to ±2%.

The display used is a 1mA f.s.d. panel meter and the instrument is small, portable and, with a current consumption of 14mA, is easily powered by a PP3 battery. So, if you are looking for an inexpensive and unsophisticated means of frequency measurement, this could be your answer.

Circuit

The circuit diagram of the instrument is shown in Fig. 1. The input signal whose frequency is to be measured is applied to the base of Tr1 via R1 and C1. Capacitor C1 blocks any d.c. that may be present in the circuit under test, and R1 serves to limit the base current of Tr1 when relatively high-amplitude inputs are applied. Diode D1 performs a similar function for large negative excursions of the input waveform.



The amplified output from Tr1 is fed to IC1, a 555 timer used in the Schmitt trigger mode. The output (pin 3) is a squarewave with a respectably fast rise-time which, after differentiation by R7 and C3, is fed to IC2—another 555 connected as a monostable. This input to pin 2 of IC2, is a series of positive and negative-going spikes—the device produces a fixed-width pulse for each positive-going spike, which causes current to flow through the meter. The more fixed-width pulses, the more current and therefore the current through M1 is directly proportional to the input frequency to the instrument. All that is necessary to obtain a direct read-out of frequency is a suitably calibrated scale, such as that shown in Fig. 3 which is designed for the specified panel meter.

Switch S1 selects one of four 2% resistors (R8–R11) and therefore determines the frequency represented by the full scale deflection of M1.

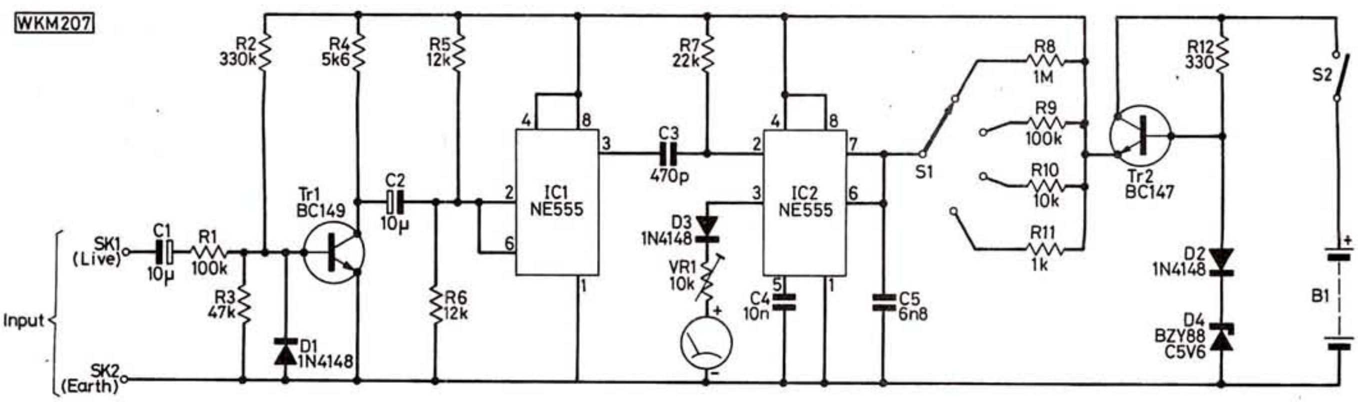


Fig. 1: Circuit diagram of the Linear Frequency Meter

Track breaks at :-
B5, 21, 32, 40
C5, 40
D5, 40
F32
I20, 23, 32
J20, 23, 32
K20, 23, 32
L20, 23, 32
N23
O23
P15, 23
R15, 25
S7
U11
W5, 40
X5, 40
Y5, 40

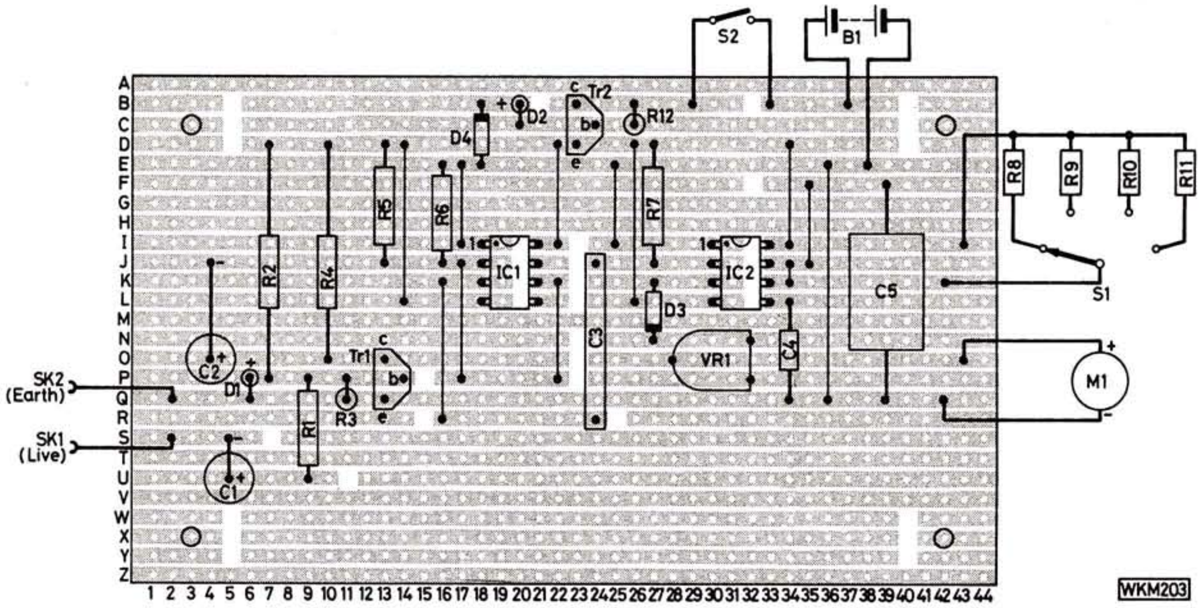


Fig. 2: The suggested Veroboard layout (full size) including track breaks

Construction

Start by making the breaks in the Veroboard tracks and then carefully solder the components onto the Veroboard panel which should be the same size as that shown in the component layout diagram (Fig. 2). Take care to ensure that the semiconductors and electrolytic capacitors are correctly orientated, and that the wire links are neatly inserted in the correct positions.

The face diagram of the front panel (Fig. 4) may be used as a drilling template—the cut-out and mounting holes are correct for the specified meter (see advertisers' catalogues) so if you decide to use a different type you

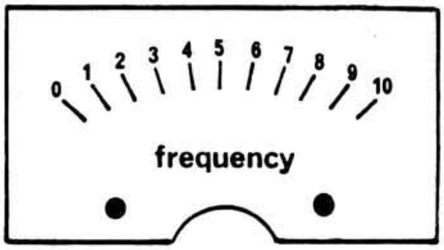


Fig. 3: The scale for the panel meter (full size)

★ components

Resistors

½W 5%

330Ω	1	R12
5·6kΩ	1	R4
12kΩ	2	R5,6
22kΩ	1	R7
47kΩ	1	R3
100kΩ	1	R1
330kΩ	1	R2
1MΩ	1	R8

½W 2%

1kΩ	1	R11
10kΩ	1	R10
100kΩ	1	R9

Potentiometers

Min. open preset, horizontal mounting

10kΩ	1	VR1

Capacitors

Electrolytic 63V

10μF	2	C1,2

Polystyrene

470pF	1	C3
6·8nF	1	C5
10nF	1	C4

Semiconductors

Diodes

1N4148	3	D1,2,3
BZY88C5V6	1	D4

Integrated circuits

555	2	IC1,2

Transistors

BC147	1	Tr2
BC149	1	Tr1

Switches

Midget wafer

3p4w	1	S1

Min. toggle

s.p.d.t.	1	S2

Miscellaneous

PP3 battery plus holder and snap-connector; Verobox Type 75-1239K, or similar case; 0·1in Veroboard (115 × 65mm); 2in panel meter, ME4-T24, 1mA f.s.d.; knob, small, 15mm collet type with wing; tilt-leg assembly (optional); 4mm insulated terminals, red (1) and black (1); equipment wire, fixings, Letraset, etc.

will need to modify the mechanical arrangement accordingly, of course.

The PP3 battery which powers the instrument is best accommodated in a panel-mounting holder as shown in the photograph (Fig. 5)—make a 58 × 24mm cut-out in the rear panel to hold it securely. Incorporating this type of holder avoids having to open the case each time the battery requires changing; once snapped together the recommended type (Verobox Type 75-1239K) can be a bit awkward to reopen.

In constructing the test model, we added the matching tilt-leg assembly which makes the instrument easier to read during bench use and adds a neat and inexpensive touch.

The obvious accurate frequency source for calibration is the mains electricity supply—*not* a direct connection, of course, but at a very much reduced voltage! In fact, you may find it possible to calibrate the meter by simply placing a finger on its live input (not to be confused with mains "live"!) and using the a.c. induced in your body to do the job! This will, however, depend very much on your individual physiology and location so you may find it more satisfactory to connect the frequency meter to the secondary of a mains step-down transformer via a suitable divider network. Aim at an input level of 1V peak-to-peak or thereabouts, switch to the 0–100Hz range and adjust VR1 for half-scale deflection; as R8–R11 are 2% types, the other ranges should fall into line.

When it was tested in the *PW* workshop, the instrument returned a sensitivity figure of 100mV r.m.s. up to 20kHz and 1V r.m.s. at 35kHz; it then fell off to 2V r.m.s. at 100kHz. The sensitivity at the higher end of the instrument's frequency range can be improved by reducing the value of C3, incidentally—but if you *do this, you* must be prepared to accept less sensitivity at the lower end! ●

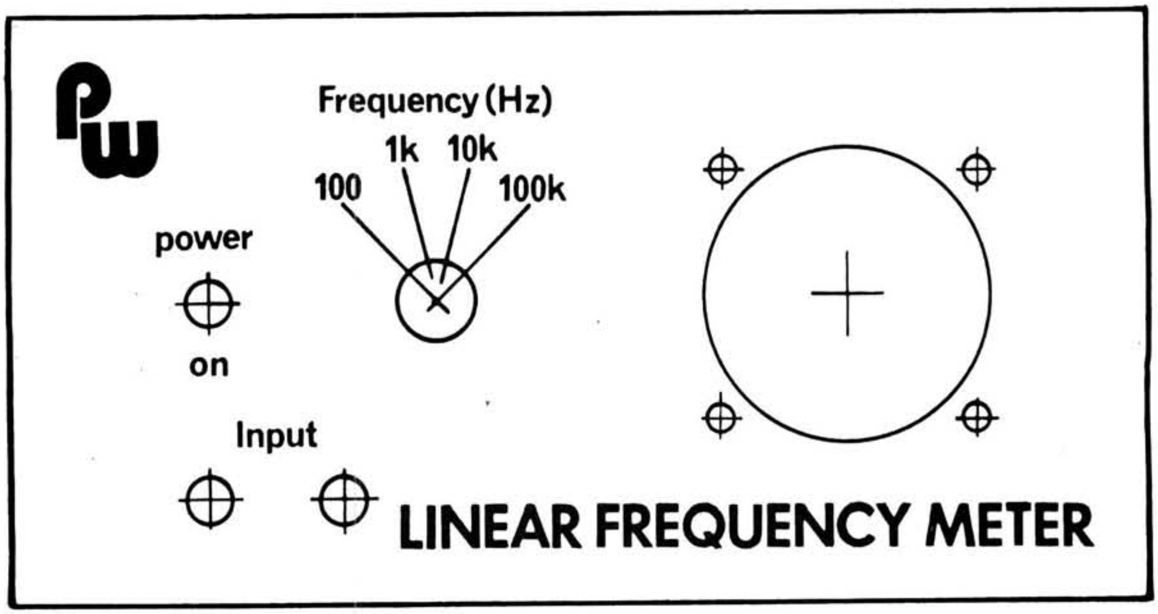


Fig. 4: The front panel design (full size). It can be used both as a drilling template and to enhance the appearance of the finished instrument

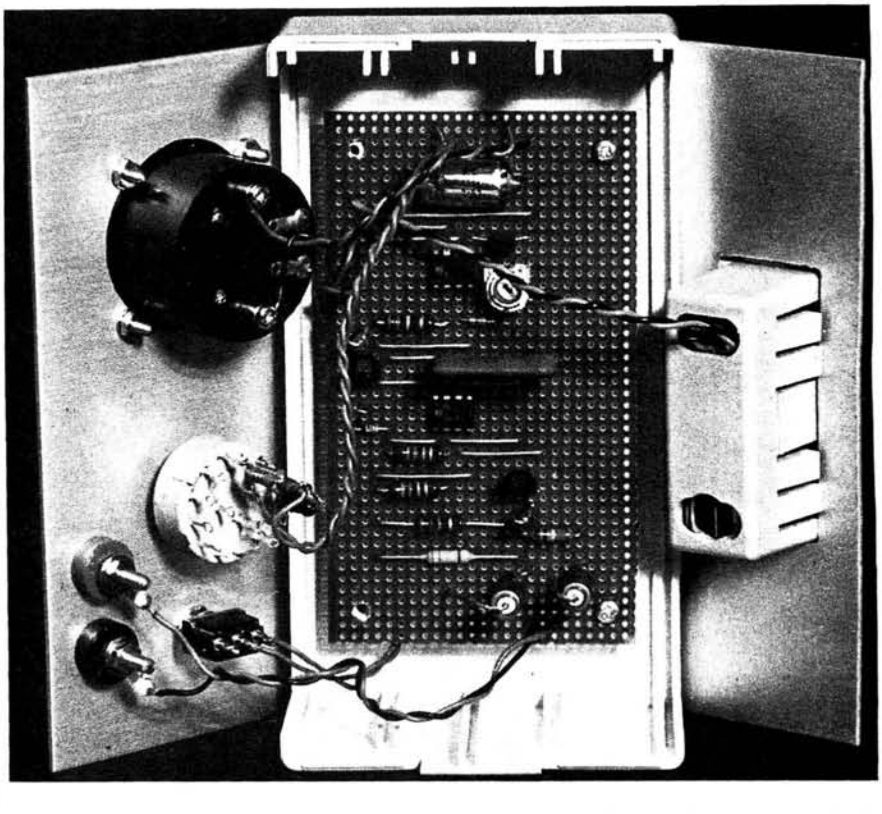


Fig. 5: Interior view of the completed unit

RADIO SPECIAL PRODUCT REPORT

SUGIYAMA

F850 HF/VHF TRANSCEIVER

The Sugiyama F850 is a most unusual animal among amateur transceivers, covering as it does, all UK bands (pre-WARC '79) from 160—2 metres, and all modes. In fact, within its power limitation, it comes close to being a "universal" amateur station, being really three transceivers in one.

The first impression (having recovered from lifting the set from its packing!) was of a superbly engineered piece of equipment, not flashy, but very professional. This was confirmed by the feel of the controls and switches, even before power was applied, and also by the internal construction, with one minor reservation, but more of that anon.

The need for the review set to be returned for an exhibition appearance meant that we did not have time to carry out the sort of measurements that we normally perform on h.f.-band rigs, and the views here are the result of a couple of weeks of testing on the air.

Features

Perhaps the best way to give a run-down on the operating features is to describe the function of each control and connector. Starting at the top left-hand corner of the front panel, we find a large illuminated meter, controlled by two push-button switches. This indicates r.f. power output or the compression level of the speech processor when on transmit, and received signal strength or f.m. tuning point (centre zero) on receive. The 5-digit frequency display is bright, and stable in the last digit (100Hz) and indicates true transmit and receive frequencies, including any shifts.

Band switching is by push-button, and is arranged in 500kHz sections. To reduce the number of push-buttons required for band switching, two banks of eight are provided, one covering the eight bands, the other the eight 500kHz-wide sub-bands. In the UK model, only the lower four sub-bands are used, but in export models for Regions 2 and 3, a 4MHz spread is required on the 6-metre (fitted in place of the UK 4-metre band) and 2-metre bands. An invalid selection of bands or sub-bands will cause the frequency display to flash, alerting the operator to his error.

Below the band and sub-band switches, is another bank of 16 buttons. Four of these allow the transmit and receive frequencies to be controlled from the internal v.f.o. or an external source, as desired. A further four buttons select the receive i.f. bandwidth on c.w., a.m. and s.s.b. Only the 2·4kHz filter is fitted as standard, the remainder being optional extras. The bandwidth on f.m. is fixed at 16kHz.

The lowest row of buttons control a 10dB r.f. attenuator, a noise blanker, a 25kHz crystal calibrator and select the mode—c.w., u.s.b., l.s.b., a.m. and f.m.

At the bottom right-hand corner of the front panel are the receiver incremental tune (±5kHz) and variable b.f.o. (±2kHz) controls, each with its on/off selector button and warning l.e.d. indicator. When on 2m f.m., these push-buttons instead select repeater shift and automatic 1750Hz toneburst respectively, though there is no indication of this on the front panel markings.

The main tuning control is a heavy flywheel knob, approximately 55mm in diameter, with a finger-dimple for rapid winding, and placed well clear of all other controls. The tuning rate is about 16kHz per revolution. Like all the rotary controls on this set, the operation is silky smooth.

To the left of the main tuning are four knobs: the microphone gain control, setting speech level and compression; the r.f. power control, allowing the output to be varied between 1W and 10W (nominal) on f.m. and c.w.; the squelch control (f.m. only) which is of the "gradual" type, rather than the "step" type, and so is precisely settable, rather than having hysteresis; the receive volume control (a.f. gain). A large push-button switch turns the power on and off, and three smaller ones connect the p.t.t. lines and select "fast" or "slow" VOX time constants. Normally, "fast" would be used for c.w. (the Morse key controls a tone oscillator, which provides sidetone and keys the transmitter via the VOX), and "slow" would be used for speech. Connectors for headphones (4–8Ω), and 600Ω microphone with p.t.t. complete the front panel features.

On the rear panel are three sockets, all SO-239 u.h.f. type, for h.f., 4m and 2m aerials, plus connectors for external v.f.o., linear amplifier, p.t.t., key, extension loudspeaker (4–8Ω) and power. Two power leads are provided, one for a.c. mains, the other for 13·5V d.c. M or /P operation, and both fitting the same connector.

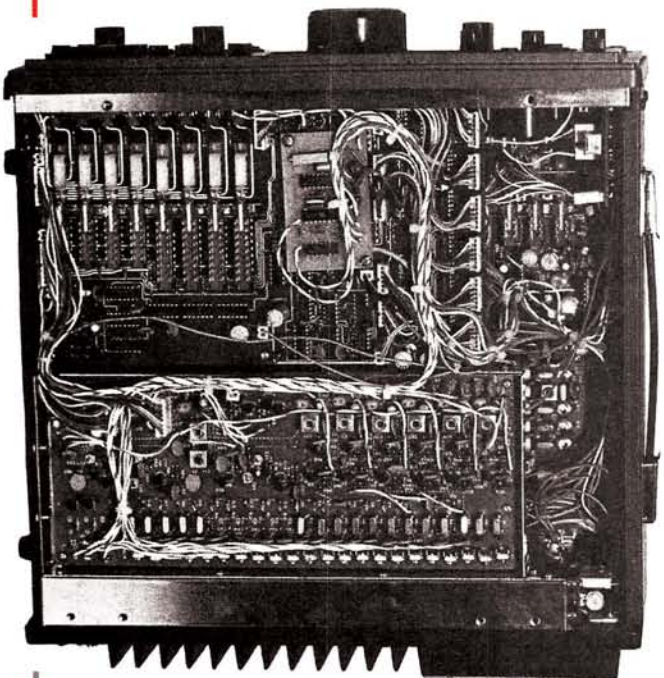
Operating Impressions

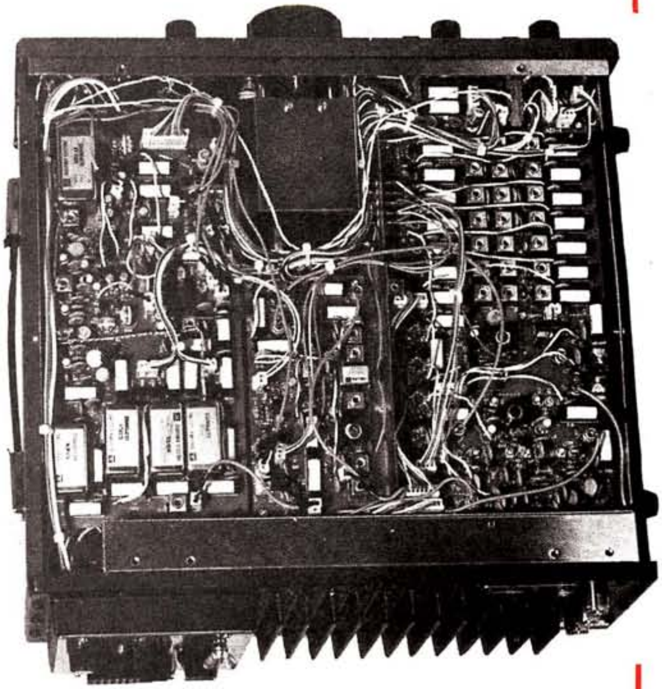
Contacts were made on all bands except 70MHz, and all modes, over a period of about two weeks in March this year. No stations were heard on 70MHz, though on an admittedly makeshift aerial. Contacts on c.w. with W/VE-land on 20m, 15m and 10m, all brought reports of around the S4–S6 mark, which can't be bad for a set pushing out a measured 12–14W via a Z-match into a 60ft long wire. Similar results were obtained on 80m and 40m, with European stations.

Phone contacts around the UK brought reports of really excellent speech quality on 80m and Top Band, the latter using a large "T" aerial at a different QTH, as the long wire refuses to tune at those frequencies.

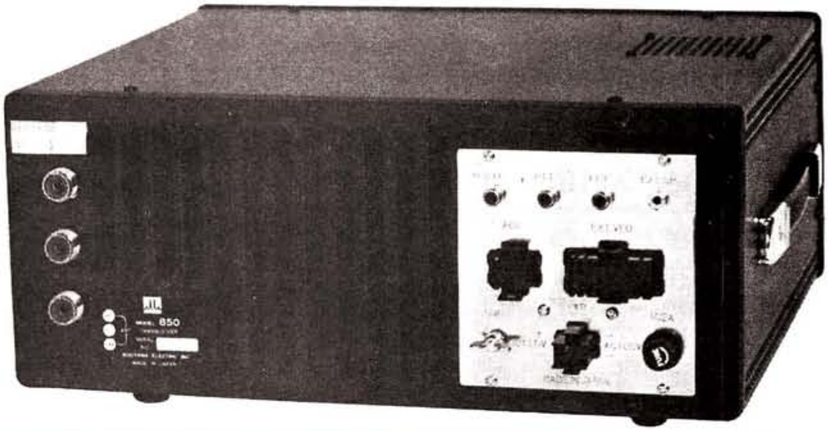
Front panel view of the F850 showing the various controls and indicators. The frequency is displayed as a digital readout with an analogue S meter to its left

Bottom view of the transceiver gives some indication of the excellent workmanship as well as the complexity of the rig





This top view shows the complexity of the switching arrangements together with the many crystals needed to cover the bands



As well as acting as the main heatsink for the unit the rear panel also carries the various aerial sockets and the power inlets

★ specifications

Frequency coverage:	
	1·5–2·0MHz
	3·5–4·0MHz
	7·0–7·5MHz
	14·0–14·5MHz (extended to 15MHz on receive only)
	21·0–21·5MHz
	28·0–30·0MHz
	70·0–71·0MHz
	144·0–146·0MHz
Types of emission:	
	A1, A3, A3J, F3
Power output:	A1, A3J, F3:10W, A3:5W
Carrier suppression:	
	Better than 40dB
Sideband suppression:	
	Better than 40dB at 1kHz
Spurious radiation:	
	Down 50dB or more (1·8–28MHz band)
	Down 60dB or more (70–144MHz band)
Harmonic radiation:	
	Down 60dB or more (1·8–28MHz band)
	Down 70dB or more (70–144MHz band)
Distortion products:	
	Down 30dB or more
Aerial output impedance:	
	50Ω unbalanced
Frequency stability:	
	Less than 100Hz drift in any 30 minute period
Receiver sensitivity:	
	Better than 0·3μV for 10dB S/N (1·8–14MHz band)
	Better than 0·2μV for 10dB S/N (21–144MHz band)
Selectivity:	0·4kHz, 1·2kHz, 1·8kHz, 2·4kHz (–6dB): A1, A3, A3J
	16kHz (–6dB): F3
Intermodulation— 2-tone dynamic range:	
	100dB (1·8–14MHz band)
	95dB (21–144MHz band)
Intercept point:	28dBm (1·8–14MHz band)
	13dBm (21–144MHz band)
Intermediate frequency:	
	12·375MHz (single conversion)
Image rejection:	Better than 60dB
IF rejection:	Better than 70dB
Squelch sensitivity (F3):	
	0·33μV or better
Audio output:	2·5W
Power consumption:	
	240V 50/60Hz; 50VA (receive) 118VA (transmit)
	13·5V d.c.: 1·5A (receive) 3·5A (transmit)
Dimensions:	356 x 153 x 356mm
Weight:	13·6kg (approx)

On 2m f.m., a rather poorly sited "Slim Jim" brought an S9 report from a hand-held, operating indoors, about five miles away on the other side of a hill. Other contacts around the district seemed to produce similarly respectable results. A quick test on 2m s.s.b. using an 8-element Yagi at a different QTH seemed to suggest that receive sensitivity was somewhat down, by comparison with another rig.

Apart from this, the receiver side performed superbly, the very low rate of the main tuning making s.s.b. operation a joy. The r.i.t. rate was, as on almost all sets looked at recently, greater than desirable, or indeed necessary. As to the switchable bandwidth facility, the basic 2·4kHz performed well on s.s.b. and a.m., whilst 1·2kHz was good for c.w. searching, and 0·4kHz excellent for winkling out c.w. from the QRM. The 1·8kHz filter did not seem to fill any particular need. The audio output quality was reasonable, but suffered from being emitted from an upward-facing loudspeaker. An external speaker was not tried.

The operating manual supplied with the set very definitely did not match up to its quality, being a duplicated typewritten document just 13 pages long. No technical description of any sort was included, though there was a circuit diagram on a loose sheet. This had obviously been reduced from a very much larger original, and would require either extremely good eyesight or a magnifying glass to be of much practical use. The operating instructions given were quite comprehensive. We understand that a better manual is in preparation.

I mentioned earlier one reservation on the internal construction, and this was regarding the linkage between some of the push-buttons and their switches. However, the remainder of the set gives such an impression of being designed and built by people who know exactly what they are about, that I'm prepared to give them the benefit of the doubt on this point. Certainly, I had no problems during the tests, and the importers say they have had none either.

