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Radio & Electronics World

The communications and electronics magazine

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At the time of going to press YAESU and ICOM are planning to announce price increases! R. Withers will hold their prices whilst stocks last!!!

YAESU — Full Range Stocked

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FBA5	Empty battery pack	6.50
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FC757AT	Auto ATU inc WARC bands	255.00
FIF65	Comp. I/face for Apple II	46.75
FL2100Z	HF 1.2KW linear 1.8-30 MHZ	675.00
FNB2	10.8V nicad pk for FT208/708	26.50
FNB3	Nicad for FT203/9/703/9R/RH	29.50
FNB4	Nicad pack for FT209RH etc.	33.50
FP700	20A power supply	159.00
FP757GX	Switched mode power supply	159.00
FP757HD	Heavy duty power unit	175.00
FRA7700	Active ant. for FRG7700/8800	42.50
FRG8800	All band RX	445.00
FRT7700	Receiver ATU for FRG7700/8800	48.50
FRV7700A/B/C/D	VHF conv. for FRG7700/8800	49.00
FRV8800	VHF converter	75.00
FT203R-FBA5	2mtr H/H 1.5W	172.50
FT203R-FNB3	2 mtr H/H 2.5W	189.00
FT203R-FNB4	2 mtr H/H 3.5W	195.00
FT209RH-FBA5	2 mtr H/H C/W empty b/case	220.00
FT209RH-FNB3	2 mtre handheld 3.7W	239.00
FT209RH-FNB4	2 mtr handheld 5W	245.00
FT2700R	V-UHF 25W transceiver	459.00
FT270R	VHF 25W transceiver	295.00
FT290R	2 mtre multimode	299.00
FT690R	6 mtr multimode transceiver	249.00
FT703R-FBA5	70cm H/H 1.5W	209.00
FT703R-FNB3	70cm H/H 2.5W	235.00
FT703R-FNB4	70cm H/H 3.5W	235.00
FT709R-FBA5	70cm H/H 1.8W	235.00
FT709R-FNB4	70cm H/H 4W	259.00
FT726R	2mtr base station	760.00
FT757GX MK2-RWC	All band all mode 100W TXR	729.00
FT790R	70cm multimode transceiver 2W	379.00
FT980	Gen coverage + Ham band transceiver	1399.00
FVS1	Voice synthesizer for FT270/2700	19.75
LOG BOOK	YAESU amateur radio log bk.	2.00
MD1B8	Base station desk m'phone	63.95
MH12A2B	Speaker MIC for FT203-9 etc	16.50
MH1B8	Fist/mobile MIC for FT757 etc	15.50
MMB11	Mobile bkt/mt for FT290R	28.50
PA3	Mobile DC unit for FT208. 209 etc	17.50
PA4C	AC power unit for FRG9600	12.00
QTR24D	World zone clock	32.50
SAT726	Oscar/Sat unit for FT726	92.50
SB1	Switch unit	15.00
SB2	Switch unit for YH1	13.50
SB3	Switch unit	14.25
SP55	External loudspeaker	14.50
YH1	H'set/boom MIC for SB1/2/3	14.50
YH2	H'set/MIC for FT203/209 etc	15.00
YH55	Mono headphones	14.95
YH77	Lightweight mono h'phones	14.50
YHA15	Helical antenna for FT290R	7.50
YM24A	Speaker MIC for FT208/708	23.50
YM49	Speaker/MIC for FT290R	19.50

ICOM — Full Range Stocked

AT150	Matching automatic ATU for IC735	
BC35E	Desk-top charger for all nicads	59.00
BP3	Standard Nicad pack	26.00
BP4	Empty battery box for cells 6X	8.50
BP5	High capacity q/charge 10.8V Nicad	49.50
DC1	12V mobile regulator pk (2E)	13.25
EX243	Curtis keyer unit for IC735/745	53.00
EX257	FM unit for ICR71	35.50
EX310	Speech synth. unit for 271 etc	39.00
HP1	Mono headphones	28.50
HS10/HS	Headset and boom MIC assy + switch	37.50
IC-AHI	3.5-30 MHZ mobile ant.	189.00
IC-AT10	100W auto ATU	299.00
IC-AT50	500W automatic ATU	435.00
IC-CPI	Mobile ch'ing lead c/lighter	4.99
IC-HM9	Speaker MIC assy.	18.50
IC-PS30	Power supply unit 25A cont.	275.00
IC-UT16	Voice synth. for IC27 series	25.00
IC02E	2 mtr LCD k'board 2W t'ceiver	259.00
IC120	1W 1296 MHZ mobile (40MHZ cov)	499.00
IC271E	2 mtr all mode 25W b/stn	699.00
IC271H	High power 100W version of IC271E	875.00
IC27E	25W 2 mtr FM mobile 9 memories	359.00
IC27H	45W version of IC27E	389.00
IC290D	25W version of IC290E	469.00
IC290E	10W multimode 2 mtr mobile	439.00
IC2E	2 mtr H/H thumbwheel 2W	185.00
IC2KL	1KW PEP linear auto band switching	1150.00
IC3200E	Dual band 25W t'ceiver	475.00
IC471E	UHF m/mode b/stn 32 mem	799.00
IC471H	75W version of IC471E	975.00
IC4E	70cm thumbwheel H/H 2W	239.00
IC505	3/10W 50MHZ SSB(FM) transceiver	329.00
IC735	**New all mode all band t'ceiver**	**839.00**
IC745E	All band SSB/AM/CW gen cov TX-RX 16 mem	875.00
IC751E	All band all mode t'ceiver 32 mem	1250.00
IC04E	70cm LCD keyboard entry handheld 2W	265.00
ICR71	All band short wave r'ceiver 32 mem	699.00
LC11/14	Leatherette case assy for IC02/4E	6.50
LC1/2/3	Leatherette case for IC2/4/E	4.99
PS15	External power supply 20A	139.00
PS20	External PSU I/speaker 20A	175.00
PS25	Internal PUS for IC751E	95.00
PS35	IC751 int. switch mode PSU	169.00
PS55	Matching power supply unit for IC735	165.00
SM6	Desk for microphone	39.50

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RWC TOP 100

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ADONIS	AM503G	Base stn FM/SSB comp. mic	52.50
AKD	WA1	120-450MHZ wavemeter c/w ant.	24.95
ALINCO	ALM-203E	2 mtr H/H transceiver 3.5W	239.00
ALINCO	ALR-206E	2 mtr 25W mobile t'ceiver	295.00
ALINCO	EDH-25	DC/DC 12V converter	13.50
ALINCO	EMS-20	Speaker MIC for ALM203	18.50
ALINCO	ESC-3	Leatherette case and strap	14.50
AOI-MIC	DM300	600 OHM replacement microphone	6.50
AOI-MIC	DM301N	600 OHM replacement noise can. MIC	7.50
ARM-ANT	10FM-HW	10FM-portable 'HOT-WIRE' ant	7.99
ARM-ANT	TRAV-JIM	Travelling Jim portable 2 mtr ANT	7.99
BREMI	BRS35	10A 13.8 volt power supply unit	59.50
CETRON	572B	PA valve	54.00
CRITON	LS88B	8 OHM replacement ext. loudspeaker	6.60
DAIWA	SA450M	2 way 2.5KW coax switch 0-900MHZ	17.50
FDK	FDK 725X	2 mtr 25W FM mobile transceiver	269.00
FDK	FDK 750XX	2 mtr multimode transceiver	389.00
GAMMA	2MTR S-JIM	Gamma twin slim Jim type ant	9.50
GAMMA	3-5A PSU	3-5 AMP power supply unit	19.50
Hi-mound	HK703	Straight key	29.25
Hi-mound	HK704	Straight key	19.95
Hi-mound	HK706	Straight key	16.65
Hi-mound	HK707	Straight key	15.50
Hi-mound	HK808	Deluxe straight key	49.95
Hi-mound	MK703	Squeeze key c/w base	28.95
Hi-mound	MK705	Squeeze key	25.65
Hi-mound	MK706	Squeeze key	23.50
HI-Q	HI-Q coil	2X coil/formers/insulators (pat-pend)	7.50
HOXIN	70N2DX	Dual band 6/8 + 3X 5/8 mobile	23.75
HOXIN	70N2M	144/432 dual band 1/2W+2x 5/8 mobile	20.95
HOXIN	70N2V	Dual b/base ant. 3'6" long	36.80
HOXIN	HS-358	430MHZ tripple 5/8 6.3dB	30.95
HOXIN	HS-770	144/432 duplexer 50W 30dB isolation	19.55
HOXIN	HS-78F	2 mtr 7/8 fold over 4.5dB	16.95
HOXIN	HS-88F	2 mtr 8/8 fold over 5.2dB	19.96
HOXIN	SMC15SE	15 mtr 130W PEP mobile ant. 1.72M long	16.85
HOXIN	SMC20SE	20 mtr 100W PEP mobile ant. 1.72M long	21.50
ICS	AMT-2	AMTOR/RTTY/CW/ASCII terminal unit	245.00
ICS	RM-1	L-cost AMTOR/RTTY/CW/ASCII modem	69.00
Jaybeam	8XY-2M	2 mtre 8E crossed ant.	41.50
Jaybeam	LR1-2M	2 mtr omni-directional colinear	39.00
Jaybeam	LW10-2M	2 mtr 10 element YAGI	27.25
Jaybeam	MBM48	70cm 48E antenna	40.75
Jaybeam	Q4-2M	2 mtr 4 element quad	33.95
		Full Jaybeam range in stock.	
M'raker	10-12A PSU	10-12A 13.8V power supply	62.50

MuTek	BBBA 500u	20-500MHZ low noise wide band preamp	34.90
MuTeK	SLNA 144s	2 mtr low noise RF switched preamp	39.95
MuTeK	SLNA 145sb	Optimised preamplifier for for FT290R	39.00
MuTeK	TVVF50c	High performance 2M-6M transverter	189.90
RAYCOM	7.1MHZ TRAP	7.1 MHZ traps. c/w instructions	8.95
RCA	6146B	PA valve	12.85
REVCO	2044/5	Nest of dipoles w/band ant 26-500 MHZ	69.00
REVCO	Revcone	Wide band discone ant 30-500MHZ	29.95
RWC-ANT	2M HB9 CV	2 mtr 2E directional beam antenna	6.99
RWC-ANT	70CM HB9CV	70cm 2E directional beam antenna	5.99
SUN-ANT	KG208 SE10	10 mtr loaded 1/4W tilt-over	12.50
SUN-ANT	KG309 SE2	5/8 mtr tilt-over ant	13.50
SUN-ANT	SO239/CGM	Cast/chrome SO239/gutter mount assy.	4.75

RAYCOM MOD KITS

Raycom	757 modkit	FT757GX fast tuning mod kit	29.50
Raycom	FBX-RWC MOD	LC7136-7 10 mtr FM mod kit c/w ins.	22.50
Raycom	LCL/DNT MOD	LCL/DNT 10FM mod kit	12.95

RAYCOM ANTENNAS

Raycom	1/1 G5RV	Full size G5RV m/band ant	14.95
Raycom	1/2 G5RV	1/2 size G5RV m/band ant	13.95
Raycom	1/4 wave 25	145MHZ 1/4 wave PL259 fitting	2.99
Raycom	1/4wave3/	145MHZ 1/4 s/steel whip 3/8 fitting	2.99
Raycom	3/8-mag	3/8 thread mag mount c/w cable PL259	9.25
Raycom	5/8 whip	145MHZ 5/8 spring type s/steel whip	3.75
Raycom	SO239-MAG	Magnetic mount SO239 c/w cable PL259	9.50
Raycom	Swivel-mag	Swivel base mag-base c/w cable PL259	9.25
Raycom	Trap-dipole	7.1MHZ trap dipole com. kit	29.95

RAYCOM RF POWER AMPS

Raycom	V15F-145	2mtr 15W FM amp.1-3W/pt	62.50
Raycom	V35L-145	2mtr 35W linear amp.1-3W input	59.50
Raycom	V45F-145	2mtr 45W FM amp. 1-3W input	62.50
Raycom	V15L-145	2mtr 15W linear amp. 1-3W input	49.50

SPECIAL OFFERS

ARM-ANT	Multi P-6	Multi-polarization P/ant 140-800MHZ complete	36.00
Cybernet	Beta 3000	Modified 10FM inc RPT 29.3-700 MHz	79.00
Kopek	AR1002	50kg loading 3-core auto-rotator	38.50
Raycom	100W d-load	100W coaxial dummy load 0-500MHZ	12.50
SUN-ANT	KG 208 SE2	7/8 2 mtr ant. tilt-over	14.50
SUN-ANT	SGM/239	SO239 type gutter-mount c/w cable/259	9.50

SCANNING RECEIVERS

*YAESU FRG-9600 MKII very latest mod, gives improved "S METER" and RX plus extended coverage up to 950MHz.

FRG9600/MK2-RW	60-950 All mode scanning RX	449.00
REGENCY MX5000	25-550MHZ scanner AM/FM (AOR2001)	329.00
REGENCY MX7000	25-550 & 800-1300MHZ scanner AM/FM	389.00
REVCO RS2000E/RWC	AM/FM scanner 60-179 & 380-520MHZ	259.00

TONNA — Full Range In Stock

TONNA	20089N	144MHZ 9 element port. antenna 'N'	27.95
TONNA	20199	144/435 9+19 element Oscar ant.	36.90
TONNA	20419	432MHZ 19 element	36.50
TONNA	20422	435MHZ 21 element ATV	31.25
TONNA	20624	1296 23 element ant.	27.95
TONNA	20809N	144MHZ 9 ele. fixed ant. 'N'	25.65
TONNA	20813N	144MHZ 13 ele. port. ant.	39.50
TONNA	20817N	144MHZ 17 ele. fixed ant. 'N'	47.83
TONNA	20818N	144MHZ 9 ele. crossed antenna 'N'	41.50

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CONTENTS

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Safety in the shack

Some of the constructional projects featured refer to additions or modifications to equipment; please note that such alterations may prevent the item from being used in its intended role, and also that its guarantee may be invalidated.

When building any constructional project, bear in mind that sometimes high voltages are involved. Avoid even the slightest risk – safety in the shack please, at all times.

Cover Photographs

Top – One of the new Grundig Satellit receivers (no, it doesn't receive satellite TV, and yes, this could be confusing) (p9)

Bottom – New printers from Panasonic (p9)

SPECIAL FEATURES

Mr Plod on the move – page 25

Dig that Deutsche Funk – page 9

REGULARS

READER SERVICES

NEXT MONTH

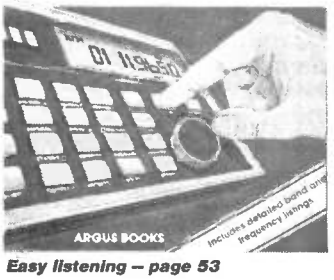
☐ **Next Issue**
Cover date August 1986 on sale Thursday, 10 July

☐ **Publication Date**
Second Thursday of the month preceding cover date

scanners

A VHF/UHF Listener's Guide

Peter Rouse GU1DKD



Easy listening – page 53

We regret to inform readers that due to continually rising production costs and to enable us to maintain the high standard of content in Radio & Electronics World the price of the magazine will be £1.30 from this issue

PRODUCT NEWS

Featured on these pages are details of the latest products in communications, electronics and computers. Manufacturers, distributors and dealers are invited to supply information on new products for inclusion in Product News.
Readers, don't forget to mention ***Radio & Electronics World*** when making enquiries

FUNCTION GENERATOR

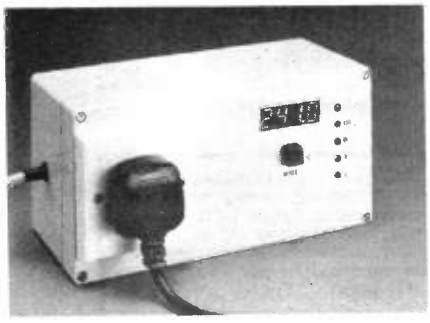
The new low cost TG302 function generator from Levell Electronics provides sine, square, triangle, pulse, sawtooth, ramp and asymmetrical sine waveforms over the frequency range of 0.02Hz to 2MHz. It is possible to sweep the frequency over three decades by applying an external voltage to the VCF input.

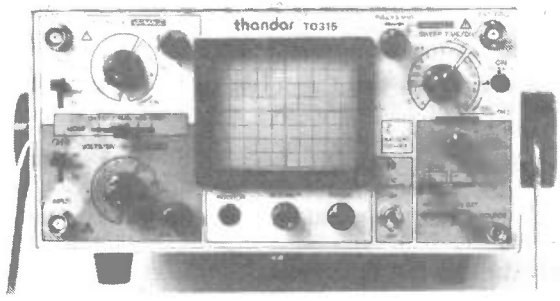
The main output amplitude can be varied from 20mV to 20V p-p from a 50 ohm source. A TTL output of rise time <3ns is also available. This output is capable of driving up to 20 TTL loads or triggering an oscilloscope. A dc offset control enables up to±10V dc to be superimposed on the main output signal.

The TG302 is housed in a high impact ABS plastic case with internal screening. The size is 85×235×280mm and it weighs under 2kg. The price is £136+VAT including UK mainland delivery.

A version is available which includes a 10MHz frequency counter which can monitor either internal or external signals.

Levell Electronics Ltd,
Moxon Street,
Barnet,
Herts EN5 5SD.
Tel: (01) 449 5028.





PORTABLE SCOPE

A new mains/battery oscilloscope has been introduced by Thandar Electronics, designated the TO315. It offers true portability with 15MHz bandwidth, a dual trace display and an input sensitivity of 2mV/div. Selection of chopped or alternate mode is automatic, as is line or frame synchronization.

The portability and performance provided by the TO315 makes it an ideal instrument for field use. It has a weight of 6kg and size of 113 × 223 × 310mm, and costs £655 + VAT.

Thandar Electronics Limited,
London Road,
St Ives,
Huntingdon,
Cambs PE17 4HJ.
Tel: (0480) 64646.

MICROWAVE COUNTERS

The Systron Donner Division of Thorn EMI Measurement Ltd has introduced a new series of wide range frequency counters operating from 10Hz to 26.5GHz, with resolution down to 1Hz.

These rugged, lightweight counters are designed for simple operation and are built to MIL-T-28800 standard. Frequency measurement up to 20GHz (model 6245B) or 26.5GHz (model 6246B) is very accurate. The instrument is extremely sensitive and has a wide dynamic operating range (the difference between sensitivity and damage level).

Designed to operate using a frequency locking technique, they will respond to signals with high levels of frequency modulation, regardless of the rate of change of modulation. Self-generated noise is very low, typically −65dBm. Both instruments have a 10-digit LED display and are available with an IEEE-488 interface.

Thorn EMI Measurement Ltd,
Archcliffe Road,
Dover, Kent CT17 9EN.
Tel: (0926) 35411.

WATTMETER

CIL has introduced a wattmeter especially designed as a low cost, simple to use test instrument for almost any electrical apparatus. Just plug in the equipment, press a button, and rms voltage applied, rms current drawn and effective power all to ±0.2% accuracy are instantly displayed.

The wattmeter is Z80 microprocessor based, using a unique analogue/digital technique for the digital sampling.

Applications include test departments, goods inward and laboratories where instruments can be easily checked for their correct ±0.2% effective power consumption, without any danger from the mains voltage.

The device supplies 240V mains voltage up to 10 amps, with the display in either watts or kilowatts.

CIL Electronics Ltd,
Decoy Road,
Worthing,
Sussex BN14 8ND.
Tel: (0903) 204646.

CAPACITANCE TESTER

Mercer Electronics has introduced a new digital capacitance tester, the model 9670, that will measure from 0.1pF to 20,000μF (9 ranges) with 0.5% basic accuracy.

Priced at $99.00, the model 9670 features input discharge protection, easy-insert 'cap-lead' jacks and colour-coded test leads with alligator clips. The tester has a 0.5 inch LCD display with over-range and a 'lo bat' indication. Weighing only ¾lb, it uses a standard 9V battery. It is conveniently sized at 6.85×3.54×1.42 inches. A flame-retardant plastic case with an acrylic window and a tilt bail are included.

Mercer Electronics,
Simpson Electric Company,
859 Dundee Avenue,
Elgin,
Illinois 60120
USA.
Tel: (312) 697 2265.

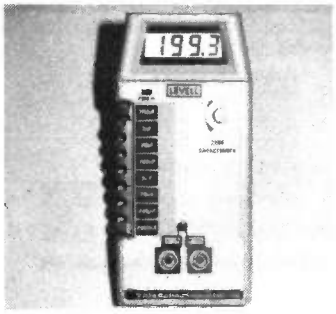
LOGIC ANALYSER

Hewlett Packard's 1615A 24-channel state and timing logic analyser is now available from Carston Electronics Ltd, the used equipment and computer specialists, for just £950 (+VAT).

This highly versatile and powerful instrument is offered fully recalibrated and with a 12-month guarantee. It gives clock rates of up to 20MHz for a multitude of fault-finding and design applications.

Specifications of the HP1615A include a 5ns 'glitch' capture capability, six additional qualifier channels, plus an extensive trigger facility. Designed for quick and easy operation with a menu-driven format, the analyser has a memory depth of 256 words and offers a built-in self-test function for rapid maintenance.

Carston Electronics Ltd,
99 Waldegrave Road,
Teddington,
Middlesex TW11 8LL.
Tel: (01) 943 4477.



CAPACITANCE METER

Levell Electronics Ltd has introduced an accurate digital capacitance meter, type 7705, with a wide measurement range at a price of £49+VAT, including test leads and a soft plastic carrying case.

Capacitance values between 0.1pF and 2,000μF may be measured on a 3½-digit liquid-crystal display (with 0.5 inch high characters, to a basic accuracy of 0.5%). The test voltage is 3.2V peak and the unit has an input protection fuse. Measurement rate is 2 per second. The 7705 is powered by an internal PP3 type battery.

Cases are moulded in high impact ABS plastic, 180×87×42mm, weighing only 350g.

Levell Electronics Ltd,
Moxon Street,
Barnet,
Herts EN5 5SD.
Tel: (01) 449 5028.

DIGITAL MULTIMETER

Two compact digital clamp multimeters, the AC20 and AC30, which accurately measure currents of up to 200 and 300A ac respectively, have been introduced by Beckman Industrial. Prices are around £60 for the AC20 and £67 for the AC30.

The AC30 measures up to 500V ac and has a built-in continuity bleeper. It features autoranging on both volt and amp scales for easy operation. Accuracy is 1.5% of reading plus 4 digits for current measurements on both models, and 1.2% of reading plus 4 digits for voltage measurements on the AC30.

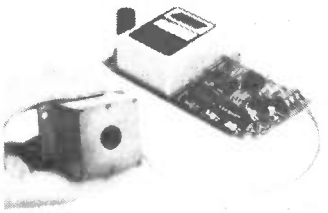
Both instruments have a clear 3½-digit display and a data hold function for easy measurement in hard-to-reach locations. Overload protection is 500A for one minute on current ranges and 750V for one minute on voltage ranges. Resolutions are 0.1A on 200A range, 1A on 300A range, 0.1V on 200V range and 1V on 500V range.

The AC20 and AC30 will capture and measure a conductor of 1.1in diameter, feature a low battery indicator and have a case insulation that will withstand 2000V ac for up to one minute.

Beckman Industrial Ltd,
Queensway Industrial Estate,
Queensway,
Glenrothes, Fife,
Scotland KY7 5PU.
Tel: (0592) 753811.

IR MEASUREMENT

A new low cost, modular, non-contact infra-red temperature measurement system is now available from Emmaflex Ltd. The system is designed for accurately measuring the temperature of objects that are moving, inaccessible, fragile or unsafe to touch.



The system consists of sensor modules operating within a temperature range of −55°C to +1000°C. One sensor module (M-100) has a distance/target ratio of 3:1, the others (M-350 and MX) have distance/target ratios of 15:1. The sensors can be used either as stand-alone units giving a 0.1V non-linear signal, or with power supply and linearizer boards giving 1mV/°C, 4-20mA, 0-5V or Type J T/C equivalent outputs. A full range of sensor housings and board housings are available.

This system provides an effective low cost method of measuring actual product temperatures rather than air temperature near a product.

Emmaflex Ltd,
192 Main Road,
Milford,
Stafford ST17 0UN.
Tel: (0785) 665566.

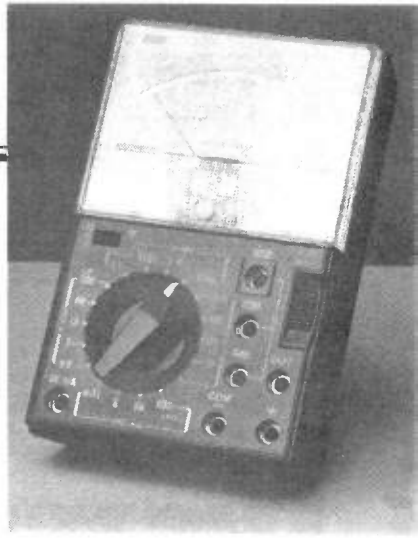
MULTIMETERS

Test equipment distributor Eagle International has introduced four new multimeters from Kaise. The meters are aimed at the hobbyist and general electronics sector of the market, with sensitivities from 20,000 to 50,000 ohms per volt.

The SK 142 is a pocket-size 20 kilohms per volt meter with case and probes, with fuse and diode protection. There are sixteen ranges covering dc and ac voltages, dc current and resistance.

The SK 20 has a similar specification to the SK 142, but with extra ranges on dc voltage and current. The SK 20 also has a polarity reversal switch and mirror scale.

The SK 44 has a sensivitity of 30,000k/V and the SK 50 is a 50,000k/V meter. Both have polarity switches, overload protection and carrying cases, and share identical range specifications: 8 ranges up to 3000V dc, 5 ranges up to 1200V ac, 5 ranges from 30μA to 12A dc, 4 resistance ranges up to 50 megohms fsd, and 3 capacitance ranges. Typical accuracy is within 3% of fsd on dc ranges.



Eagle Distributors Ltd,
Unit 5,
Royal London Estate,
29/35 North Acton Road,
London NW10 6PE.
Tel: (01) 965 3222.

DC POWER SUPPLY

New from Global Specialties is the model 1300, a low cost bench power supply which has been specifically designed for use by designers, technicians, educational institutions and hobbyists.

The instrument has a fixed output of 5V dc (±0.25V) at 1A maximum, with a line regulation of 0.2%, a load regulation of 1.0%, and a maximum ripple of 10mV peak-to-peak. Variable outputs are 0-20V dc at 0.25A maximum, with a line regulation of 0.05%, and a maximum ripple of 10mV peak-to-peak.

The outputs can be used independently or interconnected to accommodate different voltage and current requirements. Current limiting guards against damage due to short circuits.

The instrument's front-panel voltage and current meter has an accuracy of ±5% of full scale, and a light-emitting diode (LED) indicates overload on the 5V supply.

Weighing only 2.7kg and with dimensions of 76×254×178mm, the model 1300 power supply is easily portable. It is supplied with an illustrated manual which provides specifications, operation instructions, maintenance and calibration information, a circuit description, and a schematic diagram.

Global Specialties Corporation,
Shire Hill Industrial Estate,
Saffron Walden,
Essex CB11 3QA.
Tel: (0799) 21682.

TWO FOR THE ROAD.

The very latest IC-28E 2m. FM mini-mobile from ICOM.

This new 2 metre band transceiver is just 140mm (W) x 50mm (H) x 133mm (D) and will fit nearly anywhere in your vehicle or shack. Power output is 25 watts or 5 watts low power and is supplied complete with an internal loudspeaker.

The large front panel LCD readout is designed for wide angle viewing with an automatic dimmer circuit to control the back lighting of the display for day or night operation.

The front layout is very simple, all the controls are easy to select making mobile operation safe. The IC-28E contains 21 memory channels with duplex and memory skip functions. All memories and frequencies can be scanned by using the HM-15 microphone provided. Also available is the IC-28H with the same features but with a 45 watt output power.

Options include IC-PS45 13.8v 8A power supply, SP8 and SP10 external speakers, HS15 flexible mobile microphone and PTT switchbox.

IC-290D/490E Mobiles

These SSB, CW, FM transceivers are ideal for mobile or base station operation. The IC-290D for 2 metres produces 25 watts/5 watts low power. The IC-490E for 70 centimetres produces 10 watts/1 watt low power. Both transceivers have a range of operating features, these include 5 memory channels, dual V.F.O.'s and a priority channel to automatically check your most used frequency. Squelch on FM and SSB to allow silent scanning whilst searching for signals, slow or fast AGC for SSB and CW and a noise blanker to suppress pulse type QRM. Sidetone is provided on CW.
Memory and full or programmable band scan with internal switches to stop on busy or empty channels. Programmable offsets are included for odd frequency splits.

Options include: IC-PS45 13.8v 8A power supply, IC-BU1 memory back up battery unit, IC-SP8 and SP10 mobile speakers.

British TELECOM
Cellnet

Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM

ICOM

Total coverage.. 100Khz to 2Ghz!

IC-R7000.

The R71E now has a team-mate – the IC-R7000. With these matching receivers it is now possible to tune from 100KHz-2GHz.

The IC-R7000 covers Aircraft, Marine, FM Broadcast, Amateur Radio, Television and weather satellite bands. The IC-R7000 incorporates FM wide/FM narrow, AM, USB and LSB modes of operation with six tuning speeds - 0.1, 1.0, 5, 10, 12.5, and 25KHz. Frequency coverage 25-1000MHz and 1025-2000MHz (25-1000MHz and 1260-1300MHz guaranteed specification). With the IC-R7000 you have normal tuning capability with the front panel tuning knob or for quick tuning of a desired frequency by using the front panel key-pad. A total of 99 memory channels are available for storage of received frequencies and operating mode. Memory channels can be called up by pressing the memory switch then rotating the memory channel knob or by direct keyboard entry.

These receivers are available seperately but together would make a superb listening station for the shortwave listener or licensed amateur.

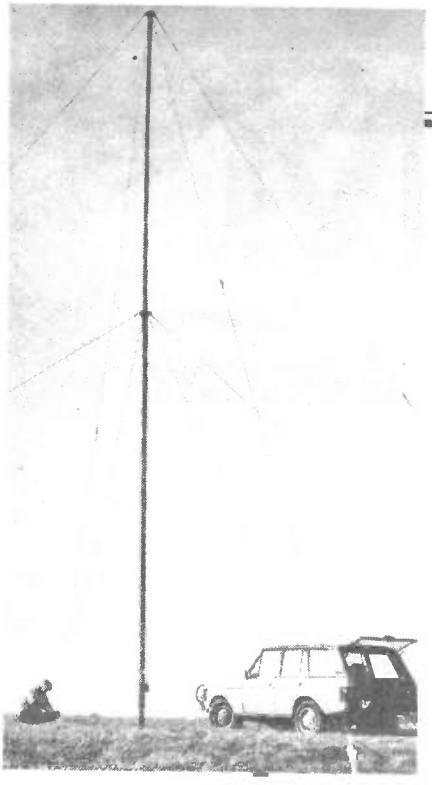
A sophisticated scanning system provides instant access to specific frequency ranges. By depressing the Auto M switch, the IC-R7000 automatically memorises frequencies that are in use whilst in the scan mode and can be recalled later. The scanning speed is adjustable and the scanning system includes memory selected frequency ranges or priority channels. All functions including memory channel readout are clearly shown on a dual-colour fluorescent display with dimmer switch. Other features include dial-lock, noise blanker, S-meter and attenuator.

Options include: RC12 infra red controller, EX310 voice synthesizer, SP3 and SP7 external loudspeakers, HP1 headphones and the ICOM AH-7000 super wideband discone antenna.

The IC-R71E is a general coverage receiver 100KHz-30MHz featuring direct keyboard frequency entry and infra-red remote controller (optional). SSB, AM, CW, RTTY and FM (optional) modes of operation. With 32 programmable memory channels, twin VFO's scanning systems, selectable AGC, noise blanker, pass band tuning and a deep notch filter. Keyboard frequencies can be selected by pushing the digit keys in sequence of frequency. The frequency is altered without changing the main tuning control. Options include: EX257 FM unit, RC11 infra-red controller, CK70 D.C. adaptor for 12 volt operation, CW filter options and a high stability crystal filter, SP3 and SP7 external loudspeakers, EX310 voice synthesizer, HP1 headphones.

IC-R71E.

Computer Control These receivers can be connected to a computer terminal via a suitable interface.
JT602 Serial Interface for IC-R7000
JT603 Parallel Interface for IC-R71E (IC-R7000)
The ICOM IC-R71E requires the IC-EX309 interface connector



CARBON FIBRE MASTS

Antenna Technologies can now supply communications antenna masts of up to 30 metres (100 feet) manufactured from an ultra light and strong carbon/glass fibre composite material. This new range of masts is particularly suitable for portable professional and defence requirements where light weight and high durability are very important, enabling the masts to be quickly and easily transported and deployed.

As well as being typically less than half the weight of traditional metal masts, this new range is less susceptible to corrosion and icing, and a 15 metre mast can be deployed by two people in less than half an hour.

They are also radio transparent, which can prevent degradation of radiation patterns and loss of efficiency for many HF antennas. Applications include radiating masts for MF and HF communications and navigation, support structures for wire, yagi and dish antennas and environmental monitoring.

Antenna Technologies use computer programs to analyse users' requirements in terms of static loading, wind loading, deflection, and safety factors to ensure that the recommended mast optimises performance and cost.

Antenna Technologies,
Horace Road,
Kingston-upon-Thames,
Surrey KT1 2SN.
Tel: (01) 546 7808.

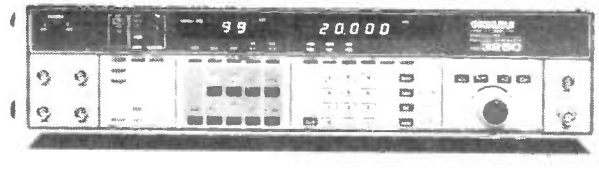
FUNCTION GENERATOR

Telonic Instruments Ltd, UK distributor for Kikusui, has announced the availability of a new programmable synthesizer/function generator, FGE 3250. This new product combines a high stability 10Hz-20MHz synthesizer and a multi-function generator in a single programmable instrument (frequency range .001Hz-20MHz as a function generator).

In the synthesizer mode frequency is continuously settable with an accuracy of 0.002%, and in the function generator mode triggered, gated or burst oscillations are possible for sine wave, triangle wave, square wave, pulse output and complemented pulse output. Maximum output level is 30V p-p.

Tactile switches combine with a rotary knob in this easy to use instrument to enable the operator to set and store conditions for up to 100 programmed steps, enabling recall of any or all of these steps as required, making the FGE 3250 ideal for automated production line and similar applications. A GPIB interface is provided as standard.

Telonic Instruments Ltd,
Boyn Valley Road,
Maidenhead,
Berkshire SL6 4EG.
Tel: (0628) 73933.



MOBILE AERIALS

A new UHF mobile aerial is now available from On-Glass Aerials Ltd of Cannock, Staffs, which will mount directly onto a windscreen without the need for fixing holes.

Although primarily developed for the PMR market, with models covering 420-540MHz, a 70cm amateur band model, the OW432, has now also been produced. This will retail at around £35 + VAT.

Specifications include a 200W maximum power rating and nominal 50 ohm impedance, and connection is via a miniature UHF connector. The radiator can be removed from the ABS plastic base for security.

The company hopes to produce a VHF version for 144MHz in the near future.

B D Price G4DVB,
93 Highview,
Vigo Village,
Kent DA13 0TG.

BENCH POWER SUPPLY

The new Thurlby LB-15 bench power supply is a low cost general purpose unit designed for versatility and ease of use. It provides up to 15V at currents up to 2A.

An output range switch allows the user to select a higher maximum output curent when using lower output voltages. Voltages up to 7.5V are available at currents up to 4A.

Voltage and current levels are set using rotary switches which provide a rapid and accurate means of setting the output. Calibrated vernier controls provide infinite adjustment of voltage and current between each switch setting.

The units operate in constant-voltage or contact-current mode with automatic crossover. LED indicators show the mode of operation and provide a convenient means for measuring the load current. Adjustment of the current controls until the CV and CI indicators are illuminated simultaneously gives an accurate reading of the load current flowing.

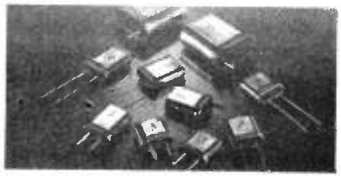
Line regulation and load regulation figures are exceptionally good, as is the transient performance. Ripple and noise levels are very low.

The design is totally protected against overload conditions and incorporates a sophisticated 'power foldback' protection system. The mechanical construction is equally robust.

The Thurlby LB-15 is designed and built in Britain and costs £89+VAT.

Thurlby Electronics Ltd,
New Road,
St Ives,
Huntingdon,
Cambs PE17 4BG.
Tel: (0799) 26699.

QUARTZ CRYSTAL FILTERS



A new range of quartz crystal filters from Piezo Products includes a large variety of standard designs for use in HF, VHF and UHF communications, spanning the 100kHz to 100MHz frequency range.

Made by the specialist firm CR Snelgrove of Canada, the filters come with a wide range of selectable attributes including sharp selectivity, low insertion loss, high stopband rejection and excellent intermodulation characteristics. Linear phase filters and filters with precise group delay characteristics are also offered.

The HF range includes types for many standard frequencies including 99.8, 250, 455, 1400, 1500, 1748, 1750, 1751 and 4400kHz, plus 35.4, 40, 45, 68.6, 75 and 100.2MHz types for roofing filter applications. The VHF/UHF range covers 9.9 to 31MHz in a variety of standard frequency selections.

This range of standard quartz crystal filters also includes 200, 500 and 700kHz versions for miscellaneous applications.

Piezo Products Ltd,
Millstream Trading Estate,
Christchurch Road,
Ringwood,
Hants BH24 3SD.
Tel: (0425) 479337.

COMMS RECEIVERS

Grundig have just introduced two new models in their Satellit range of communications receivers (not to be confused with their new, and rather good, satellite TV receiver).

The 400 and 650 models both feature a PLL synthesizer and an LCD display for time (the clock covers two time zones) and frequency display.

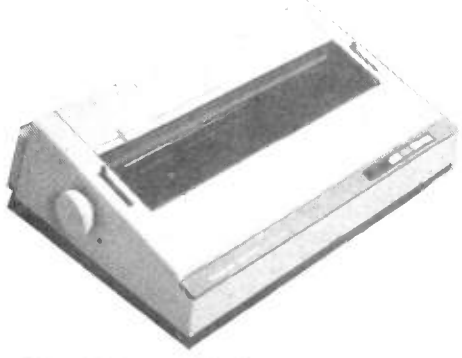
The 24-memory Satellit 400 covers VHF (88-108MHz), SW (1.6-30MHz), MW (513-1611kHz) and LW (148-353kHz), and has a scanning facility for the selected waveband. Sensitivity is quoted as 2μV for 6dB signal to noise, with a −6dB bandwidth of 2.3kHz (−50dB : 3.6kHz).

The larger Satellit 650 has 60 memories (because of the microprocessor control, all are fully independent of mode and waveband). VHF and SW coverage are the same as the 400, with MW coverage from 510-1620kHz and LW from 148-420kHz. A BFO is provided, and short wave bandwidth is selectable between 2.2kHz and 3.5kHz. Sensitivity is 0.7μV-4.5μV.

Both receivers will accept either 120V or 240V mains input in addition to the internal batteries.

Prices will be approximately £180 for the 400 and £400 for the 650 and we shall be reviewing both in the near future.

Grundig International Ltd,
Mill Road, Rugby,
Warwickshire.
Tel: (0788) 77155.



PANASONIC PRINTERS

The complete range of Panasonic KX printers is now in stock at First Software and includes five dot matrix and two daisy wheel machines. The dot matrix units, from the 80-column KX-P1080 to the 136-column KX-P1595, are all bidirectional with full logic seeking and have multiple print modes selectable from the front panel. These machines offer draft, near letter quality and proportional printing as well as graphics capabilities.

The daisy wheels, KX-P3131 and KX-P3151, are respectively 110-column and 132-column machines offering outstanding letter quality printing plus compatibility with the majority of small business and personal computers.

To complement the range a wide selection of accessories and options are available which will allow the printers to be configured for virtually any requirement.

First Software,
Intec 1, Wade Road,
Basingstoke,
Hants RG24 0NE.
Tel: (0256) 463344.

DATA BUS CABLE

Amphenol has introduced a data bus cable with enhanced performance for use in applications where extra protection against interference is required, such as aircraft control systems and ground and marine-based communication systems.

Type 711-Pan 6421 is a 77 ohm, twin 24awg multiplex data bus cable approved to MIL-STD-1553B and DEF 00/18 (part 2), and meeting the requirements of Panavia specification.

The construction features dual screens of silver-plated copper strands, giving 85% minimum optical coverage for each screen. Silver-plated copper alloy cores are insulated with red and blue Kapton/FEP tape plus dispersion. The outer sheath is blue extruded FEP of 0.2mm minimum thickness.

Characteristic impedance is 77 ohms ± 3 ohms, mutual capacitance 98.4pF/m max, and attenuation is 4.92dB/100m max at 1MHz. Maximum core-to-screen working voltage is 600V rms.

Nominal diameter over outer sheath is 3.5mm, and mass is 28kg/km max. The cable is supplied in multiples of 1m length, minimum 5m.

Amphenol Ltd,
Thanet Way,
Whitstable,
Kent CT5 3JF.
Tel: (0227) 264411.

RACAL PHONE-PATCH

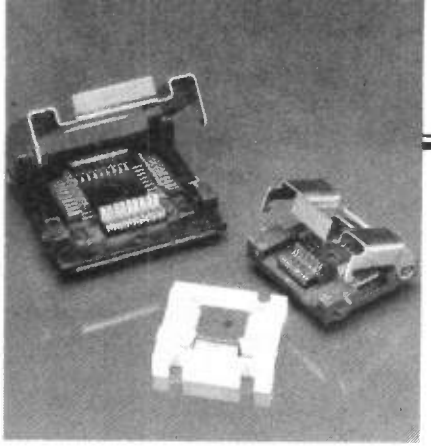
Racal Acoustics Limited has launched its unique 27A300 series Phone-Patch.

This new telephone/radio interface incorporates a modern electronic telephone and a radio interconnect system within a compact unit, enabling interface between the public telephone system and users of simplex radio sets. This facility increases the scope of communication networks available by allowing access between telephone and radio systems.

Phone-Patch has three modes of operation which can be selected by push-button keys: Radio – for normal radio operation; Line – for normal telephone operation; and Radio to Line – which enables the user to switch the radio through to the exchange line, allowing him to communicate with subscribers on the telephone network.

While the call is in progress the operator can monitor both Radio and Line speech, and in the case of poor telephone line condition can manually key the radio using a switch on the handset or by a remote foot-switch. Automatic keying of the radio transmitter is achieved by a built-in voice operated switch.

Racal Acoustics Limited,
Beresford Avenue,
Wembley, Middlesex.



BURN-IN/TEST SOCKETS

The latest Welcon range of burn-in/test sockets from Wells Electronics is now available from their UK distributor, Dage Intersem.

Wells' updated socket range caters for surface-mount technology, with new high-temperature sockets for leaded and leadless chip carriers and SOICs. The LCC sockets are self-aligning and allow devices to be held either way up. They are designed for even heat dissipation on all four sides, and contacts can be probed without withdrawing the device.

The new SOIC socket family saves valuable board space by its compact design. It is designed for fully automatic device loading and un loading.

Conventional burn-in sockets for device outlines from TO-5 to 48-pin DIP offer a wide choice of materials and features, including beryllium-copper or Pfinodal contacts with 10 or 30 micro-inches of gold plating.

Dage (GB) Ltd,
Intersem Division,
Rabans Lane,
Aylesbury,
Bucks HP19 3RG.
Tel: (0296) 33200.

LAN CHIP SETS

A new chip set resulting from a joint development programme between Texas Instruments and IBM is now available from VSI Electronics.

Designated the TMS380, the set provides standardised interfaces for connecting external equipment to the recently announced IBM Token-Ring network. Meeting the ANSI/IEEE Std 802.5,1985 and other relevant specifications, the TMS380 also meets the European Computer Manufacturers' Association (ECMA) standard for token-ring local area baseband networks.

The set comprises five integrated circuits containing local area network (LAN) management services. Providing a data rate of 4Mbits/sec using existing telephone twisted-pair, shielded twisted-pair and fibre optics, the set is designed for LAN connection to personal computers, advanced technology PCs and 32-bit professional workstations.

VSI Electronics (UK) Ltd,
Roydonbury Industrial Park,
Horsecroft Road,
Harlow,
Essex CM19 5BY.
Tel: (0279) 29666.

RFI FILTERS

The metal-cased, hermetically-sealed, RFI/EMI filter and feed-through capacitor range available from Steatite has been updated to provide a more comprehensive family.

The filters are designed to operate in the most rugged industrial and military environments, being of bulkhead mounted construction and operating over a temperature range of −55° to +125°C. The family includes 'L', 'Pi' and 'T' configurations in addition to straight feed-through capacitor elements.

According to configuration, current rating and type, insertion losses are defined from as low as 30kHz, extending to 1GHz and above. The range includes filters with working voltages of up to 400V dc and 125 and 240V ac at 50Hz and 400Hz.

Steatite Group,
Hagley House, Hagley Road,
Birmingham B16 8QW.
Tel: (021) 454 6961.

IC KIT

ITT has announced a kit of ICs which can be used to design telephone subsets with a 'hands-free' facility using very few additional components. Previously exclusive to ITT, the devices are now available to the commercial market.

In the past, hands-free telephones have been built with discrete analogue circuitry, using simple switches as attenuators. They used many discrete components and were expensive. ITT has adopted a new approach which uses the advantage of LSI. The kit comprises three ICs: ITT 90 is the subset IC, ITT 91 is the hands-free control IC, and ITT 92 is the tone ringer and loudspeaker IC.

The ITT 90 subset IC is designed to be the line interface component for a wide range of telephones. It replaces the hybrid coil assembly with an electronic hybrid, which drives the line directly. In its simplest form a telephone subset may be designed using this IC and no other active components.

The ITT 91 controls hands-free operation by means of attenuators in the transmit and receive paths, which are set in response to voice levels into receive, talk or standby states. The device is powered from the line via the ITT 90, which acts as a voltage regulator. Four modes of operation are selectable by the user: hands-free mode, loudspeaking mode using handset microphone, plain, ordinary telephone or handset mode, and handset mode with a small amount of voice-controlled attenuation. There is a user-operated receive volume control.

ITT Semiconductors Ltd,
145-147 Ewell Road,
Surbiton,
Surrey KT6 6AW.
Tel: (01) 390 6578.

BNC CONNECTORS

A commercial-quality BNC connector from Amphenol is designed to be cost-effective without sacrificing the RF electrical performance typical of BNC receptacles. Application areas include computer and business equipment, television broadcast and other communications equipment.

Series 31 connectors are ruggedly constructed, with a zinc diecast body finished in durable Astroplate, moulded insulators, and stamped and formed tin-lead contacts with solder-cup termination. They are designed to accommodate 0.125 and 0.25in panel thicknesses, both types being front-mounted for easy installation. The BNC two-stud bayonet mechanism provides for quick connect and disconnect.

Connector impedance is nominally 50 ohms, rated working voltage 500V rms. The connector is designed for a frequency range of 0 to 4GHz. Ground lugs and shield ground lugs are available as options.

To mate with Series 31 receptacles, Amphenol manu factures low-cost BNC Sure-twist plugs for RG-59 and 62/U cables. They will, however, mate with any male BNC plug.

Amphenol Ltd,
Thanet Way, Whitstable,
Kent CT5 3JF.
Tel: (0227) 264411.

PHILIPS MONITORS

In a recent agreement with Philips (MAP Division) of Milan, Sabre Computers International Limited has been appointed sole stockist for the 'Fimiline' ranges of professional quality open-frame data monitors.

Sabre is stocking the popular 6-inch model 601, already in use in many applications including bank tellers' terminals, machine tool controllers and cash tills etc, and has now added the 9GP and 12GP frameless 'kit' style units, which are electrically identical to each other.

The 601 delivers a full 80 character × 25 line resolution on a green (P31) anti-glare tube, running on 12V dc at approximately 700mA, with a choice of 1V composite, or 5V (TTL) separate sync + video inputs. The mounting frame and I/P connector are industry standard so that the model 601 can directly replace other manufacturers' 5.25-inch units.

The 9GP has a 9-inch tube, and the 12GP has a 12-inch tube. Both are ideally suited for high resolution data and graphics displays, with P31 (green) dark glass, anti-glare tubes, and greater than 25MHz video bandwidth. They run on 12V dc at approx 800mA, with 5V (TTL) separate sync and video inputs.

Sabre Computers
International Ltd,
Process House,
43 Selsdon Road,
South Croydon,
Surrey CR2 6PY.
Tel: (01) 681 8241.

DC-DC CONVERTERS

Coutant Electronics Ltd have recently introduced a new range of wide input dc-dc converters that are specifically designed for telecomms applications.

Known as the SA series, these PCB mounted units operate over the temperature range −25°C to 71°C without any loss of performance. Most units in the range incorporate a six-sided continuous EMI/RFI screen.

The range consists of over 20 different units that provide a choice of 12V, 24V or 48V dc inputs with outputs of ±5V, ±12V, ±15V or 5V and ±12V.

Coutant also supply a variety of encapsulated and semi-regulated dc converters.

Coutant Electronics Ltd,
Kingsley Avenue,
Ilfracombe, Devon EX34 8ES.
Tel: (0271) 63781.

HOT-MOULDED RESISTORS

Now available from Online Distribution are Allen-Bradley hot-moulded resistors, in values from one ohm to 100 megohms. Values up to one million megohms are also available to order. Standard tolerances are 5, 10 and 20 per cent.

The main feature of these resistors is reliability plus uniform quality. Pairs of resistors from the same package or reel will track with each other throughout changes of temperature, humidity and load. This assures reliable behaviour in circuits such as flip-flops. Between 0°C and 85°C the resistors are almost immune to temperature.

Online Distribution Ltd,
Melbourne House,
Kingsway,
Bedford.
Tel: (0234) 217981.

NEWS DESK

Thunderbirds are go!

Eutelsat, the European Telecommunications Satellite Organisation, has decided to award the procurement contract for three Eutelsat II satellites, with an option for five more, to a consortium headed by Aérospatiale. This consortium includes Marconi Space Systems Ltd, who will provide the communications system.

This second generation system will replace Eutelsat I, which consists of four ECS satellites (of which two are still to be launched, in July '86 and spring '87). The first Eutelsat II satellite will go up in mid-1989.

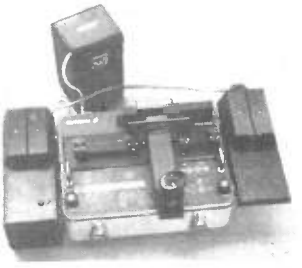
Each satellite will provide telephony, television and business services over a total of 16 channels operating in the Ku band with an EIRP of 51dBW or 45.5dBW depending on the coverage used. Projected lifetime is 7 years, and the satellites will be launch-compatible with both Ariane and the American space shuttle.

The ubiquitous idiot box

Luton based Continental Microwave Limited have recently received a contract from the Independent Broadcasting Authority worth £600,000 for the supply of low power UHF television transmitters.

Some of these transmitters are to be installed at existing UK television relay stations by the IBA in 1986-87 and will extend the coverage of Channel 4 television programmes to many areas at present unable to receive them. The order also includes low power transmitters which are destined to extend coverage of both ITV and Channel 4 to new areas for the first time.

The low power transmitters are of the type known as transposers, which obtain their input signal off-air from another station, amplify it and retransmit it on a new frequency. They can handle both the vision and sound signals together and can provide powers from about 0.5W up to 1kW for retransmission.



