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Radio & Electronics World

The communications and electronics magazine

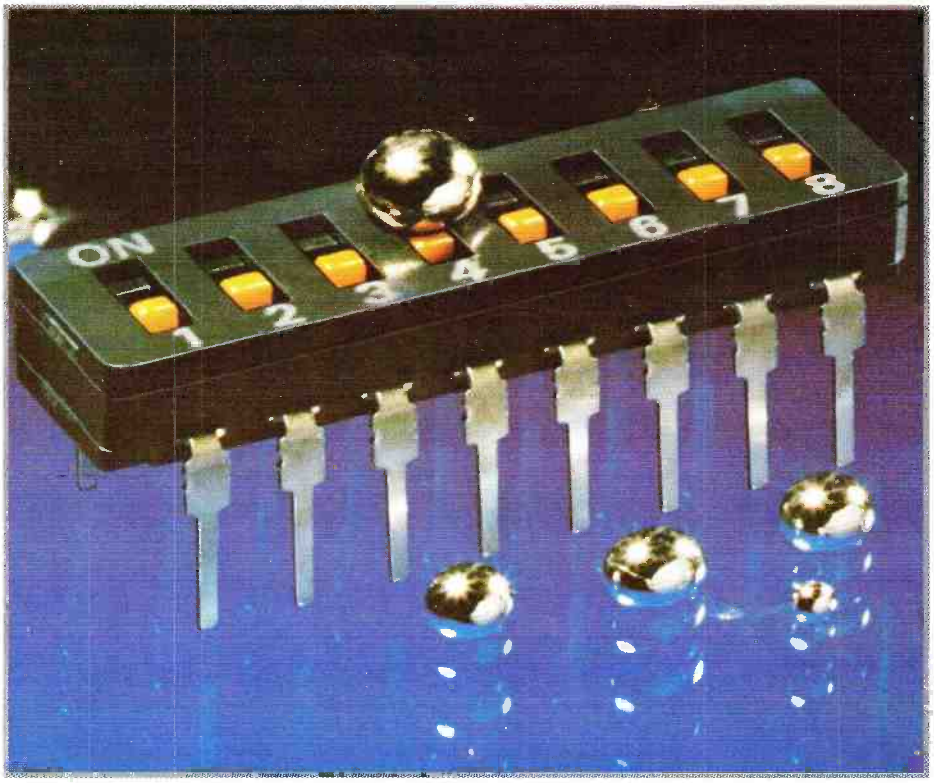
VALVES: THE HISTORY LESSON CONTINUES...

DATA FILE: OSCILLATORS – CLAPP, COLPITTS, ET AL

SPECTRUM CW: DECODING MORSE WITH THE SINCLAIR

NOISE LIMITER: CUT THE CACKLE ON THE SHORT WAVES

REGULATORS: THE BASICS OF VOLTAGE REGULATORS



SPECTRUM WATCH: NEW BROADCAST SERVICES

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FRV8800	VHF converter	75.00
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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
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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
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FT790R	70cm multimode transceiver 2W	379.00
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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
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SB2	Switch unit for YH1	13.50
SB3	Switch unit	14.25
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YH77	Lightweight mono h'phones	14.50
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YM49	Speaker/MIC for FT290R	19.50

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BC35E	Desk-top charger for all nicads	59.00
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BP5	High capacity q/charge 10.8V Nicad	49.50
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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
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IC-AT10	100W auto ATU	299.00
IC-AT50	500W automatic ATU	435.00
IC-CPI	Mobile ch'ing lead c/lighter	4.99
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IC-PS30	Power supply unit 25A cont.	275.00
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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 l/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

RWC TOP 100

ADONIS	AM303G	Base stn FM/SSB m'phone	39.95
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+2× 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
M'raker	10-12A PSU	10-12A 13.8V power supply	62.50

Full Jaybeam range in stock.

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 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	S0239-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.1-3Wi/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.	36.50
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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Published by
Radio & Electronics World Magazines
Sovereign House
Brentwood
Essex CM14 4SE
England
Tel: (0277) 219876

ISSN
0262-2572

Printed
In Great Britain

Newstrade sales
Argus Press Sales & Distribution Ltd
12-18 Paul Street
London EC2A 4JS
Tel: 01-247 8233

Subscriptions
Tel: 01-760 0409

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 – IMO DIP switches: not the most exciting subject in the world, but it ain't half a pretty pic (p11)

Bottom – A digital lumberjack? Well, a data logger, anyway (p9)

SPECIAL FEATURES

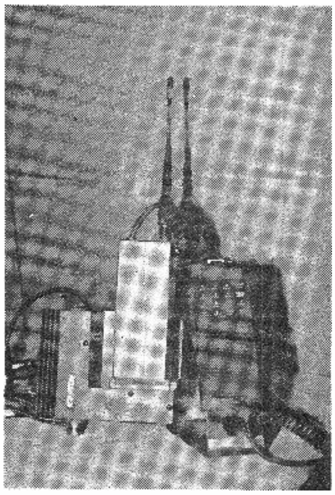
REGULARS

READER SERVICES

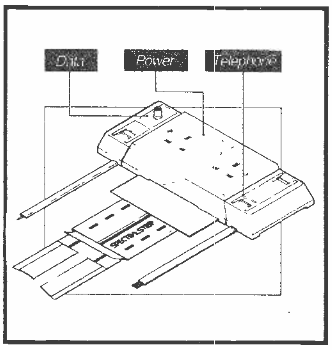
NEXT MONTH

☐ **Next Issue**
Cover date July 1986 on sale Thursday, 12 June

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



Voice of the people – page 21



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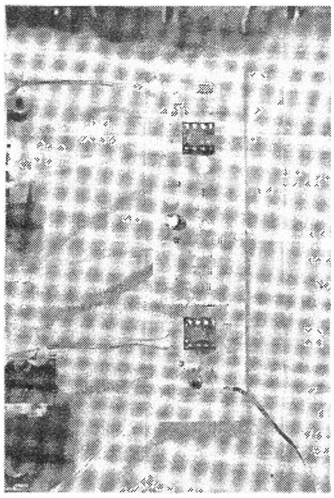
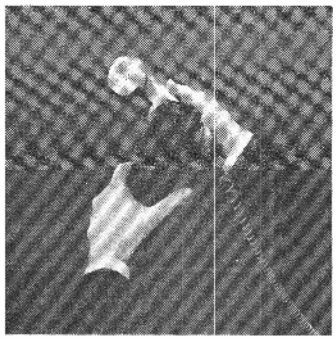


Noise annoys – page 40



Min-Email size – page 9

PRODUCT NEWS

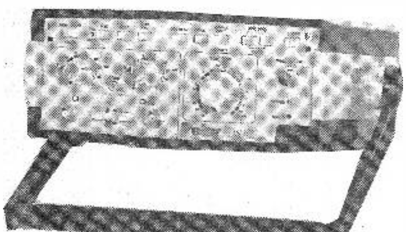
Featured on these pages are details of the latest products in communications, electronics and computers. Manufacturers, distributors and dealers are invited to supply information on new products for inclusion in Product News.
Readers, don't forget to mention ***Radio & Electronics World*** when making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

DIGITAL STORAGE MODULE

Antron Electronics Limited now has available a new low cost digital storage module unit manufactured by Polar Instruments.

The Model DS102 is designed to convert the user's own conventional oscilloscope for one or two channel digital storage. A sampling rate of 10MHz per channel, together with 2048 bytes of memory for each data capture, results in high resolution and excellent display definition.

The conventional DSO front panel controls are easy to drive and give the user the following modes of operation: single shot with pre-trigger, roll and refresh mode (save channel 2 or hold both channels) with output to plotter and view back to original signal source.



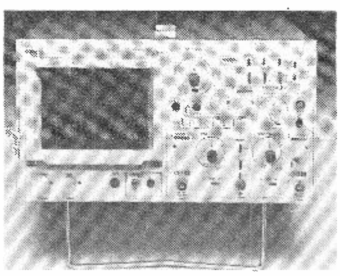
Antron Electronics Ltd,
Hamilton House,
39 Kings Road,
Haslemere,
Surrey GU27 2QA.
Tel: (0428) 54541.

35MHz SCOPE

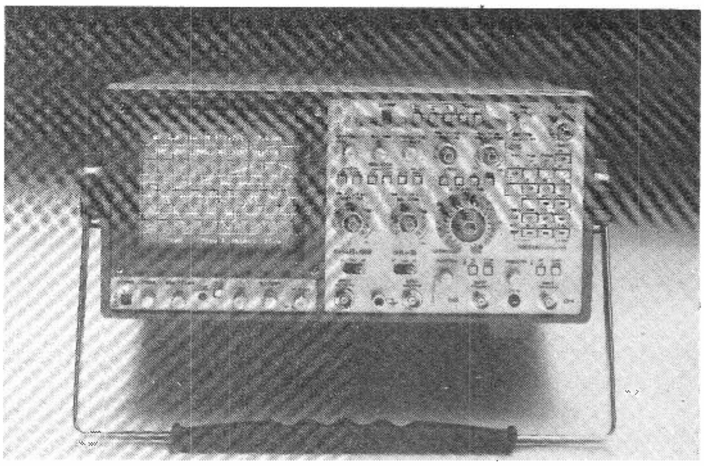
Fieldtech Heathrow has further expanded its range of general purpose test equipment with the addition of the Meguro MO-1252 35MHz 2-channel oscilloscope.

Reliable performance and ease of operation, with high sensitivity and sweep speed as well as a trigger delay function, is intended to make the MO-1252 ideal to meet the demand for a versatile oscilloscope with a wide range of applications.

Other features include a single sweep function, and a unique component test utilising the X-Y operation, which enables the operator to verify the quality or value of components.



Fieldtech Heathrow Ltd,
Huntavia House,
420 Bath Road, Longford,
Middlesex UB7 0LL.
Tel: (01) 897 6446.



100MHz OSCILLOSCOPE

New from Thurlby Electronics is the Hitachi V-1100A, a high performance 100MHz oscilloscope which incorporates a sophisticated microprocessor-controlled digital measurement centre.

The V-1100A provides automatic measurement and on-screen display of dc or ac voltage, decibel ratios, frequency, period, time delay and phase shift. A comprehensive cursor system allows the user to interact with the measurement centre to provide measurement data on selected sections of the waveform.

On-screen display of all setting conditions (input sensitivity, sweep speed etc) is also provided along with ground reference information. A further feature is the ability to enter alphanumeric text via a built-in keypad and to display a line of text on the screen.

The V-1100A has four independent input channels which may be displayed simultaneously. Its full dual-timebase sweep system includes trigger facilities for both timebases and provides sweep speeds up to 2 nanoseconds/div.

The high resolution 18kV internal graticule CRT has a good writing speed commensurate with the oscilloscope's rise time of better than 3.5ns.

Thurlby Electronics Ltd,
New Road,
St Ives,
Huntingdon,
Cambridge PE17 4BG.
Tel: (0480) 63570.

IEEE DSO

Paxton Instruments have announced the introduction of the HM208 digital storage oscilloscope with IEEE option.

This is a 20MHz real-time oscilloscope in addition to the 20MHz sampling frequency in the digital storage mode. The storage memory size is 4 × 1K × 8-bit. However, if used in the single channel mode, channel 1 resolution becomes 2K × 8-bit.

The HM208 IEEE also has a second page memory facility which enables captured signals to be saved for later reference, whilst freeing the original memory for separate storage of channel 1 and/or channel 2.

Another feature is an X-Y display capability available at all times in both analogue or digital modes. This enables the display of semiconductors and filter curves, lissajous figures and representations of parameters related to reference voltages other than time.

The IEEE option gives the HM208 the ability to be remotely addressed to allow the transfer of captured waveforms from the 4 digital memories to the host computer or controller for long term storage and future data analysis.

Paxton Instruments,
Unit B1,
Pixmore Industrial Estate,
Pixmore Avenue, Letchworth,
Hertfordshire SG6 1JJ.
Tel: (0462) 685648.

DIGITAL MULTIMETERS

Thandar Electronics have added two new digital multimeters to their range, designated the TM357 and TM358.

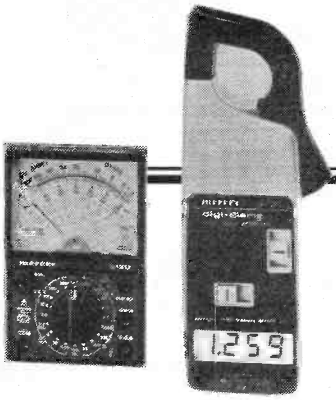
The TM357 is a 3.5-digit LCD multimeter with facilities to read ac/dc voltage, current, resistance and diode test. A continuity buzzer is also provided. A temperature probe is available as an optional accessory and reads in centigrade and fahrenheit.

Housed in a rugged yet compact hand-held case, the TM357 retails at £39.00 + VAT including probes.

The TM358 is a 3.5-digit LCD multimeter which, besides incorporating similar ranges to the TM357, has the additional features of conductance and transistor H_{FE} measurement.

Selling for £69.00+VAT, the TM358 is also supplied complete with probes.

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



NEW MERCER PRODUCTS

Mercer Electronics, a division of Simpson Electric Company, has introduced a new VOM with several new features.

The Mercer model 9120 has 25 ranges including dB, 20,000 ohms/volt dc sensitivity (5,000 ohms/volt ac) and a frequency response up to 100kHz on 3, 12 and 60V ac ranges. It will measure up to 12A dc, has a 3V ac range and dc accuracy is ±3% fs.

Convenience features include a front panel polarity reversal switch, a single-knob range/function switch with an 'off' position, an output jack for dc isolation and a large, easy to read, 3.5in mirrored, colour-coded scale.

Also included is a high-energy fusing system along with standard fusing and diode meter protection. Size is 4in × 6in × 1¾in, and it weighs 13oz. The unit comes complete with batteries, test leads and an operator's manual. It costs $39.00.

Another new product from Mercer is a digital clamp-type ac volt-ohm-ammeter, the model 9701 digi-clamp.

It will make measurements up to 300A (2 ranges), 2000 ohms or 750 volts ac with basic accuracy of 0.8%.

Other features include 0.1 amp resolution, audible continuity indication and a data hold switch. It is very compact, being 7.28 × 2.44 × 0.98in, and weighs ½lb. A 9 volt battery, colour-coded test leads, operator's manual and carrying case are also included in the price, which is $69.00.

Mercer Electronics,
859 Dundee Avenue,
Elgin, Illinois 60120.
Tel: (312) 697-2265.

AM/FM SIG GEN

Electronic Brokers can now supply the Marconi Instruments Model 2022 AM/FM signal generator, a compact, lightweight instrument which offers frequency, phase, and amplitude modulation over the 10kHz-1000MHz frequency range.

The instrument uses microprocessor control to provide simple and rapid operation by direct keyboard entry of settings, and the non-volatile memory, which can store up to 100 settings, further reduces measurement time.

With comprehensive amplitude, frequency and phase modulation, the 2022 also has a range of powerful second functions for rapid fault finding and calibration, and reverse power protection up to 25W which prevents damage to output circuits when power is accidentally applied while testing transceivers.

The instrument's wide range frequency modulation facility provides FM deviation up to a maximum of 99.9kHz depending on modulation and carrier frequency. Phase modulation is available with a deviation range of up to 9.99 radians and amplitude modulation is provided with steps of 0.5% up to 99.5% depth.

Available as an optional extra is the GPIB talker/listener interface.

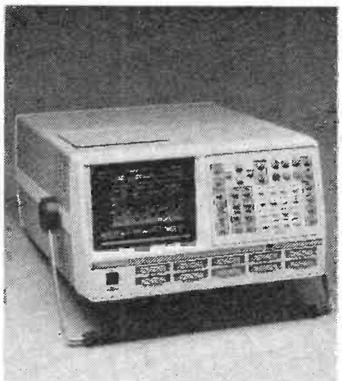
Electronic Brokers Ltd,
140-146 Camden Street,
London NW1 9PB.
Tel: (01) 267 7070.

REAL-TIME SCOPES

At the 1986 Control & Instrumentation Exhibition, Gould Electronics will be exhibiting a new family of three high performance, real-time oscilloscopes covering 60MHz, 100MHz, and 150MHz bandwidths.

A recent addition to the company's display is the 4050 digital storage oscilloscope, a high-speed instrument which has twin 100MHz digitizers enabling its use in electronics and analytical applications not previously suited to DSO measurements.

The company will also exhibit a recently introduced series of logic analysers



which combine ease of use with high performance. The new family of products – the K20, K40, K115, K125 and K450 – range from low cost, easily portable units to an instrument suitable for computer aided engineering (CAE) design and test verification.

The latest developments in software for use with Gould logic analysers will be displayed, including the K105 Smartpak software package that runs on the IBM PC.

Gould Electronics Ltd,
Instrument Systems,
Roebuck Road,
Hainault,
Essex IG6 3UE.
Tel: (01) 500 1000.

KIKUSUI DSO

Telonic Instruments, Kikusui's UK distributor, has introduced two new low priced digital storage oscilloscopes, the DSS5040 and DSS5020A.

The DSS5040 has 40MHz real-time capability with a 25MHz clock rate 8-bit A/D for storage. The DSS5020A has 20MHz real-time bandwidth with a 1MHz 8-bit A/D. Both instruments have been designed with ease of operation in mind, and have only 6 controls for the storage function.

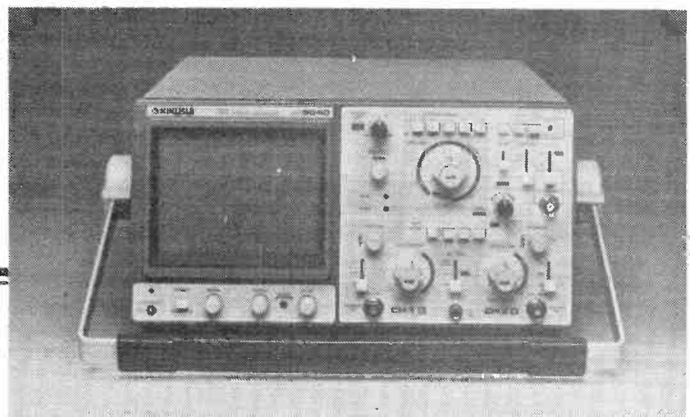
In the real-time mode both are two channel, single timebase oscilloscopes with vertical sensitivity ranges from 1mV to 5V/div.

In storage operation both have similar operating modes and facilities which include pre-trigger, post storage magnification, roll function and variable view time. An interesting feature is sine wave interpolation which reduces the number of sample points required to 2.5 for a single shot sine wave, thus increasing effective storage bandwidth to 400kHz for the DSS5020A and 10MHz for the DSS5040.

The memory system enables waveforms on both channels to be stored, and a reference memory capability allows a reference waveform to be stored for comparison with a new input.

Both instruments have pen output capability for X-Y plotters.

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



IC-R7000

rcial quality receiver
d all competition

Actual Size

Options include: RC12 infra red remote controller, voice synthesizer, external loudspeaker, HP1 headphones and the ICOM AH-7000 super wideband omnidirectional discone antenna.

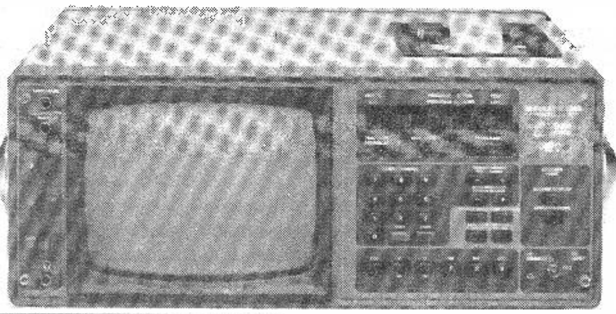
There are two ways of using this advertisement, one is to cut out the life-size photograph of the R7000 and paste it to the side of an old shoe box, who knows if your shack is dimly lit visiting Amateurs will be impressed by your excellent choice. The alternative (and one we strongly recommend) is if you are an Amateur or SWL call us on free HELPLINE 0800-521145 for the location of your local ICOM dealer where you can see and actually buy the competitively priced R7000, you have the choice.

Computer Control The IC-R7000 can be easily connected to a computer terminal via a very simple interface. Receiver control is performed serially in the IC-R7000 by ICOM's C1-V communication interface system. Operation is possible with a personal computer that has an RS-232c serial port.

	H = HELP	↔	Frequency Steps
FO	Frequency	. ↑ V	Up/Down (arrows)
F1	Select Mode	M	Memory Channel
F2	Freq/Memory Scan	, .	Memory Up/Down
F3	Mode Scan	/	VFO/Memory
F4	VFO → Memory	B	Bargraph Select
F5	Memory Write	@	Occupancy On/Off
F6	Memory Clear	:	Scan Stop Off/On
F7	Set 'SIG' Level	S	Change Set
F8	Memory File Read	DEL	Speech (If fitted)
F9	Memory File Write	Q	Quit

net ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet Electronics

Sea Street, Herne Bay, Kent CT6 8LD
Tel: (0227) 363859.
Dept. RW



AUTO TEST RECEIVER

The Grundig ME-90 test receiver and field strength meter, now available exclusively in the UK from Electronic Brokers, is a microprocessor controlled, fully automatic antenna measuring system which provides level measurement in all the VHF and UHF television bands as well as the long, medium, short and ultra-short wave radio bands.

The unit employs simple front panel keypad control to carry out a wide variety of intelligent measurement functions.

The instrument can store up to 100 pre-selected frequencies by channel number or other designation, and the stored data can be collated and processed prior to hardcopy print-out on a built-in thermal matrix printer.

Other features of the ME-90 include a TV-IF input at 38.9MHz, the capability to measure separate sound channels in stereo signals, a built-in VHF-FM stereo decoder with LED indication, a headphone socket for evaluation of received quality, a switch for picture enlargement and a switch for picture offset.

The Grundig ME-90 is equally suited to mains or battery operation, and has its own built-in charger.

Electronic Brokers Ltd,
140-146 Camden Street,
London NW1 9PB.
Tel: (01) 267 7070.

WAVE FORM SYNTHESIZER

Analogic's new Data2020 synthesizes complex waveforms specified by the user in the form Y = f(t), with 16-bit precision.

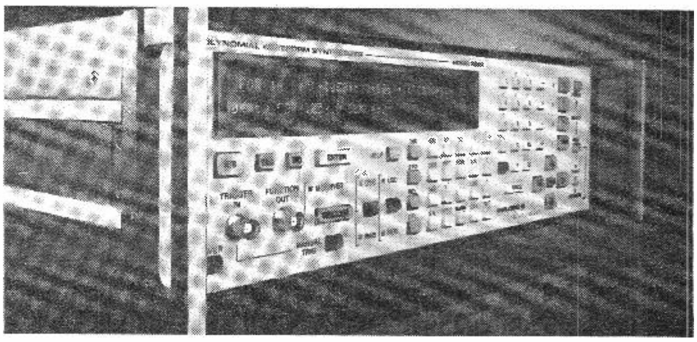
This technique provides new levels of flexibility when complex or unusual waveforms are required. It can eliminate the need to use several instruments connected together, to program complex switching sequences, or to hard-wire special damped tuned circuits. In many cases even these laborious methods can still only approximate the desired waveform.

By keying mathematical expressions into the Data2020 front panel (or sending them via the IEEE-488 interface), waveforms of any complexity can be specified absolutely. The Data2020 can evaluate several expressions between different limits to build up complex sequences – high speed pulse trains for radar testing and video colour bar signals for TV testing are typical examples.

Functions built in include sine, square and triangle waves. Waveforms can be triggered, continuous, repeated, or gated.

The instrument's analog output provides ±5V (maximum) into a 50 ohm load with a total dynamic range of 136dB (72dB for any one waveform). Internal dc offset and noise (independent of the stored waveform) can be summed from 0 to 60dB below the waveform level.

Analogic Ltd,
68 High Street, Weybridge,
Surrey KT13 8BN.
Tel: (0932) 56011.



4½-DIGIT MULTIMETERS

Two 4½-digit hand-held multimeters have been added to Beckman Industrial's Circuitmate series, both of which have a built-in frequency counter.

The DM800 provides average sensing on ac voltage and current ranges, while the DM850 gives true rms. Basic dc accuracy of both meters is 0.05%.

The built-in frequency counter allows measurements up to 200kHz, and reduces equipment requirements by combining two instruments into one handy package.

A useful function is 'data hold', which makes delayed reading of short duration events easy by enabling the user to freeze the display manually while the reading is present. Continuity is indicated on both meters by a beeper.

Each meter has five dc and ac voltage ranges (to 1000V and 750V respectively), six dc and ac current ranges from 200μA to 10A and six resistance ranges from 200Ω to 20MΩ.

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

AUDIO OSCILLATOR

Sage Audio have introduced the SA1 ultra low distortion audio oscillator, designed to offer the performance necessary when analysing today's high quality audio equipment.

The SA1 provides a continuously variable output of up to 1V rms at four separate spot frequencies, 100Hz, 400Hz, 1kHz and 10kHz. These are accurate to 1%, with other frequencies available to order. Harmonic distortion is quoted as typically 0.0001% (1ppm) at 1kHz.

A noise reference button allows measurement of harmonics buried below the noise level. When pressed, this removes the sine wave output without significantly altering the generator's gain, source impedance or residual white noise level. A noise reference can then be measured and subtracted from the THD + noise reading. This reference represents the oscillator noise, amplifier under test noise and the analyser noise floor.

Sage Audio,
Construction House,
Whitley Street,
Bingley,
West Yorkshire BD16 4JH.
Tel: (0274) 568647.

RF MONITORING SYSTEM

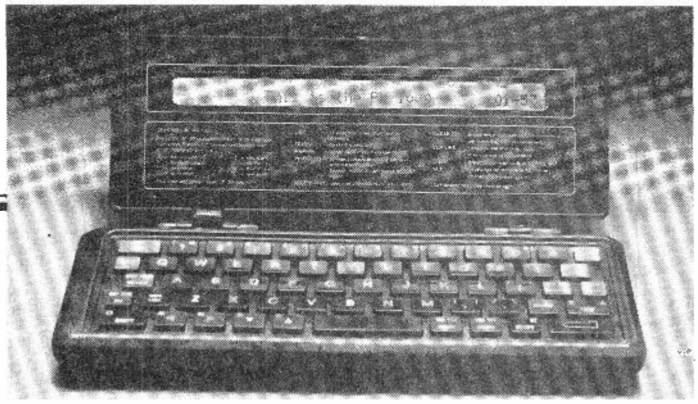
Communication Systems Research Ltd has recently introduced a range of remote RF spectrum monitoring systems to permit the real-time measurement of RF or IF spectra at a number of remote, possibly unattended, locations from a central control and monitor facility.

The central control facility comprises the control, analysis and graphics software (designed using Ada and implemented in Fortran 77) running on a PDP or microVAX computer, together with disk storage, keyboard, VDU, plotter and a colour graphics display.

Each of the remote measurement sites contains a programmable spectrum analyser, input signal switching equipment and (if required) an RF calibration source. These are all controlled by a local controller running Ada-designed Basic for instrument setting, calibration and data capture. The communication between the central and the remote controllers is handled by CCITT V22 bis modems and error controllers.

One example is a 3-monitor system supplied to the International Maritime Satellite Organisation (INMARSAT), London, to allow the C and L Band downlink spectra from their Atlantic, Pacific and Indian ocean region satellites to be displayed and processed at their operation control centre in London. The remote monitors are located at coastal Earth stations in England, Norway and Singapore.

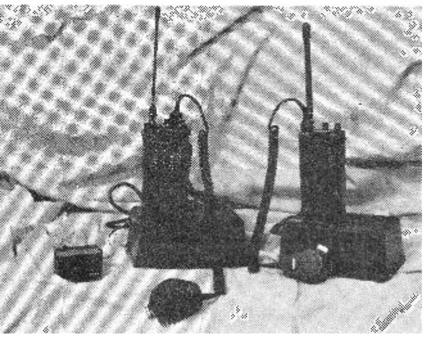
Communication Systems Research Ltd,
Prospect House,
The Grove, Ilkley,
West Yorkshire LS29 9EE.
Tel: (0943) 603018.



ICOM PSU

Now available from MRZ Communications is a desk-top power supply for use with the Icom range of hand-held transceivers.

The BPU series of power supplies offers a regulated voltage with over-voltage protection and over-current shutdown for Icom's PMR, marine or amateur band hand-helds. The unit is used by removing the battery pack and sliding the radio onto the mounting provided.



Also available is a desk supply with a charging system for the BP3 battery pack.

The MRZ power units are available for the H2 and H6, M2, M5 and M12, and 2E, 4E, 02E and 04E models.

MRZ Communications Ltd,
Newton House,
248 Uttoxeter Road,
Longton,
Stoke on Trent ST3 5QL.
Tel: (0782) 336221.

PORTABLE E-MAIL

Linc (UK) Communications are now marketing what must be the smallest electronic mail unit available. The PX1000 is a low cost 62-key, 7400 character memory device with elementary word processing functions and built-in acoustic modem which measures just 224 × 85 × 26mm.

The PX1000 features a 40-character LCD screen and has a transmission speed of 300, 600 and 1200 bps. Power is provided by built-in rechargeable batteries.

By connecting the PX1000 to a phone, messages can be sent to another PX1000, the Linc DX90 message centre or an IBM PC compatible computer. Connection to the Connex electronic mail network is also possible, and messages can be sent encoded for security.

Also available is the PXP40 mini printer, a thermal printer offering 40 characters per line, 25 characters per second and a 2K buffer memory.

Linc (UK) Communications,
5 Dover Street,
London W1X 3PJ.
Tel: (01) 493 9337.

VHF PRE-AMP

A metal-housed AM or FM radio preamplifier, giving a 22dB gain boost for improved reception, is now available in kit form from Electronic and Computer Workshop Ltd.

The kit comprises a high quality PCB, all the necessary components, and a strong metal housing, together with full constructional and operational instructions. The kit is simple to build and will much improve the reception performance of VHF FM or AM radio in the house or car.

The 22dB gain is from 10 to 150MHz and the amplifier operates from an unstabilised power supply of between 12 and 15V dc, which allows direct operation from a car supply if desired. The supply can be connected directly to the amplifier or, for use where the amplifier is mounted close to a loft or roof mounted antenna, can be fed by way of the coaxial cable. Supply current requirement is 1 to 3mA.

ECW offers the K2622 kit at £8.84 including VAT and post/packing.

Electronic & Computer Workshop Ltd,
171 Broomfield Road,
Chelmsford,
Essex CM1 1RY.
Tel: (0245) 262149.

ORYX 15 IRON

The comprehensive Oryx soldering iron range has been extended by the introduction of the Oryx 15 watt 240 volt lightweight iron. This low cost iron is based on a successful unit Oryx has built for a national public service organisation, which has used a similar device for many years.

Now in 'civvy' colours of orange and black, this unit will serve all aspects of the market from the hobbyist through to industrial applications. The temperature is set at 350°C nominal from a wire-wound element in a tubular ceramic insulator. The soldering tip is iron plated for long life.

The unit can be purchased direct from Greenwood Electronics by cheque, Barclaycard or Access at a price of £5.00, inclusive of VAT and postage.

Greenwood Electronics,
Portman Road,
Reading RG3 1NE.
Tel: (0734) 595843.

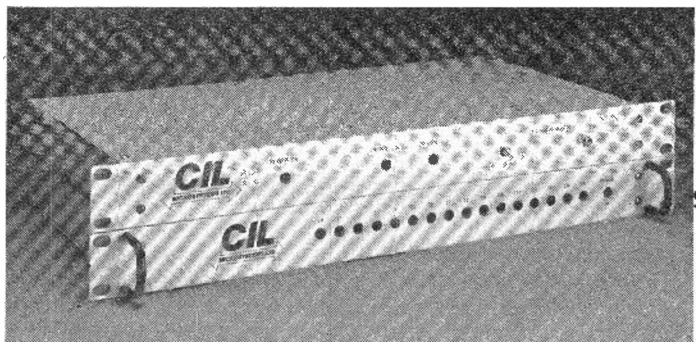
DATA LOGGING SYSTEM

CIL Microsystems has recently produced a new data logging system, the DTR 1680, for use with RS232 or IEEE-488, especially designed for strain gauges, thermocouples and millivolt signals.