So there we are. The F850 is a bit weighty, and rather low in power, though the importers, Zycomm, do offer a suitable 220W linear for the h.f. bands at around £80 including VAT. On a value-for-money basis, it seems pretty competitive with an assemblage of sets and converters to provide the same facilities, though it does sound a lot of money for a 10W transceiver at first sight. There is, I suppose, the "eggs in one basket" aspect as well. Finding a spot for mobile installation will prove a problem in most cars.

Price

The Sugiyama F850 is currently priced at around £900 with all filters fitted, and is available from **Zycomm Electronics Limited, 47/51 Pentrich Road, Ripley, Derby DE5 3DS, telephone Ripley (0773) 44281,** to whom we offer our thanks for the loan of the review unit.

OF THE MONTH

Brian DANCE M.Sc

µA78S40 SWITCHING REGULATOR

During the past few years quite a number of monolithic linear i.c.s have been introduced which contain all of the semiconductor devices needed for use in a switching regulator circuit. The Texas Instruments TL496 and TL497 have already been discussed in *PW* together with the principles of operation of switching regulator circuits. This month's device operates in circuits of the same general type as those used with the TL497 i.c. and readers who wish to understand the operational principles of such circuits should refer to our December '79 issue.

Comparison

The Fairchild µA78S40 performs functions rather similar to those of the TL497—there are various differences between the two devices, however. For example, the Fairchild µA78S40 can operate from input voltages in the range 2·5V to 40V, whereas the recommended range for the TL497 is 4·5V to 12V (with a 15V absolute maximum). The µA78S40 can provide an absolute maximum *output* voltage of 40V whereas the TL497 has an absolute output maximum of 35V. The minimum output voltage in the step-down configuration is limited in both devices by the value of the internal reference voltage source, quoted as 1·3V for the µA78S40 and 1·2V for the TL497. The µA78S40 can provide output currents of up to 1·5A without the use of external transistors, and the TL497 can handle 0·5A; however, much higher currents can be obtained from circuits using either device if one or more external transistors are employed. The i.c. then switches the transistors (mounted on suitable heatsinks) between the "conducting" and the "non-conducting" states so as to maintain a constant output voltage.

A particular advantage of the µA78S40 is the low standby current drain (typically 2·3mA to 2·8mA, compared with approximately 6mA, in the case of the TL497). The µA78S40 is supplied in a 16-pin d.i.l. package (the TL497 has a 14-pin d.i.l. case) and both devices have on-chip protection circuits which limit the maximum current to a value small enough to prevent damage in the event of the output becoming short-circuited, etc.

Connections

The pin connections and internal configuration of the µA78S40 switching regulator sub-system are shown in Figs. 1 and 2. The circuit blocks on the chip include an oscillator whose frequency is determined by the value of a capacitor connected to pin 12. A portion of the output voltage is tapped off by a potential divider and the internal comparator is used to compare this fraction of the output voltage with the internal temperature-compensated reference voltage.

The comparator, in turn, feeds a logic circuit controlling a driver transistor; this feeds an internal power transistor which acts as a switch for fairly high voltages and currents. The power diode (D1) required for the step-down and step-up voltage circuits is integrated onto the chip, but an external diode is used in the voltage inverter circuit design, which will be described later. The diode has the same current and voltage ratings as the transistor output device; typical switching times of 300 to 500ns are obtainable.

An operational amplifier has been included (in order to increase the circuit flexibility) although this is not required in the basic circuits in which the device is normally employed. The performance of this op. amp. is rather similar to that of the well-known 741 device, but a power output stage has been incorporated so that it can deliver an output current of up to 150mA and so that it can accept (or sink) a current of up to 35mA. The input circuit of this amplifier has been modified so that it will operate correctly with input voltages right down to the negative supply line potential, which enables the amplifier to be used with a single power supply (when the input could fall to 0V) instead of the more normal positive and negative arrangement.

Applications

A few typical applications of the µA78S40 are given in this article but the design of switching regulator power supplies is a complex subject and it is possible only to scratch its surface in the space available here! For simplicity's sake, the discussion is limited to advising readers as to how they can make some typical circuits work without much trouble, rather than covering details of the numerous circuits in which this very versatile device can be employed by an experienced and clever circuit designer! Much more detailed circuit designs have been published by Fairchild (Application Note 344) but it is, as we said, a complex matter indeed.

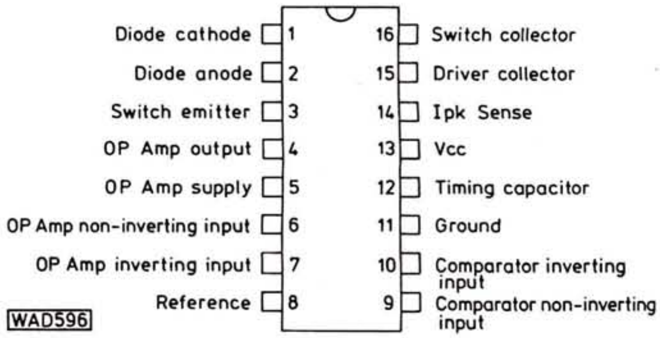


Fig. 1: Pin connections to the µA78S40

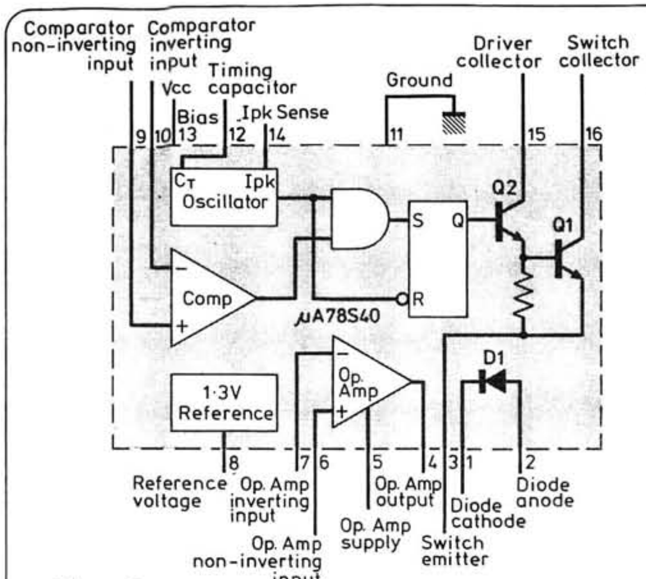


Fig. 2

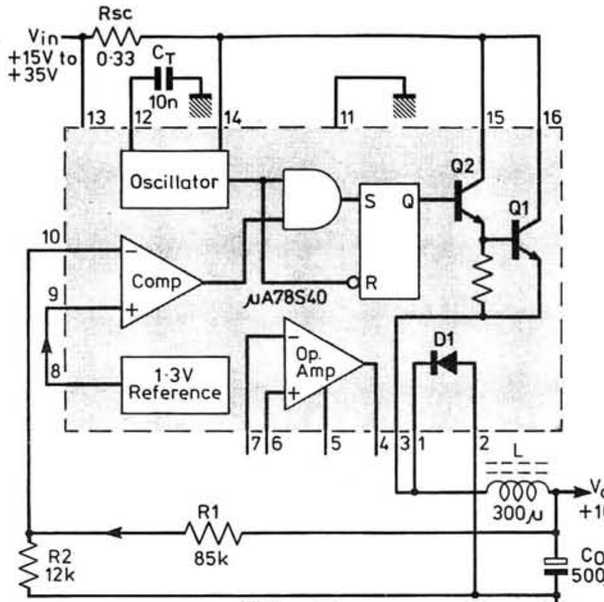


Fig. 3

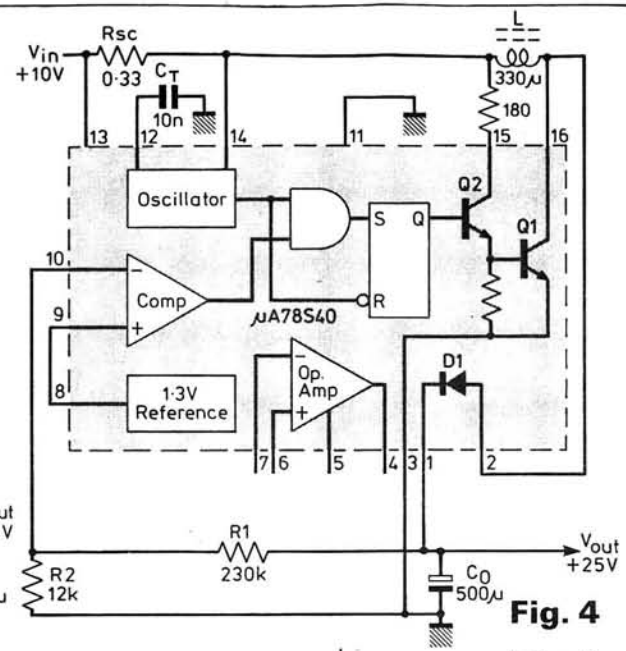


Fig. 4

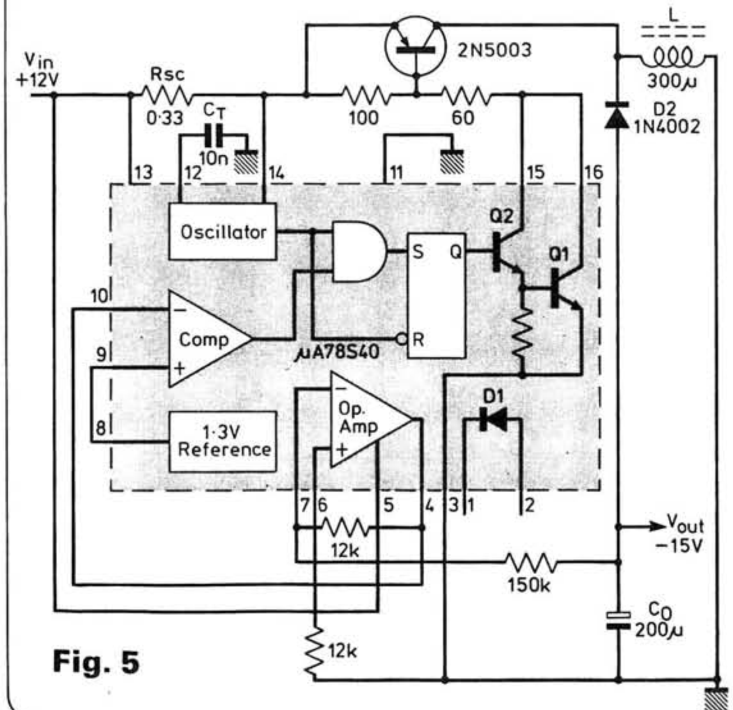


Fig. 5

Fig. 6

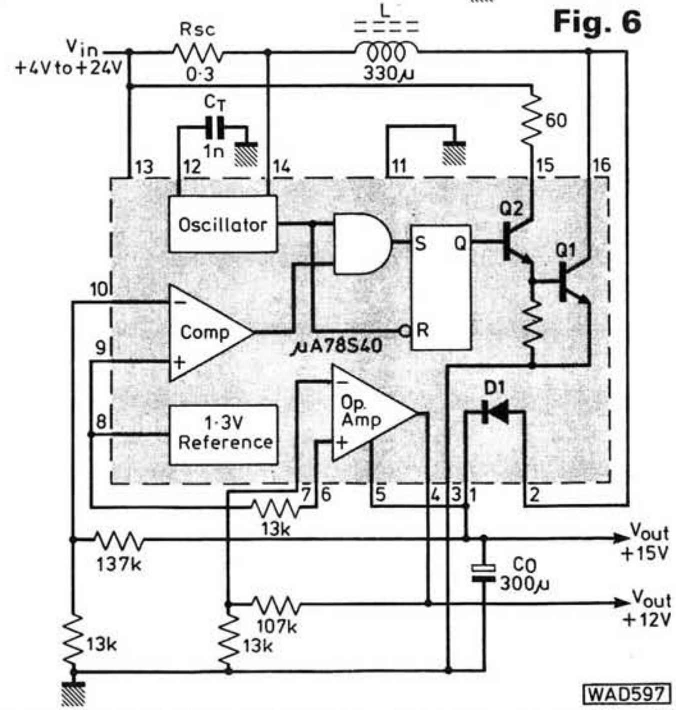


Fig. 2: µA78S40 internal circuit

Fig. 3: Step-down regulator circuit

Fig. 4: Step-up regulator circuit

Fig. 5: Polarity inverter circuit

Fig. 6: This circuit produces +12V and +15V from any input voltage in the range +4 to +24V

Step-down Regulator

A simple step-down circuit using the μA78S40 is shown in Fig. 3. When the component values shown are used, this circuit accepts an input supply of about 15V to 35V and produces an output of +10V at a current of up to approximately 0·5A. Unlike series voltage regulator i.c.s, the input power is used with a relatively high efficiency, typically 74% when the output current is 200mA. Thus the output current normally exceeds the input current—if the input voltage rises, then the input current automatically falls (assuming that the output current is being drawn), since the input power is used so efficiently.

A portion of the output voltage is tapped off by means of the potential divider circuit R1/R2. This portion of the output voltage is fed to the inverting input of the comparator while the 1·3V reference voltage is fed to the non-inverting input. The circuit feedback system ensures that the output voltage changes so as to keep the two inputs to the comparator at almost the same level; the output voltage is equal to the 1·3V internal reference multiplied by: (R1 + R2)÷R2.

In this case, it works out as just over 10V, but the value of the internal reference can be from 1·18V to 1·31V depending upon the individual device; if an output of exactly 10V is required, arrangements must therefore be made to vary the ratio of the potential divider accordingly.

In a typical circuit the output voltage varied by only 1·5mV as the input supply voltage was increased from +20V to +30V—similarly as the output current was increased from 5mA to 300mA, the output voltage changed by only 3mV. The output ripple at the switching frequency was about 50mV in this type of circuit.

The op. amp. is not used in the Fig. 3 circuit and can therefore be used for any other appropriate purpose. The reference voltage is also available (pin 8) for other purposes, but the maximum current that may be drawn from this pin is 10mA, *and must be observed.*

Capacitor C_T determines the basic circuit timing of the oscillator. If the value shown (10nF) is employed, the charging current of 25μA produces an "on" time of some 200μs during which the output transistor conducts. Similarly, the discharging current of about 225μA produces an "off" or "non-conducting" time of about 22μs with this same capacitor value. Although the ratio of the basic "on" time to the "off" time is internally set at 8:1, the user can reduce this ratio by a suitable choice of resistor R_{SC}, this determines the peak current.

The oscillator timing is fairly critical if optimum performance is to be obtained. If the "on" time is too short, then the peak current through the inductor (L) and hence the maximum output current are reduced. An excessive "on" time can result in high currents and possibly even the destruction of the device and the same effect can be produced by a very short "off" time. A long "off" time can result in a reduced maximum value of the output current—thus one should be wary of altering the component value unless one knows what one is doing!

Step-up Regulator

The regulator circuit of Fig. 4 provides an output voltage which is greater than the input voltage. In this circuit the output voltage is again equal to:

$$1{\cdot}3\,(R1 + R2) \div R2.$$

When an output current of 50mA was taken from this circuit, the overall power efficiency was found to be typically 79% and the output ripple at the oscillator frequency about 30mV. The maximum output current was about 160mA. As the input supply voltage rose from 5V to 15V, the change in the output voltage was only about 4mV. Load regulation was also very good, an increase in the load current from 5mA to 100mA producing an output voltage change of only approximately 2mV.

Inverter

A μA78S40 circuit is shown in Fig. 5 which provides a negative output voltage from a positive input voltage; it is therefore known as an "inverter" circuit. This circuit requires both an external *pnp* power transistor (such as the 2N5003) and an external "catch" diode, D2. Efficiencies as high as 93% at full load and 90% at 10% of full load have been reported for this circuit.

In the inverter mode, the internal op. amp. is used to invert the polarity of the part of the output voltage tapped off by the potential divider circuit so that the resulting positive potential can be compared with the positive reference voltage. This technique is possible only with an op. amp. which can operate with an input down to 0V.

A particularly interesting feature of this inverter circuit is that no part of the μA78S40 device is connected to the full output voltage. Thus the maximum value of the output voltage is not limited by possible breakdown of the device itself. The readily available 1N4002 is shown for D2, but for maximum circuit efficiency (output power/input power) a fast-switching Schottky diode may be used.

Fig. 6 shows a circuit which will accept any input voltage from +4V to +24V and which will provide outputs of +15V and +12V. Thus the output voltages may be either lower or higher than the input voltage. The basic circuit is essentially similar to that of the step-up circuit of Fig. 4, the basic circuit which provides a 25V output supply. However, the internal op. amp. is also used as a series pass regulator which converts the +15V supply into a +12V output. When the input voltage exceeds +16V, the step-up regulator output of +15V follows the input voltage at approximately (V_{in} − 1), but the potential of the +12V line remains virtually constant.

A particular advantage of this circuit is the high ripple rejection provided by the op. amp. This rejection is typically 100dB (minimum 76dB in any μA78S40 device) and therefore output ripple at the oscillator frequency is virtually non-existent on the +12V line. However, the use of the op. amp. as a series regulator reduces the power efficiency of the circuit somewhat at the higher input voltages; the overall efficiency of this circuit is quoted as about 50% for both the upper (+24V) and lower (+4V) limits of the input voltage range, but increases to a maximum of about 75% for intermediate voltages.

Inductor

Switching regulator circuits require an inductor and this is always an added complication for the home constructor. The inductor values suggested of 300μH and 330μH can be easily made, however, using Mullard RM6 and RM10 cores, which are readily available with an inductance factor (A_L) of 250nH in the case of a single-turn coil. As the inductance is proportional to the square of the number of turns it is easy to calculate that 35 turns on one of these cores will produce an inductance of approximately 300μH and 36 turns about 330μH.

The RM10 core has larger dimensions than the RM6 core and, although the same number of turns are required with either type of core, the maximum wire diameter which

continued on page 61▶▶▶

NEXT MONTH IN...

practical WIRELESS

A PW Scoop!

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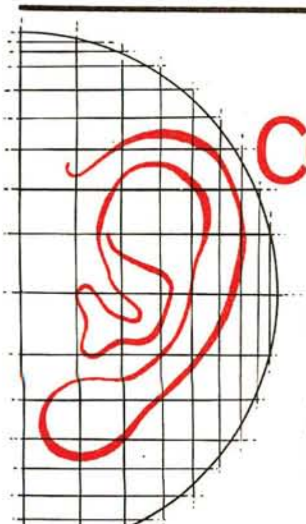

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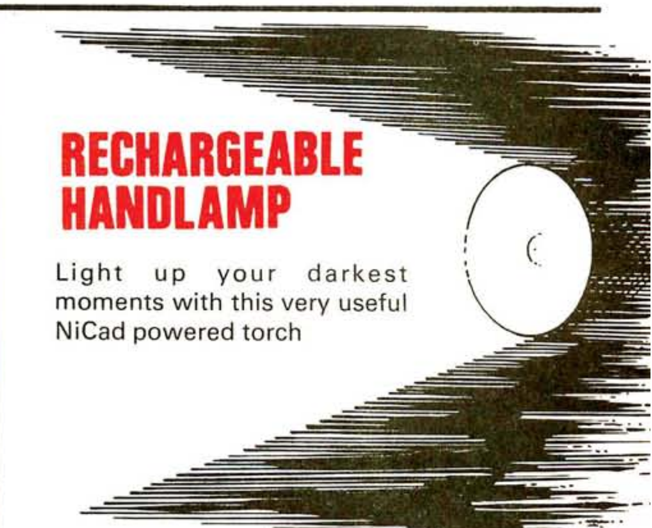


TRANSCEIVER POWER UNIT

R.A.Ganderton G8VFH

The modern mobile rig is designed to run from the car's 12 volt supply. This ensures that the transceiver is fed from a low impedance source, as long as the cable used to feed the rig is large enough, but it does give problems when the transceiver is removed from the vehicle and used as a fixed station.

Commercially-built power supplies are available but these tend to be rather expensive if they are conservatively rated. To run a v.h.f. or u.h.f. f.m. transceiver giving around ten to fifteen watts r.f. power output the power unit will need to be able to supply a nominal 13·8V at 5A continuously. The current taken by an f.m. transmitter, unlike an a.m. one, is constant and the unit described here is capable of giving 5A all day, with 6A available but with increased ripple. Short-circuit protection is incorporated together with full over-voltage protection to guard against possible regulator failure.

Raw Power Supply

The raw d.c. supply is conventional with a high current bridge rectifier feeding into a large reservoir capacitor. This capacitor must be capable of handling very large ripple currents and this unfortunately means that it will not be cheap. The primary of the mains transformer is fused and incorporates a filter built into the mains input plug. The raw d.c. supply is also fused with a 7·5A fast blow fuse which is also part of the overvoltage protection.

Stabiliser

It is desirable to have a stable output voltage to avoid large fluctuations in the performance of the transceiver. The stabiliser helps with smoothing the supply and also provides a low output impedance.

With high current supplies the choice of stabiliser can prove to be a problem as there are very few i.c. regulators available capable of handling five or six amps particularly if reasonable cost is of importance. Discrete components can be used but this approach can also prove bulky as well as pricey.

For this unit a 78HG 5A variable regulator i.c. was chosen as this is reasonably priced, provides full overload and thermal protection and allows the output voltage to be adjusted exactly to the 13·8V recommended by the majority of transceiver manufacturers. The 78HG is a four terminal device in a TO3 case and can supply 5A continuously, with current limiting coming in at 7A. The output voltage is controlled by varying the voltage on the control pin of the regulator. Capacitors C2 and C3 prevent the regulator from bursting into high frequency oscillation.

Overvoltage Crowbar

The regulator will not function unless the input is more than 3V greater than the output required and in this power supply the raw d.c. input to the regulator will be 1·4 × Vr.m.s. or 21V with a 15V transformer. If the regulator chip fails and goes short-circuit then all of the 21V will appear at the output terminals and cause a lot of damage to the expensive transceiver.

Overvoltage protection can be simply added with a cheap overvoltage protection i.c. such as the 3423. This monitors the output of the power supply and when it senses that the output has exceeded a preset value the output of the i.c. triggers a thyristor arranged so as to short-circuit the supply and blow the fuse.

Overvoltage crowbar i.c.s have a reputation for firing at the slightest provocation and this can be very inconvenient, especially if the fuse is blown each time. For this reason the crowbar is arranged to ignore very short duration transients but to fire if the output rises above, say, 15V for longer than 200µs. In practice this has proved to

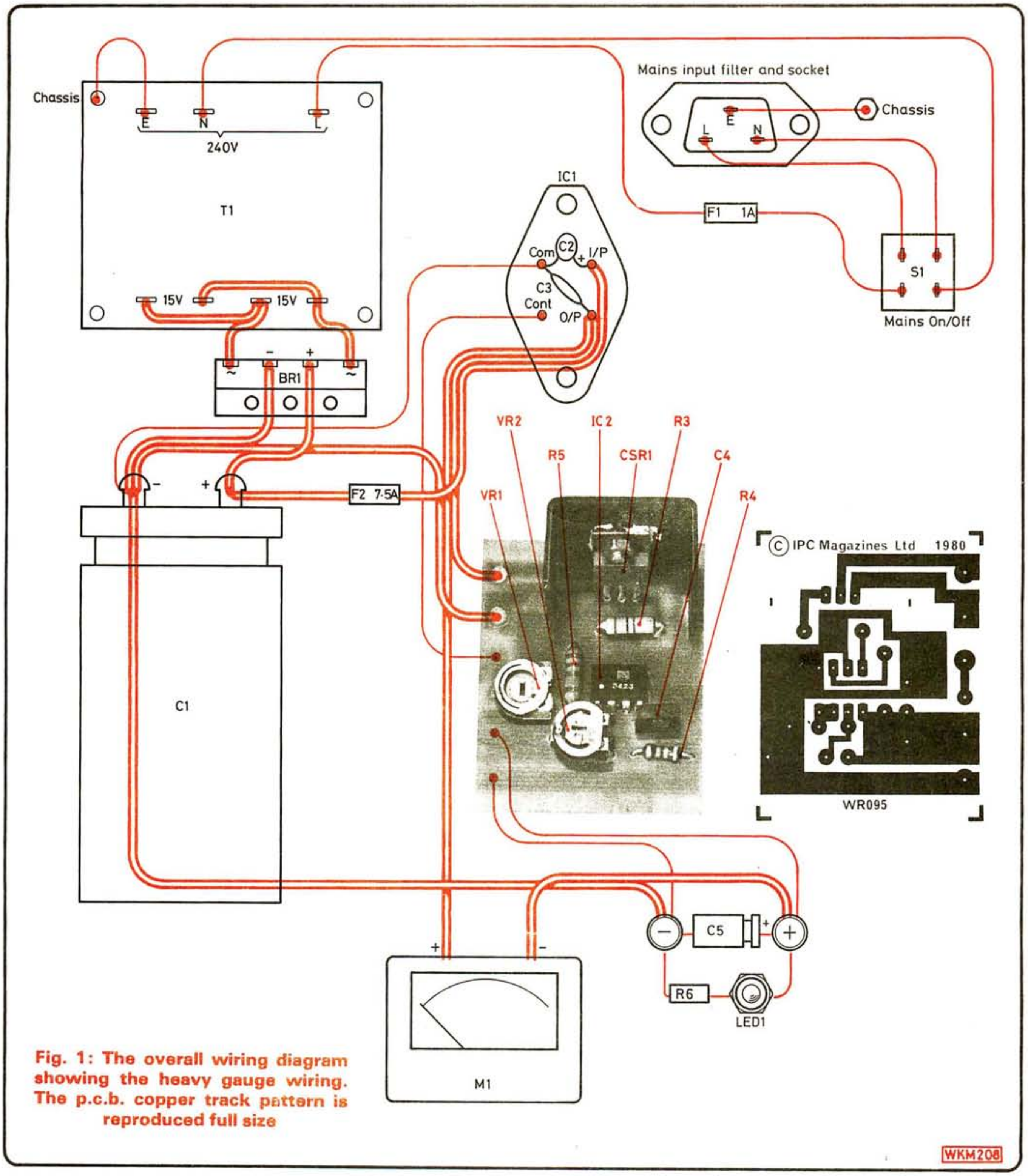


Fig. 1: The overall wiring diagram showing the heavy gauge wiring. The p.c.b. copper track pattern is reproduced full size

be about right as tripping is very rare. The 1000μF capacitor across the output terminals prevents the output rising faster than the sensing voltages on the i.c. during initial switch on. If this happens the crowbar trips, making it difficult to actually switch the supply on.