Seeing the light

British Telecom has, through Comtec Cable Accessories Ltd, signed an order worth approximately £1 million for equipment to fusion-splice optical fibres. Ericsson Fiber Optics AB, Sweden, received the order in the face of intense international competition.

This order means that the Swedish company is today the sole supplier to British Telecom of fusion splicing equipment for so-called single mode fibres.

The splicing system consists of the fusion splicing machine FSU 850 and its accompanying equipment.

Ericsson Fiber Optics AB, with approximately 50 employees, was formed one year ago to develop and market new products within the fast growing area of fibre optic communication.

Tx à la Francais

Eddystone Radio has received an order worth approximately £200k via its agent, Marconi Instruments France, to supply ten 2kW stereo transmitters to the largest commercial FM radio network in France. The network will use the type 1707/2 transmitters to create new radio services.

Completely self contained, this solid-state transmitter features broadband RF power amplifiers and filters. Its paralleled modular system allows transmission to be maintained under fault conditions.

During the past year, Eddystone Radio Ltd, a division of Marconi Communication Systems Ltd, has sold over £350k worth of FM transmitters to France.

Well I never department

Marconi Radar Systems have come up with an 'over the horizon' radar. This OTH radar is designed for coastal and ship-borne air defense, and uses a short wave radio signal which follows the curvature of the Earth (apparently because of the salinity of the sea). The range is claimed to be up to 200 miles.

It seems that the theory behind this technique has been known for many years, but it has taken the power of modern computers to exploit it. Recent developments in HF communications equipment have also helped to some degree.

Mobile radio specs

New technical specifications and an engineering memorandum for land mobile radio services have been published by the Radio Regulatory Division of the DTI. They are:

MPT 1318: engineering memorandum – trunked systems in the land mobile service.

MPT 1323 (JRC): angle modulated radio equipment in the frequency bands 139.5-140.5MHz and 148.0-149.0MHz for use by the joint radio committee of the fuel and power industries.

MPT 1325: VHF and UHF radio transmitters for use at base stations in the wide area paging service.

MPT 1326: angle modulated VHF and UHF radio equipment for use at fixed and mobile stations.

Engineering memorandum MPT 1318 is intended to give an introduction to the principles and potential benefits of trunked systems, and contains design methods and recommended parameters for successful system design.

Specification MPT 1323 (JRC) was prepared to cover frequency bands 139.5-140.5MHz and 148.0-149.0MHz, to be used by the national power industries when displaced from the band 105-108MHz.

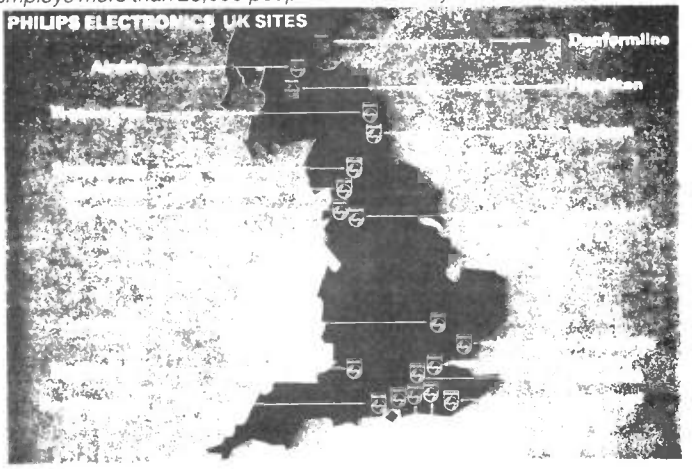
Specification MPT 1326 was prepared as an eventual replacement for MPT 1301 and includes transmitter intermodulation limits designed to reduce intermodulaton product levels at shared radio sites.

Testing, testing

Electronic Brokers, supplier of a wide range of test and measurement equipment, has announced the setting up of a new division dedicated to second-user ATE (automatic test equipment) systems.

Electronic Brokers has considerable experience in larger-scale equipment because of its second-user DEC computer activities, and it will carry out the same degree of refurbishing and

The map shows the extent of Philips' operation in the UK. The company employs more than 20,000 people in this country with a £1 billion turnover



re-manufacture to ensure that its used ATE systems match up to the original manufacturers' specifications.

Effective EMC

A new publication from ERA Technology, *Guide to Achieving Immunity from Electrical Interference*, completely updates the previous report *Code of Practice for the Avoidance of Electrical Interference in Electronic Instrumentation and Systems.*

The report emphasises the importance of considering electromagnetic compatibility (EMC) at all stages of design, development, manufacture and installation of equipment, if acceptable immunity to interference is to be achieved effectively and economically.

Comprehensive guidance on the design and installation of sensitive equipment is given, and the characteristics of interference in typical environments is summarised. The guide also describes interference propagation, the coupling mechanisms into sensitive circuits and a range of susceptibility tests that can be used to evaluate equipment immunity and diagnose the causes of problems.

The report concludes with guidance on safety and the environmental constraints on measures used to prevent interference effects, plus a review of relevant standards and codes of practice.

Copies of the report can be obtained for £50 (£45 to members) from the publication sales department of ERA Technology on (0372) 374151, extension 234.

New transatlantic cable

A major development in British Telecom's plans for transatlantic digital communications was announced during May. An agreement was signed in Paris aimed at the construction of a new optical fibre cable that will be ready for service in 1991 and will land in Britain, France, Spain, the USA and Canada.

The four partners who have joined with British Telecom in signing this agreement are AT&T of the USA, Teleglobe Canada, the French PTT and Telefonica of Spain. Many other international communications carriers will be invited to join in the project as joint owners of the $400m cable, which will be known as TAT9.

The partners intend to take a major step forward in submarine fibre optic cable technology by operating the fibres at the more efficient wavelength of 1.55 microns instead of the 1.3 microns of present cables, thereby reducing the number of amplifiers needed. The transmission rate of 565 megabits of information per second will be double that planned for earlier cables.

Direct dialling to China

British Telecom has reached an agreement with the Ministry of Posts and Telecommunications in China to open an international direct dialling (IDD) service.

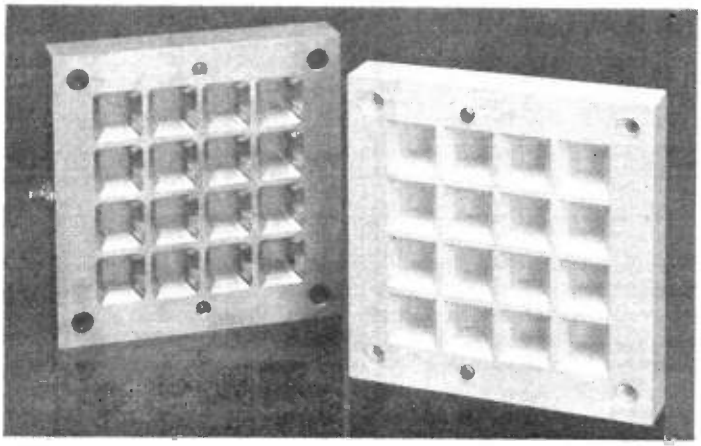
Direct dialling will open between Britain and Beijing (Peking), Shanghai and 24 other major cities and towns, covering all but a handful of China's five million telephones. The IDD service will commence as soon as the new international switching centres in China become operational. This is likely to be in a month or two's time.

Calls will be sent via a geostationary satellite above the Indian Ocean, between British Telecom's Goonhilly Earth station and a new satellite station at Beijing.

A three minute call will cost £3.45, which is £2.59 less than making a call through the international operator.

With a population of more than 1,000 million, China has only one telephone for every 200 people, compared with Britain's one for every two people. By 1990 the number of phones in China is expected to double, rising to more than 30 million by the year 2000.

China will become the 165th country to join British Telecom's IDD network. IDD services began in 1963 between London and Paris and have since been extended to every telephone customer in the country with access to over 550 million telephones world-wide. Now, more than 18 million IDD calls are made from Britain every month (no wonder BT is making so much money).



ERA Technology has been examining the use of plastics in the production of low-cost, lightweight antennas. The result is the 12GHz 4×4 element planar array on the right, moulded to sufficiently close tolerances while still using simple tooling. A report covering the research work is now available

Stinking rows department

A recent survey by NOP Market Research into home audio taping has revealed gaping holes in the Government's case for imposing a ten per cent levy on blank audio tape.

The levy would be paid to copyright holders and would entitle tape buyers to make recordings of broadcast or pre-recorded material. Yet the survey found that more than half of blank tape recording time is used to record an individual's own records – on which a copyright fee has already been paid. A further 18 per cent of home taping time is to record radio broadcast material – on which a copyright fee has also been paid.

The rest of the sample used tape for many different purposes, some of which were totally unconnected to copyright material, such as dictation, taking letters and recording lectures.

The survey found that the majority of people tape albums either to preserve an LP's condition or to allow them to play their music in their car or personal stereo.

The anti-levy view is backed up by the survey finding that the heaviest buyers of blank audio tape are also the heaviest purchasers of pre-recorded music. This shows that copyright owners benefit from home taping.

I think the message is clear,

How about this for a shack? It's a set-up from Rohde & Schwarz for information and press services, and will recieve morse, SSB, DSB, teletype, fascimile and speech over the range 10kHz to 30MHz. I want one!

TEL 0902 712083 TELEX 338490

HA1374	4.80	LR3419	9.37	NE565N	1.33	SKE4F2/08	1.24	STK3042	11.05	TA7312P	2.45	TD62105P	2.50	TDA3560	5.00	TUA2000	6.98
HA1377	3.96	LR3471	9.37	NE645BN	3.35	SKE4F2/06	0.85	STK3044	5.75	TA7313AP	1.50	TD62104P	2.50	TDA3571Q	2.83	TV106	1.76
HA1389R	2.05	LU1141	7.27	NP1106	5.61	SKE4F2/10	1.24	STK4019	4.50	TA7314	5.94	TD62706P	4.50	TDA3576	7.09	TY6010B	2.97
HA1389	2.39	LU52012	5.95	OA202	0.11	SKE4G2/02	0.96	STK430	11.75	TA7323P	3.15	TDA1001B	2.31	TDA3590	5.79	U05G	1.14
HA1392	3.90	LU52011	4.95	OA47	0.14	SKE5F3/10	1.60	STK433	5.45	TA7325P	1.15	TDA1003A	2.25	TDA3591	6.45	ULN2204	11.45
HA1394	3.95	LU03112	12.37	OA91	0.09	SKS1/10	2.15	STK4332	8.25	TA7339P	1.35	TDA1005A	2.22	TDA3650	7.50	UPA53C	4.94
HA1397	3.76	M193	12.75	OA95	0.09	SL1310	3.14	STK435	5.94	TA7340P	5.06	TDA1006A	2.11	TDA3652	5.44	UPC1003	4.95
HA1398	3.98	M21C	1.00	OC28	2.95	SL1430T	2.31	STK4352	12.25	TA7607AP	13.90	TDA1010AF	4.25	TDA3651AQ	2.96	UPC1009C	6.32
HA1406	2.07	M23C	0.83	OC29	2.15	SL414	3.69	STK436	7.21	TA7609	3.28	TDA1011	2.40	TDA3651	3.30	UPC1025H	2.90
HA1452	1.63	M293	9.15	OC36	1.28	SL432A	3.44	STK437	7.80	TA7611AP	4.80	TDA1010	1.15	TDA3651A	2.65	UPC1026C	1.24
HBF4030AF	2.40	M51102L	6.35	OC44	0.35	SL439	2.48	STK4372	3.85	TA7616P	5.25	TDA1011A	5.25	TDA3950	3.25	UPC1028H	2.00
HD14538	2.07	M5115P	5.24	OC45	0.18	SL471	3.28	STK439	8.31	TA7622AP	8.94	TDA1028	2.45	TDA4050B	3.95	UPC1020H	2.77
HD38702-A2	7.45	M51203L	3.15	OC72	0.44	SL480	3.14	STK441	11.28	TA7628P	5.62	TDA1034B	2.42	TDA4280	7.20	UPC1032H	0.62
HD38750A53	8.71	M51231P	3.04	OC75	0.44	SL490	2.37	STK443	10.29	TA7629P	7.50	TDA1035S	2.95	TDA4290	4.47	UPC1042C	8.95
HD38750A-7	7.25	M5134-9341	4.13	ON236	1.06	SL901B	8.32	STK457	13.45	TA7630P	2.98	TDA1035T	2.55	TDA4400	2.27	UPC1156H	2.96
HD38800A50	14.09	M51353P	5.25	ON782	1.98	SL918A	9.07	STK460	14.83	TA7640AP	1.19	TDA1037	1.98	TDA4420	5.01	UPC1158	5.84
HD44801A05	17.49	M51381P	4.50	OT121	1.45	SN16861AN0	4.95	STK461	9.68	TA7672P	1.75	TDA1037D	3.25	TDA4422	8.32	UPC1161C	4.50
HEF4001BP	0.67	M51393AP	7.78	PT6042	2.45	SN16862AN	2.98	STK463	11.53	TA7676P	2.81	TDA1044	2.62	TDA4427S	9.00	UPC1182H	1.82
HISH1010	8.59	M51394P	11.97	PT8504	4.98	SN16966N	10.25	STK466	11.77	TA7726P	10.25	TDA1047	4.10	TDA4431	2.27	UPC1186H	1.05
HISH1004	6.00	M5142P	5.49	R1038	2.19	SN29717N	7.19	STK4833	16.95	TAA320A	1.27	TDA1059B	0.80	TDA4440	2.87	UPC1181H	1.25
HISH1002	9.50	M5144P	4.25	R1039	2.19	SN29716N	3.66	STK501	6.32	TAA350A	0.80	TDA1054M	1.21	TDA4442	4.85	UPC1185H	2.94
HM6231	9.81	M51513L	2.55	R2008B	1.33	SN29715N	6.04	STK502	5.74	TAA570	1.74	TDA1060	2.60	TDA4500	7.30	UPC1188	6.95
HM6232	8.89	M51515BL	3.23	R2009	1.98	SN29722	11.95	STK5314	9.48	TAA621AX1	2.48	TDA1082	3.25	TDA4600	2.84	UPC1213C	0.99
HM6251	5.70	M51517L	3.71	R2010B	1.33	SN29723AN	7.65	STK5730	3.95	TAA621A12	2.14	TDA1151	1.22	TDA4610	4.80	UPC1212C	1.72
HM7103	2.46	M5192	2.20	R2029	1.33	SN29764AN	1.38	STK7216	12.67	TAA661B	1.00	TDA1170S	2.25	TDA4620	4.46	UPC1225H	3.25
HM9032	3.22	M5194AP	5.74	R2030	1.33	SN29767	4.98	STK772	6.95	TAA691	8.58	TDA1190	2.11	TDA5500	4.78	UPC1230	7.24
HM9012	3.22	M5231L	1.95	R2257	2.38	SN29770BN	4.24	STR1096	4.50	TAA700	3.75	TDA1190Z	3.96	TDA5700	2.60	UPC1238	2.98
HM9015	3.24	M53274P	1.33	R2265	1.49	SN29772BN	4.91	STR4090	11.75	TAA930	4.87	TDA1200	1.50	TDA7270S	2.25	UPC1263	3.45
HT4207	17.16	M54532P	2.15	R2305	1.18	SN29771BN	4.93	STR440	7.85	TAA970	2.83	TDA1235	3.88	TDA8190	3.47	UPC1277H	5.85
HT4208	18.25	M54544L	4.75	R2322	0.59	SN29791	1.67	STR441	9.45	TAA110	2.52	TDA1236	4.30	TDA9403	3.15	UPC1278H	4.85
IN5401	0.11	M58478P	6.75	R2323	0.76	SN29798N	5.56	STR451	4.95	TAG232-600	0.73	TDA1270	3.76	TDA9503	2.92	UPC1351C	1.81
IR2403	4.25	M58485P	10.74	R2354A	2.01	SN2709	0.44	STR453	8.16	TAG626-600	1.06	TDA1327A	1.33	TDA9513	5.44	UPC1350C	1.40
IR2C05	4.25	MA06	1.07	R2354B	2.01	SN7400N	0.34	STR454	7.50	TBA120AS	1.24	TDA1412	1.05	TDB1033	2.08	UPC1353	7.85
IR3P06	2.25	MA8001	0.82	R2443	0.88	SN7401N	0.36	STR6020	8.31	TBA120SB	1.05	TDA1420	1.55	TDE1081	6.61	UPC1355C	2.13
IR3P08	4.95	MA8003	1.16	R2461	1.50	SN7402N	0.65	T6029V	5.75	TBA120T	0.95	TDA1440	3.45	TE626	1.49	UPC1363	4.20
IR94558	6.25	MB3705	1.98	R2540	2.31	SN7404N	0.24	T6035V	0.73	TBA120U	2.50	TDA1470	3.16	TEA1002	3.47	UPC1362	7.75
IS751	2.85	MB3712	1.85	R2540X	3.30	SN7408N	0.27	T6036	0.67	TBA120A	1.05	TDA1470P	4.25	TEA1009	1.86	UPC1365C	6.98
ITT425	0.18	MB3713	1.69	R2615	0.67	SN7410N	0.27	T6037	2.11	TBA1440	2.03	TDA1506	7.45	TEA1014	3.15	UPC1366	7.14
IZ0003GE	5.37	MB3730	3.25	RCA16029	2.01	SN74121	1.60	T6044V	0.95	TBA1441	1.62	TDA1510	5.90	TEA1020SP	8.21	UPC1360C	4.51
IZ0020GE	5.93	MC13002	3.55	RCA16600	1.38	SN7413N	0.37	T6045	1.20	TBA1440G	5.20	TDA1512	2.89	TIC106C	0.61	UPC1378H	4.25
K174YP	3.46	MC1310P	2.25	RCA16802	1.08	SN74141N	2.65	T6049	1.45	TBA1441	1.75	TDA1515	16.60	TIC106M	0.77	UPC141C	3.75
KA2101	2.92	MC1327P	1.33	RCA17074	6.60	SN74151AN	1.51	T6052V	0.87	TBA240A	3.99	TDA1559	3.15	TIC116Y100	2.07	UPC1458	8.66
KC581C	6.32	MC1330P	1.69	RCA17376	1.58	SN74154N	1.27	T6058	0.59	TBA395	1.10	TDA1670	4.48	TIC44	0.72	UPC151C	2.95
KC582C	3.97	MC1350P	1.61	RCA17524	0.83	SN74190	2.00	T6059	0.65	TBA395Q	1.10	TDA1770	6.85	TIC45	0.77	UPC2002	1.48
KC583C	5.54	MC1351P	3.96	RCA17523	0.83	SN7420N	0.34	T9003V	1.25	TBA396	0.80	TDA1905	1.76	TIC47	0.35	UPC30C	2.51
L200CV	1.69	MC1352P	2.50	RCA2060	2.00	SN7430	0.49	T9005V	2.38	TBA400	2.39	TDA1908	2.52	TIP120	1.06	UPC324C	4.70
LA1201	1.02	MC1357P	2.15	RGP01-15	0.70	SN7440N	0.27	T9011V	0.49	TBA440P	2.45	TDA1940	1.95	TIP110	0.53	UPC32C	4.94
LA1210	1.56	MC1358P	1.30	RGP10	0.50	SN7472	1.54	T9013V	7.96	TBA480Q	1.30	TDA1950	4.75	TIP112E	0.85	UPC339C	4.90
LA1230	2.87	MC14001	2.40	RGP30M	0.59	SN7474N	0.44	T9014V	2.60	TBA500P	6.58	TDA2005	5.08	TIP112	0.88	UPC41C	4.10
LA1320	2.87	MC14013	0.41	RT402	1.58	SN7490AN	0.93	T9016	1.02	TBA510	1.37	TDA2006	1.55	TIP117	0.95	UPC4558C	2.15
LA1352	1.75	MC14493P	3.44	RT905A	2.38	SN74LS26N	0.53	T9019W	1.98	TBA520	1.84	TDA2004	2.27	TIP121	0.87	UPC474	5.11
LA1357N	11.07	MC14494P	2.15	S1299	5.74	SN76001N	1.65	T9034V	1.38	TBA520Q	1.68	TDA2002	0.90	TIP126	0.73	UPC554C	1.85
LA1363	7.25	MC14497	3.65	S175	31.48	SN76013ND	2.48	T9035V	1.39	TBA530	1.30	TDA2003	1.75	TIP132	1.40	UPC566H	2.95
LA1364	3.02	MC14510BAL	3.75	S2062D	2.07	SN76023N	5.15	T9051	7.45	TBA530	1.30	TDA2010	1.85	TIP137	1.50	UPC574	3.25
LA1365J	3.44	MC14511BCP	1.10	S2800D	5.54	SN76023ND	3.96	T9054V	1.15	TBA540	1.15	TDA2020	2.77	TIP29	0.66	UPC575C2	2.40
LA1385	1.94	MC14528BCP	2.70	S2802	3.47	SN76033N	4.15	T9057V	0.70	TBA540Q	1.15	TDA2030	1.99	TIP29C	0.95	UPC576H	2.58
LA1387	7.60	MC1712	3.88	S2818	4.05	SN76110N	0.90	T906ZV	0.49	TBA560C	1.40	TDA2140	1.59	TIP29A	0.46	UPC577H	1.25
LA3155	1.25	MC5192	13.50	S3702S	6.15	SN76115AN	1.61	T9064	1.51	TBA560CQ	1.60	TDA2150	6.20	TIP29B	0.63	UPC578C	7.35
LA3301	1.41	MC7724CP	3.49	S40W	10.89	SN76131	1.92	TA6002	4.35	TBA570Q	1.60	TDA2151	1.93	TIP29C	0.40	UPC580C	4.13
LA3350	1.43	MC7818C	2.18	S6080B	8.80	SN76227N	1.33	TA7027	4.80	TBA570A	1.71	TDA2160	4.01	TIP29D	0.75	UPC587C2	1.34
LA3361	1.23	MCR100/7	1.65	SA8063	5.17	SN76226DN	1.98	TA7050	1.74	TBA641A12	4.13	TDA2161	1.85	TIP3055	0.75	UPC592H	2.15
LA3365	3.98	MCR106-5/6	0.85	SAA1006	1.75	SN76228N	3.27	TA7051	1.74	TBA641B72	3.03	TDA2170	2.98	TIP30A	0.41	UPC595	2.95
LA3390	4.25	MCR220/7	2.28	SAA1020	4.76	SN76242	8.95	TA7054	2.55	TBA651	1.76	TDA2190	4.95	TIP30C	0.16	UPC596	1.98
LA4030P	4.20	ME0402	0.17	SAA1025	4.40	SN76243	5.23	TA7060AP	0.71	TBA673	2.60	TDA2270	4.65	TIP31A	0.34	UPD1514C	8.95
LA4031P	3.20	ME0404/2	0.47	SAA1024	2.81	SN76396	2.90	TA7061AP	1.27	TBA700	1.85	TDA2510	7.85	TIP31B	0.38	UPD2819C	4.98
LA4032P	2.35	ME0411	0.28	SAA1075	6.25	SN76533N	2.47	TA7069	3.13	TBA720	1.55	TDA2520	2.37	TIP31C	0.50	UPD4013B	4.00
LA4100	1.25	ME6002	0.26	SAA1121	5.14	SN76532N	2.95	TA7070P	1.83	TBA730	3.55	TDA2522	3.46	TIP32A	0.53	UPD4066B	4.95
LA4101	1.30	ME6102	0.28	SAA1124	3.25	SN76545	4.87	TA7072P	2.57	TBA750Q	2.90	TDA2524	4.50	TIP32B	0.69	UPD553-164	19.25
LA4102	2.81	ME8001	0.34	SAA1130	4.99	SN76546N	3.47	TA7073P	5.86	TBA760	1.71	TDA2521	3.71	TIP32C	0.40	UPD8049C-1	10.14
LA4112	4.83	ME0411	0.75	SAA1174	7.77	SN76549	2.59	TA7074P	1.98	TBA800	1.08	TDA2525	3.90	TIP33	0.85	X0007TA	4.68
LA4125	2.25	MJ2501	3.30	SAA1250	3.96	SN76570	3.08	TA7076P	7.50	TBA810S	1.61	TDA2532	2.50	TIP33A	1.05	X0022CE	5.75
LA4138	3.38	MJ3001	1.69	SAA1251	9.85	SN76611	2.59	TA7089P	1.50	TBA810T	1.50	TDA2530	2.70	TIP33C	0.80	X0029CE	4.95
LA4140	1.15	MJ481	1.53	SAA11351	4.95	SN76620	2.59	TA7092P	7.50	TBA810AS	1.80	TDA2541	2.48	TIP34	3.54	X0031CE	4.95
LA4192	3.65	MJ802	5.45	SAA3027P	10.03	SN76660N	2.48	TA7093P	3.99	TBA820	1.52	TDA2540	2.15	TIP41A	0.49	X0035TA	5.11
LA4220	1.62	MJE2955	1.89	SAA5000	2.95	SN76666N	1.41	TA7102P	5.88	TBA820M	0.82	TDA2545Q	5.94	TIP41B	0.65	X0040TA	4.50
LA4250	6.75	MJE3055	1.65	SAA5010	5.39	SN76708	4.86	TA7108P	1.61	TBA890	2.50	TDA2560	2.17	TIP41C	0.49	X0042CE	4.35
LA4400	2.25	MJE340	0.49	SAA5012	5.20	SN76709	5.12	TA7109	4.90	TBA920	1.89	TDA2575A	0.50	TIP42A	0.49	X0043CE	2.75
LA4420	1.72	MJE520	0.49	SAA5020	5.78	SN76709N	5.45	TA7122B/P	0.92	TBA920Q	2.31	TDA2571AQ	3.60	TIP42B	0.53	X0056CE	5.11
LA4422	1.72	ML231	3.33	SAA5030	8.25	SN76707N	4.39	TA7124P	2.34	TBA940	1.87	TDA2576A	2.85	TIP42C	0.53	X0057GE	6.00
LA4430	1.47	ML232B	2.15	SAA5050	7.74	SN76705N	1.34	TA7129P	1.50	TBA950	1.55	TDA2571A	3.66	TIP47	0.65	X0062CE	6.52
LA4440	4.95	ML237B	2.51	SAB1009B	6.81	SN76730	5.36	TA7130P	1.27	TBA970	1.79	TDA2578A	4.95	TIP48	0.92	X0065CE	5.75
LA4445	7.25	ML238	5.77	SAB3011	7.34	SN76810N	0.60	TA7136AP	1.27	TBA990	1.82	TDA2576A+K	11.98	TIP49	3.61	X0074GE	10.00
LA4460	2.32	ML923	3.30	SAB3013	5.61	SN76832N	3.25	TA7137P	0.98	TBA990Q	1.68	TDA2581	2.25	TIP55A	3.65	X0077GE	12.95
LA4461	2.95	ML926	3.58	SAB3021	7.90	SN94041	5.54	TA7141AP	3.87	TC4001BP	3.25	TDA2582	2.18	TIS43	1.43	X0079CE	4.95
LA4505	5.94	MM5314N	4.02	SAB3024	6.36	SN94042	4.35	TA7146	2.50	TC4011BP	3.50	TDA2591	2.50	TIS90	0.28	X0092CE	4.95
LA5112N	2.65	MM5316N	4.25	SAB3209	5.82	SP8385	0.55	TA7146P	4.23	TC4013BP	3.75	TDA2594	3.26	TL011CP	1.55	X0096CE	4.29
LA7020	7.33	MM5318N	3.11	SAB3210	3.49	SPS5384	1.98	TA7148P	1.67	TC4016BP	3.15	TDA2593	2.47	TL072	2.85	X0109CE	10.90
LA7025	8.05	MM5369N	2.01	SAF1032P	6.50	ST1702L	0.99	TA7149P	3.26	TC4053BP	4.34	TDA2591Q	0.83	TL494CN	6.74	X0113CE	2.07
LA7027	9.35	MM5387AA/N	6.20	SAF1039	3.35	STA401	6.76	TA7152P	1.72	TC4069	1.52	TDA2595	5.26	TL072CP	2.55	X0195CE	4.00
LA7040	9.20	MM5841N	6.49	SAS5010	8.39	STA441C	2.75	TA7153P	7.47	TC4071BP	2.76	TDA2600	5.50	TMP4320	15.00	X0204CE	8.74
LA7042	4.25	MN1400VL	9.96	SAS560S	2.26	STA471C	6.76	TA7161P	5.45	TC4081BP	3.25	TDA2611AQ	2.98	TMS1024NLL	6.86	X0261CE	8.75
LA7800	2.65	MN1405	9.52	SAS560T	5.42	STK0029	5.54	TA7162P	2.98	TC40H000	1.98	TDA2612Q	4.68	TMS1025N	6.25	X1222AF	3.63
LA7801	4.15	MN1435VX	11.48	SAS570T	5.42	STK0039	5.35	TA7169	9.54	TC4514BP	4.15	TDA2611A	1.25	TMS3720ANS	19.50	IX0111CE	2.95
LB1274	3.08	MN6016A	20.56	SAS570S	2.61	STK0040	12.00	TA7172P	1.41	TC9002BP	11.95	TDA2610	2.79	TMS3748NS	14.95	Y969	0.82
LC7800	9.20	MP1192	5.07	SAS580	2.85	STK0050	7.67	TA7176P	2.48	TCA270Q	1.71	TDA2620	2.15	TMS3755	13.65	TDA3310	2.15
LD3120	1.13	MP2794	4.00	SAS660	2.97	STK0080	9.16	TA7193AP	6.67	TCA270S	2.15	TDA2630	1.96	TMS3894NL	19.25	ZPY120	0.95
LD3150	2.25	MP2812	5.07	SAS6700	1.33	STK011	3.96	TA7193P	5.50	TCA270SQ	1.65	TDA2631	2.73	MS5102NLL	6.25	ZTK33	0.43
LM1017N	4.29	MP8512	1.57	SAS670	3.96	STK013	9.25	TA7201P	2.71	TCA290A	2.39	TDA2640	2.59				
LM1877	10.92	MPC596	2.13	SAS6710	1.33	STK014	9.80	TA7203P	2.18	TCA420A	2.16	TDA2652	6.95				
LM224	1.75	MPF256C	0.60	SBA750	1.61	STK015	7.75	TA7204P	2.16	TCA440	1.93	TDA2653	5.65				
LM2808	5.94	MPS6570	0.48	SC84203	18.98	STK016	6.94	TA7205P	1.38	TCA530	2.16	TDA2654	6.18				
LM2877	4.93	MPSA42	0.65	SC9504P	1.95	STK022	5.25	TA7206P	6.35	TCA640	10.26	TDA2670	2.48				
LM317CKC	1.38	MPSA56	0.27	SDA2006	18.95	STK025	12.50	TA7207P	3.34	TCA650	2.04	TDA2680	3.20				
LM324N	0.75	MPSA92	0.45	SDA2112/2	12.85	STK031	12.95	TA7208P	2.15	TCA660B	3.30	TDA2690A	2.65				
LM339N	0.80	MPSU05	0.86	SG264A	5.26	STK040	8.70	TA7210P	3.58	TCA730	3.81	TDA2740	6.00				
LM340K	11.85	MPSU10	1.56	SG613	8.75	STK043	13.44	TA7214P	3.63	TCA750	2.25	TDA2780AQ	5.14				
LM342P	1.62	MPSU56	0.60	SG629	8.27	STK054	7.13	TA7215P	2.58	TCA800Q	6.95	TDA2795	2.78				
LM342P	1.62	MPSU60	1.33	SG6533	10.31	STK058	18.25	TA7217AP	1.45	TCA830S	2.38	TDA2791	2.5				
LM342P	1.62	MR818	0.33	SI-1020H	10.89	STK077	7.67	TA7222	1.95	TCA890	5.44	TDA2910	13.25				
LM348N	2.15	MR854	0.72	SI-1125HD	17.63	STK078	8.52	TA7226	10.25	TCA900	2.04	TDA3000T	2.55				
LM380N	2.80	MR914	1.20	SI1125H	7.50	STK080	16.50	TA7227P	2.81	TCA910	1.65	TDA3300B	9.00				
LM384N01	3.25	MSM5816RS	17.35	SI1225HD	17.73	STK082	11.86	TA7229P	4.45	TCA940	1.80	TDA3330	3.30				
LM567CN	1.71	MSM5840H	9.15	SI1630HD	17.85	STK086	13.59	TA7230P	4.98	TCA940E	2.93	TDA3506	7.98				
LM6402/011	10.23	MVS460-02	0.61	SI6900	12.00	STK1039	5.75	TA7232P	6.60	TCE330	3.89	TDA3501	7.25				
LM6402A093	10.15	NE542	2.50	SKE1/02	1.85	STK2110	7.33	TA7233P	5.32	TCEP100Q	10.25	TDA3500	4.25				
LM748	1.82	NE545B	3.94	SKE2F1/04	1.39	STK2145	16.25	TA7240AP	7.83	TCEP100	9.61	TDA3510	6.55				
LM8360	3.87	NE555	0.38	SKE2G3/04	1.05	STK2230	7.70	TA7245P	7.50	TD3406AP	3.98	TDA3520	9.71				
LM8361	3.57	NE556	0.95	SKE4F1/06	0.73	STK2240	14.40	TA7270	6.75	TD3F800R	3.92	TDA3540	2.98				
LR2612	11.95					STK2250	18.95	TA7310P	2.15	TD3F900H	4.16	TDA3541	3.80				

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15/80H	3.30	2SA940	1.81	2SC535	0.79	AF180	0.55	BA656	8.99	BC560C	0.14	BDX63A	1.96	BFY52	0.27	BYX71-350	0.72
15/85R	3.30	2SA940-2	2.14	2SC536	0.29	AF181	0.53	BA7100	10.85	BC635	0.36	BDY20	1.21	BFY79	0.49	BYX94	0.14
16039	0.79	2SA950	0.72	2SC537	0.54	AF186	0.53	BA841A	16.72	BC636	0.42	BDY81	1.18	BFY90	0.61	BYY56	1.20
16181	1.04	2SA951	1.26	2SC605L	1.16	AF239	0.43	BA843	3.96	BC637	0.24	BF115	0.40	BLY49	2.20	BZY93C30	1.86
16182	1.04	2SA966-Y	1.16	2SC620	1.46	AF279	0.88	BA854	5.76	BC639	0.20	BF117	0.66	BR00	0.22	BZY88 RANGE	0.10
16334	0.98	2SA999	1.36	2SC643A	1.54	AL113	1.36	BAV18	0.21	BC640	0.24	BF118	0.67	BR01	0.75	BZX61 RANGE	0.18
16335	0.94	2SB774	1.15	2SC668	0.67	AN115	3.98	BAV19	0.11	BC879	0.39	BF121	0.25	BR03	0.75	BZX79 RANGE	0.10
16446	0.98	2SB185	1.13	2SC681	4.40	AN155	1.89	BAV20	0.31	BC880	0.31	BF123	0.13	BR03	1.26	C106D	0.46
16600	1.38	2SB375	3.87	2SC682	1.88	AN206	2.58	BAV21	0.34	BCX34	0.40	BF127	0.13	BRC116	0.67	C106M	0.76
16802	1.27	2SB400	0.40	2SC684	1.65	AN208	3.55	BAW62	0.19	BCY70	0.30	BF137	0.29	BRC300	2.01	C1129	0.58
17052	5.61	2SB405	1.03	2SC693	0.63	AN210	2.28	BAX12	0.44	BCY71	0.21	BF153	0.58	BRC5296	0.77	CA3046	2.06
17053	5.61	2SB407	3.24	2SC710	0.69	AN211	3.25	BAX13	0.11	BCY72	0.20	BF154	0.26	BRC6109	0.83	CA3089	0.83
17074	9.30	2SB449B	6.93	2SC711A	0.50	AN214Q	2.75	BAX16	0.11	BD115	0.46	BF157	0.33	BRC82	1.08	CA3090AQ	3.25
17089	5.35	2SB511	2.50	2SC717	1.28	AN231	14.65	BC107	0.13	BD116	0.70	BF158	0.18	BRC83	2.19	CA3094	2.20
17127	3.51	2SB54	1.39	2SC734	1.43	AN234	5.92	BC107A	0.11	BD124	1.31	BF159	0.18	BRC84	2.08	CA3131EM	3.12
17376	1.58	2SB546	3.75	2SC761-Y	0.95	AN236	3.78	BC107B	0.18	BD124P+KIT	0.69	BF160	0.31	BRX44	0.60	CBF16848N-071	1.56
17523	1.32	2SB56	2.80	2SC783	3.98	AN239	5.88	BC108	0.15	BD131	0.42	BF167	0.38	BRX49	0.53	CD4001	0.38
17524	1.32	2SB618A	2.22	2SC790Y	1.64	AN240P	1.52	BC108B	0.15	BD132	0.42	BF173	0.34	BRY39	0.69	CD4002	0.27
1N4001	0.06	2SB631	3.25	2SC828	0.28	AN241	1.71	BC109	0.12	BD133	0.53	BF177	0.35	BSS38	0.87	CD4008	1.35
1N4002	0.06	2SB643	0.54	2SC867A	3.05	AN245	4.49	BC109B	0.15	BD135	0.36	BF178	0.40	BSTBD140G	5.25	CD4011	0.29
1N4003	0.06	2SB669	3.67	2SC876	0.96	AN253	2.97	BC109C	0.12	BD136	0.26	BF179	0.36	BSTC0246	7.25	CD4012	0.24
1N4004	0.06	2SB681	3.96	2SC930	0.54	AN260	3.85	BC113	0.14	BD137	0.36	BF180	0.36	BSTC0233	7.25	CD4013	0.47
1N4005	0.08	2SB695	1.98	2SC935	4.13	AN262	1.98	BC119	0.36	BD138	0.46	BF181	0.32	BSTCC0143	3.07	CD4016	0.46
1N4006	0.08	2SB75	1.04	2SC936	8.66	AN272	7.92	BC126	0.20	BD139	0.34	BF182	0.34	BSTD1043	2.85	CD4017	0.82
1N4007	0.07	2SB774	0.65	2SC940	4.68	AN281	6.65	BC132	0.14	BD140	0.37	BF183	0.39	BSV57B	3.49	CD4020	1.23
1N4148	0.04	2SB819	0.89	2SD1128	2.90	AN295	5.52	BC135	0.14	BD144	1.70	BF184	0.43	BSW68	0.60	CD4021	0.39
1N4448	0.05	2SC1034	6.75	2SD1138	0.99	AN301	5.55	BC137	0.18	BD150	1.25	BF185	0.39	BSX19	0.34	CD4023	0.28
1N5401	0.14	2SC1050	5.06	2SD1273	1.25	AN302	3.99	BC138	0.34	BD157	0.67	BF194	0.14	BSX20	0.34	CD4025	0.64
1N5402	0.15	2SC1096	1.16	2SD1453	0.75	AN303	4.39	BC139	0.28	BD160	1.60	BF195	0.14	BSY52	0.50	CD4028	0.84
1N5403	0.16	2SC1104	3.98	2SD152K	2.64	AN305	9.47	BC140	0.45	BD163	0.71	BF196	0.17	BSY79	0.51	CD4040B	0.85
1N5404	0.15	2SC1106	4.54	2SD198	3.87	AN315	2.46	BC141	0.34	BD165	0.62	BF197	0.16	BT100A	1.61	CD4047	1.06
1N5408	0.35	2SC1114	6.75	2SD234	0.49	AN316	5.53	BC142	0.34	BD166	0.42	BF198	0.17	BT106	1.55	CD4049	0.46
1N914	0.04	2SC1116	4.95	2SD235	0.60	AN318	6.27	BC143	0.33	BD168	0.73	BF199	0.17	BT108	1.45	CD4052	0.75
IR3403	5.00	2SC1124	1.26	2SD24	2.29	AN320	5.47	BC147	0.08	BD175	0.60	BF200	0.37	BT119	1.76	CD4066	0.38
1S1555	0.20	2SC1129	0.34	2SD257	2.94	AN321	2.25	BC148A	0.10	BD179	0.49	BF218	0.36	BT120	2.17	CD4069	0.29
1S44	0.10	2SC1131	0.50	2SD292	2.59	AN322	5.85	BC148B	0.13	BD181	0.99	BF224	0.17	BT121	2.48	CD4070	0.66
1S5012A	0.81	2SC1158	3.33	2SD313	2.59	AN331	4.59	BC148C	0.11	BD182	0.99	BF237	0.65	BT123	1.98	CD4081	0.35
1S921	0.10	2SC1162	1.05	2SD325D	1.95	AN337	5.37	BC149	0.11	BD183	0.99	BF240	0.17	TBA970	3.06	CD4093	0.72
2N1303	0.38	2SC1172	2.22	2SD348	16.13	AN340P	1.17	BC149B	0.13	BD184	1.21	BF241	0.17	BT151-800R	1.15	CD4511	1.10
2N2219A	0.40	2SC1195	3.26	2SD350	5.20	AN355	5.98	BC153	0.14	BD187	0.53	BF245	0.50	BTT6018	2.42	CD4528	2.04
2N2222	0.38	2SC1212A	1.97	2SD350A	2.80	AN362	1.75	BC154	0.14	BD189	0.69	BF245A	0.37	BTT8124	4.89	CD4556	3.47
2N2646	0.80	2SC1213	0.89	2SD353	7.50	AN370	3.95	BC159	0.36	BD190	0.69	BF245B	0.49	BU106	2.48	CR02AM-8	1.55
2N2904	0.36	2SC1226	1.46	2SD389	2.41	AN5010	5.70	BC160	0.40	BD201	0.53	BF246A	2.52	BU108	1.50	CV12E	3.07
2N2905	0.43	2SC1293	0.90	2SD401	2.55	AN5111	2.92	BC161	0.28	BD202	0.60	BF255	0.20	BU109	2.25	CX095D	3.14
2N2906	0.38	2SC1306	1.98	2SD414	1.98	AN5120N	4.50	BC168	0.36	BD203	0.50	BF256	0.28	BU110	5.69	CX104	9.64
2N2926	0.15	2SC1316	4.10	2SD471	2.13	AN5132	4.39	BC169C	0.16	BD204	0.59	BF256LB	0.42	BU111Y	4.16	CX108	10.50
2N3053	0.27	2SC1317	0.87	2SD560	2.95	AN5250	2.89	BC170	0.16	BD207	1.79	BF256LC	0.42	BU125	2.48	CX109	7.86
2N3054	0.99	2SC1364	0.49	2SD588A	1.99	AN5435	3.08	BC171	0.11	BD208	1.23	BF257	0.34	BU126	1.55	CX130	8.76
2N3055	0.61	2SC1383	1.20	2SD600	3.25	AN5610	7.43	BC172	0.13	BD222	0.49	BF258	0.36	BU137	9.25	CX134	11.04
2N3442	1.16	2SC1391	2.45	2SD601R	0.65	AN5612	3.81	BC172B	0.27	BD225	0.49	BF259	0.34	BU205	1.08	CX136	11.49
2N3702	0.14	2SC1398	0.84	2SD613	1.03	AN5613	3.80	BC173	0.17	BD228	0.63	BF262	0.57	BU206	1.27	CX139	11.83
2N3703	0.14	2SC1413A	3.05	2SD621	12.67	AN5630	3.95	BC174B	0.27	BD229	1.05	BF263	0.57	BU207	1.65	CX157	4.84
2N3705	0.16	2SC1446	1.25	2SD636	0.55	AN5701N	1.66	BC177	0.20	BD232	0.50	BF271	0.34	BU208	1.12	CX158	4.10
2N3706	0.14	2SC1447	2.07	2SD639-R	0.85	AN6250	2.95	BC178	0.26	BD234	0.42	BF273	0.20	BU208/02	1.97	CX177	6.75
2N3707	0.16	2SC1475	0.37	2SD655	0.98	AN6300	7.00	BC179	0.26	BD237	0.47	BF274	0.20	BU208A	1.12	CX187	5.26
2N3711	0.11	2SC1505	1.00	2SD657	2.85	AN6310	8.74	BC182	0.09	BD238	0.45	BF324	0.23	BU208D	1.95	CX755	12.95
2N3771	2.04	2SC1514	1.37	2SD661A	0.80	AN6320N	4.28	BC182L	0.10	BD239	0.45	BF336	0.33	BU209	1.93	CX885A	6.85
2N3772	1.71	2SC1573Q	1.25	2SD731	2.45	AN6340	6.46	BC182LB	0.14	BD240	0.37	BF337	0.40	BU226	2.95	DEC1	2.20
2N3773	2.29	2SC1578	8.74	2SD773	0.33	AN6341	4.00	BC183L	0.11	BD241	0.39	BF338	0.40	BU326	2.00	DEC2	2.20
2N3819	0.42	2SC1583	1.17	2SD811	5.54	AN6342	1.61	BC183LB	0.26	BD242	0.39	BF355	0.49	BU326A	2.20	DS3486N	4.33
2N3823	1.17	2SC1617	3.89	2SD823	1.98	AN6363	16.00	BC184	0.13	BD243A	0.37	BF362	0.66	BU326S	2.20	DS3487N	4.33
2N3904	0.62	2SC675	1.41	2SD837	1.20	AN6371	6.50	BC184L	0.14	BD243C	0.79	BF363	0.60	BU406	1.49	E1222	0.40
2N3908	0.62	2SC1678	1.98	2SD841	3.65	AN6387	7.95	BC184LB	0.26	BD244	0.51	BF371	0.50	BU406D	1.79	E5024	0.28
2N4101	1.33	2SC1741	1.25	2SD856	2.25	AN6531	1.95	BC186	0.27	BD244C	0.79	BF391	0.25	BU407	0.82	E5386	0.25
2N4240	3.30	2SC1810	1.70	2SD857Q	1.84	AN6551	1.35	BC187	0.28	BD245C	0.99	BF417	0.84	BU407D	1.00	E9003	0.46
2N4444	0.90	2SC1815	0.66	2SD882	1.50	AN6552	0.68	BC204	0.16	BD246C	0.89	BF418	1.87	BU412	9.15	E9005	0.50
2N5293	0.50	2SC1826	0.65	2SD894	1.50	AN6610	2.40	BC207	0.14	BD253	1.05	BF422	0.29	BU426A	1.67	ESM310BP	4.15
2N5294	0.50	2SC1829	2.22	2SD898	5.45	AN6677	6.60	BC212	0.11	BD278A	0.80	BF423	0.52	BU500	1.95	FND500	5.78
2N5296	0.49	2SC1875	5.19	2SK105H	2.15	AN7111	1.45	BC212B	0.26	BD317	2.60	BF450	0.35	BU508A	1.89	GC374	1.65
2N5297	0.50	2SC1881K	2.98	2SK152	2.95	AN7114E	5.94	BC213L	0.10	BD318	2.85	BF451	0.29	BU536	5.80	GD243	4.95
2N5298	0.61	2SC1893	3.02	2SK34	0.76	AN7115	1.75	BC213LB	0.15	BD375	0.42	BF457	0.41	BU608	2.65	GF758	0.84
2N5771	1.18	2SC1906	0.98	2SK41	1.07	AN7120	4.65	BC214	0.10	BD380	0.76	BF458	0.39	BU705	4.07	GH3F	1.82
2N6109	1.58	2SC1921	1.37	2SK79	2.98	AN7145	2.80	BC214LB	0.26	BD410	0.52	BF459	0.52	BU806	1.79	HA11215	5.06
2N6130	0.72	2SC1923	1.07	40408	0.50	AN7146	4.35	BC225	0.40	BD433	0.47	BF460	1.56	BU807	0.80	HA11211	2.53
2N6133	1.25	2SC1929	2.25	40594	1.53	AN7151	2.26	BC237	0.10	BD434	0.49	BF469	0.31	BU826A	2.15	HA11225	4.29
2N6180	0.95	2SC1942	5.70	40636	1.43	AN7156	2.85	BC237BJ	0.12	BD435	0.49	BF470	0.55	BUW84	1.39	HA11226	8.71
2N6292	1.65	2SC1945	4.53	4EX581	0.80	AN7158	6.75	BC238	0.10	BD436	0.60	BF471	0.31	BUX84	1.00	HA11229	2.88
2N696	0.43	2SC1959	0.31	741	0.30	AN7218	1.64	BC238A	0.13	BD437	0.49	BF472	0.33	BUX85	1.10	HA11235	2.48
2N698	0.43	2SC1957	0.95	7805-T022	0.63	AN7223	4.25	BC238B	0.13	BD438	0.40	BF479	0.61	BUY69A	2.04	HA11124	5.25
2SA1006	1.50	2SC1953	1.93	7806	0.73	AU107	3.50	BC239	0.12	BD441	1.42	BF480	0.60	BY126	0.13	HA11244	2.82
2SA1011	1.65	2SC1962	1.93	7808	0.85	AU110	2.25	BC239B	0.25	BD442	0.66	BF491	0.32	BY127	0.13	HA11251	4.47
2SA1015	0.49	2SC1969	3.10	7812-T022	1.16	AU113	5.25	BC251A	0.12	BD509	1.42	BF495	0.64	BY133	0.11	HA1125	4.29
2SA1012	1.25	2SC1983	8.35	7815	0.64	AY105K	2.08	BC294	0.50	BD510	1.07	BF506	0.43	BY164	0.47	HA1137W	2.87
2SA1020Y	0.86	2SC1985	0.55	7818	0.92	AY106	1.09	BC300	0.36	BD519	1.50	BF509	0.41	BY176	0.52	HA1138	5.03
2SA1027R	0.45	2SC2009	0.34	7824	0.64	BA524	8.21	BC301	0.45	BD529	1.32	BF523	0.24	BY179	0.62	HA11414	5.65
2SA473	0.75	2SC2029	2.33	7905	0.80	B250	2.65	BC302	0.53	BD530	1.10	BF532	0.45	BY182	1.05	HA1144	7.87
2SA766S	4.95	2SC2028	2.11	9368	10.70	B40	1.55	BC303	1.04	BD533	0.67	BF596	0.18	BY184	0.47	HA1156	1.16
2SC1173Y	1.25	2SC2063	0.99	AA133	0.12	BA130	0.14	BC307	0.18	BD534	0.53	BF597	0.27	BY187	0.77	HA1160	4.78
2SC1474	1.25	2SC2078	2.39	AC133	0.12	BA1310	1.98	BC307A	0.14	BD535	0.78	BF694	0.22	BY189	1.79	HA1166	5.25
2SC1509	1.35	2SC2073	1.54	AC123K	0.43	BA1320	1.38	BC308	0.18	BD536	0.61	BF757	0.59	BY198	1.62	HA1166X	5.36
2SD1391RL	3.95	2SC2085-Q	1.40	AC127	0.27	BA1322	3.95	BC308A	0.11	BD537	0.74	BF759	0.47	BY201/2	1.50	HA1167	5.36
2SA1095	4.10	2SC2091	1.30	AC128	0.34	BA1330	2.75	BC309	0.17	BD538	1.18	BF761	1.05	BY203/20	0.59	HA11706	9.50
2SA1103	6.55	2SC2141	1.86	AC138	0.24	BA145	0.19	BC317A	0.13	BD544B	0.83	BF762	0.75	BY207	0.22	HA11705	8.00
2SA329	0.40	2SC2166	1.98	AC141	0.29	BA148	0.33	BC327	0.15	BD598	1.25	BF869	0.85	BY208	0.46	HA11703	9.56
2SA351	1.17	2SC2216	0.69	AC142K	0.43	BA154	0.40	BC328	0.11	BD677	0.53	BF870	0.30	BY210-400	0.18	HA11701	9.56
2SA489	1.17	2SC2233	2.20	AC151	0.28	BA155	0.12	BC337	0.09	BD679	0.57	BF959	0.42	BY210-600	0.27	HA11710	9.50
2SA490	1.67	2SC2236	1.65	AC176	0.30	BA156	0.05	BC338	0.34	BD680	0.76	BF960	0.69	BY210-800	0.34	HA11713	8.13
2SA493	2.25	2SC2278	1.14	AC179	0.28	BA159	0.12	BC368	0.24	BD681	1.48	BF970	0.69	BY218	1.64	HA11711	20.16
2SA562	0.57	2SC2314	2.17	AC183	0.72	BA182	0.24	BC440	1.09	BD696	2.47	BFR39	0.44	BY223	1.23	HA11715	8.13
2SA564	0.58	2SC2335-KI	10.41	AC187	0.39	BA222	1.66	BC441	0.44	BD699	3.49	BFR61	0.50	BY224-600	1.88	HA11714	7.76
2SA614	4.88	2SC2551	1.26	AC187K	0.43	BA302	1.24	BC454	0.36	BD700	3.70	BFR62	0.50	BY225-100	1.13	HA11716	13.10
2SA628	1.14	2SC2565	3.36	AC188	0.25	BA311	1.32	BC460	0.42	BD707	1.06	BFR79	0.29	BY226	0.25	HA11725	18.26
2SA639S	1.50	2SC2570	1.85	AC188-01	0.49	BA312	0.97	BC461	0.47	BD709	1.12	BFR81	1.65	BY227	0.49	HA11725MP	16.00
2SA659	0.49	2SC2577	1.75	AC188K	0.43	BA313	0.76	BC462	1.15	BD710	0.80	BFR86	1.08	BY228	0.60	HA117555P	6.23
2SA673	1.27	2SC2578	6.75	AC193K	0.65	BA317	0.05	BC463	0.64	BD809	0.75	BFR89	1.63	BY229-1000	1.12	HA11781	8.90
2SA684	1.61	2SC2671	1.99	AC194K	0.65	BA318	0.09	BC477	0.37	BD810	0.69	BFR90A	1.30	BY229-600	0.92	HA1180	5.15
2SA697	0.82	2SC2826	2.07	AD140	1.06	BA328	4.77	BC478	0.32	BD879	0.74	BFT42	0.43	BY255	0.69	HA1196	7.43
2SA699	1.75	2SC288A	1.45	AD143	1.25	BA333	1.37	BC479	0.41	BD880	0.79	BFT43	0.43	BY295-600	1.03	HA13001	6.25
2SA715	0.95	2SC3153	5.26	AD145	1.60	BA335	6.27	BC532	0.28	BD895	2.31	BFT84	0.40	BY298	0.20	HA1306	2.26
2SA747	8.26	2SC372	1.40	AD161	0.56	BA5102A	3.78	BC546	0.17	BD899	2.48	BFW10	0.60	BY299	0.60	HA1338	7.50
2SA748	1.08	2SC373	1.16	AD162	0.45	BA511	2.92	BC547	0.10	BD901	0.79	BFX29	0.34	BY407	0.84	HA1339	2.33
2SA817	0.65	2SC383	1.33	AD262	1.25	BA514	2.25	BC548	0.10	BD902	0.84	BFX84	0.37	BY409	1.49	HA13402	7.87
2SA818	1.82	2SC388	0.50	AF114	2.47	BA521	2.02	BC549	0.10	BDW83C	1.56	BFX85	0.41	BY448	0.69	HA13342	2.65
2SA835	2.50	2SC394V	0.81	AF115	1.24	BA524	8.94	BC550	0.40	BDW84C	1.56	BFX86	0.36	BY713	1.10	HA13365	4.02
2SA836	0.89	2SC403C	0.39	AF118	1.20	BA526	7.98	BC556	0.16	BDX32	1.75	BFX87	0.55	BYW19/1000	0.69	HA1366WR	1.86
2SA844	0.35	2SC41	2.19	AF127	0.50	BA527	2.98	BC557	0.10	BDX53A	4.93	BFX88	0.34	BYW56	0.34	HA1367	4.32
2SA872	0.70	2SC458	0.39	AF139	0.53	BA532	2.67	BC558	0.10	BDX53B	3.35	BFX89	0.44	BYX10	0.29	HA1368R	2.45
2SA884	2.15	2SC495	0.92	AF178	1.45	BA536	2.95	BC559	0.10	BDX54B	2.16	BFY50	0.32	BYX55-600	0.19	HA1368	1.90
2SA937R	0.97	2SC515A	2.85	AF179	0.55	BA6209	4.75	BC559B	0.11	BDX62A	2.15	BFY51	0.50	BYX71-600	1.25	HA1370	3.71

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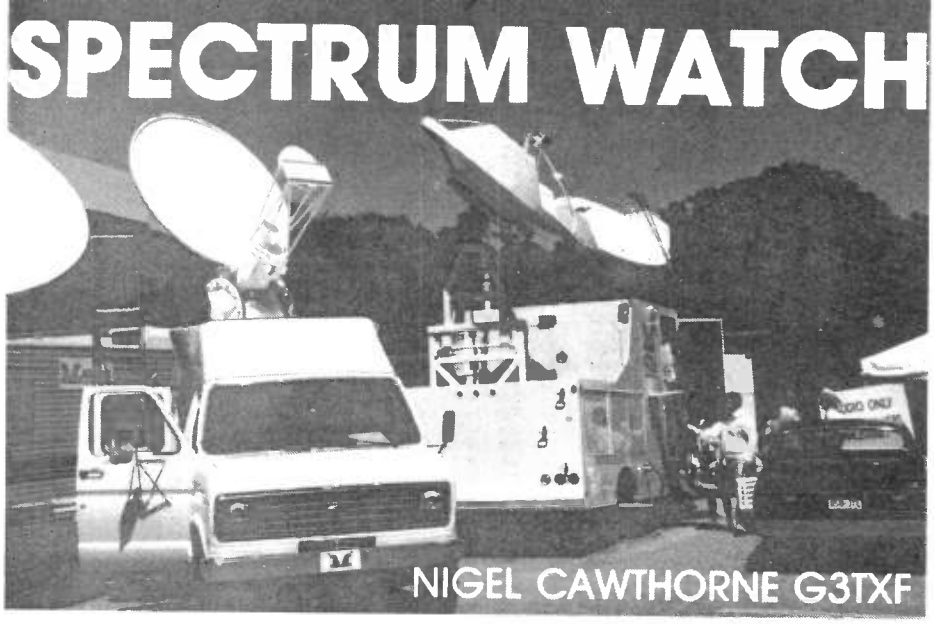


According to a recently published report, the number of cellular subscribers in the US nearly tripled during 1985 and reached 340,000 by December of that year.