The system is designed around the PCI 1280 16-bit analogue/digital converter with the addition of a range of 24 channel input conditioning and multiplexer units, to provide direct measurement of low-level signals. Each A/D converter thus has a capacity of 192 channels with possible expansion to over 2000 channels.

The hardware is complemented by a selection of software packages for a variety of common microcomputers, *viz* the IBM PC, Apricot, Commodore and Apple IIe. Simple programs are provided showing the techniques used to acquire data and control the system.

CIL Microsystems Ltd,
Decoy Road,
Worthing,
Sussex BN14 8ND.
Tel: (0903) 210474.



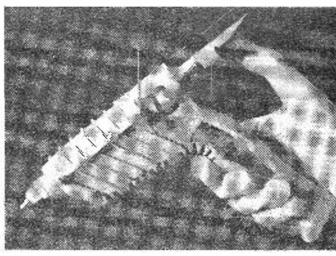
POTTING ADHESIVE

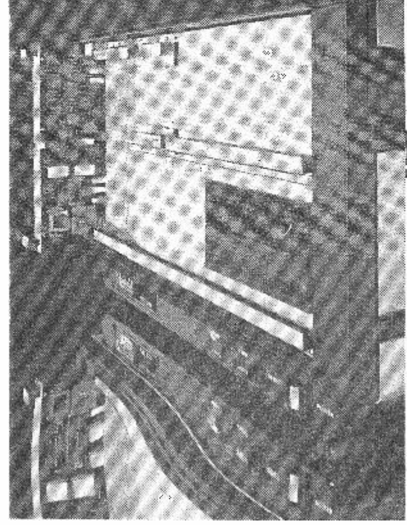
The latest one-part hot-melt adhesive from 3M's Jet-melt range is Jet-melt 3797. It is claimed to offer several advantages in medium to large electrical and electronic potting applications.

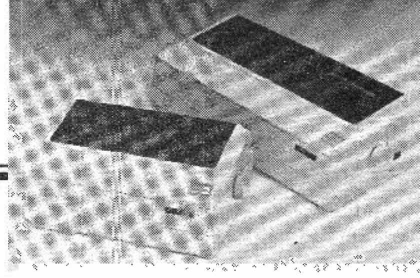
Applied with the electrically-powered 3M TC applicator – designed to be left switched on all day without adhesive degradation, dripping or back-melting – Jet-melt 3797 offers an excellent combination of electrical properties with high dielectric constant and strength, high volume resistivity and low dissipation.

Recommended for electrical applications including potting, encapsulating and wire bundle unitising, Jet-melt 3797 exhibits zero water absorption (even in aqueous or high humidity environments), no breakdown under acidic conditions, good shock resistance and good resistance to flow up to 151°C.

3M United Kingdom plc,
Adhesives & Sealants Group,
PO Box 1, Bracknell,
Berkshire RG12 1JU.
Tel: (0344) 58606.







VMEBUS SYSTEM

The new VME starter system from Bicc-Vero Microsystems is designed as a low-cost but expandable system for those wishing to evaluate or prototype VMEbus technology.

Starting at under £5000, this 6U system features a 68010 or 68000 CPU, a DSDD floppy and 10Mbyte hard disc, 10-slot-J1 and J2 backplanes subdivided to take both double and single Eurocards, cooling, front panel switches and indicators, a large 400W power supply, plus a range of optional software including the multi-user multi-tasking OS-9 operating system and the C language. The enclosure comes from Bicc-Vero's award-winning Microrack VMEbus family.

The system achieves its low-cost objectives by utilising a high-functionality 68010 or 68000 CPU card with 128K dual-ported RAM (expandable to 512K), twin serial ports, dual 8-bit parallel ports, sockets for a 68451 MMU and 128K EPROM, interrupt handling logic and an on-board system controller.

Bicc-Vero Microsystems,
Flanders Road,
Hedge End,
Southampton SO3 3LG.
Tel: (04892) 5824.

IMAGEWRITER INTERFACE

A new Apple Imagewriter interface, which allows Mannesmann Tally's MT85/86 printers to work with the Apple Macintosh PC, is now available to dealers ex-stock from Rapid Winners.

The interface card/MT printer combination is less expensive than the Imagewriter and provides higher performance and extra facilities. Both the MT85 and MT86 are serial matrix machines that offer draft printing at 180cps, correspondence printing at 45cps and a 3K line buffer to speed throughput. The printers also handle bit-map graphics screen dumps.

ASCII multinational and IBM PC character sets are standard on the machines, and optional plug-in font cartridges are available to provide additional type-styles for document enhancement. Super/subscript, compressed, expanded bold print plus various graphics modes give further flexibility.

Rapid Winners,
Rapid House,
Denmark St, High Wycombe,
Bucks HP11 2ER.
Tel: (0494) 450111.

REAL-TIME CLOCK

Now available from PPM is the PPM 100 clock, which doubles as a calendar and is IEEE-488 programmable. The instrument has been designed for use in bus-controlled test, data logging, and other computer-based systems which have no built-in clock facility.

The clock is mains powered, with rechargeable battery back-up. It has full calendar read-out with automatic leap year compensation, and is easily programmed with an 11-character numeric string. A 12-character read-out is terminated by a carriage return.

Time and data output is for one month, day of the week, day of the month, hours, minutes, seconds and tenths of seconds. Programming is for a year, month, day, date, hours, minutes, and start/stop.

PPM Instrumentation Ltd,
Hermitage Road,
St Johns,
Woking,
Surrey GU21 1TZ.
Tel: (04867) 80111.

BAR CODE READER

Available from DMS Electronics is the DMS SABRU, a stand-alone bar code reader. The unit contains its own CPU and power supply to give independence from the host computer, and is designed to work with any computer via an RS232 line. It will decode 8/13-digit EANA, 12-digit UPCA, 3 of 9, 2 of 7, interleaved 2 of 5, or Plessey bar codes, and features auto-selection of the bar code. Special bar codes can be installed on request, as well as CMOS RAM to batch store the bar codes.

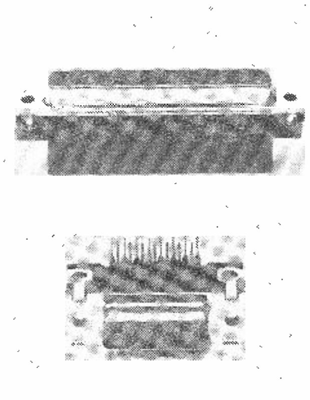
Options include a real-time clock to provide date and time information.

The stand-alone reader retails at £400 + VAT, and will be available in Europe, the USA and Australia. DMS can also supply a bar code labelling system.

DMS Electronics Ltd,
Bretton Court,
Manor Road,
Wales Village,
Sheffield S31 8PD.
Tel: (0909) 773399.

REDUCED RFI/EMI

The metal shell D-subminiature is a new addition to the Viking connector range. This right-angle PCB connector has been designed to substantially reduce electromagnetic (EMI) and radio frequency (RFI) interference emanating from computers, peripherals and other similar equipment.



The metal shell is bright tin-plated rolled steel over an insulator of high quality UL 94V-O approved flame retardant thermoplastic, and is available in 9, 15, 25 and 37 positions, all with a 0.590-inch PCB footprint. This means that they have excellent shielding and grounding properties and are easily interchangeable with any 0.590 footprint D-subminiatures.

A choice of two contact platings of 10 or 30 microinch gold plating is available, as well as a wide variety of grounding and mounting hardware.

Viking Connectors (UK) Ltd,
Chatsworth House,
Portland Close,
Houghton Regis,
Dunstable,
Beds LU5 4AW.
Tel: (0582) 603600.

BAR CODE NETWORK

RTD Limited and Eyetech Security Print Limited have announced Barway, a low cost, local area network (LAN) specifically designed for interactive data collection in an industrial or office environment, primarily by bar code or other automatic identification techniques.

Barway offers a method of connecting different types of data collection equipment such as bar code readers, terminals and RF tags to a single computer port. Almost any type of equipment can be used with Barway, including equipment from different manufacturers, the sole requisite being the RS232 interface for connection to the central computer. Bar code and document printers can also be attached to the system.

Fully portable, Barway allows two-way data transfer between the controlling computer and the data collection unit and, as an option, can be supplied with a liquid crystal display to provide operator prompts and messages. Barway's software will permit up to 99 data collection devices to be individually handled by a single computer program, achieved through the use of an identity code which is built into each Barway node system.

Eyetech Security Print Ltd,
Dukes Way,
Teeside Industrial Estate,
Thornaby, Cleveland.
Tel: (0642) 760306.

DIP SWITCHES

IMO Precision Controls has introduced an innovative concept in DIP switch technology which allows complete immersion cleaning without having to use sealing tape. The new IMO/Omron A6D DIP switches thus improve overall production efficiency while assisting in the reduction of costs by up to 20%.

Conventional taping is eliminated because each switch is specially equipped with a rubber inner-sealing under its striker, ultrasonic welding between its cover and housing, plus insertion moulding terminals. The compact structures also assure the A6D's resistance to dust and corrosive atmosphere.

IMO has developed both top actuated and side actuated types. Both are available with 4, 6 and 8-way pins and bifurcated movable contacts which offer contact reliability and a self-cleaning mechanism. The A6D range has a switching capacity of 100mA at 50V dc.

The subminiature size of each switch also reduces the overall volume to 41% and mounting surface to 67% when compared to standard devices.

IMO Precision Controls Ltd,
1000 North Circular Road,
Staples Corner,
London NW2 7JP.
Tel: (01) 452 6444.

TV TUNING IC

Push-button synthesized control of up to thirty-nine TV stations is provided by the new SAA1293 IC from ITT Semiconductors. The device uses voltage synthesis for low system cost, providing an alternative to mechanical tuning methods. A range of built-in software options in the chip's program memory enables it to offer additional features over other voltage synthesis devices.

Tuning voltage is generated accurately by an on-board 12-bit D/A converter. Three outputs for uses such as volume, colour and contrast control are also provided. As well as direct station selection, the SAA1293 offers sequential selection, automatically scanning through the stations at intervals.

An interface to the standard Teletext ICs on the market is included for flexibility – no extra logic is required to connect. The device interfaces to a 32-key pad, which it automatically debounces.

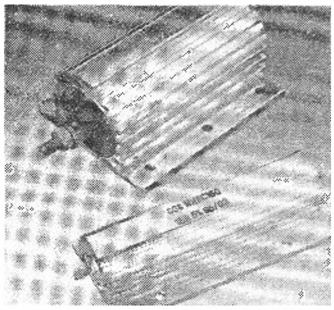
ITT Semiconductors,
145-147 Ewell Road,
Surbiton,
Surrey KT6 6AW.
Tel: (01) 390 6578/9.

HIGH-QUALITY RESISTORS

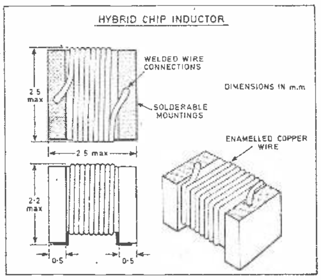
CGS has announced that its established HS range of high quality wire-wound resistors has been extended to include 75, 150, and 250W ratings.

These high-stability resistors are capable of dissipating high power in a limited space with a relatively low surface temperature. The power is dissipated rapidly through the aluminium housing to the heat sink.

The new types are available with ohmic values R10 to 50k, 100k and 75k and maximum working voltages 1400, 2500, and 2200V. Tolerance on value is ±5% standard, with ±10% and tolerances down to ±0.25% also available. Stability is 2%/1000hr for 75 and 150W types, and 3%/1000hr for the 250W type. Temperature coefficient is 50ppm/°C for values below 100R, and 30ppm/°C for values above 100R.



The CGS Resistance Company Ltd,
Marsh Lane,
Lymington,
Hants SO4 9YQ.
Tel: (0590) 75255.



CHIP INDUCTORS

A new range of microminiature chip inductors from Steatite has been designed for use in hybrid circuitry.

Measuring only 2.5 × 2.5 × 2.2mm, the inductors are of lacquered copper wire wound on a ceramic or ferrite former according to the inductance value. Values from 10nH to 1.2μH exhibit Q values of 35 to 50 (min) and are ceramic based. Ferrite based types, with a minimum Q of 25, cover values from 1.5μH to 10μH.

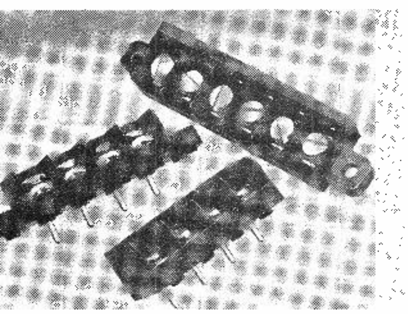
Coil connections are welded to the termination pads which are fully solderable. The welding prevents the coil from unravelling during assembly.

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

TERMINAL STRIPS

AF Bulgin & Co has introduced a new series of space-saving barrier terminal strips for PC board applications. The products are manufactured by the Beau Products Division of Vernitron Corporation, Laconia, New Hampshire, USA.

The new closed-side, single-row strips have terminals spaced on 0.325-inch centres, and are rated at 20A.



The closed-side design provides increased protection by acting as a wire stop. Wires cannot pass through the closed side, or contact other wires or PC board components, so shorts are virtually eliminated. The closed side also allows components to be positioned close to the terminal strip, resulting in a more compact PC board.

Made of break-resistant thermoplastic, these strips are available in closed-back or feedthrough styles and can be furnished with a variety of terminals.

AF Bulgin & Company plc,
Bypass Road, Barking,
Essex IG11 0AZ.
Tel: (01) 594 5588.

RF ROTATING JOINTS

The Kevlin range of RF rotating joints from Tony Chapman Electronics is available from dc to 50GHz in a wide choice of configurations from single-channel coaxial waveguide models to hi-military specifications. Dedicated components for satcomm frequencies are also available.

The range includes single-channel coaxial types, single-channel waveguide, and combinations where both coaxial and waveguide RF paths can be passed through a multi-channel rotating joint.

Tony Chapman Electronics Ltd,
Electron House,
Hemnall Street, Epping,
Essex CM16 4LS.
Tel: (0378) 78231/2.

HIGH GAIN FET AMPS

Covering the frequency bands from 7.5 to 15.3GHz, a new range of thin-film microwave FET amplifiers for communications and radar systems can now be supplied by Anglia Microwaves Ltd.

The Zeta 1523 range, comprising four models, is available on a 30-45 days delivery time. This family of high stability devices features a low noise figure – typically 3.0dB maximum.

The 1523 amplifiers are designed to be efficient, giving an RF output power of +11dBm for an 85mA (+5V) input current. Gain flatness figure is ±0.5dB and VSWR is 2.0:1 maximum.

Anglia Microwaves Ltd,
Radford Business Centre,
Radford Way,
Billericay,
Essex CM12 0BZ.
Tel: (02774) 58955.

NEWS DESK

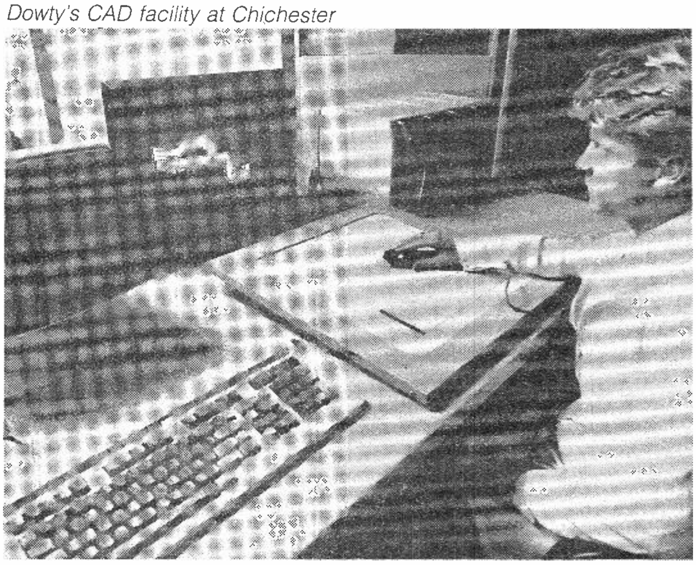
Howdy, Dowty!

Things are stirring down in Chichester. Dowty Electronic Circuits have been industriously investing £1.2M in their two factories there, with the new facilities including a CAD/CAM system and a design, prototype and production service for rigid multilayer circuits.

Dowty can now offer design to manufacture of flexible, flex-rigid, flexi-rigid multilayer, sculptured flexible and rigid multilayer products, all with the benefit of the speed and accuracy offered by modern computer power (Data General in this case).

Methinks it's a step removed from breadboarding on the kitchen table. I think I'll go back to playing with Lego...

Dowty's CAD facility at Chichester



Déjà vu?

Remember those old black and white war films in which stiff-backed and stiff upper lipped Royal Navy officers exchanged ship to ship messages via flashing lamps? Well, Northgate Associates of Letchworth are developing the modern equivalent based on semiconductor lasers and microelectronic reception and processing circuitry.

The aim is to provide an economical and secure method of communication over a short range. This method avoids the possibility of listening in, as is possible with ordinary radio links, and enjoys a considerable advantage in size and portability over microwave links, which can also be jammed.

Available details were sparse at the time of going to press, the promised info not yet having arrived, but evidently the system has been prototyped and tested.

Since it uses a light beam it is obviously line of sight, and it employs a semiconductor laser and a high sensitivity avalanche PIN diode photomultiplier receiver. The range is quoted as being about 5 miles, although it has only been tested to 1½ miles so far. The beam width at this range is a matter of yards, which means that alignment is fairly straightforward while making interception unlikely. The modulating signal can also be encoded (using error-correction if required).

There's only one problem – what happens when there's heavy rain or fog?

Let's make money

News comes from the Safeguard Fuse Company Ltd (via their PR agents) of a new solder designed to save 'time, money and the aggro of unsatisfactory solder joints'. The PR world being what it is, and editors being particularly fond of the wicker-work filing cabinet on the floor by the desk, this press release begins, 'most manufacturers prefer to keep the secret of their success to themselves'.

The implication is, of course, that Safeguard are being very philanthropic, benevolent etc, whereas we all know that in common with every other company in the country (with the exception of Sinclair Research until the Amstrad takeover) they are in the business of making money.

Anyway, leaving aside such pedantry, the wondrous new product is called HS10, and is a high-speed flux-cored solder, the attributes of which include high oxidation tolerance of older component wires to reduce dry joints, and an ultra-fast spreading action which gives the solder a greater wetting area than most conventional resin-cored solders.

HS10 is said to show advantages on copper, brass, silver, German silver, cadmium or silver-plated, and tinned surfaces, with outstanding performance claimed on nickel-plated components.

As a bonus (you mean there's more?) the quick-spreading flux makes it possible to lower the percentage of tin in HS10 and still make a fast joint. So it seems that Safeguard are not only out to make themselves a couple of bucks, but aim to save their customers money, too (I hereby take back that philanthropy remark).

For all the cynics out there (who, me?), Safeguard are offering a free sample to any inquirer. Their address is 63 Woodham Lane, New Haw, Weybridge, Surrey KT15 3ND. Telephone (0932) 45300.

Just goes to show, some editors will fall for the silliest gimmicks in a press release...

High-fibre comms

Plessey Research has developed a system which enables up to 40 separate communications channels to be combined onto a single optical fibre the size of a human hair. This development has potential in increasing the capacity of existing cable links and reducing the quantity of fibre needed.

Known as Wavelength Division Multiplexing (WDM), the process involves different wavelengths, or colours, of light carrying different information, to be transmitted at the same time along a single optical fibre. The colours are combined at the transmitting end of the fibre and separated at the receiving end without significant interference occurring between them.

Although 40 separate light sources (LEDs) are required for the process, these need only be drawn from five differing variants in the infrared part of the spectrum, as each can be further subdivided into eight separate colours by a process known as spectrum slicing.

Multimeter recall

Thorn EMI Instruments Limited is asking all owners of AVOmeter models 1000 and 1001 analogue multimeters bearing the serial numbers listed below to return them to the company for a slight modification to be made.

A potential fault has been identified which could result, in certain circumstances, in the fuse blowing within the instrument when used on the 1000 volt ranges, and which could therefore be dangerous to the user.

The only instruments affected are the ones with the following serial numbers:

1) numbers where the *second* letter is C or D;

2) numbers which include adjoining letters AE, BE, CE, DE.

Instruments should be returned to:

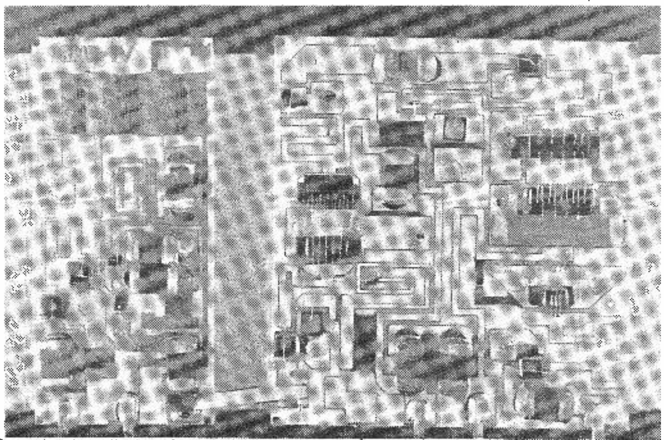
Thorn EMI Instruments Limited,
Parts and Service Centre,
Archcliffe Road,
Dover,
Kent CT17 9EN

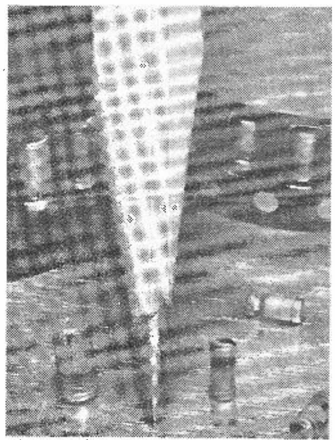
with packages clearly marked on the outside 'For Modification'.

Go north-west, young man

Computer '86, a major computing exhibition aimed at professional and business users, will be held in the Greater Manchester Exhibition Centre (G-MEX) from 24 to 26 June. By mid-March it was nearly 90% booked, and it should prove an attraction to all those northerners who resent having to travel all the way to Birmingham or London for big computer shows.

More details are available from Reed Exhibitions, Surrey House, 1 Throwley Way, Sutton, Surrey SM1 4QQ. Telephone (01) 643 8040.





So what's all the fuss about surface mounting? The main advantage is the saving in space over leaded components, as can be appreciated from the pics. On the left is a hybrid amp for cellular radio, and on the right surface-mounting Zeners, both from Motorola.

Money talks

On 15 April the White Paper on copyright, 'Intellectual Property and Innovation', was published by the DTI. The immediate response from Mrs Rachel Waterhouse, chairman of the Consumers' Association (who publish *Which?*) was one of 'extreme disappointment' that the government seems to have given way to the intense lobbying by the record industry for the introduction of a tax on blank audio tape.

The Consumers' Association quite rightly describes such a tax as 'grossly unfair', and calls on the Government to 'reaffirm its stand against the pressure to impose this arbitrary and anti-progressive tax'.

Who knows, if such a tax is levied maybe the next step will be pressure from book and magazine publishers to introduce a tax on blank paper in order to prevent copying. It certainly wouldn't be any more deplorable than the present proposals.

Invention seekers

Inventalink, the invention broking company, has launched a new product search service geared to finding products according to the specific marketing needs of manufacturers. This has been inspired by enquiries from manufacturers who want Inventalink to find products to help them extend their range or diversify into new areas. Inventalink claims that it's much cheaper than a lot of new product development and has been taken on by international companies involved in packaging, biotechnology and office equipment to look for new product ideas.

Inventalink started out three years ago presenting new product ideas to manufacturers on behalf of their inventors and designers. Last year Inventalink found manufacturers for 14 product ideas.

Anyone interested in the New Product Search service should contact Kit Grundy at Inventalink, 28-32 Lexington Street, London W1R 3HR. Tel: (01) 439 8427.

When the going gets tough

GSPK (Circuits) Ltd, experts in board production, are developing a special projects division to deal with the increasing demand for multilevel circuitry, higher packing densities, the increasing development of communications systems accessed by gold and carbon keypads, and the wider use of surface-mounted components.

Production facilities available include an in-line deep nickel and gold plating plant, apparently one of the very few in the world, and the ability to screen-print silver conductive material on circuits. This latter makes possible the production of double-sided multilevel circuit boards with the same capabilities as multilayer PCBs but without their expensive complexity.

In the realm of surface mounting, GSPK believe the most suitable technique to be a process of nickel and tin-lead selective plating. The result, it seems, is the elimination of complex layout design involving such things as goosenecks, and a solder mask is not generally needed. This process is only in limited use, but GSPK have great hopes for it.

Radio receiver conference

The Institution of Electronic and Radio Engineers (IERE) is organising the fourth international conference on radio receivers, to be held at University College, Bangor, North Wales from 1 to 4 July this year.

Major topics will include recent advances in receiver and system design, digital techniques and receiver ICs. Six speakers have accepted invitations to present tutorial lectures on 'leading edge' subjects: digital signal processing, spread spectrum techniques, frequency synthesis and phase-locked loops, modulation and coding, cryptography, and gallium arsenide applications in receiver design.

The conference on 'Radio Receivers and Associated Systems' will be chaired by Professor William Gosling of Plessey, and is organised by the IERE in association with the IEE, the RSGB, Eurel, URSI-Hungary, and the Institute of Electronics and Communication Engineering, Japan.

Further info and registration forms are available from The Conference Secretariat, Institution of Electronic and Radio Engineers, 99 Gower Street, London WC1E 6AZ. Telephone (01) 388 3071.

Getting IT together

A consortium of 10 major European companies has announced the start of work on a new research and development project addressing industrial communications standards. The project is partly funded by the Commission of the European Communities, under their ESPRIT programme (European Strategic Programme of Research and Development in Information Technology).

The ten companies are British Aerospace, acting as prime contractor, Aeritalia, BMW, Bull Sems, GEC, Nixdorf, Olivetti, PSA Peugeot, Siemens and TITN/CGE.

The new project will complement work undertaken in recent years under the auspices of the International Standards Organisation's model for open system interconnection (OSI). The new European project will build heavily on earlier initiatives, and complement continuing programmes in this area. It will promote, implement and validate the emerging international standards for electronic communications in industry, relating to shop floor and office environments.

The general aims of the project and the other related initiatives are to make it easier for vendors of computer, communication and control equipment to develop and market compatible equipment. This will also make it easier to purchase equipment, without being tied to a single vendor.

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AC128K	0.32
AC141	0.28
AC141K	0.34
AC142K	0.45
AC176	0.22
AC176K	0.31
AC187	0.25
AC187K	0.28
AC188	0.25
AC188K	0.37
AD142	0.79
AD143	0.82
AD149	0.70
AD161	0.39
AD162	0.39
AD161/2	0.90
AF106	0.50
AF114	1.95
AF121	0.60
AF124	0.65
AF125	0.35
AF126	0.32
AF127	0.65
AF139	0.40
AF150	0.60
AF178	1.95
AF239	0.42
AU106	4.50
AU107	3.50
AU110	3.50
AY102	2.95
BC107A	0.11
BC107B	0.11
BC108	0.10
BC108A	0.11
BC108B	0.12
BC109	0.10
BC109B	0.12
BC109C	0.12
BC114A	0.09
BC116A	0.15
BC117	0.19
BC119	0.24
BC125	0.25
BC139	0.20
BC140	0.31
BC141	0.25
BC142	0.21
BC143	0.24
BC147A	0.12
BC147B	0.12
BC148A	0.09
BC148B	0.09
BC149	0.09
BC153	0.30
BC157	0.12
BC158	0.09
BC159	0.09
BC161	0.28
BC170B	0.15
BC171	0.09
BC171A	0.10
BC171B	0.10
BC172	0.10
BC172B	0.10
BC172C	0.10
BC173B	0.10
BC174	0.09
BC174A	0.09
BC177	0.15
BC178	0.15
BC182	0.10
BC182LB	0.10
BC183	0.10
BC183L	0.09
BC184LB	0.09
BC204	0.10
BC207B	0.13
BC208B	0.13
BC212	0.09
BC212L	0.09
BC212LA	0.09
BC213	0.09
BC213L	0.09
BC214	0.09
BC214C	0.09
BC214L	0.09
BC237B	0.09
BC238	0.09
BC239	0.12
BC251A	0.12
BC252A	0.15
BC258	0.25
BC258A	0.39
BC284	0.30
BC300	0.30
BC301	0.30
BC303	0.26
BC307B	0.09
BC327	0.10
BC328	0.10
BC337	0.10
BC338	0.09
BC347A	0.13
BC461	0.35
BC478	0.20
BC527	0.20
BC547	0.10
BC548	0.10
BC549A	0.10
BC550	0.14
BC557	0.08
BC557B	0.08
BC558	0.10
BC639/10	0.30
BCY33A	1.60
BD115	0.30
BD124P	0.59
BD131	0.42
BD132	0.42
BD133	0.40
BD135	0.30
BD136	0.30
BD137	0.32
BD138	0.30
BD139	0.32
BD140	0.30
BD144	1.10
BD150C	0.29
BD159	0.65
BD160	1.50
BD166	0.55
BD179	0.72
BD182	0.70
BD201	0.83
BD202	0.65
BD203	0.78
BD204	0.70
BD222	0.46
BD223	0.59
BD225	0.48
BD232	0.35
BD233	0.35
BD234	0.35
BD236	0.49
BD237	0.40
BD238	0.40
BD242	0.65
BD246	0.75
BD376	0.32
BD410	0.65
BD434	0.65
BD437	0.75
BD438	0.75
BD520	0.65
BD538	0.65
BD597	0.95
BD701	1.25
BD702	1.25
BD707	0.90
BDX32	1.50
BF115	0.35
BF119	0.65
BF127	0.39
BF154	0.20
BF158	0.22
BF160	0.27
BF167	0.27
BF173	0.22
BF177	0.38
BF178	0.26
BF179	0.34
BF180	0.29
BF181	0.29
BF182	0.29
BF183	0.29
BF184	0.28
BF185	0.28
BF194	0.11
BF195	0.11
BF196	0.11
BF197	0.11
BF198	0.16
BF199	0.14
BF200	0.40
BF241	0.15
BF245	0.30
BF257	0.28
BF258	0.28
BF259	0.28
BF271	0.26
BF273	0.18
BF336	0.34
BF337	0.29
BF338	0.32
BF355	0.37
BF362	0.38
BF363	0.65
BF371	0.25
BF394	0.19
BF422	0.32
BF423	0.25
BF457	0.32
BF458	0.36
BF467	0.68
BF595	0.23
BF597	0.25
BFR39	0.23
BFR40	0.23
BFR81	0.25
BFR88	0.30
BFR90	1.50
BFR91	1.75
BFT42	0.35
BFT43	0.35
BFW61	0.60
BFW92	0.85
BFX29	0.30
BFX84	0.26
BFX85	0.32
BFX86	0.30
BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.77
BLY48	1.75
BR100	0.26
BR101	0.49
BR103	0.55
BR303	0.95
BRC4443	1.15
BRY39	0.45
BT100A/02	0.85
BT106	1.49
BT116	1.20
BT119	3.15
BT120	1.65
BU105	1.95
BU108	1.69
BU124	1.25
BU125	1.25
BU126	1.60
BU204	1.55
BU205	1.30
BU208	1.39
BU208A	1.52
BU208D	1.85
BU326	1.20
BU326S	1.50
BU407	1.24
BU500	2.25
BU508A	1.95
BU526	1.90
BU807	2.25
BUY20	2.15
BUY69B	1.70
MJ3000	1.98
MJE340	0.40
MJE350	
MJE520	0.48
MJE2955	
MPSA13	0.29
MPSA92	0.30
MRF237	4.95
MRF450A	13.95
MRF453	17.50
MRF454	26.50
MRF455	17.50
MRF475	2.95
MRF477	10.00
OC16W	1.95
OC23	1.50
OC29	2.25
OC36	2.25
OC42	0.75
OC44	0.75
OC45	0.55
OC70	0.45
OC71	0.55
OC75	0.95
OC81	0.50
OC16W	2.50
R2008B	1.45
R2010B	1.45
R2322	0.58
R2323	0.66
R2540	2.48
RCA16334	0.90
RCA16335	0.80
S2060D	0.95
SKE5F	1.45
TIP29	0.40
TIP29C	0.42
TIP30C	0.43
TIP31C	0.55
TIP32C	0.42
TIP33C	0.95
TIP34B	0.95
TIP41A	0.45
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP120	0.60
TIP125	0.65
TIP142	1.75
TIP146	2.75
TIP161	2.95
TIP2955	0.80
TIP3055	0.55
TIS91	0.20
TV106/2	1.50
ZRF0112	16.50
2N1100	6.50
2N1308	1.35
2N1711	0.30
2N2219	0.28
2N2905	0.40
2N3053	0.40
2N3054	0.59
2N3055	0.52
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.12
2N3706	0.12
2N3708	0.12
2N3733	9.50
2N3773	2.75
2N3792	1.35
2N4280	3.50
2N4427	1.95
2N4444	1.15
2N5294	0.42
2N5296	0.48
2N5298	0.60
2N5485	0.45
2N5496	0.95
2SA329	0.95
2SA715	0.60
2SC495	0.80
2SC496	0.80
2SC931D	0.95
2SC1096	0.80
2SC1106	2.50
2SC1172Y	2.20
2SC1173	1.15
2SC1307	1.75
2SC1364	0.50
2SC1449	0.50
2SC1678	1.25
2SC1945	2.65
2SC1953	0.95
2SC1957	0.80
2SC1969	1.95
2SC2028	1.15
2SC2029	1.95
2SC2078	1.45
2SC2091	0.85
2SC2098	2.95
2SC2166	1.95
2SC2314	0.80
2SC2371	0.36
2SC931D	0.95
1SD234	0.50
2SD325E	1.65
3N211	2.95
3SK88	0.95