The thyristor, which shorts the supply when the crowbar trips, is connected across the output of the regulator rather than the input This has the advantage of using the current limiting facility of the regulator, limiting at 7A, instead of blowing the fuse. The fuse will still blow however, if the overvoltage condition is caused by regulator failure.

Construction

As long as a large enough heatsink can be provided for the regulator and bridge rectifier the unit can be built into any case. The prototype was built into a West Hyde Swiftcase which not only gives the supply a professional appearance but has the advantage of providing adequate heatsinking as well.

The regulator has an insulated case so no insulating kit is required when mounting it on the back of the case. However, the holes must be deburred and heatsink compound should be used to ensure good thermal connection.

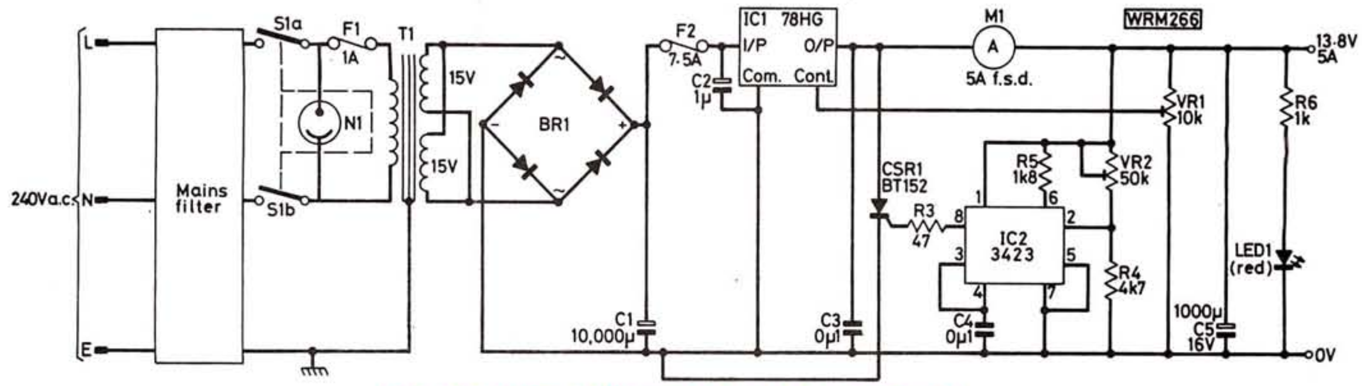


Fig. 2: The circuit diagram of the 5A power supply

The transformer, mains filter, plug and fuse are also mounted on the back of the case. The front panel carries the mains switch, ammeter if desired, output terminals and an indicator lamp to show the state of the overvoltage trip.

The thyristor, overvoltage trip i.c. and the presets for overvoltage level and output level are mounted on a small p.c.b. which can be secured to the case bottom by self-adhesive foam pads.

The wiring of the unit is important as the currents involved are very high. All high current paths should be wired using 1·5mm² cable. The voltage control and sensing wiring can be carried out in more normal thickness wire. It is advisable to follow the wiring diagram (Fig. 1) even if a different case is used.

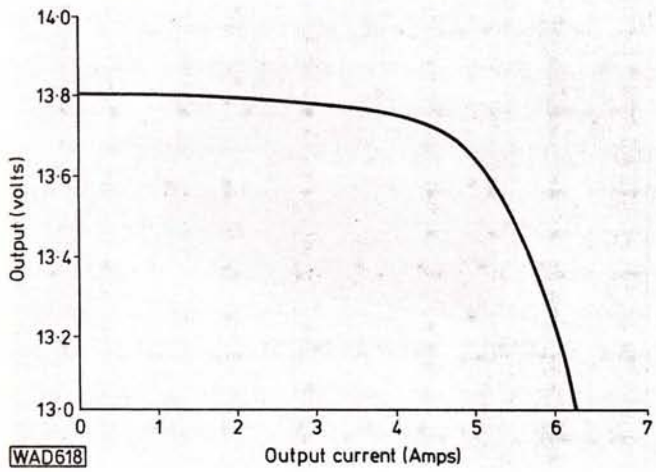
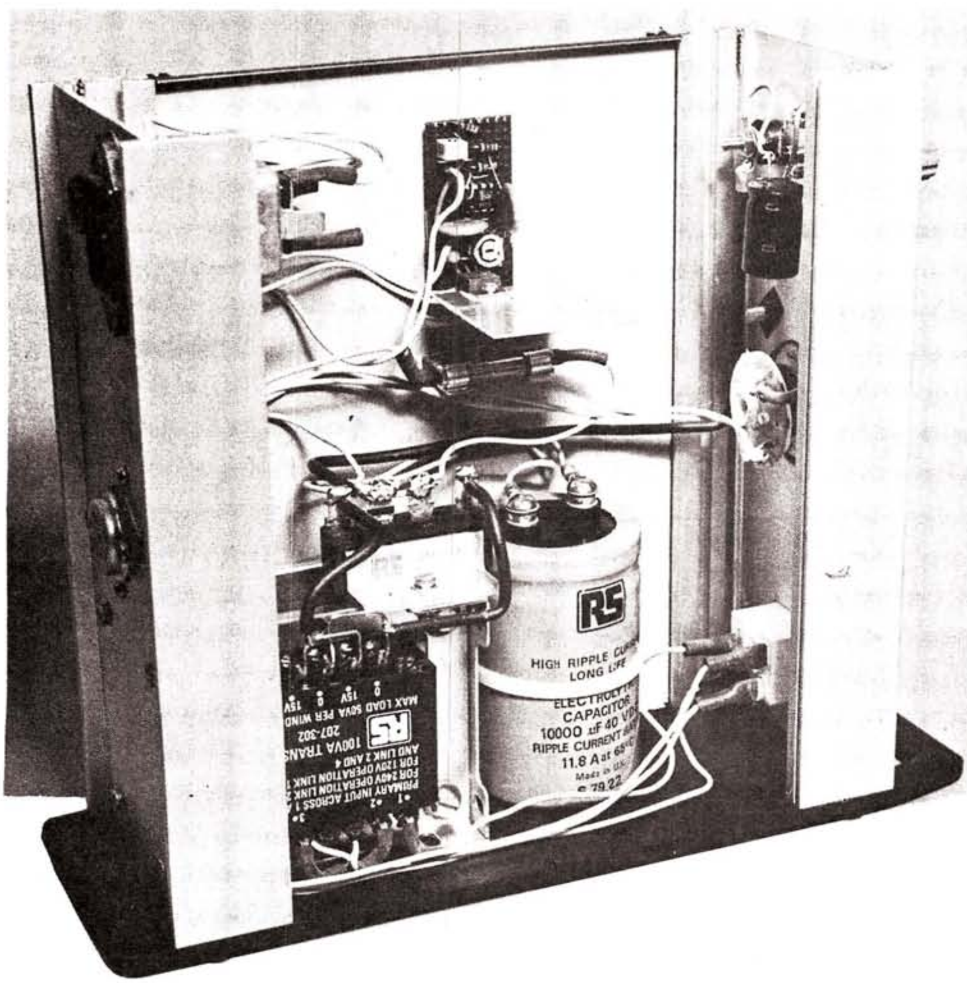


Fig. 3: The performance of the prototype unit is shown in this graph. The maximum short-circuit current is held at 7A by the regulator itself and up to 5A the regulation is good. The output ripple increases at about 5A as the regulator starts to drop out on the negative going ripple peaks but this could be improved by increasing C1, at greater expense



The interior of the prototype unit. The actual positioning of the components is not critical, but high current paths should be kept as short as possible to prevent excessive voltage drop occurring. The overvoltage crowbar circuit is built here on Veroboard, but the final version uses the p.c.b. shown in Fig. 1

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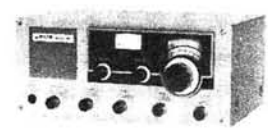


SRX30

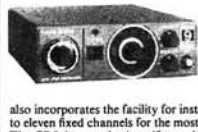
The SRX-30 represents a new step forward for the keen short wave listener or the radio amateur who needs to tune frequencies outside the amateur bands.
In the past, the performance of general coverage receivers has been limited by the dificulty inherent in setting to a known frequency – OK, so you know that Radio Peking is on 8547 KHz but how do you set the receiver dial?
The SRX-30, due to application of new technology solves the problem by utilising a drift cancelling loop system converting to a very high (40 MHz) first IF so as to remove image interference problems. This is followed by a stable VFO controlled tunable second IF with excellent reset accuracy. The frequency range covered by the SRX-30 is 500 KHz – 30 MHz in thirty bands, each 1 MHz wide. If you wish to tune to say 14250 KHz, simply set the MHz dial to 14, the KHz dial to 250 and there you are, no fuss, no twiddling, no need to use calibrators, etc. (remember the drift cancelling system).
The SRX-30 is housed in a rugged metal case and operates from 240V ac mains or 12V dc supply. Reception modes are USB/LSB/AM/CW to cater for all HF operation and the receiver is equally at home on VHF using an external convertor.
This receiver combines small size, accurate readout, ease of use, all mode operation, mains/battery power supply and excellent performance at a remarkably low price.
See it, use it and you will like it.
Price **£178·00** including V.A.T. Carriage £4·50.

FS10

The FS10 VHF FM monitor receiver is a high performance unit in such a small lightweight package that it will fit into a pocket. The receiver can be aligned for the 2 metre amateur band or the VHF marine band and provides top performance on either band.
The FS10 automatically scans up to ten crystal controlled channels, stopping on any channel where a signal is present. Manual selection of any channel is also provided. Complete with rechargeable battery pack, charger and personal earphone with provision for external antenna.
Price **£82·00,** including V.A.T., crystals extra. (Fitted ten channels **£109·25,** including V.A.T.) Carriage £1·50.

AMR217B

The AMR217B VHF FM monitor is an outstanding receiver suitable for either the 2 metre amateur band or the VHF marine FM band and can be supplied for either band on request. The AMR217B has an eight channel scanning facility and can also accommodate up to ten additional switched channels to extend its versatility even further. The receiver is extremely sensitive and is one of the best monitor receivers available to either the amateur or professional user. It is completely self-contained with a built-in speaker and operates from 240V AC mains or 12V DC supplies. A matching mobile mount is supplied to allow easy installation in boat or car.
price £120·75, including V.A.T. (fitted 8 crystals). Carriage £1·50.



SR9

The SR9 represents the finest value for money ever offered in the FM monitor receiver market. Available in two versions to suit the 2 metre amateur band or the VHF marine FM band the SR9 gives fully tunable coverage of either band and also incorporates the facility for installing optional crystals which will provide up to eleven fixed channels for the most popular frequencies.
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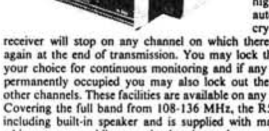
Price **£46·00,** including V.A.T. Carriage £1·50.

AP12

The AP12 is a 12 channel crystal controlled airband monitor receiver covering a frequency range from 108 to 136 MHz which utilises a micro-computer which automatically peaks the R.F. oscillator and mixer stages in accordance with the crystal frequency in use. This means that you can install crystals for any frequency in the entire band without any drop in performance. Supplied complete with rechargeable battery pack, charger and personal earphone.
Price £89·70, including V.A.T. Fitted 12 channels: £118·45, including V.A.T.
Carriage £1·50



R512

The R512 airband receiver is a high performance unit which automatically scans up to eight crystal controlled channels. The receiver will stop on any channel on which there is a transmission, stepping on again at the end of transmission. You may lock the receiver onto any channel of your choice for continuous monitoring and if any channel should be more or less permanently occupied you may also lock out the channel to permit scanning of other channels. These facilities are available on any or all channels.
Covering the full band from 108-136 MHz, the R512 is completely self-contained including built-in speaker and is supplied with mains and 12V DC power leads, whip antenna, mobile mounting bracket and personal earphone.
Price including five fitted channels is **£138·00,** including V.A.T. Carriage £1·50.

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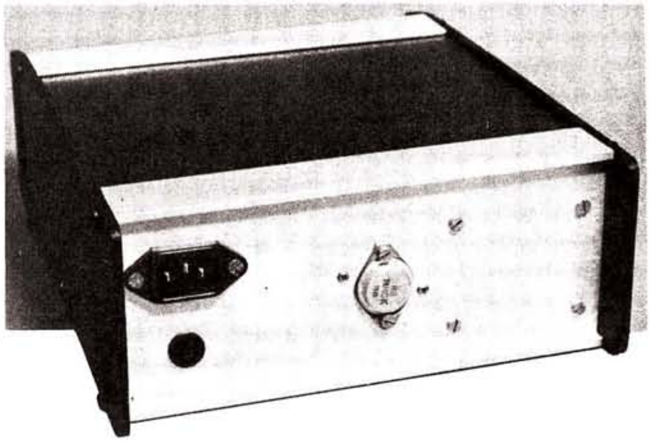
1kΩ	1	R6
1·8kΩ	1	R5
4·7kΩ	1	R4
Potentiometers		
Min. horizontal preset		
10kΩ	1	VR1
50kΩ	1	VR2
Capacitors		
Ceramic		
0·1μF	2	C3,4
Electrolytic		
1000μF 16V	1	C5
10 000μF 40V	1	C1 (see text)
Tantalum		
1μF 35V	1	C2
Semiconductors		
Diodes		
150V 18A Bridge	1	BR1
BT152	1	CSR1
Integrated circuits		
3423	1	IC2
78HG	1	IC1

Miscellaneous
Transformer 15V 100VA; Case, West Hyde Swiftcase SWF222; Illuminated mains switch (S1 and N1); Meter 5A f.s.d.; Mains plug with built-in filter unit; Panel mounting fuse holder; Chassis mounting fuse holder; 4mm insulated terminals, red (1), black (1); p.c.b.; 14-pin d.i.l. socket; Heatsink for CSR1.



The back panel of the West Hyde Brightcase doubles as the heatsink for the regulator. If a different case is used adequate heatsinking must be provided. The integral mains input plug and filter helps to minimise interference being transmitted via the mains wiring

Testing and Setting-up

The overvoltage control VR2 should be set to maximum voltage (minimum resistance) and the output voltage control VR1 set fully anti-clockwise to give minimum output voltage. Switch on and check for any possible signs of trouble. With a voltmeter across the output terminals set the output to 15V by adjusting VR1. Now carefully adjust VR2 until the crowbar trips and the indicator on the front panel goes out.

The only way to reset the trip is to switch off, but before switching on again reset VR1 to give minimum voltage. After switching on again the output voltage can be set to exactly 13·8V and the output checked on load. A short-circuit across the output terminals should give a current of 7A without blowing fuse F2.

If the unit performs satisfactory it can be put into service powering your transceiver. ●

KINDLY NOTE!

Dual Trace Unit, February 1980 and March 1980
There are several minor discrepancies between the circuit diagrams in Part 1 and the p.c.b. layout in Part 2. The p.c.b. layout should be taken to be the definitive version. There are some extra tracks on the p.c.b. track plan which should be removed. These are between the source and gate of Tr603, 604, 605, 606.

'2BCX 16-element 2-metre beam, February 1980
Quite a number of readers have constructed and are successfully using this aerial. Some, however, have chosen to make the driven elements, reflector and directors etc. of 6mm ($\frac{1}{4}$in) aluminium rod or tube instead of 4·76mm ($\frac{3}{16}$in) rod as specified, and as a result found it difficult to get an accurate match to 50 ohms and consequently a rather high s.w.r.

Although it is quite in order to use thicker element material, this does necessitate using a slightly longer matching line (Fig. 5 (a) and (c) in the article). This line may be constructed either from rod of the original diameter or from 6mm (0·25in) rod or tube, but must be about 100mm (4in) longer so that the shorting bar as in Fig. 5 (b) and feed tapping points can be moved further out. All other dimensions and materials remain the same.

introducing RTTY part 1

Jeff MAYNARD G4EJA

Telegraphy (of which RTTY is a development) was the first electrical communications technique to gain widespread acceptance. Samuel F. B. Morse brought together a number of then existing technologies and his own invention—Morse code—to provide the first telecommunications system. For many years the hand key, linked to another with copper wire, was the only means of direct remote communication.

Many brains worked through the turn of the century on improving the Morse code system. A cross between typewriter and a telegraph system was invented by Joy Morton and Charles L. Krum and the resulting Morkrum machine adopted by Associated Press in 1915. Concurrently, one Edward Kleinschmidt devised his own similar machine, and in 1925 he merged his company with Morkrum. Five years later this company was absorbed by AT & T and christened The Teletype Corporation. The machine name Teletype was an amalgam of telegraph and typewriter and is, incidentally, still a registered trademark of The Teletype Corporation. The use of the word to describe any mechanical printer is, strictly speaking, illegal, though like Hoover, it has tended to become part of everyday speech. The pedants amongst us may prefer to use the common abbreviation TTY which is not protected by trademark or copyright legislation.

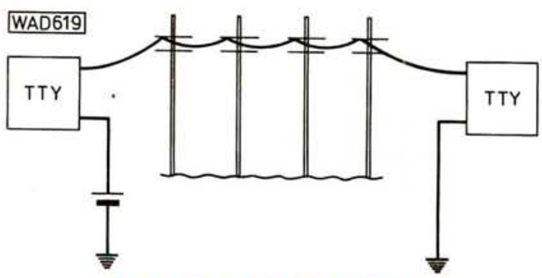


Fig. 1: The basic TTY system

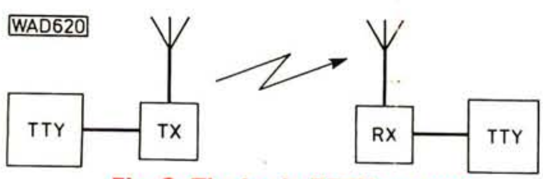


Fig. 2: The basic RTTY system

The developments of remote TTY printing terminals outlined above took place in respect of land-line signalling (Fig. 1) and this should be borne in mind when reading the description of printer interfaces in Part Two of this series.

During World War II, when the modern war machine demanded volumes of textual communications to armies in the field, it became apparent that the land lines hitherto used to link TTY terminals could be replaced by radio transmissions with only minor interface modifications (Fig. 2). Thus RTTY (radio TTY) was born. There then followed parallel developments of RTTY and TTY systems, the latter manifesting itself as the international telex system. The widespread use of TTY machines in commerce and military applications inevitably led to their appearance on the surplus market and hence to their use by amateurs.

RTTY Code Format

The decoding and coding of Morse traffic by machine is complicated by the variable character length and the use of five different signalling units (dot, dash and three lengths of spaces). TTY on the other hand uses only two signalling elements—mark and space—and, because all characters are the same length, there is no significance to any inter-character spacing (there being no intra-character spacing).

Computer enthusiasts will immediately see the possibilities for processing what is basically a binary system. RTTY was developed before the microprocessor of course, and it is therefore more by good luck that computer techniques can be applied to the system. Such methods will be discussed in the final article of this series.

The two RTTY signalling conditions are known as Mark and Space. Mark is the normal or idle condition of the line (the various methods of representing Mark and Space in RTTY will be outlined later). A character is represented by a combination of marks and spaces and defined in the particular code in use. In order that the start of a character can be correctly identified it is always preceded by a space. Thus from the idle condition there will be mark-to-space transition; the space will last for a defined unit of time (depending on the overall system speed) and be followed by a combination of marks and spaces (each of the same defined unit of time) specifying the particular letter or number being transmitted. The character is finished with a stop pulse—always a mark—which is one-and-a-half units of time. So that is the theory of the code; now let us take a detailed look at the code format and the timing.

The Baudot Code

In theory at least, any code could be used to represent characters in RTTY (e.g., ASCII, EBCDIC, ISO and so on). In practice RTTY used the same code as telex—the International Five-Unit Code also known as CCITT No. 2 and Baudot (from the gentleman who devised it). As the name implies, the Five-Unit code uses a combination of five elements (marks and spaces) to represent each character. The total number of combinations available is therefore 32 (2^5). It is clear that this is insufficient for normal use, since the alphabet and a few control characters (such as carriage return and line feed) will need 32, leaving no combinations available for figures, punctuation marks and so on.

Character		Signal element				
Letter shift	Figure shift	1	2	3	4	5
A	–	●	●			
B	?	●			●	●
C	:		●	●	●	
D	wru	●			●	
E	3	●				
F	%	●		●	●	
G	@		●		●	●
H	£			●		●
I	8		●	●		
J	bell	●	●		●	
K	(	●	●	●	●	
L	)		●			●
M	.			●	●	●
N	,			●	●	
O	9				●	●
P	0		●	●		●
Q	1	●	●	●		●
R	4		●		●	
S	'	●		●		
T	5					●
U	7	●	●	●		
V	=		●	●	●	●
W	2	●	●			●
X	/	●		●	●	●
Y	6	●		●		●
Z	+	●				●
Letters shift		●	●	●	●	●
Figures shift		●	●		●	●
Space				●		
Carriage-return					●	
Line-feed			●			

Notes:
wru means 'who are you' and is used in telex.
All space is not used.

● = Mark

WAD621

◀ **Fig. 3: The full Baudot International Five-Unit Code (CCITT No. 2)**

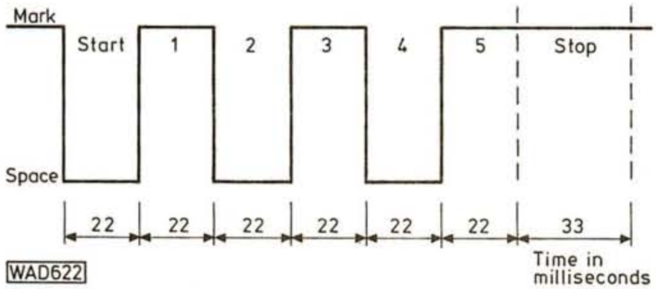


Fig. 4: Composition of an RTTY character

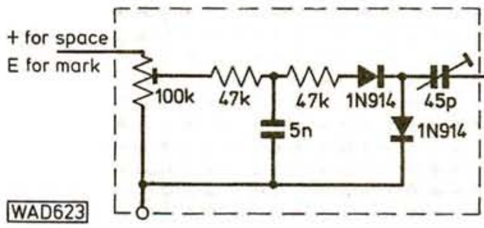


Fig. 5: A simple circuit to produce FSK on a v.f.o.-controlled transmitter

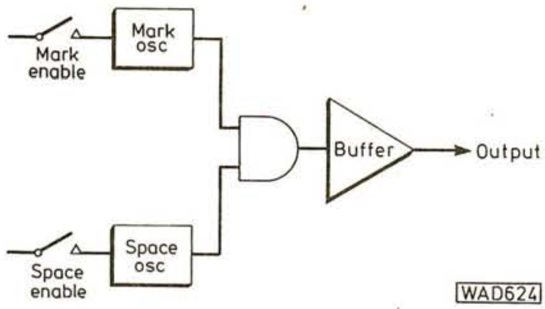


Fig. 6: General principle of an AFSK generator

This problem was neatly circumvented by Mr Baudot who introduced shifts. Thus a TTY machine can be in letter shift or figure shift. When in letter shift, any following keys denote their respective letter; when in figure shift, each key denotes a figure or punctuation mark. To change from one shift to another it is necessary to press the appropriate shift key.

The aspiring RTTY enthusiast should bear the shift system in mind; when tuning into an RTTY signal that appears unintelligible it may be that the receiving machine is in the wrong shift. For example a machine in figure shift will print:

:1 :1 :1 :1

when tuned to a station transmitting:

CQ CQ CQ CQ

The full Baudot code is shown in Fig. 3, to which the following comments apply:

1. Some characters (e.g., line feed) are the same in both shifts.
2. The code pattern is the same as the hole pattern across five-unit paper tape.
3. WRU means who are you and is the signal used in telex to request the remote terminal to send its identification (answerback).
4. All space is not a valid code.

Speeds

The speed of an RTTY signal is expressed in baud, where one baud is equal to one signal element per second. We have already seen that a single RTTY character consists of: a start element; five code elements; $1\frac{1}{2}$ stop elements, giving a total of $7\frac{1}{2}$ elements per character. If then the signal was to be one character per second the RTTY rate would be 7·5 baud.

Most commercial RTTY is at 50 baud (telex being 75 baud) whilst amateur RTTY enthusiasts have standardised at 45·45 baud. Each code element is therefore 22 milliseconds long (60 divided by 45·45) and a complete character is 165 milliseconds long. Fig. 4 illustrates the basic RTTY character timing. From the idle mark state the character always starts with a 22ms space; this is followed by five character elements (10101 in the example) each also 22ms in length; the character is terminated by a stop pulse—always mark—of 33ms (one-and-a-half elements) in length. The amateur RTTY speed corresponds to six characters per second or (for average five-character words plus inter-word spaces) to 60 words per minute; this nomenclature is used by North American amateurs in preference to baud rates.

The timing of RTTY signals is important both in receive and transmit if correct decoding is to be guaranteed. Note that, unlike some modern data transmission codes, Baudot does not contain any mechanism for error checking. Distortion in the received pulse chain can lead to erroneous decoding. The two most common forms of distortion (which can arise from the transmission medium or the originating terminal) are bias and end distortion.

Bias distortion displaces the space-to-mark transition. Lengthening the mark by advancing the transition is called marking bias whilst lengthening the space by delaying the transition is called spacing bias. End distortion displaces the mark-to-space transition. Marking end delays the transition giving a long mark and spacing end advances the transition giving a long space. The RTTY enthusiast will normally have to contend most with characteristic distortion—that is distortion introduced by the transmission medium.

Converting TTY to RTTY

To achieve a radio TTY link it is necessary to replace the hard-wired d.c. path by some form of coded radio transmission. Two methods of doing this are commonly used:

1. FSK (frequency shift keying) shifts the transmitted carrier frequency for each mark to space transmission.
2. AFSK (audio frequency shift keying) modulates a carrier with two different tones, one each for mark and space. This technique is also known commercially as VFT (voice frequency telegraphy).

The shift between the two frequencies is most important. The receiving unit (discussed next month) will use sharply tuned filters and will not decode for a wrongly spaced shift. The shift also determines the maximum transmission rate and the bandwidth required, although these are topics beyond the scope of the current article. The shift for amateur RTTY is 170Hz whilst most commercial traffic is at 850Hz.