The US cellular market is currently estimated to be around 400,000. At the beginning of 1985 there were less than 100,000 cellular subscribers, but this figure doubled during the first half of that year to over 203,000 and then continued its dramatic climb to end 1985 at just over 340,000.

For comparison, the total European cellular subscriber base is currently around 350,000, made up predominantly of Scandinavia, the UK, Austria and the Netherlands. The table shows the European cellular breakdown as at April.

US cellular

Cellular radio in the US operates on a similar basis to the UK inasmuch as there are two network operators in each area. Whereas in the UK there are two national operators, Cellnet and Vodafone, in the US every cellular operating area has different companies providing the two competing services. In all other countries cellular car telephone services are run by the central PTT body. It is only in the US and the UK that there is direct competition at cellular network level.

The total number of cellular car telephone systems 'up and running' in the US was 116 in April, serving 82 cities.

Cellular is big business in the States. The same report estimates that the service revenues from cellular are at least $300 million pa.

800MHz vs 900MHz

The UK TACS cellular system is a derivative of the American AMPS system. The first AMPS network to go fully operational was the Ameritech cellular network in Chicago, which was switched on in late 1983.

Both the UK and US cellular networks use upper UHF frequencies. In the US the cellular bands, with 45MHz duplex split, are 825-845MHz and 870-890MHz. The current UK cellular bands are 890-905MHz (mobile Tx) and 935-950MHz (base Tx).

However, the US cellular operators are trying to convince the FCC that they need access to 12MHz of cellular reserve allocations (845-851MHz and 890-896MHz). The FCC is reported to be considering loaning this additional spectrum in all US cellular markets, but only for a limited number of years.

There are parallels between the US cellular operators' wish to expand into the 'reserve' frequencies and the UK operators' request to expand into frequencies set aside for the future pan-European cellular network (915-925MHz and 950-960MHz).

In service	Country	System	Subscribers	
Oct 81	Sweden	NMT-450 (S)	84,400	
Nov 81	Norway	NMT-450 (S)	70,100	
Jan 82	Denmark	NMT-450 (S)	50,100	
Mar 82	Finland	NMT-450 (S)	36,400	Scandinavian total: 241,000
Nov 82	Spain	NMT-450	800	
Nov 84	Austria	NMT-450 (A)	11,500	
Jan 85	UK	TACS-900	58,500	Cellnet 31,500, Vodafone 27,000
Jan 85	Netherlands	NMT-450	7,000	Dutch ATF2 part of Benelux network
Aug 85	Luxembourg	NMT-450	50	Connected to Rotterdam MTX
Sep 85	Germany	C-450	2,000	Full service May 1986
Nov 85	France	RC 2000	1,000	Quasi-cellular, mixed PMR/carphone
Dec 85	Ireland	TACS-900	300	

European cellular subscriber total (April 86): 322,150

Source: *European Mobile Communications Report*

In the US, expansion into the 'reserve' frequencies would limit their possible use for other applications, while in the UK, expansion into the 'pan-European' reserve by Cellnet and Vodafone would undoubtedly complicate the introduction of a pan-European cellular system at 900MHz.

Cellular operators both in the US and the UK can be heard moaning that they don't have enough spectrum to provide the sort of service they would like, particularly in densely populated areas. No firm decisions on either request have yet been taken by the FCC in the US or by the DTI in the UK.

Nationwide cellular

Cellular in the UK will eventually be virtually nationwide in its coverage. Both network operators (Cellnet and Vodafone) are racing ahead to achieve 90% population coverage, as required by the conditions of their licence. This corresponds to covering about 64% of the area of the UK. Vodafone announced last month that they were already up to over 70% population coverage with 156 base stations and 306 cells. However, in the US national coverage with the current generation of cellular networks could never be possible because of the much greater distances involved. It would not make economic sense to install 800MHz 'cell' sites all over the country. In some more remote places it may be days before a car equipped with a telephone passes by.

The distances between major centres of population are just too great to seriously contemplate a nationwide US cellular car telephone network. However, key areas are being linked. It is now possible to drive from New York to Washington maintaining telephone contact all the way.

HDTV: Europeans speak out

With just weeks to go before the opening of the all-important CCIR Plenary in Dubrovnik, HDTV was a major subject for debate at this year's NAB in Dallas. NAB is the world's largest professional broadcast equipment show and conference, and is attended by over 40,000 visitors from all over the world.

The 'European and 50Hz' lobby was making its voice heard at NAB. A new CCIR discussion paper presented by the French said, bluntly, that 'there is no question of setting definitive values for HDTV parameters (at the present CCIR Plenary) as a good deal of research and experiment are still required.'

This is in sharp contrast to the US/Japanese (60Hz) view that 'now' is the time to decide on a world-wide HDTV studio production standard. The US and Japan are strongly advocating acceptance of the 1,125 line 60Hz NHK HDTV proposal.

This proposal is being opposed by

much of the 50Hz world because of the problems that the selection of a system based on a 60Hz field rate would create. There is also a feeling among Europeans and other 50Hz countries that they are being rushed into an important decision by the US/Japanese without full consideration having been given to the whole question of HDTV, including such areas as receiver and transmission standards as well as the studio standard.

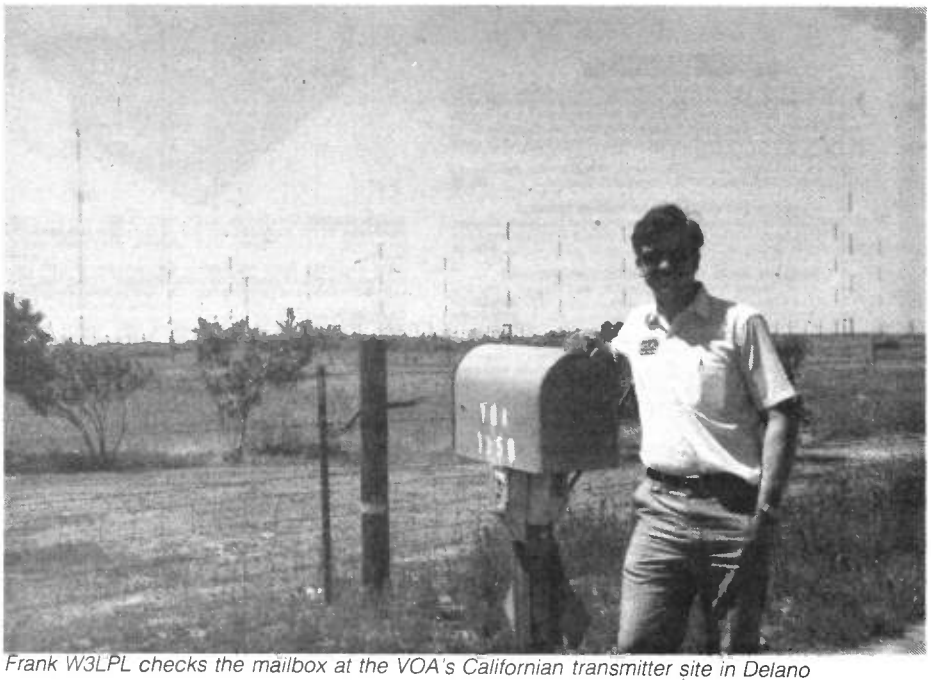
Although it is a studio standard that is now being discussed by the CCIR, proponents of the 'wait and see' view on HDTV (largely the Europeans and 50Hz countries) argue that you cannot sensibly define a TV production studio standard without seriously considering transmission. And for HDTV, this means satellite transmission.

EBU wants 22GHz band

In his address to the NAB Engineering Dinner, EBU Technical Director George Waters revealed that the combined broadcasting unions' recent meeting in Prague had passed a resolution calling for the allocation of spectrum in the 22GHz band for HDTV broadcasting in ITU Region 1 (Europe, Africa and the USSR). Regions 2 and 3 already have this allocation. Waters explained that such an international frequency allocation, if it could be agreed, would greatly simplify HDTV transmission from satellites.

Such an agreement, it must be said, would be difficult to achieve in practice in the short term as different uses are already made, or planned, for these frequencies in different Region 1 countries. For instance, in the UK 22GHz is partly allocated to Mercury for fixed links.

Satellite dish park, NAB, Dallas



Frank W3LPL checks the mailbox at the VOA's Californian transmitter site in Delano

HDTV transmission

HDTV transmissions from satellites at 22GHz could be made without having to resort to bandwidth compression techniques such as the Japanese MUSE system, which are essential for the relatively restricted channel bandwidths available in the 12GHz band. At 12GHz a broadband HDTV signal has to be 'squeezed' into a single channel. By doing this it is argued that some of the advantages of HDTV are lost.

For the full benefits of HDTV to be realised, a broader channel bandwidth is required. An international satellite broadcast band at 22GHz would have the advantage of being both high enough to provide adequate bandwidth and low enough to be within reach of today's, or at least tomorrow's, technology.

The next higher satellite broadcast band at 40GHz could provide adequate bandwidth for HDTV, but is said to be too high for current technology.

EBU chief Waters argued that a single world-wide satellite broadcast band would be the best solution for HDTV broadcasting. He warned that the world somehow had to avoid the proliferation of TV standards which currently exist: if all the variations of PAL and SECAM are included, today there are 14 different TV standards around the world. A single world-wide HDTV standard could provide the answer.

However, judging by the strength of feeling on both sides (European/50Hz and US/Japan/60Hz) it is hard to see what the outcome of the current CCIR discussions can be other than a compromise. A compromise at the CCIR will mean that there won't be agreement on a single standard for HDTV . . . well, not for a while at least.

Spectrum review

Peter Rouse GU1DKD has written *Scanners: A VHF/UHF Listener's Guide*. The book contains plenty of information on what equipment is available in the scanner market, as well as some useful frequency tables and other general information for the listener.

Aimed at the newcomer to radio, Peter's book fills a gap in scanner reading material in the UK. Scanners appear to be the current 'boom' in radio. Peter is already back at the WP, bashing out the second edition! REW

K6NA has a 3-tower hilltop contest station near San Diego. Two towers are 140ft

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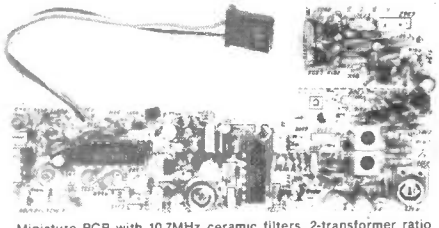

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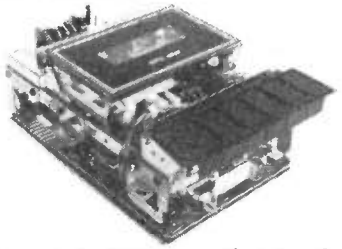

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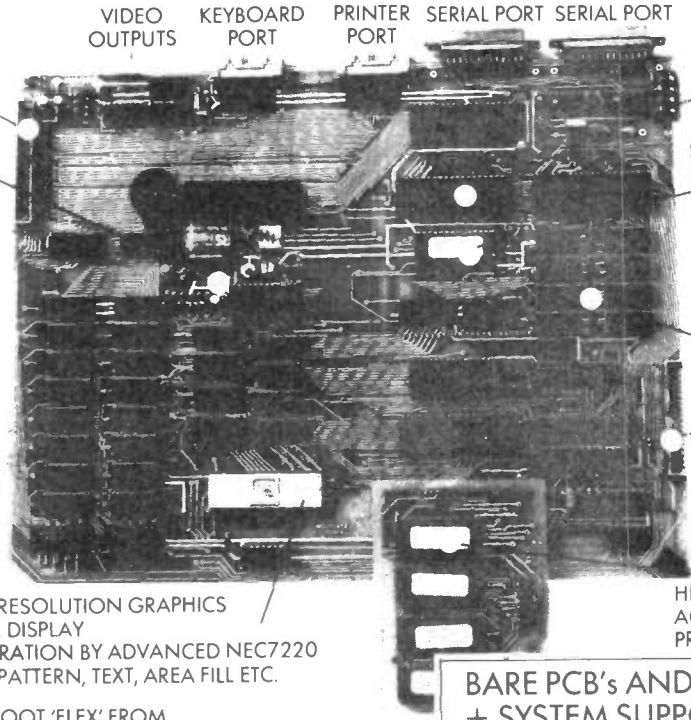

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AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

The latest furore to hit the amateur radio world, in this country at any rate, is what seems to be a very severe change in the procedure adopted by the Radio Investigation Service of the DTI for dealing with amateur radio transmission breakthrough causing TVI and radio interference to nearby receivers.

In the past, complaints of such interference were dealt with by an investigation into whether the fault lay with the amateur transmitting equipment or with the complainant's equipment. If the former, help was given in curing the trouble; if the latter, the complainant was expected to take steps to adapt his equipment so that it was not susceptible to such interference.

Now, it seems, such complaints are dealt with by sending the amateur under suspicion a standard letter couched in such terms that it suggests that the problem is automatically the radio amateur's fault and ends up by saying 'please inform this department (the local RIS office) within a month if you have resolved the problem to your neighbour's satisfaction.' If this has not been done, they suggest that your station will be inspected 'to see what action should be taken.' It concludes by indicating that 'in certain circumstances the department may need to vary your licence'. A copy of this letter is sent to the complainant!

What this 'variation' may be is unclear; it is presumed it may mean a restriction on the times when operating can be carried out and/or a reduction in the power to be used. Clearly the blame for the problem has been shifted on to the amateur and removed from his complaining neighbour.

Not unnaturally, the Radio Society of Great Britain has taken vigorous action over this matter. So far the DTI has agreed to 'have talks' about it.

AMSAT name change

The Radio Amateur Satellite Organisation, which has been in operation for a number of years, has decided to change its policy. Originally its aim was to represent and organise amateur satellite affairs on a 'global' basis. It started off reasonably successfully in this objective and its board of directors was drawn from as wide a field as the USA, Canada, the UK, Japan and South Africa.

However, as world-wide interest in amateur radio satellites grew, and 'local' AMSAT groups were established, it became only too apparent that the original AMSAT concept was too unwieldy to function efficiently. Many problems arose and many personnel changes took place. Funds dwindled and its intended functions failed.

Consequently it has been reconstituted and will in future concern itself primarily with looking after the amateur radio satellite affairs of North America only. The board of directors has voted to change the name of the organisation to AMSAT-North America, shortened to AMSAT-NA. It will specifically serve as the regional representative of amateur satellite users in the US and Canada.

Hands across America

From the amateur radio newsletter *Westlink Report,* we learn that amateur radio provided communications for the 'Hands Across America' project. On Sunday 21 May, some six million Americans attempted to join hands in a line stretching over 4000 miles from New York City to Los Angeles, California!

This event is a follow-up to the 'US Aid for Africa' project held last year. The National Communications Co-ordinator for this project was Charlie Kosman WB2NQV, who organised the communications for the Olympic torch run in 1984.

Shuttle flight amateur radio log

Last autumn the Columbia shuttle flight carrying the European Spacelab D1 had several radio amateurs amongst its crew. One of them, Dr Ernst Messerschmid DG2KM, managed to find time to make some amateur radio calls using the callsign DP0SL, and there was also an automatic QSO recording machine in operation logging the calls, DARC, the German Amateur Radio Council, recently released the log of those amateurs who made calls: the list contained nearly three hundred such calls.

Old Timers' Association

At one time this organisation was a very active and lively group, but in recent years it seems to have been rather in decline. Recently, however, steps have been taken to revive it.

Its object is to keep alive the pioneering spirit of amateur radio by personal and radio contacts and to preserve the legends of the past. Membership is open to anyone who has had an interest in the field of communication by radio for twenty-five years or more.

Applications for membership should be addressed to Miss Mabel Gadsden, 19 Rannock Court, Adelaide Road, Surbiton, Surrey KT6 4TE. As older readers will know she is a real 'old timer', having been associated with the OT Assn for forty years. Applicants should send £6.50 to cover the joining fee, the proposed subscription and the highly distinguished RAOTA badge.

28MHz activity

Considerable concern is being expressed in several quarters at the lack of activity on the 28MHz band during the present solar cycle minimum. With such low usage by radio amateurs, the fear exists that the band may be taken over by intruders!

'Band condition' commentators describe activity on the band as being 'at an all time low' and 28MHz being 'terribly under-used and vulnerable to take-over bids', to quote two recent comments. The suggestion that 'more converted CB rigs in the hands of licensed amateurs could help to retain the present width of the band' was not made in jest!

However, there *are* occasional openings, and even when these are few and far between there are other signals of interest to be heard if one looks for them. For instance, there is much to be gained from looking for the down-link satellite signals on mode B from the Russian RS series of amateur radio satellites.

Quite a lot of exotic calls can be heard, particularly if you can read CW. These can be found around the 29.5MHz region of the 10 metre band. They can be easily heard on any modern SW receiver or transceiver with an ordinary long-wire or dipole antenna. If you join AMSAT-UK and get their orbital prediction calendar, you'll get all the information you need to find out how and when to listen for them.

Then there are numerous 28MHz beacons operating under the auspices of the International Beacon Project which are interesting to monitor. The RSGB have produced log sheets for beacon reception, which may be obtained from

(and returned to) G4CEB, Building R25, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon OX11 0QX.

Some radio clubs and '28MHz interest groups' are organising 28MHz activity periods. One such is the White Rose Amateur Radio Society. They have organised 28MHz test periods on the last Sunday in four consecutive months, *viz* 28 May, 29 June, 27 July and 31 August. Each test period starts at 0900 UTC and continues for eight hours. Activity is on all modes and centres around 28.0 to 28.1MHz for CW, 28.5 to 28.6MHz for SSB and around 29MHz for FM. Reports of activity will be welcomed from SWLs as well as transmitting operators. Reports to White Rose ARS, PO Box 73, Leeds LS1 5AR. Send them immediately after each activity day.

Now is the time to start watching 10 metres regularly, as we shall soon be seeing an up-turn in the solar cycle and a resulting gradual improvement in propagation on that band.

Satellite news

The 'student constructed' ISKRA 4 Russian satellite has been delayed for several months for a variety of reasons, and further delays are predicted for RS 9 and 10 launches. Permission has been granted for the RSGB/AMSAT-UK news bulletins on Oscar 10 to be transmitted on days other than Sundays, to which they were previously restricted by the licensing authority. This facility is much appreciated, since with Oscar 10's present orbit suitable periods for this broadcast do not always occur on a Sunday. The callsign GB2RS will be used for these transmissions. REW

THE WORLD'S MOST ADVANCED INSTRUMENT

The instrument illustrated is the first of a new series now available from CIL.

This range of instrumentation is called the JAY series and is unique in that different modules can be inserted into the front of the instrument to perform many measurement tasks.

The JAY basically consists of a Z80 based microcomputer circuit with RS232 option housed in a bench mounted case. The front panel has a 2 x 16 Dot Matrix LCD display, switches for control functions and access for the modules.

Other modules shortly available are:

DMM 202 – Strain Gauge Monitor (now available)
DMM 203 – Multimeter V-I-W (RMS)
DMM 204 – Precision Voltmeter (DC) (now available)
DMM 205 – Precision DC Calibrator
DMM 206 – Precision RT Thermometer
DMM 207 – Multimeter V-L-C-R & Temperature

The module installed in the illustrated JAY is the 6 channel thermocouple temperature monitor. The microprocessor program is stored in PROM within the module. Each module therefore has a different program to perform its particular task.

This means that after the instrument is purchased for say temperature measurement, other modules can be purchased to perform almost all measurement tasks.

Advantages include low cost, simplicity and flexibility.

The DMM 201 allows any type of thermocouple to be used. There are 3 fundamental modes of operation:

1. Monitoring 1 channel at any one time
2. Monitoring all 6 channels
3. Data logging via RS232

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Price: Basic Jay £245.00
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DMM 201 Module..... £150.00
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Ken Michaelson G3RDG looks at some UoSAT hardware

I found the opportunity to review this piece of equipment a most rewarding experience. First of all, the unit is British, made in Pickering, North Yorkshire to be precise. Secondly, it was my first excursion into the realms of UoSATs 1 and 2, otherwise known as OSCAR 9 and 11 (Orbital Satellite Carrying Amateur Radio). Both these satellites were designed and constructed at the University of Surrey. Neither is a commercial communications satellite: they are intended for amateur experimentation and research. Further information can be obtained from AMSAT-UK (details at the end of the article).

ASTRID is an acronym for Automatic Satellite Telemetry Receiver and Information Decoder. The complete kit, if I can call it that, arrived well packed in a block of polystyrene. The receiver is housed in a heavy gauge steel case finished in a pleasant shade of cream enamel. It is quite small, measuring approximately 6⅜in² by 1⅝in high, with a sloping front panel taking it down to 1 inch.

The power supply actually has the three flat pins of a 13 amp plug projecting from the back, so it is only necessary to plug it into the nearest 13 amp socket. It has a lead coming out of it which plugs directly into the receiver – very convenient. A complete set of leads is also supplied, as is a collapsed dipole antenna with approximately 25ft of co-ax attached and a Belling-Lee standard TV plug at the end suitable for inserting into the antenna socket of the receiver.

A brief specification of the receiver might be useful here. It is a dual conversion superheterodyne, which works at only one frequency, nominally 145.825MHz. It has a bandwidth of 12kHz and a sensitivity of 0.2μV for 10dB S/N ratio. It has an audio output of 0.3 watts into 8 ohms and the antenna impedance is 75 ohms. Its power consumption is only 100mA at standby (16 volts) and the remote control relay will switch up to 2 amps at 24 volts.

Switches

There is no on/off switch, the unit being live the moment the lead from the power supply is plugged in. There is a red LED on the front showing that the unit is 'on' and to the right of this is a switch which will allow the decoding of data from UoSAT 1 when switched one way, and from UoSAT 2 when switched the other. This is because the data received from UoSAT 2 is inverted with respect to UoSAT 1. If there is doubt as to which satellite you have recorded, the wrongly positioned switch will print groups of 'ffffff' and 'qqqqqq' at regular intervals. The other two 'edge' controls on the front are volume and squelch.

The underlying theory of the idea is that a VHF radio receiving system converts signals from the UoSAT satellites on a frequency of 145.825MHz into data tones. The information is sent from the 'bird' at a speed of 1200 bauds and can easily be recorded by a standard small tape recorder using the microphone socket and which, if the remote microphone facility is used, can be arranged to switch on and off on receipt of a signal and on the cessation of that signal. If the tape recorder is operated on batteries, then no power is used while on 'standby' as the remote control switches the battery output off.

ASTRID is equipped with a squelch control which is arranged to control a relay operating the remote control of the tape recorder. As soon as the squelch is opened on receipt of a signal from a satellite, the recorder commences operation. Thus the unit can be left unattended for long periods, overnight for example.

The recorded signals are now fed back to ASTRID to be converted into digital 'ones' and 'noughts' to drive the serial port of the computer. Most home computers have an RS232 serial port, and in my case I used the BBC micro.

Data display

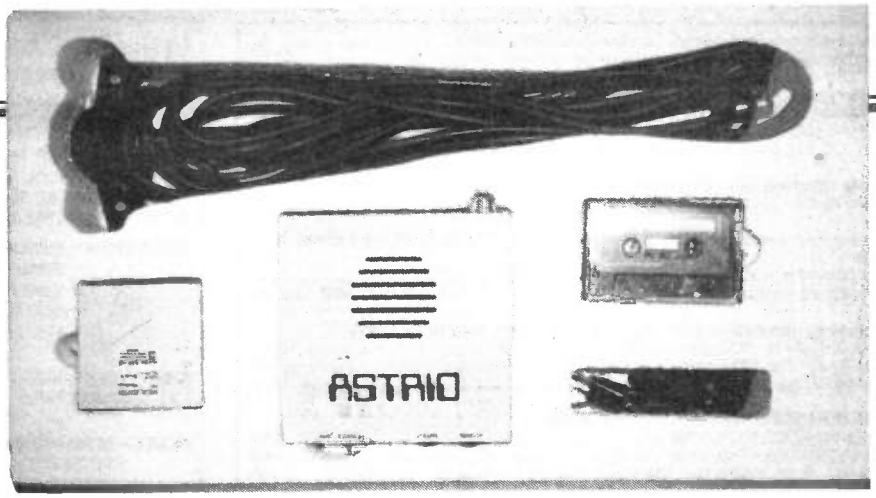
There are several ways to get the data displayed on the screen. In the kit supplied by the manufacturers, a demonstration data tape is supplied which also has two programs on it, either of which have to be loaded into the computer before attempting to decode the data. Then, by typing 'RUN' and pressing the 'play' key of the recorder, the demonstration tape, or the tape which had been previously recorded live from the satellite, will be shown on the screen. This of

```
FRAME No.: 0411531001340     (8)

POSSIBLE DATA BLOCKS
 02258   03586   04056   05041   30523   05237   31036   10367   32285   33577
 34000   35216   36278   37444   38478   39513   40769   41121   42641   43062
 44160   45000   46000   47497   48513   50469   51105   52620   53258   54648
 55000   56000   57507   58500   59501   60822   615FC   621F4   63334   64440
 651E0   66480   67700   68000   69000

ACCEPTED DATA BLOCKS
 30523   31036   32285   33577   34000   35216   36278   37444   38478   39513
 40769   41121   42641   43062   44160   45000   46000   47497   48513   50469
 51105   52620   53258   54648   55000   56000   57507   58500   59501   60822
 615FC   621F4   63334   64440   651E0   66480   67700   68000   69000


@::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
***UOSAT 2 COMPUTER STATUS INFORMATION***
COMMAND DIAR" V3.0 IN OPERATION
UNIVERSAL TIME IS 21:01:37
DATE 11/04/86
AUTO MODE IS SELECTED
SPACECRAFT SPIN PERIOD IS -03CDH SECONDS
LAST CMD SENT BY COMPUTER WAS 40H TO 1
LAST CMD RECD BY COMPUTER WAS 0EH TO 1 WITH DATA 00H
CURRENT WOD COMMENCED AT 00:00:00
DATE 11/04/86
SURVEY ICLUDES CHANS 02,03,51,52,::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::ED 00 TIMES:::::::::::::::::::::::::::::::::::::::
:::::
***UOSUNIVERSAL TIME IS 21:01:42
DATE 11/04/8 PERIOD IS -03CDH SECONDS
LAST CMD SENT BY COMPUTER WACURRENT WOD COMMENCED AT 00:00:0003,51,52,:::::::::
:::::::
MAGNETORQUER HAS BEEN ACTIVATED 00 TIMES:::::::::::::::::::::::::::
***UOSAT 2 COMPUTER STATUS INFORMATION***
COMMAND DIARY V3.0 IN OPERATION
UNIVE IS 03CDH NDS
LAST CMD SENT BY COMPUTO 1 WITH DATA 00H
CURRENT WOD COMMENC2,03,51,52,::::::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::   1986
        **************    ************    *************
```



course will only give the figures or plain language which has been recorded on the tape and will not give the information which is contained in those figures. The instruction handbook suggests a method of decoding these numbers and letters to give meaningful results, but really there is only one way to do it.

Firstly, join AMSAT-UK. Next, purchase two discs entitled 'SATPAC'. They are written by Eric Twose and Craig Underwood and, in my opinion, are truly fantastic programs. The first one gives the display of any satellite on a world-wide basis so that you can see exactly where your satellite is and how long it will be before it arrives over the horizon. The second one takes all the mass of figures and letters received from UoSAT 1 or 2 and with the aid of the computer gives you back clear and understandable results.

The catch

There was one snag as far as I was concerned. I found it impossible to get a decent signal on the dipole provided. In fact, at this QTH I have a normal pair of crossed dipoles on a mast on the centre chimney stack, an additional pair of crossed dipoles with reflectors and a masthead pre-amplifier, and although I received reasonable signals on the chimney stack dipoles, they were far improved using the dipoles with the reflectors.

It may well be that I have a bad situation here but, nevertheless, by leaving the unit on standby overnight I was able to get some quite interesting results. I agree most strongly with the suggestion in the handbook that you seek the aid of a TV antenna erector and get him to place the dipole as high as possible in the clear. It may well have been that if I had mounted the dipole supplied in the open, then the signal levels would have been improved.

Another problem which developed occasionally was that the frequency would for no apparent reason be used as a simplex channel by local 2 metre operators with scant regard for the satellite transmissions.

Once bitten by the ability to receive these very interesting transmissions from the satellites, I must confess that I wanted to continue using a better antenna. I had no trouble in printing out the results of the processed data or, for that matter, printing data before processing when using the SATPAC package. The printer used was the Epson RX80 F/T, and possibly it was due to the SATPAC program that I was able to extract the information.

Of course the plain language was quite a different matter and proved to be very interesting reading. I found that, as the handbook and leaflets suggest, it was preferable to make a recording during the night because there was less likelihood of interference and the computer was switched off. It is unfortunate that my BBC micro, in common with others I understand, generates a lot of RF interference and would sometimes obliterate the signal from the satellite. But it always was a lucky dip to see what the night's recording had brought me!

In conclusion, I can say that I was impressed with the unit. Its compact size and excellent finish both inside and out are to designer Stephen Webb's great credit. However, there are some small points which I feel need attention. Both the volume and squelch controls are far too fierce. It would appear that slightly different values for the potentiometers might be helpful. As it was, I found it very difficult to find the correct position for both of them. I also thought that an 'on/off' switch would have been a good thing, incorporated perhaps in the volume control.

The unit should nevertheless prove to be a very attractive purchase for those who are interested in space reception. The simplicity of the connections to the BBC micro, or other computers with an RS232 port, is a great selling point, and the very competitive price of £149.00 fully inclusive makes it, in my view, a sure winner.

Thanks

Thanks are due to Stephen Webb, of MM Microwave Ltd, Thornton Road Industrial Estate, Pickering, North Yorkshire, YO18 7JB, telephone (0751) 75455, for the loan of the equipment for this review.

The AMSAT-UK honorary secretary is RJC Broadbent G3AAJ. He can be contacted at 94 Herongate Road, Wanstead Park, London E13 5EQ, telephone (01) 989 6741. Please enclose an sae when writing. REW

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UoSAT-2 TELEMETRY
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Source file: 'RESULT'

FRAME No.      :8604115210026       (2)
Mission time   :11/04/86    21:00:26
AOS date/time  :11/04/86    20:30 hrs.


Digital channel:61 <5FC>

Gravity Gradient Boom Deployment Pyros      Point: 13 Condition: Safe
Gravity Gradient Boom Deployment Pyros      Point: 14 Condition: Fire
Gravity Gradient Boom Deployment            Point: 15 Condition: Safe
Gravity Gradient Boom Deployment            Point: 16 Condition: Deploy

Gravity Gradient Boom Deployment            Point: 17 Condition: Retract
Attitude Control Magnetorquers              Point: 18 Condition: Arm
Attitude Control Magnetorquer -X            Point: 19 Condition: Off
Attitude Control Magnetorquer -Y            Point: 20 Condition: Off

Attitude Control Magnetorquer -Z            Point: 21 Condition: Off
Attitude Control Magnetorquer               Point: 22 Condition: Forward
435 MHz PSK Mode                            Point: 23 Condition: NRZI
2401 MHz PSK Mode                           Point: 24 Condition: NRZI


Digital channel:62 <1F4>

Attitude Control Magnetorquers              Point: 25 Condition: High Power
Digitalker Expt. Power                      Point: 26 Condition: Off
CCD Camera Expt. Power                      Point: 27 Condition: Off
CCD Camera Integration Period Bit 0         Point: 28 Condition: 1

CCD Camera Integration Period Bit 1         Point: 29 Condition: 1
CCD Camera Expt. Video Amp Gain Bit 0       Point: 30 Condition: 1
CCD Camera Expt. Video Amp Gain Bit 1       Point: 31 Condition: 1
DSR Power                                   Point: 32 Condition: On