DIODES

AA119	0.08
BA115	0.13
BA145	0.16
BA148	0.17
BA154	0.06
BA156	0.15
BA157	0.30
BAX13	0.04
BAX16	0.06
BB105B	0.30
BT151	0.79
BY126	0.10
BY127	0.11
BY133	0.15
BY164	0.45
BY176	1.20
BY179	0.63
BY182	0.55
BY184	0.35
BY199	0.40
BY206	0.14
BY208-800	0.33
BY210-800	0.33
BY223	0.90
BY298-400	0.22
BY299-800	0.22
BYX10	0.20
BYX36-150R	0.20
BYX38-600R	0.60
BYX55-600R	0.30
BYX71-600	1.10
BZX61	0.15
BZY88	0.10
BZY95C30	0.35
CS4B	4.50
CS10B	8.45
OA47	0.09
OA90	0.05
OA91	0.06
OA95	0.06
OA202	0.10
1N21DR	2.95
1N23B	2.95
1N23C	2.95
1N23ER	2.95
1N23WE	2.95
1N4001	0.04
1N4003	0.04
1N4004	0.05
1N4005	0.05
1N4007	0.06
1N4148	0.02
1N4448	0.10
1N5401	0.12
1N5402	0.14
1N5403	0.12
1N5406	0.13
1N5407	0.16
1N5408	0.16
ITT44	0.04
ITT923	0.15
ITT2002	0.10

BASES

B5D	5.50
B7G	0.25
B7G SKTD	0.25
B8G	0.35
B8H	0.70
B9A	1.50
B9A SKTD	0.40
B9G	0.75
B10B	0.20
B13B	0.50
B14A	3.00
12 Pin CRT	0.95
Nuvistor	2.95
Octal	0.35
SK610	35.00
UX5	1.75
Valve Can	0.30
8 Pin Dil	0.14
14 Pin Dil	0.15
16 Pin Dil	0.17
18 Pin Dil	0.18
Socket for 813	9.50

WIREWOUND RESISTORS

4 Watt 2R4-10K	0.20
7 Watt R47-22K	0.20
11 Watt 1R5-15K	0.25
17 Watt 1R-15K	0.30

ZENER DIODES BZX61 0.15

6V2 7V5 8V2 9V1 10V 11v 12V 13V 15V 16V 18V 20V 22V 24V 27V 30V 33V 36V 39V 47V 51V 56V 68V 75V

THERMISTORS

VA1040	0.23
VA1056S	0.23
VA1104	0.70
VAT8650	0.46
VA1097	0.25

BZY88 0.07

2V7 3V 3V3 3V6 3V9 4V3 4V7 5V1 5V6 6V2 6V8 7V5 6V2 9V1 10V 11V 12V 13V 15V 18V 20V 24V 27V 30V

BATTERIES

7V Power Mike batteries TR175 £2.25 ea other prices on request

LINE OUTPUT TRANSFORMERS

DECCA 100	7.95
DECCA 1700 MONO	9.95
DECCA 1730	8.95
DECCA 2230	8.25
GEC 2040	8.95
GRUNDIG 1500	15.45
GRUNDIG 5010-6010 2222, 5011-6011	13.45
ITT CVC20	8.20
ITT CVC30	8.25
PHILIPS G8	8.50
PHILIPS C9	8.99
PHILIPS G11	13.39
PYE 725	10.95
RBM T20A	12.40
TANDBERGE 90	11.15
TELEFUNKEN 711A	11.15
THORN 1590	9.50
THORN 8000	23.50
THORN 9000	9.95
THORN 9800	22.40
THORN MAINS TRANSFORMER 3000/3500	9.70

EHT MULTIPLIERS

ITT CVC20	6.35
ITT CVC30	6.35
PHILIPS G8 550	6.96
RANK T20A	6.91
THORN 3000/3500	7.57
THORN 8500	5.50
THORN 9000	8.00
UNIVERSAL TRIPLER	5.45

SPARES & AIDS

HEAT SINK COMPOUND	1.00
FREEZE IT	0.95
SOLDA MOP	0.64
SWITCH CLEANER	0.85
WD40	1.25
PUSH PUSH MAINS SWITCH (DECCA, GEC, RANK, THORN ETC)	1.02
PYE IF GAIN MODULE	6.99
ANODE CAP (27KV)	0.69

REPLACEMENT ELECTROLYTIC CAPACITORS

DECCA 30 (400-400/350V)	2.85
DECCA 80/100 (400/350V)	2.99
DECCA 1700 (200-200-400-350V)	3.55
GEC 2110 (600/300V)	2.25
ITT CVC20 (220/400V)	1.80
PHILIPS G8 (600/300V)	2.25
PHILIPS G9 (2200/63V)	1.19
PHILIPS G11 (470/250V)	2.35

PUSH BUTTON UNITS

DECCA, ITT, CVC20 6 WAY	7.95
ITT CVC5 7 WAY	10.19
PHILIPS G8 (550) 6 WAY	14.49

VARICAP TUNERS

ELC1043/05 MULLARD	8.65
ELC1043/06 MULLARD	8.65
U321	8.25
U322	8.25
U324	8.25

POTENTIOMETERS

STANDARD VERTICAL POTS	0.12
MIN VERTICAL POTS	0.12
STANDARD HORIZONTAL POTS	0.12
MIN HORIZONTAL POTS	0.12
CONVERGENCE PRE-SETS	0.30
SLIDERS LOG	0.48
SLIDER LINEAR	0.48

SOLDERING EQUIPMENT

25W Antex Iron	4.59
Weller Instant Heat Gun	11.30
240V Weller Marsman	4.74
1/2 Kilo Solder 60/40	6.95

20MM ANTI SURGE FUSES

100MA-800MA	15p each
1A-5AMP	12p each

20MM QUICK BLOW FUSES

100MA	8p each
200MA-5AMP	5p each

SPECTRUM WATCH

NIGEL CAWTHORNE G3TXF

The new high-power broadcast installation on the west coast of Finland will greatly increase Radio Finland's voice around the world on the short wave bands.

The FM102 million (£14M) project involves the building of a complete transmitter station and antenna installation on a new site near Pori to replace Finland's existing short wave transmitting centre in the same town. Apart from an old 250kW short wave transmitter and a rotatable log-periodic antenna which are being transferred from the existing site, all the equipment will be new.

For their international short wave services, the Finnish Broadcasting Company (Yleisradio) have purchased three 500kW self-tuning transmitters from the Swiss company BBC (Brown Boveri). The project also includes the purchase of a single 600kW medium wave transmitter from the same company for coverage of Scandinavia and parts of Europe.

A fifth new transmitter is a single 100kW fixed-frequency short wave transmitter which will operate on Finland's allocation at 6120kHz for services to Europe.

When completed, the new transmitter hall will house three 500kW SW, one 250kW SW, one 100kW SW and a 600kW MW transmitter. The station has been designed for unmanned operation. The entire scheduling (times, frequencies, powers and antenna selection) is computer controlled. The station control system is being built by the Finnish company Altim Control Oy.

Jorma Laiho, who is responsible for the masts and antennas on the project, told *Spectrum Watch* that Yleisradio had decided, in order to keep costs down, to do much of the work themselves rather than going for a turn-key project with one supplier. For example, Yleisradio are building their own antenna feeder systems and are doing all the installation and rigging work themselves.

Time GMT	Freq (kHz)	Area	Language	Bearing
0430-2300	6120	Europe	F + S + E	230°
0430-2030	11755	Europe	F + S + E	205°
0345-0600	9605	Middle East	F	160°
0600-0715	9560 6120	Europe	F + S	230° 205°
0800-0930*	11935 15265	Europe Far East/Australasia	F + E	220° 234°
0930-1050	11935 15265	Europe Far East/Australasia	F + E	220° 234°
0800-0930*	11935	South America	F + S + E	260°
0930-1100	11935	South America	F + S + E	260°
1200-1630	11945 15400	North America	F + E + S	305° 305°
1500-1530	17785	Africa/Middle East	E	180°
1530-1700	11850	Africa/Middle East	F + S	170°
1700-2300	6120 9530	Europe	F + S + E	230° 220°

Notes: * = Sat/Sun only
Languages: F=Finnish S=Swedish E=English
Lahti 254kHz and Turku 963kHz carry the external service daily between 2230-0030 local Finnish time with programmes in Finnish, Swedish and English.

Curtain antennas

The ability to operate on two SW frequencies simultaneously was an important consideration in the design of the new Pori transmitter installation. Apart from the LPA that is being transplanted from the old site, there will be ten new SW curtain antennas and a new MW mast radiator.

The US antenna manufacturer TCI is supplying the antennas. The towers at Pori are being built by the national Finnish power company. The ten curtain antennas are in the form of a horseshoe, with the open end of the horseshoe towards the north. Short wave propagation through the polar region is notoriously difficult. In order to reach their main target audience areas, Radio Finland are installing their antennas with bearings ranging from 75° to the east round through south and on to north-west at 310°.

For the North American service there are two slewable curtains firing at 310°. Slewing allows the direction of the main lobe of a fixed curtain array to be altered to increase the potential coverage area of the antenna. For South America, the southern Pacific and parts of Europe and Africa, there are two more slewable curtains at 240°. Further European coverage is provided by two pairs of arrays at 220°/240° and 160°. For the Australian and Far East services (via the short-path) there are two curtains at 75°. For long-path to Australia the 240° curtains will be used.

Where there are two curtains for the same direction there is a deliberate overlap in the frequency ranges covered. The ranges of the two curtains are 9-17MHz (31m, 25m, 19m and 16m) and 11-21MHz (25m, 19m, 16m and 13m). This will allow a greater degree of flexibility than exists at the old transmitter site in Pori which has been operational for forty years.

The table shows Radio Finland's current operating schedule, which is provided by three ageing transmitters at the original Pori site. The old site houses a 250kW transmitter which is being relocated to the new station, and an old Marconi 100kW SW transmitter, which will be scrapped. There is also an antique 'home-made' pair of 15kW transmitters which date back to World War II.

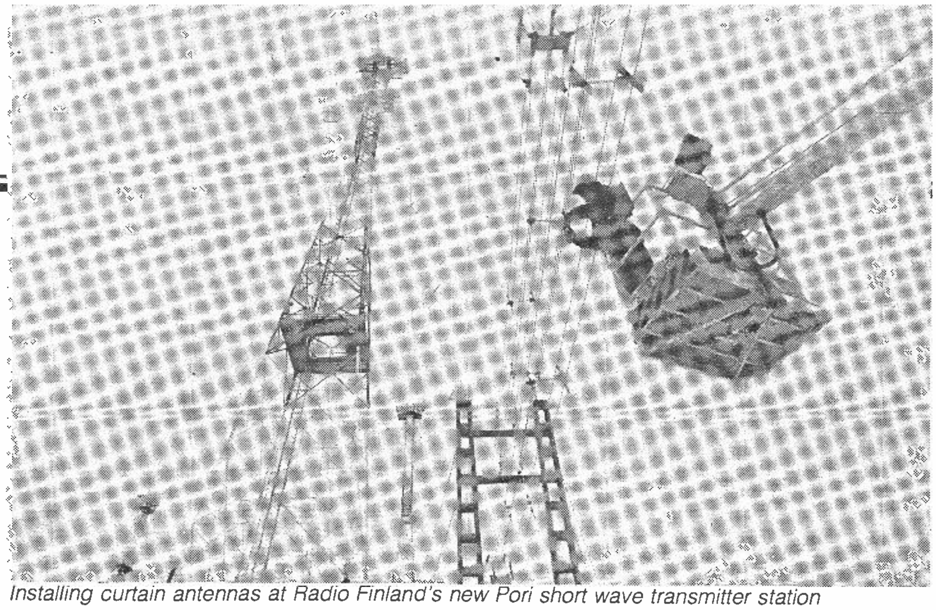
Planned on-air date

Installation and commissioning work for both the transmitters and antennas at the new Pori site is continuing during 1986, with the planned on-air date for the new station being 1 January 1987. Once the new site is operational, Radio Finland's world-wide broadcasting schedule will be expanded.

A 0.6λ mast radiator is being built 700m from the new Pori transmitter building for the 600kW medium wave transmitter, which is expected to be audible across much of Europe in the evenings. The new MW transmitter will operate on 963kHz, which is currently used by a 100kW transmitter at Turku. During the late evening both 963kHz and Radio Finland's long wave allocation at 254kHz carry the international service with programmes in English, Finnish and Swedish. Once the new 600kW MW transmitter at Pori takes over the 963kHz allocation, the original 963kHz transmitter at Turku will be transferred to 1278kHz for Radio Finland's domestic Swedish service. Finland has two official languages: Finnish and Swedish. All street signs and most official documents are in both languages.

Because the new transmitter station at Pori is an international broadcast service, two-thirds of the finance for the project will come from central Finnish government funds and one-third from Yleisradio. This is similar to the situation in the UK, where funding for the BBC's External Services comes from the Foreign and Commonwealth Office.

Yleisradio already have two other major expansion projects on the drawing-board. These are, firstly the installation of a third national TV network, which will be on UHF, and secondly, increasing the power of their existing long wave broadcasting service.



Installing curtain antennas at Radio Finland's new Pori short wave transmitter station

Third TV network

The two existing national TV services are on VHF and UHF. Yleisradio is currently studying the possibility of using an over-the-air pay TV system for at least part of the time on the third network. The only other European station using over-the-air pay TV is the French Canal Plus. Decisions on Finland's third TV network are expected within a few weeks.

Yleisradio have already drawn up engineering plans of how they would provide the UHF transmitter network. The initial requirement would be for four 40kW UHF klystron transmitters and a 25kW transmitter. The ERPs at the five main stations would be between 600kW and 1,000kW. Finland's relatively flat terrain allows the use of high-power UHF installations to obtain good coverage.

Long wave expansion

A much longer term project for Yleisradio is the installation of a high-powered long wave transmitter. Finland currently operates a long wave service from Lahti on 254kHz with a 200kW transmitter. However, Finland does have an allocation within the 1975 Geneva Plan which permits the use of 1,500kW. Listeners to 254kHz in the UK have to try to 'null-out' Algiers, which is on the same frequency, in order to hear the Lahti transmitter.

Yleisradio have already purchased a seaside site near Turku in western Finland for their new long wave installation, but funding for this project is unlikely to be available until the new short wave centre at Pori is completed.

BBC introduce RDS on FM

The BBC have announced that they intend to introduce the EBU agreed Radio Data System (RDS) on the English FM transmitter network from September 1987. Later it will be extended in stages to the entire UK FM transmitter network.

RDS is a new system that will make it easier for listeners to find their favourite FM radio programmes. A subcarrier at 57kHz (3 × the 19kHz pilot-tone subcarrier frequency) is used to transmit data at a rate of 1187.5bps. This bit rate is determined by dividing the 57kHz subcarrier frequency by 48. RDS is thus 'locked' to the pilot-tone.

RDS, when added to VHF-FM transmitter networks, will enable a new generation FM receiver to provide a number of 'user-friendly' functions for the listener. These will include advanced automatic tuning with read-out of the station name, an accurate clock, automatic switching to pick up traffic messages on other channels, as well as a read-out of, say, the name of the record you are listening to!

The EBU have drawn up a technical specification for RDS which includes some fourteen possible functions. From September '87 the BBC will be providing five of these.

Programme Identification (PI) enables the receiver to automatically find a chosen service and always selects the strongest signal available with that service. Programme Service (PS) uses a longer code of up to eight characters which may be displayed on the receiver to indicate the name/callsign of the station being received.

An Alternative Frequencies (AF) facility informs the receiver of the other frequencies to which it can switch if it finds a stronger signal. Using the Other Network (ON) information, a receiver tuned to one station can monitor information about broadcasts on other stations, allowing, for example, instant retuning to a different station on which a traffic announcement is due.

The fifth facility being provided by the BBC on their FM network is Clock Time and Date (CT), giving accurate date/time information which automatically takes care of local time variations (eg daylight saving time).

When launching the new service, Richard Francis, Managing Director of BBC Radio, said that the take-up of FM services in the UK had always been disappointing. The fully automatic tuning facilities available through RDS would, Francis hoped, make it much easier for the FM listener. Ease of tuning is the first priority, he emphasised.

He explained that implementation of RDS would represent only about 1% of BBC Radio's total annual capital budget, or equivalent to 3p of the UK viewer's annual combined radio and TV licence fee of £58.

Automatic scanning feature

Dr Bob Ely, of BBC Engineering Research at Kingswood Warren, who is chairman of the EBU Specialist Group on RDS, explained to *R&EW* that the scanning feature within RDS works automatically without the listener being aware that anything is happening. The RDS receiver is switched to other possible frequencies for just 10ms, during which time a comparison between the signal level of the station being listened to and alternative stations is made. This allows the RDS receiver to select the optimum programme frequency for any given location.

Francis said that he did not expect an RDS-FM receiver to be much more expensive than a normal FM receiver, but that the popularisation of RDS would depend on the development of suitable LSI chips for use in the receivers. The BBC said they are in contact with a number of receiver manufacturers and that they expect receivers to be available on the market when RDS-FM starts in September 1987. REW

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

Mildenhall magistrates recently fined a self-employed taxi proprietor for using a citizen's band radio on the wrong frequency and for installing a linear amplifier which had been illegally modified.

The DTI, who brought the case, said that CB users could only transmit between 27.601 and 27.991MHz, whereas on 15 July of last year the defendant had used the radio equipment on 28.340MHz – a frequency 'allocated for other services'. These services, as readers will know, are those for amateur radio.

The defendant pleaded ignorance and said that he did not know which frequency he had been on. However, he admitted that he had installed the equipment, including the illegally modified linear amplifier, and operated it.

It is not unusual to find CB users operating in the bottom end of the 28 to 30MHz amateur radio band, either knowingly or by mistake. The defendant in this case was heavily fined and the gear confiscated. So CBers take heed and make sure you do not transmit outside your own frequency.

The defendant's wife was also fined for refusing to let the DTI inspector into their house to check for equipment. She would not tell him if there was another transmitter in the house, nor would she let him seize the equipment in the car.

Donation to the Wireless Museum

Those who read the interesting article entitled 'Looking Back – through the eyes of Sir Douglas Hall' in the December 1985 edition of *R&EW*, will be interested to hear that Sir Douglas has agreed to bequeath all the items mentioned in that article to the Communications and Electronics Museum, which now incorporates the National Wireless Museum. This follows discussions with Douglas Byrne G3KPO, who is now the museum's curator. This will, Sir Douglas says, "in a small way perpetuate the 'Radio Constructor'." Thank you, Sir Douglas!

The space scene

Activities in the space scene continue to have implications for amateur radio activity. The Giotto/Halley's Comet TV coverage certainly increased popular interest in space activities, as did the subsequent publicity given in the media to the USSR's MIR space station.

Radio transmissions from MIR have been heard by many radio amateurs on narrowband FM VHF channels between 142 and 144MHz, as well as transmissions from it on 19.955MHz. As MIR is such a bright object in the sky, it is most interesting to correlate visual sightings with the reception of its radio transmissions. It has been described as being 'the brightest object apart from the moon to be seen in the sky.' Best viewing times are orbits about an hour before sunrise or after sunset. If you care to listen to the AMSAT-UK net on 3780kHz at 10.15 local time on Sunday mornings, you may hear from the conversations which take place on that net the best time to look or listen for it.

Competition

Just how popular space activities are with the younger generation is well illustrated by the response to a recent competition sponsored by the European Space Agency for children in Europe under the age of ten, who were asked to send in a drawing or painting illustrating what they thought the encounter between Giotto and Halley's Comet would look like. Over 20,000 illustrations were received! These are now being sorted out, but the process will take much longer than expected.

Every child who sent in an entry should receive a picture of the Comet taken by Giotto's on-board camera, a diploma stating that he or she participated in the competition and confirmation that his or her drawing will indeed be archived as previously announced in the terms of the competion.

The Giotto space probe performed so magnificently that it has now been directed back towards the Earth. This manoeuvre was carried out from the ESA's ground station at Carnarvon, Australia, which 'sees' the spacecraft for a twelve hour period every twenty-four hours. They commanded the firing of the on-board thrusters to put it into a new trajectory to bring it back to within 20,000km of the Earth in 1990. During its voyage home, it will be put into a 'long-duration hibernation'!

It is possible that another small Russian amateur radio Iskra-type satellite may be launched from MIR. This will be Iskra-4 and it may have an amateur band transponder aboard. Listen to the AMSAT-UK net for the latest news and details, which have not yet been announced.

JAS-1

The Japanese amateur radio satellite JAS-1 has been completed and is awaiting an opportunity for launching, which is currently scheduled for August. It is a 26 facet polyhedron, measuring 40 × 40 × 47cm and weighing 50kg. It is to be launched into a circular low-Earth orbit, non-sun synchronous and non-polar.

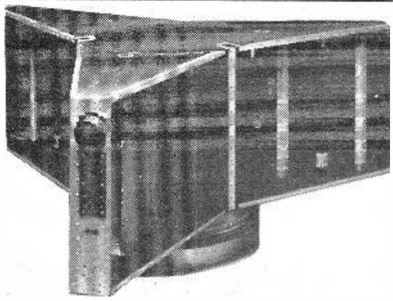
It carries two separate mode J transponders. One is a linear transponder, designated JA as it is an analogue transponder. This will have an output of 1 watt PEP, with a passband 100kHz wide. Ground stations will need an uplink power of 100 watts EIRP. The other transponder is a digital unit, designated JD. It has four 145MHz input channels using Manchester Code FM for its uplink. Again 100 watts EIRP will be required by ground stations for input.

One downlink channel in the 435MHz band will be provided, using PSK with 1 watt rms. This transponder will be 1200 bits/sec. Modem designs and perhaps kits should be available soon after a successful launch.

The reason for using J mode transponders for this first Japanese amateur radio communications satellite is that it is becoming increasingly difficult to use 145MHz for a satellite downlink because of various 145MHz sources of interference. In addition, its planners wanted to provide a successor to AMSAT Oscar 8's mode J, which was originally developed by the JAMSAT engineering team in 1976. Again, 435MHz is much quieter than 145MHz as a downlink, as it is comparatively free from man-made electrical noise and sky temperature effects.

Satisfactory progress

The AMSAT Oscar Phase 3-C satellite continues to progress satisfactorily. It is reported that whilst vacuum testing was being carried out at the Martin Mariette Corporation's vacuum testing site in Colorado, clearance was given for testing the satellite's radiation potential. It is not known at the time of writing whether the transponders were switched on during the tests, but if they were it is possible that some radio amateurs in the area got the chance to work the satellite during that time!



The tests lasted two weeks and were carried out with all the components installed with the exception of the kick motor. After these tests the satellite was due to be 'potted up', that is, everything will be cemented up solid. It then goes back to Germany for final checkout and then out to the Korou launch site for integration and launch, which is now expected to be sometime in October.

The Russian satellites RS5 and RS7 have been on very variable schedules due to sunlight eclipsing and consequent low battery charge rates. When in a 'heavy use' situation, these satellites command themselves off if their power voltage drops to a certain low level. They will not come on again until they are commanded to do so by one of the control ground stations. This accounts for what often appears to be erratic performance. The satellites will be in eclipse again from the first week in June to the end of August but will then be in full sunlight until the third week in September.

The solar cycle

One of the indications of the state of the solar cycle is an index called the Night Sky Brightness, its name indicating its characteristics. It is being said that the present solar cycle minimum is the second most active one ever seen.

Visual astronomers have indicated that there has been little evidence that the average intensity of the airglow emission has fallen much since that at solar maximum. However, last year measurement of the night sky brightness had at last begun to show a fall. At the Siding Spring observatory in Australia, which is a good dark site, such an unusual phenomenon as the Zodiacal band was observed for the first time in ten years, an indication of a really dark sky.

The lowest night sky brightness occurred at the last solar minimum in mid-1975. Thereafter it increased steadily to a maximum in 1983 and has since been falling, particularly over the past year.

Sunspots have begun to be visible on the sun's face quite regularly again. The recent auroral activity also indicates that the minimum sunspot period of this cycle has been passed.

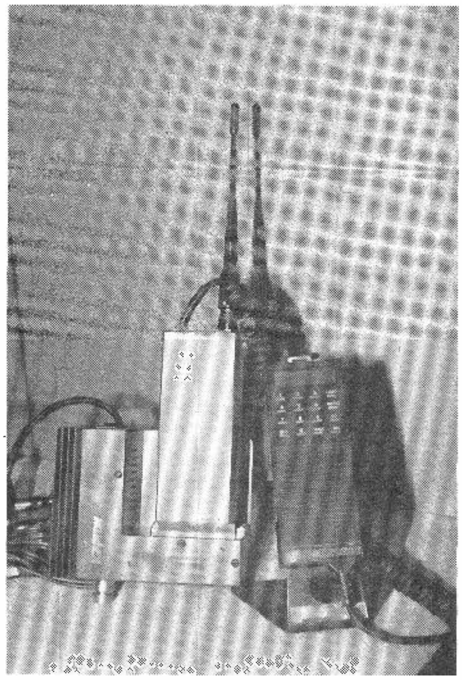
RSGB VHF Committee vacancies

The RSGB Council is seeking members to fill vacancies on their VHF Committee, one of which is for someone to investigate the possibilities of a move from 25kHz to 12.5kHz channel spacing for FM and repeaters in the 2 metre band. Another is for someone with knowledge of the Syledis radio location system which operates in the 430MHz region, primarily for oil exploration purposes, to investigate the technical parameters of the interference both to and from the system.

HF QRP Day

At the Region 1 IARU Conference in Cefalu a resolution was agreed that 17 June each year should be designated 'HF QRP Day', and member societies of Region 1 are being encouraged to organise QRP activities on this day. In this country the G-QRP Club has organised a special contest for its members, who must undertake to restrict their transmitters to three watts or less output. They will try to work one station in each Region 1 country on each HF band. REW

SPOTLIGHT ON PRS



Andy Emmerson G9BUP sheds some light on what could become the poor man's PMR

In May's *Spectrum Watch,* Nigel Cawthorne reported that the DTI is considering a Personal Radio Service (PRS) at 900MHz (next to cellular radio and the UHF CB service). Nigel mentioned its considerable potential as a low-cost business radio service, and PRS has also been welcomed by Selectronic, one of Britain's largest dealers in 900MHz equipment. However, Band III private mobile radio (PMR) equipment suppliers – notably Storno and Motorola – are not so pleased.

"PRS has to be good news for small businesses", says Mike Machin, boss of the Essex-based importers Selectronic. "There are many firms which need low-cost short range communication, something better than CB but cheaper than cellular or PMR, and PRS fits the bill exactly. I suppose PRS could take a few customers who might have signed up for Band III, but mainly we're talking about a whole new market of people who could not afford conventional business radio."

Asked if the timing of the DTI's decision on PRS could detract from Band III business and harm UK manufacturing prospects, Machin answered that he thinks these are misconceptions: "PRS is a pan-European initiative and the CEPT is setting the pace on this. PRS has already taken off in Switzerland and yes, all the sets are Japanese. There's no way UK firms could match the price and quality – we're bringing in a beautiful 5 watt hand-held set which is pre-programmed for four European standards. You can use it for PRS or, as we do, as a 20-channel simplex set for 934MHz. The range of these sets is between 5 and 8 miles on average – just right for a TV aerial installer, a taxi firm or a vet. It's no challenge to Band III though, nor is it meant to be".

In the light of this, it may be useful to take a closer look at PRS and why it is such good news for radio users.

Oriental origins

PRS started off in 1983 when Japan replaced its chaotic 27MHz citizen's band radio service with a high-tech substitute called PRS. Operating in the 900MHz UHF band the system offered 80-channels of interference-free short range communication. The user allocates himself a number (rather like a telephone number) which can apply either to him alone or, more often, to a group, for instance the cars of a small taxi firm or members of a club. Both business and private use is permitted.

To use the (microprocessor controlled) set users merely dial in the desired number and press the transmit switch. In an instant the set sends the digital code of the required set, which in turn responds automatically if it is switched on and in range (typically up to 15km).

Entirely automatically the two sets search for a clear channel and a conversation is established. The set-up process takes about one second and conversations are cut off after 5 minutes, though they can be re-established with a recall button. There are special numbers for emergency use and 'CQ' calls.

The system is superficially similar to cellular radio, but there is no repeater station involved, neither is connection to the telephone system possible. It is entirely foolproof in operation, and has proved popular with 'normal' users as well as most of the CB fraternity.

So far around 450,000 sets have been sold, and whilst market saturation has now been reached, the system is considered extremely successful. It is particularly useful to small businesses, since the sets cost around £400 and no special radio technique is necessary. The system works like a telephone, with no interference, and is limited only by the range of the 5 watt sets.

European activity

Since September 1984 Switzerland has had a pilot PRS system modelled on Japanese lines: more than 2000 sets are in operation. It uses a two megahertz band of frequencies (933-935MHz) which has been set aside for personal radio services across Europe. Under the CEPT aegis, other European countries are examining PRS, notably Austria, the Netherlands and Britain, and it is this initiative which inspired the DTI's considerations.

The DTI is known to be sympathetic to PRS if there is a demand from users, and at around half the price of PMR a personal radio service should find take-up amongst many British users, particularly small businesses who do not need the sophistication of cellular radio nor the wide coverage of Band III PMR. The 934MHz open channel has proved to be no real substitute for PRS because of the interference of the manual system.

People's radio

PRS is essentially a low cost 'people's radio' service and should be seen as such, not as an alternative or threat to PMR. The intention of the CEPT initiative is that there should be a common standard for the sets across Europe. A start has been made by reserving the frequencies in most countries.