Table 1

Band	Frequency	Modulation
80m	3·60MHz ± 20kHz	
40m	7·04MHz ± 5kHz	
20m	14·09MHz ± 10kHz	
15m	21·10MHz ± 20kHz	
10m	28·10MHz ± 50kHz	
4m	70·56MHz	
2m	144·6MHz	FSK
2m	145·3MHz	AFSK
70cm	432·6MHz	FSK
70cm	433·3MHz	AFSK

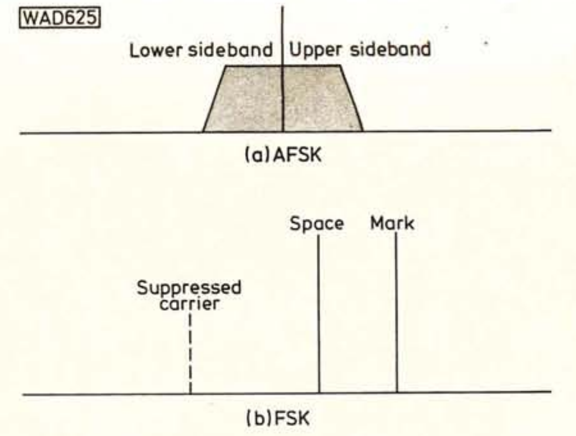


Fig. 7: Frequency spectra of (a) an AFSK signal (b) an FSK signal

FSK can be achieved by "pulling" the v.f.o. of a transmitter as shown in Fig. 5. The positive voltage appearing for a space will cause the diodes to forward conduct, placing the capacitor across the v.f.o., thus reducing its frequency (the capacitor being adjusted for the appropriate shift).

AFSK is generated by switching between two audio oscillators (for amateur RTTY of 1275 and 1445Hz), or by pulling a mark oscillator down to the required space frequency. The detailed methods of producing AFSK will be covered in a later article but Fig. 6 shows the general idea. The output of the AFSK oscillator is fed to the microphone input of a transmitter.

The frequency spectra for FSK and AFSK are shown in Fig. 7, which demonstrates clearly that FSK is more efficient (in terms of spectrum utilisation and signal power). However AFSK is much easier to produce. A nice compromise is available, because feeding AFSK to a s.s.b. transmitter will cause a signal closely akin to FSK to be radiated. This is the normal method adopted on the h.f. bands and for v.h.f. DX working. Local RTTY nets on v.h.f. and upwards tend to use AFSK with f.m. transmitters.

Equipment

Traditionally, the RTTY enthusiast's shack has been instantly recognisable from the smell of oil and the clanking of gears. Old electro-mechanical machines—such as from Creed, Siemens and Teletype—have been the mainstay for RTTY for years (and can still be bought for £10–£20). Recently RTTY has been invaded by the microprocessor revolution and many more stations are now operational using Pets or Apples or home-brew systems. The use of microprocessors for RTTY will be covered later in this series.

Where to find RTTY

The IARU band plan recommendations for RTTY are shown in Table 1. Tuning around these frequencies,

continued on page 61▶▶▶

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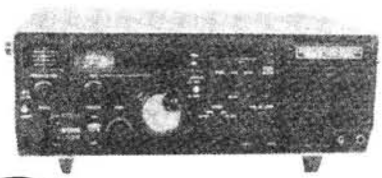

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This pocket monitor is a brand new VHF monitor receiver that can be supplied for eitehr the 2 metre amateur band or the VHF Marine band. Built into a strong metal case, the unit scans 8 crystal controlled channels with manual overide. A telescopic aerial plus "fly lead" aerial are supplied to cater for all portable needs. At this price the stocks will go pretty fast so don't delay.

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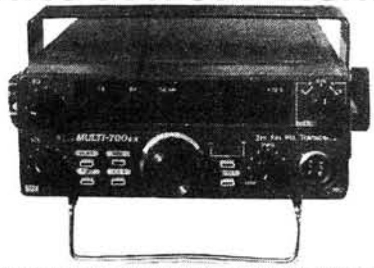

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Beginners' 2 metre CONVERTER

R.A.Penfold

Most people who become interested in amateur radio do so initially by listening to the s.w. amateur bands. However, the v.h.f. and u.h.f. bands are very popular these days and many short-wave listeners soon wish to explore the bands above 30MHz in particular the 2-metre band, as it carries much local activity and also has interesting DX possibilities.

For the owner of a good s.w. receiver the obvious way to progress to v.h.f. reception is by using a converter ahead of the receiver, thus enabling it to operate on the required band. This is far less expensive than obtaining a separate v.h.f. set, which would result in unnecessary and costly duplication of circuitry.

There are two basic types of converter; the tunable type where the tuning is carried out in the converter and the receiver is used as a fixed i.f. unit, or the type where the converter tuning is fixed and the receiver is used as a tunable i.f. unit. The latter is the more popular method for use in v.h.f. converters where only a relatively small frequency range, e.g., 144–146MHz is to be covered.

The fact that the tuning and therefore the oscillator frequency are fixed, enables a crystal controlled oscillator to be employed, which greatly simplifies the alignment of the converter and gives excellent frequency stability, avoiding the necessity for an expensive tuning drive mechanism like that in the receiver. Even the calibration of the s.w. receiver can be used, as explained later.

The Circuit

The main design aim was for the simplest possible circuit which would give good results and for a unit which would be easy to set up once completed. The circuit diagram is shown in Fig. 1 and for simplicity no r.f. stage is used. The input signal is coupled direct to a tapping on the mixer input tuned circuit which consists of L1 and VC1, preset tuning only being necessary as its bandwidth is more than adequate to embrace the entire 2-metre band.

In order to compensate as far as possible for the absence of an r.f. amplifier stage, a high gain, low noise mixer stage must be used. A MOSFET mixer, Tr1, is therefore employed in the unit having a fairly low value source bias resistor, R1, in order to optimise gain. Capacitor C3 is the bypass capacitor and R2 fixes the bias on gate 2 of Tr1. Capacitor C1 and coil L2 form a broad-band tuned circuit, tuned to the centre of the i.f. output tuning range, the resultant i.f. signal being coupled to the receiver from a tap on L2 via d.c. blocking capacitor C2.

Transistor Tr1 can be either an MEM616 or a 40673 device, the former giving slightly higher gain and a lower noise level.

Oscillator

The purpose of the oscillator is to provide a signal which, when heterodyned with the input signal in the mixer, produces the required i.f. output. In this case, the oscillator operates at a frequency of 116MHz producing an i.f. output of 28–30MHz. Heterodyning produces sum and difference signals and it is the difference signal which is required, as shown below:

144MHz – 116MHz = 28MHz
145MHz – 116MHz = 29MHz
146MHz – 116MHz = 30MHz

The sum and input frequencies also appear at the mixer output but are removed by the output tuned circuit, L2/C1 and the input tuned circuits of the receiver. It should be apparent that the reception frequency is equal to the frequency indicated on the receiver's tuning dial plus 116MHz. Thus it is an easy matter to convert the indicated reception frequency to the actual frequency of reception, so using the receiver's dial calibration. As the oscillator in the converter is crystal controlled the converter will contribute little to calibration errors.

The choice of an i.f. of 28–30MHz may not appear to be advantageous at first sight as the performance of most s.w. receivers falls off to some degree at high frequencies.

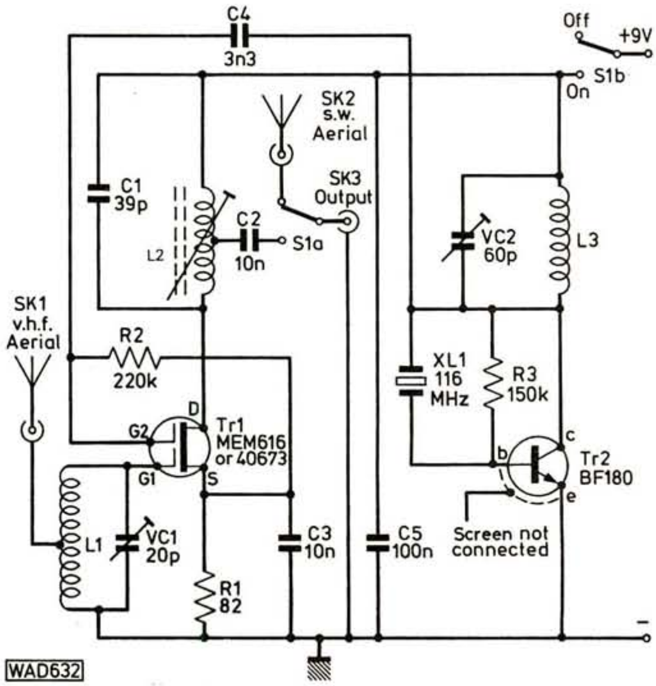


Fig. 1: Circuit diagram of the beginners 2 metre converter

However, this particular i.f. is popular as it is covered by most amateur bands only receivers as well as by most general coverage types. Also, in this instance, it is beneficial to use a high i.f. in order to obtain good image rejection with only the single tuned circuit which is used between the aerial and the mixer stage.

Oscillator Crystals

Crystals with fundamental frequencies as high as 116MHz are not generally available, but conventional methods of obtaining crystal controlled signals at high frequencies are to use either a low frequency oscillator and multiplier chain, or an overtone oscillator, the latter being the method used in the circuit of Tr2.

With this type of oscillator, the fundamental frequency of the crystal is a fraction of the required output frequency, but the crystal is cut in such a way that it can be made to oscillate at the required frequency determined by VC2 and L3. Crystal XL1 is a fifth overtone type which means that its fundamental frequency is one fifth of its marked frequency.

Transistor Tr2 is used in the common emitter mode and is biased by R3; the screen leadout wire being left unconnected in this circuit. The oscillator output is coupled to gate 2 of Tr1 via C4.

Switch S1b is the on/off switch and S1a disconnects the converter output from SK3 in the "off" position and connects it to SK2 to which a s.w. aerial can be connected, avoiding the need to manually disconnect the converter from the receiver and reconnect the s.w. aerial when using the receiver normally.

The current consumption of the converter is only about 4mA, so a PP3 battery will provide very many hours of operation.

Construction

With the exception of the sockets, battery and switch, all the circuitry is assembled on a p.c.b. as shown in Fig. 2. The layout of a v.h.f. circuit such as this is highly critical and it is recommended that this board should be used, the component overlay being shown in Fig. 3. The coils must be made accurately as proper alignment of the finished unit will otherwise be impossible.

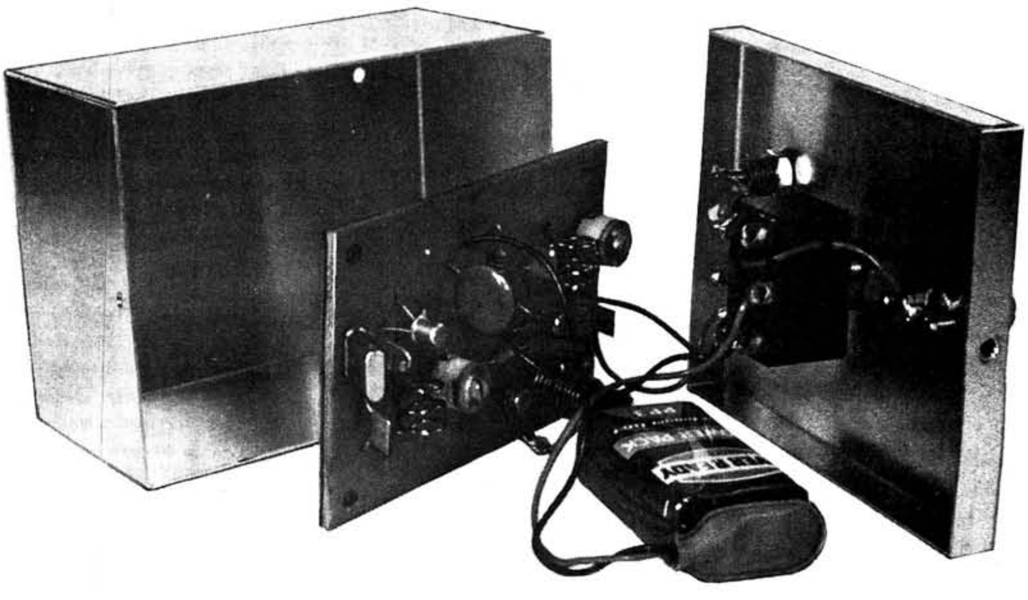
Coil L1 is wound using 20 s.w.g. enamelled copper wire and is self-supporting, being wound on an 8mm diameter temporary former such as the shank of a twist drill of appropriate size. This winding consists of precisely 3 turns and is 13mm long. It is left with short, vertical leadout wires which have the enamel insulation scraped off and must be tinned before the coil is soldered into position on the p.c.b., the same treatment being required for the tapping point.

The prototype was used with a telescopic aerial which plugged straight into the front of the converter with the tap at the centre of L1. If the unit is fed from an aerial via a length of coaxial cable, matching will be improved if the tap is placed a little under one turn up from the earthy end of the coil. Coil L3 is identical to L1 except it has no tapping.

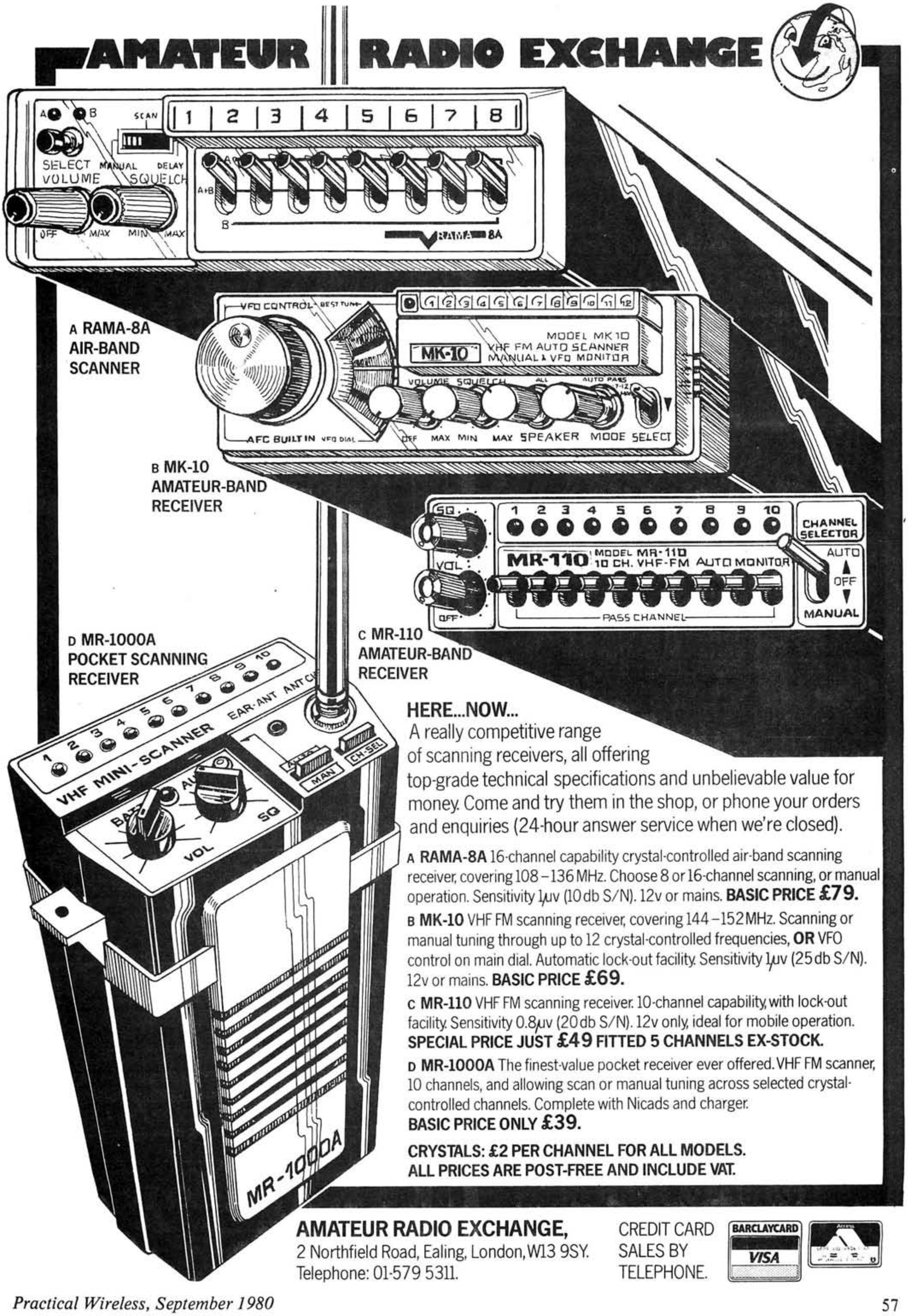
A 6mm diameter coil former having a dust iron tuning slug is used for L2. The former is fixed to the p.c.b. using two 8BA bolts and nuts, with a solder tag secured under each mounting nut which act as anchor points for the ends of the winding, which consists of 10 turns of 20 s.w.g. enamelled copper wire, close wound with C1 wired across the two solder tags. The enamel is removed from the coil $4\frac{1}{2}$ turns down from the positive supply rail end of the winding, this point being tinned and connected to C2. The ends of the winding connect to the p.c.b. conductors via the two mounting bolts.

The specified crystal is a wire-ended type which is soldered direct to the p.c.b., but be careful when soldering as excessive heat could damage the crystal or its mounting. The prototype is housed in an aluminium box which measures approximately 102 × 76 × 51mm. Any similar case should be suitable provided it is of all-metal construction.

The general layout of the front panel can be seen from the photograph. The p.c.b. is mounted on the rear panel of the case using three 6BA mounting bolts about 13mm long, spacers being used to hold the p.c.b. about 6mm clear of the rear panel. However, connect the p.c.b. to the front panel components before finally mounting it, and make sure that it is mounted in a position which does not obstruct S1 when the two parts of the case are fitted together, the battery fitting into the space below SK3.



Internal view of the converter



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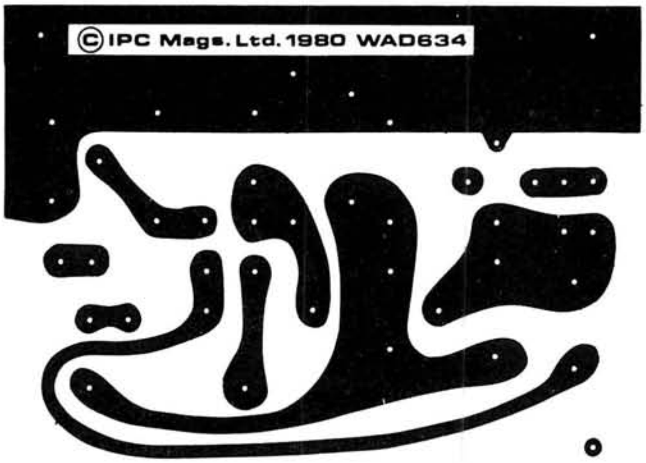

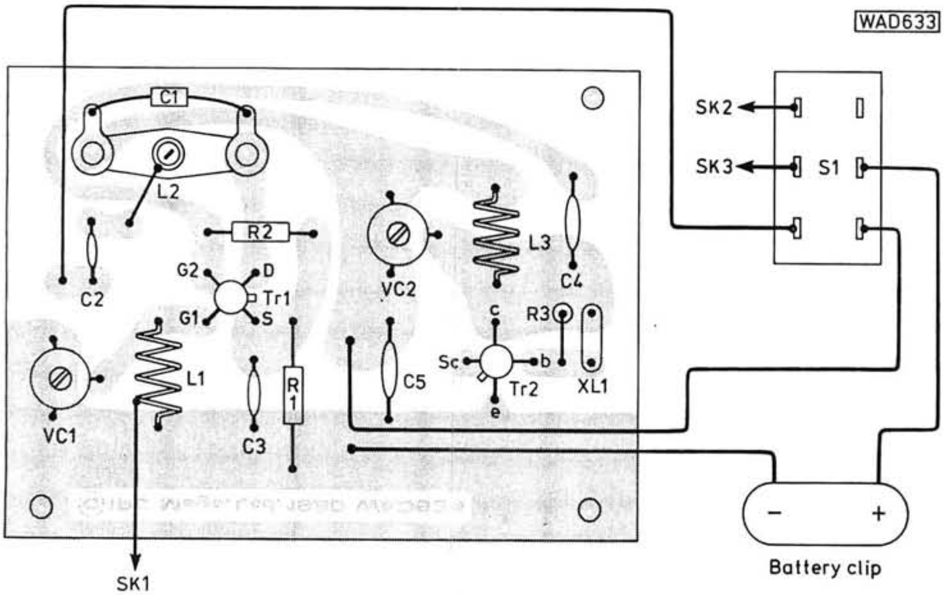

Fig. 2 (Top): The p.c.b. copper track pattern shown full size

Fig. 3 (Left): The component overlay on the p.c.b.

★ components

Resistors		
¼W 5% carbon		
82Ω	1	R1
150kΩ	1	R3
220kΩ	1	R2
Capacitors		
Ceramic		
3·3nF	1	C4
10nF	2	C2,3
100nF	1	C5
Polystyrene		
39pF	1	C1
Ceramic Trimmers		
4–20pF	1	VC1
10–60pF	1	VC2

Semiconductors		
MEM616		
or 40673	1	Tr1
BF180	1	Tr2
Sockets		
Coaxial	2	SK1,3
Wander type	1	SK2
Crystal		
116MHz		
5th overtone	1	XL1 (see text)

Miscellaneous

Toggle switch d.p.d.t. (S1); 102 × 76 × 51mm aluminium box (1); 20 s.w.g. enamelled copper wire; 6mm coil former with dust core (1); printed circuit board (1); PP3 battery and connector (1).

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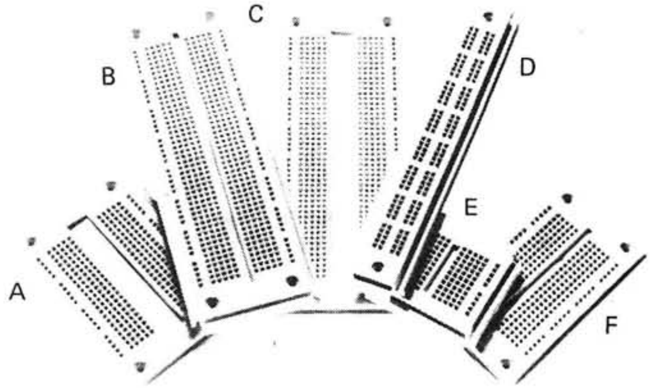

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Alignment

The first step in the alignment procedure is to adjust VC2 to obtain maximum output from the oscillator. If a multimeter set to read 5mA f.s.d. is connected in series with the positive battery lead, VC2 should be adjusted for minimum meter reading which will correspond to maximum oscillator output and give optimum sensitivity. Make sure that this adjustment is done accurately, because if VC2 is maladjusted in the decreased capacitance direction, the oscillator may become unreliable and not always start when the unit is switched on.

Next the core of L2 is adjusted, and this may be easily set for maximum noise output from the receiver which should be tuned to about 29MHz while this adjustment is made.

Assuming a suitable signal generator is not available, VC1 is most easily adjusted by locating a 2-metre transmission and then simply adjusting it for maximum signal strength. If a suitable signal cannot be found, try VC1 at various settings until such a signal is located. Most areas of the country are now served by a repeater, the output from which occupies the high frequency end of the band and provides a suitable tune-up signal.

Note that although the front panel must be detached from the rest of the case while VC1 and L2 are adjusted, the two sections of the case should be maintained in electrical contact, achieved by holding the two parts together while these adjustments are made. The lead between the converter output and the receiver aerial socket must be made by coaxial cable, the outer braiding connected to the chassis of the converter and the receiver in order to prevent breakthrough of signals on the 10-metre band and must be kept as short as possible.

Operation

In conjunction with a Trio-Kenwood QR666 receiver the prototype provided excellent results when used in a first-floor room with a telescopic aerial plugged into SK1. This type of aerial should be about 47 inches long for the 2-metre band. Most stations use vertical polarisation and will be received most strongly with the aerial in a vertical position. Some stations, particularly those operating s.s.b. at the low frequency end of the band, use horizontal polarisation, and will be best received with the aerial horizontal and rotated for maximum signal strength. Of course, it is possible to use a more sophisticated aerial system giving a corresponding improvement in results, and suitable designs will be found in *"Out of Thin Air"*, see page 69.

It should perhaps be pointed out that a.m., c.w. and s.s.b. modes are all used on the 2-metre band and can all be received providing the main receiver is equipped to resolve these signals. The most popular form of transmission is f.m. and unless the receiver is fitted with a suitable detector, can best be resolved by switching the receiver to the a.m. mode and slightly offsetting the tuning from the usual maximum signal strength position. This is known as slope detection, usually giving quite good results, and if the receiver has variable selectivity it will almost certainly be best to use the widest available bandwidth. ●

μA78S40 SWITCHING REGULATOR

▶▶▶*continued from page 42*

can be easily accommodated on the RM6 bobbin is about 0·5mm, whereas the RM10 bobbin can accommodate wire of about 0·9mm diameter and should be selected in circuits which may be required to deliver a relatively high output current (above 0·3A).

At lower output currents either type of core is satisfactory, but the RM10 can be wound to have a lower series resistance and this will result in a higher power efficiency.

The μA78S40 is a very versatile switching regulator sub-system which can be used in a wide variety of circuits providing much higher power efficiency than the usual series regulator devices. However, switching regulator circuits do have their disadvantages; in particular, circuits of this type are more complex than simple series regulator circuits and require the use of an inductor. In addition, the circuits generate a switching waveform which, together with its harmonics, can cause radio interference. A further disadvantage is the relatively slow response of a switching regulator to a fast change in the load conditions when compared with a simple series regulator circuit.

In order to minimise electro-magnetic interference, it is important that the output reservoir capacitor (C_O) should be placed close to the μA78S40 device and that all wiring should be kept short. In general, it is wise to decouple the input voltage supply with a capacitor soldered directly between pins 13 and 11 (the positive and negative supplies).

The μA78S40 is available from Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex CM14 4BN together with RM6 and RM10 cores with the required 250nH inductance factor. ●

INTRODUCING RTTY

▶▶▶*continued from page 52*

particularly on 80m and 20m, will almost always produce the rhythmic "jingle bells" of RTTY (using 170Hz shift and 45·45 baud). The BARTG (British Amateur Radio Teleprinter Group) transmits RTTY news bulletins on 80m on Sunday mornings. An RTTY repeater (GB3PT) transmits on channel RB12 (433·30MHz) from Barkway in Hertfordshire. A German amateur, DL1WX, operates a "store and forward" type of RTTY repeater around 14·075MHz.

Readers interested in copying commercial RTTY transmissions are warned that neither the Broadcast Receiving Licence nor the UK Amateur Licence permit the reception of such signals (a number of successful prosecutions have been brought in the last couple of years). However the Home Office Radio Regulatory Department have indicated that permission can be granted for reception of commercial short-wave RTTY, provided permission is previously obtained from the various press agencies. Interested readers should write to the Home Office at Waterloo Bridge House, Waterloo Bridge Road, London SE1 8UA.