DSR Mode                                    Point: 33 Condition: Read
DSR Mode                                    Point: 34 Condition: Reset
Radiation Detect. Geiger-A EHT Power        Point: 35 Condition: Off
Radiation Detect. Geiger-B EHT Power        Point: 36 Condition: Off
```

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1 watt mixed metal/Carbon Film 5% E12 series 10RO to 10 Megohms 5p
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Disc/plate ceramics E12 series 1PO to 1000P, E6 sries to 1500P to 47000P 2p

Polystyrene capacitors 63V working E12 series long axial wires
10 pf to 820 pf – 3p. 1000 pf to 10,000 pf – 4p. 12,000 pf 5p
741 Op Amp – 20p. 555 Timer 22p
cmos 4001 – 20p. 4011 – 22p. 4017 ..... 40p

ALUMINIUM ELECTROLYTICS (Mfds/Volts)
1/50, 2.2/50, 4.7/50, 10/25, 10/50 ..... 5p
22/16, 22/25, 22/50, 47/16, 47/25, 47/50 ..... 6p
100/16, 100/25 7p; 100/50 12p; 100/100 ..... 14p
220/16 8p; 220/25, 220/50 10p; 470/16, 470/25 ..... 11p
1000/25 25p; 1000/35, 2200/25 35p; 4700/25 ..... 70p

Submin, tantalum bead electrolytics (Mfds/Volts)
0.1/35, 0.22/35, 0.47/35, 1.0/35, 3.3/16, 4.7/16 ..... 14p
2.2/35, 4.7/25, 4.7/35, 6.8/16 15p; 10/16, 22/6 ..... 20p
33/10, 47/6, 22/16 30p; 47/10 35p; 47/16 60p; 47/35 ..... 80p

DIODES (piv/amps)
75/25mA 1N4148 2p. 800/1A 1N4006 6p. 400/3A 1N5404 14p. 115/15mA OA91 ..... 6p
100/1A 1N4002 4p. 1000/1A 1N4007 7p. 60/1.5A S1M1 5p. 100/1A bridge 25p
400/1A 1N4004 5p. 1250/1A BY127 10p. 30/45mA OA90 6p. 30/15A OA47 ..... 8p
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VP18	30	Metres PVC Multi Strand Wire Mixed Cols	£1.00
VP19	40	Metres PVC Single/Multi Strand Wire	£1.00
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VP29	30	Assorted Volts Zeners 250mw-2w	£1.00
VP30	10	Assorted Volts Zeners 10w Coded	£1.00
VP31	10	5a SCR's TO66 50-400v Coded	£1.00
VP32	20	3a SCR's TO66 Up to 400v Uncoded	£1.00
VP33	200	Sil Diodes Like 1N4148	£1.00
VP34	200	Sil Diodes Like 0A200/BAX13/16	£1.00
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VP36	100	Sq Inches Total Copper Fibre-Glass Board	£1.00
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VP40	40	TTL IC's All New Gates – Flip Flop – MSI Data	£4.00
VP41	40	CMOS IC's All New Inc Data	£4.00
VP42	10	Black Heatsinks Fit TO-3 TO-220 Drilled	£1.00
VP43	4	Power-Fin Heatsinks 2 X TO-3 2 X TO-66	£1.00
VP44	15	Asst Heatsinks TO-1-3-5-18-220	£1.00
VP45	50	BC107/8 NPN Transistors Good Uncoded	£1.00
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IP47	10	**Sil Power Trans Similar 2N3055 Uncoded**	£1.00
VP48	5	Pairs NPN/PNP Plastic Power Trans Data 4a	£1.00
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VP52	25	Asst Audio Plugs Phono-Din-Jack Etc	£1.50
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VP55	10	IC's 4116 Memorys	£2.00
VP56	100	Semiconductors From Around the World	£4.00
VP57	25	Opto Special Pack Assorted	£5.00
VP58	10	Hybrid LED Colour Displays	£4.00
VP59	20	Asst IC's Coled, Linear, Etc	£2.00
VP60	100	All Sorts Transistors, NPN/PNP	£1.00
VP82	1	Electronic Buzzer, 3v, 25MA	£0.95
VP83	1	Electronic Buzzer, 6v, 25MA	£0.95
VP84	1	Electronic Buzzer, 9v, 25MA	£0.95
VP85	1	Electronic Buzzer, 12v, 25MA	£0.95
VP86	1	TECASBOTY '86, Bargain Pack	£8.00
VP87	1	Telephone Pick-Up Coil	£1.25
VP88	1	Pillow Speaker	£1.45
VP89	1	2Metre Metric/Inches Tape	£1.75
VP90	1	Electronic Siren, 12v DC	£6.50
VP95	1	Small Plastic Vice, with suction base	£1.75
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VP128	1	Miniature FM Transmitter/Babyphone	£6.50
VP130	6	RED 7 Seg CC 14mm x 7.5mm RDP FND353 LED	£2.00
VP131	4	GREEN 7 Seg CA .6" LDP XAN6520 LED	£2.00
VP132	5	RED 7 Seg CC .6" LDP XAN6940 LED	£2.00
VP133	6	RED Over-flow .6" 3 x CA 3 x CC 6630/50 LED	£2.00
VP134	5	GREEN Over-flow .6"CA XAN6530 LED	£2.00
VP135	5	RED 7 Seg CA .3"XAN3061 LED	£2.00
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VP147	1	Pair Opto Coupled modules	£0.60
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VP150	20	BC183B Sil Trans NPN 30v 200mA Hfe240+ TO92	£1.00
VP151	25	BC171B Sil Trans, NPN 45v 100mA Hfe 240+ TO92	£1.00
VP152	15	TIS90 Sil Trans NON 40v 400mA Hfe100+ TO92	£1.00
VP153	15	TIS91 Sil Trans PNP 40v 400mA Hfe100+ T092	£1.00
VP154	15	MPSA56 SIL Trans PNP 80v 800mA Hfe+ TO92	£1.00
VP155	20	BF595 Sil Trans NPN eqvt BF184 HF TO92	£1.00
VP156	20	BF495 Sil Trans NPN eqvt BF173 HF TO92	£1.00
VP157	15	ZTX500 Series Sil Trans PNP Plastic	£1.00
VP158	15	ZTX107 Sil Trans NPN eqvt BC107 PLASTIC	£1.00
VP159	15	ZTX108 Sil Trans NPN eqvt BC108 PLASTIC	£1.00
VP160	20	E5024 Sil Trans PNP eqvt BC214L TO92	£1.00
VP161	25	BC183L Sil Trans NPN 30v 200mA TO92	£1.00
VP162	5	5 SJE5451 Sil Power Trans NPN 80v 4A HFe20+	£1.00
VP163	2	NPN/PNP pairs Sil Power Trans like SJE5451	£1.00
VP164	4	2N6289 Sil Power Trans NPN 40 v 40w 7A Hfe30+	£1.00
VP165	6	BFT33 MPN Sil Trans 80v 5A Hfe50-200 TO39	£1.00
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VP168	10	BC478 eqvt BCY71 PNP Sil Trans TO18	£1.00
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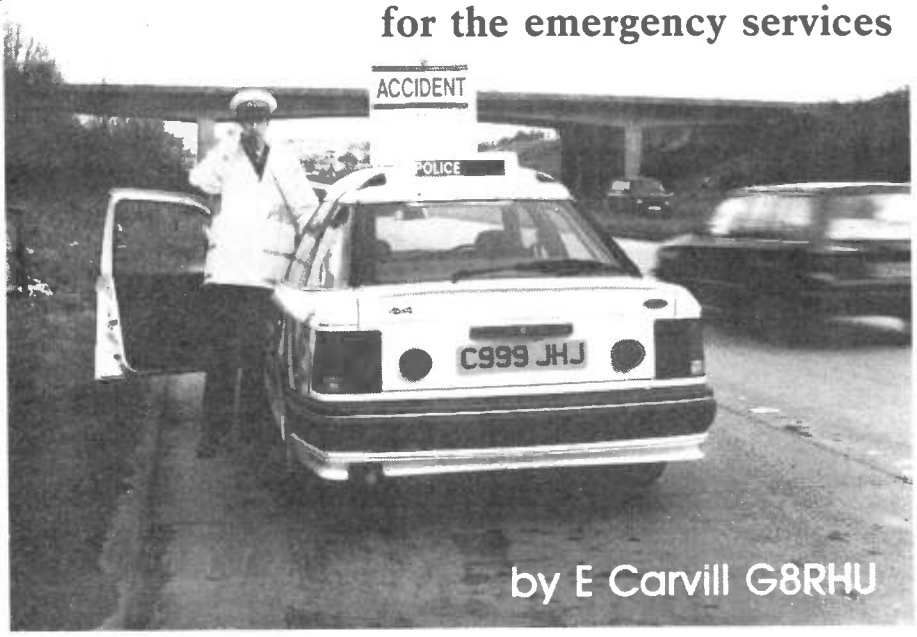
ALL CHANGE

for the emergency services



by E Carvill G8RHU

This year the police and fire services are beginning a re-equipment programme to change their radio services as a result of the World Administrative Radio Conference of 1979. At present they use frequencies within the range 97.6 – 102.1MHz and 80 – 84MHz. This will change to the 150MHz and 140MHz bands with 12.5kHz channel spacing.

The FM broadcast Band II has to be cleared by 1995, and it is expected that the emergency services will have moved by the end of 1989. Police and fire services are suffering increasing continental broadcasting interference, especially in the south.

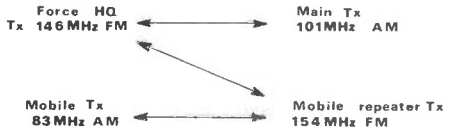
Duplicate radio systems are being installed at more than 250 sites throughout the country. As the change-over is made it will be necessary for vehicles which cross into adjacent areas to be equipped with radios operating on both bands: engineers will have to ensure that there is no break in transmissions during this change-over. The cost of the programme is estimated at £70 million.

Kent police will be the first to operate the new equipment. Present radio equipment is crystal controlled and limited to about 15 channels, but the new equipment is synthesized and will work on all of the 256 channels allocated in the Police National Plan. All-British equipment is to be used, and contracts have been awarded to Burndept Electronics in Erith, Kent and Marconi Communications in Chelmsford. More than 25,000 vehicle radios will have to be replaced at a cost of £18 million.

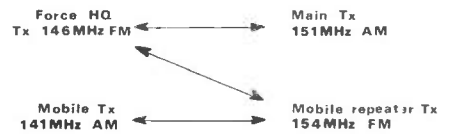
Typical of the new equipment is the Marconi model RC690 mobile radio, capable of handling all of the allocated channels and with the added advantage of being able to handle transmission and reception of data from a computer link.

The UK FM broadcast band

The present system



The forthcoming arrangement



The new equipment has been subjected to rigorous testing to ensure it stands up to the demands of 24-hour use.

AM versus FM

The Home Office Directorate of Telecommunications, which is responsible for the installation and maintenance of radio services in England and Wales, has decided to continue with AM (amplitude modulation) for VHF channels.

However, not all forces are in agreement with this. The Metropolitan Police, the Lancashire Constabulary, the Royal Ulster Constabulary and most Scottish forces have equipment supplied direct from the manufacturers and will continue to use FM (frequency modulation) on the new channels.

The main factor in deciding on AM for the police service was that wide area coverage with single-button action, enabling transmission simultaneously from a number of hill-top sites, was essential. Not all of the British mobile radio industry was in agreement with this, but the Home Office engineers opted for AM, and there will consequently be no common national system of modulation. The police are nevertheless confident that the problems, the like of which have been encountered before, can be overcome again with the new channels and equipment.

The fire brigades will have a national FM system which will enable them to communicate throughout the country, in much the same way as the ambulance service is able to do now. When the regional health authorities were reorganised in 1974 they adopted a national FM system on 166MHz. This allows a common system to be used for all county ambulance services, so that it is now possible for any ambulance to contact the local ambulance control by switching to the emergency reserve channel. The ambulance service will not be affected by the WARC 1979.

Other users

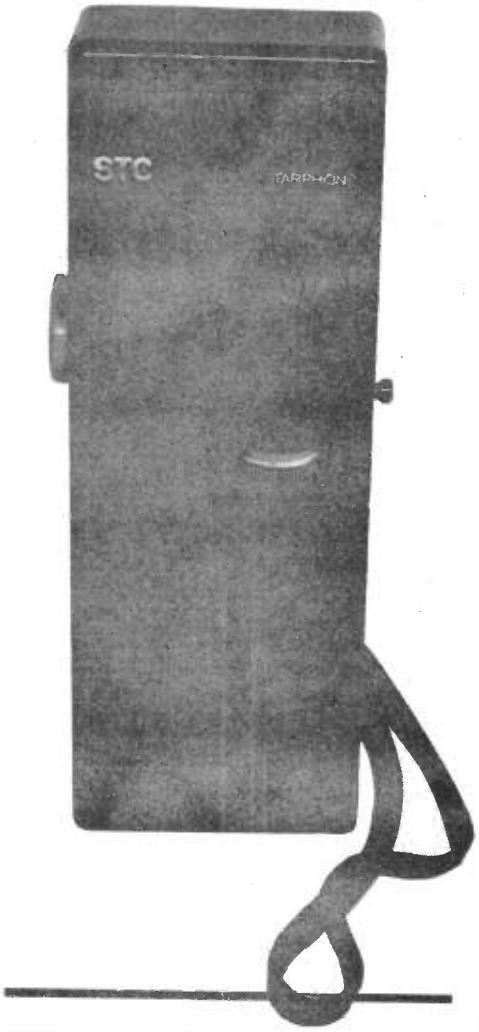
The police and fire services are not the only services having to move out of Band II. The gas and electricity boards, British Rail and the bus companies have their mobile frequencies in the range 105-108MHz.

The gas and electricity companies will move to the new VHF mid-band at 139 – 149MHz, while British Rail and the bus companies will be allocated frequencies in the new Band III radio channels. Most of the vehicle sets will have to be replaced by 1991 because of interference from continental users, but it may be possible for users in some parts of the country who are outside the range of the continent to continue until 1995. REW

The microprocessor-controlled Marconi RC690 VHF AM mobile transceiver. It can be programmed for single or dual channel simplex or full duplex operation. In full duplex mode it can also operate as an automatic repeater

THE STARPHONE ON 70

Peter Rouse GU1DKD has a few tweaks and mods for this compact single-channel UHF hand-held



The STC Starphone made its first appearance in the summer of 1969 and was clearly intended to be a rival for the Pye PF1 UHF pocketphone, unlovingly referred to as the 'two bit radio'. Unlike its rival, however, the Starphone was a complete one-piece transmitter/receiver, and so on single-channel simplex operation the user wasn't forced to adopt comical postures in order to hold the receiver far enough away from the transmitter to avoid howlround, as was the case with the PF1.

Despite the Starphone's easier method of operation it never bred in quite the same numbers as the PF1 (put two on a stand at a rally and half an hour later there will be a dozen). Even so, batches have appeared on the surplus market in recent years and have been snapped up by amateurs.

The Starphone is very compact (little bigger than the PF1 receiver), with a quoted output power of 150mW and a receiver sensitivity of 2μV. Although it can be used for simplex operation, with that kind of power and sensitivity it is obviously better for repeater operation. Despite its small size, with a bit of fiddling room can still be found inside to fit toneburst – but more on that later.

Getting it going on 70

Although the set was designed to operate on PMR and emergency frequencies higher than the 70cm band, there is no particular difficulty in tuning it down as long as certain steps are taken.

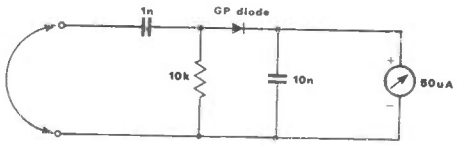
First of all the crystals needed must be ones specified for this particular set, since the receiver works on an unusual triple superhet system where the first LO crystal fundamental is also used as the second conversion LO in order to reduce possible image problems. However, the mathematics of this are eliminated if crystals are ordered from firms like Quartslab* as it is only necessary to specify the channel number and the set.

Delving inside

A look inside the Starphone will reveal a clear dividing line down the middle with the transmitter stage on one side and the receiver on the other. The transmitter stage must be aligned before the receiver as the aerial tuning capacitor C1 must be set up for transmit and then not touched again.

The transmitter is aligned as follows: first locate the deviation control next to the transmit crystal. Mark its position and then turn it fully clockwise. Use a meter on the 3V range and connect between the positive side of the supply and the 100 ohm resistor R137 and its junction with the 47k resistor and L104. Adjust L101 for maximum meter reading.

Now move the negative probe of the meter to the junction of the 100 ohm resistor R141 and its junction with L106. Adjust L104/L105 for maximum reading. Set the meter to the 12V range and move the negative probe to the junction of the 220 ohm resistor and L107 and adjust C138 for maximum deflection. If a suitable RF 'sniffer' isn't available use the circuit shown placed near the PCB aerial assembly.



By now some kind of indication should be apparent when the transmitter is keyed, so adjust C143/C147/C138 and L101/L104/L105 for maximum indication. Finally adjust C1 and repeat these last procedures until maximum output has been achieved.

A digital frequency meter or a second receiver to tune the crystal onto frequency exactly will now be needed. Connect the meter on its 100mA current range in line with the power supply and then tune L102 for correct frequency. Now adjust L101 for maximum current. It will probably be necessary to repeat this procedure a few times as the two coils are interactive.

Transmitter deviation can now be reset. Return the potentiometer to its original position and inject a 5mV signal at 1kHz into the microphone line. With a 'scope connected between the collector of Tr102 and the chassis, adjust the potentiometer next to the transmit crystal until the displayed waveform just starts to clip.

Receiver alignment

Firstly the squelch must be disabled. This is accomplished by connecting a link between ground and test point 2 (the small brass stud on the transmitter half of the PCB). Now set L7 to its mid position and L6/L8 fully out. Connect the RF sniffer between ground and the base of transistor Tr5 and adjust L6/L8 for maximum deflection. Move the sniffer to the emitter of Tr2 and adjust C21 for maximum deflection.

With a digital frequency counter connected to the base of Tr5 it should now be possible to tune L7 to give an output of double the crystal frequency. Without a DFM this part of the alignment will have to be carried out last of all with an off-air signal: a rough starting point can always be the harmonics of a synthesized 2m rig feeding into a dummy load. This same signal will also be needed for the RF alignment if a suitable signal generator is not available.

Start by setting L5 fully out and C5/C7 not quite fully in. If an FM signal generator and 'scope are available then the 'scope should be connected across the speaker terminals and the volume adjusted for suitable indication. It is now

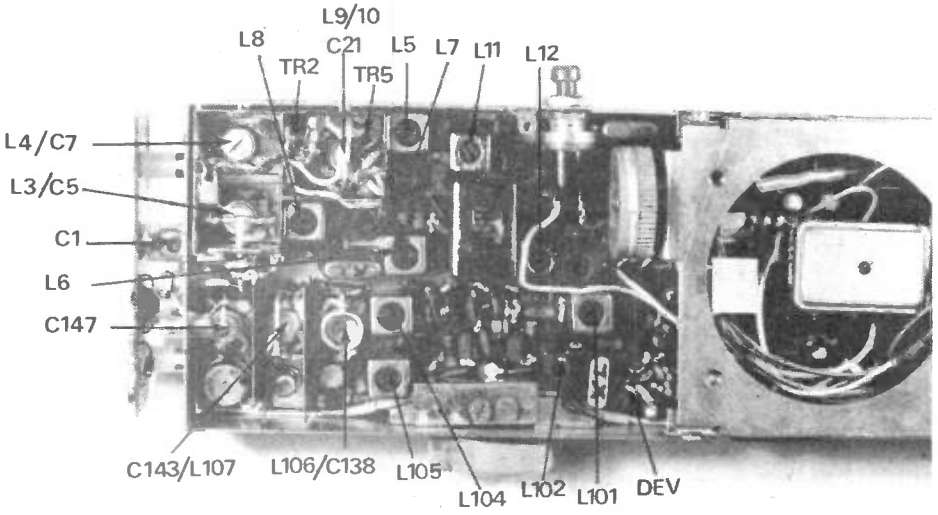
Quartslab Marketing Ltd, PO Box 19, Erith, Kent DA8 1LH

merely a question of adjusting the following controls for minimum waveform distortion and best signal to noise ratio. Start with C5 and then work through C7/L5/L11/L12 in that order and repeat the procedure until satisfied.

This stage of the alignment is the only one where problems are likely to occur. The L4/C7 combination often seems reluctant to tune low enough, but a 4.7pF fixed capacitor strapped across C8 will usually cure this and a further slight improvement in sensitivity can sometimes be made by bending L4 slightly closer to L3.

If a DFM isn't available it should now be possible to tune the receiver exactly onto frequency using an off-air signal.

Once all is working check that the muting potentiometer R56 is correctly set with the link to TP2 removed. Early models had a fixed resistor in place of R56.



Modifications

One of the most useful mods on this set is a simple mute override. By removing the earphone socket there is room for a small push switch, and this merely connects between ground and TP2.

Repeater toneburst can be fitted. Many miniature circuits have been presented in *R&EW* and so I have no intention of repeating them here. Room was made for my own by removing the loudspeaker and fitting a much smaller one from a PF1 (see photo). However, it may be possible to use a smaller microphone than the one mounted in the big rubber block and achieve a similar space saving.

Finally, the Nicads for this set seem to be in short supply. If you managed to get a pack that does not work don't throw it away. The cells inside are identical to the ones used in readily available PF1 packs, and by carefully opening up the plastic case of the battery pack it is possible to fit replacement cells.

INTEGRATED CIRCUITS

AN124	2.50	MC1351P	1.50	STK437	7.95	TBA720A	2.45	TDA2581	2.95
AN214Q	2.50	MC1357	2.35	STK439	7.95	TBA750Q	2.65	TDA2582	2.95
AN239	2.50	MC1358	1.58	STK461	11.50	TBA800	0.89	TDA2593	2.95
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AN362L	2.50	MC1496	1.25	TA7129P	2.50	TBA820Q	1.45	TDA2640	3.50
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AN7145	3.50		7.95	TA7137P	1.00	TBA920	1.65	TDA2690	2.45
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CA1352E	1.75	ML231B	1.75	TA7204P	2.15	TBA990Q	1.49	TDA3560	3.95
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CA314QT	1.15	PLL02A	5.75	TA7227P	4.25		1.50	UPC575C2	
ETT6016	2.50	SAA500A	3.50	TA7310P	1.80	TCA650	2.50		2.75
HA1339A	2.95	SAA1025	7.25	TA7313AP	2.95	TCA800	2.95	UPC1025H	
HA1366W	2.75	SAS560S	1.75	TA7314P	2.95	TCA830S	1.95		1.95
HA1377	3.50	SAS570S	1.75	TA7137P	1.00	TCA900	2.50	UPC1028H	
HA1156W	1.50	SAS580	2.85	TA7314P	2.95	TCA940	1.65		1.95
HA1551	2.95	SA/SB/T/U		TA7321P	2.25	TDA440	2.20	UPC1032H	
LA1230	1.95		1.00	TA7609P	3.95	TDA1001	2.95		1.50
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LA4420	1.95	SL1327	1.10	TAA350A	1.95	TDA1010	2.15		0.75
LA4430	2.50	SL1327Q	1.10	TAA570	1.95	TDA1035	2.50	UPC1167C2	
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LA4422	2.50	SN76013N	3.95	TAA700	1.70	TDA1044	2.15	UPC1181H	
LA4461	3.95	SN76023N	3.95	TBA120AS	B -	TDA1170	1.95		1.25
LC7120	3.25	SN76033N	3.95		C 1.00	TDA1190	2.15	UPC1182H	
LC7130	3.50	SN76110N	0.89	TBA395	1.50	TDA1270Q	3.95		2.95
LC7131	5.50	SN76115N	1.25	TBA396	0.75	TDA1327	1.70	UPC1185H	
LC7137	5.50	SN76131N	1.30	TBA440N	2.55	TDA2002	1.95		3.95
LM1011	3.15	SN76226DN		TBA480Q	1.25	TDA2003	2.95	UPC1191V	1.50
LM324N	0.45		2.95	TBA510	2.50	TDA2010	1.95	UPC1350C	
LM380N8	1.50	SN76227N	1.05	TBA510Q	2.50	TDA2020	2.95		2.95
LM380N8	1.75	SN76533N	1.65	TBA520	1.10	TDA2030	2.80	UPC1353C	
LM383T	2.95	SN76544N	2.65	TBA520Q	1.10	TDA2140	3.95		2.45
LM390N	3.50	SN76570N	1.00	TBA530	1.10	TDA2151	1.95	UPC1365C	
M51513L	2.30	SN76650N	1.15	TBA530Q	1.10	TDA2160	2.50		3.95
M5155L	2.95	SN76660N	0.90	TBA540	1.25	TDA2190	3.95	UPC2002H	
M51521L	1.50	STK014	7.95	TBA540Q	1.35	TDA2521	3.25		1.95
MB3712	2.00	STK015	5.95	TBA550Q	1.95	TDA2522	1.95	555	0.35
MB3756	2.50	STK025	11.95	TBA560C	1.45	TDA2523	2.95	556	0.60
MC1307P	1.00	STK043	9.50	TBA560Q	1.45	TDA2524	1.95	723	0.50
MC1310P	1.95	STK078	11.95	TBA570	1.00	TDA2530	1.95	741	0.35
MC1327	1.70	STK415	7.95	TBA651R	2.50	TDA2532	1.95	747	0.50
MC1327Q	0.95	STK433	5.95			TDA2540	1.95	748	0.35
MC1349P	1.20	STK435	7.95			TDA2541	2.15	7808	0.60
MC1350P	0.95					TDA2560	2.15	7805	0.65
						TDA2571	2.95	7812	0.65
								7815	0.65

SEMICONDUCTORS

AAY12	0.25	BC182	0.10	BD238	0.40	BFX88	0.25	TIP32C	0.42
AC126	0.45	BC182LB	0.10	BD242	0.65	BFY50	0.21	TIP33C	0.95
AC127	0.20	BC183	0.10	BD246	0.75	BFY51	0.21	TIP34B	0.95
AC128	0.28	BC183L	0.09	BD376	0.32	BFY52	0.25	TIP41A	0.45
AC128K	0.32	BC184LB	0.09	BD410	0.65	BFY90	0.77	TIP41C	0.45
AC141	0.28	BC204	0.10	BD434	0.65	BLY48	1.75	TIP42C	0.47
AC141K	0.34	BC207B	0.13	BD437	0.75	BR100	0.26	TIP47	0.65
AC142K	0.45	BC208B	0.13	BD438	0.75	BR101	0.49	TIP120	0.60
AC176	0.22	BC212	0.09	BD520	0.65	BR103	0.55	TIP125	0.65
AC176K	0.31	BC212L	0.09	BD538	0.65	BR303	0.95	TIP142	1.75
AC187	0.25	BC212LA	0.09	BD597	0.95	BRC4443	1.15	TIP146	2.75
AC187K	0.28	BC213	0.09	BD701	1.25	BRY39	0.45	TIP161	2.95
AC188	0.25	BC213L	0.09	BD702	1.25	BT100A/02	0.85	TIP2955	0.80
AC188K	0.37	BC214	0.09	BD707	0.90	BT106	1.49	TIP3055	0.55
AD142	0.79	BC214C	0.09	BDX32	1.50	BT116	1.20	TIS91	0.20
AD143	0.82	BC214L	0.09	BF115	0.35	BT119	3.15	TV106/2	1.50
AD149	0.70	BC237B	0.09	BF119	0.65	BT120	1.65	ZRF0112	16.50
AD161	0.39	BC238	0.09	BF127	0.39	BU105	1.95	2N1100	6.50
AD162	0.39	BC239	0.12	BF154	0.20	BU108	1.69	2N1308	1.35
AD161/2	0.90	BC251A	0.12	BF158	0.22	BU124	1.25	2N1711	0.30
AF106	0.50	BC252A	0.15	BF160	0.27	BU125	1.25	2N2219	0.28
AF114	1.95	BC258	0.25	BF167	0.27	BU126	1.60	2N2905	0.40
AF121	0.60	BC258A	0.39	BF173	0.22	BU204	1.55	2N3053	0.40
AF124	0.65	BC284	0.30	BF177	0.38	BU205	1.30	2N3054	0.59
AF125	0.35	BC300	0.30	BF178	0.26	BU208	1.39	2N3055	0.52
AF126	0.32	BC301	0.30	BF179	0.34	BU208A	1.52	2N3702	0.12
AF127	0.65	BC303	0.26	BF180	0.29	BU208D	1.85	2N3703	0.12
AF139	0.40	BC307B	0.09	BF181	0.29	BU326	1.20	2N3704	0.12
AF150	0.60	BC327	0.10	BF182	0.29	BU326S	1.50	2N3705	0.20
AF178	1.95	BC328	0.10	BF183	0.29	BU407	1.24	2N3706	0.12
AF239	0.42	BC337	0.10	BF184	0.28	BU500	2.25	2N3708	0.12
AU106	4.50	BC338	0.09	BF185	0.28	BU508A	1.95	2N3733	9.50
AU107	3.50	BC347A	0.13	BF194	0.11	BU526	1.90	2N3773	2.75
AU110	3.50	BC461	0.35	BF195	0.11	BU807	2.25	2N3792	1.35
AY102	2.95	BC478	0.20	BF196	0.11	BUY20	2.15	2N4280	3.50
BC107A	0.11	BC527	0.20	BF197	0.11	BUY69B	1.70	2N4427	1.95
BC107B	0.11	BC547	0.10	BF198	0.16	MJ3000	1.98	2N4444	1.15
BC108	0.10	BC548	0.10	BF199	0.14	MJE340	0.40	2N5294	0.42
BC108A	0.11	BC549A	0.10	BF200	0.40	MJE350		2N5296	0.48
BC108B	0.12	BC550	0.14	BF241	0.15	MJE520	0.48	2N5298	0.60
BC109	0.10	BC557	0.08	BF245	0.30	MJE2955		2N5485	0.45
BC109B	0.12	BC557B	0.08	BF257	0.28	MPSA13	0.29	2N5496	0.95
BC109C	0.12	BC558	0.10	BF258	0.28	MPSA92	0.30	2SA329	0.95
BC114A	0.09	BC639/10	0.30	BF259	0.28	MRF237	4.95	2SA715	0.60
BC116A	0.15	BCY33A	1.60	BF271	0.26	MRF450A		2SC495	0.80
BC117	0.19	BD115	0.30	BF273	0.18		13.95	2SC496	0.80
BC119	0.24	BD124P	0.59	BF336	0.34	MRF453	17.50	2SC931D	0.95
BC125	0.25	BD131	0.42	BF337	0.29	MRF454	26.50	2SC1096	0.80
BC139	0.20	BD132	0.42	BF338	0.32	MRF455	17.50	2SC1106	2.50
BC140	0.31	BD133	0.40	BF355	0.37	MRF475	2.95	2SC1172A	2.20
BC141	0.25	BD135	0.30	BF362	0.38	MRF477	10.00	2SC1173	1.15
BC142	0.21	BD136	0.30	BF363	0.65	OC16W	1.95	2SC1307	1.75
BC143	0.24	BD137	0.32	BF371	0.25	OC23	1.50	2SC1364	0.50
BC147A	0.12	BD138	0.30	BF394	0.19	OC29	2.25	2SC1449	0.50
BC147B	0.12	BD139	0.32	BF422	0.32	OC36	2.25	2SC1678	1.25
BC148A	0.09	BD140	0.30	BF423	0.25	OC42	0.75	2SC1945	2.65
BC148B	0.09	BD144	1.10	BF457	0.32	OC44	0.75	2SC1953	0.95
BC149	0.09	BD150C	0.29	BF458	0.36	OC45	0.55	2SC1957	0.80
BC153	0.30	BD159	0.65	BF467	0.68	OC70	0.45	2SC1969	1.95
BC157	0.12	BD160	1.50	BF595	0.23	OC71	0.55	2SC2028	1.15
BC158	0.09	BD166	0.55	BF597	0.25	OC75	0.95	2SC2029	1.95
BC159	0.09	BD179	0.72	BFR39	0.23	OC81	0.50	2SC2078	1.45
BC161	0.28	BD182	0.70	BFR40	0.23	OC16W	2.50	2SC2091	0.85
BC170B	0.15	BD201	0.83	BFR81	0.25	R2008B	1.45	2SC2098	2.95
BC171	0.09	BD202	0.65	BFR88	0.30	R2010B	1.45	2SC2166	1.95
BC171A	0.10	BD203	0.78	BFR90	1.50	R2322	0.58	2SC2314	0.80
BC171B	0.10	BD204	0.70	BFR91	1.75	R2323	0.66	2SC2371	0.36
BC172	0.10	BD222	0.46	BFT42	0.35	R2540	2.48	2SC931D	0.95
BC172B	0.10	BD223	0.59	BFT43	0.35	RCA16334	0.90	1SD234	0.50
BC172C	0.10	BD225	0.48	BFW61	0.60	RCA16335	0.80	2SD325E	1.65
BC173B	0.10	BD232	0.35	BFW92	0.85	S2060D	0.95	3N211	2.95
		BD233	0.35	BFX29	0.30	SKE5F	1.45	3SK88	0.95
BC174	0.09	BD234	0.35	BFX84	0.26	TIP29	0.40		
BC174A	0.09	BD236	0.49	BFX85	0.32	TIP29C	0.42		
BC177	0.15	BD237	0.40	BFX86	0.30	TIP30C	0.43		
BC178	0.15					TIP31C	0.55		

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A1865/20	65.00	D14-173GR	55.00	M19-103W	55.00	M50-120GV	65.00
AW36-11	25.00	D14-181GH/98	65.00	M23-110GH	55.00	M50-120LC	65.00
CME822W	19.00	D14-181GJ	55.00	M23-112GM	55.00	M61-120W	75.00
CME822GH	25.00	D14-181GM	53.00	M23-112GV	55.00	S6AB	45.00
CME1428GH	45.00	D14-181GM50	59.00	M23-112GW	55.00	SE4/D-P7	45.00
CME1428W	39.00	D14-182GH	59.00	M23-112KA	55.00	SE42BP31AL	55.00
CME1523W	39.00	D14-200BE	89.00	M23-112LD	55.00	SE42BP31	55.00
CME1431GH	39.00	D14-200GA/50	65.00	M24-120GM	59.00	SF5Fp31	55.00
CME1431W	39.00	D14-200GH	75.00	M24-120LC	59.00	T937	65.00
CME202GH	45.00	D14-210GH	75.00	M24-120WAR	59.00	T948N	65.00
CME2024W	45.00	D14-270GH/50	75.00	M24-121GH	55.00	T948H	65.00
CME2325W	45.00	D14-310W	110.00	M28-12GH	55.00	V4150LC	55.00
CME3128W	45.00	D14-320GH/82	85.00	M28-13LC	49.00	V5004GR	59.00
CME3132GH	45.00	D14-340GH/KM	45.00	M28-13LG	49.00	V5004LD	59.00
CME3155W	45.00	D14-340KA	45.00	M28-13GR	49.00	V6001GH	65.00
CRE1400	25.00	D16-100GH	65.00	M28-131GR	55.00	V6007DP31	59.00
CV429	89.00	D16-100GH/65	69.00	M28-133GH	55.00	V6008GH	59.00
CV1450	35.00	D16-100GH/67	65.00	M31-101GH	55.00	V6034WA	59.00
CV1526	19.00	D16-100GH/79	69.00	M31-182GR	55.00	V604CLA	59.00
CV2185	15.00	D16-100GH97	65.00	M31-182GV	53.00	V6048J	49.00
CV2191	19.00	D18-160GH	69.00	M31-184W	65.00	V6052GR	65.00
CV2193	15.00	D21-10GH	65.00	M31-184GH	65.00	V6064BP31	55.00
CV5119	85.00	DB7 36	35.00	M31-184P31	65.00	V6064CLA	55.00
CV5320	85.00	DB7 36	55.00	M31-186W	69.00	V6069GH	55.00
CVX389	55.00	DG7 5	55.00	M31-190GH	55.00	V6070P31	49.00
D9-110GH	39.50	DG7 32	45.00	M31-190GR	55.00	V7016A	65.00
D10-210GH	45.00	DH3 91	55.00	M31-190LA	55.00	V7030	59.00
D10-210GH68B	65.00	DH7 91	45.00	M31-191GV	55.00	V7031GH	59.00
D10-230GH	35.00	DP7 5	35.00	M31-220W	59.00	V7031/67A	59.00
D10-230GM	35.00	DP7 6	35.00	M31-270GY	65.00	V7035A	49.00
D10/293GY/90	55.00	DN13 78	35.00	M31-271P31	65.00	V7037GH	45.00
D13-30GH	49.50	F16-101GM	75.00	M31-271GW	65.00	V8004GR	65.00
		F16-101LD	75.00	M31-271W	65.00	V8006GH	65.00
D13-47GH/26	69.00	F21-130GR	75.00	M36-141W	75.00	V8010A	65.00
D13-47GH	55.00	F21-130LC	75.00	M36-170LG	75.00	VCR139A	11.50
D13-51GL/26	85.00	F31-10GM	75.00	M38-103GR	65.00	2BP1	13.50
D13-51GM/26	85.00	F31-10GR	75.00	M38-120W	65.00	3BP1	11.50
D13-450GH/01	55.00	F31-10LC	75.00	M38-120WA	65.00	3DP1	11.50
D13-471GH/26	55.00	F31-10LD	75.00	M38-121GHR	65.00	4EP1	30.00
D13-600GM	59.00	F31-12LD	75.00	M38-121LA	65.00	3HYOBM	55.00
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D13-611GH	59.00	F31-13LD	75.00	M38-140LA	65.00	5BP1	9.00
D13-611GM	59.00	F31-13LG	75.00	M38-142LA	65.00	5BHP1	30.00
D13-630GH	59.00	F41-123LC	185.00	M38-341P31	65.00	5BHP1FF	30.00
D14-150GH	75.00	F41-141LG	185.00	M38-344P39	65.00	5BHP31	30.00
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D14-172GR	55.00	M14-100GM	45.00	M44-120LC	65.00	13BP1	13.50
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D14-173GH	55.00	M17-151GVR	175.00	M50-120GH	65.00	17DWP4	25.00
D14-173GM	53.00	M17-151GR	175.00	M50-120GR	65.00	32J-1085	69.00
						88D/88B/89D/89L	15.00
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BA148	0.17	BY299-800	0.22	1N23WE	2.95
BA154	0.06	BYX10	0.20	IN4001	0.04
BA156	0.15	BYX36-150R		IN4003	0.04
BA157	0.30		0.20	IN4004	0.05
BAX13	0.04	BYX38-600R		IN4005	0.05
BAX16	0.06		0.60	IN4007	0.06
BB105B	0.30	BYX55-600	0.30	IN4148	0.02
BT151	0.79	BYX71-600	1.10	IN4448	0.10
BY126	0.10	BZX61	0.15	IN5401	0.12
BY127	0.11	BZY88	0.10	IN5402	0.14
BY133	0.15	BZY95C30	0.35	IN5403	0.12
BY164	0.45	CS4B	4.50	IN5406	0.13
BY176	1.20	CS10B	8.45	IN5407	0.16
BY179	0.63	OA47	0.09	IN5408	0.18
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C6A 9.00
C1112G 70.00
C1108 65.00
C1134 32.00
C1148A 115.00
C1150/1 135.00
C1534 32.00
CCA 2.60
CC3L 0.90
CL33 2.00
CV Nos Prices on request
D3a 29.50
D63 1.20
DA41 22.50
DA42 17.50
DA90 4.50
DA100 125.00
DAF91 0.45
DAF91 0.70
DAF96 1.00
DC70 1.75
DC90 1.20
DCX4-1000 12.00
DCX4-5000 25.00
DET16 28.50
DET18 28.50
DET23 35.00
DET24 39.00
DET25 22.00
DF91 0.70
DF92 0.60
DF96 0.65
DF97 1.00
DH63 1.20
DH77 0.90
DH79 0.56
DH149 2.00
DK91 0.90
DK92 1.20
DL35 2.60
DL63 1.00
DL70 2.60
DL73 2.60
DL91 1.50
DL92 0.95
DL93 1.10
DL94 2.60
DL96 2.50
DLS10 13.60
DLS16 10.00
DM70 1.95
DM160 2.75
DY51 1.60
DY86/87 0.65
DY802 0.72
E80CF 11.00
E80F 18.50
E81CC 3.15
E81L 12.00
E82CC 3.50
E83CC 3.50
E83F 5.50
E86C 9.50
E88C 7.95
E88CC 3.80
E88CC Siemens Special 5.95
E90CC 7.95
E90F 7.95
E91H 4.50
E92CC 3.95
E99F 6.99
E130L 25.00
E180CC 9.50
E182CC 9.00
E180F 6.50
E186F 6.50
E188CC 7.50
E280F 19.60
E283CC 10.00
E288CC 13.50
E55L 42.00
E810F 25.00
E1148 1.00
E1524 6.95
EA50 1.00
EA76 1.95
EA79 1.95
EAA91 0.60
EABC80 0.70
EAC91 2.50
EAF42 1.20
EAF801 2.00
EB34 1.50
EB41 3.95
EB91 0.85
EBC33 2.60
EBC41 1.95
EBC81 1.50
EBC90 0.90

EBC91 0.90
EB91 0.60
EBF80 0.65
EBF83 0.65
EBF85 0.95
EBF89 0.70
EBF93 0.95
EBL1 2.50
EBL21 2.00
EC52 0.75
EC70 1.75
EC80 9.50
EC81 7.95
EC86 1.00
EC88 1.00
EC90 1.10
EC91 5.50
EC92 1.95
EC93 1.50
EC95 7.00
EC97 1.10
EC157 439.50
EC8010 12.00
ECC32 3.50
ECC33 3.50
ECC35 3.50
ECC81 1.15
ECC81 Special quality 1.95
ECC82 0.65
ECC82 Mullard 1.50
ECC82 Philips 1.95
ECC83 Siemans 2.50
ECC83
ECC83 Philips 1.95
ECC83 Siemans 2.50
ECC83 Tungsram 1.50
ECC84 0.50
ECC85 0.75
ECC86 2.75
ECC88 0.95
ECC91 2.00
ECC180 0.72
ECC189 1.95
ECC801S 3.50
ECC803S 4.95
ECC804 0.60
ECC2000 12.00
ECF80 1.15
ECF82 1.15
ECF86 2.25
ECF200 1.85
ECF202 1.85
ECF801 0.85
ECF805 2.50
ECF806 10.25
ECH3 2.50
ECH4 3.00
ECH35 3.50
ECH42 1.00
ECH81 0.65
ECH83 0.78
ECH84 0.69
ECH2000 1.50
ECL80 0.60
ECL82 0.65
ECL81 0.55
ECL83 2.50
ECL84 0.74
ECL85 0.69
ECL86 0.80
ECL805 0.69
EF22 2.50
EF37A 2.00
EF39 1.10
EF40 4.50
EF41 3.50
EF42 3.50
EF50 2.50
EF55 4.95
EF70 1.20
EF71 1.50
EF72 1.20
EF73 1.00
EF80 0.55
EF83 3.95
EF85 0.50
EF86 2.25
EF86 Mullard 4.50
EF89 1.50
EF91 1.95
EF92 2.15
EF93 0.95
EF94 0.95
EF95 1.50
EF97 0.90
EF98 0.90
EF183 0.65
EF184 0.65
EF730 1.80
EF731 3.50
EF732 3.50
EF800 11.00
EF805S 13.50
EF812 0.65
EFL200 1.50
EH90 0.72
EK90 9.95
EL32 0.95
EL33 4.00
EL34 2.25
EL34 Mullard/Phillips 4.50
EL36 1.95
EL37 9.00
EL38 4.75
EL41 3.50
EL42 2.00
EL81 6.95
EL82 0.58
EL83 5.95
EL84 0.75
EL85 4.50
EL86 0.85
EL90 2.15
EL91 6.00

EL95 1.75
EL153 12.15
EL183E 3.50
EL183P 3.50
EL500 1.40
EL504 1.40
EL509 5.25
EL519 6.95
EL802 3.65
EL821 8.50
EL822 12.95
EM1 9.00
EM4 9.00
EM80 0.70
EM81 0.70
EM84 1.65
EM85 3.95
EM87 2.50
EN32 16.50
EN91 1.50
EN92 4.50
ESU150 14.95
ESU872 25.00
EY51 0.80
EY81 2.35
EY83 1.50
EY84 5.95
EY86/87 0.50
EY88 0.55
EY91 5.50
EY500A 1.50
EY802 0.70
EZ35 0.75
EZ40 2.75
EZ41 2.15
EZ80 0.75
EZ81 0.75
EZ90 1.50
F6064 2.95
FW4/800 2.95
G55/1K 9.00
G180/2M 6.95
G232 Mullard 3.95
G240/2D 9.00
GC10B 17.50
GC10D 17.50
GC10/4B 17.50
GC12/4B 17.50
GD86W 6.00
GDT120M 5.00
GN4 6.00
GN10 15.00
GR10G 4.00
GS10C 16.50
GS10H 12.00
GS12D 12.00
GT1C 14.00
GT1C S/S 13.00
GTE175M 8.00
GTR150W 1.00
GU20 35.00
GXU1 13.50
GXU3 24.00
GXU50SS 14.50
GY501 1.20
GY802 1.00
GZ30 1.00
GZ32 1.00
GZ33 4.50
GZ34 2.15
GZ37 4.50
HAA91 1.00
HABC80 0.90
HBC90 0.75
HBC91 0.80
HF93 0.75
HF94 1.50
HK90 1.06
HL2K 4.95
HL23DD 4.00
HL90 0.70
HL92 1.50
H133/DD 3.50
HR2 4.00
HY90 1.00
HVR2 3.00
K3118 86.00
KR6/3 45.00
KT8C 7.00
KT33C 3.50
KT36 2.00
KT44 4.00
KT45 4.00
KT61 4.00
KT63 2.00
KT66/CV1075 special yellow ssss pot 19.50
KT66USA 9.95
KT77 Gold Lion 10.95
KT81 7.00
KT88USA 10.95
KT88 Gold Lion 18.95
KTW61 2.50
KTW62 2.50
KTW63 2.00
KTZ63 2.50
L102/2K 6.95
L120/2K 12.00
LB7-20 95.00
LS9B 6.95
M502A 60.00
M537A 60.00
M5143 155.00
M8079 6.00
M8082 7.50
M8083 3.25
M8091 7.50
M8096 3.00
M8098 5.50
M8099 5.00
M8100 5.50
M8136 7.00
M8137 7.95
M8161 6.50
M8162 5.50

M8163 5.50
M8190 4.50
M8195 6.50
M8196 5.50
M8204 5.50
M8223 4.50
M8224 2.00
M8225 3.50
ME1401 29.50
ME1402 29.50
ME1501 14.00
MH4 3.50
MHLD6 4.00
ML4 4.50
MS4B 5.50
MU14 3.50
N37 12.50
N78 9.85
OA2 0.85
OA2WA 2.50
OA3 2.50
OB2 0.85
OB2WA 2.50
OC2 2.50
OC3 1.50
OD3 1.70
OM4 1.00
OM5B 3.00
QM6 1.75
ORP43 2.50
ORP50 3.95
P61 2.50
P41 2.50
PABC80 0.50
PC86 0.75
PC88 0.75
PC92 3.50
PC97 1.10
PC800 1.10
PC900 1.25
PCC84 0.40
PCC85 0.54
PCC88 0.70
PCC89 0.70
PCC189 0.70
PCC805 0.70
PCC806 0.80
PCE82 0.80
PCF80 0.65
PCF82 0.60
PCF84 0.65
PCF86 1.20
PCF87 0.40
PCF200 1.80
PCF201 1.80
PCF800 0.40
PCF801 1.35
PCF802 0.60
PCF805 1.25
PCF806 1.00
PCF808 1.25
PCH200 1.50
PCL82 0.85
PCL83 2.50
PCL84 0.75
PCL85 0.80
PCL86 0.85
PCL800 0.80
PCL805 0.90
PD500 3.50
PD510 3.65
PEN25 2.00
PEN40DD 2.50
PEN45 3.00
PEN45DD 3.00
PEN46 2.00
PEO5-25 39.50
PEO5-40N 42.50
PFL200 0.95
PL21 2.50
PL36 0.95
PL38 1.50
PL81 0.72
PL81A 0.72
PL82 0.60
PL83 0.52
PL84 0.78
PL88 1.00
PL95 1.75
PL302 1.00
PL345 12.50
PL500 0.95
PL500 1.10
PL504 1.15
PL508 1.75
PL509 4.85
PL519 4.95
PL802T 3.50
PL820 2.95
PL5557 29.50
PL5727 2.50
PY32 0.60
PY33 0.50
PY81 0.70
PY82 0.70
PY83 0.70
PY88 0.66
PY500A 1.95
PY800 0.79
PY801 0.79
QB3-300 54.95
QB5-1750 139.50
QBL5-3500 495.00
QEO3-10 4.95
QE08-200 £145.00
QF40 65.00
QP25 1.00
QQEO2/5 19.50
QQEO3-12 7.95
QQEO3-20 35.00
QQEO6/40 45.00
QQVO2-6 19.50
QQVO3-10 Mullard 15.00
QQV03-10 5.50

QQVO3-20A 25.00
QQVQ3-20B 32.00
QQVO6-40A 27.50
QQVO7-50 63.50
QQZO3-20 42.50
QS75/20 1.50
QS75/40 3.00
QS92/1D 6.00
QS95/10 4.85
QS108/45 4.00
QS150/15 6.95
QS150/30 1.15
QS150/45 7.00
QS1200 3.95
QS1202 3.95
QS1203 4.15
QS1205 3.95
QS1206 3.95
QS1206 1.05
QS1207 0.90
QS1208 0.90
QS1209 3.15
QS1210 1.50
QS1211 1.50
QS1212 3.20
QS1213 5.00
QS1215 2.10
QS1218 5.00
QU37 9.50
QU37 11.50
QVO3-12 4.95
QVO5-25 1.75
QVO6-20 29.50
QV2-250C 45.00
QVO8-100 145.00
QY3-125 65.00
QY4-250 70.00
QY4-400 76.00
R10 4.00
R16 12.00
R17 1.50
R18 2.50
R19 2.50
R20 1.20
R1169 55.00
RG1-125 4.95
RG1-240A 14.50
RG3-250A 3.50
RG3-1250A 35.00
RK2K25 62.50
RK-20A 12.00
RL16 1.50
RPL16 12.00
RPY13 2.50
RPY43 2.50
RPY82 2.50
RR3-250 15.00
RR3-1250 35.00
RS613 45.00
RS685 54.95
RS688 52.15
S6F17 5.95
S6F33 29.95
S11E12 38.00
S30/2K 10.00
S104/1K 10.00
S109/1K 15.00
S130 5.95
S130/P 5.95
SC1/800 5.00
SC1/1100 6.00
SC1/1200 5.00
SC1/1300 6.00
SC1/2000 9.00
SD6000M 45.00
SP4B 4.95
SP41 5.00
SP42 3.00
SS501 35.00
ST11 1.50
STV280/40 11.95
STV280/80 19.95
SU42 4.95
TB2.5/300 85.00
TB2-300 45.00
TB3 2000 395.00
TBL-2-300 275.00
TBL2-500 395.00
TD03 10E 40.00
TD1-100A 25.00
TD3-12 4.00
TP25 1.50
TSP4 7.00
TT11 1.50
TT21 45.00
TT22 45.00
TT100 57.00
TTR-31MR 65.00
TY2-125A 85.00
TY4-400 85.00
TY8-600W 365.00
TYS2/250 375.00
U18-20 2.75
U19 11.95
U24 2.00
U25 0.90
U26 0.90
U37 9.00
U41 6.95

U50 2.00
U82 3.00
U191 0.70
U192 1.00
U193 0.65
U251 1.00
U801 0.75
UABC80 0.65
UAF42 1.00
UBF80 0.60
UBC41 2.95
UBC81 1.50
UBF89 0.60
UBL21 1.75
UC92 1.20
UCC84 0.70
UCC85 0.60
UCF80 1.00
UCH21 1.20
UCH41 2.50
UCH42 2.50
UCH81 0.65
UCL82 1.75
UCL83 2.50
UF85 1.20
UF41 1.15
UF42 1.15
UF80 0.80
UF89 2.50
UL44 3.50
UL84 0.85
UU5 3.50
UU7 8.00
UU8 9.00
UY41 3.50
UY85 0.70
V235A/1K 250.00
V240C/2K 225.00
V241C/1K 195.00
V246A/2K 315.00
V339 3.50
VLS631 10.95
VP133 2.00
VR75/30 3.00
VR101 2.00
VR105/30 1.50
VR150/30 1.15
VT52 2.50
VU29 4.50
VU39 1.50
W77 5.00
W729 1.00
W739 1.50
X24 1.00
X66/X65 4.95
X76M 1.95
XC24 1.50
XC25 0.50
XFW47 1.50
XFW50 1.50
XG5-500 22.50
XL 1-5V 1.50
XL628FT 7.50
XNP12 2.50
XR1-1600A 49.50
XR1-3200A 79.50
XR1-6400A 99.50
Y65 6.95
Y503 25.00
Y602 12.00
Y4070 130.00
YD1100 75.00
YJ1060 265.00
YL1000 9.50
YL1020 29.00
YL1030 59.50
YL1060 95.00
YL1070 195.00
YL1071 195.00
YL1290 59.50
Z77 1.20
Z303C 9.00
Z359 9.00
Z505S 15.00
Z520M 4.00
Z521M 8.00
Z700U 3.00
Z749 0.60
Z759 19.95
Z800U 3.00
Z803U 18.95
Z900T 9.50
ZA1000 12.50
ZA1001 1.50
ZA1002 1.50
ZC1040 8.00
ZM1005 8.00
ZM1020 8.95
ZM1021 8.00
ZM1023 7.95
ZM1041 14.00
ZM1082 9.00
ZM1084 10.00
ZM1177 9.00
ZM1202 55.00
ZM1263 4.00
ZM1612 3.00
1A3 4.50
1AC6 1.20
1B3GT 1.95
1B22 10.00
IB27 55.00
1B35A 29.50
1C5GT 2.50
1FD1 2.50
1G3GT 2.50
1K3GT 2.50
1N1 4.50
1N2 4.50
1P28 25.00
1N5GT 2.50
1P28 25.00
1S2 0.55
1S5 0.70
1T4 0.70
1U5 1.00
1X2B 1.40
1Z2 8.95
2AS15A 11.50
2B22 69.50

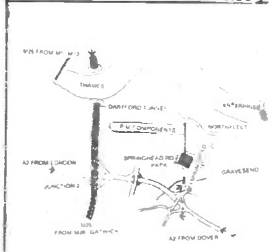
2C39A 29.50
2C39BA 29.50
2C40 37.00
2C42 29.50
2C51 0.75
2CY5 1.50
2B7 1.50
2D21 1.50
2D21W 2.50
2E22GY 45.00
2E26 7.95
2J42 93.00
2K25 27.50
2K25 Ray 75.00
2K26 95.00
2K29 250.00
2K56 250.00
3A108A 9.00
3A/107B 12.00
3A/109B 11.00
3A/110B 12.00
3A/141K 11.50
3A/147J 7.50
3A/167M 10.00
3A2 3.95
3A3A 3.95
3A4 1.10
3AL5 0.95
3AT2 3.35
3AU6 0.65
3B2 3.00
3B4 7.00
3B7 4.50
3B24 10.00
3B26 24.00
3B28 12.00
3BZ6 1.50
3C4 2.50
3C45 24.00
3CB6 1.50
3CN3A 2.50
3CS6 0.95
3CY5 1.50
3CX3 2.50
3D6 4.50
3D21A 29.50
3E22 49.50
3EH7 1.95
3EJ7 1.95
3W4GT 2.50
4B32 35.00
4B551B 115.00
4BQ7A 1.75
4BZ6 1.95
4-65A 59.00
4-125A 72.50
4-250A 79.50
4-400A 87.50
4C27 25.00
4C28 25.00
4CB6 1.95
4CX250B 49.00
4CX250B EIMAC £59.50
4CX250BM 75.00
4CX250K EIMAC 95.00
4CX350A 95.00
4CX350F 79.50
4CX1500B 398.50
4GS7 2.25
4GV7 2.25
4JC6A 2.95
4J52 75.00
4KT6 1.50
4X150A 35.00
5A/102D 9.50
5A152M 9.00
5A163K 10.00
5A170K 6.25
5A-206K 10.00
5A-180M 9.00
4AM8 4.15
5AM8 2.15
5AN8 1.20
5AR4 2.00
5AU4 1.50
5B.110M 10.00
5B-254M 14.50
5B-255M 19.50
5B255M 19.50
5B/256M 9.00
5B-257M 9.00
5B-258M 14.50
5C22 125.00
5R4GB 3.50
5R4GY 3.50
5T4 5.95
5U4G 2.95
5U4GB 3.50
5V4G 1.25
5Y3GT 1.95
5Z4GT 0.85
6/30L2 0.70
6A/203K 9.00
6A7 4.95
6A8G 1.50
6AC7 2.00
6AF4A 2.50
6AG5 1.50
6AG7 1.95
6AH6 2.50
6AJ4 2.00
6AJ7 2.00
6AK5 1.50

6AK6 2.50
6AL5 0.60
6AM4 3.25
6AM5 6.00
6AM6 1.50
6AN5 2.65
6AN8A 2.65
6AQ5 2.15
6AQ8 0.85
6AR5 5.95
6AR8 3.95
6AS5 1.50
6AS6 2.50
6AS7G 4.50
6AT6 0.75
6AT8 1.75
6AU4 2.00
6AU6 0.95
6AV6 0.75
6AW8A 2.50
6AZ8 5.95
6B7 2.80
6B8G 1.50
6BA6 0.95
6BA7 4.50
6BA8A 3.50
6BC8 1.00
6BE6 0.72
6BG6G 3.00
6BH6 1.95
6BH8 1.50
6BJ6 1.20
6BK4 4.00
6BK7A 1.95
6BL8 1.15
6BM8 0.58
6BN4 1.65
6BN6 1.65
6BN7 4.50
6BN8 3.95
6BQ5 0.75
6BQ7A 0.72
6BL7GTA 3.95
6BL8 1.15
6BR5 0.70
6BR7 4.95
6BR8 2.15
6BR8A 2.15
6BS7 5.50
6BW4 1.50
6BW6 5.35
6BW7 1.50
6BW8 4.00
6BX6 0.48
6BX7GT 3.50
6BZ6 2.50
6BZ7 2.95
6C4 1.10
6C5 1.95
6C6 2.50
6C8G 1.50
6C11 2.50
6C18 2.50
6CA4 4.95
6CA7 3.50
6CB5 3.95
6CB6 1.95
6CD6GA 4.60
6CF6 1.50
6CG7 2.25
6CH6 6.95
6CL3 3.95
6CL6 3.95
6CL8A 2.00
6CM5 1.60
6CM7 2.95
6CS6 0.75
6CS7 0.95
6CW4 6.50
6CY5 1.00
6CY7 2.95
6D6 2.95
6DC6 2.95
6DJ8 0.95
6DK6 1.15
6DQ5 5.95
6DQ6B 2.50
6DW4 2.15
6EA4 4.95
6EA7 2.50
6EB8 2.50
6EH7 1.75
6EM5 2.50
6EM7 2.50
6EU7 £1.95
6EU8 1.75
6EV7 2.95
6EW6 1.50
6F1 2.00
6F5 4.95
6F7 5.50
6F6G 2.00
6F12 1.50
6F13 3.00
6F14 1.00
6F17 2.75
6F21 2.50
6F23 0.60
6F24 1.25
6F25 1.25
6F28 1.25
6F32 1.25
6F33 17.00
6FH8 12.50
6G6G 5.50
6GH8A 0.80

6GK5 1.50
6GK6 1.95
6GM6 0.95
6GS7 2.15
6GV7 2.50
6GW8 0.80
6H1 9.50
6H3N 1.10
6H6 1.95
6H6GT 1.95
6HB7 0.95
6HF5 5.50
6HF8 2.50
6HS6 4.95
6HS8 1.95
6HZ6 2.65
6J4 2.15
6J4WA 3.15
6J5 2.50
6J6 2.05
6JB6A 3.95
6JE6C 5.50
6JM6 3.95
6JS6C 4.95
6JU8 2.50
6J7 2.50
6K7G 2.00
6K8Y/G 3.00
6KD6 5.95
6KM8 2.50
6KT8 2.95
6KZ8 1.95
6L1 2.50
6L19 3.95
6L6GC 2.95
6L6GC (GE) 4.95
6L6GT 1.95
6LD20 1.15
6LF6 7.50
6LJ8 2.50
6LQ6 5.50
6L15 3.15
6MJ6 4.95
6N7 2.50
6N7GT 2.50
6P15 1.50
6P25 4.00
6P26 4.00
6P28 2.00
6Q7 1.75
6Q7GT 1.20
6R7G 3.15
6S4A 1.50
6SA7GT 1.35
6SC7 1.50
6SG7 2.50
6SH7 1.35
6SJ7GT 1.35
6SK7 1.35
6SK7GT 1.35
6SL7GT 0.85
6SN7GT 1.35
6SQ7 1.35
6SS7 1.95
6U4GT 1.75
6U8 1.15
6U8A 1.60
6V6GT 1.50
6X2N 1.00
6X4 1.50
6X5GT 1.00
6X5GTY 1.00
6X8A 2.25
7A6 4.50
7A7 2.00
7AD7 1.75
7AU7 1.60
7B6 3.50
7B7 2.50
7C6 2.50
7E7 2.50
7J7 5.50
7V7 4.15
7Y4 2.50
8B10 2.50
8BQ5 1.95
8D8 2.50
8EQ7 1.95
8298A 8.50
85A8 1.50
10D2 1.25
10DE7 2.50
10F1 0.75
10GK6 1.95
10P14 2.50
10P18 0.70
10LD12 0.65
11E3 55.00
12A6 3.95
12AD6 1.50
12AG8 1.50
12AL5 1.00
12AT6 0.95
12AT7 1.15
12AT7WA 2.50
12AU6 1.95
12AU7 0.65
12AV6 1.95
12AX4GT 1.00
12AX7 0.65
12AX7WA 2.50
12AY7 3.95
12AZ7A 1.95
12B4A 4.50
12BA6 1.50
12BE6 1.95

12BH7A 2.50
12BL6 1.75
12BY7A 2.75
12CA5 1.95
12CX6 1.20
12DQ6B 3.50
12DW4A 3.50
12DW7 2.50
12E1 17.95
12E14 38.00
12GN7 4.50
12HG7A 4.50
12J7GT 3.50
12K5 1.95
12K7GT 1.50
12K8 1.95
12SA7GT 1.95
12SG7 4.75
12SH7 1.95
12SK7 1.95
12SJ7 1.50
12SN7GT 1.85
12SQ7GT 1.95
12SR7 2.50
13D3 3.20
13D7 3.20
13D7 3.20
13D9 3.20
13DR7 2.95
13E1 145.00
13EM7 3.50
14S7 1.95
7BR3 3.95
17EW8 0.95
17DW4 2.50
17DW4A 2.95
17JZ8 4.50
18D3 6.00
19AQ5 3.50
19AU4GT 2.50
19G3 17.00
19H5 33.50
19Q6 9.00
20A2 10.50
30D1 0.70
20LF6 3.50
20L1 0.95
20P1 0.55
20P3 0.60
20P4 1.95
20P5 1.15
21JZ6 3.15
21LU8 2.50
24B1 39.50
24B9 39.50
25L6GT 1.75
25BQ6 1.75
29C1 19.50
29KQ6 6.50
30C17 0.40
30C18 1.48
30F5 0.95
30FL1 1.00
30FL2 1.35
30FL12 0.95
30FL13 1.10
30FL14 1.25
30L1 0.45
30L15 0.60
30L17 0.80
30P4MR 1.00
30P12 1.00
30P18 0.60
30P19 1.00
30PL1 2.50
30PL13 0.60
30PL14 1.75
31JS6A 5.50
33A/158M 19.50
35A5 4.50
35L8GT 2.00
35W4 0.70
35Z3 1.85
38HE7 4.50
40KD6 5.50
42 6.95
47 6.00
50A5 1.50
50C5 0.95
50CD6G 1.15
50EH5 1.50
52KU 2.00
53CG 15.00
60B5 1.00
60JY6 2.96
61SPT 4.50
75B1 3.50
75C1 2.50
83 8.50
83AI 9.00
84 3.00
85A1 6.50
86A2 1.50
90AV 10.00
92AG 19.50
92AV 12.50
95A1 6.50
108C1 1.50
150B2 6.95
150C2 1.50
150C4 2.15
185T 1.50
274A 15.00
307 5.00
328A 15.00
388A 17.50

404A 10.95
425A5 8.00
431U 4.50
572B 65.00
5636 1.50
6146A 7.50
6158 3.20
6386 14.50
6883B 9.95
6973 5.95
705A 8.00
706A 8.00
715C 45.00
725A 275.00
7527 89.50
7703 395.00
603 14.95
605 39.00
807 1.95
810 85.00
811A 15.00
813 23.50
829B 14.50
832A 14.50
833A 95.00
866A 4.50
872A 25.00
873 60.00
884 5.50
927 15.00
930 9.95
931A 17.50
954 1.00
958A 1.00
1299A 0.60
1619 2.50
1625 3.00
1626 3.00
1927 25.00
2050 3.95
2050W 4.50
3545 4.00
4313C 4.00
4328D 9.00
5642 9.50
5651 2.50
5654 1.95
5663 1.95
5670 3.25
5672 4.50
5687 4.50
5692 3.50
5696 3.50
5704 3.50
5718 6.15
5725 2.50
5726 1.50
5727 1.95
5749 2.50
5750 1.85
5751 2.95
5763 4.95
5814A 3.25
5829WA 6.50
5840 3.50
5842 11.00
5847 10.95
5879 8.50
5886 13.95
5894 39.50
5899 4.50
5963 2.00
5965 2.25
6005 1.85
6012 16.00
6021 3.65
6057 2.50
6058 3.95
6060 2.25
6062 4.50
6063 2.00
6064 2.95
6067 1.95
6072 4.20
6080 7.95
6132 10.00
6146B 9.50
6688 6.50
6887 9.50
6080 7.95
6080WA 9.50
6096 5.50
6132 10.00
6136 2.50
6146B 8.95
6157 2.50
6201 6.45
6211 2.50
6267 2.25
6350 3.50
6688 6.50
6870 11.50
6887 9.50
6873 4.50
7189 3.50
7199 6.15
7239 17.50
7247 2.95
7360 13.50
7527 85.00
7586 15.00
6591A 4.95
7868 3.95



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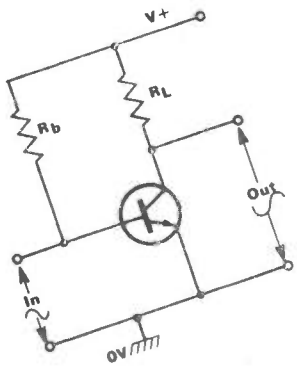


CAD

FOR THE ZX SPECTRUM

Design common-emitter amps, op-amp circuits and active filters using a home computer

Bob Nutt G4LIJ

It was my intention to write a program that would help in the design of small signal common-emitter amplifiers. The emphasis was to be on the practical rather than the theoretical aspects. As I went along I decided to include the 741 operational amplifier in my program, so it was a short step from there to go on to active filters.

The program in essence deals with the design of transistor common emitter amplifiers, operational amplifiers and active filters (high, low and band-pass). The program is menu driven and from the menu the user can choose one of the three circuit designs. A circuit diagram is drawn for whichever circuit is chosen, and the values of the components are worked out after some basic parameters are supplied following prompts.

Filter selection

In the case of the active filters the response curves are drawn for each type of filter. The user is then asked for the type of filter wanted, and the program goes on to draw the appropriate circuit. After this the user has only to supply an arbitrary value for R and a −3dB cut-off frequency and the program will compute the value for C. Values for C are given in terms of pF, nF and μF.

In the same way both the op-amp design and transistor design values for R are given in megohms, kilohms etc.

Program notes

The program entry is rather tedious due to the many plot and draw statements, so care must be exercised when keying in.

Lines 15-25 set up the array which stores the ohms, kilohms and megohms strings.

Line 30 calls the subroutine at line 6000 which sets up the User Defined Graphics used when drawing the circuits. The user graphics 'A' to 'O' are used.

Line 35 calls the menu.

Lines 45-490 draw the circuit and do the mathematics of the transistor design, printing out the values for the different components.

This is followed by the menu at lines 1000-1100 which offers the choice of the design.

Lines 1500-1890 are concerned with the op-amp design and also give some relevant design information concerning operating parameters.

Moving on through the program, lines 2000-2215 draw the circuit of the low-pass filter and lines 2500-2575 draw the circuit diagram of the high-pass filter.

General information is given by lines 3000-3045 concerning the filters. The program goes on to draw the response curves of the three different types of filters via lines 3050-3255. From line 3300 onwards the program computes the value for C in the high and low filters given a starting value for R and a cut-off frequency.

Finally the user is given the option of trying different values of R and frequency before returning to menu.

Lines 6000-6070 are the machine code loader and data lists for the User Defined Graphics.

Rough & ready rules, OK?

Finally, remember that the results given in this program may not satisfy the purist but rather will enable you to 'knock something up' that will work and so get you on the way.

Happy experimenting! REW