If a British PRS is permitted it is inevitable that Japanese sets will be used because of the established manufacturing base. All the sets used in Switzerland are Japanese – made by Uniden, Clarion and Mitsubishi – and it is unrealistic to imagine that a UK manufacturer could produce radios of similar sophistication at a lower cost.

A true people's radio service should be in line with the government's policy of fostering small business, so it will now be interesting to see if it is to become a reality. REW

ERS — PRINTERS — PRINTERS — PRINTERS

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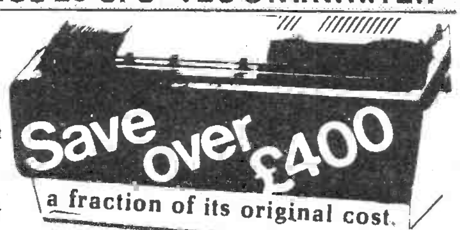

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SHUNTING PANEL METERS

by Ken Williams

For many years it has been the practice in homebrew and good quality commercial communications equipment to provide a panel meter for monitoring internal parameters within the equipment by switching into the appropriate circuits.

Although such close monitoring is not always essential in modern broadband solid state equipment, there still remain many instances, particularly in high power valve linear amplifiers, where such monitoring is not only desirable but essential. In such a linear amplifier, for example, it is essential to be able to measure the grid and anode currents, and it would also be desirable to be able to monitor the bias, screen grid and anode voltages and output level.

For such a range of currents (perhaps 25mA maximum for the grid circuit and up to 500mA or 1A for the anodes) a single range meter is clearly unsuitable, for a meter range adequate to allow for the current flowing in the anode circuit would hardly deflect with the grid current. Therefore, the general practice is to use a meter with a full scale deflection (fsd) suitable for the lowest current range and shunt it to read higher ranges when necessary. The shunts for achieving this are usually left permanently in the circuit to be monitored and the meter switched across them whenever necessary.

By using a rather more sensitive movement than is really necessary, it is also possible to switch to series resistors in order to use the panel meter as a voltmeter to read power supply levels. This technique has been made possible by the availability of meter movements of 1mA fsd or even greater sensitivity, at a cost little, if any, more than their less sensitive brethren.

Suitable shunts

When using such movements, however, the problem of obtaining suitable meter shunts very soon arises, for even though the basic meter movement may have a resistance of several hundred ohms, in order to monitor a high power circuit the necessary shunt may well be in the order of a tenth of an ohm. Unfortunately, resistors of such values rarely appear in the catalogues!

For commercial manufacturers this represents little problem, for they arrange for the shunts to be specially manufactured to their requirements. For the homebuilder, however, the situation is much more difficult, for even if the value required is available, the tolerance may well be 10 or 20%. The problem therefore remains, and the author has in the past used, and seen used by others, old RF chokes, clusters of low value resistors and many other techniques for obtaining the necessary low values, these having been selected on a 'trial and error' basis.

Recently, however, I constructed a high power linear amplifier for which a very elegant panel meter of 0.5mA fsd was selected. In this circuit the PA cathode current is in the order of 700mA, and in consequence a meter range of 1A was chosen. As the resistance of the meter movement is 185 ohms, this required a shunt resistor of 0.093 ohm – a value rarely available off the shelf!

Therefore, some other technique had to be devised. This caused a little head scratching until it occurred to me that there was no reason why a convenient value resistor should not be placed in the circuit to be monitored, and the panel meter used to measure the developed voltage.

Of course, the resistor used must be of a value which will not affect the normal operation of the circuit, so in the case of the anode circuit the lowest value available in the spares box was selected. This was a 0.5 ohm wirewound resistor of dubious accuracy.

As the meter range in this position had already been selected as 1A, with this current flowing a voltage of 0.5 volts would be developed. Therefore, in order to measure this, a resistor had to be placed in series with the meter to convert it to a voltmeter to read the voltage.

The fsd of the meter is 0.5mA which, when used as a voltmeter, would give a sensitivity of 2,000 ohms per volt. To read a voltage of 0.5 volts at fsd the combined resistance of the meter and series resistor must therefore equal 1000 ohms. The resistance of the meter is 185 ohms (this is marked on the face), therefore a series resistor of 815 ohms must be used. The nearest preferred value to this is 820 ohms.

Trial and error

Several 20% tolerance resistors of this value were found in the box and one was tacked in circuit with the intention of trying each in turn to determine which one would give the most accurate metering, remembering, of course, that the resistor across which we were measuring voltage was not necessarily an accurate 0.5 ohm.

In order to select the most suitable series resistor, a current of about 0.5A was passed through the 0.5 ohm resistor with an AVO multimeter in series, and the indication on the panel meter and the AVO readings compared. If the panel meter read low the series resistor was of too high a value and vice versa. After

Fig 1 *Traditional method of shunting panel meters. Using this method the value of the meter shunt R1 may be as low as 0.1 ohm*

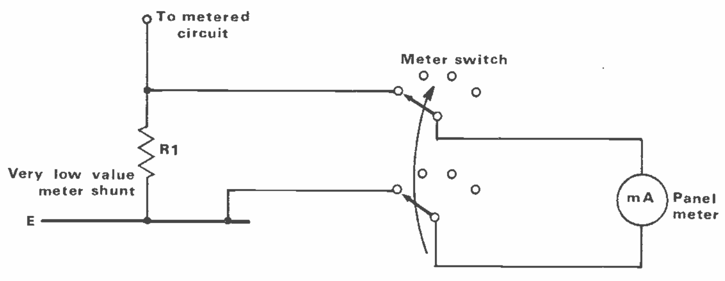
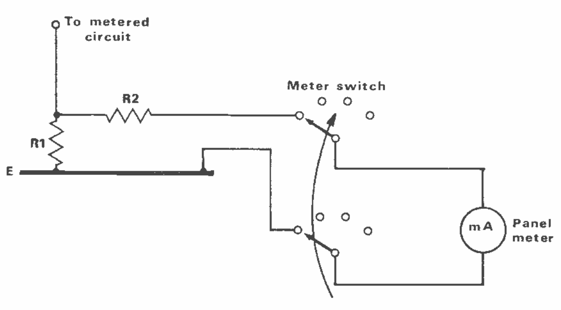


Fig 2 *In this circuit R2 effectively converts the panel meter into a voltmeter to measure the voltage drop across R1, which may now be of higher and more convenient value than in Figure 1*



trying several resistors, the one which caused the panel meter to give the most accurate indication was found and fitted permanently in circuit.

At this point of the proceedings it may be found that, due to the tolerance of the 0.5 ohm resistor, the theoretical value of the series resistor will not give a sufficiently accurate meter reading. In such circumstances try the next preferred value up or down as appropriate.

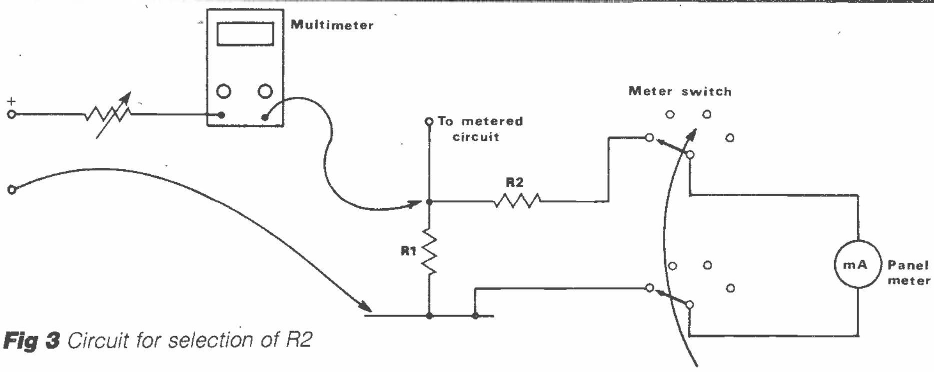


Fig 3 *Circuit for selection of R2*

Success fever

Flushed with the success of the technique in the anode circuit, attention was then turned to the grid circuit, which required a panel meter fsd of 25mA. In this instance a value of 10 ohms was selected for the resistance in series with the grid circuit, this developing a voltage of 0.25 volts at 25mA. As the sensitivity of the voltmeter (ie panel meter plus series resistor) is 2000 ohms per volt, the total resistance of the voltmeter should be 500 ohms, which, as the meter resistance is 185 ohms, results in a series resistor of 215 ohms. The nearest preferred value to this is 220 ohms, so selection was initially made from a number of resistors of this value.

Unfortunately, however, possibly due to the tolerance of the 10 ohm resistor, none gave a sufficiently accurate result and eventually 270 ohms was used.

This technique was used twice more within the linear amplifier for measuring the HT and screen grid voltages (which were supplied from different power units). The method used in these cases was to insert a 10 ohm resistor at the earthy end of the power unit bleeder resistor and then select the meter series resistor as before, with the exception that the AVO was used to measure the voltage across the bleeder resistor instead of the current flowing through it.

Although I have described the use of this meter shunting technique with regard to a high power valve linear amplifier, the same method can readily be used wherever current or voltage has to be monitored. The only precautions to be taken are to ensure that the resistor across which the voltage is measured is of sufficiently low value so as not to affect the operation of the circuit, and that sufficient voltage is generated across that resistor to operate the meter. In cases where low currents are being measured, it may be necessary to use a more sensitive panel meter – perhaps 100 or 50 microamps fsd.

For many years, in common, I am sure, with many other constructors, I have been plagued with the difficulties of finding or manufacturing suitable inexpensive shunts for panel meters. This technique, however, should provide an answer to the problem, for it requires only standard value resistors, readily available at your local emporium. REW

VOLTAGE REGULATORS

David Corder outlines the basics of voltage regulator ICs, with examples of their use

Since their introduction about ten years ago, voltage regulators have become one of the most widely used types of integrated circuit. There are many different sorts of regulator, and in this article I hope to outline the main ones, give data for them and show how to design circuits with them.

1. Fixed voltage regulators

These basically consist of a three-terminal device, one pin for the unregulated smoothed input, one for connection to the ground rail, and the third providing the stabilised output. Using these regulators power supply design becomes much simpler than previously. They are ideal for on-board regulation, for example in hybrid CMOS/TTL circuits.

Figure 1 shows the basic circuit. The decoupling capacitor on the input should be connected as close as possible to the terminals. It prevents high frequency instability, which can sometimes upset regulation. The capacitor on the output helps to reduce the regulator output impedance at high frequencies, and also helps to remove voltage spikes. For best results it should be a tantalum bead capacitor.

Any voltage regulator may be used, so long as the input voltage is about 3V more than the output, up to a maximum of around 30V. In the event of a current overload the voltage output folds back to reduce the current.

To provide a negative output voltage, the 79 series can be used in the same way. A typical application is an operational amplifier power supply, using the circuit in *Figure 2*.

The diodes on the output prevent one regulator starting before the other, which could cause it to latch off. A suitable input would be from a centre-tapped transformer and rectifier/capacitor system.

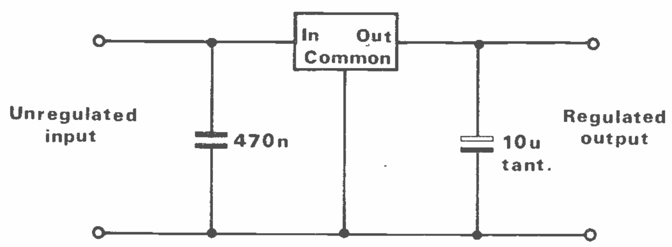


Fig 1 *Basic 78/79 series circuit*

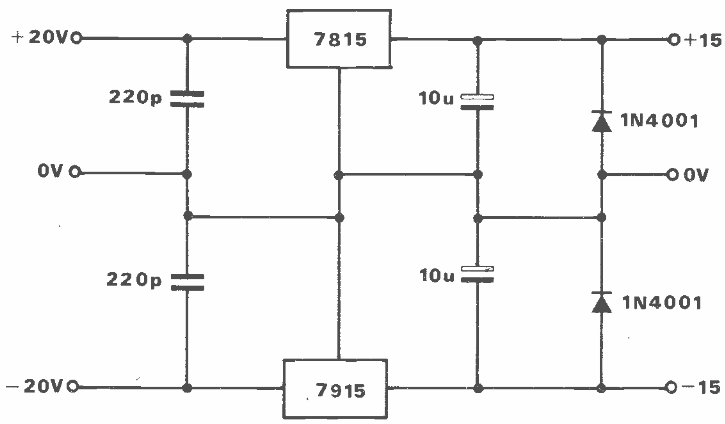


Fig 2 *Dual voltage power supply*

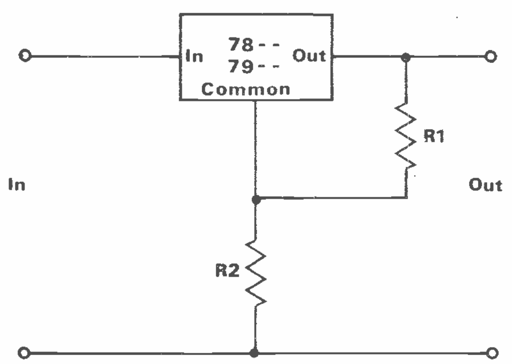


Fig 3 *Boosting the regulator voltage output*

Varying the output

These regulators perform well for one voltage and current, but sometimes it is necessary to supply non-standard voltages or larger currents. *Figure 3* shows the circuit for boosting the output voltage of either the 78- or 79- series.

The required resistor values can be worked out as follows:

$$R1 = Vr/0.02$$
$$R2 = Vb/0.025$$

Where

Vr is the normal regulated output voltage, and

Vb is the voltage that the output must be raised above Vr

eg, for 9V from a 5V regulator

$$R1 = 5/0.02 = 250R \text{ or } 220R$$
$$R2 = 4/0.025 = 160R \text{ or } 150R$$

The table shows some examples, worked for preferred resistor values. The values are not exact, so for best results R2 can be replaced with a preset.

Regulator output boosting

V_{out}	Regulator	R1	R2
6V	5V	220R	39R
9V	5V	220R	150R
13.8V	12V	560R	68R
18V	15V	680R	120R

The output current of a regulator can be increased using the circuit in *Figure 4*. This has the advantage that a cheaper low current regulator may be used in place of a larger current one.

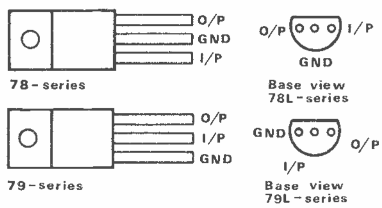
When the current through the regulator exceeds 100mA the transistor starts to turn on, taking the extra current. The threshold current can be raised by lowering the value of the resistor using the formula below:

$$\text{Resistance (ohms)} = \frac{0.56}{\text{Threshold current}}$$

$$\text{For 100mA, } R = \frac{0.56}{0.1} = 5.6$$

The problem is that above the set current the output current is no longer limited. For the 79- series the pass transistor should be npn, for example the 2N3055. This circuit can be used easily up to about 5A.

If the unregulated input to the regulator is high then there can be problems with excess heat dissipation, causing the regulator to shut down prematurely. *Figure 5* shows a pre-regulator circuit which solves the problem. The Zener diode should have a voltage of more than the regulator output. The circuit has the additional advantages that there is less ripple at the output, and the regulator has to dissipate less heat, aiding reliability. Finally, the table summarises the parameters of the 78-, 79- series.



Type number	Voltage	Current	Case style
7805	5V	1A	TO220
7812	12V	1A	TO220
7815	15V	1A	TO220
7818	18V	1A	TO220
7905	–5V	1A	TO220
7912	–12V	1A	TO220
7915	–15V	1A	TO220
78L05	5V	100mA	TO92
78L12	12V	100mA	TO92
78L15	15V	100mA	TO92
79L05	–5V	100mA	TO92
79L12	–12V	100mA	TO92
79L15	–15V	100mA	TO92

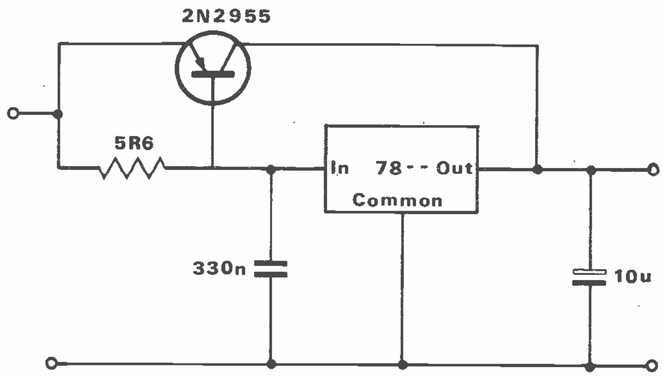


Fig 4 *Boosting the regulator current output*

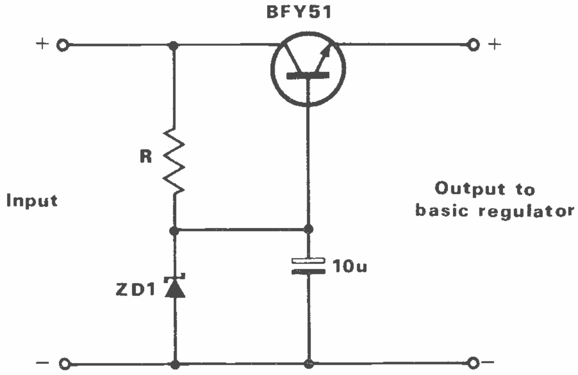


Fig 5 *Pre-regulator to ease overheating problems*

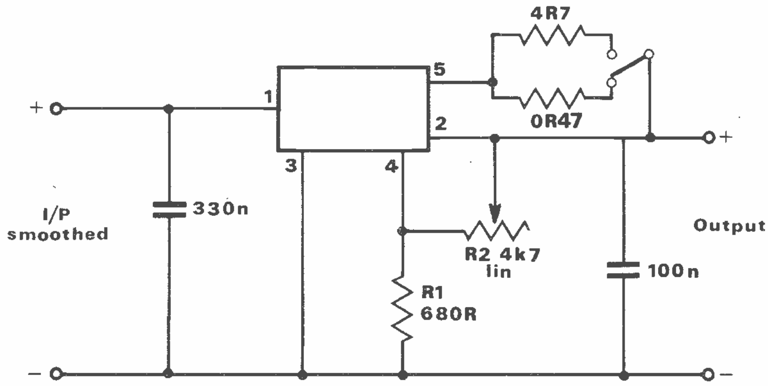
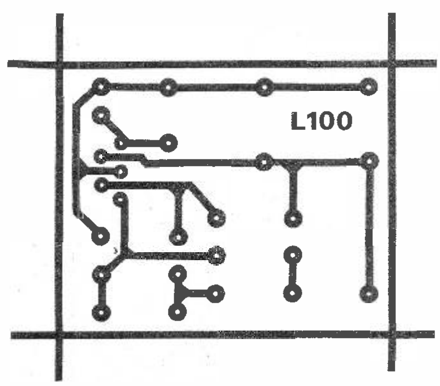


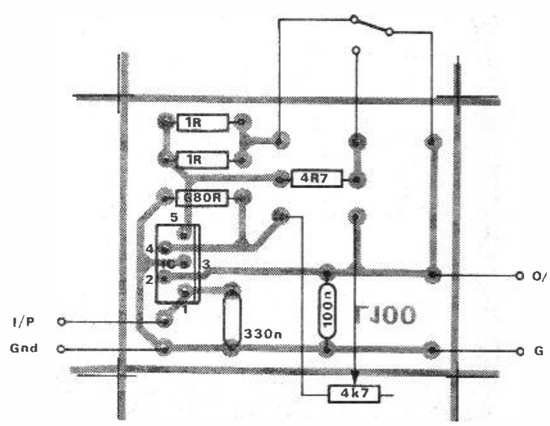
Fig 6 *L200 power supply, with formula for output voltage below*

$$V = 2.77\left[1+\frac{R2}{R1}\right] \text{ eg } V_1 = 2.77\left[1+\frac{4700}{680}\right] \quad V_2 = 2.77\left[1+\frac{0}{680}\right]$$

$$=2.77\times7.91 \qquad =2.77$$

$$=21.9V \qquad =2.77V$$



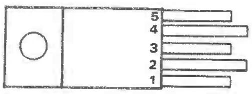


2. Variable regulators

It is now possible to buy several different variable output regulators, each with their own advantages and disadvantages. The chosen example device is the L200, which has the advantage that it can regulate voltage and current in the same package, providing a wide range of output current and voltage. The circuit of a 3V-20V regulator is shown in *Figure 6*.

In this application R1=680R, and R2 is a 4k7 pot. The output is variable from about 3V to over 20V, as can be seen in the worked examples. This range can be altered using the formulae, and so non-standard voltages can be easily generated.

L200 PARAMETERS



Max input voltage	40V
Max in-out voltage	32V
Drop-out voltage	2.5V
Max short circuit current (no limit resistor)	3.6A
Case	Pentawatt

The current limit level is set using the formula below. In this circuit two resistors are switched to provide two limit levels: more may easily be added. The levels are at about 100mA and 1A.

$$R=\frac{0.45}{I_{max}} \quad \text{eg } R_1=\frac{0.45}{0.1}=4.5R \quad R_2=\frac{0.45}{1}=0.45R$$

A PCB design is given, but layout is not critical. The input to the circuit should come from a full-wave rectifier and capacitor, providing about 3V more than the highest output at full load. A voltmeter may be connected across the output to monitor the voltage, or the potentiometer may be calibrated. The IC should be mounted on a heatsink using an insulated mounting kit. If heatsinking is insufficient then the IC will shut down until it has cooled off.

3. Current regulators

There is now a device available, the LM334Z, which allows a constant current to be generated. Any output current may be set in the range 1μA to 10mA, with an input of 1V to 40V. If it is used in place of the resistor in a timing circuit, then by providing a constant current a good ramp may be generated.

The demonstration circuit is for a Nicad trickle charger; it will also charge button Nicads well. The output current is set by the formula below:

$I=\frac{0.0677}{R}$ where R=resistor on control pin

For 5mA output $R=\frac{0.0677}{0.005}=15R$

The circuit is shown in *Figure 7*. An ideal power supply would provide around 5V, but this is not critical.

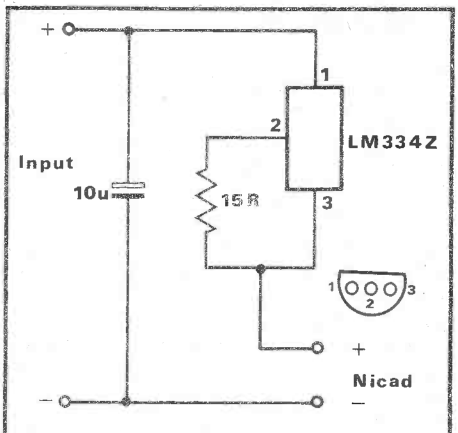


Fig 7 *Nicad trickle charger*

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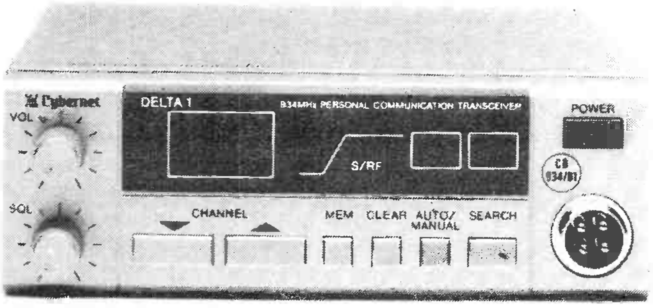

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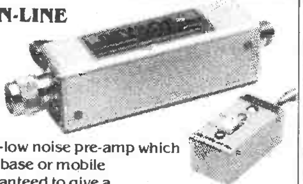

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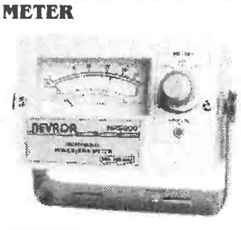

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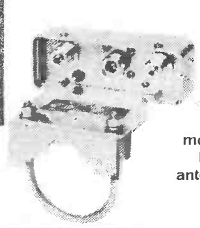

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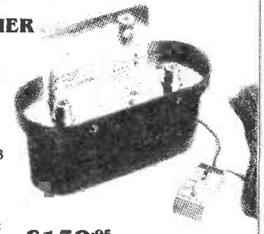

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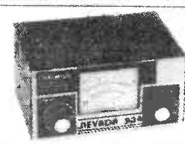

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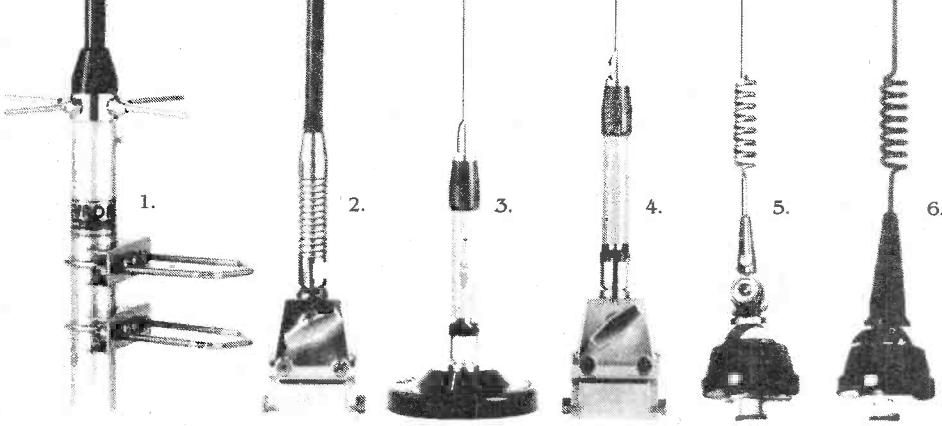

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PART 2

Having covered the history last month, Roger Alban makes the brain glow with the theory

Operating conditions

The method of applying the operating voltages is shown schematically in *Figures 9, 10* and *11.* A battery or other source of power is applied across the anode and cathode to make the anode positive with respect to the cathode. This voltage is designated Va volts, and since its value is likely to be of the order of 100 volts or more the voltage source is referred to as the high tension (HT) supply. The filament is heated from a low tension (LT) supply providing the required low voltage across the heater filament terminals. It is immaterial which end of the filament is positive.

With a directly heated filament, however *(Figure 7)*, electrode potentials are referred to the negative end of the filament, which results in the connections shown.

The indirectly heated cathode, *Figure 8*, has the advantage that the cathode is distinct from the heater filament and its potential can be quite independent of filament potential considerations. It is convenient to feed the heater of the indirectly heated valve with alternating current, obtained at the correct voltage from a transformer winding, as shown in *Figure 11.*

In operation the stream of electrons from cathode to anode is equivalent to the conventional flow of current from anode to cathode. This is termed the anode current, designated by the symbol I_a. The ability of the diode valve to pass current flow in one direction only is the fundamental property of the electronic valve.

Using the circuit shown in *Figure 12*, the characteristics of the diode valve can be plotted, *Figure 13.* When S1 is switched to position 2, with the anode negative with respect to the cathode, no current flow will take place. However, when switch S1 is in position 1, with the anode positive with respect to the cathode, anode current will flow and its relationship to anode voltage can be plotted. The heater voltage can also be varied by adjusting R, and a set of different characteristics plotted for various heater voltages, *Figure 14.*

It will be seen that the diode will pass conventional current, from the anode to cathode, provided the cathode is hot enough. The strength of the current flow will depend on both the applied anode voltage and the cathode temperature.

The characteristic curve

When examining, say, a fixed value resistor, we know that if a dc supply is connected across it, the resulting current flow will be proportional to the

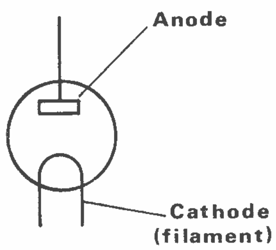

Fig 7 *Directly heated diode valve*

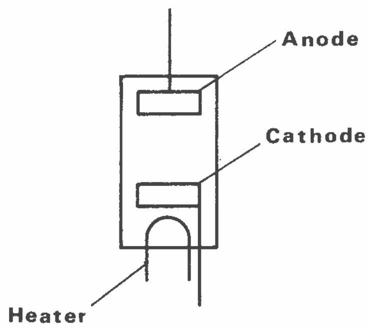

Fig 8 *Indirectly heated diode valve*

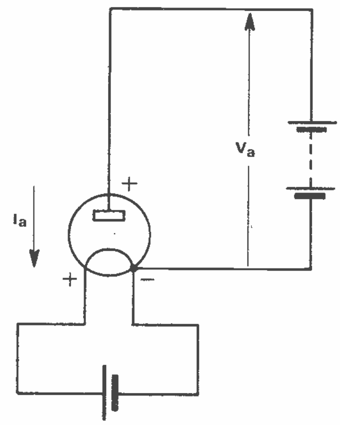

Fig 9 *Operating conditions for directly heated diode valve*

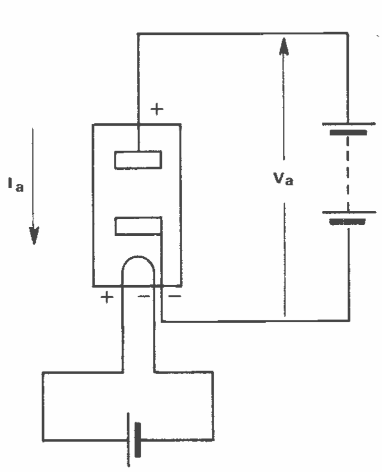

Fig 10 *Operating conditions for indirectly heated diode valve*

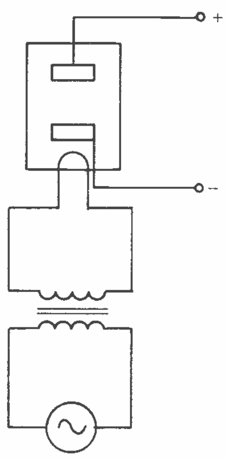

Fig 11 *Indirectly heated diode valve filament heated at the correct voltage from a transformer winding*

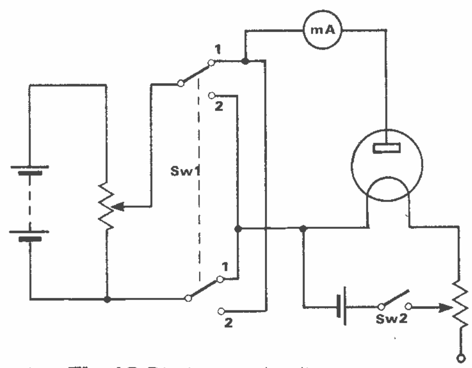

Fig 12 *Diode test circuit*

applied voltage (Ohm's Law). This simple state of affairs does not hold true however for a diode, which is a conductor which does not obey Ohm's Law.

If the filament heating current is held constant and the applied dc voltage gradually increased from zero, the anode current will rise slowly at first, then more quickly, until it reaches a maximum value and the valve reaches saturation. Further increase of applied voltage will then cause only a very slight further increase of current. The characteristic curve is shown in *Figure 13*.

Resistance calculation

What is the resistance of the diode? It is first of all necessary to agree under what preset conditions the valve is to operate. Suppose we are told that the diode is to operate with a current of 6mA, corresponding to point P on the characteristic curve. From the graph we see that the corresponding anode voltage will be 60 volts. Thus the diode passes 6mA for an applied voltage of 60 volts, and from Ohm's Law the resistance will be:

$$R = \frac{V}{I} = \frac{60V}{6mA}$$

$$= 10{,}000 \text{ ohms}$$

However, this is not the only possible answer to the question. For example, at 100 volts the current is 16mA, giving a resistance of about 6,670 ohms. Thus the resistance of the diode varies with different current flows. The point P is called the operating point, and the resistance of the diode will depend upon the operating point chosen.