Part 2 of this series deals with RTTY demodulator circuits

air test

USER REPORTS ON SETS AND SUNDRIES

DATONG UC/1 Up-converter

Using a converter is an easy and economical way of adding coverage of an additional band or bands to an existing receiver. Probably the most popular example is a unit converting the 2-metre amateur band down to a frequency covered by an h.f. bands receiver, typically 28–30MHz. If this is done by mixing the 2m signal with the output of a local oscillator running at 116MHz, then 28MHz corresponds to 144MHz, and 30MHz to 146MHz. Other mixing methods could be used, but these could well result in the band being inverted, so that mental arithmetic would be required each time the h.f. receiver was retuned.

A simple constructional design for such a converter appears elsewhere in this issue, but in the Datong UC/1 the same idea is taken and developed to produce a system capable of several different conversions.

The basic unit converts up in frequency any selected 1MHz band in the range 0–30MHz, so that it can be tuned on a 2m receiver covering 144–145MHz. At the same time, a built-in down-converter reconverts the band of frequencies down to the 28–29MHz range, where it can be tuned on receivers designed for the 10m amateur band. It thus gives general coverage of the l.f., m.f. and h.f. bands on a 2m or h.f. amateur bands receiver.

The down-converter is also accessible for use as a conventional 2m converter, as described at the beginning of this article.

When in the up-converter mode, the megahertz portion of the desired frequency is selected digitally by means of two switches on the UC/1, and the kilohertz portion on the tuning scale of the associated receiver. The UC/1 preselector tuned circuits are then peaked by means of a "Band" switch and an "RF Tune" control. A three-position input attenuator (0, 15 and 30dB) is also provided.

The preselector limits the lowest band to frequencies above 90kHz, though reception at reduced sensitivity is possible down to 60kHz (Rugby MSF). Sensitivity is specified at 0·3μV from 0·8–30MHz, 0·6μV from 300–800kHz, 1·2μV from 90–300kHz, and 0·3μV from 144–146MHz, all for 10dB S/N (c.w. or s.s.b. in 2·4kHz bandwidth).

Internally generated spurii occur at harmonics of 1MHz, due to the crystal oscillator, and are typically equivalent to an input signal of 4μV p.d. External spurious responses are typically 60dB below the main response. Input and output impedances are all 50Ω nominal, and the unit is designed to withstand the accidental short-term application of 10W of r.f. to either output terminal.

Power requirements are 120mA at 11·5–13V d.c. The unit measures 272 × 60 × 203mm overall, and weighs 1·75kg.

Results

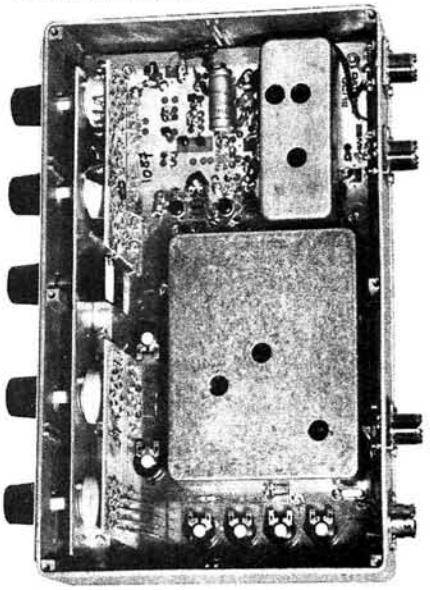
Tests of all the modes of operation were carried out in conjunction with the Sugiyama F850, reviewed elsewhere in this issue. The 2m converter was also checked using an FRG-7.

In any converter, and especially one so complex as the UC/1, possible spurious responses, both internal and external, are always one of the fears. Time and facilities did not allow us to carry out any checks with instruments, but listening tests revealed no obvious "nasties", other than the 1MHz crystal harmonics.

The input attenuator is very useful, and at times essential, when converting from h.f. or v.h.f. to 28MHz, to avoid overloading the associated receiver. The UC/1 is specified to have a gain of some 15dB in these modes, whereas the gain when converting up to 144MHz is around 2dB. The "RF Tune" control is very critical to adjust at l.f. and m.f., and would benefit from the addition of a slow-motion drive.

One feature of the unit that would be of great interest to the broadcast bands DX enthusiast is its fantastic performance on the medium and long wave bands. On the latter, using a 60ft long wire, and up-converting to 28MHz into F850, it outperformed any receiver I've ever heard, in terms of sensitivity and selectivity.

The UC/1 costs £136.85, including carriage and VAT, from **Datong Electronics Limited, Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE, telephone Leeds (0532) 552461,** to whom we offer our thanks for the loan of the review unit.



TRIO TR-2400 Transceiver

The hand-held v.h.f. f.m. transceivers are not only getting smaller in size, they are also improving in performance and the facilities being offered are now rivalling the larger mobile rigs. The Trio TR-2400 is amazing for its size.

It is a fully synthesised transceiver offering 400 channels between 144–145·995MHz together with ten memories and scanning facilities. Repeater shift is built-in together with a tone-burst unit to make repeater operation as simple as possible.

Frequency readout is by four digit l.c.d. with the two lefthand digits of the frequency not shown. Selection of the channel required is by a calculator style keyboard and extra switches provide locks against accidental frequency shift and inadvertent operation of the p.t.t. switch. The other controls, together with the 50Ω b.n.c. aerial socket are on the top of the case.

Rechargeable NiCad batteries are used to power the TR-2400 and these are carried in a compartment at the bottom of the case. Trio reckon that a fully charged battery pack will provide about $2\frac{1}{2}$ hours of operation based on one minute of transmission followed by three minutes' reception.

The transmission puts out 1·5W of r.f. power and in use this proved just enough to get into GB3SC from some 15 miles away on a very cold night, using the "rubber duck" aerial supplied.

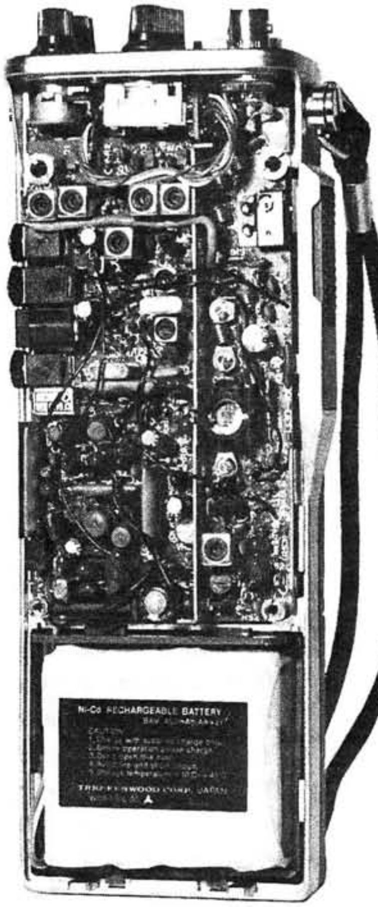
In use the rig proved to be easy to use and fairly comfortable to hold. The l.c.d. readout was easy to read and a backlight enabled it to be read in the dark. However for night time operation it would be advisable to carry a small torch to enable the keyboard controls to be identified.

The only annoying feature was the p.t.t. switch. This took the form of a microswitch operated by a large push-bar on the side of the case. The switch gave very little indication that it had been satisfactorily operated, and a much more positive click action would have been better.

Performance seemed to be good and the construction of the rig was also very good.

The ten memories are useful if you have a choice of repeater and work a lot of simplex as well.

The TR-2400 costs £210·45 inc. VAT.



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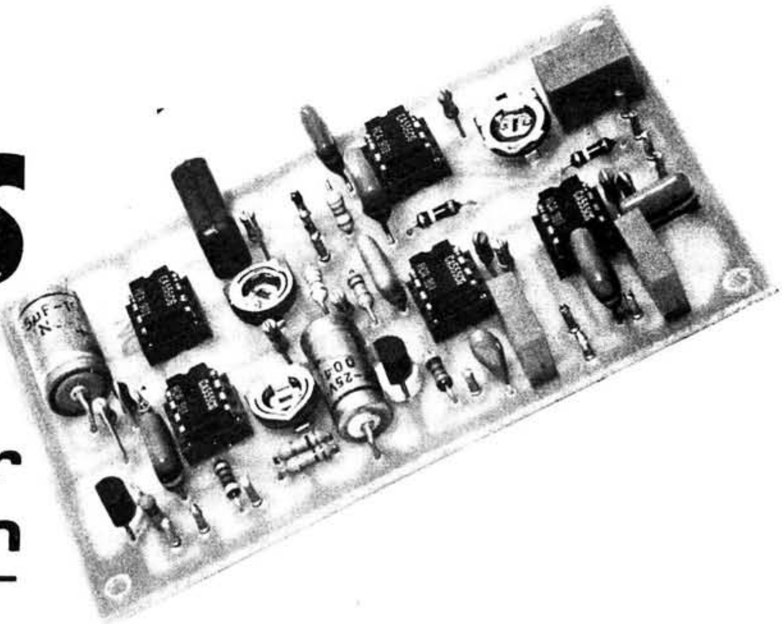


Modular 2m Transceiver System

Timeburst and Timer Module

(Part 6)

Michael TOOLEY BA G8CKT & David WHITFIELD BA MSc G8FTB

The module described in this article can be a boon to any serious repeater user and, although designed for use with the *PW* "Nimbus", it can readily be incorporated into almost any v.h.f. f.m. transceiver. The module provides a toneburst for operating a transceiver in conjunction with any 2-metre f.m. repeater in the UK, and also accurately times the transmission, providing both visible and audible warnings at the end of a pre-determined period when the user is about to "time-out" through the repeater. The module is simple to construct and uses readily available components. A full range of adjustments allows the builder to satisfy his own requirements as to time duration, etc.

FM Repeaters

In recent years, one of the major growth areas in amateur radio has been on the repeater front, the number of v.h.f. repeaters in the UK having increased very considerably. In 1974 there were three 2-metre repeaters in operation, in 1976 there were 12 and in 1978 there were 23. Today there are some 37 repeaters operational on 2m, with still more in the pipeline. With such a large number of active repeaters, coverage of the UK is almost complete, the few remaining gaps tending to be in the more remote areas, such as the far north of Scotland. In many of the more populated regions there is even a choice of repeater. London, for example, is well served by four "machines": GB3SL in the south, GB3WL in the west, GB3NL in the north and GB3EL in east London.

Repeaters are primarily intended for mobile and portable use. As such they offer greatly enhanced coverage, extending the range of a mobile-to-mobile contact from typically 10 miles "direct" to as much as 50 miles via a repeater. Repeaters are usually situated in the most favourable of locations. GB3SL, for example, is sited at the BBC transmitting station at Crystal Palace. Indeed, the repeater is housed in the same building and shares the same aerial mast as the BBC transmitter. Repeaters are built and financed by local groups. The repeater network as a whole is, however, co-ordinated by the Radio Society of Great Britain who, incidentally, are also the licence holders of all of the individual repeaters.

In the UK eight 2-metre channel pairs have been designated specifically for repeater usage. The "input" and "output" frequencies of each pair are spaced by 600kHz and the channels are designated "R0" to "R7", as shown in Table 1. Adjacent channels are spaced by 25kHz and frequencies are allocated on a geographical basis in order to minimise interference. As an example repeaters in West Wales (GB3WW), Aberdeen (GB3GN), Burnley (GB3RF), Tyrone (GB3WT), and North London (GB3NL) all operate on channel "R7". Only under the most exceptional of circumstances are there any problems of overlapping coverage.

The "heart" (or perhaps we should say "brain"!) of any repeater is its control system. There are, of course, considerable variations in the control systems employed in UK repeaters, since each local group designs its own. However, to ensure compatibility, some common standards have become established. The most important of these is the frequency and duration of the tone signal which is required in order to gain "access" to a repeater. The tone frequency should be 1750Hz (plus or minus 10Hz or so), and its duration should be approximately 500ms. The burst of tone should, of course, occur at the start of the transmission (i.e., as soon as the press-to-talk switch is operated). The tone is detected in the repeater's control system (see Fig. 1), and is used both to reset the timer and also to activate the transmit relay and thus permit "talk-through".

Having sent the necessary tone, the operator is then free to continue with "talk-through" for a period determined by the setting of the timer in the repeater's control system. This is usually set at around 60 seconds after which the repeater will normally either give its callsign and close down or indicate "time-out" whilst at the same time

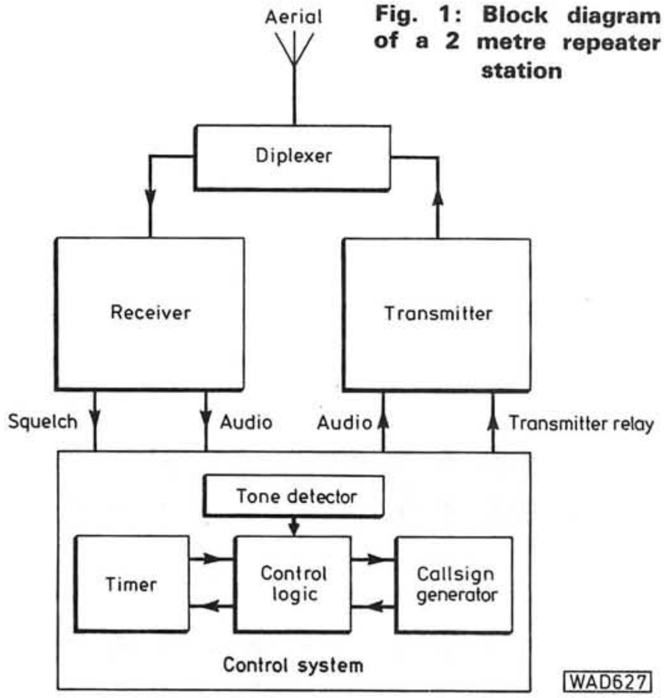


Fig. 1: Block diagram of a 2 metre repeater station

inhibiting the "talk-through" audio. The unfortunate operator who continues talking after "time-out" will then only be talking to himself and, furthermore, the repeater will normally not be usable by others until the input frequency becomes clear again. Long-winded "overs" are thus actively discouraged and users are forced to keep it short. Furthermore, regular breaks in transmissions allow others to "break-in" or call others who may be listening on the repeater channel. If a user does wish to talk for more than one minute it is merely necessary for him to momentarily cease transmission, allow the repeater to send an acknowledgment (often given in the form of a "K" (–•–) or "T" (–) in Morse code) and then re-access for another minute's worth. The system may, at first, sound complex but it has proved to be relatively fool-proof whilst providing for the maximum number of users. Some repeaters do not have a "time-out" limit.

System Description

The general arrangement of the combined toneburst and timer module is shown in the block schematic of Fig. 2. The toneburst and timer sections are, in fact, quite separate and, should the timing facility not be required, the basic toneburst module may be constructed separately. The input to both the toneburst and the timer is derived from the p.t.t. rail in the transceiver. At the commencement of any transmission, the p.t.t. rail is connected to 0V and stays at 0V for the duration of the transmitting period (see Fig. 3). At the end of a transmission the p.t.t. rail rises again to almost the full value of the positive supply. The negative-going (falling) edge of the p.t.t. voltage which occurs at the start of any period of transmission is used to trigger a monostable with a period of approximately 500ms. The output of this monostable is used to enable an astable oscillator which, as a consequence, provides a 500ms burst of 1750Hz tone at the start of every transmission.

The negative-going edge of the p.t.t. voltage is also used to initiate a monostable with a period of approximately 45 seconds (adjustable to suit the individual user's needs). The monostable output is "high" during the nominal 45s period and a green l.e.d. is used to indicate that normal talk-through may proceed. At the end of the 45s period the monostable output falls (see Fig. 3) and the l.e.d. is extinguished. Furthermore, if the p.t.t. rail is still at 0V (indicating that the transmission is still continuing) a NOR gate is used to set an astable oscillator which has a period of approximately 2s. A red l.e.d. is used to indicate the output state of this astable and, should the period of transmission exceed 45s, this l.e.d. flashes on and off thus providing a visual indication of the fact that "time-out" is about to occur. A further astable oscillator is incorporated in order to provide an audible warning. This astable is set by the output of the previous astable and provides a series of 1s bursts of 1·4kHz tone from the loudspeaker fitted in the transceiver.

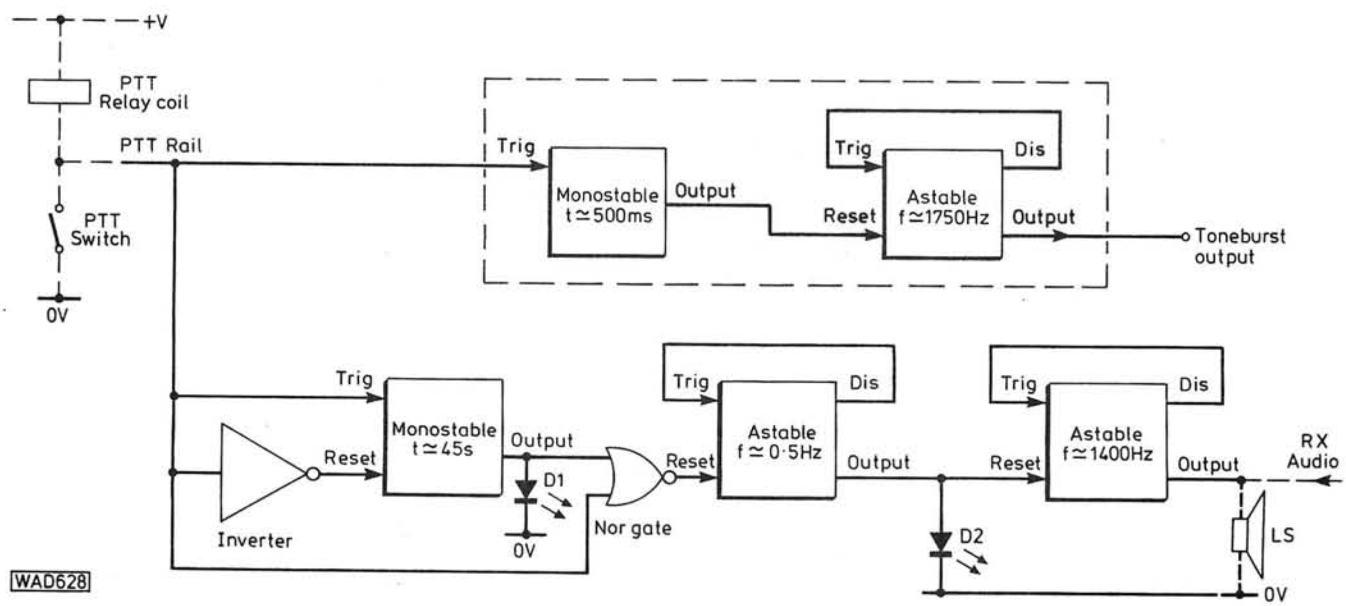


Fig. 2: Block diagram of the *PW* "Nimbus" Toneburst and Timer module

The 555 Timer

Both the toneburst and the timer circuits make use of the ubiquitous 555 timer i.c., the simplified block diagram of which is shown in Fig. 4. The i.c. can be used in either a monostable or an astable configuration depending upon the external circuitry. The 555 contains two operational amplifiers (both employed as voltage comparators) connected to the "set" and "reset" inputs of a bistable. The inverting input of one operational amplifier and the non-inverting input of the other are supplied from a voltage reference potential divider. An output stage capable of delivering up to 200mA into a non-inductive load buffers the bistable output from the i.c. output at pin 3. A transistor stage is also incorporated and this operates as a saturated switch for the discharge of an external timing capacitor.

In the monostable mode, the trigger input (pin 2) is held at, or near, $+V_{cc}$ in the quiescent state. The bistable is thus held in the "reset" condition with the $\overline{Q}$ output at $+V_{cc}$ which in turn ensures that the transistor is saturated and effectively short-circuiting the timing capacitor C, so inhibiting charge. If a negative-going pulse of sufficient amplitude is applied to the trigger input, the bistable becomes "set" and its output changes state, with the voltage at the $\overline{Q}$ output falling to zero. The transistor then turns off, allowing the timing capacitor to charge through the series resistor, R. The voltage across the timing capacitor will then rise exponentially to $\frac{2}{3}V_{cc}$ at which potential the output of the upper operational amplifier will change state resetting the bistable again. This ends the monostable timing period, the time interval for which the output at pin 3 is high after the application of the trigger pulse being given by:

$$t = 1{\cdot}1\,CR$$

In the astable mode, the trigger input pin 2 is connected to pin 6 and an extra resistor is inserted between pin 6 and pin 7. The "reset" input is held at, or near, $+V_{cc}$ and, as soon as the supply is connected, the timing capacitor (connected at pin 6) starts to charge exponentially. When the capacitor voltage reaches $\frac{2}{3}V_{cc}$ the initial monostable action ceases and the transistor conducts. The timing capacitor now discharges exponentially through the resistor connected between pins 6 and 7 until the voltage at pin 6 falls to $\frac{1}{3}V_{cc}$ whereupon the trigger voltage initiates another monostable period. The cycle then repeats itself and the output voltage at pin 3 takes on a square waveform which has a frequency inversely proportional to the CR time constant.

★ components

TONEBURST/TIMER MODULE

Resistors		
¼W 5% carbon		
470Ω	2	R11,16
2·2kΩ	1	R3
3·3kΩ	4	R2,4,6,15
10kΩ	7	R1,8,10,12,13,17,19
100kΩ	3	R7,9,20
220kΩ	2	R5,14
330kΩ	1	R18
Potentiometers		
Min. preset (horizontal mounting) 0·1W		
100kΩ	1	VR2
1MΩ	2	VR1,3
Capacitors		
Polyester		
10nF	2	C6,12
22nF	1	C4
100nF	7	C1,3,5,8,10,11,13
1μF	1	C2
25V Tantalum bead		
4·7μF	1	C9
25V Electrolytic (tubular)		
47μF	1	C7
100μF	1	C14
Semiconductors		
Transistors		
BC548	2	Tr1,2
Integrated circuits		
555	5	IC1–5
Diodes		
1N4148	1	D1
Light-emitting diodes		
0·2in green	1	D2
0·2in red	1	D3
Miscellaneous		
Printed circuit board, p.c.b. pins (12 off)		

Circuit Description

The circuit of the basic toneburst module is shown in the top half of Fig. 5. When the transceiver is switched from "receive" to "transmit" the p.t.t. rail voltage falls from approximately 12V to 0V. C1, D1 and R3 produce a short-duration, negative-going pulse from this transition and this triggers the monostable, IC1. The monostable pulse duration is determined by the time constant (R5 + VR1) C2, and this pulse is used to enable IC2 which is connected in astable mode. The frequency of the astable is set by VR2 and C6, while R7, R8, C4 and R9 provide attenuation and shaping of the output waveform. Since it would be impossible to make any adjustment to VR2 during the 500ms toneburst period, a link, LKB (shown dotted), is incorporated in order to permit continuous operation of the astable oscillator.

The circuitry in the bottom half of Fig. 5 provides the timing and warning functions. IC3 is connected in monostable configuration with its period governed by the time constant (R14 + VR3) C7. When the transceiver is on "receive", the p.t.t. rail is "high" and Tr1 operates as an inverter holding IC3 in the reset condition. When the transition is made from "receive" to "transmit", the p.t.t. rail voltage falls, Tr1 ceases to conduct and IC3 is set and triggered by the negative-going pulse formed by C1, R3 and D1. At the end of the time-out period the output of IC3 falls to 0V.