```
  1 REM Computer Aided Design
MAY 1985
  3 REM By BOB NUTT :- G4LIJ
 10 BORDER 6: INK 1
 15 DIM p$(3,7)
 20 LET p$(1)=" Ohms  "
 21 LET p$(2)=" K Ohms"
 22 LET p$(3)=" M Ohms"
 25 PRINT AT 10,2;"LOADING GRAPHICS PLEASE WAIT"
 27 STOP
 30 GO SUB 6000
 35 GO TO 1000: REM MENU
 40 REM * TRANSISTOR DESIGN *
 45 CLS : PRINT '''''   Enter Transistor Type'
 47 INPUT " NPN  or PNP  (N/P)?   ";a$: IF CODE a$=78 OR CODE a$=110 OR CODE a$
=110 OR CODE a$=80 THEN  PRINT AT 10,8: FLASH 1;a$;" chosen": PAUSE 75: GO TO 50
 48 GO TO 47
 50 CLS
 52 REM CCT DIAG TRANS AMP
 53 IF a$(  TO 1)="N" OR a$(  TO 1)="n" THEN  GO SUB 113
 54 IF a$(  TO 1)="P" OR a$(  TO 1)="p" THEN  GO SUB 117
 55 PRINT AT 10,5;"CB";AT 8,19;"CF"
 57 PRINT AT 11,6;"RI": PRINT AT 9,19;"RI"
 59 PRINT AT 15,19;"N";AT 16,19;"O"
 61 PRINT AT 6,10;"L";AT 7,10;"M"
 63 PRINT AT 14,10;"A";AT 15,10;"M"
 65 PRINT AT 6,17;"A";AT 7,17;"P"
 67 PRINT AT 14,17;"A";AT 15,17;"M"
 69 PLOT 40,151: DRAW 160,0: PRINT AT 2,22;"Vcc"
 71 PLOT 40,25: DRAW 160,0: PRINT AT 19,23;"0V"
 73 PLOT 84,47: DRAW 0,-21
```

```
 75 PLOT 140,47: DRAW 0,-21
 77 PLOT 156,39: DRAW 0,-13
 79 PLOT 84,64: DRAW 0,46
 81 PLOT 140,64: DRAW 0,15: DRAW -12,0
 83 PLOT 156,56: DRAW 0,14: DRAW -14,0
 85 PLOT 84,64: DRAW 0,47
 87 PLOT 84,151: DRAW 0,-23
 89 PLOT 140,151: DRAW 0,-23
 91: PLOT 140,112: DRAW 0,-18: DRAW -12,0
 93 PLOT 152,100: DRAW -12,0
 95 PLOT 167,100: DRAW 10,0
 97 PLOT 64,84: DRAW 20,0
 99 PLOT 86,87: DRAW 25,0
101 CIRCLE 44,84,3: PRINT AT 12,3;"1/P"
103 CIRCLE 179,100,3: PRINT AT 7,22;"O/P"
105 PRINT AT 6,7;"R1";AT 14,7;"R2";AT 6,15;"RL";AT 14,15;"Re";AT 15,20;"Ce"
107 PRINT AT 21,0; FLASH 1;" DRAW CCT FOR REF ": PRINT #1;" Press Enter to Cont
inue"
109 IF CODE INKEY$=13 THEN  GO TO 300
111 GO TO 109
113 PRINT AT 1,1;" NPN ": PRINT AT 10,14;"ß";AT 11,14;"CD"
115 RETURN
117 PRINT AT 1,1;" PNP ": PRINT AT 10,14;"ß";AT 11,14;"CE"
119 RETURN
121 STOP
300 CLS : PRINT AT 3,8;"DESIGN PARAMETERS"
310 PRINT AT 6,1;"1) SUPPLY Vcc  "
320 PRINT AT 8,1;"2) CURRENT GAIN hfe "
330 PRINT AT 10,1;"3) COLLECTOR CURRENT IN MA (IC) "
340 PRINT AT 12,1;"4) SILICON OR GERMANIUM "
342 PRINT AT 14,1;"5) LOWEST FREQ USED "
345 PRINT #0;" Press Enter To Continue"
348 IF CODE INKEY$=13 THEN  GO TO 350
349 GO TO 348
350 CLS : INPUT " Enter Supply Volts Vcc ";Vcc: PRINT '''  Vcc = ";Vcc;"V"
355 INPUT " Enter Current Gain ";hfe: PRINT '''  hfe = ";hfe
360 INPUT "  Collector Current MA  ? ";Ic: PRINT '''  Ic = ";Ic;" MA"
365 INPUT " GERMANIUM OR SILICON G/S ? ";q$
368 IF q$="g" OR q$="G" THEN  LET Vbe=0.25: PRINT '''  GERMANIUM": GO TO 374
370 IF q$="s" OR q$="S" THEN  LET Vbe=0.7: PRINT '''  SILICON": GO TO 374
372 GO TO 368
374 INPUT " LOWEST FREQUENCY IN Hz ";freq: PRINT '''  LOWEST FREQ ";freq ;" Hz"
380 PRINT '''  ARE ALL PARAMETERS CORRECT ? "
383 INPUT " Correct y/n ";z$
385 IF z$="n" OR z$="N" THEN  GO TO 300
387 IF z$="y" OR z$="Y" THEN  GO TO 400
390 GO TO 383
400 LET Ve=Vcc*.15: LET Ic=Ic/1000
401 LET Ib=Ic/hfe
403 LET Ich=Ib*10: LET Re=INT (Ve/Ic)
406 LET VR2=Ve+Vbe: LET R2=INT (VR2/Ich)
408 LET VR1=Vcc-VR2
410 LET R1=INT (VR1/Ich): LET Vc=0.5*(Vcc+Ve)
413 LET RL=INT (Vc/Ic): LET littlere=INT (26/(Ic*1000))
415 LET rin=INT (hfe*littlere)+100: LET Av=INT (hfe*(RL/rin)): LET XC=INT (Re/1
0)
417 LET Ce=INT (1e6*(1/(6.28*freq*XC)))
419 LET Xp=INT (rin/10)
421 LET Cp=INT (1e6*(1/(6.28*freq*Xp)))
423 IF Cp=0 THEN  LET Cp=(1e6*(1/(6.28*freq*Xp))): LET Cp=INT (Cp*1000): LET Cp
=Cp/1000
428 IF Ce=0 THEN  LET Ce=(1e6*(1/(6.28*freq*Xc))): LET Ce=INT (Ce*1000): LE
T Ce=Ce/1000
430 CLS
434 PRINT
435 LET x=R1: GO SUB 480: PRINT " R1 = ";x;p$(w)
440 LET x=R2: GO SUB 480: PRINT " R2 = ";x;p$(w)
445 LET x=RL: GO SUB 480: PRINT " RL = ";x;p$(w)
450 LET x=Re: GO SUB 480: PRINT " Re = ";x;p$(w)
455 PRINT " Ce = ";Ce;"mf"
456 PRINT " Cp = ";Cp;"mf"
458 PRINT " Voltage Gain = ";Av
460 PRINT " Collector volts = ";Vc
465 PRINT " Emitter volts = ";Ve
467 PRINT " Base Volts = ";VR2
470 PRINT #1;" Press enter to return to menu "
472 IF CODE INKEY$=13 THEN  GO TO 1000
475 GO TO 472
478 GO TO 1000
480 IF x<1000 THEN  LET w=1: RETURN
485 IF x>=1000 AND x<=1e6 THEN  LET x=INT (x/100): LET x=x/10: LET w=2: RETURN
490 IF x>=1e6 THEN  LET x=INT (x/1e5): LET x=x/10: LET w=3: RETURN
1000 CLS
1010 PRINT AT 3,13; INV 1;"MENU"
1020 PRINT '''' 1). TRANSISTOR AMP DESIGN "
1030 PRINT '''' 2). OPERATIONAL AMPLIFIERS"
1040 PRINT '''' 3). ACTIVE FILTERS"
1050 PRINT AT 16,4;" ENTER NUMBER OF CHOICE  "
1060 PRINT #1;" Enter 1,2 or 3 .....  "
1070 IF INKEY$ = "1" THEN  GO TO 45
1080 IF ONKEY$ = "2" THEN  GO TO 1500
1090 IF INKEY$ = "3" THEN  GO TO 3000
1100 GO TO 1070
1499 REM Start of op amp design
1500 CLS : PRINT '''' There are two types of OP AMP  circuit  configurations...
...
1505 PRINT '' 1) NON INVERTING  Output in  Phase with Input.....'
1510 PRINT '' 2) INVERTING  Output antiphase with Input.....'
1515 PRINT '''''  INPUT AMP TYPE"
1520 INPUT " INV or NON INV  (I/N) ";z$
1525 IF z$="i" OR z$="I" THEN  GO SUB 1640
1530 IF z$="n" OR z$="N" THEN  GO SUB 1655
1532 IF CODE z$=105 OR CODE z$=73 OR CODE z$=78 OR CODE z$=110 THEN  GO TO 1535
1533 GO TO 1520
1535 PLOT 120,130: DRAW 38,-30: DRAW -38,-30: DRAW 0,60
1540 PLOT 110,115: DRAW -20,0: PRINT AT 7,10;"  ": PLOT 78,115: DRAW -20,0
1545 PLOT 110,83: DRAW -8,0: DRAW 0,-63
1550 PLOT 40,20: DRAW 170,0: PRINT AT 19,27;"0V"
1555 PLOT 105,115: DRAW 0,32: DRAW 29,0: PRINT AT 3,17;"  ": PLOT 153,147: DRA
W 25,0: DRAW 0,-47
1560 PLOT 169,100: DRAW 30,0
1565 PRINT AT 8,10;"R1";AT 2,17;"R2"
1570 PRINT AT 13,21;"PIN 4= -Ve";AT 14,21;"PIN 7= +Ve"
1573 PRINT AT 21,0;" DRAW cct for ref "
1575 PRINT AT 6,5;"1/P";AT 8,24;"O/P"
1580 PRINT #1 ;" Press Enter to continue "
1582 IF CODE INKEY$=13 THEN  GO TO 1585
1583 GO TO 1582
1585 CLS : PRINT '' Inverting Amp gain is given by  R2/R1"
1590 PRINT '' Non Inverting Amp gain is given by R1+R2/R1"
1593 PRINT '' Rin is approx = to R1 "
1597 PRINT '' DATA FOR 741 OP AMP"
1600 PRINT '' Freqs upto 1kHz max gain =1000"
1605 PRINT " Freqs upto 10KHz gain falls  with increasing freq to 100"
1607 PRINT '' Input gain required... "
1610 INPUT " Gain read ? ";gain
1612 PRINT '' GAIN = ";gain
1615 PRINT '' Input a value for R1 in Ohms"
1620 INPUT " R1 = ? ";R1op: PRINT '' R1 = ";R1op;" Ohms"
1625 PRINT '' Inverting or Non Inverting"
1630 IF INKEY$="i" OR INKEY$="I" THEN  GO TO 1700
1635 IF INKEY$="n" OR INKEY$="N" THEN  GO TO 1800
1637 GO TO 1630
1640 CLS : PRINT AT 7,15;"-";AT 11,15;"+";AT 9,20;"6"
1645 PRINT AT 0,5;"741 INVERTING AMP"
1650 PRINT AT 7,14;"2";AT 11,14;"3";AT 6,17;"4";AT 12,17;"7": RETURN
1655 CLS : PRINT AT 7,15;"+";AT 11,15;"-";AT 9,20;"6"
1660 PRINT AT 0,3;"741 NON INVERTING AMP"
1665 PRINT AT 7,14;"3";AT 11,14;"2";AT 6,17;"4";AT 12,17;"7": RETURN
1700 CLS : PRINT '''' INV AMP CHOSEN": PAUSE 50
1702 LET R2= Gain*R1op
1710 IF R2<1000 THEN  LET w=1
1720 IF R2>1000 AND R2<1e6 THEN  LET R2=INT (R2/100): LET R2=R2/10: LET w=2
1725 IF R2>1e6 THEN  LET R2=INT (R2/1e5): LET R2=R2/10: LET w=3
1730 IF R1op<1000 THEN  LET t=1
1735 IF R1op>1000 AND R1op<1e6 THEN  LET R1op=INT (R1op/100): LET R1op=R1op/10:
LET t=2
1740 IF R1op>1e6 THEN  LET R1op=INT (R1op/1e5): LET R1op=R1op/10: LET t=3
1775 PRINT '' R1 = ";R1op;p$(t)
1780 PRINT '' R2 = ";R2;p$(w)
1785 PRINT '' Gain = ";gain
1790 PRINT #1;" Press enter for Menu"
1795 IF CODE INKEY$=13 THEN  GO TO 1000: REM menu
1797 GO TO 1795
1800 CLS : PRINT '''' NON INV AMP CHOSEN"
1802 LET R2=(gain*R1op)-R1op
1810 IF R2<=1000 THEN  LET w=1
1815 IF R2<=1e6 AND R2>1000 THEN  LET R2=INT (R2/100): LET R2=R2/10: LET w=2
1820 IF R2>1e6 THEN  LET R2=INT (R2/1e5): LET R2=R2/10: LET w=3
1830 IF R1op<=1000 THEN  LET t=1
1845 IF R1op>1000 AND R1op<1e6 THEN  LET R1op=INT (R1op/100): LET R1op=R1op/10:
LET t=2
1850 IF R1op>1e6 THEN  LET R1op=INT (R1op/1e5): LET R1op=R1op/10: LET t=3
1860 PRINT '' R1 = ";R1op;p$(t)
1870 PRINT '' R2 = ";R2;p$(w)
1880 PRINT '' Gain = ";gain
1882 PRINT #1;" Press enter for Menu"
1885 IF CODE INKEY$=13 THEN  GO TO 1000
1890 GO TO 1885
2000 CLS : REM   FILTER SECTION
2010 PRINT
2100 PRINT AT 1,0;" LOW PASS FILTER 12 DBS/OCTAVE "
2105 PRINT AT 3,0;" DRAW CCT FOR REF"
2110 PRINT AT 7,15;"-";AT 11,15;"+";AT 9,20;"6";AT 7,14;"2";AT 11,14;"3";AT 6,17
;"4";AT 12,17;"7"
2115 PLOT 120,130: DRAW 38,-30: DRAW -38,-30: DRAW 0,60
2120 PRINT AT 7,9;"#1";AT 11,9;"FG";AT 11,5;"fG"
2125 CIRCLE 23,83,2: PLOT 25,83: DRAW 14,0: PLOT 55,83: DRAW 16,0: PLOT 87,83: D
RAW 24,0
2130 PLOT 63,83: DRAW 0,33: DRAW 8,0: PLOT 87,116: DRAW 24,0
2135 PRINT AT 14,12;"N";AT 15,12;"O": PLOT 100,83: DRAW 0,-20: PLOT 100,50: DR
AW 0,-20
2140 PLOT 25,30: DRAW 190,0: CIRCLE 23,29,2: PRINT AT 18,27;"0V"
2145 PLOT 169,100: DRAW 43,0: CIRCLE 215,100,2
2150 PLOT 180,100: DRAW 0,35: DRAW -7,0: DRAW 0,-18
2165 PRINT AT 14,3;"1/P";AT 14,25;"O/P"
2170 PRINT AT 10,5;"R";AT 10,9;"R";AT 6,16;"C";AT 15,13;"C/2"
2175 PRINT AT 21,0;" N.B. Pin 4 = -ve...Pin 7 = +ve "
2200 PRINT #0;" Press Enter to continue"
2210 IF CODE INKEY$=13 THEN  RETURN
2215 GO TO 2210
2500 CLS : PRINT AT 1,0;" HIGH PASS FILTER  12DBS/OCTAVE "
2505 PRINT AT 3,0;" DRAW CCT FOR REF"
2510 PRINT AT 7,15;"-";AT 11,15;"+";AT 9,20;"6";AT 7,14;"2";AT 11,14;"3";AT 6,17
;"4";AT 12,17;"7"
2515 PLOT 120,130: DRAW 38,-30: DRAW -38,-30: DRAW 0,60
2520 PRINT AT 7,9;"FF";AT 11,5;"HI";AT 11,9;"HI";AT 14,12;"2";AT 15,12;"M"
2525 CIRCLE 20,84,2: PLOT 22,84: DRAW 18,0: PLOT 56,84: DRAW 15,0: PLOT 86,84: D
RAW 24,0
2530 PLOT 99,84: DRAW 0,-20: PLOT 99,47: DRAW 0,-20
2535 PLOT 62,84: DRAW 0,31: DRAW 9,0
2540 PLOT 88,115: DRAW 22,0
2545 PLOT 23,20: DRAW 190,0: CIRCLE 20,20,2: CIRCLE 215,20,2
2550 PLOT 168,100: DRAW 44,0: PLOT 178,100: DRAW 0,35: DRAW -75,0: DRAW 0,-20: C
IRCLE 214,100,2
2555 PRINT AT 21,0;" N.B. Pin 4 = -ve...Pin 7 = +ve"
2560 PRINT AT 6,10;"R";AT 10,5;"C";AT 10,9;"C";AT 15,10;"2R"
2565 PRINT AT 18,28;"0";AT 14,28;"O/P";AT 14,3;"1/P"
2570 PRINT #0;" Press Enter to continue"
2575 IF CODE INKEY$=13 THEN  RETURN
2580 GO TO 2575
3000 REM  FILTER DESIGN SECTION
3002 CLS
3005 PRINT "   THERE ARE THREE TYPES OF  FILTERS AND EACH HAS A
DIFFERENT RESPONSE CURVE "
3010 PRINT '' 1). HIGH  PASS.."
3015 PRINT '' 2). LOW PASS.."
3020 PRINT '' 3). BAND PASS.."
3025 PRINT '' THIS PROGRAM SHOWS THE DESIGN  OF LOW AND HIGH PASS FILTERS..  B
AND PASS FILTERS CAN BE MADE  BY COMBINING THE TWO"
3030 PRINT '' PRESS ENTER TO CONTINUE"
3035 IF CODE INKEY$=13  THEN  GO TO 3040
3037 GO TO 3035
3040 CLS
```

CAD FOR THE SPECTRUM

```
3045 PRINT "*      HIGH PASS RESPONSE *
3050 PLOT 35,130: DRAW 0,-100: DRAW 150,0
3055 PRINT AT 19,11;"Freq ---)"
3060 PRINT AT 14,1;" Z ": PRINT AT 12,2;"*": PLOT 35,110: DRAW 40,0: DRAW 20,-15
,-PI/3: DRAW 20,-65
3065 PLOT 88,98: DRAW 0,14: PRINT AT 7,10;"Fc"
3067 PRINT AT 15,16;"Pass":AT 16,16;"Band"
3070 PRINT AT 6,15;"THE SHARPNESS OF";AT 7,15;"THE SLOPE SHOWS";AT 8,15;"ATTENUA
TION OF";AT 9,15;"THE FILTER";AT 10,15;"WHERE Fc = ";AT 11,15;"CUT OFF FREQ"
3075 PRINT AT 21,0;" Press Enter to continue"
3080 IF CODE INKEY$=13 THEN  GO TO 3085
3082 GO TO 3080
3100 CLS : PRINT "*      LOW PASS RESPONSE"
3105 PLOT 35,130: DRAW 0,-100: DRAW 150,0
3110 PRINT AT 19,11;"Freq ---)"
3115 PRINT AT 14,1;" Z ": PRINT AT 12,2;"*"
3120 PLOT 100,30: DRAW 20,65: DRAW 40,20,-PI/3: DRAW 20,0
3125 PLOT 135,105: DRAW 0,10
3130 PRINT AT 7,14;"Fc"
3133 PRINT AT 15,6;"Pass";AT 16,6;"Band"
3135 PRINT AT 11,16;"THE SHARPNESS OF";AT 12,16;"THE SLOPE SHOWS ";AT 13,16;"THE
 ATTENUATION";AT 14,16;"OF THE FILTER";AT 15,16;"WHERE Fc = ";AT 16,16;"CUT OFF
FREQ"
3140 PRINT AT 21,0;" Press Enter to continue"
3145 IF CODE INKEY$=13  THEN  GO TO 3150
3147 GO TO 3145
3150 CLS : PRINT "*      BAND PASS RESPONSE"
3155 PLOT 35,130: DRAW 0,-100: DRAW 160,0
3160 PRINT AT 19,11;"Freq ---)"
3165 PRINT AT 14,1;" Z ";AT 12,2;"*"
3170 PLOT 35,110: DRAW 20,0: DRAW 20,-15,-PI/3: DRAW 20,-65
3175 PLOT 130,30: DRAW 15,60: DRAW 20,15,-PI/3: DRAW 30,0
3180 PLOT 65,100: DRAW 0,10: PLOT 155,95: DRAW 0,10
3185 PRINT AT 7,7;"Fc1",AT 7,18;"Fc2"
3187 PRINT AT 12,12;"Pass";AT 13,12;"Band"
3190 PRINT AT 21,0;" Press Enter to continue"
3195 IF CODE INKEY$=13 THEN  GO TO 3200
3197 GO TO 3195
3200 CLS
3205 PRINT "* BAND PASS RESPONSE IS ACHIEVED  BY PUTTING THE TWO TYPES OF     F
ILTERS IN SERIES"
3210 PRINT "* EXAMPLE"
3215 PLOT 45,65: DRAW 30,0: PLOT 75,80: DRAW 30,-15: DRAW -30,-15: DRAW 0,30
3220 PLOT 105,65: DRAW 30,0: PLOT 136,80: DRAW 30,-15: DRAW -30,-15: DRAW 0,30:
PLOT 166,65: DRAW 20,0
3225 PRINT AT 10,5;"HIGH PASS";AT 10,17;"LOW PASS";AT 13,24;"O/P";AT 13,2;"i/P"
3230 PRINT AT 16,9;"Fc1";AT 16,18;"Fc2"
3235 PRINT AT 18,1;" Pass Band =Fc2-Fc1"
3240 PRINT AT 21,0;"where Fc= cut off freq of filter"
3245 PRINT #0;" Press Enter to continue"
3250 IF CODE INKEY$=13 THEN  GO TO 3300
3255 GO TO 3250
3300 REM    MATHS FOR  FILTERS
3305 CLS
3310 PRINT "/* CHOOSE FILTER TYPE *
3315 PRINT "* ENTER"
3320 PRINT "*       1) For Low Pass ccts"
3325 PRINT "*       2) For High Pass ccts"
3330 PRINT #1; FLASH 1;" Enter 1 or 2  "
3333 IF INKEY$<>"1" AND INKEY$<>"2" THEN  GO TO 3333
3337 IF INKEY$="1" THEN  GO SUB 2000
3340 IF INKEY$="2" THEN  GO SUB 2500
3350 CLS : PRINT "/* The Program Computes the value  for C.  Remember the value
s of  R and C change with filter type please refer to the circuit      diagram.."