If the anode voltage consisted of direct and alternating currents together, so that the operating point oscillated between points A and B, the corresponding changes in anode current could be found by drawing the right-angle triangle ABC. The resistance to varying or alternating current could then be found by taking AC divided by CB (ie V÷I). It is usually more convenient, however, to construct a tangent to the curve at point P so as to make the measurement to a longer scale. This tangent is shown as line PT and the value of resistance is given as:

$$R = \frac{\text{change in V}}{\text{change in I}}$$

$$= \frac{TQ}{QP} = \frac{30}{0.006}$$

$$= 5{,}000 \text{ ohms}$$

The resistance calculated in this way is known as the ac resistance or slope resistance and is the value needed in most calculations on valves.

Diode application

As the diode is capable of passing current in one direction only, it can be used as a rectifier. A simple rectifier circuit is shown in *Figure 15*. When the voltage at point A is sufficiently positive with respect to point B, a current I flows through the valve into the load resistance R, the current magnitude depending upon the voltage across the diode and upon the valve characteristic.

During alternate half-cycles when point B is positive with respect to point A, the diode will not conduct. The dc output current and voltage will vary in the manner shown in *Figure 16*, if the valve is not saturated. The output current consists of a series of unidirectional pulses. These pulses can be smoothed by placing a large capacitor across the load resistance.

It was not until 1908 that it was discovered that the introduction of a third electrode between the cathode and anode could independently control the anode current, and can be regarded as having made possible modern radio and the birth of electronics; but that's another story! REW

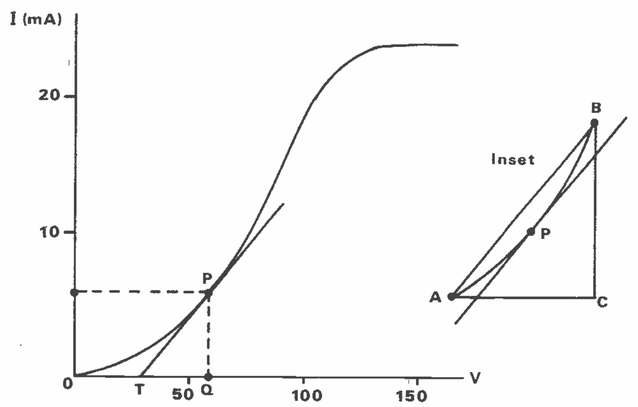

Fig 13 *Diode characteristic*

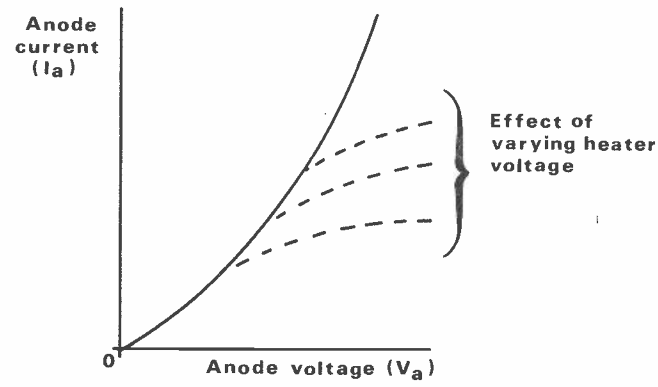

Fig 14 *The effect of altering heater voltage*

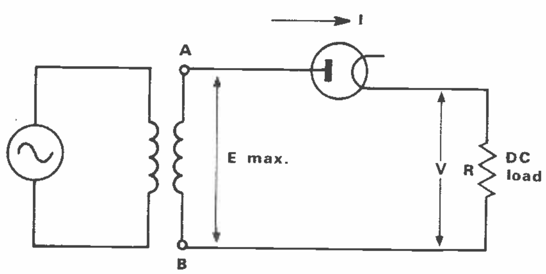

Fig 15 *Diode rectifier circuit*

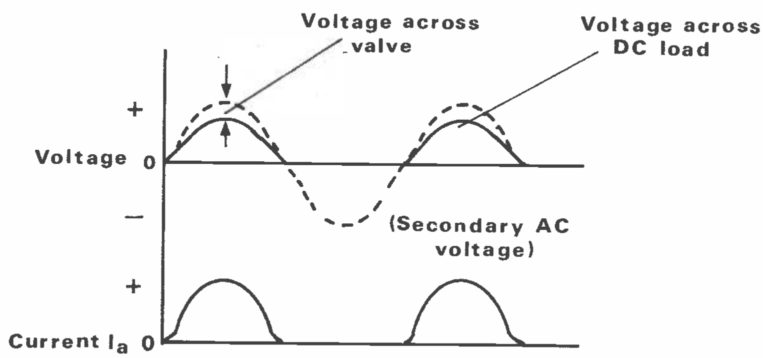

Fig 16 *Relationship of voltage and current flow in the simple rectifier circuit*

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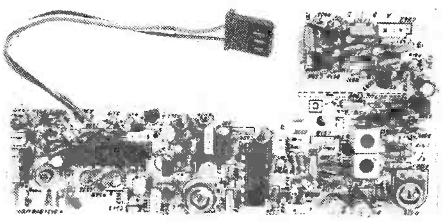

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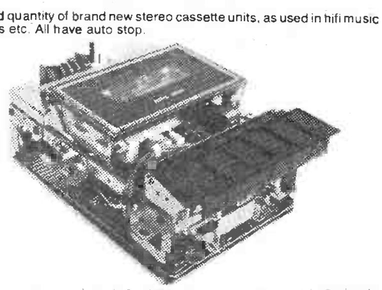

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DATA FILE . . .

Ray Marston looks at transistor oscillators and astable multivibrator circuits

In the last few editions of *Data File* we have given an introductory outline of the discrete bipolar transistor and its basic characteristics. This has included a general round-up of popular applications, configurations, and details of the common-collector amplifier and its derivatives, common-emitter and common-base 'voltage amplifier' circuits. In the present edition of 'The File' we continue the transistor theme by looking at a variety of oscillator and astable multivibrator circuits.

Oscillator basics

Transistor oscillator circuits are usually designed to generate fairly pure sine wave output signals. Two basic requirements must be satisfied to make such an oscillator, as shown in *Figure 1*. First, the output of the amplifying device (A1) must be fed back to its input via a frequency-selective network (A2). This must be done in such a way that the sum of the amplifier feedback-network phase-shifts equals zero degrees (or 360°) at the desired oscillation frequency: ie, so that x° + y° = 0° (or 360°).

Thus if the transistor stage generates 180° of phase shift between input and output, an additional 180° of phase shift must be introduced by a frequency-selective network connected between input and output, in order to meet the first requirement of a sine wave oscillator.

The second requirement of sine wave oscillation is that the gain of the amplifying device must exactly counter the loss or attenuation of the frequency-selective feedback network at the desired oscillation frequency, to give an overall system gain of precisely unity: eg, A1 × A2 = 1. If the gain is less than unity the circuit will fail to oscillate, and if it is greater than unity the system will be over-driven and the circuit will produce distorted (non-sinusoidal) waveforms.

The frequency-selective feedback network of a sine wave oscillator normally consists of either a C-R or L-C filter network, or a tuned transformer or a crystal filter. Let's look at some practical C-R feedback oscillator circuits.

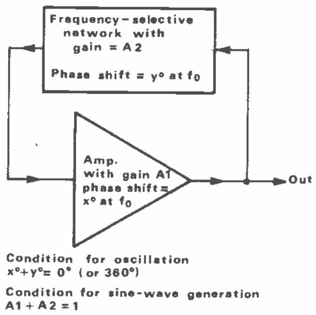


Fig 1 *Conditions for sine wave generation*

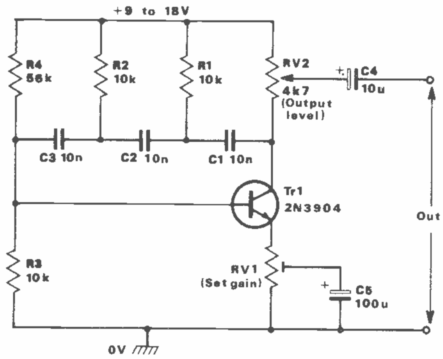


Fig 2 *800Hz phase-shift oscillator*

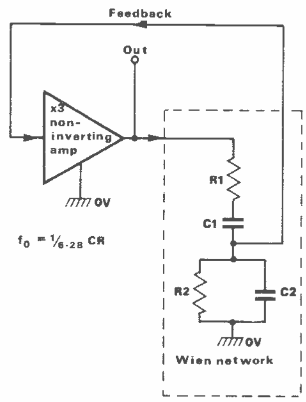


Fig 3 *Basic Wien oscillator*

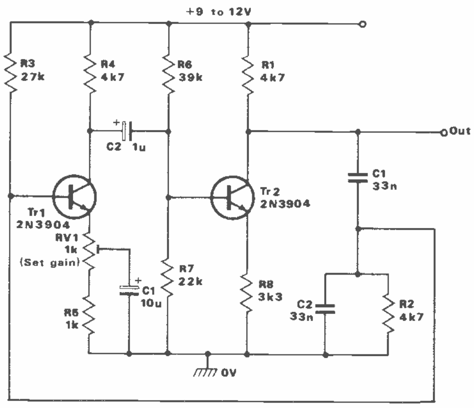


Fig 4 *Practical 1kHz Wien oscillator*

C-R oscillators

Figure 2 shows the practical circuit of one of the crudest types of C-R sine wave oscillator, this being the so-called 'phase-shift' oscillator. Here, Tr1 is wired as a common-emitter amplifier and has its output (collector) signal fed back to its input (base) via a three-stage C-R ladder network. This essentially comprises C1-R1, C2-R2, and C3-R3.

Each C-R stage of the ladder network generates a phase shift between its input and output terminals, and the size of this shift depends on frequency and on the C-R value, with a maximum value of 90°. The total phase shift of the complete ladder network equals the sum of the individual stage shifts, and in *Figure 2* (in which C1=C2=C3=C, and R1=R2=R3=R) equals 180° at a frequency of roughly 1/14CR. Since the transistor stage itself generates a phase shift of 180°, the circuit actually oscillates at a frequency of about 1/14CR. The 3-stage ladder network has an attenuation factor of about 29 at the oscillation frequency, and the gain of the transistor stage must be adjusted (via RV1) to counter this signal loss and give an overall circuit gain of unity if stable sine wave generation is to be obtained.

In practice, the *Figure 2* circuit oscillates at a frequency of about 800Hz. To set up the circuit RV1 should, to ensure stable oscillation, be adjusted so that a slightly distorted sine wave output signal is obtained. The amplitude of the output signal can be varied via RV2.

The simple phase-shift oscillator circuit has the advantage of simplicity, and can be built around a single transistor. Its main disadvantages are that it has poor gain stability, and its operating frequency cannot easily be varied (unless a 3-gang R or C component is used). A far more versatile C-R oscillator circuit, which can easily have its operating frequency varied via a 2-gang component, can be built using a so-called Wien bridge network, connected in the basic form shown in *Figure 3*.

In *Figure 3*, the Wien network comprises the four passive components shown within the dotted box. Normally these component values are 'balanced' so that R1=R2=R, and C1=C2=C. The phase shifts of this balanced Wien network are exceptionally sensitive to frequency; the shift is negative (to a maximum of −90°) at low frequencies, is positive (to a maximum of +90°) at high frequencies, and equals precisely zero at a 'centre' frequency of 1/6.28CR. At this centre frequency the network has an attenuation factor of three. Thus the Wien network can be made to oscillate by connecting a non-inverting ×3 high input impedance amplifier between its output and input terminals, as shown in the diagram.

Practical Wien oscillators

In reality, practical variable-frequency Wien oscillators are best built using sophisticated semiconductor devices such as op-amps in conjunction with automatic gain control feedback systems, and a number of circuits of this type have in fact been published in past editions of *Data File*. A simple fixed-frequency Wien oscillator can, however, be built using a couple of bipolar transistors, as shown in *Figure 4*.

In *Figure 4*, Tr1 and Tr2 are both wired as low-gain common-emitter amplifiers.

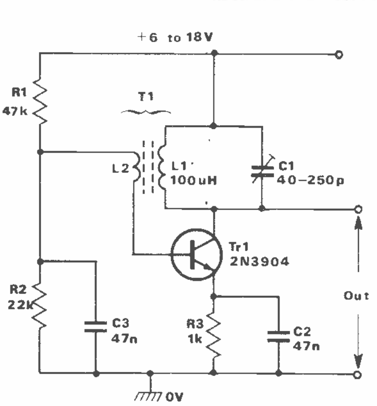


Fig 5 Tuned collector feedback oscillator.

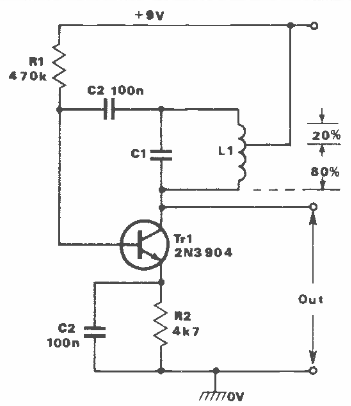


Fig 6 Basic Hartley oscillator

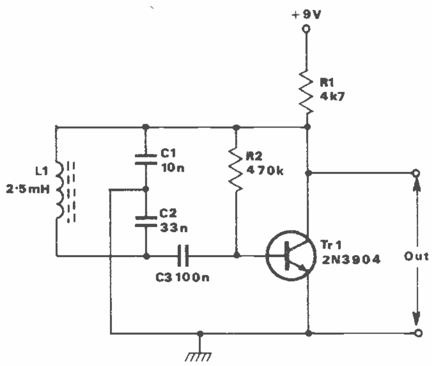


Fig 7 37kHz Colpitts oscillator

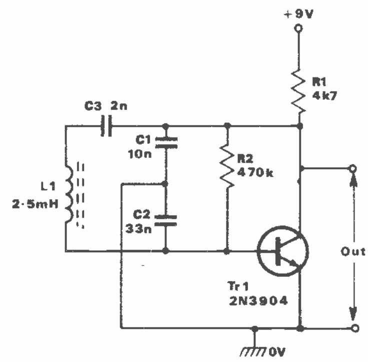


Fig 8 80kHz Gouriet or Clapp

Tr2 gives a voltage gain slightly greater than unity, and uses Wien network resistor R1 as its collector load. Tr1 provides a high input impedance to the output of the Wien network, and has its gain variable over a limited range via RV1. With the component values shown the circuit oscillates at about 1kHz. In use, RV1 should be adjusted so that a slightly distorted sine wave output signal is generated.

L-C oscillators

C-R sine wave oscillators are useful for generating signals ranging from a few Hz up to several tens or hundreds of kHz. L-C oscillators, on the other hand, are useful for generating signals from a few tens of kHz to hundreds of MHz.

An L-C oscillator consists, in essence, of an amplifying device that gives significant gain between input and output, and an L-C network that provides frequency-selective feedback between the output and the input terminals of the amplifier. Because of the inherently high 'Q' or 'frequency selectivity' of L-C networks, L-C oscillators almost inevitably produce reasonably pure sine wave outputs, even when the loop gain of the circuit is far greater than unity.

Many different versions of the L-C transistor oscillator are in common use. The simplest type is the so-called 'tuned collector feedback' oscillator, and an example of this is shown in *Figure 5*. Here, Tr1 is wired as a common-emitter amplifier, with base bias provided via R1-R2 and with emitter resistor R3 decoupled to high frequency signals via C2. L1-C1 forms the tuned collector circuit, and collector-to-base feedback is provided via L2, a small winding inductively coupled to L1 which thus provides a 'transformer' action. By selecting the phase of this feedback signal, the circuit can be made to give zero loop phase shift at the tuned frequency, so that if the loop gain is greater than unity (the loop gain is determined by the turns ratio of T1) the circuit will oscillate.

A feature of any L-C tuned circuit is that the phase relationship between its energising current and induced voltage varies over the range −90° to +90°, and equals zero at a centre frequency given by:

$$f=\frac{1}{2\pi\sqrt{(LC)}}$$

Thus the *Figure 5* circuit gives zero overall phase shift, and therefore oscillates: with the component values shown, the frequency can be varied from 1MHz to 2MHz via C1. In practice the basic circuit can be designed to operate at a wide range of different frequencies, ranging from a few tens or hundreds of Hz using a laminated iron-cored transformer up to tens or hundreds of MHz using RF techniques.

Figure 6 shows a simple variation of the *Figure 5* design, this particular circuit being known as a Hartley oscillator.

Here, collector load inductor L1 is tapped roughly 20% down from its top, and the circuit's positive supply rail is connected to this tap point; L1 thus gives an auto-transformer action, in which the signal voltage appearing at the top of L1 is 180° out of phase with the signal voltage appearing at its low (Tr1 collector) end. The voltage signal from the top of the coil (which is 180° out of phase with the collector signal) is coupled to the base (input) of Tr1 via isolating capacitor C2, and the circuit therefore oscillates at a centre frequency determined by the L-C values.

Note from the above description that the oscillator action depends on some kind of 'common signal' tapping point being made into the tuned circuit, so that a phase-splitting auto-transformer action is obtained. This tapping point does not have to be made into the actual tuning coil, but can be made into the tuning capacitor, as in the Colpitts oscillator circuit shown in *Figure 7*. With the component values shown, this particular circuit oscillates at a frequency of about 37kHz.

Note in *Figure 7* that C1 is in parallel with the output capacitance of Tr1, and C2 is in parallel with the input capacitance of Tr1. Consequently changes in Tr1 capacitance (due to thermal shifts etc) cause a change in frequency. This effect can be minimised (and good frequency stability obtained) by making C1 and C2 large relative to the internal capacitances of Tr1.

A modification of the Colpitts oscillator, known as the Clapp or Gouriet oscillator, is shown in *Figure 8*. Here, a further capacitor (C3) is wired in series with L1, and has a value that is small relative to C1 and C2. Consequently the resonant frequency of the circuit is determined mainly by the values of L1 and C3, and is substantially independent of variations in transistor capacitances. As a result, this circuit gives excellent frequency stability. With the component values shown, the circuit oscillates at about 80kHz.

Finally, *Figure 9* shows the basic circuit of a so-called Reinartz oscillator. Here, the tuning coil has three inductively-coupled windings. Positive feedback is obtained by coupling the collector and emitter signals of the transistor via windings L1 and L2. Both of these inductors are coupled to L3, and the circuit oscillates at a frequency that is determined by L3-C1. The diagram shows typical coil-turns ratios for a circuit designed to oscillate at a few hundred kilohertz.

Modulation

The L-C oscillator circuits of *Figures 5* to *9* can be fairly easily modified so that they produce modulated (AM or FM) rather than continuous wave (CW) output signals. *Figure 10*, for example, shows how the *Figure 5* circuit can be modified so that it acts as a 465kHz beat frequency oscillator (BFO) with an amplitude modulation (AM) facility.

In *Figure 10*, a standard 465kHz transistor IF transformer (T1) is used as the L-C tuned circuit, and an external audio frequency amplitude modulating signal can be fed to the emitter of Tr1 via blocking capacitor C2, thus effectively modulating the supply voltage of Tr1 and thereby amplitude modulating the 465kHz 'carrier' signal. This simple circuit can be used to generate modulation depths up to about 40%. Note that the value of emitter-decoupling capaci-

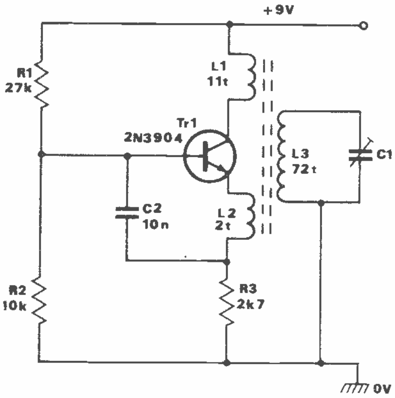


Fig 9 *Basic Reinartz oscillator*

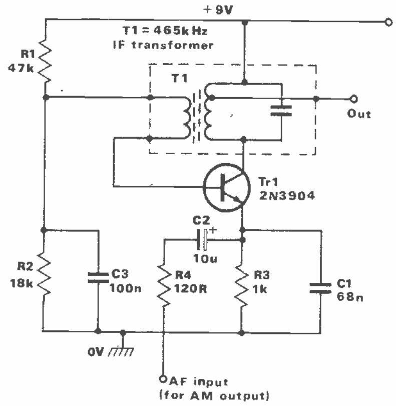


Fig 10 *465kHz BFO with AM facility*

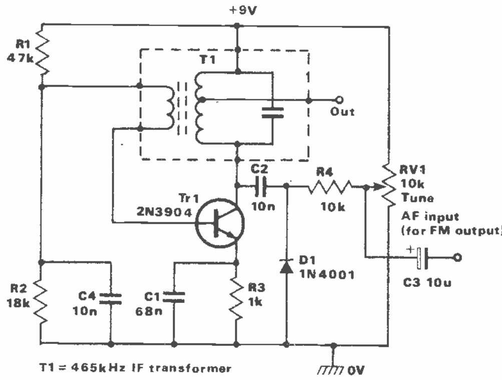


Fig 11 *Varicap tuning and FM facility*

tor C1 is such that it presents a low impedance to the 465kHz carrier signal, but a high impedance to the low frequency modulation signal.

Figure 11 shows how the above circuit can be modified to provide a frequency modulation (FM) facility, together with 'Varicap' tuning via potentiometer RV1. In this circuit, silicon diode D1 is used as an inexpensive Varicap diode or 'voltage-variable capacitor'. It is a simple fact that when any silicon diode is reverse biased it exhibits a capacitance that varies with the applied voltage; the capacitance is greatest when the voltage is low, and is least when the voltage is high. Varicap diodes are specifically manufactured to exploit this effect.

In *Figure 11*, an ordinary 1N4001 silicon rectifier is used as a Varicap diode to apply FM to the 465kHz BFO circuit. Here, C2 and diode 'capacitor' D1 are wired in series, and the combination is effectively wired across the T1 tuned circuit (since the circuit's supply rails are shorted together as far as ac signals are concerned). Consequently the centre frequency of the oscillator can be varied by altering the capacitance of D1 via RV1, and FM signals can be obtained by feeding an audio frequency modulation signal to D1 via C3 and R4. Note that C2 provides dc isolation between Tr1 and D1.

Astable basics

The circuits that we have looked at so far are all designed to generate reasonably pure sine waves. Repetitive square and rectangular waves are also of great value in electronics, and an easy way to generate these is to use the basic transistor astable multivibrator circuit shown in *Figure 12*. This circuit is a self-oscillating regenerative switch in which the on and off periods are controlled by the C1-R1 and C2-R2 time constants. If these time constants are equal (C1=C2=C, and R1=R2=R), the circuit acts as a square wave generator and operates at a frequency of roughly 1/1.4CR.

Thus the frequency of the *Figure 12* circuit can be decreased by raising the

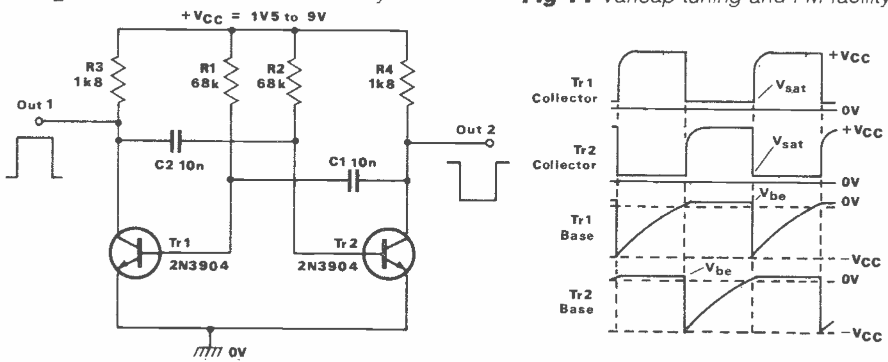


Fig 12 *Basic 1kHz astable multivibrator and waveforms*

values of C1-C2 or R1-R2 or vice versa. The frequency can be made variable by using twin-gang variable resistors (in series with 10k limiting resistors) in place of R1 and R2. The operating frequency can, if required, be synchronised to that of an external signal of higher frequency by coupling part of the external signal into the timing networks of the astable circuit. Outputs can be taken from either collector of the circuit, and the two outputs are in anti-phase.

The operating frequency of the *Figure 12* circuit is substantially independent of supply rail values in the range 1V5 to 9V. The upper supply voltage limit is set by the fact that as the transistors change state at the end of each half-cycle, the base-emitter junction of one transistor is reverse biased by an amount roughly equal to the supply voltage. Consequently, if the supply voltage exceeds the reverse base-emitter breakdown voltage of the transistor, the timing operation of the circuit will be upset. This snag can be overcome by using the modifications shown in *Figure 13*.

In *Figure 13*, a silicon diode is wired in series with the base input terminal of each transistor, and raises the effective 'base-emitter' reverse breakdown voltage of each transistor to a value greater than that of the diode. The 'protected' *Figure 13* circuit can be used with any supply voltage in the range 3V to 20V, and gives a frequency variation of only 2% when the supply is varied from 6V to 18V. This variation can be reduced to a mere 0.5% if required by wiring an additional

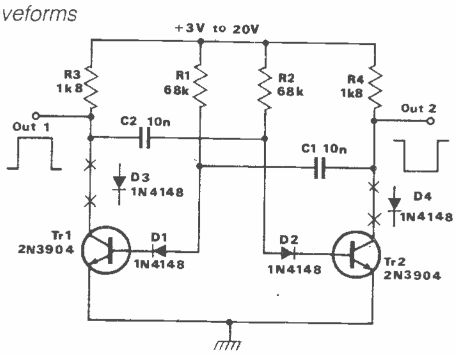


Fig 13 *Frequency-corrected multivibrator*

'compensation' diode in series with the collector of each transistor, as indicated in the diagram.

Astable variations

The basic astable circuit of *Figure 12* can be usefully modified in a variety of ways, either to give an improved circuit performance, or to alter the type of output waveform that is generated. Some of the most popular of these variations are shown in *Figures 14* to *19*.

One weakness of the basic *Figure 12* circuit is that the leading edge of each of its output waveforms is slightly rounded; the lower the values of timing resistors R1-R2 relative to collector load resistors R3-R4, the worse this waveform rounding becomes. Conversely, the larger the values of R1-R2 relative to R3-R4, the better the waveform will be. The maximum permissible values of R1 and R2 are, however, limited by the current gains of the transistors, and equal $h_{fe} \times$ R3 (or R4).

One obvious way of improving the

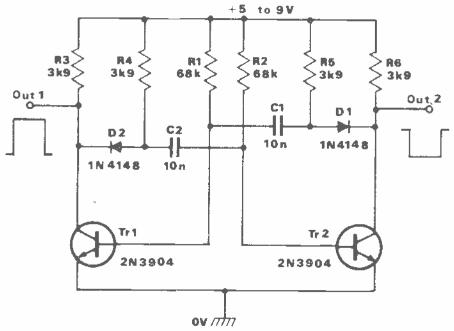


Fig 15 *1kHz astable with waveform correction*

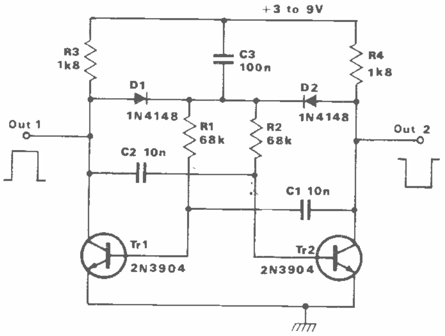


Fig 16 *1kHz sure-start astable*

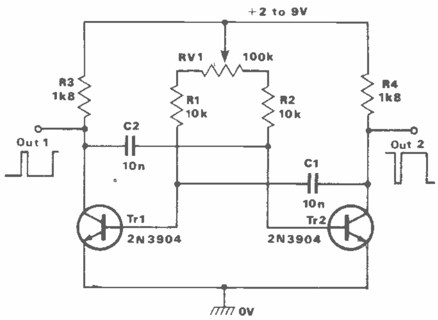


Fig 17 *1100Hz variable mark/space generator*

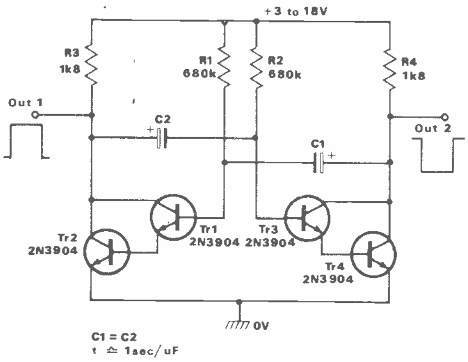


Fig 14 *Long period astable multivibrator*

circuit waveform, therefore, is to replace Tr1 and Tr2 with Darlington or super-alpha connected pairs of transistors, and to then use the large values of timing resistance that are permissible, as shown in the long-period astable circuit of *Figure 14*.

In the *Figure 14* circuit, R1 and R2 can in fact be given any values in the range 10k to 12M, and the circuit can be used with any supply voltage in the range 3V to 18V. With the specific R1-R2 values shown, however, the circuit gives a total period or cycling time of about 1 second per μF when C1 and C2 have equal values, and generates an excellent square wave output.

The leading-edge rounding of the *Figure 12* circuit is actually caused by the fact that as each transistor switches off, its collector voltage is prevented from switching abruptly to the positive supply rail value by the loading that occurs between that collector and the base of the 'on' transistor via the cross-coupling timing capacitor.

This action can be altered, and excellent square waves obtained, by effectively disconnecting the timing capacitor from the collector of its transistor as it turns off, as shown in the 1kHz generator circuit of *Figure 15*. Here, D1 and D2 are used to disconnect the timing capacitors at the moment of switching. Again, the main time constants of the circuit are determined by C1-R1 and C2-R2. The effective collector loads of Tr1 and Tr2 are equal to the parallel resistances of R3-R4 and R5-R6 respectively.

Operation of the basic astable multivibrator relies on slight imbalances of the transistor characteristics, which cause one transistor to turn on slightly faster than the other when power is first applied, thus initiating the oscillatory action. If the supply voltage of the circuit is applied by slowly increasing it from zero, however, both transistors may turn on simultaneously, in which case the oscillator will not 'start'. This snag can be overcome by using the 'sure-start' circuit of *Figure 16*, in which the timing resistors are connected to the transistor collectors in such a way that only one transistor can ever be turned on at a given moment.

Asymmetrical waveforms

The astable circuits that we have looked at so far are all designed to give a symmetrical output waveform with a 1:1 mark/space ratio. A non-symmetrical waveform can be obtained simply by making one set of astable time constant components larger than the other. *Figure 17* shows the circuit of a fixed-frequency (about 1.1kHz) variable mark/space ratio generator in which the ratio can be fully varied over the range 1:10 to 10:1 via RV1.

The leading edges of the output waveforms of the above circuit may be objectionably rounded for some applications when the mark/space control is set at its extreme positions. Also, the circuit may be difficult to start if the supply voltage is applied to the circuit slowly. Both of these snags can be overcome by using the connections of *Figure 18*, in which the circuit is fitted with both sure-start and waveform-correction diodes.

And finally folks

Finally, to complete this edition of 'The File', *Figure 19* shows how the basic astable can be modified so that its frequency can be varied over a 2:1 range (from 20kHz down to 10kHz) via a single pot, and so that the generated waveform can be frequency modulated via an external low frequency signal. Timing resistors R3 and R4 have their top ends taken to the slider of RV1, and the frequency is at its greatest when the slider is in contact with the positive supply line.

The *Figure 19* circuit can be subjected to frequency modulation by feeding the low frequency signal to RV1 slider via C4. The C3 value is chosen so that it presents a low impedance to the carrier signal, but a high impedance to the modulating signal.