A warning indication is initiated when the collector of Tr2 goes "high". This only occurs when the output from IC3 has fallen to 0V (at the end of the time-out period) and, at the same time, the p.t.t. rail is still at 0V (indicating that the transceiver is still on "transmit"). IC4 then operates as an astable with a fixed frequency determined

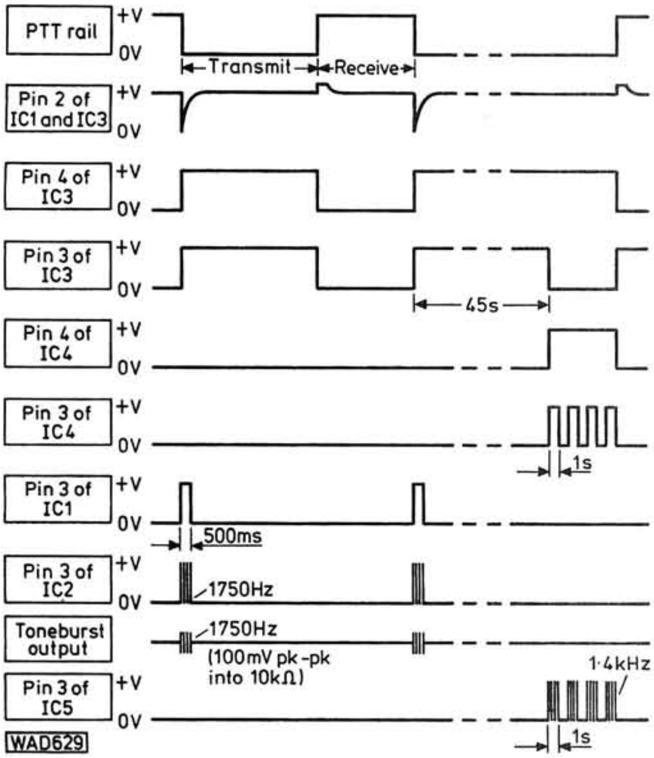


Fig. 3: Timing waveforms for the Toneburst and Timer module

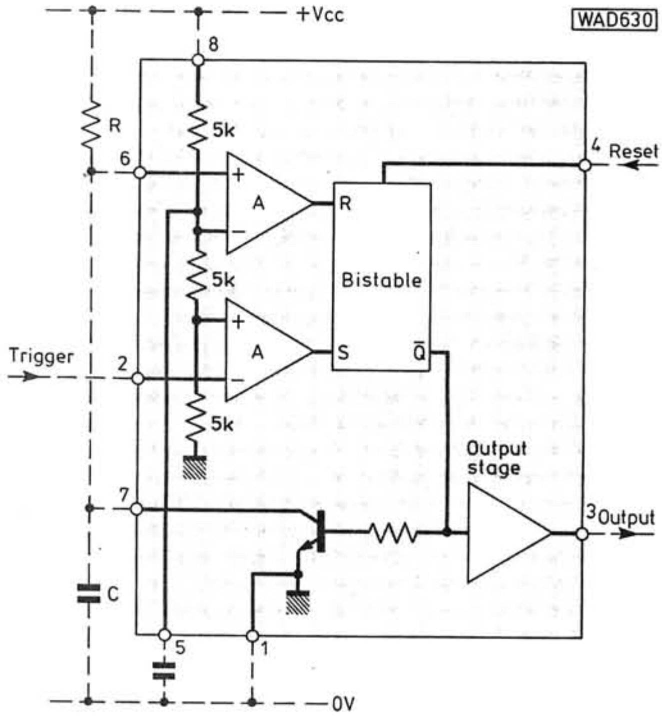


Fig. 4: Internal block diagram and external timing components for the 555 timer

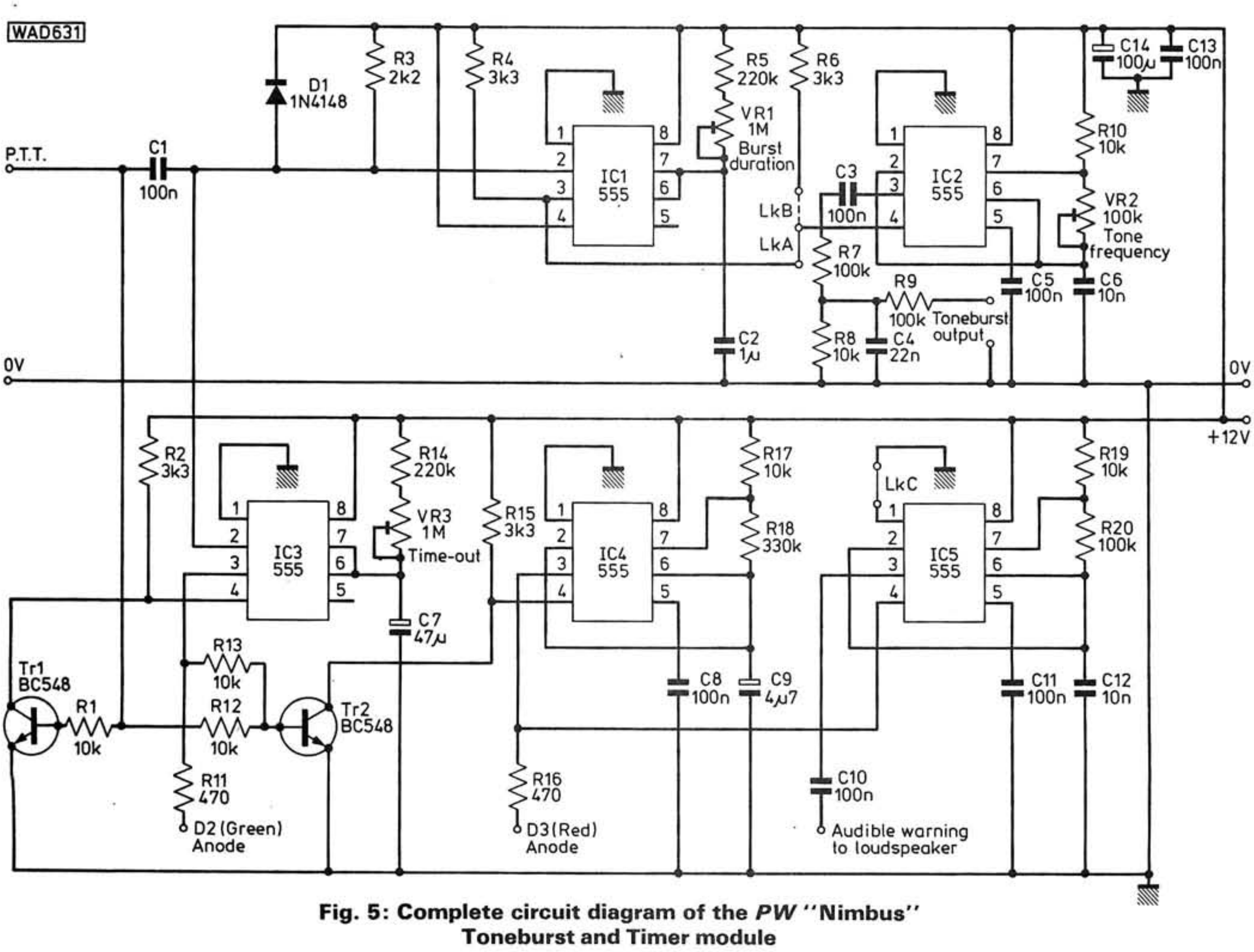


Fig. 5: Complete circuit diagram of the *PW* "Nimbus" Toneburst and Timer module

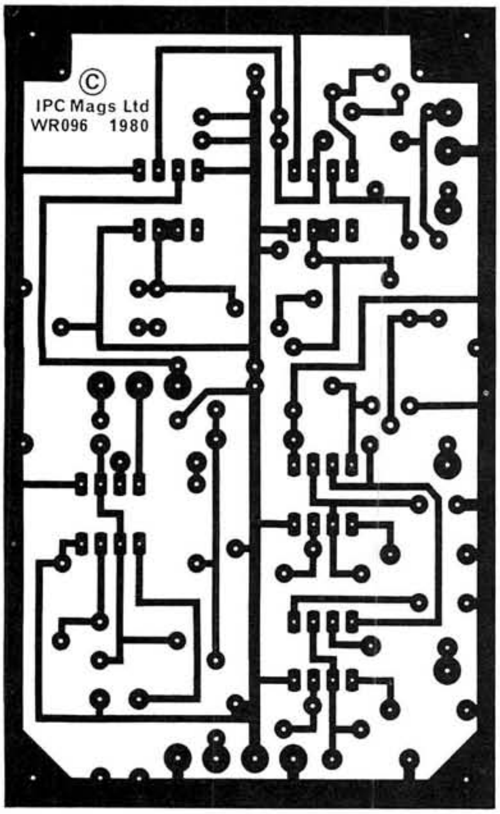


Fig. 6: Track pattern for the p.c.b., shown full size

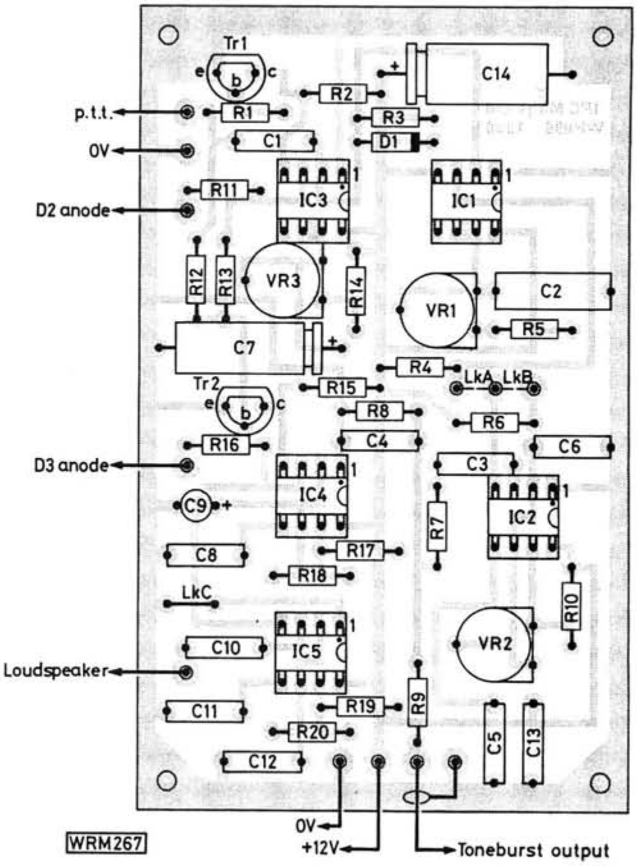
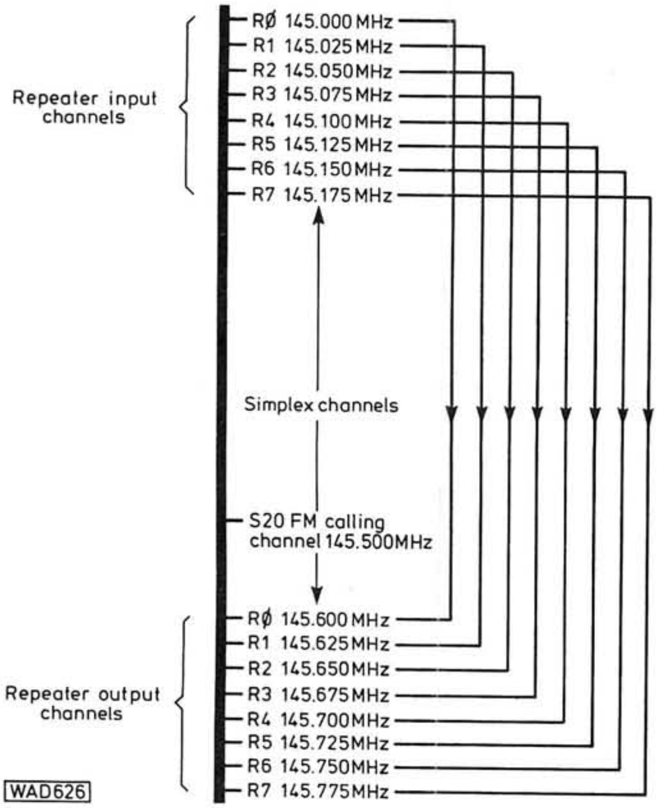


Fig. 7: Component placement and external connections

NEXT MONTH
Battery charger and mains p.s.u. for the *PW* "Nimbus" hand-held

Table 1



by R18 and C9. The output from IC4 is used to flash a l.e.d. and also to gate a further astable, IC5, to provide an audio frequency signal suitable for direct connection to the loudspeaker in the transceiver. Link LKC is provided so that the audible warning facility may be disabled when not required.

Construction and Adjustment

A recommended p.c.b. layout and corresponding component overlay are shown in Figs. 6 and 7. The circuit layout is not critical and builders may, if desired, employ alternative construction techniques such as Veroboard, matrix board, etc.

Alignment of the toneburst oscillator must be carried out accurately, either using a digital frequency meter or by comparison techniques using an accurately calibrated audio frequency signal generator. LKA should be disconnected and LKB connected. VR2 is then adjusted until the correct frequency is achieved (1750Hz will be obtained with VR2 approximately in the centre of its track). It is very anti-social to carry out toneburst adjustments by trial and error with your local repeater and thus "air testing" should not be attempted until after initial bench adjustments have been made. Adjustment of the time-out period, which will depend largely on the requirements of the constructor's local repeater, can be carried out using a stop-watch or wrist-watch. A period of approximately 45 seconds will be obtained with VR3 set to the centre of its track. Similarly, a 500ms burst of tone will be obtained with VR1 in its centre position, and it will not normally be necessary to make any further adjustment to either this pre-set or to VR3. It is recommended that the toneburst frequency be checked periodically after the toneburst module has been fitted to the transceiver. ●

PRODUCTION LINES

alan martin

Gould DMM

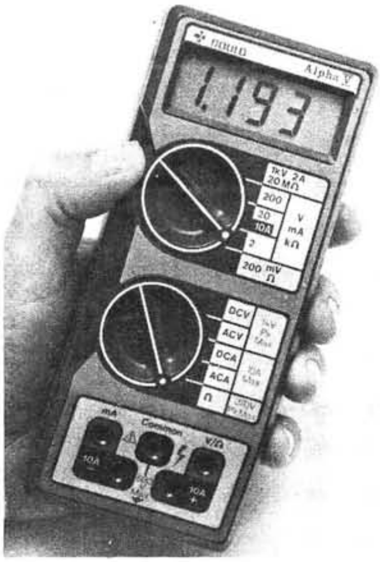
The new Alpha V, the latest and smallest in the comprehensive range of digital multimeters from Gould Instruments Division, is a low-cost hand-held instrument combining versatility and ruggedness. The Alpha V has a $3\frac{1}{2}$-digit liquid-crystal display, and the 25 measuring ranges cover the five basic functions of d.c. voltage, a.c. voltage, d.c. current, a.c. current, and resistance.

The multimeter is powered by a 9V carbon-zinc or alkaline battery (PP3 or equivalent), the latter giving a typical life of 200 hours. Battery-low indication is provided by the multimeter's display, which shows "BAT" when less than 10% of useful battery life remains. Automatic decimal-point, polarity and over-range indication is also provided.

The Gould Alpha V measures only 178 × 76 × 38mm and weighs 282g.

Accessories supplied with the basic instrument include standard red and black test leads, battery and handbook. Other accessories available are a soft protective carrying case, high-voltage probe, r.f. detector, and a special set of test leads rated at 2kV r.m.s. and 20A.

Costing £85.00 plus VAT and £3.00 p&p, the Alpha V carries a two-year guarantee and is available from: *Gould Instruments Division, Roebuck Road, Hainault, Essex. Tel: 01-500 1000.*



2-Chip Synthesisers

A unique range of three 2-chip frequency generating circuits which dramatically simplifies the design of synthesisers for radio applications is announced by Plessey Semiconductors.

The circuits are intended for three types of application—ultra low power for hand-held equipment, general purpose for applications up to 500MHz, and higher frequency for applications up to 1GHz. Each application requires one bipolar high speed divider and one *n*-channel m.o.s. control circuit. As the typical number of i.c.s is therefore reduced from 12 to 2, this gives a considerable space saving.

Radio synthesisers can take up to a year to design but the new circuits considerably simplify the task of the designer. They are easy to design in and the same circuits can be used for different frequency bands. A typical tuning range would cover 20:1 range of frequencies. Also, the *n*-channel m.o.s. circuits interface directly with memories and microprocessors.

There are considerable financial advantages over conventional solutions as, for example, marine, taxi and police radios can have a choice of channels instead of just one channel for approximately the same cost. In addition, the ultra-low power synthesiser uses less than half the power of alternative solutions, thus prolonging battery life.

The circuits are believed to be the only complete range available in the world from a manufacturer and are the result of a 10 year involvement by Plessey Semiconductors in the development and production of high speed dividers.

Plessey Semiconductors, Kembrey Street, Crowdy's Hill Estate, Swindon SN2 6BA.

UHF Helical Filters

The 7HW series of helical filters for u.h.f. have been designed for various communication applications in u.h.f. radio, s.h.f. i.f. filters, etc. The very small size makes them suitable for replacing all other types of u.h.f. resonator — especially as the first i.f. filter in the booming field of satellite receiving systems.

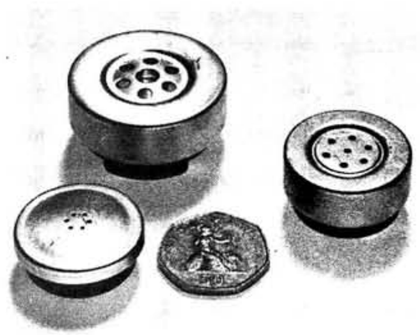
Although various types are available in the range 300–500MHz, Ambit are stocking units centred on 435MHz, with 1dB bandwidth of 11MHz, and a −50dB bandwidth of only 50MHz (using two blocks coupled together). Temperature coefficients are plotted over the range −10°C to +60°C.

The 7HW costs £1.46 plus VAT and 35p p&p and is available from: *Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG. Tel: (0277) 230909.*

Telephone Mics

Stolec Ltd. of Rye can now supply a new range of Primo telephone handset cartridges suitable for different applications. The range comprises transmitter and receiver units designed for use with both telephones and radio telephones, and a special feature is the use of a new thin receiver unit providing clear, uniformly high-quality sound.

Various types of cartridges can be supplied to meet a large variety of applications. DM61 and DM76 are dynamic transmitters, the 76 being a low-cost unit, and Model EM 84 is an electret transmitter. The three receivers are dynamic units, suitable as replacements for standard magnetic types.



In addition an electret microphone cartridge with integral amplifier is also available, and this miniature unit is only 10mm in diameter and 9·5mm deep. Prices start from 80p per cartridge.

Further details from: *Stolec Ltd., Eagle Road, Rye, East Sussex. Tel: (079 73) 3725.*

Remote Recall Telephone Answering Machine

Storacall, one of the authorised telephone answering machine suppliers, has recently launched its new Ansamaster II Telephone Answering Computer. This revolutionary unit is the first in the world to use a self diagnostic microcomputer that continually monitors each function of the machine and can "Talk" to the user through an alphanumeric digital display. Among other things, the display can indicate how much time has elapsed while recording the outgoing announcement, how many calls have been received, which call is being listened to during playback, whether a call is being taken, and whether the user has misoperated the unit, or if there is a fault with either of the two cassettes.

Among its many features are included fast forward, fast rewind, an answer only facility, variable length outgoing announcement, built-in microphone and call monitor facilities. The most important feature, however, is the remote recall that enables the user to listen to his messages without returning to his home or office. Unlike most other remote controlled answering machines, the Ansamaster II does not use bulky and expensive pocket activators. Instead a changeable voice code is used, which is programed by five changeable code switches on the back of the unit. This means that it is easy for more than one person to use the unit and greater security is gained as the code can be changed at will.

The Ansamaster II from Storacall is available either as an outright purchase or on a rental contract from as little as £3.36 per week.

For further details contact: *Storacall Ltd., 28 York Street, Twickenham, Middlesex. Tel: 01-891 3321.*

Cassette Head Demagnetiser

The totally new Bib Electronic Cassette Head Demagnetiser is a completely self-contained and automatic unit. Its use could restore lost output levels, reduce background noise and overall distortion. Removing virtually all residual magnetism, the head demagnetiser is housed in a standard cassette, powered by two internal batteries (supplied) and generates an audible tone when operating.

Available from most hi-fi accessory shops, the unit costs £10.49 inclusive of VAT.

Bib Hi-Fi Accessories Ltd., Kelsey House, Wood Lane End, Hemel Hempstead, Herts HP2 4RQ. Tel: (0442) 61291.

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

I never miss the opportunity of commenting on the complete inadequacy of the present system for issuing amateur transmitting licences, which enables anyone passing the entirely theoretical Radio Amateurs' Examination to go straight on the air with 150W input on a.m. or 400W p.e.p. of s.s.b. This was underlined this month when I received a letter from a young lad who passed his RAE last December.

He, very wisely, says he doesn't feel that he ought to go on the air yet without spending some time listening "to the technical talk" on the bands to find out "what it's all about", ending by asking me what receiver I would recommend he buy! Now our friend is in an area containing very few radio clubs, so he has probably been studying on his own for the RAE (so all the more credit to him for succeeding), but how is it that he has never got around to listening on the bands, normally the first step on the road to getting a ticket? It is fairly obvious that he will soon be passing his code examination with the same facility that he passed the RAE and yet he appears to have no practical experience whatsoever.

I have frequently come across people capable of constructing, and using, almost any piece of amateur radio gear you care to mention but who are quite incapable of sitting down and passing the examination. They just can't express their thoughts in writing, especially in the atmosphere of an examination room. Perhaps the new multi-choice type of exam, which, in my own view represents yet another lowering of standards, may be more suited to such candidates.

The fact remains, as I have said before, that an entirely theoretical exam is not the best way to ensure that a new licensee does not cause widespread interference with mishandled high-power transmitting equipment on the v.h.f. and h.f. bands. Of the two types of candidate mentioned, which one deserves to be on the air? Obviously the one with the practical experience, but who, in practice, gets the licence? The theorist.

I repeat my suggestion, for what it is worth, that since the Home Office cannot be expected to set up a practical examination on the subject, it should take advantage of the facilities offered (at no cost) throughout the country, of amateur radio clubs, where potential candidates for the RAE can get a specified number of hours of practical experience of handling transmitting and receiving equipment under the watchful eye of an appointed licensed amateur, or amateurs.

This, in effect, happens already with the RAE classes held in many clubs, technical colleges and evening classes, although these tend, naturally, to be largely theoretical. There is no reason, however, why they should not become a little more practical, especially in the clubs. Certainly no candidate for the RAE should be allowed to sit until the practical experience has been obtained.

Here and There

Well, the May RAE has been sat by all and sundry and there will be many anxious eyes cast upon the postman in a couple of month's time, with many candidates wondering why it takes so long to mark a multiple-choice paper. One candidate was **John Dainty** (West Wickham, Kent) who still finds little time for listening. For months past it's been the swotting for the RAE and now its holidaying, but John has persisted with his code, aiming for his G4. He did manage to hear FH8CM on 20m s.s.b. for his 149th country heard.

From Bangor, Co Down, **Sam Mulholland** GI8WAZ tells me the other young lads that made the RAE last time were John McBlain GI8VTV and Alan Stringer GI8VHZ whose father it was who coached the trio to their success, mentioned last month, in the form of GI3KDR! All three are hard at it in preparation for their code tests very shortly. Sam is thinking of knocking up a QRP d.s.b. rig for the 80m and 160m bands, an idea I heartily endorse as it will soon lead to more ambitious building projects.

Having acquired an R1968 receiver complete with manual and a spare set of valves for £8, **Keith Taylor** in Camborne, Cornwall, has passed his R1155 onto a friend which is a very thoughtful action and one others might bear in mind in a similar situation.

Although he is 75 now, **Norman Cahill** (Blackley, Manchester) has been dabbling around in radio for the last 40 years. When I suggested he take the RAE, so that he could talk back to the stations instead of just listening to them, he regarded it as "the spark to set me off again", so here's hoping it comes off. In Forest Row, Sussex, **Jonathan Bigwood** is also getting into the act having got hold of a Realistic DX160 but *sans* instruction manual. If anyone can help, and I know many will offer, I suggest first contact him on Forest Row 3085.

DXing

From 15-year-old **Simon Phillips** in Potters Bar, Herts, comes a first letter on the DX he has been hearing on his FRG-7 and a 110ft long wire, which will shortly be supplemented by an a.t.u. now on the stocks. On 10m Simon found N4ANU (who said he was using just 5W) and HS1WR, with HS1AMT and 4Z6BM on 15m. In Sunderland

Paul Barker G4HPS still sends info on his keying activities although, sad to say, the G4MH minibeam bought recently has still not been found a permanent site. He still managed to work FM7BM, HM1JJ, KH6AQ, TZ4AQS, VP2MGQ and ZL2GH on 15m c.w.

In Braintree, Essex, **Richard Guest** has three a.t.u.s and a Codar PR30 pre-selector which links his 60ft wire to his FRG-7. With a set such as this I doubt whether the PR30 is contributing anything at all except more noise! It is always worth switching a pre-selector in and out of circuit on an actual signal, to see if it improves the signal-to-noise ratio rather than just the signal strength. It can be deceptive if one just compares signal strengths.

Monthly report from **Dennis Sheppard** of Minster, Kent, could be the last one for a while as he prepares to move to a new QTH, where he will get his RTTY gear going again. From his past comments let's hope the new place will be a bit freer of local QRM! However, Dennis did copy the following on RTTY: 10m PT2WS, UA0CBO and ZS6ACB, 15m FR7AT, JA3DK, HP1XUL, PY4UP and 9G1JX with JJ1FXD, N4AZB/KP4, PZ1AP, TU2AA, VK2SG, VK5RY, ZS1XR, and a rare one 5T5JD.

Down in Truro, Cornwall, **Bill Rendell** continues to make improvements on his valved AR3 receiver, this time to the i.f. stages to try and improve adjacent-channel selectivity. This did not stop him copying some good DX on 40m in the shape of HK6AQT, VK3XI and 8P6KY. This is a band which is often written off by listeners because of the heavy-weight BC stations to be found there, but a little delving around in between can often prove worthwhile, as exemplified above. Catches for Bill on old favourite 20m included C5ACK, KH6WU, M1D, W6ENK/KH4 on Midway Is, ZK1AC, and 6W8DY who said QSL via VE4SK. Bill was amused at the QTH of HP2XSG given as "Coco Solo" heard on 15m together with HS1AMT (QSL W2TK), J3AH on Grenada, S79MC on Mahe Is in the Seychelles, TJ1BB, TN8MD, VP2MDG (Montserrat), VQ9WE on Diego Garcia (QSL to WA6IJZ), 4S7RS, 8Q7AR (QSL to K2TJ) and 9J2LL, all s.s.b. on all three bands.

During the excitement of the run-up to taking the RAE in May, **Arthur White** of Grantham, Lincs, managed to get hold of an AR88, "almost needing a small crane to get it into the shack" but all well worthwhile he says. Friend G3ZOA has done his best to instill the rudiments of the exam into Arthur but I'm quite sure, from the many letters received from Arthur over the last few months, that he will make it OK. With a 240ft aerial trapeze and a.t.u. in front of the AR88, he found HS1AMR, and AMT, P29JS on Papua New Guinea, 9H4G on Gozo Is, YC3BDL and YB0WR, all on 15m s.s.b.

While "spinning the dial" on his FRG-7, **Dave Coggins** of Knutsford, Cheshire, ran into a rare one in the shape of VR6TC on Pitcairn on the 15m band. With a 66ft inverted Vee aerial, supplemented by dipoles for 10 and 20m, Dave has logged other goodies on 15m such as FP0MD on St Pierre, YJ8YS, and an unusual prefix in 5N9GM who'd like cards through Box 1488 in Kaduna, Nigeria. Similar work on 10m unearthed AH2C on Guam, KG4WM in Guantanamo Bay, VP8QG, and VP8SB on Adelaide Is, 8R1J and 8Q7AR. A look at 20m revealed FK8DH, FO8AK, VP8QI, and extremely desirable ZL2UW/C indicating a QTH on Chatham Is. Forty metres found J3AH, VP2SK and to end with, XT2AW of Upper Volta and please QSL to KN1DPS.

On 10m, **Allan Stevens** (Crowthorne, Berks) went to the trouble of taping the pile-up around what appeared to be SV1DP/P on Mount Athos, but as he was still unable to positively identify the call directly he has not logged it. This is as it should be, of course, as there is no point in deceiving oneself in these matters. Others noted by Allan on 10m were HL9UG and YB0ACL, with 20m producing HC1EE, M1D, and KB6CC in the Phoenix group, but the precise island is not known, unless some reader can help out on this one.

Club Time

Cheshunt & District RC. Wednesdays at 2000, Church Room, Church Lane, Wormley, Herts. Lectures interspersed with natter-nights and Morse practice and club stations G4ECT and G8KJF on the air. Contact: Bill Pooley G8VBL, 36 Montayne Road, Cheshunt, Herts or ring Waltham Cross 32198.

Bournemouth RS. At 1930 in club room of Dolphin Hotel, Holdenhurst Road, B'mouth, first and third Fridays. Contact: G. Freeth G4HFQ, 9 South Avenue, New Milton, Hants or ring New Milton 618092.

Mid-Warwickshire ARS. First and third Mondays at 2000, at 61 Emscote Road, Warwick or have a chat with Mary Palmer G8RZR at 12 Edmondes Close, Woodloes Park, Warwick which is Warwick 496453.

Edgware & District RS. Second and fourth Thursdays 2000, at the Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware with Morse practice for starters, in both senses! A club net operates on Top Band and slow Morse under the RSGB scheme is transmitted from club station G3ASR on Top Band and on 2m. Publicity bod is Howard Drury G4HMD, 39 Wemborough Road, Stanmore, Middx or 01-952 6462.