3355 PRINT "*  CHOOSE A VALUE FOR R"
3360 INPUT " VALUE FOR R IN OHMS ";rr
3365 PRINT "*  R = ";rr;" Ohms"
3370 PRINT "*  CHOOSE A CUT OFF FREQ IN HZ"
3375 INPUT " CUT OFF FREQ ? ";fc
3380 PRINT "*  Fc chosen = ";fc;" HZ"
3385 LET Cf=1/(6.28*rf*fc)
3390 IF Cf>1e-12 AND Cf<1e-9 THEN  LET Cf=INT (Cf*1e12): LET s=1: GO TO 3420
3400 IF Cf>1e-9 AND Cf<1e-6 THEN  LET Cf=INT (Cf*1e9): LET s=2: GO TO 3420
3410 IF Cf>1e-6 THEN  LET Cf=INT (Cf*1e6): LET s=3: GO TO 3420
3420 DIM d$(3,3)
3425 LET d$(1)= " pf": LET d$(2)=" nf": LET d$(3)= " mf"
3430 PRINT "*  Capacitor = ";Cf;d$(s)
3440 PRINT "* WOULD YOU LIKE TRY DIFFERENT     VALUES"
3445 PRINT #0;" TRY AGAIN  (y/n) "
3450 IF INKEY$="y" OR INKEY$="Y" THEN  GO TO 3350
3455 IF INKEY$="n" OR INKEY$="N" THEN  GO TO 1000
3460 GO TO 3450
3998 STOP
5999 REM GRAPHICS FOR CCTS
6000 FOR x=USR "a" TO USR "a"+7
6005 READ a: POKE x,a
6010 NEXT x
6015 DATA 0,0,0,3,3,3,3,3: REM  usr a
6020 DATA 0,2,4,8,16,32,64,128: REM usr b
6025 DATA 255,3,3,3,3,0,0,0: REM usr c
6030 DATA 128,64,32,20,12,60,2,1: REM usr a,b,c,d = npn transistor
6035 DATA 128,64,60,48,40,36,2,1: REM usr a,b,c,e pnp transistor
6040 PRINT
6045 DATA 0,0,32,80,136,5,2,0,0,0,32,80,140,4,0,0: REM  usr f & g...resistor hor
izontal
6050 DATA 0,8,8,254,8,8,0,0,0,9e,9e,127,9e,9e,0,0: REM  usr h & i...capacitor
6055 DATA 0,1,1,1,255,1,1,1,0,32,160,224,255,224,160,24: REM  usr j & k diode
6060 DATA 16,8,4,8,16,32,64,32,16,8,4,8,16,32,16,8: REM  vet resistor
6065 DATA 0,0,0,0,0,62,62,0,0,62,62,8,8,8,8,8: REM vertical capacitor usr m & n
6070 RETURN
9000 INPUT r
9010 LET f=1 6.28*(SQR 22*22+1.2*1.2)
9020 PRINT b
```

ADD 5 POKE 23658,8 : REM CAPS LOCK ON

DATA FILE . . .

Ray Marston looks at a variety of useful transistor waveform generating and waveform shaping circuits

In last month's edition of 'The File' we looked at transistor R-C and L-C oscillator circuits, and at the astable multivibrator. This month we continue this theme by looking at other types of multivibrator circuit.

Multivibrator basics

A transistor multivibrator can be simply described as a cross-coupled two-stage 'switching' circuit in which each active stage (transistor) is regeneratively cross-coupled to its companion, so that one stage automatically turns on as the other turns off and vice versa.

This cross-coupling can be arranged to give either stable or semi-stable switching operation. When 'stable' cross coupling is used, the transistor switch locks permanently into the 'on' or 'off' state until it is forced to change state via an external signal. When semi-stable cross-coupling is used, the transistor initially locks into the on or off state, but then automatically becomes unlocked again after a delay period determined by the time constant of the cross-coupling components.

Four basic types of transistor multivibrator circuit are in common use, and these are shown in simplified form in *Figures 1* to *4*. The *Figure 1* circuit is that of a manually-triggered bistable (two 'stable' states) multivibrator in which the base-bias of each transistor is derived from the collector of the other, so that one transistor automatically turns off when the other turns on and vice versa. Thus the output can be driven low by briefly turning Tr2 off via S2: the circuit locks into this state until Tr1 is turned off via S1, at which point the output locks into the high state, and so on.

Figure 2 shows a monostable (one 'stable' state) multivibrator or one-shot pulse generator circuit. The output is normally low, but switches high for a preset period (determined by C1-R5) if Tr1 is briefly turned off via S1.

Figure 3 shows the circuit of an astable (no 'stable' states) multivibrator or free-running square wave generator. The on and off periods of the square wave are determined by C1-R4 and C2-R3.

Finally, *Figure 4* shows the circuit of a Schmitt trigger or sine-to-square waveform converter. The circuit action is such that Tr2 switches abruptly from the on state to the off state, or vice versa, as Tr1 base goes above or below predetermined 'trigger' voltage levels.

We took a detailed look at a variety of practical astable multivibrator circuits in last month's edition of 'The File'; we'll now look at practical versions of the three other types of multivibrator.

Monostable circuits

The monostable multivibrator circuit of *Figure 2* acts essentially as a triggered pulse generator. Normally, Tr1 is driven to saturation via R5, so the output (taken from Tr1 collector) is low; Tr2 (which derives its base-bias from Tr1 collector via R3) is cut off under this condition, and its collector is at full supply-rail voltage.

When a 'start' signal is applied to Tr1 by momentarily closing S1, Tr1 switches off, driving the output high and driving Tr2 on via R3, thus initiating a regenerative switching action in which (when S1 reopens) Tr1 base is driven negative by the charge of C1.

As soon as the regenerative action is complete C1 starts to discharge via R5, until eventually its charge falls to such a low value that Tr1 starts to turn on again, thus initiating another regenerative action in which the transistors revert to their original states and the output pulse terminates; the action is then complete.

Thus a positive-going pulse is developed at the output of this circuit each time an input trigger signal is applied via S1. The period (t) of the pulse is determined by the R5-C1 values, and approximates $0.7 \times R5 \times C1$, where t is in μs, C is in μF and R is in kilohms.

In practice the basic *Figure 2* circuit can be triggered either manually or electronically; it can be triggered by applying either a negative pulse to the base of Tr1, or a positive pulse to the base of Tr2. *Figure 5* shows a practical

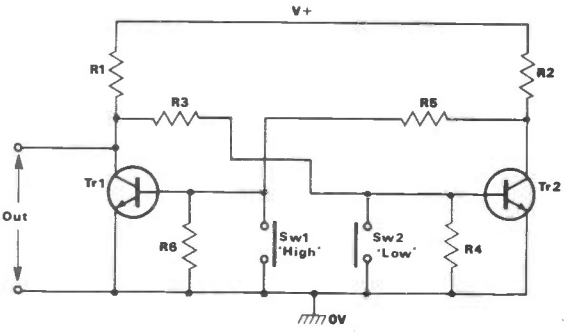


Fig 1 *Manually-triggered bistable multivibrator*

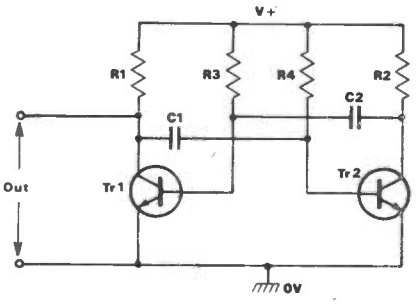


Fig 3 *Free-running square wave generator*

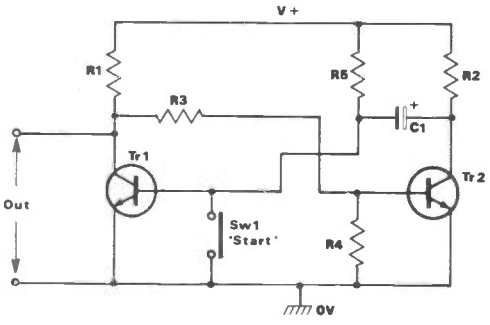


Fig 2 *Manually-triggered monostable multivibrator*

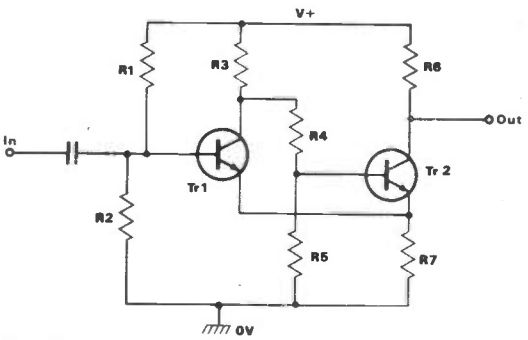


Fig 4 *Sine-to-square waveform converter*

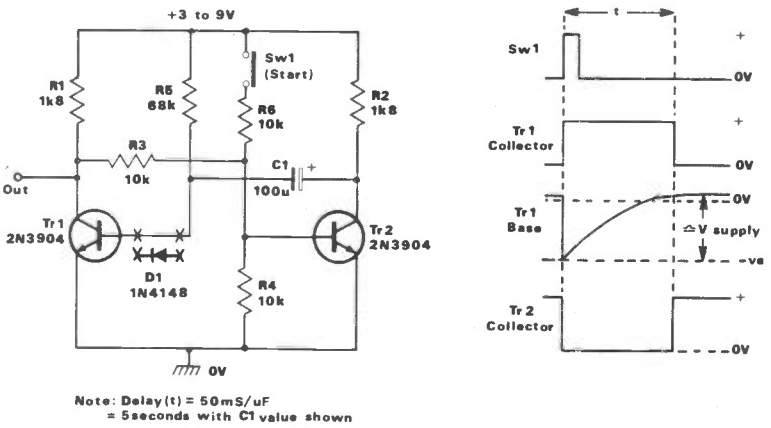


Fig 5 *Basic manually-triggered monostable pulse generator*

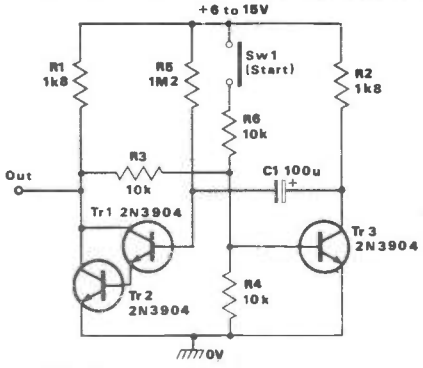


Fig 6 *Long period (100 second) monostable*

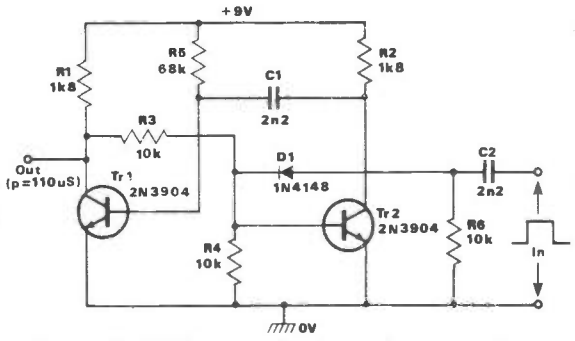


Fig 7 *Electronically-triggered monostable*

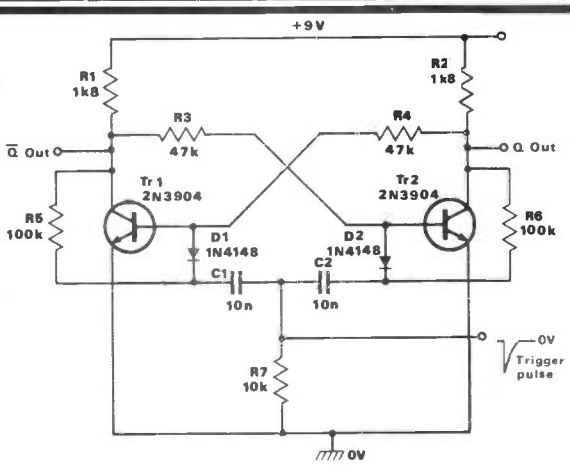


Fig 10 *Divide-by-two bistable*

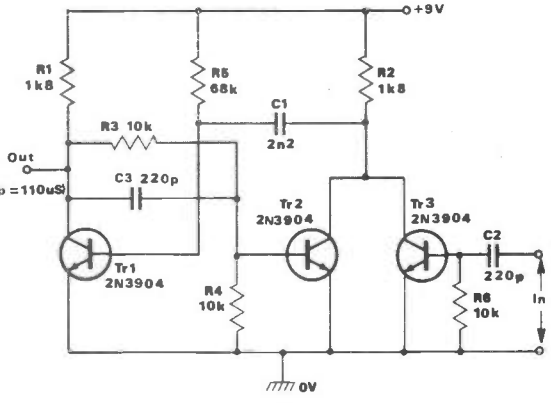


Fig 8 *Monostable with gate-input triggering*

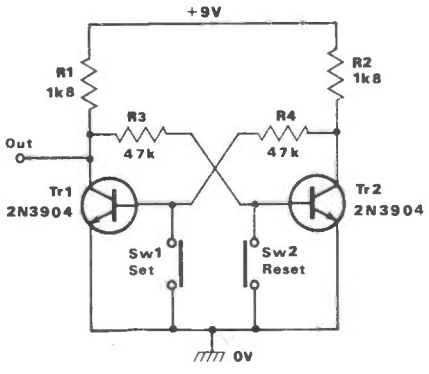


Fig 9 *Manually-triggered R-S bistable*

example of a manually triggered monostable, in which triggering is achieved (via S1) by feeding a positive pulse to Tr2 base via R6. This diagram also shows the waveforms of the circuit.

Note in the basic *Figure 5* circuit that the base-emitter junction of Tr1 is reverse biased during the operating cycle by a peak amount equal to the supply voltage value, and this fact limits (to about 9 volts) the maximum supply voltage that can sensibly be used with the circuit.

Supply voltages greater than the reverse base-emitter breakdown value of Tr1 can be used in the circuit by simply wiring a silicon diode in series with Tr1 base, as shown in the diagram, to provide the same 'frequency correction' action as described last month for the transistor astable multivibrator circuit.

The value of timing resistor R5 used in the basic monostable circuit of *Figure 5* must be large relative to R2, but must be less than the product of R1 and the h_{fe} of Tr1.

Very long timing periods can be obtained by using a Darlington or super-alpha pair of transistors in place of Tr1, thus giving a very high effective h_{fe} and enabling large values of R5 to be used, as shown in *Figure 6*. This particular design can be used with any supply voltage in the range 6V to 15V, and gives a pulse output period of about 100 seconds with the timing component values shown.

An important fact to note about the manually triggered monostable circuit of *Figure 5* (and *Figure 6*) concerns the duration of the input trigger signal. The circuit triggers at the moment of application of a positive-going pulse to the base of Tr2: if this pulse is removed before the monostable completes its normal timing period, the period will end regeneratively in the way already described.

If, on the other hand, the trigger signal has not been removed by the time the monostable completes its natural timing period, the timing cycle will simply end non-regeneratively, and the output pulse will have a longer period and fall-time than in the former case.

Electronic triggering

Figures 7 and *8* show alternative ways of applying electronic (rather than manual) triggering to the monostable pulse generator circuit. In each case the circuit is triggered by a square wave input signal with a short rise time. This waveform is differentiated by C2-R6 to produce a brief trigger pulse.

In the *Figure 7* circuit, the differentiated input signal is discriminated by diode D1 to provide a positive trigger pulse on Tr2 base each time an external trigger signal is applied. In the *Figure 8* circuit, however, the differentiated signal is fed to gate transistor Tr3, which allows the trigger signal to be quite independent of Tr2.

Note in the latter circuit that 'speed up' capacitor C3 is wired across feedback resistor R3 to help improve the shape of the circuit's output pulse.

The *Figure 7* and *8* circuits each give an output pulse period of about 110μs with the component values shown. The period can be varied from a fraction of a microsecond to several seconds by suitable choice of the C1-R5 values. The circuits can be triggered by sine or other non-rectangular waveforms by feeding them to the monostable's input via a Schmitt trigger or similar sine-square converter circuit (see *Figure 11*).

Bistable circuits

Figure 9 shows a practical version of the basic *Figure 1* manually-triggered bistable multivibrator which was described earlier. This circuit is also known as an 'R-S' (reset-set) flip-flop, and acts as a crude 'memory' element; the output can be 'set' to the high state by briefly closing push-button switch S1 (or by applying a negative pulse to Tr1 base); the circuit then 'remembers' this state until it is 'reset' to the low state by briefly closing S1 (or by applying a negative pulse to Tr2 base). The circuit then 'remembers' this new state until it is again set via S1, and so on.

The above circuit can be modified by connecting two 'steering' diodes and associated components, as shown in *Figure 10*, to give a divide-by-two or 'counting' action in which the circuit changes state each time a negative-going trigger pulse is applied. Thus if the input pulses are derived from a square wave input signal, the circuit will generate a square wave output signal at half the frequency of the input.

Note that the circuit generates a pair of anti-phase output signals, known as the 'Q' and '$\bar{Q}$' outputs. Also note that the introduction of very inexpensive CMOS IC versions of the bistable 'counter' circuit have now made the *Figure 10* transistor circuit obsolescent.

The Schmitt trigger

The final member of the multivibrator family is the so-called Schmitt trigger. This is a voltage-sensitive switching circuit which changes its output state

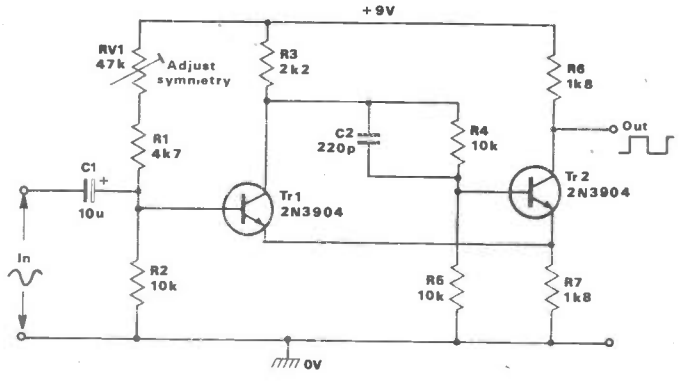


Fig 11 *Schmitt sine/square converter*

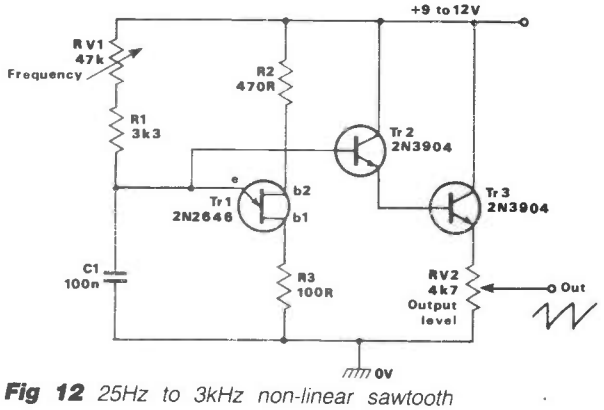


Fig 12 *25Hz to 3kHz non-linear sawtooth generator*

when the input signal goes above or below preset upper and lower threshold levels.

Figure 11 shows how the circuit can be used as a sine-to-square waveform converter. The circuit uses emitter coupling, together with cross-coupling between Tr1 collector and Tr2 base, to provide the necessary regenerative switching operation; C2 helps to speed up the switching action by shunting R4. The sine wave input signal is superimposed on a dc voltage (determined by RV1-R1 and R2) that is applied to Tr1 base.

In practice, the *Figure 11* circuit needs a sine wave input signal amplitude of at least 0.5V rms. The square wave output signal symmetry varies with the input signal amplitude, so RV1 should be adjusted to give optimum symmetry. The circuit acts as a good sine/square converter at frequencies up to a few hundred kHz, producing square wave output signals with rise times of only a fraction of a microsecond.

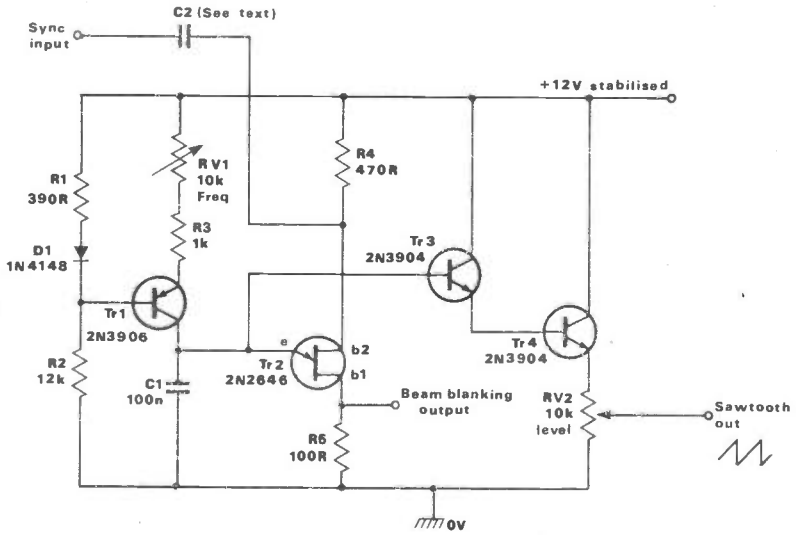


Fig 13 *Linear sawtooth generator or 'scope timebase*

Sawtooth generators

Sawtooth waveforms can be generated in a variety of ways. The astable multivibrator circuit of *Figure 3*, for example, generates negative-going sawtooths on the bases of both Tr1 and Tr2, and this circuit can thus be regarded as a free-running sawtooth generator. Similarly, the monostable multivibrator circuits of *Figures 5* to *8* each generate a negative-going sawtooth on Tr1 base during the active phase of operation, and can thus be regarded as triggered sawtooth generators.

In practice, each of the above circuits generates a slightly non-linear sawtooth, since each of its timing capacitors charges exponentially (rather than linearly) via its timing resistors. This snag can easily be overcome by replacing each timing resistor with a constant-current generating device so that linear waveforms are generated.

If you need to generate positive-going triggered sawtooth waveforms, the best way is to use a 555 'timer' IC for the purpose. If you need to generate free-running positive-going sawtooth waveforms, however, you can do so by using a unijunction transistor (UJT) wired in the basic configuration shown in *Figure 12*.

The UJT is a 3-terminal device, with terminals known as 'emitter', 'base 1' (b1), and 'base 2' (b2). In use the UJT is wired as shown in the diagram, with b2 positive to b1 and with the input applied to the emitter terminal.

The basic action of the UJT is such that its emitter presents a very high impedance until the input reaches a certain 'firing' voltage. At this point the UJT switches abruptly to the on state, in which the emitter presents a low input impedance, thus drawing significant current from the input circuitry; if this input current falls below a certain threshold value, however, the UJT automatically switches back to its 'high input impedance' state again.

Thus in *Figure 12* the circuit action is such that C1 charges exponentially towards the positive supply rail voltage via RV1-R1 until the C1 voltage reaches the 'firing' value of the UJT, at which point the UJT switches on and rapidly discharges C1. As soon as C1 is effectively discharged the UJT turns off again, so C1 starts to recharge again via RV1-R1, and so on.

In practice, this simple circuit generates a stable but non-linear sawtooth waveform that is variable from 25Hz to 3kHz via RV1 using the C1 value shown. Tr2-Tr3 are wired as a Darlington emitter follower buffer stage, which makes the sawtooth waveform externally available at a low impedance level.

The above circuit can be made to generate a linear sawtooth waveform by charging timing capacitor C1 from a constant-current source, as shown in the circuit of *Figure 13*, which can be used as an oscilloscope timebase generator.

Here Tr1 is used as a temperature-compensated constant-current generator, with current variable from 35μA to 390μA via RV1. The linear sawtooth is externally available at variable amplitude via RV2, and should be fed to the 'external timebase' socket of the 'scope. Positive 'flyback' pulses from R5 can be taken via a high voltage blocking capacitor and used for beam blanking the 'scope.

With the component values shown the operating frequency of the *Figure 13* circuit is variable over the 60Hz to 700Hz

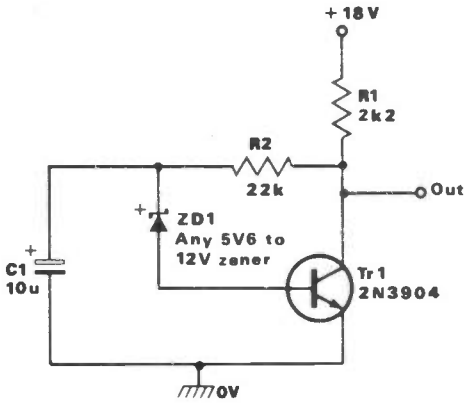


Fig 14 *White noise generator*

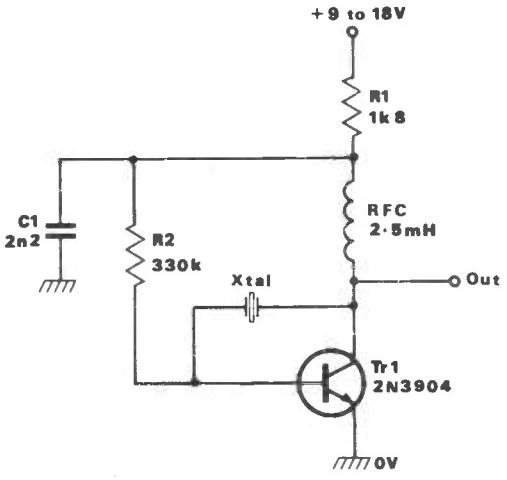


Fig 15 *Wide-range Pierce oscillator*

range via RV1; other frequencies can be obtained by changing (or switch-selecting) the C1 value.

The generator can be synchronised to an external signal by feeding the external signal to Tr2 via C2. This signal, which needs a peak amplitude between 200mV and 1V, effectively modulates the supply voltage (and thus the trigger point) of Tr2, thus causing Tr2 to fire in synchrony with the external signal.

C2 must have a lower impedance than R4 at the sync signal frequency, and needs a working voltage greater than the external voltage from which the signal is applied; if the sync signal takes a rectangular form, with short rise and fall times, C2 can simply be given a value of a few hundred pF.

White noise generator

Another useful type of waveform is that known as 'white noise', which can be simply described as a signal containing the full spectrum of randomly generated frequencies, each having equal mean power when averaged over a unit of time. White noise is of value in testing AF and RF amplifiers, and is widely used in special-effects sound generator systems.

Figure 14 shows the practical circuit of a simple but useful white noise generator, which relies on the fact that any reverse-biased Zener diode inherently generates substantial white noise.

In this circuit R2 and ZD1 are wired in a negative-feedback loop between the collector and base of common-emitter amplifier Tr1, thus stabilising the dc working levels of the circuit; the loop is ac decoupled via C1. Consequently the Zener diode acts as a white noise source that is wired in series with the base of the transistor, which then amplifies the Zener noise to a useful level of about 1V p-p. Any 5V6 to 12V Zener diode can be used in this circuit.

Crystal oscillators

Crystal oscillator circuits are designed to generate waveforms with a very high degree of frequency accuracy and stability. They use piezo-electric quartz crystals as high-precision electro-mechanical resonators or tuned circuits; these crystals have typical Qs of about 100,000 and provide roughly 1000 times greater frequency stability than a conventional L-C tank circuit. Their operating frequency (which may vary from a few kHz to 100MHz) is determined by the mechanical dimensions of the crystal, which may be cut to provide either series or parallel resonant operation; series-mode devices present a low impedance at resonance, while parallel-mode devices present a high impedance at resonance.

Figure 15 shows the practical circuit of a wide-range crystal oscillator designed for use with a parallel-mode crystal. This is actually a Pierce oscillator circuit, and it can be used with virtually any good 100kHz to 5MHz parallel-mode crystal, without need for circuit modification.

Alternatively, *Figure 16* shows the circuit of a 100kHz oscillator that is designed for use with a series-mode crystal. In this case the circuit is wired as a Colpitts oscillator. Note that the L1-C1-C2 tank circuit is designed to resonate at the same frequency as the crystal, and that the tank component values must be changed if other crystal frequencies are used.

Finally, to complete this edition of 'The File', *Figure 17* shows the circuit of a very useful 2-transistor oscillator circuit that can be used with virtually any 50kHz to 10MHz series-resonant crystal. In this design Tr1 is wired as a common-base amplifier and Tr2 is an emitter follower, and the output signal (from Tr2 emitter) is fed back to the input (Tr1 emitter) via C2 and the series-resonant crystal. This is an excellent circuit that will oscillate with almost any crystal that shows the slightest sign of life.

In next month's edition of *Data File* we'll continue the 'transistor' theme by looking at practical audio amplifiers and associated circuits. REW

Fig 16 *100kHz Colpitts oscillator (series-mode crystal)*

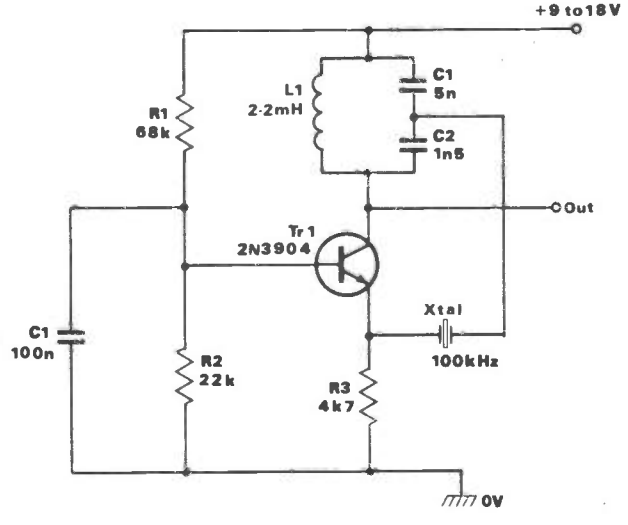
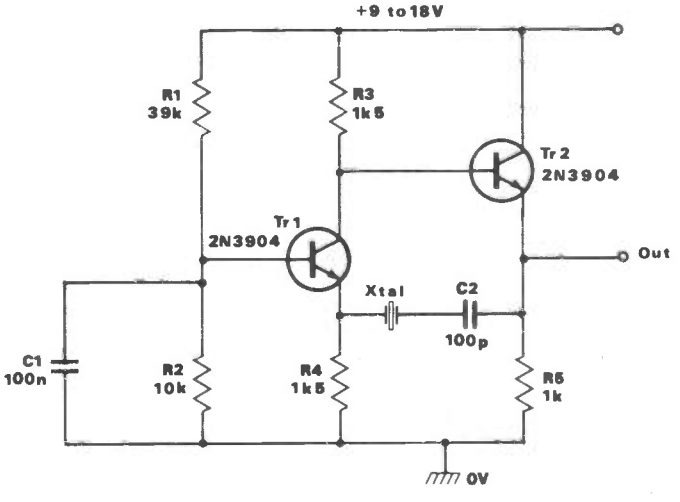


Fig 17 *Wide-range oscillator using almost any series-mode crystal*



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2. 5 – 13 amp ring main spur boxes
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13. 12 – glass reed switches
17. 2 – ultra transmitters and 2 receivers with circuit
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113. 1 – FM front end with tuning condenser and data
114. 1 – 1W amplifier Mullard 1172
115. 1 – wall mounting thermostat 24V
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120. 2 – p.c. boards with 2 amp full wave and 17 other recs
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123. 100 – staples for thin flex
124. 25 – clear plastic lenses 1¾ diameter
127. 4 – pilot bulb lamp metal clip on type
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129. 4 – extra thin screw drivers for instruments
132. 2 – plastic boxes with windows, ideal for interrupted beam switch
134. 10 – model aircraft motor – require no on/off switch, just spin to start
136. 2 – car radio speakers 5" round 4 ohm made for Radiomobile
137. 1 – 6½" 4 ohm 10 watt speaker and 3" tweeter
142. 10 – 4 BA spanners 1 and open, other and closed
145. 2 – 4 read relay kits 3V coil normally open or c/o if magnets added
148. 20 – pilot bulbs 6.5V.3A Philips
147. 1 – secret switch kit with data
149. 4 – socket covers (protect inquisitive little fingers) for twin 13A
152. 1 – air or gas shut off valve – clockwork operated
153. 1 – air or gas shut off valve – thermostat operated
154. 1 – 12V drip proof relay – ideal for car jobs
155. 3 – varicap push button tuners with knobs
158. 5 – 12 way connector blocks 2A 250V
159. 3 – 12 way connector blocks 25A 250V
162. 1 – 13A fused and switched spur for surface mounting or can be removed from box for flush mounting
163. 3 – 13A sockets good British make but brown
169. 4 – short wave air spaced trimmers 2-30f
171. 1 – shocking coil kit with data – have fun with this
172. 10 – 12V 6W bulbs Philips m.e.s.
178. 3 – oblong amber indicators with lilliputs 12V
180. 6 – round amber indicators with neons 240V
181. 100 – p.v.c. grommets ⅜ hole size
182. 1 – short wave tuning condenser 50 pf with ¼" spindle
184. 1 – three gang tuning condenser each section 500 pf with trimmers and good length ¼" spindle
188. 1 – plastic box sloping metal front, 18 × 95mm average depth 45mm
2 – double pole 20 amp 250V flush mounting switch – white
191. 8 – B.C. lamp holder adaptors white
193. 8 – 5 amp 3 pin flush sockets brown
195. 5 – B.C. lampholders brown bakelite threaded entry
198. 1 – in flex sammerstat for electric blanket soldering iron etc.
197. 2 – thermostats, spindle setting – adjustable range for ovens etc.
199. 1 – mains operated solenoid with plunger 1" travel
200. 1 – 10 digit switch pad for telephones etc
201. 8 – computer keyboard switches with knobs, pcb or vero mounting
206. 20 – mtres 80 ohm, standard type co-ax off white
211. 1 – electric clock mains driven, always right time – not cased
216. 1 – stereo pre-amp Mullard EP9001
232. 2 – 12V solenoids, small with plunger
236. 1 – mains transformer 9V 1 amp secondary C core construction
241. 1 – car door speaker (very flat) 6½" 15 ohm made for Radiomobile
241. 2 – speakers 6" × 4" 4 ohm 5 watt made for Radiomobile
243. 2 – speakers 6" × 4" 16 ohm 5 watt made for Radiomobile
244. 1 – mains motor with gear-box very small, toothed output 1 rpm
245. 4 – standard size pots, ¼ meg with dp switch
249. 1 – 13A switched socket on double plate with fused spur for water heater
286. 2 – mains transformers 9V ½A secondary split primary so ok also for 115V
267. 1 – mains transformers 15V 1A secondary p.c.b. mounting
289. 50 3.5V torch bulbs
290. 3 7" reel to reel tape spools
291. 1 ten turns 3 watt pot ½ spindle 100 ohm
292. 5 two plate brown bakelite ceiling roses
293. 50 silicon diodes mixed unmarked
294. 50 Germanium transistors mixed and unmarked
295. 10 round pointer knobs ¼ spindle
298. 3 car cigar lighter socket plugs
297. 1 cover for 24hr time switch ref 8D45
298. 2 15 amp round pin plugs brown bakelite
300. 1 mains solenoid with plunger compact type
301. 10 ceramic magnets Mullard 1" × 3/8 × 5/16
303. 1 12 pole 3 way ceramic wave charge switch
304. 1 stereo amp 1 watt per channel
305. 1 tubular dynamic microphone with desk rest
306. 1 module, speaker & battery to make musical card
307. 5 thermal fuses 15 amp woods metal
308. 1 T.V. turret tuner (black & white T.V.)
309. 12 adaptable legended knobs ¼" spindle
310. 2 oven thermostats
311. 1 Clare Elliot sealed relay 12V
312. 1 pressure pad switch 24 × 18 (Trigger Mat)
313. 5 sub miniature micro switches
314. 1 12" 8 watt min fluorescent tube white
315. 1 8" 4 watt min fluorescent tube white
318. 1 round pin kettle plug with moulded on lead

MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules – i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for **£6.00** plus £2 postage. For prices of modules bought separately see TWO POUNDERS.

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Flat Batteryl Don't worry you will start your car in a few minutes with this unit – 250 watt transformer 20 amp rectifiers, case and all parts with data **£16.50** or without case **£15.00** post paid.

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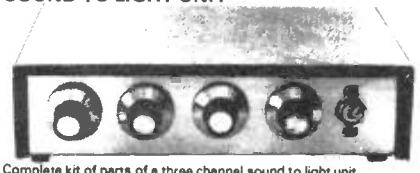
SOUND TO LIGHT UNIT



Complete kit of parts of a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is **£14.95** in kit form.

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1/10 hp **£3.45**
1/8 hp **£5.75**, 1/6 hp **£7.50**

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Some of the features are: long wave band 115 – 170KHz, medium wave band 525 – 1650KHz, FM band 87 – 108 MHz, mono, stereo & AFC switchable, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or headphones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands). All made up on very compact board.
Offered at a fraction of its cost **only £4.95**

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these notes are often hastily written and technical information sheets are seldom available about the items we have to describe, also advertisements sometimes go to press without our having a chance to correct any mistakes, however, everything we sell is supplied on the understanding that if it is not suitable for your project you may return it within 7 days for credit. If there was a definite error of description in our copy then we will pay postage. If not, then you pay the postage. Note this offer applies to kits, but only if construction is **not started.**

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5" Plannair extractor **£5.50**
9" Extractor or blower 115V supplied with 230 to 115V adaptor **£9.50** + £2 post.
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2P15 – Interrupted Beam kit for burglar alarms, counters, etc.
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2P18 – Liquid/gas shut off valve mains solenoid operated
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2P21 – 10 watt amplifier, Mullard module reference 1173
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2P24 – Clockwork operated 12 hour switch 15A 250V with clutch
2P26 – Counter resettable mains operated 3 digit
2P27 – Goodmans Speaker 8 inch round Bohm 12 watt
2P28 – Drill Pump – always useful couples to any make portable drill
2P29 – 24 position Yaxley switch contacts rated 5A – ¼ spindle
2P31 – 4 metres 98 way interconnecting wire easy to strip
2P32 – Hot Wire amp meter – 4½ round surface mounting 0–10A – old but working and definitely a bit of history
2P34 – Solenoid Air Valve mains operated
2P35 – Battery charger kit comprising mains transformer, full wave rectifier and meter, suitable for charging 6v or 12v
2P36 – 20 Amp meter, with shunt unused but ex-equipment
2P38 – 200 R.P.M. Geared Mains Motor 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc.
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2P46 – Our famous drill control kit complete and with prepared case.
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2P48 – Telephone ringing unit reduces mains to 50 volts and changes frequency from 50 hz to 25 hz to give right ringing tone.
2P49 – Fire Alarm break glass switch in heavy cast case
2P51 – Stereo Headphone amplifier, with pre-amp
2P54 – 2½ kw. blow heater section of coal or log effect fire, this is a sheet metal assembly which holds the elements, the motor with fan, and the lamp holders and bits which give the flickering flame effect. Collect or add £3 to cover p&p
2P55 – Mains motor, extra powerful has 1½" stack and good length of spindle
2P62 – 1 pair Goodmans 15 ohm speakers for Unilex
2P63 – 1 5Kv 20 mA mains transformer ex-equipment
2P64 – 1 five bladed fan 6½" with mains motor
2P65 – 2 resettable trips 4.5A mains
2P66 – 1 2Kw tangential heater 115v easily convertible for 230V
2P67 – 1 12v–0–12v 2 amp mains transformer
2P68 – 1 15v–0–15v 2 amp mains transformer
2P69 – 1 250v–0–250v 60 mA & 66 3v 5A mains transformer
2P70 – 1 E.M.I. tape motor two speed and reversible
2P71 – 1 PAPST 240 5 hz motor
2P72 – 1 115v Muffin fan 4" × 4" approx.
2P75 – 1 2 hour timer, plugs into 13A socket
2P76 – 1 audax tweeter partner to 5P26 speaker
2P77 – 1 instrument box with key size 12" × 4½" wide 6" deep
2P81 – ORACLE VB100 instrument panel, is a MODEM with extras, it is the heart of many viewdata systems including the Prestel unit we recently stocked. It uses 25 I.C's, 2 crystals, u.h.f. modifier Aztex UM1233 etc. etc. You receive this, new, unused and complete except for 7 of the plug in I.C's.
2P82 – 9v–0–9v 2 amp mains transformer
2P83 – 25m .75 twin flat flex for mains appliances
2P84 – Modem board with press keys for telephone redialler
2P85 – 20v–0–20v ½A Mains transformer
2P88 – Sangamo 24 hr time switch 20 amp S.H.
2P89 – 120 min. time switch with knob
2P90 – 90 min. time switch with edgewise engraved controller
2P91 – Panel meter size 2½" × 2" scaled power factor
2P92 – Bailey & Macky pressure switch 50 p.s.i.

£5 POUNDERS*

1. 12 volt submersible pump complete with a tap which when brought over the basin switches on the pump and when pushed back switches off, an ideal caravan unit.
2. Sound to light kit complete in case suitable for up to 750 watts.
3. Silent sentinel ultra sonic transmitter and receive kit, complete.
4. Dial indicator, measures accurately down to .01mm, "John Bull" or equally first-class make, a must for toolmaker or lathe worker.
5. 250 watt isolating transformer to make your service bench safe, has voltage adj. taps, also as it has a 115V tapping it can be used to safely operate American or other 115V equipment which is often only insulated to 115V. Please add £3 postage if you can't collect as this is a heavy item.
6. 12V alarm bell with heavy 6" gong, suitable for outside if protected from direct rainfall. Ex GPO but in perfect order and guaranteed.
7. Tape punch and matching tape reader, not new but believed in perfect working order if not so we would repair or replace within 12 months. Please add £2.50 postage.
8. Sensitive voltmeter relay, this consists of a 4½" dia moving coil meter with electronics (we will supply cct. dig.) over £120 each, they are new and still in maker's boxes.
9. Box of 25 fluorescent tubes 40 watt daylight or warm white ideal window pelmets, signs, etc. Please collect or add £2 postage.
10. Box of 25 18" fluorescent tubes assorted colours, please collect or add £2 postage.
11. 24 x 8 ft 85-120 watt warm white tubes. Ideal plant growing. Collect or send open cheque to cover carriage.
12. Equipment cooling fan – minin snail type mains operated.
13. Ping pong ball blower – or for any job that requires a powerful stream of air – ex computer. Collect or add £21 post.
14. Uniselector 360 degrees rotation, 5 poles, 50 ways, 50V coil.
15. Washing machine water pump, main motor driven so suitable for many applications.
16. Control panel case, conventional design with hinged front and finished metallic silver, easily arranged as lockable size approx. 15" × 10" × 5½", wall mounting.
17. Two kits: matchbox size surveillance transmitter and 2 FM receivers.

13.8 VOLT 20 AMP POWER SUPPLY

Good regulation, low cost and a useful output: what more could you ask?

W G Borland G3NXM

Some commercially constructed power supplies quote a regulation of better than 700mV, which would seem to be quite good until one realises that this is 5% of 13.8V. The power unit to be described has a regulation somewhat better than this. In addition, as all the components were obtained at rallies the cost was considerably less.

Originally one rather large transformer was used. During a rebuild it was decided to limit the power supply height to 4 inches to match the transceiver, so two transformers were used in parallel.

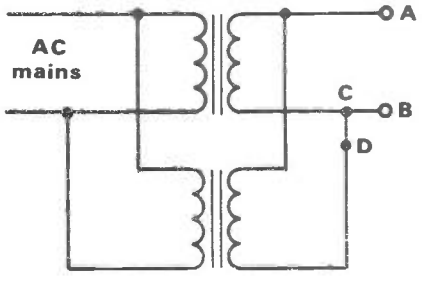
Parallel transformers should be identical, and should be checked. Referring to *Figure 1*, connect the two transformers in parallel and check the voltage across A and B. This should be the transformer voltage. If it is about zero then the transformers are connected out of phase, so reverse the primary connections.

Now disconnect one secondary connection at point C and measure the voltage between C and D. Theoretically it should be zero, but a fraction of a volt, say under 0.2V, would be acceptable.

In theory one would be quite safe in using a transformer which had a continuous commercial service (CCS) value of about one third of the peak power required for SSB. It would be advisable, however, to have a CCS rating not less than one half. Indeed, the prototype had a CCS rating nearly equal to the peak requirement.

The transformer voltage should not be less than 16V. If it is much more than about 19 or 20V the pass transistors will have to dissipate more power and will get hotter.

Fig 1 *Test points for parallel transformers*



The rectifying diodes should be at least 25A rating and mounted on a heat sink. The smoothing capacitor C1 consists of two 26,000μF units in parallel. This is larger than necessary, and a good rule of thumb is 2000μF per volt. C1 is rated at 30V working.

When power is applied, C1 appears to be a short circuit until it is charged up, putting a great strain on the rectifying diodes. The current is limited to about 10A by R_x, which is 9 inches of 1kW radiator element wire coiled like a spring, and has a value of about 2 ohms. Of course a heavy duty resistor can be used *in lieu*.

When the 'short circuit' C1 had exhibited across the relay RL1 disappears the relay is energised, closing the contacts RL1/A and shorting out R_x. This gives a 'soft switch-on'.

R1 drops the voltage to suit the relay, and will need changing if a different voltage relay is used. The relay must have heavy duty contacts. RL1 and R1 also act as a bleeder for C1. It takes about 20 seconds for the relay to fall out on switching off.

Convenience

The pass transistors used were 2N3771s simply because they were available already mounted on heat sinks. There is no reason why 2N3055s could not be used, although as their dissipation is less they will become slightly hotter.

Originally the bases were held at a constant voltage by means of the 7812 voltage regulator, with the common being raised above ground by a variable resistor. Although this did give reasonable regulation, it did not take into account voltage drops due to the balancing resistors and fuse F3, the latter dropping as much as ½V at full current.

Therefore the common of the 7812 is connected to the output of a 741. The non-inverting input of the 741 is held at 6.8V by means of R3 and ZD1. R4, RV1 and R5 sample the output voltage and *must* be connected to the output terminal of the unit. RV1 is connected to the inverting input of the 741. If the output voltage rises the voltage to the inverting input of the 741 rises, is inverted, and its output falls. The voltage to the common of the 7812 is reduced, and hence its output. As the voltage to the bases of the pass transistors is now reduced, their output is reduced.

If the output voltage falls, the opposite occurs. RV1 thus controls the output voltage of the unit.

The balancing resistors R_b each consist of 9 inches of 2A mains wire (figure 8 cable split down the middle), making sure all lengths are exactly equal. Alternatively, 0.1 ohm 5W resistors could be used.

The crowbar protection circuit consists of RV2, ZD2, C5 and the thyristor. Its input must also be taken from the output terminal of the unit.

To adjust the crowbar voltage, disconnect the anode of the thyristor and insert a 12V bulb, which will light when the thyristor triggers. Adjust RV1 for the required output voltage and then adjust RV2 so that the thyristor triggers, lighting the bulb. Readjust RV1 for the output voltage and reconnect the thyristor. It has been noticed that at several rallies a firm was selling similar crowbar circuits already built on a small PCB.

Metering

It was decided to include an expanded scale voltmeter to monitor the voltage output. This comprises RV3, RV4, ZD3 and the meter M1, which should not have a greater sensitivity than 1mA. If it has, then shunt it.

RV3 is a voltage divider again connected to the output terminal. Set the output voltage to 13 volts using RV1, and adjust RV3 until the meter pointer is just moving off the stop. Readjust the output voltage to 14V and adjust RV4 for full-scale deflection on the meter (ZD3 is passing 1V).

Without altering either RV3 or RV4, adjust the output voltage to 13.2V and make a note of the meter scale reading. To calibrate the meter, divide the scale from the 13.2V point to full scale into eight segments, each of which will represent 0.1V.

Owing to the 'knee' of the Zener diode, the calibration below 13.2 volts is not linear and should not be used. A simple way to re-scale the meter is to draw the new scale on a self-adhesive label which can be fixed over the old scale.

R6 is present to provide some load even when the power supply is disconnected. C6 is to stiffen the supply; its value is not critical but it should be rated at 16V working, preferably higher. L1 is an indicating lamp with R7 dropping the voltage to suit. If preferred, an LED and a 1.2k resistor may be used.

Fuses F2 and F3 presented a problem until it was discovered that some motor car fuses fitted a 1¼-inch panel fuse holder. They are small clear plastic tubes with capped ends. The one used for F2 is

labelled 12A continuous, 25A blow and F3 is 10A continuous, 20A blow. F1 is a standard 5A fuse in the 13A plug.

The Trio TS-130S transceiver for which this supply was designed has a double-pole on/off switch, one pole for switching dc to all stages except the PA transistors and the other pole for switching the ac for the power supply.

If your transceiver or transmitter does not have this type of switching, a switch will have to be fitted to the power supply. If this is the case, the transceiver should be switched on before the power supply. It will then have a 'soft switch-on'. Otherwise a surge or spike may occur, and as the crowbar circuit acts a few milliseconds quicker than the regulating circuit, the fuse will blow.

Most of the small components are mounted on a printed circuit board as shown in *Figure 3*. The preset variable resistors are the horizontal mounting type. Do not use the subminiature type as the wattage is too low. If the crowbar PCB is purchased separately then this part of the printed circuit can be omitted.

The two capacitors forming C1 are mounted side by side horizontally and the PCB can be mounted on top of them with 'Blu-Tack'.

Fig 2 *PSU Circuit diagram*

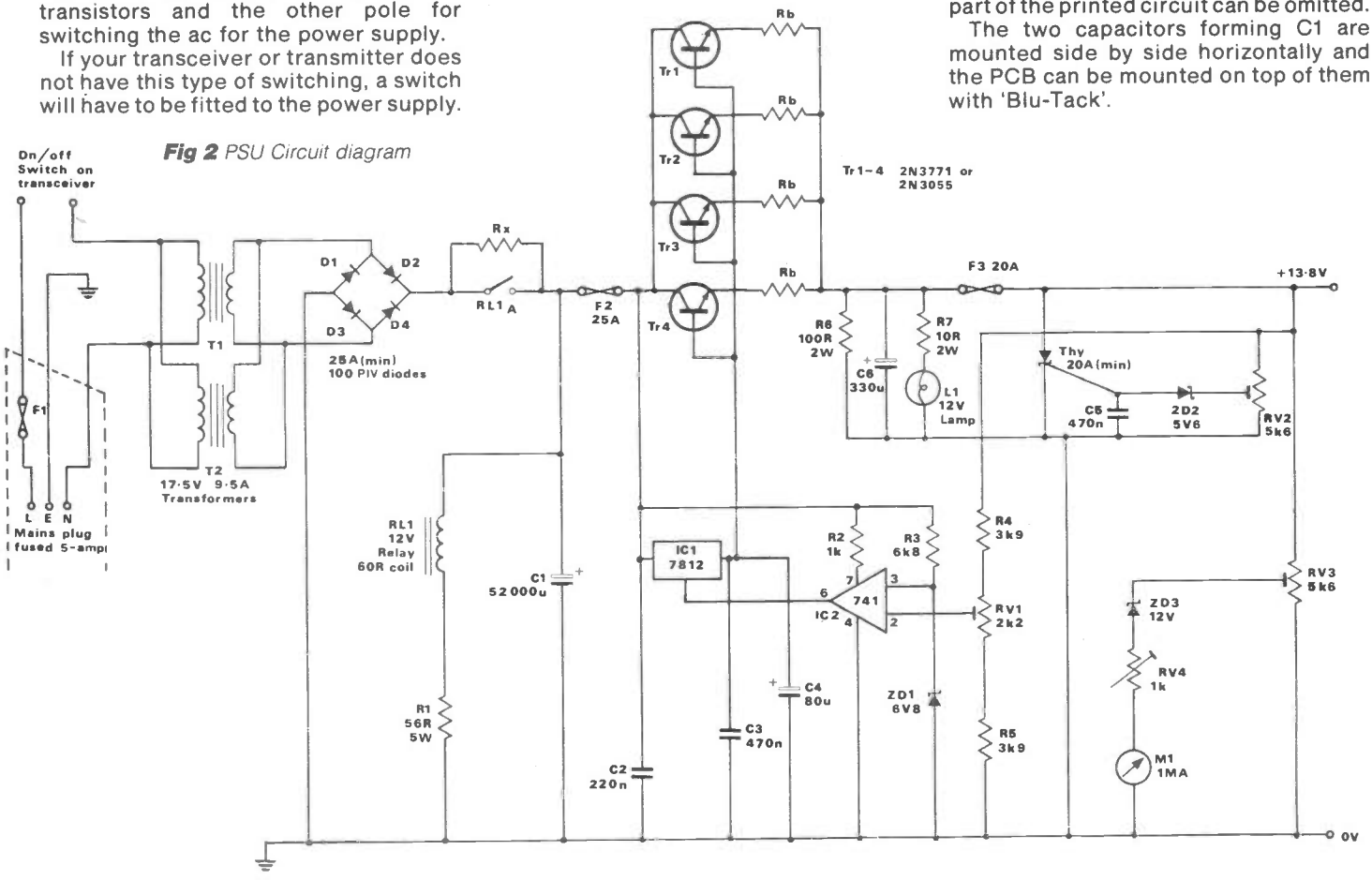
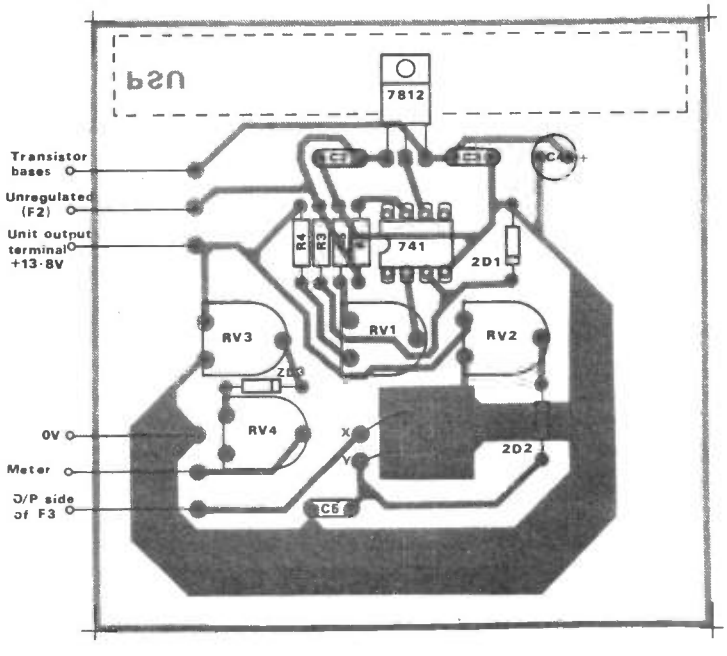
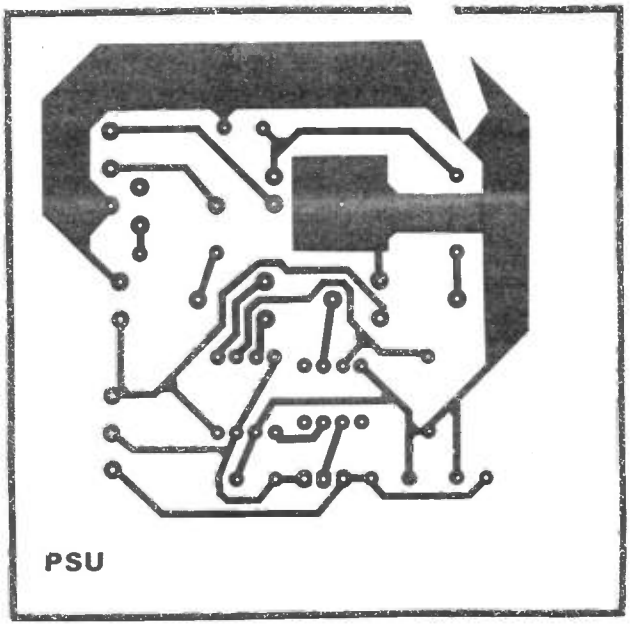


Fig 3 *Foil pattern and overlay*





The power supply is constructed on an aluminium tray 7 inches wide×13 inches deep with 1½ inch lips on the long side and ½ inch lips back and front. The front and back panels are 7¼ inches wide× 4 inches high with ½ inch lips on both sides and top.

Each of the sides is formed with two of the pass transistor heat sinks and a small filling-in panel. A ⅝×⅞ inch angle holds the tops of these heat sinks and the filling-in panel.

The panel fuse holders for F2 and F3, the indicating lamp and meter are on the front panel. The power connections are on the rear panel.

The heavy current parts of the circuit were wired with 1.5mm solid conductor electric wire, which can usually be obtained from the local electrician by the yard.

In order to prevent voltage drop between the power unit and the transceiver, the plugs and cables must be capable of carrying a heavy current. 12-way square plugs and sockets were used, with four pins connected together for the positive and four for the negative. Two pins were used for the mains switching and two left spare. The connecting cable was made up of two 15A flexible mains cable wires for the positive and two for the negative.

The usual twin double insulated 5A mains cable was used for the ac mains switching. A 3-pin chassis-mounting connector was provided for connection to the mains.

This power supply has been in operation for three years with very good results, and regulation seems excellent. I hope it performs as well for you. REW

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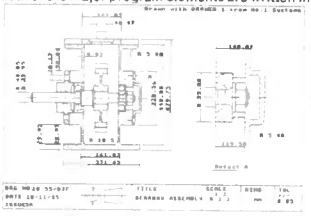

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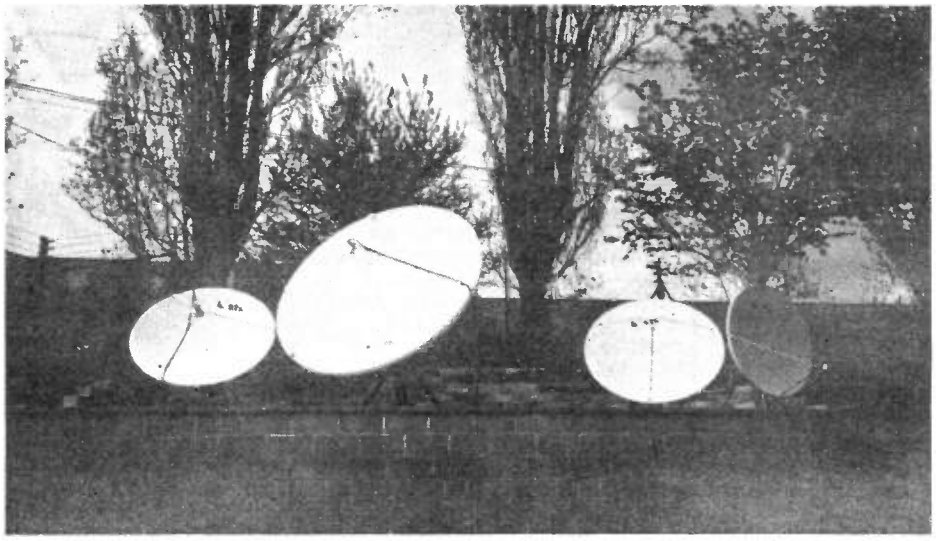


Since we last covered the subject, the satellite TV market has developed to the point where the companies offering receiving equipment can be counted by the dozen rather than in single figures. There is a certain amount of badge engineering, of course (ie different companies selling the same equipment with their own labels), but since some fairly large concerns are becoming involved it is a safe bet that a lot of people think there is a lot of money to be made.

Most readers will probably be familiar with established companies such as Connexions, Megasat (who don't actually make equipment but supply a large range of other peoples'), SATVRN etc. Household names now entering the field include Philips, through their French subsidiary Portenseigne (availability in the UK is uncertain, though), Grundig, who produce an excellent tuner but whose total system price is well over the top, and Ferguson, who have taken the easy option and badge-engineered someone else's system. Other big names around include Luxor and Salora, both of whom have been offering equipment for a while now.

There are also some entirely new companies being formed. Notable amongst these is STS (Satellite Technology Systems), who supply the only British-designed low noise converter (LNC).

Prices are generally £1100+ for a basic system, although it is possible to get one for less than a thousand. As expected there are various enhancements on offer, such as automatic polarization changing for horizontally and vertically polarized channels, actuators for rotating the dish between satellites, and remote control.

As far as technical developments are concerned, flavour of the month seems to be the offset dish. This design approach places the LNC below the direct line between dish and satellite, since the LNC/mount assembly casts quite a 'shadow' if mounted centrally. As a result, offset dishes can be slightly smaller for the same gain.

If the price quoted above seems a little high (well, I wouldn't pay it) there are more than a few people prepared to part with that sort of money. No-one seems quite certain about total UK sales to date, but a rough estimate would put the figure at around 2500. Most of these sales have been made since last autumn.

That might not seem very many, but it is, perhaps, significant that the Japanese are becoming involved – they usually bother only with large volume markets, so maybe they anticipate rapid growth. With the amount of money behind some of the companies now providing equipment, a cynic might say that if there is no market now some judicious expenditure on promotion will create one. The profit motive is a powerful one.

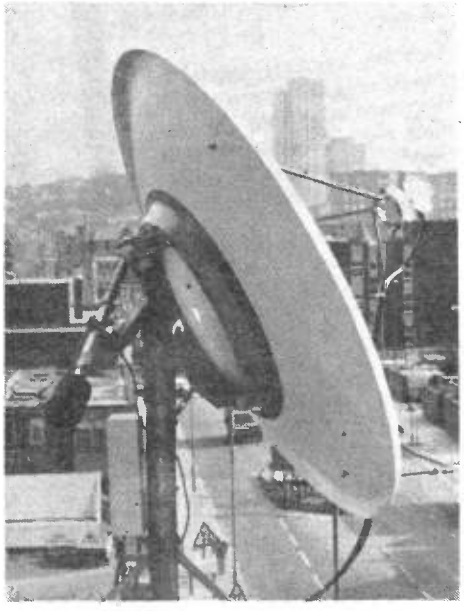
As the market expands the price of equipment will fall. You could probably expect to pay about £600 for a system by the end of 1987, although there's a limit to how far the prices can fall because of the technology involved.

Over in the United States, where there is already a sizeable market for such equipment, it is possible to buy a C-band sytem for as little as $300. Some Stateside manufacturers are now producing Ku-band systems suitable for the European market.

Anyway, if it's a cheap system you want, and you want it now rather than in 18 months' time, I suggest you read *R&EW* next month . . .

If you *must* buy a system (more money than sense, some people), then make sure you shop around. Although all the set-ups I've seen will give acceptable results there is no doubt that some will give a better picture than others. Also check that the system you buy has a baseband output so that you can plug in decoders when (or rather, if) programme providers start encrypting *en masse*.

This shows the actuator used for moving the dish, in this case part of an NEC system



HOW IT WORKS

The Ku-band signals from ECS1 or Intelsat V (11–12GHz downlink) are reflected off the parabolic dish onto the low noise converter (LNC). This dish gives a gain of around 42dB, and further amplifier stages in the LNC give another 50dB or so (this amplification is essential since each channel transmits at a mere 20W).

After amplification the signal is mixed with the output of a local oscillator running at 10GHz (an extremely stable dielectric resonator oscillator or DRO) to provide a 950–1750MHz signal for the set-top tuner. Power for the LNC is fed up the coaxial cable from the tuner.

A typical offset dish. Despite its apparent simplicity, LNC positioning is critical

Thursday 1st SATELLITE TV EUROPE-MAY

SKY CHANNEL

07 45 08 15 09 00 09 45 10 45 11 30 12 15 Sky Trax
13 15 Skyways drama
14 05 FTV Special Reviewf-shion Special
15 00 15 45 16 30 Sky Trax
17 30 The Deputy action adventure
18 00 The Lucy Show comedy
18 30 Green Acres comedy
19 00 Charlie's Angels action adventure
20 00 A Gift to Last drama
20 55 The Untouchables crime
21 50 All Star Wrestling
22 45 Italian Football 1st Division 23 45 Closedown

FILMNET

17 00 Tales of the Gold Monkey High Stakes Lady
17 50 The Man Who Loved Cat Dancing 18
19 40 Voyagers That of Phineas Bogg
20 30 Baby Love 92
22 15 The Brotherhood 96
23 50 Who finds a Friend, finds a Treasure 106
01 48 Closedown

EUROPA

13 00 Sports Report Dutch World Tennis 1986
17 30 Weather Report and Programme Schedule
17 35 Children's Programmes
18 00 Count Down Pop programme
18 40 Weather Report
18 45 Documentary series
19 20 World Watch and Weather Report
19 30 Report Special
20 05 Documentary series C'est l'hiv
21 00 Sports Report
22 30 World Watch Weather Report, Preview next day and Closedown

Children's Channel

07 00 Roostabout Home
07 30 Lucky Luke 08 00 Taagrams, Inspector Hazy and Laff-a-lots
08 30 European Fairy Tale and Emma and Grandpa
09 00 Jack in the Box Timothy the Thinker Sing a Song World's Most Beautiful Tales On Sooty Barnse
10 00 Magic Corner, Storytime including Captain Pugwash, Victor and Maria, Emily, Ludwig, Rocky Hollow, Rub a Dub Dub
11 00 Roostabout
13 00 Jack in the Box
15 00 Closedown

TV GUIDE

17 30 Info-Show 30
18 00 A Man Called Hannassy 1 40
19 40 Telemix/ Programmeorscheve 20
20 00 Ein Sack voller Flöhe 1 35
21 35 Die Jagger der goldenne Goetlin

SCREEN SPORT

17 00 Kick Off
17 05 Sportswees
17 30 County Championship Indoor Cricket
19 30 American Sports Carousels
20 30 Golf
22 30 Tokio Tennis
00 00 Closedown

Music Box

07 00 13 00 19 00 Jolie and Edwina
08 00 14 00 20 00 In Search of Style repeat of Sunday s Special
09 00 15 00 21 00 Euro-Tour Geldz latest tour news with Sunet
10 00 16 00 22 00 Martin & Gary
11 00 17 00 23 00 Sit Tight Simon
12 00 18 00 00 00 And That's A Fact all your pop questions answered by Gaz & Sunet

LIFESTYLE

09 00 Sotty Jessy Raphael
09 30 Ill Figaros
10 00 Farmhouse Kitchen
10 30 Look Who s Talking
11 00 Geed Sez
11 55 Tokio Kerr
12 00 It s a Vet's Life
12 30 Divorce Court

PREMIERE
THE NO.1 MOVIE CHANNEL

15 00 Cha Cha and the Philly Flash
16 30 Edisan Twins Eps 34 Let Them Eat Cake
16 55 Sleeping Beauty
17 50 Gordon Willis Interview
18 15 Broadway Danny Rose
19 40 Martin Scorsese Interview
20 00 Electric Dreams
21 30 Premiere Review, May 1986
22 00 Slaughter
23 30 The Long Ride
01 00 All the Right Moves

THE ARTS CHANNEL

06 00 Open
06 05 Viewpoint Leonard Nimoy presents a one-man show as Theo Van Gogh brother of the great Dutch painter
07 40 Vincent Van Gogh his paintings
07 50 Popular Neurotics A contemporary comedy setting its sights on love and success in the 1980 s and starring Jeff Goldblum
09 00 Closedown

SAT 1

15 00 Marco
15 30 Lassie
16 00 Musicbox
17 00 Ricker – Stammtisch
18 00 Boomer der Streuner
18 30 APF Blick news
18 45 BRAVO TV
19 45 Wie bortfich, jung zu sein
21 30 APF Blick news and sport
22 15 Lasthere ist angesagt
22 45 High Chaparral
23 15 APF Blick late news

MTV

16 05 Private Showing cultural magazine
16 45 The Hotel of the Century series
17 45 Apostrophes literary magazine
19 00 Champs-Elyseesvariety show
20 20 The Hotel of the Century series
21 25 Private Showing cultural magazine
22 00 News relay of main French news
22 30 Closedown

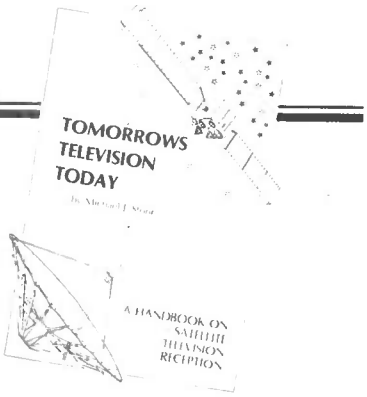
This is a page from Satellite TV, a monthly magazine featuring program previews and schedules. It costs £1.50 and is published by 21st Century Publications, who also produce Cable & Satellite Europe offering more technical coverage of the subject. 21st Century Publications are at 531-533 Kings Road, London SW10 0TZ. Tel: (01) 351 3612

Only Sky Channel encrypts at present, but the Dutch FilmNet is due to start doing so from autumn.

A major factor in the expansion of the home satellite TV receiver market is the quality and diversity of programming available. At the moment you can disregard many of the channels available unless you happen to be an accomplished linguist. Of the remainder, some just aren't worth watching. CNN (Cable News Network), for example, carries little European news, and I, for one, am not particularly interested in the weather prevailing in the Blue Ridge Mountains or the financial difficulties of southern peanut growers . . .

The language differences needn't be a problem. Europa-TV currently broadcasts in 5 different languages, each on a different audio subcarrier. Other channels could do the same in the future.

Encryption raises other questions. The reason for it in the first place is to allow programme providers to make money by charging people to see their programmes. However, if a significant number of channels do not encrypt, choosing to try and make money solely through advertising revenue, then people are bound to watch the unscrambled channels and not bother with the others (who, given the choice, would pay for their TV?). Consequently encryption might be a non-starter.



Back in 1983 Mike Stone, Technical Director of Bristol-based STS, wrote a book about satellite TV. Copies are still available, and although it is a little out of date it is still well worth reading

The number of channels available should increase steadily. The IBA is due to start transmitting Superchannel in the autumn, and two DBS satellites will be launched this year if all goes well, the French TDF1 and German TV-SAT.

An Irish DBS satellite is imminent, agreement having been reached with the Hughes company in the States, and SES in Luxembourg also plan a satellite for the near future.

What remains to be seen is whether what's on offer is worth watching. REW

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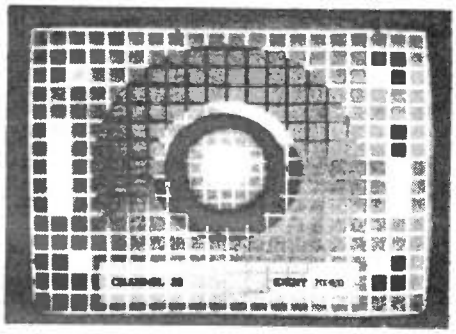
DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

March was largely an inactive month for DX-TV reception, following the trend of the previous few months. During almost two decades of TV DXing we cannot recall a winter with conditions matching those which we have just experienced. Hopefully it is the lull before the storm. By the time this column appears in *R&EW* we should have a clear impression of the 1986 sporadic-E season.

Thanks to a combination of patience and determination, log reports have been forthcoming for the month under review and, again, it shows just what can be achieved during adverse conditions. It's all too tempting to simply give up while everything on the DX front is quiet.

DX-TV log for March

The main log covering Band I this month is courtesy of Bob Brooks of South Wirral. The details are as follows:

1/3/86: Unidentified film received at 0909 on channel E2.

2/3/86: An unidentified picture on E2 of a Hitler look-alike, but wearing a bowler hat. This was timed by Bob at 0835.

5/3/86: Cartoon on E2, possibly of West German origin.

7/3/86: ORF (Austria) on channel E2a showing the PM5544 test card and 'ORF FS1' identification.

11/3/86: ARD (West Germany) on E2 displaying the 'ARD ZDF' logo. This was probably received from the Bayerischer Rundfunk transmitter at Grünten.

12/3/86: ARD on channel E2 with the 'GRÜNTEN' FuBK test card.

14/3/86: TVP (Poland) on channel R1 using the PM5544 with a dark background.

15/3/86: Bayerischer Rundfunk (BR-1) on E2 with the 'GRÜNTEN' electronic test card.

16/3/86: Very early morning signals consisting of an Italian programme on channel IA. Shortly after midnight a guitarist was noted on E2.

17/3/86: CST (Czechoslovakia) on channel R1 radiating the EZO-type pattern with the identification 'RS-KH'; ARD (BR-1, West Germany) with the FuBK test card on channel E2.

18/3/86: CST on R1 with the 'RS-KH' test card.

20/3/86: SR/SVT (Sweden) on E2 transmitting the 'TV1 SVERIGE' PM5534 test card; unidentified station presenter at 1024 on channel E3.

21/3/86: SR/SVT on E2 with the Philips PM5534 pattern; ARD (BR-1) on E2 with the FuBK test card.

26/3/86: TVP using the PM5544 test card on channel R1; ARD radiating the 'GRÜNTEN' FuBK test card from Bayerischer Rundfunk.

27/3/86: Swedish PM5534 test card from SR/SVT carrying the 'TV1 SVERIGE' identification.

Kevin Jackson reports the following signals noted in Leeds via improved tropospheric conditions:

3/3/86: TDF (France) with Canal Plus transmissions on channel L5 from Lille; RTBF1 (French speaking network in Belgium) on channel E8 from the Wavre outlet; DDR:F1 (East Germany) on E5 showing the electronic test card, possibly from the Inselsberg outlet.

11/3/86: BRT-1 (Flemish network in Belgium) on E43 and BRT-2 on E46, both from Egem.

12/3/86: TDF (Antenne 2) on E39; TDF (Canal Plus) L5; RTBF-1 E8; BRT-1 E10 (Wavre) and E43 (Egem); BRT-2 E46 (Egem); RTL (Luxembourg) on E7 with the PM5534 from Dudelange.

13/3/86: TDF (tf1) on E43; TDF (Antenne 2) E43; TDF (Canal Plus) from Lille on channel L5; BRT-1 E43; RTL E7.

15/3/86: TDF with Canal Plus transmissions on channel L5; BRT-1 E43; BRT-2 E46; RTBF-1 on channel E8.

Despite the adverse conditions for DX-TV reception, three interesting test cards did manage to appear in Derby. They were the East German DDR:F1 pattern on channel E4 from Cottbus on the 10th, the new Dutch FuBK test card on E4 from Lopik on the 15th and a rarity – the FuBK from West Germany on channel E3. This carried the identification 'KREUZBERG' and was noted on March 27th. The test card is radiated by Bayerischer Rundfunk.

New Dutch FuBK test card

We've at last had a chance to examine the FuBK test card which was recently introduced by NOS in the Netherlands. This pattern will eventually replace the old PM5540 monochrome electronic test card.

As we reported in the February issue of *R&EW*, the new pattern carries the name of the transmitter. It looks different from the standard FuBK – and it is! The NOS version omits the circle, and the small black triangle in the lower half of the pattern is reversed. The frequency gratings occupy a wider portion of the test card and the black band carrying the identification is correspondingly longer compared with a standard FuBK from, say, West Germany.

Reception reports

Iain Menzies of Aberdeen has written to say that job promotion has meant less time for DX-TV activities. He sums up recent conditions in one word. Unfortunately we can't use it here but roughly translated it would appear that reception has been lousy. Regular auroral activity seems to be a feature in northern parts of the UK, and during March occurrences were noted on one day in every three producing signals in Band I from Norway and Russia.

Upon arriving home on the 31st, Iain switched on to find a sporadic-E opening already in progress on channels R1 and E4. However, since a scanner was used to check the band, no clues could be gleaned as to where the signals were originating from.

Broadcasting authorities upset

Iain has advised that the first 50MHz amateur radio stations are on the air in Portugal and CT1 WW was worked via the 'big' aurora of February 8th. He also points out that the broadcasting authorities in Lisbon had the hump after seeing pictures of some of their TV transmissions taken by a DX-TV enthusiast a couple of years ago. This may have prompted them to think about ceasing TV broadcasts in Band I in the near future. Assuming they do not want their transmissions to be picked up outside Portugal we can only suggest that the Portuguese powers that be close down the FM radio network as well!

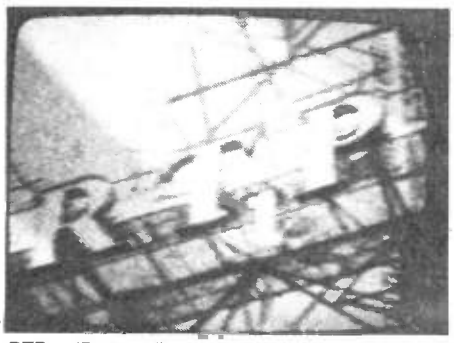
While on the subject of Band I closures, Iain mentions that correspondence with Radio Netherlands has revealed that NOS have no intention of closing the TV outlet at Lopik on channel E4 for at least the next decade. We will have to wait and see.

Chris Howles of Lichfield has again been preaching the virtues of TV DX in his neck of the woods. A chance meeting with a couple of other DXers prompted Chris to arrange an informal get together at his home recently. We were also invited to view Chris's set-up. Despite the use of loft aerials, signals from Europe are received on a daily basis. A new acquisition is a Tandy Portavision monochrome receiver which will resolve French system L signals as well as British TV. The French 'Canal Plus' transmissions from the Lille outlet on channel L5 are present for most of the time. If the programme isn't scrambled both sound and vision are usually present.

A couple of D100 DX-TV converters are pressed into service by Chris for narrowband DX reception of weak signals. A Plustron multiband monochrome portable is also used. An almost new Tatung VHS video cassette machine has been purchased for recording DX reception. Signals are fed in at UHF from the D100.

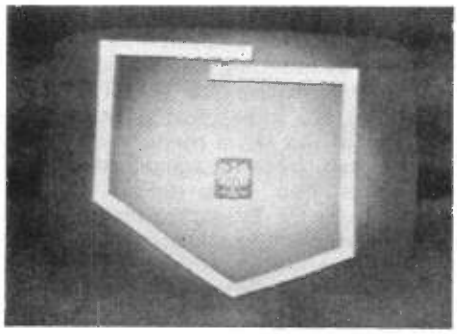
PHOTO FILE ● PHOTO FILE ● PHOTO

Clock caption radiated by the Portuguese TV service



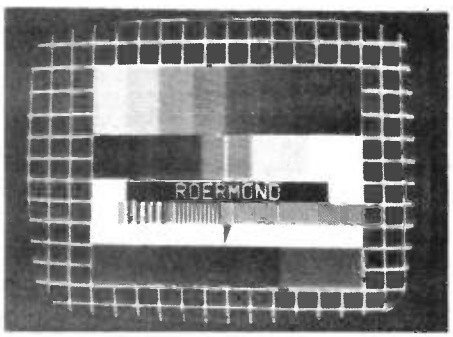
RTP-1 (Portugal) opening caption received via sporadic-E

Identification caption transmitted by RTP



Caption received at closedown on R26 from TVP-2 in Poland

Caption from TSS in White Russian SSR, received on channel R10



New FuBK test card from NOS, Netherlands

Pics: Bob Brooks and Rijn Muntjewerff

DX TV RECEPTION REPORTS

Chris wants to part with his earlier VCR – a multi-standard Ferguson. This is similar in appearance to the 3V22 with key controls. The asking price is around £90. If anyone is interested in the VCR, or just wants to chat about DX-TV, give Chris a ring on (0543) 252121 after 6pm.

Further successes

"I've seen no sporadic-E yet, but I keep checking", writes Kevin Jackson of Leeds. Band III and UHF DX proved more fruitful with the East German test card coming in and out of the noise on March 3rd via channel E5. Surprisingly, RTL-Luxembourg appeared on channel E7 during the 12th and 13th whilst radiating the PM5534 test card. Enhanced tropospheric conditions brought further successes throughout the month.

Kevin's DX set-up has been altered with regard to aerials and coaxial cable. He recently invested some cash in decent feeder cable. The type chosen is semi-airspaced and double screened. It is manufactured by Volex and called Raydex CT100. His estimated cable losses are now as follows: Band I, using three metres of CT100, the loss is less than 0.1dB at 50MHz; Band III, using two metres of CT100, the loss is estimated as being less than 0.16dB at 200MHz; at UHF using five metres of the new cable the loss is less than 0.77dB at 600MHz and 0.91 at 850MHz.

The cable lengths quoted are not misprints. Kevin lives many floors up in a tower block (it saves buying a lattice mast!) and all the aerials are indoors. His 10-element group B aerial has been replaced by a wideband version which, he feels, will be better suited as a search array. Kevin hopes to acquire a four or five element Band III wideband aerial to improve results in that particular spectrum. However, the physical size could be a problem because it would have to be hand-held. Why not use a tripod, Kevin?

David Oliver of Birmingham can't wait for the sporadic-E season to begin. He's now equipped with a D100 DX-TV converter, a Thomson T2502PI multi-standard colour portable and a multi-standard Sharp VC-477EJ video recorder. David started DXing during the latter part of the 1985 season and he logged several European countries via sporadic-E propagation.

Old modified receivers

It seems that a few modified UK dual-standard receivers are still in use for DX-TV reception. The presence of a switchable video detector diode meant they were ideally suited for standard negative-going video (systems I,B,G,D etc) and positive going French video (system L). Bert Brand of Colchester has used such a set since it was retired from domestic use in 1973. It is a Thorn 1400 series chassis and is nearly 20 years old.

What is SEB-TV?

We recently mentioned the reception in Kuwait by Jamil Charawi of transmissions from SEB TV, apparently from an American satellite used to radiate programmes to US Forces personnel stationed in Italy. Jamil received the AFRTS signals on his domestic TV.

K Jinadasa, a radiographer at the Mubarak Al Kabeer hospital in Kuwait read the report and has written in with his own observations. He noted SEB-TV on March 15th between 1.30am and 3am local time. Apparently a caption appeared which read 'SEB ITALY SERVING EUROPE'S BEST'. It was a programme featuring songs and dances called 'Solid Gold'.

Reception was via an NEC 14T 420 SB 14-inch colour set – the cheapest available in Kuwait. A standard UHF aerial was used in conjunction with a Nippon VHF/UHF pre-amplifier. The programme from SEB-TV (Southern European Broadcast TV) was noted on channels 21 and 27. The image was in the negative form without any trace of the sound carrier.

Normally our correspondent watches TV programmes from Saudi Arabia, Dubai, Abu Dhabi, Bahrain, Qatar, Oman and, of course, Kuwait but he has never seen a transmission intended for a European country. If anyone can reveal the mystery surrounding SEB-TV, we would be pleased to hear from them.

Private TV scene in France

Two additional national television networks came into service in France last year. At present, about six million viewers are covered by the new networks. This figure should soon rise to around 29 million viewers with transmitters situated in 62 locations.

The only authority in a position to allocate 'free' television channels is Telediffusion de France (TDF). Following extensive surveys the TDF decided to allow the introduction of three additional TV services; more are likely to be authorised by the TDF at a later date. Currently there are five services in operation, namely Television Francaise (TF1), Antenne 2 (A2), France Regions 3 (FR3), Canal Plus and TV5. The last one is basically a music channel with rock and pop video clips for viewers aged between 18 and 35.

The proposed sixth programme will be a co-production from the television services in Luxembourg (RTL) and Monaco (TMC). Programmes from RTL will be aired in western, northern and eastern parts of France while material from TMC will be radiated in southern and south-western France plus a few central regions. The seventh TV service will be produced on a local basis.

The search for spare channels has been abandoned in locations around Nice, Mulhouse, Strasbourg, Forbach and Belfort. Only one new TV service can be accommodated at Lille, St Etienne, Grasse-Cannes, Thionville, Hagondange, Maubeuge and Arras.

Our thanks to Gösta van der Linden (Netherlands) and Alain Duchatel (France) for providing details about the French private television scene.

Service Information

France: The official start of France's fifth TV service took place on February 20th at 2030 local time. Known as 'La Cinq' (or TV5), the first programme was *'Voila La Cinq'*.

The VHF transmitters at Saint Etienne (channel L2) and Le Havre-Harfleur (channel L4) have unfortunately been replaced by UHF outlets. The following TV5 transmitters are due to come into service this summer:
Amiens-Dury (channel E49); Avignon-Le Pontet (E47); Bourg-en-Bresse (E38); C Ferrand-Royat (E58); Le Creusot (E38); Lorient (E62); Marseille-P (E54); Nantes (E21); Poitiers (E41); Valence (E53); Ales (E62); Angers-Rochefort (E50); Bayonne-La Rhune (E56); Caen-CHU (E38); Dunkerque (E59); Le Havre-Harfleur (E53); Mantes (E53); Montlucon (E49); Orleans (E52); Tours (E57); Valenciennes (E49).

The PM5544 test card is radiated by TV5 with the identification 'TDF' at the top and 'RES 5' in the lower black rectangle. Identification slides are used such as 'La Cinq 5'.

The sixth network opened on March 1st at 1400 local time. TV6 is a music programme. The test card (Philips PM5544) carries the identification 'TDF' and 'RES 6'.

TV7 is due to open in 1987. This service will be linked via satellite so its success depends on the Ariane space project.

Finland: Yleisradio (YLE) are now operating a transmitter located in neighbouring Sweden. The outlet, at Stockholm, is on channel E39 with an ERP of between 600kW and 1000kW. The PM5544 test card is radiated with the identification 'Channel 39' and 'Stockholm'. Programmes are in Finnish and Swedish and many carry subtitles.

Sweden: Sveriges Radio (SR/SVT) have brought into service a TV transmitter located on the Finnish Aaland Isles. The channel E28 outlet has an ERP of 600kW.

Crete: The TV transmitter on channel A2 at Iraklion is apparently still in service. Operated by the American Forces Radio and Television Service (AFRTS), this outlet (on 525 lines) was occasionally received in the UK a number of years ago. It had been assumed that the transmitter had been taken out of service, but a DX-TV enthusiast recently noticed an identification caption. The channel A6 outlet is still operational.

Our thanks to Gösta van der Linden and the Benelux DX Club (Netherlands) for supplying this month's service information. REW

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Access

ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

A lot has happened in the world of ATV since a month ago, or so it seems. The BATC's convention/rally, call it what you will, has been and gone. I believe it was the most successful ever – everyone I spoke to seemed to be happy and I shall try and highlight some of the more interesting exhibits and points below.

New names, new products

This year a large marquee was hired to make room for all the extra traders who came. Among the newcomers was Comex Systems Ltd of Leicester, who introduced a range of high quality products for 24cm enthusiasts. A receiver system based on the rightly famed Astec satellite TV modules impressed several people, as did the sound and vision transmitter. This puts out 1.5 watts and there is also a matching 6 watt PA.

I hope to describe these products in greater detail in future; they are certainly of a professional standard and nicely finished. Several have gone to commercial customers, too, so they must be good!

Wood & Douglas unveiled their new reference-locked 24cm transmitter – expect a detailed report on this shortly, as they handed over a review sample!

On the surplus equipment front many bargains were to be had – if you came early enough... I saw a Hitachi colour camera go for £60, which would have been a fair price for the lens alone. What was lacking was an organised bring-and-buy stall, and I understand this will be rectified next year.

This rather well-equipped shack belongs to Heinz Venhaus DC6MR. I reckon his junk is better than most of my prized apparatus!

Repeater groups

Two repeater groups set up displays which I found fascinating. The Sussex Coast folk showed several 'goodies' they had developed, including an ingenious panoramic scanning display for 24cm receivers. This gives an on-screen display of the whole 23/24cm band, with immediate indication of any activity.

In addition they had an agc board and an expansion board for the popular Cropredy Electronics test card generator. The group also offers to blow EPROMs for this, including a new BATC-style test card; they seem to know the bugs in the circuit which several people have reported to me.

The Home Counties crowd had a display of equipment used to achieve their contest successes, together with a demonstration of the Pioneer audio-visual computer. I have mentioned this before: it's a home computer (MSX) which can superimpose genlocked colour graphics and captions, and it's now available at a very attractive price. Chase round to a Pioneer dealer if interested.

As ever, I had a chance to meet several ATVers at Crick, some old friends and some new, and they all passed on their news. I filled several pages in my notebook and as always I was promised letters describing local activity groups in great detail. Let's hope these all turn up!

Most of the activity news I shall save up for our three-monthly activity round-up, suffice to say it is clear that there is a great deal more slow-scan activity happening than ever gets reported here. But that's all I know!

There is also considerable interest in 24cm TV – newish stations reported include G8SIN in Headington (Oxford) and G6LIC and G8TIS in Wakefield.

Watch out, hamburglars about

Not as funny as it sounds because at least two people had their personal equipment thieved at Crick this year. I just hope the culprits stay away next time, we don't need their sort in the ATV fraternity.

This nicking was small fry, however, compared to what went on at other rallies. The RSGB's exhibition at the NEC saw several thefts both during opening hours and at night. Some of the thefts occurred right under the noses of traders. Worse, perhaps, was what went on at the Belle Vue rally, where more than 50 rigs were stolen from cars outside the hall. The organisers had to ask visitors to return to their cars to check them, and the police were doing a brisk trade in taking down details of missing equipment.

I suppose it's a sign of the times but it's sick, sick, sick. If you were lucky this time, don't laugh: it could be your turn next. Don't make it easy for the hamburglar, anyway.

Prestel progress

Do you have access to Prestel? If so let me remind you there is a growing amount of material of interest. If you key ★258 # and then 7 you wind up on a newish section called Waveguide. This covers broadcast radio and TV, plus ham news by Gordon Adams G3LEQ. This last is full of Gordon's excellent insidious intelligence, and you will also find the latest updates on the North Sea offshore radio stations.

London's two pirate TV stations are regularly reported on Micronet 800's news pages, while the BATC, RSGB and BARTG share pages on Clubspot 810. If you haven't checked these out lately they are well worth a look.

Stateside happenings

Apart from writing I do a lot of reading: my job includes reading about 40 technical journals a month (fancy getting paid to read *Wireless World*!). The American microwave and RF magazines are often full of fascinating information, and I spotted a couple of interesting pieces in the latest *Microwave Journal*.

The first concerned M/A-Com announcing their PH1214 power transistor. Operating in the 1200-1400MHz band, this little beauty produces 60 watts output for up to 20 watts input. Gain is 7dB and these ratings are CW, so it would be ideal in ATV service. Price in quantity is just $95, which is quite reasonable when you consider the cost of building a PA using valve technology (with its EHT power supply and blower).

No doubt this transistor would double as a three-wire fuse if you got the slightest thing wrong, but in truth these devices are a great deal more robust than thought.

The growing use of 23cm radar equipment is bringing down the price of solid-state power devices, and I guess they will be used in ham shacks all too soon. So when your 24cm TV contacts are wiped out now by radar don't curse...just think of the falling cost of high power transistors!

NETWORK 934

Andy Emmerson G9BUP

Welcome aboard this new column, the first specifically for 934MHz enthusiasts. Whether you enjoy just nattering on this band, or have a yen to do something technical as well, I hope you will find something here of interest.

As each month passes more and more folk come onto the 32cm band, and this column will be the place where you can catch up on the activity news, read about the DX everyone else has been working and find out about new rigs, aerials and accessories. We'll also tackle some technical topics.

There should be plenty of variety, and you can help by letting me have your news, care of the editor. Feel free to write in, too, if you disagree on any topic or if there's a technical subject you'd like discussed. So, without further ado, let's get down to business.

Notching out interference

In a future article I intend to take the lid off cellular radio interference, but first, a new filter which claims to offer a solution to this problem has come onto the market. It is supplied by Paul Sergent of 6 Gurney Close, Costessy, Norfolk, and is priced at £26.45, post paid. 'The genuine 934MHz cavity filter,' says the advertisement: 'If you suffer from cellular radio interference then this cavity filter could help reduce the problem. No internal connections to the rig are necessary, just connect between rig and antenna.'

For your £26 you get a short block of aluminium fitted with two N-type connectors which you can indeed connect between antenna downlead and the rig (or pre-amp). At one end is a plunger and a set screw for locking the plunger in position. In fact, the cavity works as a notch filter and can be adjusted to 'notch out' or remove (suck out) any desired frequency. In practice you listen to interference on a quiet 934 channel and gradually withdraw the plunger until cellular interference is at a minimum, then tighten the locking screw – and that's it!

Life is seldom that simple, however, and this filter only has a partial effect. Although it may be quite effective at reducing your receiver's sensitivity to cellular radio at, say, 935 or 936MHz, it will also have some effect on the 934MHz signals as well. This is because the notch is not that sharp and the laws of physics say that you cannot filter out a frequency 2MHz away without incurring some insertion loss on the desired frequency as well.

The bottom line is will this filter help you (assuming you are suffering cellular radio interference)? The answer is yes, if the interference isn't too bad, but you will find 934MHz signals a couple of 'S' points or lights down. This is tolerable on strongish local QSOs, but it won't improve your DX contacts.

Paul Sergent is happy to send these filters out on a sale or return basis and will give you a refund (less the postal costs) if you find the filter does not help. He suggests that clubs order one and pass it around to see who it helps.

To be effective, any filter should be fitted ahead of the pre-amp, and it is, of course, the pre-amp which is usually the true cause of the cellular QRM. I shall return to this point in the months to come, but briefly, most cellular interference is caused by badly tuned 934MHz rigs or, more likely, naff pre-amps!

Ideally you want a pre-amp with variable gain settings and the ability to switch it off altogether. And yes, one such beast is on its way from Corona of Japan. Watch this space for details.

Activity news

Well, not much this time because I haven't received any letters yet!

Quite a few 934 people are also ATVers as well: there's Graham GM34 who has a superb 450ft asl site in Leeds; he is G6YHW on ATV. Ivor G1IXF from Bristol is also into amateur television; and I use 934MHz as the talk-back channel when I'm sending pictures to Bill WAK101 in Kettering.

Incidentally, Ivor tells me that he can work 50 miles to Tewkesbury under flat conditions, and it needs only the slightest lift to get up to John TB152 in Chasetown, Staffs.

The exact mechanisms that give us these openings will be covered soon, but in the mean time I'd be pleased to know your best DX mileages. We can then set up a league table of super-DX contacts. Who will be the first to get an authenticated contact with the Continent? Will it be to Switzerland or to Holland, which is supposed to be the next country to adopt 934MHz?

Of course you don't need a lift for DX contacts if you go out 'hilltopping'—some very good hook-ups are made regularly from mountain top to mountain top by mobiles, but that's not the same as a DX contact from home.

QSL corner

If you have a distinctively designed QSL send it in won't you? We'll illustrate the best ones from time to time. This is your column so feel free to send in photos of any unusual aerial installations you have built, or anything else related to 934.

Can anyone tell me why stations that are so grateful for DX contacts and promise to QSL directly by return of post never do – even when you send them an sae? Strange, isn't it – and very annoying if you need the card as proof for an award!

Watch this space

That's about it for this month, but there's more to come. Next time I'll let you know what went on at the 934 Club's annual general meeting, and in the months to come we'll take a look at the Crestbyte masthead PA/pre-amp and the new antennas from Tonna, as well as mods for the Reftec transceiver, how to choose and fit N-type and BNC connectors (especially to H100 cable) and other technical topics.

I've got DIY designs for a compact HB9CV antenna (for portable and mobile operation) and for fitting a pre-amp inside a Reftec. If that doesn't keep you busy, I will also be looking at the Swiss PRS scene. So I'll see you next time, and 73 till then! REW

The other item that caught my eye was a warning issued by the FCC to satellite pirates – not the people who watch programmes without authorisation, but people who uplink their own material!

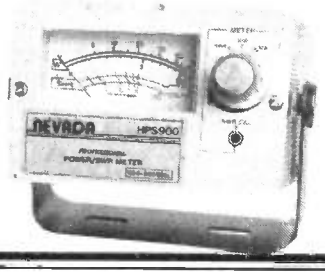
A certain 'Captain Midnight' made the headlines recently when he managed to take over pay-TV network HBO's satellite and substitute his own programme for 10 minutes. The 'programme' was a message superimposed on colour bars: Captain Midnight protested that he would not pay HBO's new tariff of $19.95 and claimed he would repeat his appearances until the company lowered its prices.

The FCC has warned satellite hackers such as Captain Midnight that they face fines of up to $10,000 and/or a year's imprisonment. It also appealed for information, which it will probably not receive if Captain Midnight and his friends become folk heroes.

The idea of disgruntled viewers turning their back garden TVRO dishes into powerful transmitters is somewhat farfetched, though; more likely Captain Midnight is 'borrowing' time on one of the many uplink transmitters in use in the States.

It couldn't happen here, could it? REW

A good power/SWR meter is invaluable, and a cheap one is next to useless. The Daiwa crossed needle effort would be worth buying, as would this Nevada unit



MEDIUM WAVE DXING

by Steve Whitt

Summertime has a couple of drawbacks as far as the MW DXer is concerned. Firstly the short nights restrict the path of darkness needed for really long distance listening, and secondly reception is often impaired by high atmospheric static noise due to thunderstorms. All is not lost though, since periods of very good DX are possible when conditions are right, and hopefully the beautiful (!) summer weather will not totally curtail your DXing.

Long waves

The introduction to the long wave band in the May edition of this column attracted quite a bit of interest, so that is why we find ourselves back in this portion of the radio spectrum. Reader R M of Canterbury writes to mention that France Inter has indeed moved from its old channel of 163.84kHz to a standard channel allocation of 162kHz. This old frequency was intended to be used as an off-air frequency standard (163.84kHz = $2^{15} \times 5$Hz) against which other signals could be compared.

A number of other long wave stations are also used as frequency standards (eg BBC R4 on 200kHz) because the propagation characteristics of these frequencies are such (see the May issue) that signals can be broadcast over very large areas with minimal disturbance of received phase or amplitude. Transmissions on MW and SW bands generally suffer considerable distortion due to propagation via ionospheric paths, whereas signals on the LW band (and lower frequencies) will traverse long distances via the stable ground wave path. Such distortion would effectively negate the effort needed to maintain the extremely high frequency stability of such transmitters.

Plenty to hear

Richard Marris (author of the LW loop aerial article published in *R&EW* April 1986) writes that from his personal observations both in the UK and the USA, there is in fact plenty of interesting activity on the long wave band.

Of course the activities of the broadcasters in Europe/USSR and North Africa are well known, but outside this area the LW band is widely used by aeronautical and maritime navigation beacons. One little known activity on the LW band is to be found between 160kHz and 190kHz (1750 metre band) in the USA where radio experimenters are able to operate low power transmitters without a licence.

The loop aerial described in the article by Richard Marris was primarily intended for use over the normal long wave band, but it is possible to adapt its operation for other frequencies. Gilbert Marazzini from Milan, Italy writes asking for details of such a modification to enable reception of meteorological chart transmissions from Offenbach and Pineborn in Germany (on 134 and 117kHz respectively).

It is generally quite simple to modify an LW loop for this purpose; one can either add a few more turns to the winding to increase inductance (and coincidentally the signal pick-up) or one can increase the tuning capacitance. *Figure 1* illustrates a loop that has been modified to cover a band of lower frequencies as well as the normal band.

Long wave loops often exhibit very selective tuning, and sometimes a resistor needs to be added in shunt to damp the Q of the tuned circuit. For example, an LW loop with a typical Q factor of 100 will typically exhibit only 2-3kHz bandwidth, which is far too narrow for good quality reception of AM signals; most receivers require a bandwidth of 9kHz for satisfactory AM reception.

UK MW news

At the end of 1985, community radio was hailed by some as a brave new experiment in broadcasting in the UK. However, the Department of Trade and Industry has still not announced the successful licence applicants; it was originally intended that station operators would be announced last December.

The latest news is that the Government is currently planning a drastic overhaul of local radio in Britain. In a green paper to be published this autumn it will consider loosening the structure and finance of the radio system to allow greater freedom of the airwaves. The green paper will discuss the freeing of the ILR stations from IBA control and will examine the now long overdue community stations, as well as the possibility of hiving off the BBC local radio network.

As for the Home Office's plans regarding the community radio stations, it is now considering the possibility of extra stations, especially in London where over 150 applications were received. The Government is expected to have announced 24 winners by the time this appears in print.

New station

A recent new arrival to the MW band is Festival Radio, a special event station being operated by Signal Radio for the duration of the National Garden Festival being held in Stoke.

It will operate from May 1st till late October 0800-1900hrs local time, using a 200W transmitter on 1017kHz and airing programmes locally produced at a £60,000 studio specially constructed at the festival site. The transmitter is co-located with the Signal Radio MW unit on 1170kHz. Unlike previous ILR operations at garden festivals, this operation at Stoke is being run on an entirely commercial basis.

DX file

The 1985-86 MW DX season is well and truly over now but it is nevertheless possible to hear many long distance stations at this time of year. All is not lost for the keen DXer; the transatlantic path to North America is often open in the few hours before UK sunrise. But by and large summer propagation conditions favour paths to South America and the Caribbean, which can be heard from around midnight (GMT) onwards.

Finally, don't forget that during the summer months it can prove worthwhile to search out some of the more elusive European and UK local stations.

As a conclusion to the DX season I managed to hear amongst others the following stations in May:

590 VOCM St John's, NF Canada with pop music heard from 0000.
918 R Ljubliana, Yugoslavia with English news at 2335 weekdays.
1050 WHN, New York, USA with country music around 0030.
1220 R Globo, Rio de Janeiro, Brazil in Portuguese as early as 2230.
1530 Voice of Peace in the Eastern Mediterranean, in English with pop music around 0100.

Remember all times quoted are in GMT/UTC, frequencies are in kHz.

Why not drop me a line here at *R&EW* (at the Brentwood office) with details of your loggings and any MW queries you may have, so that I may include them in this column in months to come.

73s till next month. REW

LATEST LITERATURE

Clubs, manufacturers, publishers and agents are invited to send details of new books, catalogues, data sheets, etc for inclusion on this page

If you visited the RSGB's annual show at the NEC this year you may well have seen Peter Rouse's new book, **Scanners – A VHF/UHF Listener's Guide,** on display at the Argus stand.

Peter (GU1DKD) regularly writes articles for this and other magazines, and is doubtless familiar to many as a writer who 'knows his onions'. This book is written to his usual standard, and is intended as a beginner's guide to scanners and what can be heard using them. This said, much of the information it contains will be useful to many more experienced radio users.

It begins, of course, with basic radio theory, covering this in an elementary, non-technical manner in just sufficient depth to allow a beginner to understand what's going on. Scanner hardware, operation, aerials and accessories are covered, with details of RT procedure so that what is heard can be understood, and a brief overview of equipment available in the UK.

The most interesting section for many people will undoubtedly be the chapter outlining UK frequency allocations. The basic list is similar to the one we published in *R&EW* some time ago, but in addition to this there are details of the air bands (including frequencies used at different airports, Volmet, etc), marine and amateur bands, PMR and radiophone frequencies, and so on.

All in all it's a rather good book, and I look forward to the promised *Scanners 2,* in which Peter will cover modifications, DIY accessories and international allocations as well as offering greater detail about some of the *Scanners 1* topics.

Scanners (ISBN 0 85242 880 4) is published by Argus Books Ltd, 1 Golden Square, London W1R 3AB. It costs £7.95.

Last month we mentioned the biography of a pioneer of television. We've another biography this month: **A First Class Job!** describes the life of Frank Murphy, who founded Murphy Radio Ltd in the late 1920s.

The book is written and published by Joan Long, Murphy's daughter, and describes a man who was not, surprisingly enough, primarily a wireless enthusiast.

Murphy became involved with radio almost by accident when he joined the Royal Flying Corps during the First World War, and although very talented and well educated he knew nothing of the subject at that time. Such was his ability that before the war ended he had set up and was running the Officers' Wireless Training School.

The book is a little disappointing here, for it just doesn't give enough information. I would like to have known a lot more about Frank Murphy's early years, with more anecdotal evidence to give a greater feel for the man's personality. *A First Class Job!* tends to merely recount the events of Murphy's life, with too little attention given to bringing the pages to life.

However, it is nevertheless a fascinating history. It gives some insight into the early days of commercial production of wireless sets, and shows Frank Murphy as a man of unusual personal philosophy and a laudable approach to running a business.

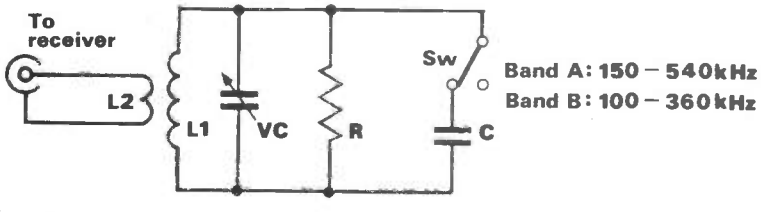
The company's logo was 'making wireless simple', and he appreciated the need for ergonomic design ('user friendliness', to use today's jargon) and reliability at a reasonable price. He kept his workforce happy with high wages and a real family atmosphere, and built up a first class dealer network in a time when rip-offs were accepted as nothing unusual (interestingly, companies such as Saab and Volvo are at present using a similar approach to engender the feeling of pride amongst the workforce, and of involvement in the success of the company, that Murphy thought so important).

That Murphy's prime interest was not radio is revealed when Joan Long describes how he left Murphy Radio to start a new business based on his ideas for a 'true industrial democracy' – his 'New Conception of Business'. Frank Murphy Ltd was formed just before the Second World War to produce cheap, good quality furniture, and it is unfortunate that the war intervened to spoil his plans.

The remainder of his life involved a series of abortive plans to start more businesses, emigration to Canada, and finally death in obscurity. The end was not as tragic as it may sound, and Frank Murphy does not come across as a man who ended his days as an unhappy and broken man: quite the reverse, in fact.

A First Class Job! is well worth reading, as much for the thought provoking business practices outlined as for the history of a fascinating

Fig 1 *Modified loop*



VC=500pF variable capacitor
C=680pF polystyrene or silver mica capacitor
L1=56 turns close wound: 7 strand flex 0.9mm OD
L2=3 turns close wound over L1
R=damping resistor, select on test (20kΩ-200kΩ)

character. It is published by Joan Long, 5c Weybourne Road, Sheringham, Norfolk NR26 8HF (ISBN 0 951120 8 0 8).

I reckon that's enough armchair reading this month: now on to more practical books. **Practical Data Communications** by Fred Jennings is a real goldmine of information for anyone with a serious interest in connecting up computer and terminal equipment.

It is intended for those with a professional interest in data communications (it most *certainly* won't lead you by the hand through connecting up your Spectrum to Micronet), but its appeal will extend to anyone with a need for a good reference book in this particular area.

Fred Jennings is one of those authors who doesn't believe in wasting a single word. Consequently there is a great deal of info in *Practical Data Communications,* but like a rich meal it will need quite a bit of digesting. It covers communications interfaces (RS232, V.25, RS449 etc), modems, direct connection, analogue and digital networks, multiplexer networks, packet switched networks, local area networks and data link protocols. There is frequent reference to the international standards organisations, and extensive appendices.

Many people will find this a very useful book, but it definitely ain't bedtime reading (not, at least, if you're as dozy as me). It's published by Blackwell Scientific Publications, Osney Mead, Oxford OX2 0EL (ISBN 0 632 01306 0), and costs £14.95.

Another couple of books sure to prove useful have been published as second editions by Newnes Technical Books.

The first is **Oscilloscopes – How to use them / How they work** by Ian Hickman, revised from the 1981 edition. Most people would acknowledge that an oscilloscope is a highly desirable piece of test equipment, and the more an operator knows about its capabilities and drawbacks the more use he will find it. The author draws an analogy with driving: the best drivers are those who know a little about what makes a car tick.

As well as describing the basic oscilloscope, the book details the functions of top range models (just so that we know what we're missing) and accessories such as probes, hoods, cameras etc, plus some special purpose 'scopes. Included in the chapter covering use are the areas likely to cause misleading results, with practical examples to describe using a 'scope.

Oscilloscopes won't tell you all there is to know about the subject, but it's a useful handbook to have about the shack. It retails at £5.50 (ISBN 0 600 33373 6).

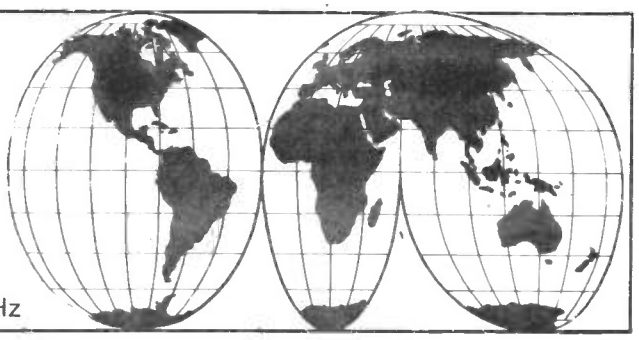
The other revision from Newnes, **Op-Amps – Their principles and applications** by J Brian Dance, seems to have been a popular book: after first appearing in 1978 it was reprinted three times before being revised (there must be money in this lark – I think I'll write a book!).

This book is a lot like *Data File:* it describes a selection of op-amps (old favourites like the 741 and LM380 as well as some newer devices) and gives useful circuits based on them, illustrating by example how they work. The circuits are fairly straightforward, including audio amps, mixers, meters etc (although no mathematical applications, for which op-amps were originally designed and from which they got their name).

Op-amps should keep many people happily occupied next autumn when the weather closes in again, and will hardly break the bank at £4.95 (ISBN 0 600 33372 8).

Newnes Technical Books are at Bridge House, 69 London Road, Twickenham, Middlesex TW1 3SB. REW

SHORT WAVE NEWS FOR DX LISTENERS



By Frank A Baldwin

All times in GMT, **bold** figures indicate the frequency in kHz

In this issue we continue our review of out of band transmitters with a look at those stations operating between the limits **4460** and **4740**, with the exception of those in the Far East operating between **4002** and **4740**. The frequencies and times are, to the best of my knowledge, correct at the time of writing. Note, however, that modifications to these published facts can always occur, sudden changes being a way of life on the short wave bands, particularly on the lower frequencies such as those presented here.

Commencing at the low end of the frequency range under discussion, a start can be made with the recently reactivated Bolivian station, Radio Movima in Santa Ana de Yacuma on **4472** operating from 1100 to 1900 and from 2000 to 0300, both closing times being variable; the power is 1kW. Radio Movima is rarely heard by DXers based in Europe. Like some other low powered stations featured here their signals are, more often than not, swamped by those emanating from local (to the listener), more powerful utility transmitters. However, hope springs eternal according to the old adage, and also according to many an old DXer – just occasionally some of these low powered super-DX stations are heard by UK and European based listeners and reported in the SWL press.

Sort 'em out

On **4485** there are two Russian transmitters: Petropavlosk, Kamchatka Oblast USSR; and Ufa, Bashkir ASSR. Petropavlosk is unlikely to be heard by UK listeners and is seldom listed in reports. It is on the air with Moscow 2 programmes from 1400 to 1600, and from 1700 to 1800, and 1800 to 1400 with those of Moscow 1; power unknown. Ufa is heard more often: at 50kW, it is on the air from 0200 to 1600 with both Moscow 1 programmes and locally originated presentations in Russian and Bashkirian.There are slight daily time variations within the limits specified.

Which station are you hearing? Sort 'em out – that is half the fun of short wave listening!

More Russians

With snow on their boots? Not exactly, but you may care to freeze on **4520** where, if the trail isn't cold, you may dig out the 50kW Khanty-Mansiyisk in the Oblast of that name, USSR, relaying Moscow 2 from 0000 to 2000. It is rarely located under the avalanche of surrounding QRM.

Then there is the more frequently heard Alm Ata, Kazakh SSR, relaying Alma Ata 1 from 0000 through to 1930. This schedule also includes local programmes in Russian and Kazakh and some relays of Moscow 1: the power is 50kW and the frequency is **4545**.

Kharbarovsk, Kharbarovsk Kray, on **4610** at 50kW, operates from 2000 to 1400 with both local programmes and relays of Moscow 1, it is reported from time to time in the SWL press.

On nearby **4615** is the 5/15kW Pavlodar, Kazakh SSR with programmes of a local origin, from 0130 to 0200 and from 1345 to 1500. Seldom logged, it is for that reason worth trying for – have a go.

A sure-fire logging of a USSR based transmitter will be obtained by aiming at **4635**. The 50kW Dushanbe, Tadzhik SSR is the target; a bullseye is likely to be scored from 0000 to 2000 when relays of Dushanbe 1 together with local programmes in Russian, Tadzhik and Uzbek are featured. Ranging on **4635** often results in a hit it seems.

Ecuador

Radio Nacional Espejo, Quito, on **4679.6**, has been back on the air for some months after an absence of just over a year. At 5kW, sign-on is reportedly at 1100 to 1130, sign-off unknown. Previously this one worked around the clock, but according to the latest information to hand it now operates irregularly.

An eventual return to the more normal schedule would not surprise me. Latin American stations, in company with those in other areas of the so called third world, encounter difficulties in obtaining spare parts when breakdowns occur; this resulting in long periods off the air and/or spasmodic operation. The hope is that Radio Nacional Espejo will soon be radiating around the clock at full power again.

Bolivia

Radio Paititi, Guayaramerin, is occasionally heard by European DXers on its **4682.2** channel where it presents local programmes from 1100 to 1730 and from 2130 to 0300 with a power of 5kW. Try around 0230 for this one.

Radio Riberalta, Riberalta at 0.5kW is, rather surprisingly, frequently reported in the SWL press world-wide. The transmissions are in the clear for those with a selective receiver. The frequency is **4696.7** and the station is on the air from 1100 to 0330, the sign-off time varying on occasions.

Radio Abaroa, Riberalta, has of late been reported on **4700.5** (ex **4718** and **4720**), so it is now back on or near the original **4700.** With a power of 0.5kW, Radio Abaroa is listed as being on the air from 1100 to around 0400. It often appears amid the reported logs of DXers world-wide.

Peru

Radio San Juan de Caraz, Caraz, radiates on **4733.9** from 1200 to 0200, both times being variable. The power is unknown, this one being reported mainly by those residing nearer to Peru than we are here in the UK.

Mozambique

Radio Mozambique, Maputo, has for some time now been logged by many DXers on **4737**. At 25kW, Emissao Nacional is on the air in Portuguese from 0300 to 0615 and from 1500 to 2215, the latter closing time being variable.

Bolivia again

Radio Mamore, Guayaramerin, at 1kW seldom shows up in the SWL press and for that reason alone is worth going for. On **4739**, the schedule is from 1030 to 1730 and from 2100 to 0300.

Radio Santa Ana, Santa Ana de Yacuma, is now being heard on **4749**. This one was widely reported when it was on its former frequency of **4803.6**. With a power of 1kW, it is on the air from 1100 to 1800 and from 2130 to 0230, all times being variable. It has reportedly been heard to sign off at 0053 and on another occasion at 0250 – which makes the sign-off time exceedingly variable!

Next month

In the next issue of this illustrious journal some information on the Colombian 60 metre band scene will be provided. To date, this country has not been individually featured in this series.

AROUND THE DIAL

We trust the following information will enable those interested to hear many of the stations listed near the times stated.

AFRICA

Ascension Island

BBC Relay on **21660** at 1523, OM with announcements, then OM with some folk songs in English during a World Service transmission to West and Central Africa, timed from 0915 to 1600.

SHORT WAVE NEWS

Cameroon

Radio Douala on **4795** at 2109, OM (Old Man = male) announcer with a newscast in English, this is a relay of Yaounde, the bulletin being timed daily from 2100 to 2115.

Libya

Tripoli on **9600** at 0613, OM with the news in an Arabic transmission for Africa, scheduled from 0400 to 2300.

Madagascar

Radio Nederlands Relay on **17575** at 1440, YL (Young Lady) with a newscast of world affairs, the station identification and then 'Background Report', all in an English programme directed at South and East Asia, daily from 1430 to 1525.

Morocco

Tangier on **17595** at 1446, OMs with songs in Arabic followed by recitations from the Holy Quran at 1448 in an Arabic presentation for Europe, the Middle East, West Africa, South Morocco and Mauritania, scheduled from 1400 to 1700.

Nigeria

Lagos on a measured **15119** at 0847, OM with news of local and African affairs and events in English. Radio Nigeria radiates English programmes in the North African and Overseas Service daily from 0500 to 0600, 0700 to 0800, 0830 to 1000, 1800 to 1900 and from 2100 to 2200.

NORTH AMERICA

Canada

Radio Canada International, Montreal, on **17820** at 1545, OM with the station identification at the end of a news bulletin in English for Europe, timed from 1538 to 1545 Monday to Saturday inclusive.

USA

WYFR Family Radio, Okeechobee, Florida on **15440** at 1845, YL with the station identification at the end of the French transmission to Europe, scheduled from 1800 to 1900.

WYFR Family Radio on a measured **15566** at 1832, OM with a talk in the Italian presentation to Europe, daily from 1800 to 1900.

WYFR Family Radio on **21525** at 1603, OM with the station identification and the English programme for African consumption, on the air from 1600 to 1700 on this channel.

SOUTH AMERICA

Brazil

Radio Difusora do Amazonas, Manaus, on **4805** at 2310, OM with announcements, then OM with a pop song in Portuguese. At 5kW, this one is on the air from 2230 to 0300 and is being reported by SWLs (short wave listeners) world-wide. The city of Manaus, on the left bank of the Rio Negro near the junction with the Amazon, is the capital of Amazonas state in north-west Brazil. It is a major inland port for ocean-going ships.

Colombia

Caracol, Neiva, on **4945** at 0502, OM with a newscast in Spanish. Caracol has a power of 20kW, the schedule is 24-hour. An easy one for newcomers to log, it is regularly heard and reported in the SWL press world-wide.

Ecuador

Radio Quito, Quito, on **4920** at 0359, OM and YL with alternate announcements in Spanish, OM with the station identification at 0401. The frequently heard Radio Quito has a power of 5kW and is on the air from 1000 to 0500 in the Red Informativa National Network.

Venezuela

Radio Rumbos, Villa de Cura, on **4970** at 2242, OM with the station identification and promos (promotions) in Spanish followed by local-style pops.

Ecos del Torbes, San Cristobal, on **4980** at 2240, OMs with the news in Spanish, each item being separated by two chimes.

Both of these Venezuelan stations are regularly heard, frequently appearing in DXers' reports submitted to club journals.

ASIA

China

Radio Beijing on **11600** at 1430, YL with annoucements in English then a violin solo during the English programme for Asia, timed from 1400 to 1600 daily.

North Korea

KCBS (Korean Central Broadcasting Station), Pyongyang, on a measured **9977** at 1919, military music then YL with songs in the Korean programme for Africa, Europe, Near and Middle East scheduled from 1900 to 1950.

PACIFIC

Philippines

VOA (Voice of America) Relay, Tinang, on **9555** at 1450, OM and YL with the Chinese programme for the Far East and Asia, scheduled from 1100 to 1600.

NEAR AND MIDD E EAST

India

AIR (All India Radio), Delhi, on **7412** at 2047, YL with a talk in English about Sri Lanka followed by the station identification, then YL with a Punjab folk song. This English transmission for Europe is on the air from 1845 to 2230.

AIR Delhi on **9950** at 1550, OM with a talk about Egypt in the programme announced as Spotlight during an English slot in the North Regional Domestic Service. Delhi is on this frequency in Indian languages and English from 1330 to 1740 but the closing time may vary to accommodate some sporting commentaries.

Iraq

Baghdad on **9630** at 2020, YL announcer then OM with war news in Arabic with many mentions of 'Irani'. The schedule of this Arabic programme to Europe is from 1500 to 2130.

Pakistan

Karachi on **7365** at 1453, YL with songs and some local-style musical backing in the Urdu/English transmission for the Middle East, timed from 1330 to 1613.

Qatar

Doha on **15265** at 1429, Arabic-type music, YL announcer in the Arabic programme for Europe, radiated from 1300 to a variable closing time around 1700.

Syria

Damascus on **9670** at 2028, OM with the station identification and a talk in English about their revolution which took place twenty-three years ago. Directed at Europe, this English presentation is broadcast from 2005 to 2105 daily.

Damascus, in Arabic *Esh-Sham* in South Syria on the Barada River, is the capital of Damascus Province and of the Syrian Arab Republic. Dating from unknown antiquity it has been held by Assyrians, Persians, Romans, Macedonians, Arabs, British (it was captured in 1918) and a French mandate (1920 to 1941) prior to independence of the Syrian state in 1943.

Turkey

Ankara on **7215** at 2059, piano music interval signal, YL with the station identification in English, 'pips' time-check at 2100 then OM with the news and English programme to Europe, North America and Asia, scheduled from 2100 to 2200.

Ankara on **9660** at 2210, OM with songs in the Turkish programme for Europe, timed from 1600 to 2150 on this frequency.

NOW HEAR THIS

(RFO (Radiodiffusion Francaise D'Outre-Mer), Cayenne, French Guiana, on **5055** at 2246, OM with a talk in French. With a power of 10kW, Cayenne is on the air in French from 0900 (Sunday from 1000) to 1100 and from 2000 to 0100 (Saturday until 0300, Sunday until 0200). The city of Cayenne, on an island at the mouth of the Cayenne River, is the capital of French Guiana.

NOW LOG THIS

Radio Nueva America, La Paz, Bolivia, on a measured **4796.5** at 0008, OM and YL with announcements then OM with a talk in Spanish – still talking at 0016 retune. Radio Nueva America is on the air from 1000 to 1430 and from 2200 to 0400 (Sunday from 1030 through to 2300, variable sign-off time). The power is 1kW and it is regularly logged here in the UK and Western Europe. The city of La Paz is the largest in Bolivia and is the *de facto* (administrative) capital whilst Sucre is the *de jura* (legal) capital. REW

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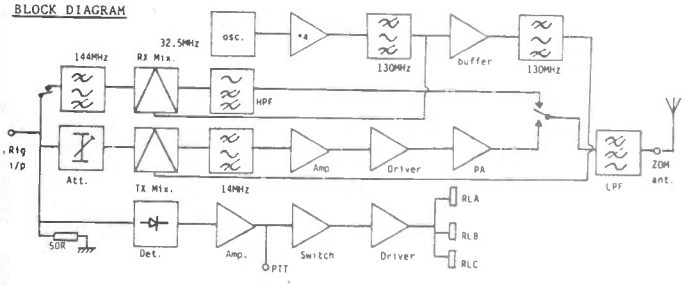
The HOWES HC220 and HC280 offer an excellent alternative to an HF transceiver. At the present point in the sun spot cycle, is there any sense in spending a small fortune on a 9 band HF rig? The two most active HF bands can be worked using your existing 2M SSB/CW rig and our transverters – and at a considerable saving in cost too.

An exciting possibility offered by these new HOWES transverters is HF mobile operation. This becomes much more practical with the combination of a compact 2M rig, and a neat little transverter tucked out of the way.



Both the HC220 and HC280 offer a good 10W RF output from missmatch proof transistors. The 2M drive level required is adjustable between 5 and 5W, but it can be easily modified to accept 10W or so. The use of a high proportion of fixed value filter components keeps alignment simple, and the output spectrum clean. No fancy test equipment is needed to align your kit.

On receive, the balanced mixer offers both sensitivity, and a good dynamic range. The 10 element bandpass filtering which is used ahead of the mixer requires no alignment at all – simply wind the right number of turns on the torroids! If you are competent with a soldering iron, you should be able to build a HOWES transverter. The full, clear documentation and the component locations printed on the double sided, solder masked PCB make construction a pleasure.

HC220 2M in, 20M out transverter kit: £48.90. **Assembled PCB: £79.90.**
HC280 2M in, 80M out transverter kit: £48.90. **Assembled PCB: £79.90.**

TRF3 SHORTWAVE BROADCAST RECEIVER.
Listen to the news, sport, music, political comment from around the world on the new HOWES TRF3 shortwave receiver. The design features switchable input impedance so that it can be used with long or short antennas, and there is an input attenuator for strong signal conditions. Up to 2W of audio output are available, but the low quiescent current consumption means that it can easily be battery powered, if you wish. Frequency coverage is 5.7 to 12.8 MHz in three bands using a 50pF tuning capacitor (available at £1.50). This simple TRF design may be firmly rooted in the silicon age, but the old thrill of far away stations heard on a home built set is still strong! Great fun to build and use – educational too!
HOWES TRF3 kit: £13.90. **Assembled PCB module: £18.90.**

DcRx Direct Conversion Communications Receiver.
This simple, but very effective, single band receiver is available for 20, 30, 40, 80 & 160M. Up to 1W audio output, stable FET VFO, and amazingly good performance for a simple set. How about using one with an MTX20 or CTX transmitter for a QRP holiday and portable station? Suitable tuning capacitors for all but the 160M version are £1.50 each – you need two per receiver.
DcRx kit: £14.80. (Please state band required) **Assembled PCB module £19.90**

MTX20 20M CW TRANSMITTER.
The HOWES MTX20 is a 20M CW transmitter giving up to 10W RF output, but this is adjustable, so you can turn it down to take part in the G-QRP Club's activities and awards. The design pays very careful attention to the quality of the output signal. Full key click and RF output filtering are provided.

The HOWES MTX20 is crystal controlled (one crystal provided), but you can wire up a tuning capacitor to VXO the frequency a few kHz, which is very useful. A matching VFO should be available soon. The MTX20, like its smaller cousins the CTX40 and CXT80, has the output transistor's heatsink mounted on the board, and it requires very little alignment. A super, new transmitter, and one that we feel will become very popular indeed.
MTX20 kit: £19.95. **Assembled PCB module: £26.95.**

XM1 Crystal Calibrator with 8 o/p.	**Kit: £16.80.**	**Assembled PCB Module: £21.30**
CTX40 (40M) or CTX80 (80M) QRP CW TX	**Kit: £12.95.**	**Assembled PCB Module: £18.95**
CVF40 or CVF80 VFOs for CTX	**Kit: £9.30.**	**Assembled PCB Module: £14.90**
ST2 Side-tone/Practice oscillator	**Kit: £7.30.**	**Assembled PCB Module: £10.80**
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CM2 Quality Mic with 'VOGAD'	**Kit: £10.25.**	**Assembled PCB Module: £13.75**

If you would like further information on any item, simply drop us a line, enclosing an SAE. We have a full page of information on each kit, plus a general catalogue.

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73 from Dave G4KQH Technical Manager.

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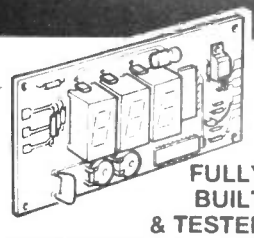

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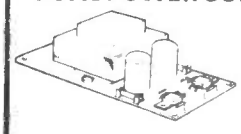

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QSO

On these pages we present details of interesting contacts from clubs and individuals. We would be happy to receive any similar items from readers

ERRATA

Spectrum RTTY (Jan/Feb '86)

A couple of points have come to light which may be causing some difficulty to the less experienced constructor who is not able to pinpoint faults:

a) R3 is shown as 12k when in fact it should be 8k2. At 12k it will prevent the baud rates from being set up correctly.

b) In the set-up procedure steps 2 to 4 are not quite correct. The 3V stated is the expected ac voltage on the outputs of the filters. The steps should read:

(2) Connect the input lead of the terminal into the 'ear' socket of the Spectrum and select 'set-up/test' on the main menu. Monitor the ac voltage on IC7 pin 7, select the '1445Hz tone' option and adjust RV3 for a maximum (about 3V). Note that the test tone lasts only 10 seconds. If a longer time is needed, the tone should be re-selected.

(3) Repeat (2) for 1700Hz tone after switching SW2, adjusting RV4 for maximum reading.

(4) Repeat (2) for 1275Hz tone, adjusting RV5 for maximum ac voltage on IC7 pin 8 (about 3V).

c) The formulae associated with *Figure 2* seem to have been omitted. These formulae will help if problems are encountered in setting up. Just for the record they should be:

Passband gain = R3/(2R1)

$$\text{Centre frequency} = \frac{1}{2\pi C}\sqrt{\frac{R1+R2}{R1.R2.R3}}$$

$Q = \pi f\ R3.\ C$ where $C_1 = C_2 = C$

It also appears that R23 is better at 33k than 39k.

Low-pass filters (April '86)

Some BBC micro owners have had problems with one of the programs accompanying this article.

The trouble arises because of the term LOG which appears in the function on line 30.

In Microsoft Basic LOG refers to $\log_e$, but in BBC Basic it means $\log_{10}$; $\log_e$ is represented by LN. If LN is substituted for LOG the program should run correctly.

Our apologies for any inconvenience caused.

Class B morse

The DTI has announced that following the successful completion of the Class B morse experiment, during which more than 6000 letters of variation were issued to allow Class B operators to transmit morse code, this facility will now be a permanent feature of the B licence.

Boozers' corner

If you want to celebrate the above announcement, you could do worse than to go along to the Southgate Amateur Radio Club gathering on 10 July, at which Ken Roberts G3DKZ is giving instruction in home brewing.

OK, I know what you're thinking: I've either cracked or I'm making rather bad jokes these days. However, I feel I ought to point out that they *do* mean the home brewing of alcohol.

The place to be (or not, depending upon your inclination) is Holy Trinity Church, Green Lanes, Winchmore Hill, London N21 at 7.30pm.

More getting stoned . . .

It seems they're just as bad in Maltby. The Maltby ARS has arranged a trip to Stones brewery for 24 June (they must be mad – that's a Tuesday, up for work in the morning).

They're also looking for 'a few bodies' to give a talk in the autumn period (seems to me they should have more than a few bodies on 25 June . . .).

I dare say they have a good idea of hospitality, all things considered, so if you've got something worth hearing get in touch.

Club secretary is Ian Abel G3ZHI, 52 Hollytree Avenue, Maltby, Rotherham.

There is life on 10

March saw the publication of the first newsletter of the Southern 10m FM Group, an organisation formed to keep up activity on the band during sunspot minimum. A year's subscription costs £1 (to cover postage) and membership is open to anyone and everyone interested in 10m, including listeners and Class B operators.

Contact Jim Hicks G4XRU, 33 Hayling Rise, Worthing BN13 3AL (you might also like to watch out for a forthcoming article in *R&EW* describing a suitable pre-amp for the band).

More morse

To return to the morse theme for a moment, Harpenden Amateur Radio Club members Keith G0CXP and Ian G0CPN run an 'on-air' morse class every Sunday night.

The club meets at the Silver Cup pub (oh my God, more dipsomaniacs), St Albans Road, Harpenden twice a month (forthcoming dates: 8 and 22 July, 12 and 26 August).

New blood

As a result of the AGM in April, the Grampian Repeater Group now has a new secretary to whom all enquiries should be addressed: Mrs Moira Brunton GM6VGL, 7 Fairview Drive, Daneston, Aberdeen AB2 8ZL.

Calling all computers

G3WHO is giving a talk on the use of microcomputers for RTTY/AMTOR at the Coventry ARS meeting on 20 June. Further info from Robin Tew G4JDO, 4 Chetwode Close, Coventry CV5 9NA. Tel: (0203) 73999 (visitors are always welcome).

Another nutter

If you live anywhere near Harrow it's worth becoming a member of the Radio Society of Harrow just to read the editorial in *QZZ*, the society's newsletter. Editor Chris Friel G4AUF definitely has a screw loose (in the latest issue he's babbling about lambs gambolling – and losing), but he writes one of the most consistently amusing columns I've come across (don't want my job do you, Chris?).

The society meets on Fridays at the Harrow Arts Centre (I bet it's got a bar, too), where on 20 June they're having a film show entitled *Let's Build a Satellite*.

A day at the races

Brighton Racecourse will play host to this year's Sussex Mobile Rally on 13 July, where all the stands will be under cover in case of typical British summer weather (that's what I like, a note of optimism).

The entrance fee will be £1,

except for those under 14 years of age who get in free, as do disabled visitors (ramps and wide gangways provide easy access for wheelchairs).

There will be plenty of stands, a cafeteria and bars (note the plural) and a special event station, GB2SMR. Further details from Mark Spillett G4UAW, 26 Westlands, Rustington, Sussex BN16 3NW. Tel: (0903) 782594.

Pushing the cause

The Telford and District ARS will be holding an open day on 29 June at Dawley Bank Community Centre, Bank Road, Dawley, Telford, Shropshire TF4 2AZ in order to promote the image of amateur radio.

Joe Public will get to see demonstrations of HF and VHF operating as well as fast-scan TV and RTTY. The event will be visited by Lord Northfield, chairman of the Telford Development Corporation.

Making contact

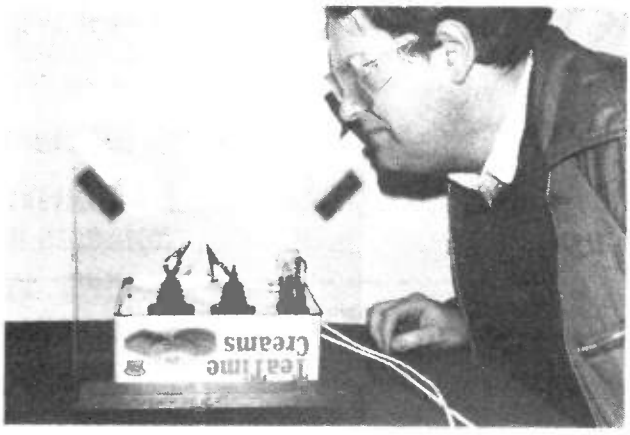
One of our younger readers is looking for a pen pal interested in electronics and computers, preferably with a Commodore 64 and disc drive and aged between 15 and 17. If you fit the bill, contact M Whitcombe, 1 Pen-y-Waun Road, Trinant, Crumlin, Gwent NP1 4JS.

Helpline

We seem to have had a lot of enquiries about where to get hold of radiation monitors lately. I wonder why? (I really *must* try and find time to read the papers more often).

Anyway, one query along similar lines concerns the radiation monitor design published in April '82, and strangely enough it was received before the Chernobyl disaster – the guy must have ESP.

This reader would like such a unit, or something similar, but doesn't have time to build it himself. Anyone care to oblige? (for a suitable remuneration, of course). Drop us a line and we'll put you in touch.



THE BIDDULPH BOMB

Wimbledon & District Amateur Radio Society Chairman G4XLM, in safety glasses, inspects the 'Biddulph Bomb' devised by Dr Dick Biddulph G8DPS, to demonstrate the dangerous amounts of energy stored in electrolytic capacitors.

The bomb was used at a WDARS presentation on electric shock in conjunction with the St John Ambulance Brigade.

It is not known who ate all the Tea Time Creams.

When Brian Kendal and Jeff Howell asked for ideas for useful programs back in April, one reader, P J Cooper G3CXI, responded with rather more than just ideas. Reproduced here are two programs he uses for designing antennas. ¼-wave spacing is used for the reflector and 0.15 for the directors, which performs fairly well in practice. The formula used is empirically derived as 5400/F (MHz), to give dimensions in inches (which makes life easier when dealing with VHF arrays). The Plus 4 program is included because not much software exists for this machine. Our thanks to Mr Cooper. It's only right that such efforts be rewarded, so a cheque is in the post!

VIC20