In next month's edition of 'The File' we continue the transistor 'waveform generator' theme by looking at more multivibrator and oscillator circuits. REW

Fig 18 *Sure-start variable mark/space generator with waveform correction*

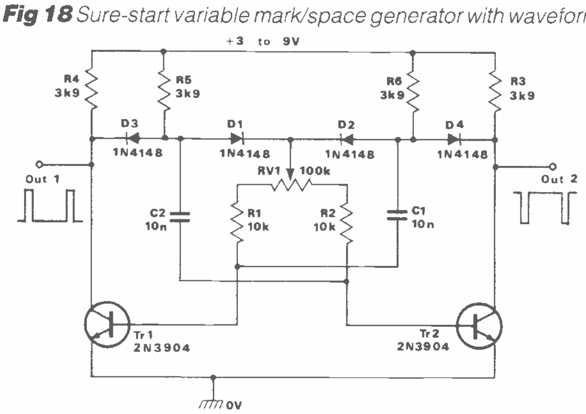
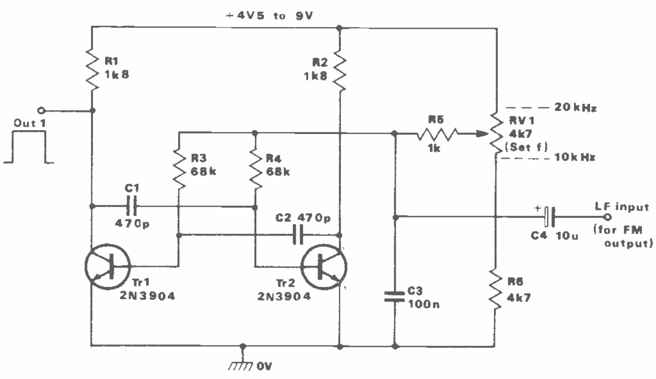


Fig 19 *Variable frequency astable with FM*



SPECTRUM MORSE

Software-only decoding for the lazy, or hardware and software for the fussy, from Colin Tallis

The Sinclair ZX Spectrum microcomputer is an extremely popular machine, and has many interesting applications in the radio and communications field. One such application is the decoding of Morse transmissions, and this article describes two ways by which this can be achieved.

The programming method is based on that described by N Kyriazis in *Wireless World* (Feb 1981), and involves machine code routines for differentiating between dots, dashes and spaces. For the first method, a direct connection is made between the receiver loudspeaker or headphone socket and the computer's 'Ear' socket, whilst the second method uses hardware in the form of a tone decoder and interface board. Assuming that a suitable receiver is available, no cost is involved in the first method. The cost for the two circuits described in the second method should be no more than about £15, and considerably less if use is made of scrap box components.

Method 1

The Spectrum's cassette interface is controlled by the ULA and is read by the command:

IN 254

If the signal at the ULA tape input is 'high', the above command should return a value of 255.

However, feeding a sine wave into the Ear socket and continuously monitoring the output by means of the following Basic program:

```
10 LET L = IN 254 : PRINT L;
20 GOTO 10
```

does not return 255 for more than about 30% to 50% of the time. The reason for this apparent discrepancy is the fact that the ULA is also reading the input on occasions when the voltage at the RC input circuit has dropped below the threshold value for correct operation *(Figure 1)*.

Therefore, a sampling technique is used by which the input signal is repeatedly read a large number of times and the number of 'highs' recorded and compared with a reference value. If more than 30% of the readings are high, then the program decides that a tone, ie a dot or dash, is being received. Conversely, if less than 30% of the readings are high, the 'no-tone' or space routines are called.

The advantage of using this sampling technique is that the effects of random noise are reduced and are less likely to be interpreted as a genuine tone or no-tone.

The program uses the ROM routine starting at address 5633, and a RESET 16 instruction for printing the character to the screen. The listing for the program, which can be placed anywhere in the memory, is given in *Table 1*. It can conveniently start at address 30,000 and occupies 311 bytes. After loading, the program is run with the command:

RANDOMIZE USR 30000

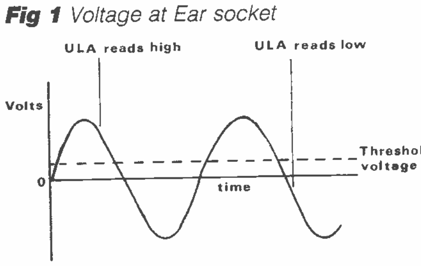
No break key is available, but this does not cause any problem since when the screen is full, the computer obligingly prints 'Scroll?' and enables the user to continue, or to break out of the program as required.

The sampling routine described above also acts as a timing delay, and the program appears to be able to read reasonable quality Morse with fair accuracy within the range of 8-20wpm.

Satisfactory decoding is dependent on correct volume control adjustment. If the level is too low then there will be insufficient signal to drive the ULA. Too high a volume setting and the noise level will prevent the program from identifying a no tone state. Moreover, if two stations are operating on frequencies that are very close together, separation is difficult and the computer is unable to decode the Morse correctly. Fading signals can also make satisfactory decoding extremely difficult.

These problems are considerably reduced with the phase-locked loop interface described below.

Fig 1 *Voltage at Ear socket*



Method 2 – hardware interface

The second method of decoding the Morse has a number of advantages over a total software system. In particular it is more selective and more sensitive to low level signals. Two separate circuits are required for the hardware, a tone decoder and computer interface board.

Tone decoder

The IC chosen for the tone detection circuit was the XR2211 decoder, which is stocked by Tandy and Maplin. At a cost of approximately £6 this IC may seem rather expensive, but it is straightforward to use and the additional component count is small. It includes an input signal preamplifier, complementary outputs and can operate quite happily on a 5 volt supply. The prototype was assembled on a small piece of Veroboard, though a neater layout can be produced with one of Tandy's Experimenter boards. The circuit diagram for the decoder is shown in *Figure 2*.

The input at pin 2 is derived from either the loudspeaker extension, headphone or tape record sockets of the receiver. The latter is preferable, since it is independent of volume control setting and will not disconnect the loudspeaker when in use. The circuit will operate satisfactorily over a wide range of input levels, which means that there is no need to compensate for fading signals.

Bandwidth is controlled by R3 and can be reduced by increasing the value of this resistor. However, if the bandwidth becomes too narrow the IC tends to go out of lock, particularly on weaker signals. The component values given in the circuit are a compromise between selectivity and ease of operation.

Table 1 *Software-only decoder*

```
M
Monitor
T7530

7530  01  01  0C  21  00  00  CD  C2
7538  75  38  34  24  7C  CB  3F  CB
7540  3F  CB  3F  B8  38  07  CD  C2
7548  75  38  E5  18  F9  CD  C2  75
7550  30  E9  2C  78  CB  3F  BD  38
7558  0C  CD  C2  75  38  F4  7C  85
7560  67  2E  00  18  D6  7C  CB  3F
7568  B8  CB  11  26  00  18  09  2C
7570  7D  CB  3F  CB  3F  B8  30  18
7578  CD  C2  75  38  F2  24  78  CB
7580  3F  BC  38  29  CD  C2  75  30
7588  F4  7D  8C  6F  26  00  18  DF
7590  79  FE  01  28  06  CD  E4  75
7598  CD  E4  75  2E  00  26  00  CD
75A0  C2  75  38  F9  24  78  CB  3F
75A8  BC  30  F4  18  A0  78  CB  3F
75B0  80  BD  38  07  78  85  CB  3F
75B8  47  18  03  CD  E4  75  2E  00
75C0  18  8B  C5  05  64  0E  00  DB
75C8  FE  CB  2F  CB  2F  CB  2F  CB
75D0  2F  CB  2F  E6  02  81  4F  16
75D8  02  15  20  FD  0F  10  E8  79
75E0  FE  1E  C1  C9  C5  E5  79  01
75E8  32  00  21  02  76  ED  B1  01
75F0  32  00  09  7E  F5  3E  02  CD
75F8  01  16  F1  D7  E1  C1  0E  01
7600  C9  00  01  06  17  15  0B  03
7608  1D  09  1F  07  18  0A  1B  04
7610  05  08  19  12  0D  0F  02  0E
7618  1E  0C  16  14  13  30  38  3C
7620  3E  3F  2F  27  23  21  20  2E
7628  6A  2D  4C  35  BA  7A  73  47
7630  47  55  52  37  00  20  41  42
7638  43  44  45  46  47  48  49  4A
7640  4B  4C  4D  4E  4F  50  51  52
7648  53  54  55  56  57  58  59  5A
7650  31  32  33  34  35  36  37  38
7658  39  30  3D  2E  2F  2C  23  2D
7660  3C  3F  3A  3B  29  22  2A  00
7668  00  00  00  00  00  00  00  00
Z
Zeus
```

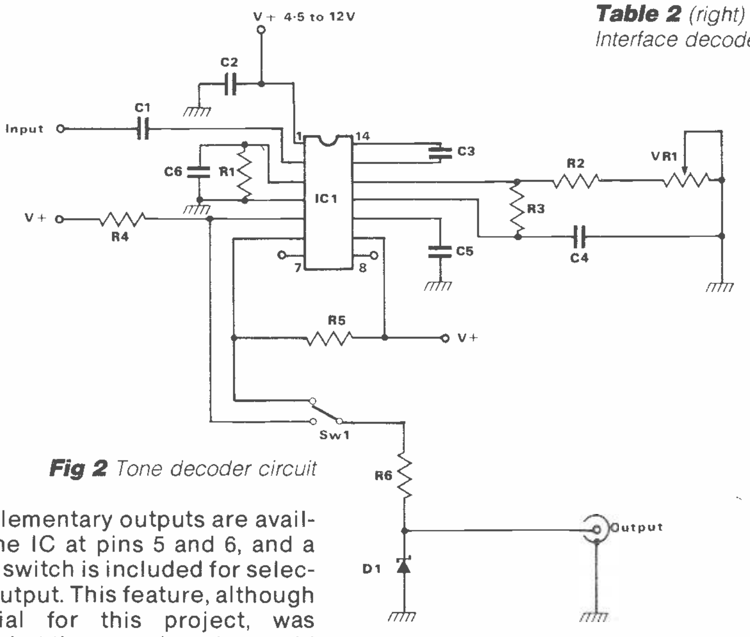


Fig 2 *Tone decoder circuit*

Two complementary outputs are available from the IC at pins 5 and 6, and a changeover switch is included for selecting either output. This feature, although not essential for this project, was included so that the tone decoder could be used with other circuits that required an input of the opposite phase. If it is decided not to fit the switch, the output should be taken from pin 5 to the computer interface.

A power supply for the decoder can be provided by the computer's 5 volt rail, although it is preferable to take the power from a separate source such as a small battery, or even from the receiver itself. However, if a supply in excess of 5

Table 2 *(right)*
Interface decoder

```
M
Monitor
T7530

7530  01  01  0C  21  00  00  CD  C2
7538  75  30  34  24  7C  CB  3F  CB
7540  3F  CB  3F  B6  38  07  CD  C2
7548  75  30  E5  18  F9  CD  C2  75
7550  36  E9  2C  78  CB  3F  BD  38
7558  0C  CD  C2  75  30  F4  7C  85
7560  67  2E  00  18  D6  7C  CB  3F
7568  B8  CB  11  26  00  18  09  2C
7570  7D  CB  3F  CB  3F  B6  30  16
7578  CD  C2  75  30  F2  24  78  CB
7580  3F  BC  38  29  CD  C2  75  38
7588  F4  7D  8C  6F  26  00  18  DF
7590  79  FE  01  28  06  CD  DA  75
7598  CD  DA  75  2E  00  26  00  CD
75A0  C2  75  30  F9  24  78  CB  3F
75A8  8C  30  F4  18  A0  78  CB  3F
75B0  80  BD  38  07  78  65  CB  3F
75B6  47  18  03  CD  DA  75  2E  00
75C0  18  8B  C5  06  05  0E  00  D6
75C8  40  E6  02  81  4F  16  C8  15
75D0  20  FD  0F  10  F2  79  FE  06
75D8  C1  C9  C5  E5  79  01  32  00
75E0  21  F8  75  ED  B1  01  32  00
75E8  09  7E  F5  3E  02  CD  01  16
75F0  F1  D7  E1  C1  0E  01  C9  00
75F8  01  06  17  15  0B  03  1D  09
7600  1F  07  18  0A  1B  04  05  08
7608  19  12  0D  0F  02  0E  1E  0C
7610  16  14  13  30  38  3C  3E  3F
7618  2F  27  23  21  20  2E  6A  2D
7620  4C  35  BA  7A  73  47  47  55
7628  52  37  00  20  41  42  43  44
7630  45  46  47  48  49  4A  4B  4C
7638  4D  4E  4F  50  51  52  53  54
7640  55  56  57  58  59  5A  31  32
7648  33  34  35  36  37  38  39  30
7650  3D  2E  2F  2C  23  2D  3C  3F
7658  3A  3B  29  22  2A  00  00  00
7660  00  00  00  00  00  00  00  00
7668  00  00  00  00  00  00  00  00
Z
Zeus
```

volts is used, the Zener voltage limiter shown in the diagram will prevent the output from rising above 5 volts.

The completed decoder board can be fitted into a small diecast box with SW1 and RV1 positioned in the lid. Screened cable should be used for the connections to the receiver and computer interface, either directly or by means of suitable coaxial plugs and sockets.

Computer interface

The circuit for the interface is shown in *Figure 3*. The address decoding is carried out with the IORQ, RD and A5 lines. When all three are low, the NOR gate of IC1a goes high. This output is inverted by IC2a and fed to the gate of the tri-state buffer, IC3a.

Thus on executing an IN A, (64) command the data bus will be read and the value placed in the accumulator. If there is no tone D1 will be high, and if a tone is present D1 will be low. The program, which is listed in *Table 2*, repeatedly checks the state of D1, and using the method referred to previously converts the sequence of tones and no-tones into the appropriate ASCII character which is subsequently displayed on the screen.

Construction is straightforward, again using Veroboard or similar material. If the Tandy IC boards are used it is easy to fit the 23-way double-sided edge connector, which should preferably be of the wire-wrap variety. The board may, however, need to be trimmed to prevent it from protruding below the base of the computer. If the computer is a Spectrum Plus this will not be necessary, because of its built-in legs.

A 23-way edge connector was chosen, rather than the 28-way version, so that use could be made of a ZX printer. *Figure 4* shows the positions of the relevant connections used in the circuit.

The RF choke, L1, is fitted between the screen from the decoder cable and the interface 0 volt line. It can be made by winding 20 turns of enamelled wire around a small ferrite toroid approximately 9mm outside diameter by 5mm bore. After soldering onto the board, the choke can be fixed in place with epoxy adhesive.

Operation

The decoder and interface should be double-checked before switching on the power supplies. Particular attention should be paid to the interface board since solder bridges can have unfortunate consequences for the computer.

If satisfied, fit the connecting cables between the receiver, decoder and interface board, switch on and load in the program using one of the many machine code loaders that have been published elsewhere. A convenient place to locate the program is address 30000 (7530 hex).

The program, which is 301 bytes long, is run with the command:

RANDOMIZE USR 30000

Locate a strong Morse signal and fine-tune with RV1 until the two LEDs flash alternately with equal intensity. Provided that there is not too much co-channel interference, the decoded message should be displayed on the screen.

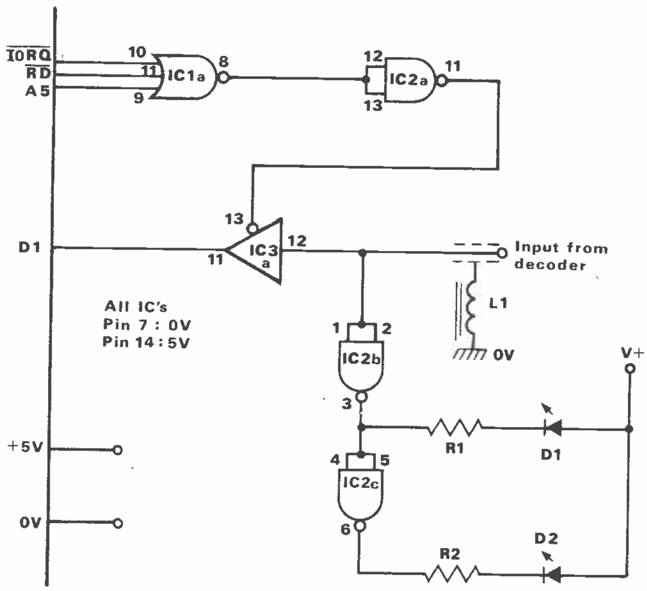


Fig 3 *Computer interface circuit*

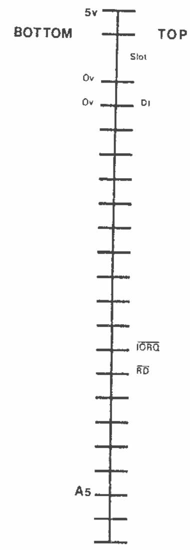


Fig 4 *Edge connector*

Interference

Finally a few words about interference. The Spectrum, as with earlier Sinclair computers, generates a considerable amount of RFI. Unless steps are taken to reduce this interference to an acceptable level, it can completely obliterate the signal being received.

Siting the aerial as far away as possible from the computer can be effective, but it must be remembered that the domestic mains wiring can distribute the computer noise over a wide area. Outdoor aerials are preferable, with screened feeder to the receiver.

Attention should be paid to earth loops. In the author's experience, it has been found that disconnecting the screen from the TV end of the TV to computer lead can be helpful. This action will degrade the picture quality to some extent, but nevertheless the display should still be acceptable. The purpose of the RF choke, L1, shown in *Figure 3* is to reduce this form of interference.

Some portable TV sets produce their own interference which can be picked up by the cassette player and prevent programs from being loaded correctly. In a particular instance, the problem was overcome by removing the computer lead from the TV and reconnecting the indoor aerial. A short piece of insulated wire with a small crocodile clip at one end was attached to the centre pin of the coaxial plug on the computer cable, and this makeshift 'aerial' placed near to the TV's indoor aerial. With this arrangement, there is no direct connection between the computer and the television and therefore no feedback into the cassette player. REW

PARTS LIST

TONE DECODER

Resistors

R1	470k
R2	15k
R3	270k
R4	10k
R5	10k
R6	2k2
RV1	5k linear

Capacitors

C1	100n
C2	100n
C3	47n
C4	10n
C5	100n
C6	100n

Semiconductors

IC1	XR2211
D1	BZY88 4V7
SW1	SPDT
Veroboard etc	

COMPUTER INTERFACE

Resistors

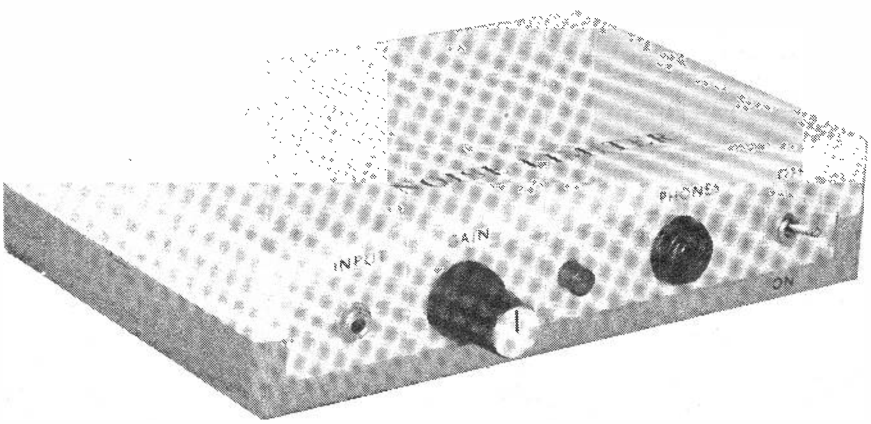
R1,2	1k

Semiconductors

IC1	74LS27
IC2	74LS00
IC3	74LS125
D1,2	LEDs
L1	see text

2×23-way edge connector,
Veroboard etc

NOISE LIMITER



Improve the perceived quality of your signals with an add-on noise limiter and filter

R A Penfold

The high sensitivity of short wave communications receivers makes them vulnerable to problems with noise spikes, picked up both via the aerial, and via the mains supply in the case of a mains powered set.

Obviously noise spikes can affect the intelligibility of the received signal, and when using headphones with many sets there is the additional problem of the deafening and painful loudness of some noise pulses.

The ideal solution is to have comprehensive mains filtering plus a noise blanker, and many modern sets have such circuits built in. For anyone wishing to improve an older set there is no problem in adding a mains filter, but noise blankers have to be merged into the existing circuitry, and this is not the type of modification that many users are willing or able to undertake.

Probably the best add-on solution to the problem is a noise limiter, which was the standard method of combating noise spikes in the pre-noise blanker days. A noise limiter is really just a clipping circuit, and the idea is to have the input signal at a level which just reaches the clipping level on signal peaks. This leaves the required signal unaffected, but strong noise spikes (which exceed the peak level of the required signal) are clipped and attenuated to some degree. This is demonstrated by the waveforms of *Figure 1.*

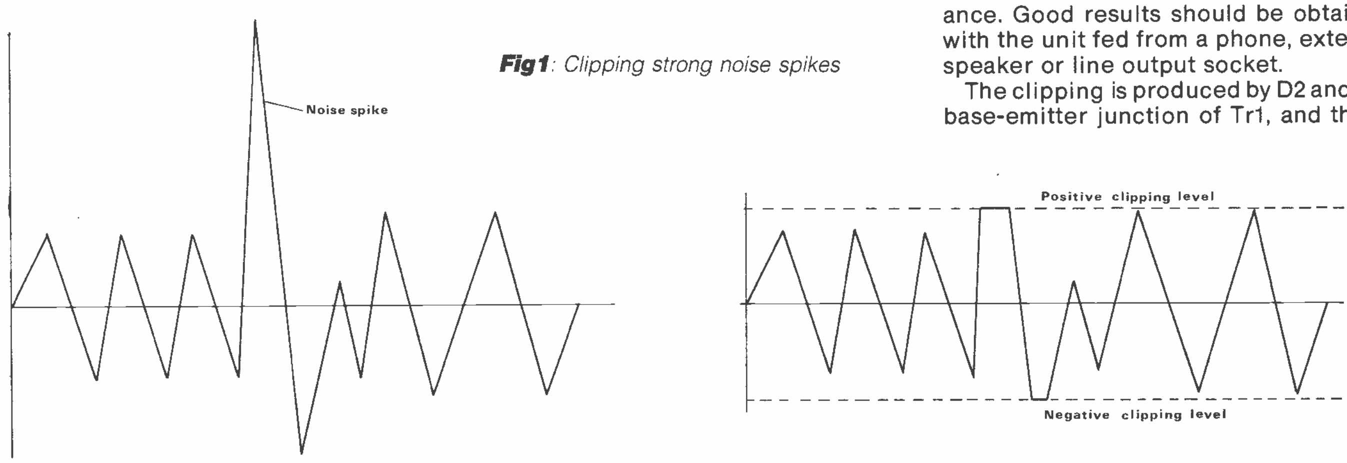


***Fig 1**: Clipping strong noise spikes*

In practice, circuits of this type are limited in their effectiveness, with the noise spikes equal in amplitude to normal signal peaks and well above the average signal level.

Improved limiter

This design achieves improved results by using a high slope low-pass filter after the clipping circuit. One advantage this brings is that it enables the main signal to be taken somewhat above the clipping level without producing serious distortion on the output. This raises the average level of the required signal while leaving the amplitude of the noise spikes unaffected. The circuit is in fact providing a simple speech processor type action. The resultant compression effectively reduces the signal to noise ratio of the received signal somewhat, but this is not a major problem provided the amount of limiting is kept within reasonable bounds.

There are a couple of benefits to the use of low-pass filtering in addition to permitting clipping of the main signal. One of these is the attenuation of the noise spikes that is provided. The reason for this attenuation is that the noise spikes often have a large high frequency content, and the clipping action tends to boost the high frequency content still further. The subjective improvement tends to be better than the objective improvement, as high frequency signals tend to stand out from and be more noticeable than low and middle frequency signals.

The second improvement is simply that the low-pass filtering helps to reduce adjacent channel interference. With a receiver that has high quality IF filtering the improvement will be minimal, but it can be very worthwhile with receivers that have inexpensive IF filters.

Circuit operation

The full circuit diagram of the unit appears in *Figure 2.* The circuit is simple in operation, with IC1 acting as the input amplifier. Its gain can be varied by means of RV1 from zero at minimum resistance to about two times at maximum resistance. Good results should be obtained with the unit fed from a phone, external speaker or line output socket.

The clipping is produced by D2 and the base-emitter junction of Tr1, and these

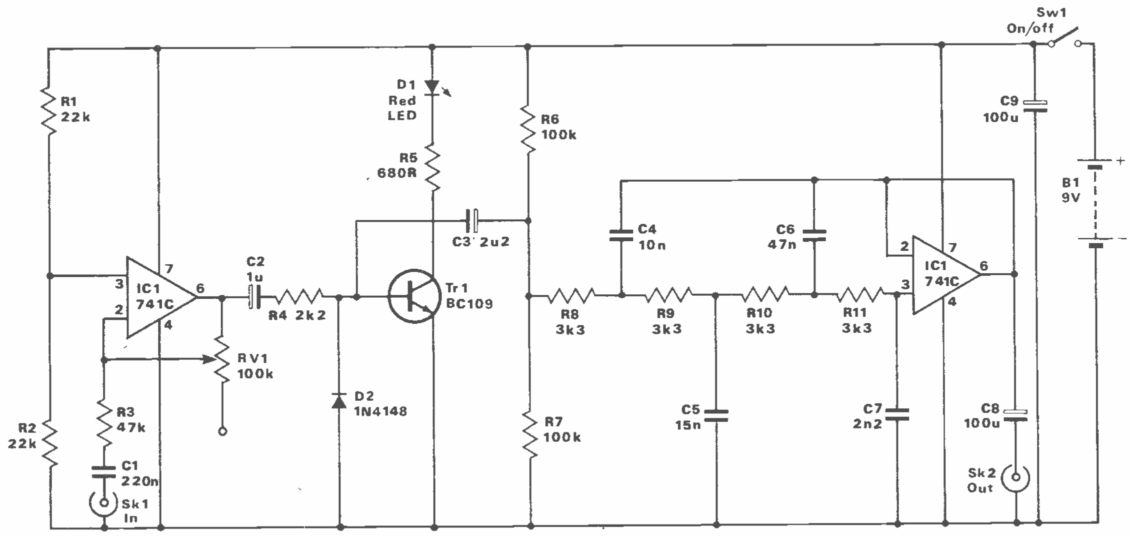


Fig 2 *Circuit diagram of the noise limiter*

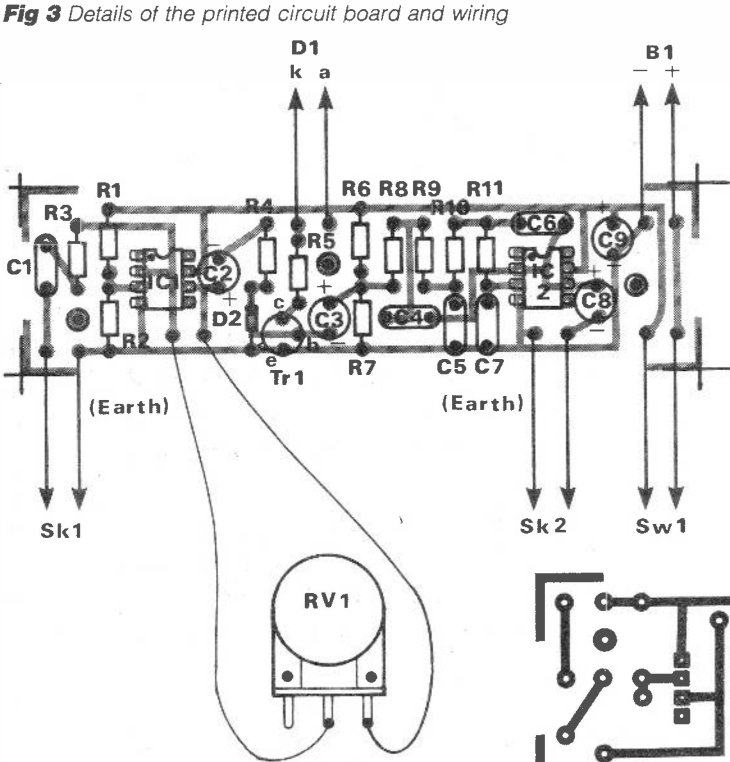
limit the signal to about ±0.6 volts. Positive half cycles bias Tr1 into conduction and cause LED indicator D1 to flash on. D1 acts as a simple clipping level indicator, with its brightness giving a rough guide to the degree of limiting used. RV1 is adjusted for a level of gain that causes D1 to light fairly brightly during periods when the input signal is at around full volume.

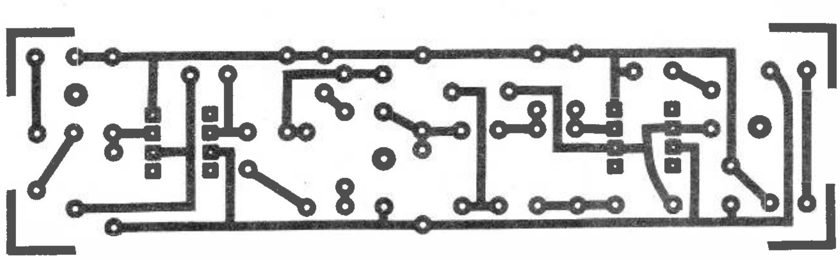
The filtering is provided by IC2 and its associated components, which form a conventional fourth order (24dB per octave) low-pass filter having a cut-off frequency of approximately 3kHz. The output is intended for use with medium impedance (about 100 to 600 ohm) headphones, but satisfactory results seem to be obtained with most high impedance types if they are wired in parallel, or with series connected low impedance types. With some sensitive types the volume might be excessive, but if necessary a reduction in volume can be obtained by adding a resistor of around 100R in value in series with C8.

Construction

Most of the components fit onto a small printed circuit board, as detailed in *Figure 3*. Construction of the board is extremely straightforward and should

Fig 3 *Details of the printed circuit board and wiring*





PARTS LIST

Resistors (all ¼W 5% carbon)

R1,2	22k
R3	47k
R4	2k2
R5	680R
R6,7	100k
R8,9,10,11	3k3
RV1	100k linear

Capacitors

C1	220nF polyester layer
C2	1μF 63V radial elect
C3	2μ2 63V radial elect
C4	10nF polyester layer
C5	15nF polyester layer
C6	47nF polyester layer
C7	2n2 polyester layer
C8,9	100μF 10V radial elect

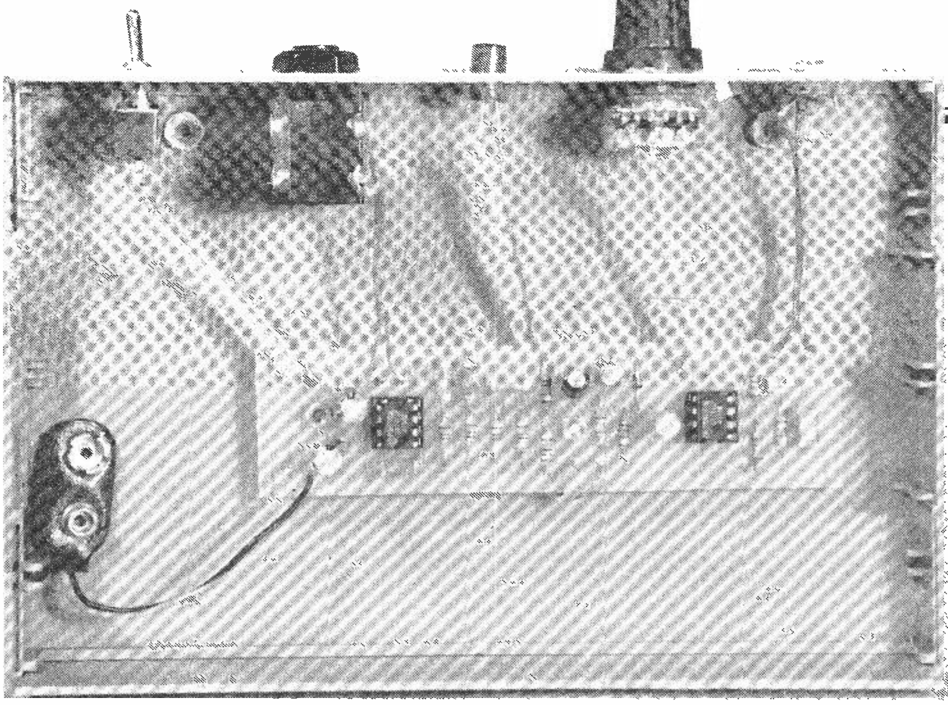
Semiconductors

IC1,2	μA741C
D1	5mm red LED
D2	1N4148
Tr1	BC109

Miscellaneous

SK1	3.5mm jack
SK2	standard (6.35mm) jack
B1	9 volt (PP3 size)
S1	SPST sub-min toggle

Case about 180 × 120 × 39mm
Printed circuit board
Control knob
Battery connector
5mm LED holder
Wire, solder, etc



not give any difficulties. Note, however, that the non-electrolytic capacitors must be polycarbonate or miniature polyester layer components with 7.5mm lead spacing if they are to fit easily onto the board.