Wirral & District ARC. Club call is G8WDC with meetings Wednesdays at Concourse Sports Centre, West Kirby at 2000, but check with Sec Ian Brooke G8PMW of 59 Mosslands Drive, Wallasey 'cos club takes time off during summer holidays!

Dover RC. At the YMCA, Godwyne Road, Dover, Kent at 1930 hours Wednesdays, with additional outdoor activities during summer. Note special event station will be active all bands at charity fete at Birchington, near Margate, for three days August 20/22, but contact: Peter Chamberlain G8EGT at 59 Capel Street, Capel-le-Ferne, Folkestone or try Folkestone 42387.

Bolsover ARC. Every Wednesday 1930 onwards at the Angel Inn. A new rapidly expanding club, with more details from John Lannigan G8TDU, 14 Keelby Road, Gainsborough, Lincs.

West Kent ARS. Adult Education Centre, Monson Road, Tunbridge Wells with meetings alternate Tuesdays with July 4 as a reference point. Sec is Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks, Kent or 0732 56708.

A special note concerning the **Scottish Amateur Radio Convention** on Saturday, September 13 in the Palace of Arts, Bellahouston Park, Glasgow, organised by the West of Scotland ARS, often mentioned in these columns. Linked will be the RSGB's Region 14 ORM in the afternoon and a dinner and dance in the evening, at the Dean Park Hotel, Renfrew. More details of Scotland's principal amateur radio event of the year from Convener: Tom Hughes GM3EDZ, 38 Ibrox Terrace, Glasgow G51. Thanks to Ian McGarvie GM4JDU for the info.

Barking Radio & Electronics Society. With calls G3XBF and G8GPK, club is active every Thursday, with Mondays devoted to constructional work and Tuesdays to Morse sessions. David Counden at 111 Shelley Avenue, Manor Park, London E12 will help with details of the meetings held at the Westbury Recreation Centre, Westbury School, Ripple Road, Barking, Essex where there is a telephone 01-594 4009.

Cambridge & District ARC. Fridays at 1930 hours in the Visual Aids Room, Coleridge Community College, Radegund Road, Cambridge. Try David Wilcock G2FKS, the

Publicity Officer, at 19 Cavendish Avenue, Cambridge for more info or ring 0223 47220.

North Bristol ARC. RAE and Morse classes plus usual events at the Self-Help Enterprise, 7 Braemar Crescent, Northville, Bristol 7 on Fridays at 1930 hours, but G. E. Taylor G2HDG will be glad to answer questions at 66 Burley Crest, Downend, Bristol.

St Helens & District ARC. YMCA, North Road, St Helens at 1945 every Thursday with details of events from Paul Gaskell G8PQD, 131 Greenfield Road, St Helens, Merseyside where there is also a telephone 0744 25472.

Liverpool & District ARS. Meets at the Conservative Rooms, Church Road, Wavertree at around 2000 on Tuesdays, catering for beginners and experts alike, while club station G3AHD helps with Morse practice on 144·250MHz every Thursday at 2030. Secretary is Al Neilson G4CVZ, 78 Ackers Hall Avenue, Liverpool L14 2EA.

Lincoln SW Club. Can be found at the Lincoln Corporation Social Club, Waterside South, on the second and fourth Wednesdays at 8pm, with current info from Michael Wells G8PNU, 4 Horner Close, Brant Road, Lincoln who is also on 0522 721277.

Afraid this is the end of the line this month with several more clubs unmentioned due to lack of space,

BROADCAST BANDS

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

The recent change in Radio Australia's QSL policy, together with the cancellation of their DX programme a couple of years ago, puts this station among a growing band who are turning away from the DXer to the short-wave listener. How has this come about?

Reception Reports

Traditionally, a DXer wanting a verification of reception (verie) sent a reception report to the station, who replied with a QSL card. The report gave the date, time and sufficient programme detail to prove that the station really had been picked up, and it continued with detailed information on the quality of reception using one of the reporting codes referred to last month, thus giving an indication how well the transmission was coming through.

This is still the pattern when reporting DX, but modern high-power broadcasters beaming a programme to the UK already know they are getting through. There are monitors, listening agencies and even embassies in the target area to give a continuous check, and a report of a single transmission is of little value. Smaller broadcasters though, still rely on listener reception reports, especially after the introduction of a new schedule.

Programme Reports

Short-wave listening is a lot easier these days especially if the receiver has digital readout. Broadcasters are now spending their funds on programmes for a growing audience and economies are made at the expense of the DXer. Even if you get a QSL card, it may not be a verie; some are more like compliment cards. The current QSL from the BBC is a lovely memento for the listener but if you turn it over, you will I think agree that it is useless as a confirmation of reception.

What do you do then to obtain a QSL? If the broadcast is in English and is beamed to this country then take the advice of the mailbag editor of the Voice of Turkey who recently pleaded: "no SINPOs please, tell us something about yourself and what you think of our programmes." It is a programme report that some stations want and if you supply one then you may get a QSL.

DX Programmes

DX programmes, too, seem to be on the way out. **Jonathan Marks** in his article *Getting the Message Across on Short Wave* in the 1980 *World Radio and TV Handbook,* put the broadcasters' point of view beautifully when he said: "It can be a tough task persuading the finance department that s.w.l.s are interested in a programme which announces times and frequencies of other radio stations."

We live in changing times, but there is compensation on the short waves as programmes too are changing. They are improving no end and are often well worth listening to.

QSL Cards

"What is a QSL card," asks reader **Frank Edward.** The one illustrated is from HCJB in Ecuador and acknowledges reception of their 100 watt experimental transmission on the 11 metre band. This card is a verification since it specifies

Heralding
Christ
Jesus'
Blessings

To:

☐ *We wish to thank you for your reception report. We have found it correct and hereby acknowledge with this verification card.*

Date of reception

Time-GMT

Transmission was heard on ______ *kHz*

☐ *We feel sure that you have heard one of our transmissions, but the information given was not sufficiently complete or correct to receive full confirmation.*

We appreciate your interest in our programs and invite you to write again.

Sincerely yours,

Director of Communications

HCJB Casilla 691 Quito, Ecuador South America

(8) Colonial architecture in CUENCA, Ecuador.
This country flower market is located at one of the numerous sites in Cuenca where colonial flavor can still be enjoyed. Note the turned columns and the old fountain.

the frequency, date, time (lasting 38 minutes) of reception and gives the name of the DXer. On the reverse side there is a photograph of a local scene in Ecuador but many stations use an artistic design of some sort in place of a photo.

Pennants

Pennants often come with, or instead of, a QSL. They are usually attractive such as the current one from the Voice of Turkey which is white, black, yellow and orange. While they add colour and atmosphere to the shack or listening area if they are displayed, they are of course no value at all as a confirmation of reception. According to reader **Brian O'Flynn,** pennants are there for the asking from Canada, Peking, HCJB, Budapest, AWR and Vietnam!

Voices

Regular listeners to Radio Finland will remember Patrick Humphreys who presented their mailbag programme. He is starting a new venture with *Voices* which is an international magazine devoted solely to international broadcasting. This 50-page monthly will include a Feature Programme Guide previewing programmes in English for the coming month, a frequency check list to keep up-to-date with latest changes, and articles about broadcasters and broadcasting. Further information from: Voices, Box 226, Helsinki 17, Finland.

World Radio, the pre-war BBC weekly which covered programmes from abroad, comes to mind. It came out in pre-TV days when listening to radio programmes from abroad was a popular pastime. Perhaps we have gone round the full circle.

Sunshine Radio

DX Corner, broadcast by the Voice of Turkey, is mentioned by Scottish reader **W. B. Stewart** of Lossiemouth who picked it up on 11 955 at 2045 using his National Panasonic DR28. I often listen to Sunshine Radio as they call themselves. The mailbag programme could really be classed as short talks, which are about various aspects of life in Turkey. A recent one brought back a vivid memory of ferryboat searchlights sweeping across the Bosporus after dark. Further information about VOT programmes is obtainable from The Voice of Turkey, Mithatpasa Caddesi 37, Ankara, Turkey.

DX Heard

Radio Free Grenada was picked up on 15 105kHz at 2100 by **Paul Hardy** of Caversham, who says the station announced itself as Radio 535, 535kHz being the m.w. outlet according to the *WRTV Handbook.* The signal was audible for about an hour but was not very strong. Radio Nepal was heard on approx 4·6MHz at 0700 in English by **Nigel Rogerson** of Plymouth, using his Heathkit SW717, homebrewed pre-selector, *PW* audio filter (May 1978 issue) and an inverted "V" aerial installed in the loft.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG. Reports for both bands **must** be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

An FRG-7, 100ft long wire and a.t.u. are in use at Bryn near Wigan by **J. Edwards,** who reports hearing Radio Rivadavia in Argentina on 5880 at 0035, La Voz de Cuba on 5315 at 0555, and on the 120m band, China on 2430 and 2600 at 2015.

Readers' Letters

Fifteen-year-old **Ian Smith** of Grimsby is using a Heathkit RA-1 amateur-bands receiver that has had the 20m and 15 bands adjusted to receive the 19m and 13m broadcast bands. When used with a homebrew a.t.u. and 100ft long wire it pulled in 66 stations on 19m and 40 on 21m. Quite an impressive list of DX Ian, sorry there is not room here to reproduce it.

Tony King of Radio New Zealand tells me that RNZ is making some major changes this year, starting with a range of new frequencies, to be phased in during the next eight months starting with 15 485 between 1800 and 2150. Tony will front *New Zealand Calling,* a new 30-minute programme which will include DX information.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

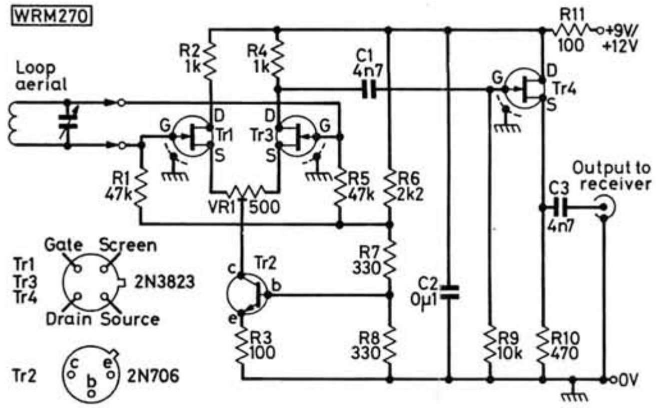
A number of readers have asked why I made no reference to the differential amplifier in my recent article on loops. Well, the Differential Matching Amplifier (d.m.a.) to give it its full name, is not really part of a loop. It is an additional piece of equipment whose purpose is rather different to what the name would suggest. It is a matching device that enables one to do without the coupling winding and any amplification obtained can be regarded as a bonus.

Matching Loop to Receiver

Why must a loop have a coupling winding? If you connected the main winding direct to the receiver then it would be loaded by the receiver input impedance which may be as low as 75 ohms. This loading will reduce efficiency *Q* and hence sharpness in tuning, and it may even cause loop detuning as well. The single-turn coupler along with the seven-turn main winding form a 7:1 step-down transformer which gives a better match than would be obtained by direct connection, but there are bound to be losses with such a crude arrangement. What is required is a matching device with a high input impedance and a low output impedance to go between the seven-turn main winding and the receiver. The d.m.a. provides this facility.

Differential Matching Amplifier

Fig. 1 is the circuit of the *Practical Wireless* d.m.a. which appeared in the April 1973 issue. As a result of some discussion that took place at a DX convention in York at that time, DXer Martin Hall offered to produce several of these d.m.a.s if a number of us chipped in to share the cost. My contribution to the enterprise, I am ashamed to say, consisted of signing a cheque and that is how I became the owner of a d.m.a!



The circuit appears rather complicated because the input is electrically balanced. If you used an ordinary unbalanced amplifier then the loop's figure-of-eight directional pattern would be distorted. The d.m.a. is mounted on the loop, close to and connected across the tuning capacitor, one input to either side. The d.m.a output is led off to the receiver in the usual way using balanced feeder (lighting flex will do). The d.m.a. ensures that the loop is completely isolated from the receiver and will not be loaded by it. An amplifier used in this way is called a buffer and the d.m.a. quite simply is a buffer amp with a push-pull input.

You can of course insert a d.m.a. between coupling winding and receiver and obtain some amplification this way, but the real point of the device is that it enables one to dispense with the coupling winding altogether and any shortcomings that go with it.

I have not made a great deal of use of my d.m.a. If you are interested in direction finding or if you frequently use a loop for listening to weak signals then a d.m.a. should be of value. A good match between loop and receiver leads to maximum transfer of signal. This will give a boost to a weak signal over and above any gain that is obtained from the amplifier. If you have trouble getting a deep enough null from your loop then a d.m.a. ought to bring an improvement here as well.

Altogether, a loop with differential amplifier should provide material for the experimenter but I feel it would be wise to master the loop on its own before straying into this field.

Sweden Calling DXers

This is the title of what must be the longest-running DX programme still on the air. It will reach its 1600th weekly edition this year, a span of some 30 years. Started by veteran DXer Arne Skoog, it is now run by George Wood, which is an appropriate choice since skoog is the Swedish word for wood.

SWCDX consists of tips and news items sent in by listeners. The English edition is aired on a Tuesday and can be picked up on 1179kHz (254m) as part of the half-hour programme starting at 1700, 1830, 2100 or 2300, all times in GMT. The 1700 and 1830 programmes are also transmitted to Europe on 6065kHz in the 49m band.

If you are successful in having one of your "tips" broadcast in the programme then you will go onto the mailing list and receive a copy of the script of the programme each week. The standard is high though, as reports come from all over the world in answer to the various language versions.

QSL card issued by R Sweden in 1969 to mark the 1000th edition of Sweden Calling DXers

Heard on a Portable

The long-wave band is usually regarded as the home of BBC Radio 4, but there are a number of other interesting broadcasts to be found there after dark.

Start at R4 on 200kHz (1500m), which is transmitted from Droitwich, south-west of Birmingham. Tune up in frequency to 209kHz (1435m). The stronger station is Munich in West Germany but if you null it out by rotating the receiver, you should pick up Azilal in Morocco which carries that country's home service in Arabic. Continue on to 218kHz where once again you will find two stations. The stronger at my QTH is Montecarlo, with programming in French, and the weaker is Oslo in Norway.

Poland is the sole occupant of 227kHz, which is the next channel, though there have been reports of test transmissions from Spain on this frequency. It should be easy to separate the two by rotating the receiver. Luxemburg (home service) is on 236kHz which it shares with stations in four different locations in the USSR. Kalundborg in Denmark puts out a strong signal on 245kHz, while next door on 254kHz the dominant signal is Tipaza in Algeria. It can be nulled out to clear the way for Lahti in Finland.

Try the far end of the band. On 155kHz (1935m) West Germany and Romania fight it out. It is unlikely that you will be able to separate them by rotating the receiver as the two stations lie roughly in the same direction from the UK, but they fade in and out and it is possible at times to hear each of them in the clear for a short period

Readers' Letters

An old HMV N2-1373 valved receiver with 15ft indoor aerial are in use at Wokingham Berks by reader **K. K. Jones,** who reports hearing Radio Algiers on 254kHz long wave, loud and clear with a daily programme in English from 2000 to 2030. He is surprised just how good this radio performs in spite of its age. Old valved receivers are not to be despised. Many perform very well when they are in good working order, and those that were designed for use with an external aerial can be used with m.w. loop.

My remarks in the July 1979 issue concerning the New Zealand punters loop, have brought a reply from **Tony King,** who assures me that the Punters Dream Aerial Company is still in existence and has sold the astonishing number of well over 1000 antennae. Sounds like something from outer space! Perhaps one of our New Zealand readers would send a photograph or some advertising material to substantiate these strange happenings "down under".

VHF BANDS

by Ron Ham BRS15744

When the start of the sporadic-E season was accompanied by a solar storm, and a long spell of fine weather, the detailed information in your letters, which arrived from Shetlands to Sussex and Wales to Scandinavia, built up a general picture of events.

Solar

"Plenty of solar noise and bursts on April 28, 30, and May 1, 2, 5 and 7," writes **John Branegan** GM4IHJ, Saline, Fife, who, like **Cmdr Henry Hatfield,** Sevenoaks, **Reg Taylor,** Shillington, and I, recorded the activity at various frequencies between 136 and 151MHz. Incidentally, Henry is currently testing a solar radio telescope at 550MHz which I hope to hear more about in the future. The consistently fine weather between April 22 and May 19 has enabled both **Ted Waring** (Bristol) and Henry to look at the sun with their optical instruments more frequently than in previous months.

While Ted counted 16 sunspots on the 22nd, 18 on 27th, 33 on 30th, 37 on May 4, 44 on 6th, 46 on 10th, 59 on 11th and 64 on 13th, Henry was looking for active areas on the sun to account for the radio noise, which persisted almost daily from April 26 to May 14. Among the many events he saw were some very angry prominences on the west limb on May 4. On the 11th his radio telescope recorded two five-minute bursts of radio noise at 1455 and 1512, and at 1516, using his spectrohelioscope, he saw two solar flares in progress which no doubt caused the noise. By 1656 one flare had died away and the other had revived. At 1334 on April 26 both Henry and I recorded an eight-minute burst, and a wide variety of much smaller bursts on April 28, 29, 30, May 3 and 7th to 14th inclusive. One burst was so strong at 1244 on the 28th that I heard it at 28MHz. A solar noise storm began at 1311 on May 3 and continued until the 6th, frequently sending our recording pens to f.s.d. on the 4th and 5th.

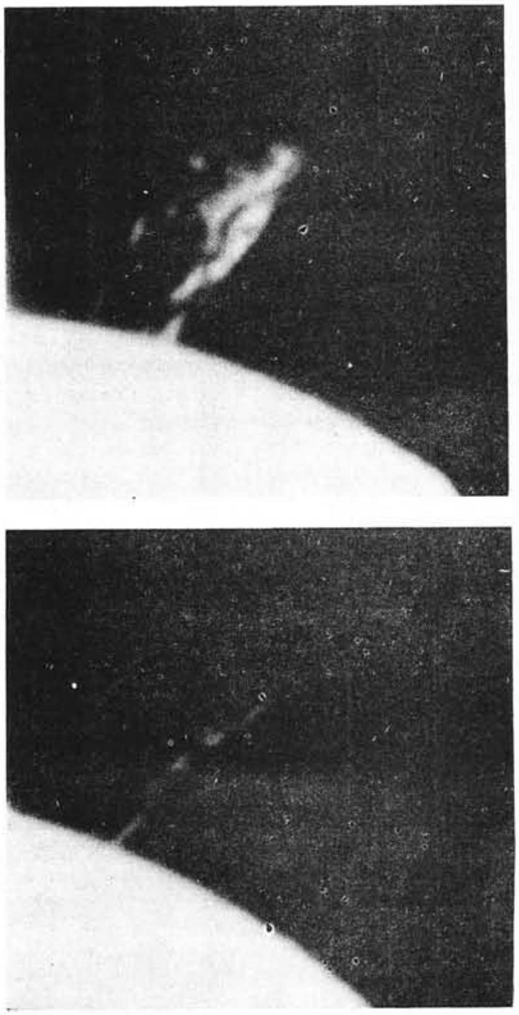
Christian Monstein, Switzerland, has built a radio telescope at the Amateur Observatory of Kreuzlingen. This instrument is part of a group project, and comprises two radio interferometers working at 230MHz and 465MHz on an east-west baseline, with two Yagi aerials spaced 10 metres apart. Christian also built in a helix antenna directed towards the pole star (Polaris) to measure cold sky. The drawings Christian sent look very impressive and I am looking forward to hearing more about the work of this instrument and the observatory in the future.

The 10 Metre Band

No doubt the solar activity was responsible for the fluctuating conditions on 10m. For instance, at 0904 on April 23 the band was quiet except for one unidentifiable signal and that was subject to a very strong echo, yet during the early morning of May 5, **Sam Faulkner,** Burton-on-Trent, received a 58 signal from H44PT, Solomon Islands, working a G4 which he sorted out from the many s.s.b. signals coming from Japan. The band was dead, except for the odd station which popped up briefly, around 0900 on April 29 and May 7, 8, 9, 12, 13, 14, and 15 and on some days there were no beacon signals either. During the 28-day period from April 22 to May 19 inclusive, I heard signals from the International Beacon Project stations in Bahrain A9XC, on 11 days, Cyprus 5B4CY, 24 days, and Germany: DL0IGI, 18 days and DK0TE, 11 days. Periodically I heard signals from the beacons in Bermuda VP9BA, Mauritius 3B8MS and South Africa ZS6PW. Ted Waring's beacon report is similar to mine except for the addition of ZS6DN, WD4MSN and YV5AYV which he occasionally heard. **Barry Ainsworth** G4GPW, Lancing, Ted and I all received very strong signals from DL0IGI during the sporadic-E disturbance on May 10, in fact Barry uses this signal as an early warning device for sporadic-E. After May 15, conditions were getting back to normal because during the early mornings of the 16th to 19th inclusive, I received strong signals from stations in Japan and Russia. "SSTV activity on 10m has been very poor," writes Sam Faulkner, having logged only two stations during the period, W6VLH at 1650 on April 23 and ZS6BQT at 1520 on May 5.

Sporadic-E

Around 1645 on May 3 I received strong signals from thirteen east-European f.m. broadcast stations between 66MHz and 73MHz, some of which appeared in the 4m amateur band. **Barry Ainsworth, Chris Smith** G3UFS, Lancing and **Alec Painter** G4HUJ, Worthing, are operational on 70·26MHz and 70·375MHz, a.m., and are looking for contacts in the hope of renewing interest in this fascinating band. I well remember the excitement in June



A solar event recorded by Henry Hatfield on March 11

1970 when many of us received strong signals from the Icelandic beacon TF3VHF on 70·275MHz and **Constance Hall** G8LY, Lee-on-Solent, working the beacon keeper (the late) Einar Palsson TF3EA. East-European broadcast stations were again heard during sporadic-E events at 0720 and 1234 on May 10, 1812 on the 11th, 1650 on the 16th and 0723 on the 18th. On each occasion the signals were subject to the long deep fading which is characteristic of sporadic-E.

DXTV

"The number and intensity of sporadic-E openings has increased," writes **Nicholas Brown,** Rugby, who at 1147 on April 29 received the RS-KH electronic test pattern from CST, Czechoslovakia on Ch. R1 (49·75MHz) and RTVE, Spain on Ch. E2 (48·25MHz) around 1600 on May 7. At 1101 on the 10th he received the PM5544 test card from RAI-1, Italy on 1a (53·75MHz) and the same card from Norway, Hemnes, Melhus and Steigen. Between 1225 and 1440 he watched pictures from Bayerischer Rundfunk, West Germany, on both E2 and E3 (55·25MHz), RTVE on E2 and at 1452, a cycle race on R1 from MTV, Hungary, and saw the "Intervision" caption at 1500.

From 0947 to 1130 on the 11th, Nicholas received signals from RTVE on E2, E3 and E4 and the pictures on E4, (62·25MHz), were so strong that they overpowered local electrical interference. During the early afternoon he received pictures from ORF Austria and again from Hungary and Italy. "On the 10th," says Nicholas, "I witnessed a fight between Melhus and Steigen and then another between Bayerischer Rundfunk and Steigen." Nicholas is using an omnidirectional Band I array, a v.h.f./u.h.f. upconverter, a wideband aerial amplifier and a dual-standard monochrome TV receiver used on u.h.f.

"The band remained fairly quiet here until May 4 when I received Scandinavian pictures on both E2 and E3 between 1300 and 1400, a music programme on R1 at 1310 and a magic show from the south at 1450 on E2," writes Sam Faulkner. On May 11 he received a variety programme, news, sport, cartoons and advertisements from RAI on 1a, and around 1435 he saw adverts from MTV-1 and a programme review. At 1610 on the 12th Sam watched a kind of soap opera on R1 and at 1810 a TVP, Poland, caption.

Like Nicholas, **Harold Brodribb,** St Leonards-on-Sea and John Branegan saw pictures from Norway during the morning of the 10th, but Harold watched the pictures from Bergen and Melhus fighting for predominance on E2, as well as brief indications of a German station. Like me, Harold saw the Hungarian test card, MTV-1, Budapest and their caption clock showing a time of two hours ahead of GMT. On the 11th, Harold received a very clear picture from Madrid and saw a news programme, with a map of Spain, showing the finish of a cycle race followed by pictures of the Pope arriving in Africa. Before 1300 he watched adverts for Coca Cola and "Pronto" furniture polish, at 1320 a part of a nature film on E2 and from about 1405 "a dull film" on R1.

"I have been receiving Band I pictures via sporadic-E for the past four days," wrote **Stephen Scott** G4CKR, Stockport, on May 13 and said that during the morning of the 10th he received programmes on R1 and R2 (59·25MHz), test cards on E3 from Norway-Hemnes and PTT SRG1, Switzerland and a news programme from Italy on 1a. On the 11th, he added Portugal and Spain to the score, and on the 12th, Hungary, along with several unidentifiable stations on each day. Steve uses a Murphy V1913 receiver fed by a rooftop dipole.

John Branegan received pictures from RTVE on E2 around 1400 on April 27, Russia and Poland on R1 on May 3, Austria and West Germany on E2 and Czechoslovakia on R1 on May 4, Portugal and Spain on E2 during the evening of the 5th, Czechoslovakia R1, and Spain E2, on the 6th and RTVE, Spain on both E2 and E4 during the afternoon of the 7th.

Guy Stanbury, Chelmsford, has installed a Wolsey Colour King aerial for the u.h.f. section of his JVC 3040 receiver, ready for tropospheric DX. He has also built a new Band II receiver, with a pen recorder output, so that he can monitor 103·9MHz for signals from the low-power RTBF transmitter at Tournai, which are only heard at Chelmsford when some form of atmospheric disturbance is in progress.

At 1400 on May 11, **Andrew Tett,** Surbiton, told Guy that he was receiving a football match on R1 and broadcast signals from Austria, Greece and Yugoslavia in Band II. At midday on the 15th, Guy received a test card from "Telewizja Polska" on R1 and MTV-1 and RAI-1 test cards between 0730 and 1030 on the 16th.

Meteor Scatter

"Every morning, when at home, I get the dawn chorus of meteors by pointing my aerial due east," says John Branegan, who regularly receives tiny bits of Band I television signals from stations in East and West Germany, Czechoslovakia, Scandinavia and Switzerland. "On an average morning," writes John, "I get a mean rate of 15/20 locked identifiable pictures per hour. When there is a meteor shower, I point my aerial to be at 90° to the expected radiant. In this way I get all the transmitters out to about 1000 miles and in to about 500 miles." John is particularly interested in meteor scatter propagation and is investigating the possibility of a relationship between this and the development of sporadic-E clouds. Readers interested in this line of research should contact John and see if their observations can help.