```
5 POKE 36879,25
7 PRINT"□"
10 PRINT"■■YAGI ANTENNA DESIGN"
15 PRINT"■■■■■■■■■■■■■■■■■■■■"
20 PRINT"■■BY P.J.COOPER G3CXI"
25 PRINT"■■┌──────────────────┘"
30 PRINT:PRINT
40 INPUT"DESIGN FREQ MHZ:=";F
70 D=5400/F
80 S=(D/100)*25
90 DS=(D/100)*15
100 R=(D/100)*110
110 D1=(D/100)*90
120 D2=(D1/100)*95
130 D3=(D2/100)*95
140 D4=(D3/100)*95
150 D5=(D4/100)*95
160 D6=(D5/100)*95
170 INPUT"NO OF DIR:(MAX 6)";E
175 PRINT"□"
180 PRINT"YAGI ANTENNA DESIGN"
185 PRINT"■■■■■■■■■■■■■■■■■■■■"
200 PRINT"DESIGN FREQ:";F"MHZ":PRINT
205 PRINT"□■■■■■■■■■■■■■■■■■■■■"
210 IF E=1 THEN 350
220 IF E=2 THEN 340
230 IF E=3 THEN 330
240 IF E=4 THEN 320
250 IF E=5 THEN 310
260 IF E=6 THEN 300
300 PRINT"DIR:6=";D6"INS"
310 PRINT"DIR:5=";D5"INS"
320 PRINT"DIR:4=";D4"INS"
330 PRINT"DIR:3=";D3"INS"
340 PRINT"DIR:2=";D2"INS"
350 PRINT"DIR:1=";D1"INS"
360 PRINT"REF SPACING:="S"INS"
370 PRINT"DIR SPACING:="DS"INS"
380 PRINT"REF LENGTH:=";R"INS"
390 PRINT"DIP LENGTH:=";D"INS"
400 PRINT"DIPOLE FOLDED AT VHF"
410 PRINT"FEED IMPEDANCE 50 OHMS"
420 INPUT"NEED PRINTOUT (Y-N)";X$
430 IF X$="Y" THEN GO TO 1000
440 IF X$="N" THEN END
1000 REM HARD SCREEN COPY
1010 R$=CHR$(145):V$=CHR$(146):OPEN4,4:PRINT#4,G=PEEK(648)*256:PRINT#4,R$:FORP=G
TOG+505
1020 C=PEEK(P):C$="":IF(P-G)/22=INT((P-G)/22)THENPRINT#4,CHR$(8)+CHR$(13)+CHR$(1
5);
1030 IF C>128 THEN C=C-128:C$=CHR$(18)
1040 IF C<32ORC>95 THEN C=C+64:GOTO1060
1050 IF C>63 AND C<96 THEN C=C+128
1060 C$=C$+CHR$(C):IF LEN(C$)>1 THEN C$=C$+V$+R$
1070 PRINT#4,C$;:NEXT:PRINT#4:CLOSE4:END