A case which has approximate outside dimensions of 180 × 120 × 39 millimetres is used as the housing for the prototype, and this gives the unit a very neat appearance, but it is somewhat larger than is really necessary and the unit can be built into practically any small metal or plastic box. Although I used a 3.5mm jack socket for SK1, this could of course be changed to some other type if it would be more convenient for your particular set-up.

In use

If the unit is fed from a line output the input signal level will be unaffected by the receiver's volume control setting. It is then just a matter of setting RV1 so that D1 lights quite brightly on volume peaks. If the unit is driven from an extension speaker or headphone output the volume control setting will affect the input level to the limiter. Results will probably be acceptable if the volume control is set at roughly the point normally used, and RV1 is then adjusted as described above. However, in some cases it might be necessary to advance the volume control a little further than normal.

While results fall short of noise blanker standards, strong noise spikes are reduced to a tolerable level and are prevented from significantly reducing intelligibility. Results are certainly far superior to those provided by straightforward clipping circuits. However, bear in mind that with interference which consists of a continuous series of closely spaced pulses, even a noise blanker is often of little value, and a noise limiter cannot reasonably be expected to provide a vast improvement in the audio output signal under these conditions. REW

15/80H	£3.05
15/85R	£3.05
16039	£0.79
16181	£1.04
16182	£1.04
16334	£0.98
16335	£0.94
16446	£0.98
16600	£1.38
16802	£1.27
17052	£5.61
17053	£5.61
17074	£9.30
17089	£5.35
17127	£3.51
17376	£1.58
17523	£1.32
17524	£1.32
1N4001	£0.06
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1N4148	£0.04
1N4448	£0.05
1N5401	£0.14
1N5402	£0.15
1N5403	£0.16
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1N5408	£0.35
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1R3403	£5.00
1S1555	£0.20
1S44	£0.10
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1S921	£0.10
2N1303	£0.38
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2SA1012	£1.25
2SA1020Y	£0.86
2SA1027R	£0.45
2SA473	£0.75
2SA766S	£4.95
2SC1173Y	£1.25
2SC1474	£1.25
2SC1509	£1.35
2SD1391RL	£3.95
2SA1095	£4.10
2SA1103	£6.55
2SA329	£0.40
2SA351	£1.17
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2SA562	£0.57
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2SC1158	£3.33
2SC1162	£1.05
2SC1172	£2.22
2SC1195	£3.26
2SC1212A	£1.97
2SC1213	£0.89
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2SC1293	£0.90
2SC1306	£1.98
2SC1316	£4.10
2SC1317	£0.87
2SC1364	£0.49
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2SC1398	£0.84
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2SC1505	£1.00
2SC1514	£1.37
2SC1573Q	£1.25
2SC1578	£8.74
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2SC1617	£3.89
2SC675	£1.41
2SC1678	£1.98
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2SC1810	£1.70
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2SC1829	£2.22
2SC1875	£5.19
2SC1881K	£2.98
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7806	£0.73
7808	£2.39
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7818	£0.92
7824	£0.64
7905	£0.80
9368	£10.70
NAT	£8.00
TELETON	£4.50
AA133	£0.12
AC123K	£0.43
AC127	£0.27
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AN5250	£2.89
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AN6250	£2.95
AN6300	£7.00
AN6310	£8.74
AN6320N	£4.28
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AN6341	£4.00
AN6342	£1.61
AN6363	£16.00
AN6371	£2.00
AN6387	£7.95
AN6531	£1.95
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AN7158	£6.75
AN7218	£1.64
AN7223	£4.25
AU107	£3.50
AU110	£2.25
AU113	£5.25
AY105K	£2.08
AY106	£1.09
BA524	£8.21
B250	£2.65
B40	£1.55
BA130	£0.14
BA1310	£1.98
BA1320	£1.38
BA1322	£3.95
BA1330	£2.75
BA145	£0.19
BA148	£0.33
BA154	£0.40
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BA159	£0.12
BA182	£0.24
BA222	£1.66
BA302	£1.24
BA311	£1.32
BA312	£0.97
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BA317	£0.05
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BA335	£6.27
BA5102A	£3.78
BA511	£2.92
BA514	£2.25
BA521	£2.02
BA524	£8.94
BA526	£7.98
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BA532	£2.67
BA536	£2.95
BA6209	£4.75
BA656	£8.99
BA7100	£10.85
BA841A	£16.72
BA843	£3.96
BA854	£5.76
BAV18	£0.21
BAV19	£0.11
BAV20	£0.31
BAV21	£0.34
BAW62	£0.19
BAX12	£0.44
BAX13	£0.11
BAX16	£0.11
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BC108B	£0.15
BC109	£0.12
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BC182L	£0.10
BC182LB	£0.14
BC183L	£0.11
BC183LB	£0.26
BC184	£0.13
BC184L	£0.14
BC184LB	£0.26
BC186	£0.27
BC187	£0.28
BC204	£0.16
BC207	£0.14
BC212	£0.11
BC212B	£0.26
BC213L	£0.10
BC213LB	£0.15
BC214	£0.10
BC214LB	£0.26
BC225	£0.40
BC237	£0.10
BC237BJ	£0.12
BC238	£0.10
BC238A	£0.13
BC238B	£0.13
BC239	£0.12
BC239B	£0.25
BC251A	£0.12
BC294	£0.50
BC300	£0.35
BC301	£0.45
BC302	£0.53
BC303	£1.04
BC307	£0.18
BC307A	£0.14
BC308	£0.18
BC308A	£0.11
BC309	£0.17
BC317A	£0.13
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BC337	£0.09
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BC637	£0.24
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BC880	£0.31
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BCY70	£0.30
BCY71	£0.21
BCY72	£0.20
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BD165	£0.62
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BD182	£0.99
BD183	£0.99
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BD187	£0.53
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BD204	£0.40
BD207	£1.79
BD208	£1.23
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BD225	£0.49
BS228	£0.63
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BDX54B	£2.61
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BU108	£1.50
BU109	£2.25
BU110	£5.69
BU111Y	£4.16
BU125	£2.48
BU126	£1.55
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BU206	£1.27
BU207	£1.65
BU208	£1.12
BU208/02	£1.97
BU208A	£1.12
BU208D	£1.95
BU209	£1.93
BU226	£2.95
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BU326A	£2.20
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BU406D	£1.79
BU407	£0.82
BU407D	£1.00
BU412	£5.29
BU426A	£1.67
BU500	£1.95
BU508A	£1.89
BU536	£5.80
BU608	£2.65
BU705	£3.81
BU806	£1.79
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BY225-100	£1.13
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BY227	£0.49
BY228	£0.60
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BY229-600	£0.92
BY225	£0.69
BY295-600	£0.81
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BY407	£0.84
BY409	£1.49
BY448	£0.69
BY713	£1.10
BYW19/1000	£0.69
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BYX10	£0.29
BYX55-600	£0.15
BYX71-600	£1.25
BYX71-350	£0.72
BYX94	£0.14
BYY56	£1.20
BZY93C30	£1.86
BZY88 RANGE	£0.10
BZX61 RANGE	£0.18
BZX79 RANGE	£0.10
C106D	£0.46
C106M	£0.76
C1129	£0.58
CA3046	£2.06
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CA3090AQ	£3.25
CA3094	£2.20
CA3131EM	£3.12
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CD4001	£0.38
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CD4008	£1.35
CD4011	£0.29
CD4012	£0.24
CD4013	£0.47
CD4016	£0.46
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CD4556	£3.47
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CX187	£5.26
CX755	£12.95
CX885A	£6.85
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DEC2	£2.20
DS3486N	£4.33
DS3487N	£4.33
E1222	£0.40
E5024	£0.28
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E9003	£0.46
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HA11714	£7.76
HA11716	£13.10
HA11725	£18.26
HA11725MP	£16.00
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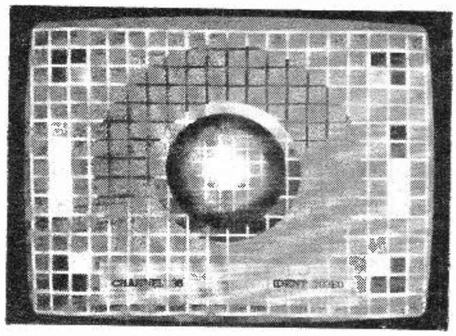
DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

Auroral activity dominated the DX scene during February. There were two instances of the phenomenon, both at the beginning of the month. Unfortunately the bitterly cold weather (remember it?) proved to be disasterous for sporadic-E reception: signals, like so many forms of life, seemed to go into hibernation. However, by the time enthusiastic *R&EW* readers are browsing through this column, sustained sporadic-E openings should be with us once again.

Meteor shower DX was lacking too, but a mini-trop opening towards the middle of February produced DX-TV in colour from West Germany on the 12th and 13th.

DX-TV log for February

This month's log is short and sweet reflecting the poor conditions experienced. The details are as follows:

1/2/86: Auroral activity noted throughout Band I affecting most channels. Signals from Swedish TV (SR) on channel E2 were identified by Chris Howles of Lichfield.

5/2/86: Czechoslovakia (CST) with the 'RS-KH' electronic test card on R1; RAI (Italy) with programmes on channel IA; TVP (Poland) on R1 with their slightly modified PM5544 test pattern. Reception noted by Simon Hamer of New Radnor in Powys.

9/2/86: Polish PM5544 pattern on channel R1 from TVP; ORF 'Telefunken TO5' monoscopic test card on channel E2a from Austria, received by Welsh DX-TV enthusiast Simon Hamer.

11/2/86: TDF (France) with programmes from tf1 (First network) on channel E42, Antenne 2 (Second French service) on E39, FR-3 on E45, and Canal Plus (Fourth network) on channel L5; BRT-1 (Belgium) on E10 from Wavre, also on E43 from the Egem transmitter; BRT-2 from Egem on channel E46. All reception via enhanced trop conditions and noted by Kevin Jackson in Leeds.

12/2/86: BRT-1 on E43 and BRT-2 E46, both from the Egem outlet; NOS-1 (Netherlands) on channel E6 from Smilde and on E39 from Wieringermeer; NOS-2 from Wieringermeer on E45; WDR-1 (Westdeutscher Rundfunk, West Germany) on channel E46 from Kleve; ZDF (Zweites Deutsches Fernsehen, West Germany) on E35, E37 and E39, probably from Wesel, Aachen and Osnabrück respectively; WDR-3 on E48 from Wesel. All DX via trop and logged by Mark Dent in Leeds.

13/2/86: NOS-1 on channel E39 and NOS-2 on E45, both from Wieringermeer; ZDF on E35 from Wesel. Trop reception noted by Mark Dent.

15/2/86: TDF Canal Plus from Lille on channel L5; BRT-1 from Egem on E43. Signals, via trops, seen by Kevin Jackson.

Test card watch

Norddeutscher Rundfunk of West Germany have been noted using an optical colour test chart. Thomas Graf of Porta Westfalica reports seeing it from the 100kW channel E9 NDR-1 transmitter at Hamburg on February 13th at 0718GMT. The pattern is based on an old EBU colour chart used mainly for checking studio cameras. It isn't normally radiated during test transmissions. It is interesting to note that this chart was considered by RAI in Italy for use with their experimental colour television service during the early seventies. However, as far as we know, it was never transmitted on a regular basis.

Sándor Rottenbacher of Hungary has sent information concerning test transmissions from Magyar Televizió. The test card is the familiar PM5544 with the identification 'MTV-1' or 'MTV-2' at the top and 'BUDAPEST' at the bottom. Occasionally a multi-burst (frequency gratings) pattern precedes the test card. Incidentally, don't be surprised to see the PM5544 for a few minutes around 2025GMT during the sporadic-E season. There is often a five minute pause in transmissions – probably it's the technicians having a quick tea break!

MTV also use an alternative colour test pattern with the identification 'MTV BUD'. This is somewhat of a rarity (just like the BBC's!), since we have had no reports of its appearance in Band I during any past sporadic-E season. It should be noted by DX-TV enthusiasts that there are no transmissions from MTV on Mondays, except for national celebrations or important sports events. So, if you receive a programme on an 'R' channel which you cannot identify and it's a Monday, it isn't likely to be Hungary. For the hardened telly addict in Hungary there's always cable TV in certain areas which operates on Mondays, but only for about an hour.

On the subject of television in the UK, DXers on the Continent may be interested to know that BBC-2 transmits the digital Test Card F or the electronic Test Card G on very rare occasions during periods which are now devoted to rubbish from Ceefax. Also, watch out for regional programme variations on BBC-2 and the accompanying captions. Until recently regional programmes were only broadcast on BBC-1.

Reception reports

Lichfield DX-TV enthusiast Chris Howles has recently been in touch concerning strange humbars and general noise effects throughout Band I on February 1st. Chris had in fact witnessed auroral activity, and the Swedish PM5534 test card could be made out on channel E2. The signal was rather unstable giving the impression that a dicky aerial connection was the culprit.

Chris recently installed a new rotatable outdoor system for UHF, but his eagerness to try it out was marred by his neighbour's equal eagerness to prevent him from using it. Apparently the sound of the rotator's motor is too much for certain delicate ears.

Record breaking aurora

Kevin Jackson of Leeds has commented on the recent poor conditions. To make matters worse he missed the whopping aurora on February 8th. The event was later brought to his attention by radio amateur colleague, Mike Allmark. The aurora started at lunchtime and it even affected 70cms (the low end of the UHF band, below channel 21). It transpires that this particular aurora was something of a record-breaker. The magnetic figure for a major storm is anything over 50, and the February aurora registered 208 according to measurements obtained in the USA.

Mark Dent, also of Leeds, has recently become a dad with a few sleepless nights it would seem. On February 22nd at approximately 0200GMT when all the BBC and IBA stations had closed, he was tuning around and noticed a weak but locked picture on channel E39 coming from the south-west. With his D-100 DX-TV converter switched to the narrow-band IF mode, Mark could just make out the film 'Beverly Hills Cop' which he had watched on video the previous week. Stray radiation from a neighbour's video recorder was considered as the possible cause, or even one of those illicit low-power transmitters advertised as having a range of 30ft or so. After the film finished at about 0300GMT there was a break lasting some five minutes followed by teletext pages. The same few pages were repeated a number of times. Could this be a pirate TV station operating in the Leeds area?

New TV receivers

Details of two new multi-standard receivers have been forwarded by Tony Privett of Basingstoke. They are guaranteed to whet the appetite of any DX-TV enthusiast with a few pounds to spare!

The first is a 10 inch battery/mains portable TV/monitor from Saba, known

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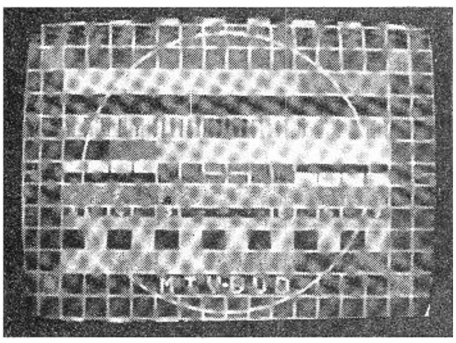
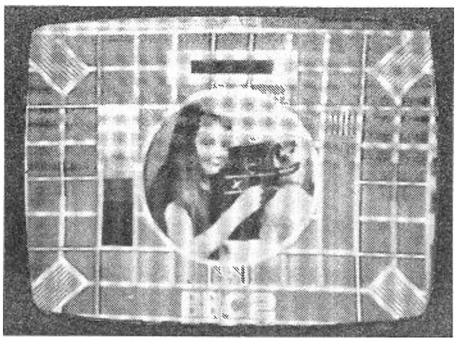
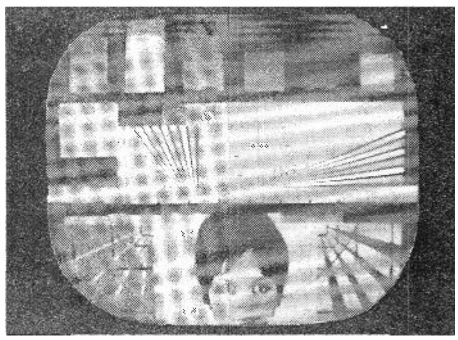


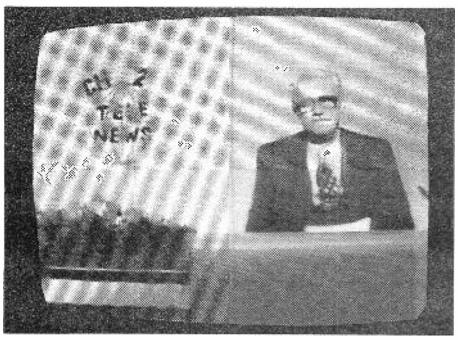
Electronic colour test card radiated occasionally by MTV in Hungary



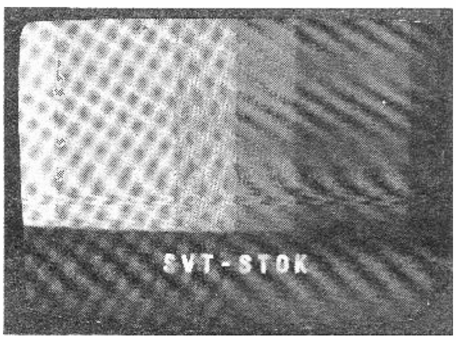
Digital test card 'F' transmitted by BBC2 on very rare occasions



EBU colour test chart – a modified version used in West Germany



News programme in English transmitted by the TV service in Egypt



Colour bar pattern radiated by the TV service in Sweden

An unusual test card used by Italian pirate station Teleradio Ragusa as the Ultracolour PM 25 S 42. It will resolve the various transmission standards found in Europe, namely PAL systems B and G (5.5MHz sound), SECAM B and G (East Germany with 5.5MHz sound), PAL system I (UK and Eire with 6.0MHz sound) and SECAM L and L' (France). The price is around the £300 mark – this includes an infra-red remote control unit. The PM 25 S 42 may be obtained from: Video Prince Ltd, 328 Edgware Road, London W2 1DY. Telephone (01) 724 3800.

The second receiver is an all singing, all dancing model from Grundig which, according to the specification, will do just about everything apart from feed the cat. Perhaps a plug-in module will be available for this in the future?

The TV is known as the Super Colour P 55-245/9 GB/UHF-VHF Multisystem. It is mains operated and the transmission standard is entered into the receiver's memory in coded form. It will resolve PAL, SECAM and NTSC (3.58MHz and 4.43MHz chroma subcarriers) colour systems and caters for the following sound spacings: 4.5MHz (US standard for use in Europe for AFN TV transmissions); 5.5MHz (CCIR Western Europe); 6.0MHz (UK and Eire); and 6.5MHz (Eastern-bloc countries, USSR and China).

The TV will also resolve French SECAM system L transmissions, thus making it an ideal receiver for anyone living in the south of England who may be considering using it for domestic and DX purposes. We recommend that you consult your local Grundig dealer for further information such as the price and availability.

How to become a DXer

In the last couple of columns we have discussed the reception of distant broadcast television stations via sporadic-E and tropospheric propagation. To summarise, sporadic-E mainly affects Band I channels (the old British 405-line channels 2-5), although an intense opening may result in the FM radio band becoming active or, in rare cases, the lower channels in Band III (the old 405-line channels 6 and 7).

Activity is at a peak during the summer months between May and September. Openings are completely random and may come from any direction. Reception can last for only a few minutes or several hours with signals ranging in strength from barely detectable to overloading. Since transmissions are reflected by the ionised E-layer a 'skip' or 'hop' distance is involved, typically 600-800 miles. Simple aerial systems can be installed initially due to the high signal strengths encountered, although a multi-element array comes into its own with weaker DX signals.

Tropospheric propagation largely affects the top end of Band I (VHF), FM radio, Band III and UHF TV channels. Very occasionally the lower Band I frequencies become active. Reception via improved trop conditions is associated with anticyclonic weather systems and can, to some degree, be predicted. DXers should watch out for the co-channel interference announcements from the BBC and IBA.

Receiver systems for DX-TV

Most UK receivers will not cover channels other than at UHF. This problem can be overcome by fitting a multi-band tuner to give facilities for Bands I and III. Various tuners are available cheaply from Sendz Components, who often advertise in this magazine. It should be borne in mind that a switch is required to select the appropriate band, and in order to prevent the risk of shock everything should be electrically isolated. If you do not feel competent to carry out such modifications, then don't! It may be better to save up and buy a multi-standard receiver or a special type of converter which plugs into a domestic TV set.

Various receivers are now available (mainly colour) with multi-standard facilities which will resolve the different sound systems found in this part of the world. They are capable of giving good results when conditions are favourable, especially during enhanced tropospheric openings. However, you must bear in mind that sporadic-E DX will form a very high proportion of long-distance TV reception. As we have already mentioned, signals can be unstable and often lack chroma or sound information, and for this reason it may be considered an extravagance to buy a multi-standard set.

Another problem concerns selectivity. This manifests itself when signals are received on channels which overlap. Two good examples are channels E2 and R1, or channels IA and E3 in Band I. The vision carrier frequencies are only 1.5MHz apart. During a good opening the different pictures will tend to float over each other, especially when they attain similar strengths. At other times the stronger signal can drown the other. This effect can be reduced by narrowing the IF bandwidth, or even by fitting an adjustable notch filter to the receiver IFs or at the aerial input.

We have found from experience that many DXers prefer to narrow the IF bandwidth since it has the added advantage of making weaker signals look less noisy. In fact, many signals which are just visible at noise level when using narrowband IFs are completely lost when utilising a receiver with normal (wide) bandwidth IFs. Fortunately a handy unit known as the D-100 DX-TV converter is available where a combination of IF bandwidths can be selected. This type of converter has proved to be invaluable to many DXers throughout the UK and Europe over the past two sporadic-E seasons thanks to its narrow IF properties. Another advantage is that the D-100 can feed a standard UK portable receiver, thus making a compact DX set-up. Further details are available from: HS Publications, 17 Collingham Gardens, Derby DE3 4FS.

Band III aerials for DX-TV

We have received confirmation from Steve Stillwell of Protel (Aerials and Communications) that his company can supply the Triax 13-element wideband Band III array at a cost of £44.20. The price includes VAT and carriage within the UK. More information regarding suitable aerials for DX-TV work may be obtained by sending an SAE to: Protel, 295 Ballards Lane, London N12.

Service information

United Kingdom: From February 2nd, the BBC's teletext service 'Ceefax' has been able to provide its range of 600 pages at a much faster rate. This is due to the broadcasting of Ceefax signals on six 'lines' compared with the four lines it had been using previously.

This improvement has been brought about by new computer software. The whole computer system should also give a more reliable service. Teletext was invented in the UK thirteen years ago and, under the name of 'World System Teletext', it is now being used in nineteen countries around the world.

A new system of network transmission of subtitles for the deaf and hard of hearing has also been introduced via teletext. It allows the broadcasting of programme subtitles on BBC-1 and BBC-2 simultaneously. Page 888 carries subtitles on all channels.

Ceefax has, until now, been broadcasting on lines 14, 15, 16 and 17 (and 327, 328, 329 and 330) during the field blanking intervals. Following the start of 'six-line' working, lines 13 and 18 (plus 326 and 331) have been added to the teletext signal.

On a different topic, the BBC has produced a new Streak Test Waveform generator. It produces four waveforms; streak, 50Hz, white and black. These are used to check the low-frequency response of video circuits and their ability to recover from the sharp transitions between white and black. It is unlikely that the new pattern will be transmitted over the air, unless of course there are any switching errors during the endless (and many would say boring) periods of sample Ceefax pages.

East Germany: A vertically polarised relay station has come into service on the Isle of Usedom in the Baltic Sea. It radiates programmes from DDR:F on channel E49 and is located at Koserow.

Our thanks to Gösta van der Linden (Rotterdam), Alain Duchâtel (France) and the BBC (London) for supplying this month's Service Information. REW

ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

Hello again – it's a real old mixture in this month's column, so there should be something for everyone. Well, in theory anyway.

Secondhand bargains again

One of the things which exerts many people's minds is the price of secondhand equipment. This usually means video equipment as, for some reason, ATV transmitters and receivers never seem to make the small ads (perhaps they are all sold by word of mouth). Anyway, seasoned rally-goers like myself tend to watch the secondhand prices at the first couple of rallies of the season to try and get an idea of what's selling and at what price.

On that basis, the RSGB exhibition at the NEC was a useful indicator. Normal black and white surveillance cameras were pitched around £40, so not much change there, and small 12in monitors still seem to range between £30 and £50. Colour cameras were also around, some boxed and new (ie, two years old but unused) and some decidedly second-user. The former category cost around £250 and the latter £175. Even if you are not a habitual rally-goer these prices might induce you to make the effort.

VCRs have dropped quite a bit compared with last year. Sony Beta portables of the F1 variety were available at £50, which is a very fair price for what is universally acknowledged to be an excellent machine. Also at bargain prices were tuners, battery packs and VHS machines.

I don't guarantee that you will find the same gear at every other rally this year, but the prices are a sign of the times.

Whatever the facts behind the unsubstantiated rumours that Sony has ceased development or production (believe whichever you like) of Beta equipment it is nonetheless true that corporate users and rental companies wish to unload their Beta inventory fast. Even in the retail sector I have seen slashed prices, particularly for VHS-compact recorders. Looking at the bargains offered in *What Video?* one gets a strong feeling that these are bad news for shops.

Amazingly, some dealers are still trying to shift 'new' Technicolor quarter-inch portable recorders; they were new around Christmas 1981. Even at £150 I wouldn't recommend these to my worst enemies...

Display Electronics was there at the NEC with a nice line in ex-Rediffusion equipment, and I guess they will still have stocks after this article is published. Pick of the video stuff were some colour monitors taking composite video input, and matching off-air TV tuners (TVs without screens) – see their ads if you're interested.

Also at the NEC was a stall with ex-rental video films which looked as if they would not make the 'Bright bill test'. One title, *Flesh Feast,* nearly made me part with £5; it offered vividly coloured scenes of morbid, trained maggots doing the business. Come to think of it, I really should have risked the fiver, even though it was bound not to have been as horrific as claimed!

BATC at NEC

As ever, the British Amateur Television Club (BATC) had a stand for the benefit of members and non-members alike. We don't visit all the shows but we normally attend the RSGB's NEC exhibition and the VHF Convention, as well as the Leicester show in the autumn and (usually) the McMichael bash at Stoke Poges. In addition there is the BATC's own rally (the event of the year!) at Crick over the May Day bank holiday weekend. By the time you read this it will be past history, though!

At these exhibitions the BATC aims to have all its publications on sale, along with most of the printed circuit boards and other components used in magazine projects. We used to bring along back issues of the club's magazine *CQ-TV,* but nearly all of these have sold out. There is a photocopy service for out-of-print articles but this works out expensive for big projects.

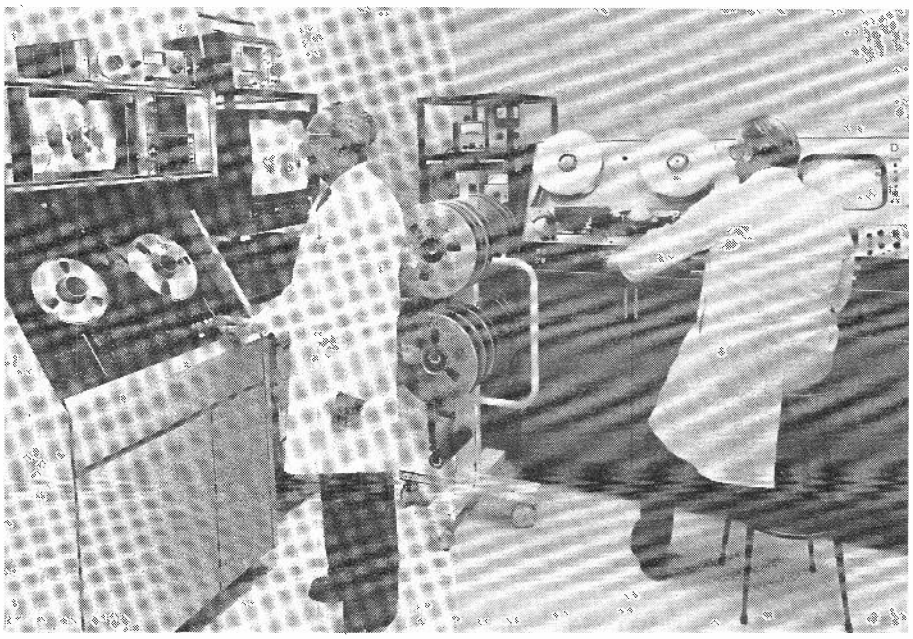
There is a solution, however! Yes it's... *The Best of CQ-TV,* and here is an unashamed plug for this excellent book (which I had nothing to do with writing). For your £3 (plus 50p postage) you get 100 pages of updated projects covering 70 and 24cm transmitters and receivers, filters and video equipment.

Now you can stop hunting for back numbers, or catch up on the best projects. Even if you have the magazines, now you can keep all the articles in one handy book. Both old hands and beginners will find this useful. Grab a copy soon or write to BATC Publications, 14 Lilac Avenue, Leicester LE5 1FN. The book was a best-seller at Birmingham and I am sure it will stay this way.

Let's stay friends

The latest issue of *CQ-TV* is out now. It contains an interesting discussion of 'how wide is wide' and the problems of mutual interference between video and other amateur transmissions. The remedy on 70cm is clear, and I quote: "Forget the subcarrier sound, do away with colour and use a filter".

At the moment we ATVers need all the



Avoid pirate tapes if you don't want to suffer dropouts and cassette jam. Scotch (Welsh, really) tapes undergo comprehensive testing and cost little more friends we can get – there are renewed pressures on the 70cm band. Whilst it is wide-bandwidth modes like ATV which are the main justification for retaining the full 10MHz allocation at 70 (remember this!), there is no point in antagonising other 70cm users by interfering with their transmissions – or going outside the band!

Sorry if I am labouring this point but it's important. A very simple 3MHz low-pass filter design is given in *CQ-TV*; seven capacitors and two coils will ensure your signal stays within limits.

Pirates back at NEC

Another thing I spotted in the NEC at Birmingham was pirate video tapes, not copied films but blank tapes with goofy names. These are definitely dodgy, and bad news for your video recorder. When brand name E-180s used to cost £10 a throw these half-price miracles were worth trying, but frequently they shed loose oxide, or their squeezy-plastic cassette housings got jammed in the recorder. Quite reasonable performance soon turned into dropout after dropout – yes, I know from experience.

By shopping around now you can find JVC and other E-180s for £4 or less, so there's no need to risk your recordings by saving 50 pence on a poor tape.

Some strange-looking tapes are not pirates, however. If you travel around a bit you will find familiar brand names in packages that are completely different from the ones you normally see. Hitachi and Panasonic have totally different box designs in some markets, and from time to time these turn up here, so don't shun them just because the cardboard box is a different colour.