Tropospheric

Although conditions were not marvellous for the RSGB 144/432/1296 and SWL contest on May 3 and 4 the atmospheric pressure remained steady at 30·0in (1015mb) and **Pete Hipkin** G8KMG, Stevenage, managed to work 113 stations on 2m s.s.b. spread over G, GW, ON and PA0 with a best DX of 350km. Pete used his Multi 2000 and SEM 40 watt linear to a 10-element Yagi, 25ft a.g.l. from his home QTH some 450ft a.s.l. **George Grzebieniak** RS 41733, London, heard three Fs, four GWs, two PA0s and several northern G stations on 2m and an F, three GWs and a PE on 70cm during the event. George wishes that the RSGB would provide more contests on 70cm to increase activity. In readiness for the next event, he has been comparing results, using the signal from GB3WHA, between his 19-

element Tonna and his MBM 48-element Jaybeam aerials, both fitted with UR67 coaxial cable. At school, George is making a ZL Special 12-element beam which he intends to test on the signals from GB3VHF.

Another 70cm enthusiast is **Peter Bowyer** G8VPN, Kettering, who uses a Standard C7800 transceiver into a colinear on the chimney at his home QTH some 320ft a.s.l. Under normal conditions, Peter can work through GB3MK RB0, GB3CI RB2, GB3LE RB4, GB3ME RB6, GB3PB and 'DY RB10, GB3HN RB11, and GB3PY and 'NH RB14, but during the tropospheric opening on April 12 he worked through 19 (70cm) repeaters, so there is no wonder that he is looking forward to the next lift when he hopes to use a 88-element multibeam.

Between 1900 and 2000 on May 7, Sam Faulkner, using his amateur TV equipment on 70cm received pictures from G4DYP/T, Chasetown, Staffs, G5KS/T Oldbury, Birmingham, G8DIR/T Shrewsbury and a local G8VBC/T.

The Shetlands

"I hope more amateurs on the mainland will turn their beams north," writes **Arthur Tait** GM8TLO, Lerwick, Shetland. I wonder if readers fully realise that the Shetland Islands are about 200 miles north of Aberdeen and about the same distance west of Bergen in Norway, which means that for the Shetlanders, any 2m contact outside the Islands is DX. I well remember listening for the signals from the original Lerwick 2m beacon, GB3LER, back in 1964 and the excitement down here in southern England when, because of a big tropospheric opening, we heard it at good strength, and sent our reports to **Ray Flavell** GM3LTP, the beacon keeper.

In 1979 there was an increase in 2m activity when the Lerwick Radio Club GM3ZET, acquired an Icom 2m multi-mode, a 6-element quad and a rotator. The station is mainly operated by GM8SOP, who has made contacts with the mainland of Scotland on s.s.b. and has worked several stations through the Aberdeen and Bergen 2m repeaters. The present v.h.f. enthusiasts include GM3HTH, 'KZH, 'RFR, GM4DQD, 'FNE, GM8HUT, 'MMA and 'RUI. GM4FNE also works through OSCAR from time-to-time.

Arthur was first licensed in September 1979, and during October made contacts through the Aberdeen and Bergen repeaters, but his first real DX came during the evening of April 25 and most of the 26th, when the 2m band opened between Shetland, G, GM and LA. Using his FDK Multi 2700, B108 linear and a 7-element home-brew Yagi, he worked 34 stations, from as far south as G8DVK, Oxford (600 miles) and up north to Caithness, between 1922 on the 25th and 0052 on the 26th. Around 0830 on the 26th, Arthur was again having 5 and 9 QSOs with stations in Yorkshire and, between 1555 and 1739, with a 7/8 whip aerial on his car roof, he worked GM3DZB/M in Macduff, GM8SVB Banff, LA2BR Bergen and LA4EV Askoy, via the Bergen repeater, from outside his home.

GM3DZB/M, operating from a location some 860ft a.s.l. on the Ward of Scousburgh, using a 9-element Tonna, worked ten GMs and two LAs on 2m s.s.b. between 1741 and 1946. After changing to the mobile whip he worked three LAs via the Bergen repeater between 2131 and 2146.

About midnight on May 1, Arthur Tait received an excited phone call from GM8SOP, who, while operating the Lerwick Radio Club station, became the first non-Faroe Island station to access their repeater OY3REA. From about 2142, he had QSOs with OY3H, OY5A, OY9R, OY5NJ and OY5NS. Arthur quickly shoved his rig into his car, put up the 7/8 mobile whip and rushed to a nearby hill with a reasonable take-off to the north-west. He soon heard the OY repeater and made contact with OY5A, OY5SJ and OY5NS. This repeater was accessed again from Shetland on May 2 and 4, and the same stations were worked again plus OY7ML and OY1VN.

Sussex Expedition

On Sunday, May 18, the Brownlow family, Gerry G3WMU, XYL Margaret G8TVN, and sons Pete G4ESC and Richard G8VEJ, pitched an open-ended tent by the radio exhibition building at the Chalk Pits Museum, Amberley, Sussex and installed an amateur station so that the museum's visitors could see and hear it working. Contacts were made around the world on the h.f. bands and through the Hampshire repeater, GB3SN on v.h.f. The aerials, a ground-plane for 2m and a vertical for 15m and 10m, were attached to their motor caravan alongside the tent. Among the station's visitors were Ron Adams G3YCS, Albert Dymock BRS26593, Dick Farley G3SSJ, Richard McLachlan G3OQT, Sid Talbot G8FCX and Louis Varney G5RV.

GEORGE GRZEBIENIAK by RON HAM

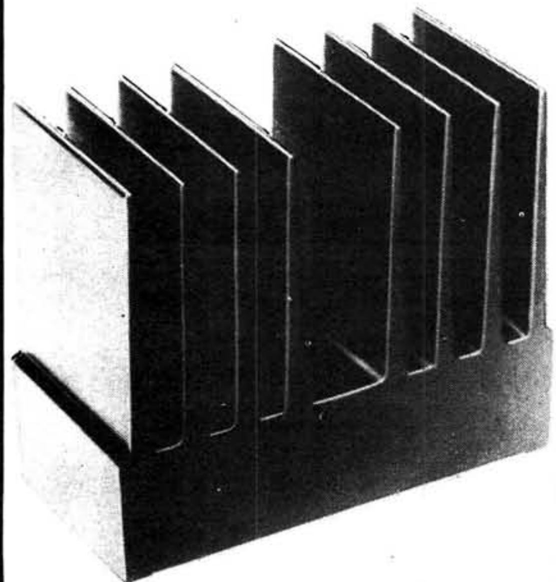
George Grzebieniak, RS41733, has built a receiving station, covering all the amateur bands from 160m through to 23cm, at his home in London and is a regular contributor to my v.h.f. column.

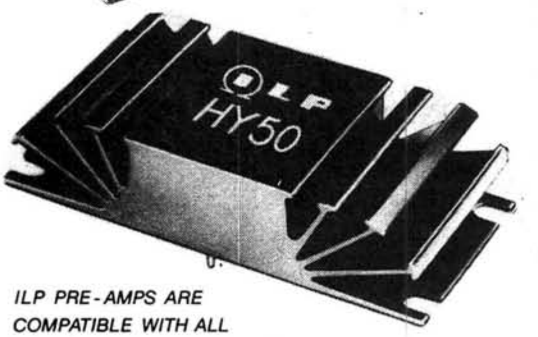
George remembers playing with wires, "just tying them up", he said, before he was six and a couple of years later he and another boy, also interested in electricity, built simple circuits using batteries and light bulbs. In time his mother bought him a 12 volt mains transformer and George still remembers the electric shocks he had when he used it. His interest in aerials began at the age of 11 when his grandfather explained to him why a radio receiver needs an aerial.

Before he was 14, George visited the Science Museum in London and was fascinated with their amateur radio station, GB2SM. On leaving, one of the operators at the station gave George a book about amateur radio, which he read with great interest. In December 1978 his mother bought him a DX160 communications receiver, and very soon young George joined the RSGB and took an interest in the bands above 30MHz. He has gradually installed aerials, complete with rotator, and converters for 4m, 2m, 70cm and 23cm.

Although still at school, George has a spare-time job with a local TV dealer, and enjoys listening for the DX during RSGB contests and tropospheric openings. He also has a teleprinter and is preparing a set and aerials for DX TV.

Simply ahead...





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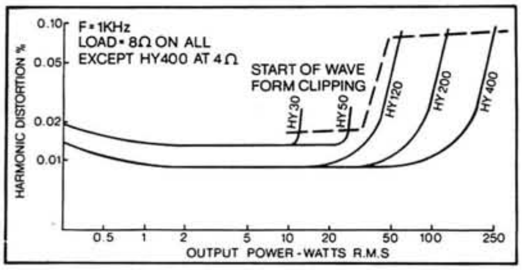

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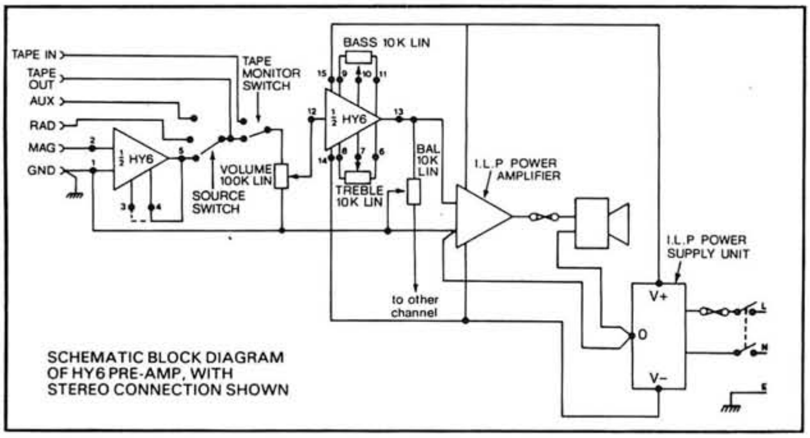

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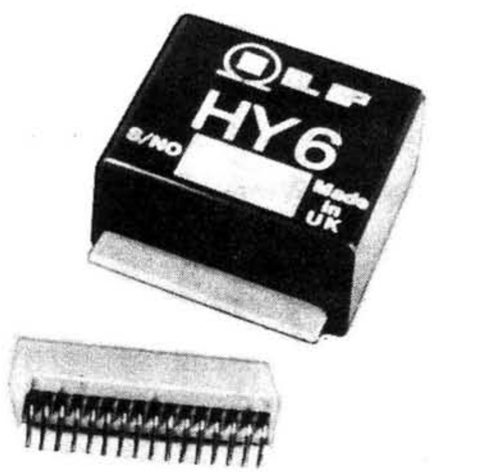

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ACY18	60
ACY19	60
ACY20	53
ACY21	50
ACY22	60
ACY28	60
ACY39	80
AD149	70
AD161	42
AD162	42
AF114	60
AF115	60
AF116	70
AF117	75
AF118	40
AF139	75
AF178	70
BC107	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC140	35
BC142	30
BC143	30
BC147	9
BC147B	10
BC148	8
BC148B	10
BC148C	10
BC149	8
BC149C	10
BC153	27
BC154	27
BC157	10
BC158	11
BC159	11
BC160	42
BC167A	11
BC168C	12
BC169C	10
BC170	18
BC172	11
BC173	12
BC177	18
BC178	16
BC179	18
BC181	20
BC182	10
BC183	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	28
BC212	9
BC212L	11
BC213	10
BC213L	12
BC214	10
BC214L	13
BC236	10
BC237	10
BC307B	20
BC308B	20
BC327	15
BC328	15

BC338	27
BC441	27
BC461	35
BC477	48
BC516	38
BC517	35
BC547	10
BC548	10
BC549C	10
BC557	15
BC558	10
BC559	10
BCY70	18
BCY71	20
BCY72	20
BD131	42
BD132	42
BD133	50
BD135	30
BD136	30
BD137	30
BD138	35
BD139	40
BD140	36
BD144	198
BD145	198
BD205	110
BD214	115
BD245	50
BD378	65
BD434	42
BD517	65
BD695A	65
BD696A	65
BDY56	156
BF115	34
BF167	30
BF180	35
BF194	12
BF195	12
BF196	12
BF197	14
BF198	18
BF199	18
BF200	32
BF224	24
BF244	29
BF245	24
BF244B	30
BF256	30
BF257	30
BF258	30
BF259	30
BF274	18
BF336	35
BF451	29
BF594	35
BF595	35
BFR39	25
BFR40	25
BFR41	24
BFR79	24
BFR80	24
BFR81	21
BFR98	105
BFX29	28
BFX84	26
BFX85	28
BFX86	28
BFX87	28
BFX88	28
BFY50	21
BFY51	21
BFY52	21
BFY56	32
BFY64	40
BFY81	99
BRY39	39

BSX20	20
BSY95A	18
BU105	105
BU205	125
BU208	225
E421	250
MD8001	225
MJ491	175
MJ2955	105
MJE340	54
MJE370	58
MJE371	60
MJE2955	105
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	22
MPSA55	22
MPSA56	22
MPSU06	50
MPSU56	60
OC26	170
OC28	120
OC35	125
OC36	130
OC41	125
OC42	48
OC43	55
OC44	55
OC45	30
OC70	35
OC71	28
OC72	35
OC74	50
OC76	45
OC81	35
OC82	50
OC83	48
OC84	45
OC140	110
OC170	85
OC171	45
OC200	48
TIP29	31
TIP29C	60
TIP30	32
TIP30C	44
TIP31A	38
TIP31C	50
TIP32A	40
TIP32C	55
TIP33A	54
TIP33C	70
TIP34A	63
TIP34C	75
TIP35A	135
TIP35C	165
TIP36A	145
TIP36C	185
TIP41A	50
TIP41B	55
TIP42A	64
TIP42B	
TIP120	70
TIP121	90
TIP142	190
TIP147	195
TIP2955	60
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TIS43	30
TIS44	45
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TIS88A	35
TIS90	20
TIS91	24
ZTX107	11
ZTX108	11
ZTX109	11
ZTX300	13
ZTX301	15
ZTX302	20
ZTX303	25
ZTX304	17
ZTX314	24
ZTX326	45
ZTX341	20
ZTX500	15
ZTX501	15
ZTX502	17
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
40311	60
40313	125
40315	55
40316	85
40361	42
40362	48
40408	70
40411	280
40467	95
40468	60
40594	90
40595	98
40603	90
40673	95
2N697	25
2N698	40
2N699	30
2N706A	19
2N708	19
2N918	33
2N1131	22
2N1132	22
2N1303	50
2N1304	50
2N1305	35
2N1671B	215
2N2219A	22
2N2220A	26
2N2221A	23
2N2222A	20
2N2369A	15
2N2646	48
2N2904	24
2N2905A	22
2N2906	22
2N2907A	22
2N2926G	10
2N3053	19
2N3054	55
2N3055	48
2N3442	140
2N3663	14
2N3702	10
2N3703	10
2N3704	10
2N3705	10
2N3706	10
2N3707	10
2N3708	11
2N3709	11
2N3710	10
2N3711	10
2N3822	130
2N3771	233
2N3772	195
2N3773	288

2N3819	22
2N3820	45
2N3823	70
2N3866	90
2N3903	20
2N3904	18
2N3905	18
2N3906	17
2N4037	52
2N4058	17
2N4061	17
2N4062	17
2N4427	75
2N4859	65
2N4871	50
2N5172	25
2N5179	60
2N5191	70
2N5305	40
2N5457	32
2N5458	32
2N5485	35
2N5642	750
2N5777	45
2N6027	40
3N128	112
3N140	112

74LS

LS00	13
LS01	13
LS02	15
LS03	15
LS04	20
LS05	23
LS08	23
LS09	23
LS10	20
LS11	32
LS12	32
LS13	40
LS14	75
LS15	40
LS20	21
LS21	32
LS22	40
LS26	48
LS27	45
LS28	48
LS30	24
LS32	30
LS33	39
LS37	39
LS38	39
LS40	28
LS42	80
LS47	85
LS51	25
LS54	30
LS55	70
LS73	40
LS74	40
LS75	48
LS76	45
LS78	45
LS83	105
LS85	105
LS86	45
LS90	50
LS91	125
LS92	75
LS93	75
LS95	115
LS96	180
LS107	45
LS109	75

LS112	80
LS113	65
LS114	49
LS122	70
LS123	95
LS124	180
LS125	60
LS126	60
LS132	95
LS136	55
LS138	70
LS139	90
LS151	96
LS153	85
LS155	96
LS157	76
LS158	85
LS160	120
LS161	98
LS162	110
LS163	100
LS164	115
LS165	155
LS166	175
LS168	210
LS169	210
LS170	288
LS173	105
LS174	147
LS175	110
LS181	295
LS183	298
LS191	120
LS192	120
LS193	120
LS194	125
LS195	125
LS196	125
LS197	125
LS200	120
LS221	120
LS240	225
LS243	232
LS244	225
LS245	270
LS251	130
LS253	130
LS257	115
LS258	120
LS259	160
LS261	450
LS266	75
LS273	180
LS279	88
LS280	250
LS283	190
LS290	130
LS293	130
LS295	215
LS298	215
LS299	420
LS323	450
LS365	65
LS366	65
LS367	65
LS368	65
LS373	180
LS375	150
LS374	180
LS377	199
LS378	185
LS379	215
LS384	50
LS390	140
LS393	140
LS395	210

74LS398	275
74LS399	230
74LS447	195
74LS490	150
74LS668	105
74LS670	270
74LS673	750
74LS674	850

VOLTAGE REGULATORS

1A, ve 5V, 12V 15, 18, 24V	**60p**
1A ve	**65p**
100mA -ve 5V, 6, 8, 12, 15V	**30p**
100mA ve	**65p**
LM309K	**135p**
LM317K	**350p**
LM323K	**635p**
LM723	**38p**
78H05	**595**
78HG05	**650**
TBA625B	**80**

BRIDGE RECTIFIERS

1A/50V	20
1A/100V	22
1A/400V	29
1A/600V	34
2A/50V	35
2A/100V	44
2A/200V	48
2A/400V	53
2A/600V	65
6A/100V	73
6A/400V	90
BY164	58
VM18 DIL	55

SCRs THYRISTORS

0.8/200V	35
5A/100V	32
5A/400V	39
5A/600V	43
8A/300V	48
8A/600V	85
12A/300V	59
12A/800V	150
15/700V	195
BT106	150
C106D	38
TIC44	22
2N4444	140

TRIACS

3A/100V	48
3A/400V	50
8A/100V	54
8A/400V	64
8A/800V	108
12A/100V	60
12A/400V	70
12A/800V	130
16A/100V	95
16A/400V	105
25A/400V	160
25A/800V	250
T2800D	120

DIAC
ST2 **25p**

LINEAR IC's

702	75
709C 8 pin	35
710*	67
741 8 pin	17
747C 14 pin	78
748C 8 pin	36
753 8 pin	185
810	159
AY-1-0212	595
AY-1-1313A	660
AY-1-1320	315
AY-1-5050	160
AY-1-5051	160
AY-1-6721/6	210
AY-3-1270	840
AY-3-8500	390
AY-3-8910	875
AY-5-1224A	235
AY-5-1230	450
AY-5-1315	595
AY-5-1317A	630
AY-5-3500	510
AY-5-3507A	450
AY-5-4007D	638
AY-5-8100	735
CA3011	110
CA3014	157
CA3018	68
CA3020	186
CA3023	191
CA3028A	80
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	71
CA3048	214
CA3059	170
CA3075	213
CA3080E	65
CA3081	190
CA3089E	215
CA3090AQ	375
CA3123	150
CA3130	85
CA3140	48
ICL7106	795
ICL7107	975
ICL8038CC	340
ICM7205	1150
ICM7215	1025
ICM7216A	1950
ICM7216B	1950
ICM7216C	1950
ICM7217A	790
ICM7555	89
LD130	452
LF365	98
LM10	395

LM301A	23
LM308T	70
LM311H	80
LM318H	205
LM324A	45
LM339	70
LM348	90
LM349	125
LM379	375
LM380	80
LM381N	145
LM381AN	248
LM382	125
LM386	99
LM387	150
LM389	93
LM733	125
LM1458	40
LM3900	60
LM3909N	70
LM3911	125
LM3914	240
LM3915	240
LM13600	135
M252AA	625
M253AA	1150
MC1303	88
MC1304P	260
MC1310P	150
MC1312PQ	195
MC1494	595
MC1495	350
MC1496L	92
MC1596	225
MC1710	79
MC3302	150
MC3340P	120
MC3360P	120
MC3401	52
MC3405	150
MFC6040	97
MK50398	635
MM5303	635
MM5307	1275
MM57160	620
MSM5526	850
NE518	210
NE543K	210
NE544	185
NE555	22
NE556DB	55
NE560	325
NE561	395
NE562B	410
NE564	425
NE565A	120
NE566	160
NE567V	170
NE570	395
NE571	420

RC4136D	110
SAB3210	275
S556B	275
SG3402	295
SN76003N	240
SN76013N	240
SN76018	148
SN76023N	170
SN76033N	240
SN76115N	215
SN76131	110
SN76227N	95
SN76477	175
SN76660	120
SP8629	299
TAA621AX1	250
TAA661A	155
TAA960	320
TAD100	159
TBA120S	70
TBA540	220
TBA550Q	330
TBA641-A12/BX1 or BX11	250
TBA651	190
TBA800	90
TBA810S	95
TBA820	70
TBA920Q	260
TBA990Q	270
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	575
TDA1024	105
TDA2020	320
TL061C	54
TL062CP	125
TL064CN	159
TL071	45
TL072CP	90
TL074CN	140
TL081CP	42
TL082CP	70
TL083CP	95
TL084CN	120
UAA170	150
UAA180	150
XR2206	350
ZN414	98
ZN424E	130
ZN425E	415
ZN1034	200
ZN1040E	685

COMPUTER IC'S

2102-2	115
2112	110
2112-2N	250

2114	295
2708	495
2716	1399
4116 16K	494
4047	750
6502	995
6532	1050
74S00	60
74S04	73
74S132	350
74S138	250
74S158	524
74S188	185
74S189	158
74S194	750
74S195	795
74S241	195
74S262	895
74S287	325
74S288	210
74S470	325
74S472	1150
74S475	825
81LS95	135
81LS96	135
81LS97	140
AY-5-2376	920
MC1488	90
TMS4039	250
MC1489	90
MK4027 4K	325
MK4118	2099
Z80A P10	720
Z80A CTC	720
Z80 CPU2 5	990
Z80A 4M	1099
Z80 P10	660
Z80 CTC	595

VDU IC'S

AY-3-1015	550
AY-5-1013	395
RO-3-2513	650
SFF96364E	1050
SFC71301	820
SFS80102	205
SN74265	63
SN74LS163	118
SN74S262	895
SN75450	120
SN75451	70
SN75452	70
SN75454	225
TMS6011	355

TTL 74 (TEXAS)

7400	11
7401	12
7402	12
03	14
04	14
05	18
06	48
07	48
08	22
09	22
10	19
11	25
12	20
13	33
14	52
16	31
17	31
20	19
21	38
22	26
23	32
25	30
26	44
27	32
28	35
30	20
32	28
33	38
37	35
38	30
40	20
41	74
42	71
43	120
44	116
45	116
46	132
47	99
48	99
50	20
51	20
53	20
54	20
60	20
70	41
72	31
73	40
74	34
75	56
76	41
80	55
81	120
82	75
83	94
84	113
85	121
86	33
89	215
90	57
91	85
92	59
93	59
94	95

95	75
96	95
97	180
100	130
104	62
105	62
107	35
109	60
110	54
111	68
112	150
116	198
118	99
119	125
120	105
121	42
122	55
123	95
125	45
126	55
128	74
132	70
136	65
141	85
142	195
143	350
144	350
145	90
147	180
148	145
150	150
151	75
153	75
154	140
155	75
156	80
157	75
159	185
160	99
161	99
162	99
163	99
164	120
165	120
166	155
167	240
170	230
172	420
173	120
174	105
175	82
176	90
177	90
178	149
180	90
181	290
182	88
184	145
185	145
188	299

190	135
191	135
192	135
193	135
194	105
195	198
196	130
197	90
198	195
199	
221	140
246	195
247	195
248	195
249	195
251	120
265	63
273	270
278	220
279	99
298	150
75108	350
75150	120
75491	89
75492	140
75450	70
75451	224
75454	224

CMOS•

4000	18
4001	18
4002	24
4006	92
4007	22
4008	82
4009	40
4010	48
4011	24
4012	24
4013	45
4014	85
4015	85
4016	42
4017	82
4018	88
4019	48
4020	99
4021	105
4022	95
4023	25
4024	75
4025	25
4026	180
4027	48
4028	82
4029	105
4030	60
4031	225
4032	125

4033	175
4034	210
4035	125
4036	365
4037	115
4038	118
4039	360
4040	105
4041	80
4042	80
4043	95
4044	95
4045	175
4046	130
4047	98
4048	65
4049	45
4050	48
4051	80
4052	80
4053	80
4054	130
4055	135
4056	135
4057	2850
4059	575
4060	130
4061	1225
4062	995
4063	120
4066	58
4067	430
4068	26
4069	26
4070	30
4071	25
4072	25
4073	25
4075	25
4076	99
4077	48
4078	30
4081	28
4082	28
4085	90
4086	90
4089	150
4093	89
4094	240
4095	105
4096	105
4097	350
4098	115
4099	190
4160	125
4161	125
4162	125
4163	125
4174	130

4175	120
4194	125
4408	790
4409	790
4410	790
4411	1020
4412V	1520
4415F	1520
4415V	850
4419	850
4422	320
4433	570
4435	1050
4440	1050
4450	999
4451	350
4452	350
4490F	
4490V	750
4501	750
4502	28
4503	125
4535	75
4506	75
4507	60
4508	325
4510	99
4511	150
4512	98
4513	225
4514	265
4515	299
4516	120
4517	450
4518	105
4519	70
4520	115
4521	250
4522	150
4526	150
4527	160
4528	120
4529	175
4530	89
4531	165
4532	140
4534	575
4536	395
4538	160
4539	135
4541	150
4543	175
4549	296
4550	
4554	
4556	175
4557	425
4558	130

DIODES

AA119	18
BY100	24
BY127	12
CR033	158
OA9	45
OA70	12
OA79	12
OA81	15
OA85	14
OA90	7
OA91	7
OA95	8
OA200	9
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N4003/4	5
1N4005/6	6
1N4007	7
1N4148	4
3A/100V	18
3A/400V	20
3A/600V	27
3A/1000V	30

NOISE DIODE
Z5J **180**

ZENERS
2V7 to 33V 400mW **8p**
3V3 to 33V 1.3W **15p**

VARICAPS

MVAM115	140
MVAM2	150
BA102	25
BB104	40
BB105B	40
BB106	40

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