READY..
```

COMMODORE PLUS 4/CBM64

```
5 COLOR0,2:COLOR4,2
7 PRINT"□"
10 PRINT"■■■■■■■■■■■■■YAGI ANTENNA DESIGN■"
15 PRINT"■■■■■■■■■■■■■┌──────────┘"
20 PRINT"■■■■■■■■■■■■■BY P.J.COOPER G3CXI■"
25 PRINT"■■■■■■■■■■■■■┌──────────┘"
30 PRINT:PRINT
40 INPUT"■■■THE DESIGN FREQUENCY IN MHZ :=";F
70 D=5400/F
80 S=D/100*25
90 S=D/100*15
100 R=D/100*110
110 D1=D/100*90
120 D2=D1/100*95
130 D3=D2/100*95
140 D4=D3/100*95
150 D5=D4/100*95
160 D6=D5/100*95
170 INPUT"■■■NUMBER OF DIRECTORS (MAX 6)";E
175 PRINT"□"
180 PRINT"■■■■■■■■■■■■■YAGI ANTENNA DESIGN"
185 PRINT"■■■■■■■■■■■■■┌──────────┘"
200 PRINT"■■■■■■■DESIGN FREQUENCY =";F"MHZ":PRINT
205 PRINT"■■■■■■■□──────────┘"
210 IF E=1 THEN 350
220 IF E=2 THEN 340
230 IF E=3 THEN 330
240 IF E=4 THEN 320
250 IF E=5 THEN 310
260 IF E=6 THEN 300
300 PRINT"DIRECTOR NUMBER  6  =";D6"INS■"
310 PRINT"DIRECTOR NUMBER  5  =";D5"INS■"
320 PRINT"DIRECTOR NUMBER  4  =";D4"INS■"
330 PRINT"DIRECTOR NUMBER  3  =";D3"INS■"
340 PRINT"DIRECTOR NUMBER  2  =";D2"INS■"
350 PRINT"DIRECTOR NUMBER  1  =";D1"INS■"
360 PRINT"REFLECTOR SPACING =";S"INS■"
370 PRINT"DIRECTOR SPACING =";S"INS■"
380 PRINT"REFLECTOR LENGTH  =";R"INS■"
390 PRINT"DIPOLE LENGTH =";D"INS  IMP  50 OHMS"
400 END

READY.
```

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■ Drake TR7, DR7, Aux7, PS7, RV7, SP7, RF clipper, SPR7 base mic, Diawa 1.5-30MHz ATU, 100 watt dummy load. Complete station £1000. All filters fitted to Drake and 2 FA7s + manual. Upmarket Txr: Drake TR7 on it's own, £700 ono. Sony ICF2001D with preselector books etc, £275. New model Ferrograph reel to reel, spare motors, mics, reground heads, three-speed, £70. AOR2002 scanner, new, £375 ono. Mr Fordham, 31C Anerley Park, London SE20

■ Yaesu FV101Z external VFO, excellent condition, hardly used, £65 ono. Tel: Coventry 450476

■ Yaesu FRG7700 HF communications receiver, 150kHz-30MHz, AM, FM, SSB, CW. Good condition with manuals, £270 ono. Paul Hutchison. Tel: Billingham (0642) 532758

■ JRC NRD515 receiver with matching speaker, mint condition, + manual. Frequency range 100kHz to 30MHz. Owner deceased, therefore must sell. Price £550 ono. Tel: Billericay (Essex) 52485 evenings and weekends

■ Drake TX4B Tx and PSU. Eddystone SA12 hamband Rx. First reasonable offer secures, buyer collects. D Bloomfield, 24 Preston Crowmarsh, Oxon OX9 6SL. Tel: (0491) 38360

■ Pye Cambridge AM 10B six channel, with leads and remote, mic etc plus spare lead. Remote and manual £25, 2 for £45. Trio KA 3700 stereo amp £20. Scientifica NMR ESR power supply, offers. Solartron digital volt meter, bench type, offers. Rory Hall, Treen House, 42 Worcester Road, Chipping Norton, Oxon OX7 5YF. Tel: Chipping Norton 3558

■ Complete RTTY station with MZ80K computer with integral screen and data recorder, all software for CW and RTTY Tx/Rx, 48K useable memory. All connecting leads and modem supplied. Auto Tx/Rx from integral Z80A PIO. RFI proof (metal case) plus handbooks. Reluctant sale, £185 ono. Also 30A 13.8V power supply, 19 inch rack type 240V I/P, £50 or exchange 7A type. Triple ⅝ 2m colinear, £12. Andy G0AYZ. Tel: Gosport (0705) 589560 anytime

■ Two ACR13 tubes, £5 each. One 89D, new, £10. Tel: (06667) 7820

■ Tektronic type G plug-in unit plus instruction manual, as new, £15. Dave. Tel: (0706) 228342

■ Bendix loop antenna, LW/MW, remote controlled for outdoor use, £40. Shure 444 mike, £25. Labgear UHF/VHF Televerta, £20. Bendix MN26 Rx, £20. Bendix BC433 Rx, £20. Marconi Guardian marine Rx (mains), £30. Ajax marine R/T (ideal Top Band rig), £45. Small Cossar scope, OK Tx monitor, £25. 200+ *Wireless Worlds*, £30. Hazeltine OAP-1 wavemeter/oscillator, VHF (WW2), mint, £35. Racal TR109L R/T with Geloso convertor (makes super amateur receiver), £75. BC906E w/meter, £10. Tel: Neath (0639) 820356

■ Storno CQM700 radio telephone, complete and in good condition, ideal for second car or for conversion or spares, £75 ono. Also Videocraft Teletext kit, built and working with data sheets and instructions, was fitted to Decca 2230 – will adapt for other makes, ideal for TV engineer, £60 ono. Michael Thompson, 41 Smallwood Road, Tooting SW17 0TN. Tel: (01) 672 5875

■ Electohome RGB high resolution monitor, brand new, in box, never used. Purchased for the QL comp but cancelled order after waiting 7 months. Cost £279, accept any reasonable offer. SG Carvell, 11 Himbleton Croft, Shirley, Solihull, West Mids B90 4UP. Tel: (021) 744 9371

■ Oscilloscope, Telequipment type D83, dual X and Y plug-ins, delayed timebase, 50MHz bandwidth, fully transistorized, in very good condition and complete with probes and manuals, only £300 ono. Tel: Stoneyburn (0501) 62231 after 6pm

■ RTTY interface G3LIV type, new condition, complete with software and leads for BBC micro, £50. *Radio & Electronics World* Uosat receiver, needs attention, £15. BBC EPROM programmer for 2764 27128 with software on disc or tape, £35. Tel: (01) 571 3551 after 7pm

■ Technics hi-fi AM/FM stereo tuner, good quality 'Analogue' type. Pushbutton MDX hi-blend and mute controls, 'pulls in' DX FM radio stations well. Demo considered for prospective buyer. Offers, or consider p/ex on 40ch CB portable handset. Tel: D Head on Stevenage (0438) 62179

■ Sony ICF7600D, £100. Tandy 40-channel 4 watt hand-held CB, legal FM 27/81, with external microphone, £70. Yaesu FRG-7700 and ATU (FRV-7700), £255. Two metre base station receiver, crystalled R7 with seven vacant channels, £35. Black and white portable TV, £25. Black and Decker electric drill, £12. 44MHz crystals wanted, *not* R7, £1.50 each offered. Duplicates OK as have two receivers. Tel: J Barton (01) 946 2967 after 6-30pm

■ Icom IC-260A 2m 143.8-148.2MHz FM/SSB 10W multimode mobile. Memories, scanning etc, 7-digit LED display, £200. No offers. Phone Roger G6HQK, Wolverhampton. Tel: (0902) 69285

■ Yaesu FRA-7700 active antenna, mint, £31. Altai KDM-6 1.5MHz-250MHz GDO/wavemeter with six plug-in coils, as new, £41. CW transceive program for Spectrum 48K (Technical Software), no hardware needed, £7. VHF/UHF Manual, 3rd edition, unmarked, £4.50. Kodak EK160 camera for great instant colour photos, used for only one film, £10 (includes carry case). All above ono. Tel: (021) 777 6086

■ Scanner, AOR2002, very little used, as new in box. Very sensitive, can demonstrate, 25-550MHz and 800-1300MHz, £340 ono. Tel: Bournemouth (0202) 520020, ask for Donald

■ 3kW Kubota generator, has only run for 30 hours, £525 ovno. Four 25-element loop yagis for 23cm, complete with Tonna four-way splitter, £100. Sixty metres of LDF450 heliax, £100. Phone (0905) 620041 and speak to the musical answer phone

■ Quad Two amplifiers, Type 22 control unit, Garrard 301, Garrard 401, Wharfedale omni-directional sand filled corner speaker, 3 units, Leak mono FM tuner, valved. *Electronic Engineering* 1949-1960, *Wireless World* 1940-1960, write or phone for price. E Whitehouse, 461 Nottingham Road, Derby DE2 6NA. Tel: Derby 664218

■ Valves, these are all brand new, boxed, with guarantee. Manufactured by Mullard, Mazda, etc 6F23, 6/30L2, 30C1, 30FL12, 30PL1, 30C17, 30L17, EB91, ECC81, ECC82, ECC83, ECC84, ECC88, ECF80, ECL80, EF85, EF89, EF183, EF184, EY86/7, PC86, PC88, PCC84, PCC89, PCC189, PC97, PC900, PCF86, PCF806, PL81, PL82, 30C15 and many more. Phone for quote or send 50p for valves listed plus 55p postage and packing. K Bailey, 40 Seymour Close, Selly Park, Birmingham B29 7SD. Tel: (024) 472 3688

■ Kenwood TS820S HF transceiver, remote VFO820, speaker, manuals, excellent, £465. KW108 monitor scope, £90. Kenwood TS530SP, manual, mic, as new, £565. Katsumi electronic keyer, £35. Admiralty No 7681 key, £25. Mics, boxed, Shure 401A Hi-Z, Trio MC35S, £10 each. Kenpro KS-065 bearing, new, £10. Kenpro speech processor, AEC SWR50A power-SWR, new, Yaesu FSP-1 speaker, new, £8 each. AVO Universal Minor £10. FP707 power, £90. Jim, 5 Luther Road, Winton, Bournemouth. Tel: 510400

■ Many valves, 6K6GT, 6F6M, 6F6GT, 12SQ7GT, 12Q7GT, 6Q7GJ, 50L6GT, 35L6GT, 25L6GT, lots of others. New, boxed, no fancy prices. SAE for list please. 12V out 240V input transformers, lugs for PCB, rated at 2A sec, Faraday screen, 75p each, 2 for £1.50 post free. 6L7G valves at £2 each. A E Jeffrey, 42 Dennis Road, Padstow, Cornwall PL28 8DF

■ Uher Report stereo 4400 professional tape recorder with mic and leather case, £375. Marconi sig gen TF801D/1/S 10-485MHz vgc, £95. Advance sig gen S2, 100kHz-100MHz, vgc, £27. Tech vacuum tube voltmeter (& ohms) 1.5 to 1500V fs, £22. Sinclair digital multimeter PDM35 0.1μA to 1000μA etc, £20. Eagle megohmeter MG-510 0-100M, 500V, £15. Belco ARF sig gen 100kHz-300MHz plus audio 20-20kHz, £17. B/W TV, vgc, 18in, £10. IXL BGSC precision lathe, 44in between centres, 15in swing, 1hp, 240V single phase, many chucks, face plates and tools, £550, no offers. Audio IFR training course, approved FAA, projector, manuals, records etc, £100. Canon 110ED, flash, leather case, £38. Minox B 'spy camera' £50. Polariod 350, portrait kit 581A, flash gun 268, £90. Philips ultrasonic burglar alarm, £10. Sextant, Hezzanith with certificate No 66127 as new, £200. Jaybeam 12XY/70, £25. 5XY/2m, £20. Both with phasing harnesses. Wayne Kerr component bridge B521, £25. Yaesu maintenance service manual FT-901DM, £12. Record-a-call remote telephone answering machine, £95. Norton Clipper Major saw 4hp 3 phase, £395. Discone antenna, £12. Portable typewriter, £10. SX200N with SSB kit, £195. 47000μF, 25V electrolytics, £2 each. Mr May, Petersfield, Hants. Tel: (0730) 892143 or 893534

■ Realistic PRO2001 V/UHF scanner, keyboard entry, £100. Ten channel xtal scanner, £30. Both 12V or mains. Hand-held four channel VHF xtal scanner, Realistic, £20. BNOS 12/15A PSU, £50. Markham, 9 St Andrews Close, Helpringham, Sleaford, Lincs NG34 0RE. Tel: (052921) 286

■ Studio Sharp colour video camera XC-320P, plus Fujinon CCTV lens 1.1.8/12.5-75, standard manual plus Sharp ac adaptor model AA-115H, input ac 240V 50Hz 50W, output dc 12V 2.5A, plus AL cable and Prinz lamp 1000X M10 all items vgc, £150. E Cerven, 37 Egerton St, Ashton under Lyne, Lancs. Tel: (061) 339 0933

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■ 144 to 28MHz converter, 3SK88 RF mixer, self-contained 240V power supply, £15. AVO electronic test meter, 45-range, £25. Heath signal generator, c/w handbook, RFIU, £15. Heath scope OS2, c/w handbook, £35. 144MHz 50W linear, self-contained 240V power supply, £50. 50MHz 50W linear 2 × 807, self-contained relay switching, 240V power supply, etc, £50. Earl G3OXV. Tel: Daventry 702265

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WANTED

■ S-meter and case for AR88 Rx. Also knobs for Canadian VRL Rx and BFO switch for R1155 Rx. Exchange Marconi signal generator TF801D/8S for R216 VHF Rx or Eddystone 770/R. CM Duncan, Roadside Cottage, Hoswick, Sandwick, Shetland ZE2 9HL. Tel: (09505) 405

■ Any information on Uniden 2030 2m FM transceiver, circuit diagrams, specs, add-ons, improvements, anything at all. PJ Ballam G1CZL, 9 Branch Street, Paddock, Hudds HD1 4JL

■ Cheap set of test equipment, oscilloscope, sig generator, RF and AF, also good pair of walkie talkies, frequency counter and power meter. Anything considered, phone and leave details anytime. Tel: (0325) 485981

■ Manual or circuits wanted for Marconi TF144G, Advance model H sig gen and Microvac valve voltmeter; also need Q/meter similar Boonton or Marconi and inductor standard for same. Also RF millivoltmeter. FS Henry, 105 Dargets Road, Chatham, Kent ME5 8BS. Tel: (0634) 681569

■ Pre-1984 *Practical Electronics* and *Everyday Electronics* magazines, WHY? Also circuit diagram or details of how to convert Pye 25kHz UHF base station receiver to receive satellite transmission. Also cheap receiver for SWL use, can have tatty appearance but must be working or repairable. Please send details. All letters will be answered asap. Mr MR Day, 39 Valnord Lane, St Peter Port, Guernsey, Channel Islands

■ Video recorder, any make, any condition, for private experiments. Must have RF modulator and tuner circuits, not concerned about mechanics/heads etc. Will collect if local. Tel: D Head on Stevenage (0438) 62179

■ Exchange 35mm camera, Cosina CT7 auto/man SLR, lenses: 50mm Tamron, 80/210 telefoto, 28mm wideangle, Vivitar 2800 flash, tripod and case, lots of extras. Worth £275. Wanted: AR2001 scanner or others considered. Tel: (0386) 858878

■ Back issues of any of the following mags, must be pre-1984: *Everyday Electronics, Practical Electronics, Radio and Electronics World, Hobby Electronics, The Maplin Magazine, Electronics Today International, Electronics Monthly, Elektor Electronics*, and *Electronics Digest*. Please send details of what you have and cost per copy. I will pay postage. Also wanted, any surplus data books on diodes, transistors, ICs, reference books for electronics etc. Mr Mike Day, 39 Valnord Lane, Saint Peter Port, Guernsey, Channel Islands

■ HF receiver, must have USB and LSB, any age but must be in good working order. Anything considered, maximum of £60. Tel: (0332) 668272

■ Early ham, domestic radios, gramophones, old trains. Jim, 5 Luther Road, Winton, Bournemouth. Tel: 510400

■ Solartron slow time-base module for model 1400 in good condition. Write to R Duncan, Park Cottage, 7 Park Road West, Sutton-on-Sea, Lincs LN12 2NQ.

■ Eddystone loudspeaker, cabinet type. Spares for Eddystone receiver EC958. Frank Ashcroft G4CJL, Southmead Lane, Henstridge, Templecombe, Somerset BA8 0RJ. Tel: Stalbridge (0963) 63357

■ Beg borrow or buy any info circuit or manual for Shibaden video recorder SV707 and SV700. Tel: Pulham Market 300

■ Exchange Storno 900 System 4 direct dial car telephone, perfect condition, for UHF or VHF mobile rig or HF linear. G4VNG. Tel: (0733) 231639

■ FL2100 or similar in good condition. John G4TEN. Tel: (0258) 53075

■ FRG7700 or similar HF receiver. Ian G1LSK QTHR. Tel: Lincoln (0522) 46145

■ Pre-war Ferguson 8-valve mains receiver with circular dial. Tel: Bristol (0272) 293738

■ Trio VFO 120. Cash waiting. Also ATU 130. G0AYZ QTHR. 22 Vale Grove, Gosport, Hants PO12 4PS. Tel: Gosport 589560 any time

■ Trio TS130S or TS120S in exchange for Drake general coverage Rx complete with noise blanker, xtal calibrator and matching Drake MS-4 speaker in absolutely mint condition, c/w handbooks, value £350, or will sell for cash. Also wanted for cash VFO120, AT130, PSU etc, must be mint condition. G0AYZ QTHR. Tel: Gosport 589560

■ R390A/URR receiver bits and pieces. Wanted in particular, metal case and an original manual, complete and in good condition. Also interested to hear from other users of this Rx and any mods. Steve Whitt, 103 Foxhall Road, Ipswich IP3 8JZ. Tel: (0473) 54405 (evenings)

■ SCR522 Tx (BC625) and SCR522 Rx (BC624) and/or handbooks, WHY? Good condition please. Also BC454. E A Alcock, High View, Sutherland Road, Longsdon, Staffs ST9 9QD. Tel: (0538) 385453 6-10pm

■ Circuit diagram and manual for Hartley type 13A oscilloscope or any info, or photostat. Mr N Brabrook, 38 Orchard Park, Laugharne, Carmarthen, Dyfed. Tel: Laugharne 524

■ In working order, a 'Marantz' professional tape recorder CD330, with Dolby, fair price paid, OAP. Mr Hicks, 91 'Casterbridge', Abbey Road, London NW6 4DR. Tel: (01) 624 6452

■ Baird/mechanical TV books or magazines, up to 1936, (or any suggestions where I can get them). Tel: Perth (0738) 37165

■ Good pair of 5 watt walkie-talkies. Frank. Tel: (0325) 485981

■ PCB service extender boards for Pye Olympic M201 and M202 radio telephones. S Cain, 13 Maes Gwynfa, Bodedern, Holyhead, Gwynedd LL65 3TH. Tel: (0407) 741879

■ Old ships' radios, especially Omega receiver, 1154 Tx. Wobbulator for 465kHz IFs. Wimshurst electrostatic generator. Woodhouse, 'Trendweth', Porthpean, St Austell, Cornwall PL26 6AU

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Radio & Electronics World
The communications and electronics magazine

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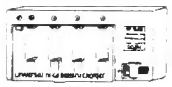

ONLY £4.25 WITH ORDER OF £10 OR OVER

12V RECHARGEABLE UNIT

Apart from the above offer you can also purchase a bank of 'D' types (10 off) encapsulated in a black plastic box complete with inlet and outlet socket (Cannon type MS3102E14S-6S) and fuse holder. this giving you 12V from a very neat and tidy unit. Dimensions. Approx 245mm x 75mm x 70mm.

£5.99 Each – £1.85 P&P

POTENTIOMETERS

Carbon Track, Rotary 0.25W Log & 1 in values. All ¼in Spindle. 20ml body dia. Shaft 2' long

4K7-2M2 Single gang log	40	10/**3.80**
1K-2M2 Single gang lin	38	10/**3.50**
5K-2M2 Single gang DP switch log	05	10/**9.50**
5K-2M2 Double gang log & lin	1.25	10/**10.50**

RESISTORS – CARBON FILM 5%

¼W 1RO to 10M (E12 Range)	**2p each. 15p/10. 75p/100**
½W 1RO to 10M (E24 Range)	**2p each. 15p/10. 75p/100**
1W 10R to 1OM (E12 Range)	**7p each. 40p/10. 3.50/100**
2W 10R to 1OMm (E6 Range)	**8p each. 60p/10. 5.00/100**

RESISTOR KITS – each value individually packed

¼W pack 10 each value E12 – 10R – 1M 610 pieces	**5.75**
¼W pack 5 each value E12 – 10R – 1M 305 pieces	**3.35**
½W pack 10 each value E12 – 2R2 – 2M2 730 pieces	**7.95**
½W pack 5 each value E12 – 2R2 – 2M2 365 pieces	**4.75**
1W pack 5 each value E12 – 1OR – 1OM 365 pieces	**15.00**
2W pack 5 each value E6 – 10R – 1OM 365 pieces	**18.50**

RESISTORS – WIREWOUND Generally 5%

2.5W 0.22 to 270R	**15p each 1.40/10**
4W 1RO to 10K. 1RO to 680R	**14p each**
1K – 3K3	**15p each**
4K7 – 6K8	**18p each**
10K	**22p each**
7W 1RO to 22K. 1RO to 5K6	**15p each**
6K8 – 12K	**16p each**
15K – 22K	**17p each**
11W 1RO to 22K. 1RO – 4K7	**18p each**
6K8 – 10K	**19p each**
15K – 22K	**22p each**
17W 1RO to 22K. 1RO – 10K	**24p each**
15K – 22K	**25p each**
Support pillars for 4W/7W/11W/17W/	**4p each 30p/10**
25W 0.47R – 47OR	**1.48 each 12.50/10**
50W 0.47R – 47OR	**1.85 each 13.00/10**

NEW LINE

ORYX PORTASOL PORTABLE GAS SOLDERING IRON – **£13.90**
Spare Tips 2.4mm/3.2mm/4.8mm. Price each 6 **£4.50**
Powered by ordinary lighter fuel. Adj temp equiv to 10/60 watts. Tip Temps to max of 400°C.

TELEPHONE SPECIAL

BT App Telephone Plug + 3m Lead **1.25**
BT App Master Socket Inc Wiring Instrns **2.85**
BT App Secondary Socket **1.95**
4 way plug **0.58ea 10/£5.50**
BT 4-Core Cable per metre **.15**
100 metres **12.00**
Cable clips for above **100/75p**

EQUIVALENT BOOKS

Diodes 1	**£9.95**
Diodes 2	**£9.75**
Pair	**£18.70**
Transistors A/Z	**£4.90**
2N-3N	**£5.10**
Pair	**£9.00**

PLUGS & SOCKETS

Metal Co-ax Plug	**0.18**
Plastic Co-ax Plug	**0.14**
Metal Line Socket	**0.32**
Single Junction Socket	**0.80**
Plastic Phono	**0.10**
F M Plugs	**0.20**
PL259 Plugs	**0.38**
Reducer	**0.15**

Terminal Blocks

2 amp 12 way	**£0.20**
5 amp 12 way	**£0.24**
15 amp 12 way	**£0.42**
32 amp 12 way	**£0.88**

NI-CAD

Universal Ni-Cad charger charges PP3, AA, C.D Price **£5.19**

RECHARGEABLE BATTERIES

AA (HP7)	**0.95 ea**	10/**0.85 ea.**
C (HP11)	**2.14 ea**	10/**1.98 ea.**
D (HP2)	**2.30 ea**	10/**2.10 ea.**
PP3	**3.75 ea**	10/**3.65 ea.**

ZENER DIODES

400mW Plastic 3V-30V **8p each 10/70p**
1/1.3W Plastic 4.7V-120V **12p each 10/£1.10**
*1.5W Plastic 11V-75V **1.25 each 10/11.50**
*2.5W Plastic 75V-75V **0.75 each 10/7.00**
*15W Plastic 12V-30V **85p each 10/8.00**
*20W Metal 7.5W-68V **1.32 each 10/11.60**
*Only Available while Stocks Last

'Zener Diode Pack 400mW-5 each-value-11 values-individually packed & marked 55 Zener Diodes **3.50 per pack**

VOLTAGE REGULATORS

78L05/08/12/15	**£0.30**
7805/08/12/15/18/24	**£0.45**
7905/12/15/18/24	**£0.50**
LM317K	**£2.40**
LM317T	**£1.25**
LM723	**£0.65**

FUSES

Prices per 10
20mm Quick Blow. 100. 125. 160. 200. 250 315. 400. 500. 630. 800mA. 1. 1.25. 1.6. 2.5 **40p. 20mm Time Delay.** 100 125. 160. 200mA **£1.80.** 250. 315. 400. 500 3.15. 4. 5. 6.3A **40p. 20mm Time Delay.** 100 630. 800mA **£1.00.** 1. 1.25. 1.6. 2. 2.5. 3.15. 4. 5. 6.3A **85p. 1" Mains** 2. 3. 5. 7. 13A **85p.**

CERAMIC CAPACITOR PACK

50V Ceramic Capacitors – 5 each value 25 values – each value individually marked and packed – 125 total **£4.75** per pack.

D C MOTORS (Min)

35/086 6-12 volts 25mmx38mm	**75p each**	**10/£6.00**
35/552 9 volts 35mmx42mm	**85p each**	**10/£7.00**
35/1296-12 volts – m/bracket 25mmx38mm	**80p each**	**10/£6.50**
35/0166-12 volts – m/bracket 38mmx42mm	**82p each**	**10/£6.70**
SPDC 12 volt Fujiya – Speed Control Board 32mmx38mm	**£2.50 each**	**£10/£22.00**

All prices are subject to change without notice

VALVES

CY802	.95
CV4015	2.80
EABC80	.98
EB91	1.30
ECC81	1.00
ECC82	.90
ECC83	1.00
ECC84	.80
ECC85	.95
ECC86	2.80
ECC88	1.25
ECC198	.85
ECF80	1.20
ECF86	1.70
ECH35	3.75
ECH42	1.20
ECL80	.75
ECL86	1.75
EF80	.75
EF86	1.80
EF91	2.00
EF184	1.00
EL34	3.25
EL84	1.00
EL95	.80
EL509	7.85
EL519	7.95
EM84	1.75
EY86/87	.65
EY500A	2.50
EZ80	1.05
GY501	1.40
KT66(GEC)	18.00
KT88(GEC)	19.00
PC189	.85
PCF80	.95
PCF84	.75
PCF87	.50
PCF800	1.20
PCF802	1.05
PCF805	2.00
PCL82	1.00
PCL84	1.00
PCL86	.90
PCL805	1.05
PD500	2.90
PFL200	1.85
PL36	1.75
PL504	1.40
PL508	2.70
PL519	5.25
PL802	5.50
PY81/800	1.10
PY88	.80
PY500A	2.20

INTEGRATED CIRCUITS

709	0.35
741	0.25
747	0.70
AN214Q	3.80
AN240P	3.42
BTT6218	1.98
CA301AT	2.88
CA58E	0.66
CA610CM	1.20
CA3020	2.10
CA3065	1.60
CA3080E	0.68
CA3130E	0.90
CA3140	0.45
HA1366W	1.59
LA4422	3.20
LC7131	4.90
LC7137	5.40
LM324N	0.45
LM380N8-P	1.15
LM380N14-P	1.80
LM1011N	3.20
LM1458N	0.98
LM3900N	0.85
M51513L	2.30
M51515L	3.18
MC1307P	1.99
MC1327P	1.50
MC1330P	1.60
ML23213	2.10
ML23713	2.30
NE555	0.25
SAA1025	4.00
SAS560	2.50
SAS570	1.85
SAS580	2.85
SN76033N	2.50
SN76131N	1.99
SN76226DN	1.70
SN76227N	1.10
SN7666ON	0.75
SN76666NO	1.40
STK015	6.20
TA7146P	4.60
TA7203P	2.76
TA7204P	1.50
TA7205AP	1.30
TA7222P	2.32
TAA550	0.50
TAA611A12	3.50
TAD100	2.90
TDA120A	0.80
AS/S/SB/T/U	0.80
TDA120B	1.30
SA/SQ/UQ	1.30
TBA520	1.50
TBA530	1.20
TBA540	1.64
TDA560C	1.50
TDA800	0.80
TDA810S	1.20
TBA950/2A	3.05
TCA270SA	4.02
TDA1003A	5.50
TDA1006A	2.45
TDA1035S	2.20
TDA1170S	1.99
TDA1352A	1.80
TDA2002	1.80
TDA2020	4.00
TDA2030	1.90
TDA2140	2.90
TDA2160	2.50
TDA2522	2.75
TDA2530	2.20
TDA2532	2.80
TDA2543	3.20
TDA2581	4.60
UPC57512	1.45
UPC741G	0.95
UPC1156H	2.75
UPC1180	2.75
UPC1218H	1.80
UPC1370C2	2.50
UPC2002H	2.75
UPC2002U	2.75

CMOS

4000	0.19
4001	0.24
4002	0.24
4006	0.68
4007	0.24
4008	0.59
4009	0.44
4010	0.48
4011	0.23
4012	0.24
4013	0.35
4014	0.58
4015	0.58
4016	0.38
4017	0.54
4018	0.59
4019	0.59
4020	0.78
4021	0.58
4022	0.68
4023	0.30
4024	0.49
4025	0.24
4026	0.89
4027	0.44
4028	0.44
4029	0.73
4030	0.33
4031	1.28
4033	1.25
4034	1.40
4035	0.68
4036	2.48
4038	0.73
4039A	2.70
4040	0.58
4042	0.48
4043	0.42
4044	0.48
4046	0.58
4049	0.38
4050	0.34
4051	0.68
4051	0.68
4052	0.58
4053	0.58
4066	0.44
4068	0.24
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.68
4077	0.24
4078	0.24
4081	0.24
4082	0.24
4085	0.58
4086	0.58
4089	1.22
4093	0.37
4094	0.70
4095	0.93
4096	0.98
4097	2.65
4098	0.78
4099	0.75
4161	0.96
4162	0.96
4163	0.96
4174	0.96
4175	1.00
4195	0.99
4501	0.38
4502	0.58
4503	0.38
4507	0.45
4508	1.28
4510	0.54
4511	0.54
4512	0.54
4514	1.10
4515	1.20
4516	0.60
4517	2.70
4518	0.48
4520	0.50
4521	1.10
4522	1.20
4526	0.58
4527	0.64
4528	0.68
4531	1.20
4532	0.64
4536	2.50
4538	0.78
4539	0.80
4541	0.94
4543	0.70
4549	3.98
4553	2.40
4554	1.80
4555	0.34
4556	0.54
4557	2.40
4558	1.10
4559	3.90
4560	1.50
4562	3.48
4566	1.60
4569	1.75
4583	1.00
4584	0.54
4585	0.55
40100	2.10
40101	1.20
40102	1.30
40103	3.95
40104	1.15
40105	2.10

74LS

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.33
74LS14	0.48
74LS15	0.24
74LS19	0.44
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.28
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.79
74LS48	0.65
74LS51	0.24
74LS55	0.24
74LS73	0.30
74LS74	0.33
74LS75	0.44
74LS76	0.38
74LS78	0.38
74LS83	0.68
74LS85	0.82
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.54
74LS93	0.54
74LS95	0.60
74LS96	1.20
74LS107	0.40
74LS109	0.44
74LS112	0.44
74LS113	0.40
74LS114	0.39
74LS122	0.68
74LS123	1.00
74LS124	1.25
74LS125	0.52
74LS126	0.50
74LS132	0.60
74LS135	0.26
74LS136	0.42
74LS138	0.44
74LS139	0.58
74LS145	0.93
74LS147	1.64
74LS148	1.28
74LS151	0.70
74LS153	0.70
74LS155	0.55
74LS157	0.45
74LS158	0.58
74LS160	0.62
74LS161	0.68
74LS162	0.70
74LS163	0.68
74LS164	0.74
74LS165	1.10
74LS166	1.50
74LS168	1.48
74LS170	1.40
74LS173	0.98
74LS174	0.75
74LS175	0.70
74LS190	0.82
74LS192	0.98
74LS193	0.98
74LS194	0.75
74LS195	0.74
74LS196	0.84
74LS197	0.96
74LS221	0.85
74LS240	0.80
74LS241	0.80
74LS242	0.94
74LS243	0.94
74LS244	0.80
74LS245	1.20
74LS247	1.00
74LS251	0.75
74LS257	0.73
74LS258	0.75
74LS259	1.20
74LS266	0.55
74LS273	1.20
74LS279	0.70
74LS283	0.80
74LS353	1.10
74LS365	0.50
74LS366	0.50
74LS367	0.50
74LS368	0.50
74LS373	1.00
74LS374	1.00
74LS375	0.70
74LS377	1.25
74LS378	0.95
74LS390	0.60

TRANSISTORS – DIODES

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC127	0.28	BC125	0.14	BC440	0.36	BF158	0.30	BRY56	0.42	BYX10	0.20	TIS43	0.88
AC128	0.30	BC140	0.27	BC441	0.40	BF160	0.23	BSX19	0.32	BYX36/150	0.40	TIS88	0.50
AC128K	0.34	BC141	0.26	BC461	0.58	BF167	0.32	BSX20	0.30	BYX36/600	0.48	TIS90	0.27
AC141	0.58	BC142	0.24	BC478	0.24	BF177	0.42	BSX59	0.78	BYX48/300	0.70	TIS20	2.45
AC141K	0.38	BC143	0.26	BC516	0.48	BF178	0.26	BSX76	0.65	BYX55/600	0.30	Y728	0.14
AC142	0.56	BC147	0.16	BC547	0.12	BF180	0.27	BSY52	0.35	BYX71/600	1.18	Y969	2.80
AC142K	0.38	BC147B	0.14	A or B	0.10	BF181	0.27	BSY95A	0.25	BYZ 212	0.78	ZE75	0.60
AC151	0.45	BC148	0.10	BC548	0.12	BF182	0.32	BT100A/02	0.90	C106D (400V)	0.48	ZTX107	0.14
AC152	0.45	BC148B	12	A B or C	0.10	BF183	0.32	BT101/300	2.75	C106F (50V)	0.36	ZTX502	0.22
AC153	0.57	BC149	0.10	BC549	0.10	BF184	0.30	BT101/500	3.25	D40C1	1.08	IN4001	0.04
AC153K	0.46	BC149C	0.14	A or B	0.10	BF185	0.28	BT102/300	3.60	D40N1	1.12	IN4003	0.05
AC176	0.30	BC157	0.10	BC550	0.10	BF194A	0.15	BT106	1.15	E1222	0.30	IN4004	0.05
AC176K	0.38	BC158	0.12	A or B	0.10	BF195	0.12	BT108	1.25	E5024	0.30	IN4006	0.07
AC187	0.28	BC159	0.12	BC557	0.10	BF200	0.30	BT109	1.15	GET872	0.60	IN4007	0.07
AC187K	0.38	B/C	0.14	BC558A	0.10	BF222	0.38	BT116	1.20	GET881	1.70	IN4148	0.04
AC188	0.28	BC160	0.30	BCY70	0.16	BF224	0.16	BT119	3.30	GET882	1.90	IN5400	0.12
AC188K	0.38	BC161	0.30	BCZ10	3.21	BF224J	0.20	BT120	3.50	ITT2001	0.18	IN5402	0.13
ACY22	1.50	BC168B	0.20	BCZ11	2.60	BF240	0.30	BT121	2.99	ITT2003	0.34	IN5405	.16
AD142	0.68	BC169C	0.12	BD124P	0.70	BF241	0.30	BT138/600	1.30	MCR106/5	1.20	IN5406	0.17
AD143	0.68	BC170	0.16	BD129	0.90	BF244	0.34	BT151/560R	0.90	ME0413	0.70	IN5408	0.19
AD149	0.72	BC170 or C	0.16	BD130Y	0.68	BF244A	0.30	BTY79/400R	2.80	MJE2002	0.26	S44	0.06
AD161/162	1.20	BC171	0.10	BD131	0.36	BF257	0.22	BU100A	2.30	MEU21	0.82	IS920	0.07
AD162	0.52	A or B	0.10	BD132	0.36	BF258	0.26	BU104	1.80	MJ400	0.45	2N1306	1.42
AF114	1.20	BC172	0.12	BD135	0.26	BF259	0.30	BU105	1.20	MJ2955	1.00	2N2122A	0.34
AF115	2.10	B or C	0.12	BD136	0.26	BF262	0.34	BU105/02	1.55	MJ3000	1.80	2N2222	0.30
AF116	2.10	BC177	0.24	BD137	0.28	BF263	0.38	BU108	1.75	MJE340	0.46	2N2904A	0.48
AF121	0.56	A B or C	0.24	BD138	0.30	BF270	0.30	BU124AE	0.98	MJE520	0.44	2N2926G	0.14
AF124	0.42	BC182	0.10	BD139	0.30	BF271	0.28	BU126	1.40	MJE2955	1.60	2N3053	0.30
AF125	0.58	A B or C	0.10	BD140	0.28	BF273	0.22	BU133	1.90	MJE3055	1.40	2N3054	0.60
AF126	0.58	BC182L	0.12	BD142	1.26	BF274	0.34	BU204	1.30	MPSA05	0.30	2N3055	0.65
AF127	0.38	LA LD LC	0.12	BD145	1.82	BF294	0.46	BU205	1.30	MPSA12	0.30	2N3703	0.10
AF139	0.40	BC183	0.10	BD150B	0.72	BF336	0.32	BU206	1.50	MPSL01	0.34	2N3773	2.80
AF178	2.28	A B or C	0.10	BD160	1.58	BF337	0.28	BU208	1.40	MPSU05	1.05	2N3904	0.20
AF239	0.50	BC183L	0.10	BD165	0.45	BF338	0.28	BU208A	1.40	MPSU06	1.18	2N3906	0.20
AF279S	1.40	LA LB LC	0.10	BD183	0.70	BF355	0.37	BU208/02	2.05	MR502	0.40	2N5294	0.80
AL100	5.40	BC184	0.10	BD201	0.52	BF363	0.35	BU326S	1.75	MR854	0.86	2N6107	0.80
AL102	4.40	A B CL LC LB	0.10	BD202	0.57	BF367	0.24	BU407	1.10	NKT SER18	1.68	2SB337	1.80
ASY80	5.20	BC207	0.15	BD204	0.50	BF371	0.27	BUX80	3.70	OA91	0.07	2SC1098	0.84
ASZ17	2.00	BC212	0.10	BD222	0.80	BF422	0.20	BUY20	2.75	OA210	0.66	2SC1172Y	1.70
AU110	2.80	A B or C	0.10	BD225	0.40	BF450	0.38	BUY69A	2.60	OC26	2.95	2SC1173Y	0.88
AY102	4.32	BC212L	0.09	BD232	0.45	BF457	0.36	BUY69B	1.98	OC35	4.75	2SC1179	0.92
B40C2200	1.03	A LB	0.10	BD234	0.30	BF458	0.37	BY100	0.80	OC36	1.75	2SC1306	0.92
BA110	0.68	BC213	0.10	BD235	0.30	BF459	0.35	BY103	0.50	OC44	0.72	2SC1307	1.50
BA115	0.14	A B or C	0.10	BD236	0.38	BFR51	0.36	BY122	0.60	OC72	0.70	2SC1413A	2.70
BA121	0.40	BC213L	0.10	BD237	0.38	BFR61	0.32	BY126	0.10	OC81	0.68	2SC1449	0.60
BA129	0.38	LA LB LC	0.10	BD410	0.76	BFR90	0.86	BY127	0.08	ORP12	0.85	2SC1507	0.60
BA148	0.16	BC237	0.11	BD434	0.58	BFT41	0.68	BY133	0.08	R2008B	1.20	2SC1678	1.00
BA155	0.12	BC238	0.12	BD438	0.58	BFT43	0.86	BY135	0.35	R2010B	1.20	2SC1758	0.68
BA157	0.28	BC251	0.14	BD439	0.85	BFW11	0.84	BY164	0.45	R2010B	1.20	2SC1909	1.20
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T/V loop aerial	75p
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Philips Neon Lamps for TV sets	5p
Freeze	£1.20
Foam Cleaner	£1.20
Contact Cleaner	£1.20
Cans of Anti Static, Degrease Cleaner and Anti Corona	All at £1.20
Push Button Mains	75p
Lorlin Full Remote Relay Switch fit most T/V sets, mains 4 tag, 2 tag 12 volt	£1.00
Mains timer, 13 amp – up to 2 hours; easy to use, plugs into socket	£3.00
Sellotape PVC Electric Insultation 50mm x 20M	70p
Screen locking agent, large can	£1.50
20 GEC Service Manuals & Rank	£5.00
Red E.H.T. LAED and Anode Cap	£1.00
10 x G11 Cap 470/250	£15.00
Weller solder iron 15 watt/25 watt	£5.00
2 way baby alarm/intercom with long leads	£5.00
Phillips universal battery tester/charger, fuse/bulb tester	to clear £4.00
Hitcachi Silver Oxide Battery G13 UCC357 IEC SR44 1.5V	60p
70ML Silicone Sealer (clear)	£1.00
100 Coax Plugs	£10.00
De-solder pump + 2 nozzels Philips	£5.00
Plastic box for i.c.s 6"x3"x½"	50p
Flat Red LED	12p
500gm 60/40 solder reel	£7.00
Clearweld glue pack	30p
Dual v/u meter –20– +10db	£1.00
K30 thermistor 232266298009	75p
GEC Mains Power Supply R.E.G.	£3.00
Frapil moving iron meter, 0-5 amp 0-60v, 0-40 amps 0-250v	£2.50 each (cost £16.00)

100 W/W Res	£1.50
BF 199	20 for £1.00
10x20 Turn 100k pots, Rank	£2.00
Thorn 9 volt power supply regulated	£3.00
BF 470	20 for £2.00
20 Slider Knobs	70p
6 Mixed UHF Aerial Isolating Sockets, some with long leads. Fit ITT, GEC, Philips, Pye	£1.00

Mixed Packs

TO66, 12 Power Trans RCA 16182 NPN	£1.00
Replacement for BD124 and Mounting Kits	£1.00
50 Mixed AC series Transistor	£4.50
15 Panel mount rocket switch 250V/10A	£1.50
25 Panel Mount Bulbs & Neons	£1.50
10A Mixed ribbon cables	£1.50
25 LEB red/yellow/green 201/C Holders	£1.00
20 Large LED Red	£1.20
20 Small LED Red	£1.00
10x20 Turn 100K Pots	£1.00
100 Transistor	£2.50
20 Convergence Pots	80p
100 Sticks	£1.00
10 Thermistors	50p
20 Slider Pots	£1.00
30 Presets	50p
40 glass reed switch	£1.00
10 press to make switch	70p
40 Pots	£1.50
10 Gun Switches	50p
5 Tube Bases	£1.00
1,000 Diodes, Condensers, Resistors on Bandolier	£2.00
Lucky Dip 600 gram	£1.00
Jungle Bag 5kg	£5.00
20 Knobs	£1.00
40 Pots, ¼" +6mm spindles for audio/TV	£3.00
20mm Fuse Holders Chassis Mount	20 for £1.00
IN4001/6 100 mixed	£2.50
EHT Diodes, small	20 for £1.00
20 Mixed Switches	£1.00
ITT M5 Microphone – ITT – Rank	50p
400V/4A Triac	30p
	10 for £1.00

SENDZ COMPONENTS

63 Bishopsteignton, Shoeburyness, Essex SS3 8AF
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