Sometimes the name is strange, but it may be a well-known one elsewhere – for instance, PD Magnetics (a Philips-Du Pont consortium) and the Victor name (complete with Nipper dog and horn gramophone, as per His Master's Voice). These tapes are quite 'legit'.

From time to time you may also see VHS tapes with 'T' numbers, eg, T-60, T-120. These, too, are quite safe to use. The T stands for time, and a T-120 tape is thus a two hour tape – in some places! These tapes are intended for the North American and Japanese markets, in other words the NTSC countries. Put them in a European machine and they will run 20 per cent longer, because our field rate is 50Hz rather than 60Hz and our VCRs run slower. So a T-120 will run for nearly three hours here because of the speed difference and because many tapes give you more than the nominal length.

Secret bonus

This is the secret bonus: I don't suppose many people actually check how long their tapes play, but I once had to do a survey for another magazine. Scotch tapes gave on average one minute extra, JVC and Thorn up to 5 minutes and RCA a generous 10 minutes. These RCA tapes used to be stocked by W H Smiths, but they have dropped them now.

In fact many shops now sell mainly British-made tapes, produced by Scotch either under their own name or as the retailer's own-brand product. Five years ago the quality of Scotch video tape was rather variable, but it is now consistently good. Presentation and packing is now (and has been for a long time) first rate – I like the little stickers which help you judge the amount of unused tape remaining in a cassette.

Next month I hope to have first-hand experience of some new 24cm transmitting and receiving equipment from Comex Systems of Leicester. I also hope I will get some readers' photographs to publish. Why not drop me a line care of the editor? REW

MEDIUM WAVE DXING

by Steve Whitt

Welcome to the MW column, where this month we feature an item on Irish Radio. First, however, we'll have a look at keeping a station log.

As you tune around the band you'll undoubtedly hear all sorts of interesting stations and programmes, and unless you are the proud possessor of a perfect memory you'll find that some sort of written record is invaluable. A station log can take many forms, but basically it is a chronological record of what you have heard, when, and how.

The sort of information worth recording includes material that one might want to include in a reception report to a station, such as reception conditions, details of programming heard, and any other comments that come to mind. Of course, the date and time in GMT as well as station frequency should be noted accurately.

Rather more difficult to assess accurately is the quality of the received signal. A number of schemes are used by radio listeners and amateur radio operators in an attempt to quantify this rather subjective condition. Whatever method is chosen, it is well worth noting reception quality so that comparisons can be made under differing propagation conditions. One of the most widely used and understood methods is known as the SINPO code, which is illustrated in the table.

Keeping a log will not only help when it comes to writing to radio stations with reception reports, but will also allow you to browse back through the past month picking out any interesting features which might be worth including in this column's DX File!

Listen to Ireland

For a great many years the Irish Republic was one of the few countries in the world not to exercise its voice on the international short wave bands, and consequently the determined radio listener had to turn to the MW band in order to hear this country. Even then only a basic radio service existed, run by the RTE (Radio Telefis Eireann). However, in the last seven years Ireland has undergone a radio revolution that has seen the emergence of a vociferous community radio movement, active mainly on the MW and VHF bands, although even the short waves have now been activated.

At the last count around seventy MW transmitters were active from the Republic, operating over the whole of the MW band from 531 to 1602kHz. The nationally operated RTE still provides the home service in the guise of Radio 1 and 2, which operate much in the style of the BBC R1 and R2 networks. In addition, a service for Gaelic speaking listeners is provided by R Na Gaeltachta operated via the RTE transmitters.

The present broadcasting situation in the Republic is derived from a period of intense pirate broadcasting. This arose when it was realised how weak the law was when it came to dealing with such a situation. On several occasions attempts were made to pass tough legislation through the Dail (Irish parliament), but each time it came to nothing. The pirates continued to operate and expand in a legal vacuum, and although, strictly speaking, they are still outside the law, they are now a major force in Irish radio.

Listening to Irish stations in England is not too difficult, but it is dependent on a couple of factors: firstly, many of the stations only operate on very low power; and secondly, they share frequencies with the powerful continental broadcasters. Obviously, the nearer one is to Ireland the better reception will be, but to give everyone a chance I've prepared a list of stations that should make good targets for the MW DXer.

Frequency	Station	Address
531	Sunshine R	11 Lower Baggot St, Dublin 2
567	RTE R1	Donnybrook, Dublin 4
612	RTE R2	Donnybrook, Dublin 4
765	R West	Patrick St, Mullingar, Co Westmeath
819	Q102	3 Upper Mount St, Dublin 2
963	R Na Gaeltachta	Casla, Conamara, Co Na Gallimhe
1125	R Carousel	Dundalk Shopping Centre, Dundalk
1188	R Dublin	58 Inchicore Rd, Dublin 8
1278	RTE R2	Donnybrook, Dublin 4
1305	Radio ERI	117 Patrick St, Cork
1413	Big 'M'	Main St, Castleblaney, Co Monaghan

Sunspot update

We are still approaching the end of sunspot cycle 21, and the latest predictions contained in Sunspot Data Bulletin No 7, published by the Royal Belgian Observatory, are as follows: the earliest predicted time for the minimum was December 1985, but there is a higher probability of it happening around September/October 1986. The prediction indicates a likely sunspot count of about 14 at this time but with 90% confidence limits at counts of 1 and 28. There is still considerable uncertainty attached to these predictions and the minimum could occur as late as June 1987.

Book review

I have recently purchased a book entitled *Mittelwellenplan Region 1 Europa* prepared by Günter Kuschnereit. This 120-page book lists all MW stations in Europe by country and by frequency. It includes maps of every country and provides particularly detailed info on German, Swiss and Austrian stations and their programming. Although written in German, the vast majority is easily understood by the ordinary English DXer and the only section that is 'lost' is the 10-page introduction to what MW DX is all about. Still, it is good value at just 7 IRCs (including post) from Günter at Selgenauer Weg 70, 1000 Berlin 47 FRG. Please mention *R&EW* if you order. REW

SINPO CODE TABLE

S Signal strength	I Interference (man-made)	N Noise	P Propagation disturbance	O Overall merit	
5 = Excellent	Nil	Nil	Nil	Excellent	= 5
4 = Good	Slight	Slight	Slight	Good	= 4
3 = Fair	Moderate	Moderate	Moderate	Fair	= 3
2 = Poor	Severe	Severe	Severe	Poor	= 2
1 = Very weak	Extreme	Extreme	Extreme	Unusable	= 1

For example, the SINPO rating for a local station could be 55555

LATEST LITERATURE

The first book this month is a little unusual for this column in that it is a biography. Called **The Secret Life of John Logie Baird**, it is the result of a collaboration between Tom McArthur, a freelance journalist, and Dr Peter Waddell, a lecturer in mechanical engineering, and charts the fascinating progress of the famous television pioneer.

I'm not quite sure what to make of this work. It makes fascinating reading, and McArthur's talent is much in evidence from the outset: from the first chapter he gets the reader hooked with tantalising hints of what's to come. My uncertainty arises from the revelations that do come, as Baird is revealed to have been a man of quite remarkable intellect and unsuspected achievement.

The man described by McArthur and Waddell was a man who dreamed of transmitting pictures from an early age. As a boy, growing up just outside Glasgow, a major industrial centre of Victorian times, he set up his own telephone exchange for communication with friends, installed electric lights in his home, and experimented with methods of producing a selenium cell (the light-sensitive properties of which were his main interest). This boy grew up to be far more than the television pioneer of popular memory, with considerable achievement in the field of radar, infra-red imaging and even three-dimensional colour television which needed no special glasses.

The claims of the authors, controversial though they may be, cannot be easily dismissed. They have researched the subject thoroughly (*vide* the many references after each chapter), and write with sufficient power and conviction to have the reader wanting to believe.

All the elements of a really gripping history are here. It's a book I thoroughly enjoyed reading, from the description of a young lad speeding over the Scottish hills on the three-wheeled 'Baird binder and reaper', through the oppressive years working in the dark satanic mills of Glasgow to the remarkable success in later years with his work in television, all the while struggling to overcome persistant ill health and with an element of romance thrown in for good measure.

You may believe the authors' claims or not, as you wish, but read the book anyway – it's well worth your time.

The Secret Life of John Logie Baird is published by Hutchinson at £16.95 (ISBN 0 09 158720 4).

Back now to the sort of book more usually featured, and Newnes have just published revised editions of two of their list. The first is in the Beginner's Guide series, this one being **Beginner's Guide to Amateur Radio** by F G Rayer G3OGR, revised by Gordon King G4VFV. More information has been included in many areas, with an extra chapter on hints and tips for the 'enthusiastic beginner'.

The Beginner's Guide series can be a little variable with regard to ease of understanding. For instance, *Beginner's Guide to Radio*, another Newnes publication, although quite sound technically, has a text that I am sure would leave many absolute beginners struggling. This book for prospective radio amateurs, however, is fine in this respect, and should give no problems. Naturally it covers propagation, short wave listening, amateur bands and licence conditions, equipment and aerials etc.

It covers the basics well, with useful diagrams and examples of circuits (many with component values), and I believe it's a better book for beginners than any of the RSGB publicatons.

Beginner's Guide to Amateur Radio is published by Newnes Technical Books at £4.95 (ISBN 0 600 33368 X).

The other revised publication from Newnes is Ian Sinclair's **Practical Electronic Handbook**. This isn't essentially a book for beginners, although there is much of use to beginners here. It contains a multitude of reference circuits and explanatory diagrams, with fairly brief outlines of the relevant theory (and the minimum of maths).

It begins with passive components, and besides the obligatory colour codes includes such subjects as resistivity and conductivity, Thévenin's theory, permittivity (with relative permittivities of various materials listed), impedance and phase angle calculations for tuned circuits, etc.

The subsequent chapters are similarly broad in their scope (and therefore necessarily brief), and cover active discrete components, discrete component circuits, linear ICs, and digital ICs (with a wealth of TTL and CMOS pinouts).

Practical Electronics Handbook, Newnes, £5.95 (ISBN 0 408 00447 9).

Read all about it

William Heinemann and Newtech Books have joined forces to form a new imprint called, surprise, surprise, Heinemann/Newtech. This imprint will concentrate on publishing guides to information technology for users of business computer systems.

The aim is certainly a good one, since IT is a subject which still causes confusion and any source of enlightenment is welcome (although until we've seen the products we must reserve judgement on just how enlightening they are).

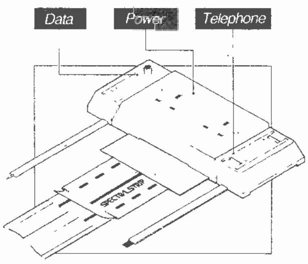
It is clear from the list of books already produced that the small businessman will be catered for, since one of the titles is a guide to CP/M Plus on the Amstrad 6128 and PCW8256. Other titles include a series of guides to the Apricot computer, applications of GEM, and office automation and telecommunications, as well as an A to Z of business computing.

Further details are available from William Heinemann Ltd at 10 Upper Grosvenor Street, London W1X 9PA. Tel: (01) 493 4141.

DX FILE

590	VOCM, St John's, NF, Canada	Celebrating its 50th birthday this year; heard around 2400
630	Radio Tunis, Tunisia	Arabic service; excellent signal around 2300
1062	Danmarks Radio, Copenhagen	English news bulletin, 0630 (Mon-Sat)
1210	R Caribes, Dominica	French programmes of news & music; heard around 0100
1377	R France Int	'Emission Maghrebien' to N Africa at 2000
1610	Caribbean Beacon, Anguilla	Religious programmes & local news at 0100 (now using 50kW from a 350-foot tower)
1611	Vatican Radio	In Russian at 1745, not very strong but clear frequency

Remember all times are GMT and European times take into account summertime variations. Frequencies in kHz



Undercarpet cabling

New from Amphenol is a 4-page brochure detailing a revolutionary undercarpet cabling system designed for power, telephone and data interconnection.

Designed to simplify the provision of electrical services to the office, the brochure covers the three basic types of flat cable available in the range: 240V/30A power cable, 6-way BT colour-coded telephone wire, and flat coaxial cables for data.

The brochure also describes the system's associated connectors, and shows a pictorial example of the system in use, explaining the simple steps required for installation.

This new literature is available free on request.

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

CMOS Z80 data pack

Low power is the major feature of the Z84C family of SGS's CMOS Z80 microprocessor devices, detailed in a new data pack from VSI Electronics.

The pack comprises 64 pages of technical data covering CPU, PIO and CTC devices. Flow charts, timing diagrams and architectural information fully support the text which includes a complete CPU instruction set.

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

Dynatech Communications

We have recently received Dynatech Communications' new product catalogue. The company, which supplies high technology equipment to the communications, medical instrumentation and electronics markets, has introduced several new products to its existing range.

The catalogue is divided into four main product categories: data transmission, packet switching, network management and test equipment. It provides descriptions of each of its products and in many instances a photograph.

Dynatech Communications Ltd,
Britannica House,
High Street,
Waltham Cross,
Hertfordshire EN8 7DR.
Tel: (0992) 33513/33555.

Instrument Rentals

Now available from Instrument Rentals is their 1986 catalogue of electronic test and measurement and computer equipment for hire and second user sale.

This year's catalogue includes some 76 different models of oscilloscope available for rent, including every standard Tektronix type on the market, and around 53 logic analyser models. A particularly wide selection of measurement systems from Hewlett-Packard are offered this year, including the latest 8510T and other network analysers and microwave systems.

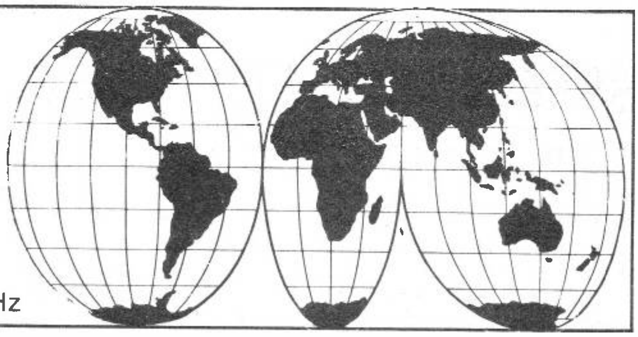
Specific weekly rental charges are given along with technical specifications and hiring procedure details.

Instrument Rentals Ltd,
Dorcan House,
Meadfield Road,
Langley, Slough,
Berks SL3 8AL.
Tel: (0753) 44878.

SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin

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



Having dealt with some of the Far Eastern stations operating out of band between the 60 and 90 metre bands, we now turn our attention to the transmitters in other areas of the world which may be heard on these frequencies during the respective 'seasons' for best reception here in the UK.

Indonesia, Peru, USSR

In order of ascending frequency, the first station to interest the DXer is RRI (Radio Republik Indonesia) Padang, Sumatra on **4002**. It is scheduled on this channel from 2300 to 0100 and from 0945 to 1700 with a power of 10kW, but in fact tends to operate on a measured **4002.7** at which point on the dial it is often logged both by UK and European listeners.

From Huancabamba in Peru, Radio Grau radiates programmes to the local populace on **4004.9** from 0800 to 2330. The power is unknown but is obviously low, the signals rarely being heard world-wide.

Easy to log

On **4010** is the frequently heard Frunze, Kirghiz SSR, USSR. Frunze 1 radiates programmes in Kirghizian and Russian from 0100 to 2000 with a power of 50kW. It is an easy one for beginners to log.

La Voz de Rioja (The Voice of Rioja), Rioja, Peru reportedly operates on **4025** (variable) from 2330 to 0020. This is another Peruvian only rarely logged outside the general area.

Another easy one for newcomers to the hobby is Yerevan, Armenian SSR, USSR on **4040**. Yerevan 1 is on the air from 0200 to 2200, this period including relays of the Moscow 1 programme timed from 0200 to 0215 and from 2100 to 2200. The power is not known.

Also on **4040** is another Russian station, but this one is not often heard by UK DXers. Vladivostok, Primor'ye Kray relays Moscow 2 from 0500 to 0400 with a power of 50kW.

On **4050** there are two Russian transmitters, the first being regularly logged and the second not so often. Frunze 2, Kirghiz SSR operates from 0000 to 2004 with programmes in Kirghizian and Russian. Frunze 2 has a power of 50kW and relays Frunze 1 and Moscow 1.

The Yuzhno-Sakhalinsk, Sakhalinsk Oblast, radiates from 1855 to 1400 in the USB mode with local programmes and relays of the Vladivostok Foreign Service in Russian from 0815 to 0900, identifying as Radio Stantsiya Tiky Okean (Radio Station Pacific Ocean). There is an English newscast on Saturdays from 0847 to 0852. The power is unknown.

Kalinin, Kalinin Oblast, USSR may often be heard on **4055** with its 50kW transmitter carrying Moscow 3 programmes from 0400 to 2100. The power is 50kW.

In Peru, Radio Gran Pajaten, Celendin reportedly operates from 0030 to 0430 with a power of 0.16kW on a frequency around **4165**. Obviously this one is seldom logged by European DXers and only then under very favourable conditions for Latin American reception.

The frequency reportedly occupied by Radio El Sol de los Andes (Radio The Sun of the Andes) Cotorumi, Peru is that of **4254.5**. Only occasionally heard by Euro-DXers and with the power unknown, this one is thought to be on the air from 1800 to 0430.

Bolivia

The Bolivian station Radio Moderna in Celendin is on the air from 2300 to 0500 with a power of 0.25kW on **4300**. It is regularly heard by nearby DXers but only rarely here in the UK and Europe. Recently it has been heard by a few European DXers when closing at 0442 on a measured **4299.3**.

Sometimes logged by nearby listeners, but only rarely by those located nearer to the UK, are the signals emanating from the Bolivian station Emisora Reyes, Reyes on **4420.5** with a power of 0.35kW. It is on the air from 1100 to an undetermined sign-off and it signs on again at 2300, then continuing until 0330.

Slightly higher in frequency is Radio Santa Rosa in Yacuma on a slightly variable **4440**, power unknown, on the air with local programmes from 2300 to a variable closing time around 0230. This Bolivian station is seldom heard here in the UK and Europe.

Bolivia appears again on **4458** in the shape of Radio Capitan Victor Ustariz in Villa Tunari, which radiates with a 0.25kW transmitter from 1000 (Sunday from 1100) to 1400 and from 2100 to 0200, identifying as La Voz del Tropico. This one is logged mainly by those residing closer to Bolivia than UK listeners.

AROUND THE DIAL

Want to hear some stations located in Africa, Latin America or the Middle East? Then read on . . .

AFRICA

Botswana

Radio Botswana, Gaborone on **4820** at 1922, YL with an announcement at the end of an English newscast: 'Our next news bulletin will be at ten past seven tomorrow morning'. The Home Service in SeTswana is radiated from 0400 to 0630 and from 1425 to 2100 (sometimes until 2300). English news bulletins are at 0510 (Monday to Friday), 0600 (relay of BBC World Service), 1610 and at 1910. The power is 50kW. Gaborone, formerly a small village, was chosen to become the capital of the then new republic, construction commencing during 1964.

Cape Verde

Radio Voz de Sao Vicente, Mindelo on **3930** at 2144, YL with a folk song in Portuguese. At 10kW, this one is on the air from 1800 to 2400. It is also often reported on **3931**.

Djibouti Republic

Radiodiffusion TV de Djibouti on **4780** at 0337, YL with a song, some local-style music then OM with a talk in the Somali programme which is timed from 0300 to 0430, from 1100 to 1300 and from 1600 to 1730. The National Service is on the air from 0300 to 0800 (Firday from 0500 to 0900) and from 0900 to 1900 in Somali (as outlined above) and in Afar and Arabic. Djibouti is not an easy one to log, being co-channel with the 50kW USSR transmitter at Petrozavodsk, Karelian SSR.

Egypt

Cairo on **9755** at 0310, recitations from the Holy Quran during the Holy Quran programme scheduled on this channel from 0230 to 2100.

Gabon

Libreville on a measured **4778** at 2332, OMs with songs in a local vernacular. This 100kW transmitter is scheduled on the air from 0430 (Sunday from 0530) to 0630 and from 1600 to 2400.

Ghana

GBC (Ghana Broadcasting Corporation) Accra on **4915** at 0600, OM with the station identification and newscast in English of both local and world affairs. GBC1 in vernaculars and English is scheduled from 0545 to 0800 (Sunday until 2200) and from 1200 to 2200. The power is 10kW.

Mali

Bamako on **7285** at 0855, YL with songs in vernacular complete with music by a local percussion orchestra. Radiodiffusion du Mali (Home Service) operates on this channel from 1200 to 1400 Monday to Thursday, from 0800 to 2400 Friday and from 0700 to 2400 Saturday and Sunday. The power is unknown.

RD du Mali, Bamako on **9635** at 0853 in parallel with **7285** above. This 18kW transmitter is on the air from 0700 to an undetermined closing time and operates in French and vernaculars.

Mauritania

Nouakchott on **4845** at 1930, OM with the station identification followed by a newscast in French. ORTM (Office de Radiodiffusion-Television de Mauritanie) Nouakchott at 100kW is on the air with the Home Service in vernaculars and French from 0600 to 0800 on weekdays and daily from 1800 (Sunday and holidays from 1700) to 2400. Nouakchott is the capital city of the Islamic Republic of Mauritania.

Morocco

Rabat on **15360** at 1420, radiating a programme of Arabic music and songs in a Home Service relay for the Middle East, West Africa, Europe, South Morocco and Mauritania, scheduled from 1100 to 1700.

Sudan

Omdurman on a measured **5038.5** at 2114, OM with announcements in Arabic, local-style music and songs. The Home and Foreign Service to Ethiopia and Somalia is on this frequency from 0400 to 2200. Voice of the Sudanese Nation programmes are timed from 1600 to 2200.

CENTRAL AMERICA

Costa Rica

Radio Reloj (Radio Watch), Irazu on **4832** at 0440, OM with announcements in Spanish then local pops on records. At 3kW, Radio Reloj is on the air around the clock.

Cuba

Radio Mayak (Lighthouse) Relay on **4765** at 0520, OM with songs in Russian. This transmitter relays USSR Home Service programmes for Soviet citizens in Central America. The schedule is around the clock, the power 50/100kW.

NORTH AMERICA

USA

World Harvest Radio, South Bend, Indiana on **7355** at 0942, OM with a religious song during a programme for European listeners, timed from 0800 to 1000.

SOUTH AMERICA

Brazil

Radio Difusora Acreana, Rio Branco on **4880** at 0445, OM with a newscast in Portuguese. This 5kW transmitter is on the air from 0900 to 0530 and is commonly reported in the SWL press.

Radio Brazil Central, Goiania, on **4985** at 0029, OM with an excited sports commentary in Portuguese. At 10kW, the schedule is around the clock.

Guatemala

Radio Tezulutlan, Coban on **4835** at 0016, OM with promotions in Spanish separated by short excerpts of marimba music. This one operates in Quechua and Spanish from 1000 to 1500 and from 2100 to 0230 at 5kW. The market town of Coban is noted for trading in coffee and Peruvian bark.

ASIA

China

Xinjiang PBS Urumqi on **4970** at 0025, OM and YL with songs in Kazakh during a Home Service programme. The Home Service in Kazakh on this channel is on the air from 0000 to 0230, from 0530 to 0700 and from 1200 to 1700, this schedule also including a relay of the Radio Beijing Minority Language Service in Kazakh timed from 1400 to 1426.

PACIFIC

Australia

Melbourne on **9655** at 0910, OM with the station identification, OM with pops on records during an English programme for Europe and the Pacific, scheduled from 0700 to 1000 on this frequency.

Guam

KTWR Merizo on **7355** at 1404, YL and OM with a discussion in a Chinese programme timed from 1300 to 1500.

NEAR AND MIDDLE EAST

Afghanistan

Radio Afghanistan, Kabul (USSR Relay) on **3965** at 0207, YL and OM talk in vernacular in the Home Service schedule 0125 to 1700 on this frequency.

Radio Afghanistan, Kabul (USSR Relay) on **15435** at 0859, interval signal, YL with the station identification repeated then OM with a news bulletin in the English transmission to South-East Asia, scheduled from 0900 to 1030.

Iraq

Baghdad on **11720** at 0842, OMs with Arabic songs in a Voice of the Masses Home Service programme which opens at 0500 and is thought to close at 1230.

EUROPE

Italy

Radio Spoleto International, Spoleto on **7140** at 1040, OM with the station identification and announcements in Italian then into a programme of local pops. The schedule is from 0700 to 1700 and from 2100 to 2300 with a power of 0.5kW.

Caltanisetta on **7175** at 1032, OM and YL with announcements in Italian followed by a discussion during which there were several mentions of Mussolini. This 5kW transmitter is on the air from 0500 to 2230.

Switzerland

Berne on **9885** at 1538, OM with a newscast in an English transmission for the Near East, Middle East and East Africa, scheduled from 1530 to 1600.

NOW HEAR THIS

Sana'a, Yemen Arab Republic on **9780** at 1533, recitations from the Holy Quran. Radio San'a at 50kW is scheduled from 0230 to 0700 and from 1000 to 2115 (Friday throughout).

NOW LOG THIS

ABC Brisbane, Australia on **4920** at 1948, OM with announcements in English, then some recorded pops followed by the station identification and a newscast at 2000. REW

£1 BAKERS DOZEN PACKS

Price per pack is **£1.00.*** Order 12 you may choose another free. Items marked (sh) are not new but guaranteed ok.

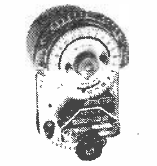
1. 5 – 13 amp ring main junction boxes
2. 5 – 13 amp ring main spur boxes
3. 25 – 13 amp fuses for ring mains
4. 5 – surface mounting switches suitably insulated for mains voltage
5. 3 – electrical switches intermediate type, will also replace 1 or 2 way switches, white flush mounting
7. 4 – in flex line switches with neons
9. 2 – mains transformers with 6V 1A secondaries
10. 2 – mains transformers with 12V ½A secondaries
11. 1 – extension speaker cabinet for 6½" speaker
13. 12 – glass reed switches
17. 2 – ultra transmitters and 2 receivers with circuit
19. 2 – light dependent resistors
25. 4 – wafer switches – 6p 2 way, 4p 3 way, 2p 6 way, 2p 5 way, 1p 12 way small one hold fixing and good length ¼ spindle your choice
28. 1 – 6 digit counter mains voltage
30. 2 – Nicad battery chargers
31. 1 – key switch with key
33. 2 – aerosol cans of ICI Dry Lubricant
34. 96 – 1 metre lengths colour-coded connecting wire
39. 1 – long and medium wave tuner kit
41. 8 – rocker switch 10 amp mains SPST
45. 1 – 24 hour time switch mains operated (s.h.)
46. 1 – hour clock work time switch
48. 2 – 6V operated reed switch relays
49. 10 – neon valves – make good night lights
50. 2 – 12V DC or 24V AC, 3 CO relays
51. 1 – 12V 2 CO miniature relay very sensitive
52. 1 – 12V 4 CO miniature relay
53. 2 – mains operated relays 3 × 8 amp changeover (s.h.)
54. 10 – rows of 32 gold plated IC sockets (total 320 sockets)
55. 1 – locking mechanism with 2 keys
56. 1 – miniature uniselector with circuit for electric jigsaw puzzle
60. 5 – ferrite rods 4" × 5/16" diameter aerials
61. 4 – ferrite slab aerials with L & M wave coils
63. 1 – Mullard thyristor trigger module
64. 10 – assorted knobs ¼ spindles
65. 5 – different thermostats, mainly bi-metal types
66. 1 – magnetic brake – stops rotation instantly
67. 1 – low pressure 3 level switch can be mouth operated
69. 2 – 25 watt pots 8 ohm
70. 2 – 25 watt pots 1000 ohm
71. 4 – wire wound pots – 18, 33, 50 and 100 ohm your choice
72. 1 – 1250 watt dimmer Ultra ref SE20
77. 1 – time reminder adjustable 1-60 mins clockwork
81. 2 – 30A panel mounting slyslok fuses
85. 1 – mains shaded pole motor ¾" stack – ¼ shaft
89. 1 – mains motor with gear box 1 rev per 24 hours
91. 2 – mains motors with gear box 16 rpm
96. 1 – thermostat for fridge
97. 1 – infra red fire element 1000 watts
98. 1 – motorised stud switch (s.h.)
101. 1 – 2½ hours delay switch
103. 1 – mains power supply unit – 6V DC
104. 1 – mains power supply unit – 4½V DC
105. 1 – 5 pin flex plug and panel socket
107. 1 – 5" speaker size radio cabinet with handle
110. 10 – slider type volume controls
111. 2 – musical boxes (less keys)
112. 1 – heating pad 200 watts mains
113. 1 – FM front end with tuning condenser and data
114. 1 – 1W amplifier Mullard 1172
115. 1 – wall mounting thermostat 24V
118. 1 – teak effect extension 5" speaker cabinet
120. 2 – p.c. boards with 2 amp full wave and 17 other recs
121. 4 – push push switches for table lamps etc.
122. 10 – mtrs twin screened flex white p.v.c. outer
123. 100 – staples for thin flex
124. 25 – clear plastic lenses 1¾ diameter
127. 4 – pilot bulb lamp metal clip on type
128. 10 – very fine drills for pcbs etc.
129. 4 – extra thin screw drivers for instruments
130. 2 – centre zero panel meters 100-0-100 UA
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 end open, other end closed
145. 2 – 4 reed relay kits 3V coil normally open or c/o if magnets added
146. 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. 8 – 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
196. 1 – in flex simmerstat for electric blanket soldering iron etc.
197. 2 – thermostats, spindle setting – adjustable range for ovens etc.
198. 1 – rod thermostat for water heater etc. 11" rod
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
218. 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) 8½" 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, ½ meg with dp switch
249. 1 – 13A switched socket on double plate with fused spur for water heater
266. 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 ¼ 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
296. 3 car cigar lighter socket plugs
297. 1 cover for 24hr time switch ref BD45
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
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 6" 4 watt min fluorescent tube white
316. 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.

CAR STARTER/CHARGER KIT

Flat Battery! 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.

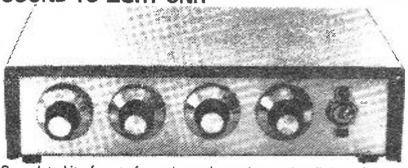


Ex-Electricity Board. Guaranteed 12 months.

VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95** without case, metal case – **£2.95**, adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2.30.**

SOUND TO LIGHT UNIT

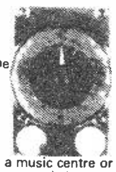


Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio 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.

FROZEN PIPES

Can be avoided by winding our heating cable around them – 15 mtrs connected to mains costs only about 10p per week to run. Hundreds of other uses as it is waterproof and very flexible. Resistance 60 ohms/metre. Price **28p**/metre or 15m for **£3.95.**

25A ELECTRICAL PROGRAMMER



Learn in your sleep. Have radio playing and kettle boiling as you wake – switch on lights to ward off intruders – have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. A beautiful unit at **£2.50**

THE AMSTRAD STEREO TUNER

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio – easy to carry about and which will give you superb reception.

Other uses are a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.

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**

GOODS ARE ON APPROVAL

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.**

TANGENTIAL BLOW HEATER

by British Solartron, as used in best blow heaters. 3Kw **£6.95** complete with 'cold' 'half' and 'full' heat switch, safety cut out and connection diagram.

Please add post £1.50 for 1 or 3 for £20 post paid
2.5 Kw KIT Still available: **£4.95 + £1.50 post**
or have 3 for £16 post paid.

CORDLESS TELEPHONES

"IT'S FOR YOU-OU" even if you are in the bath, its an infinite extension any room and even in the garden – have one on approval or come and try one here. BT approved.

SOCKETS PLUGS ETC for BT phones

Master socket (has surge arrestor – ringing condenser etc) and takes B.T. plug £3.95
Extension socket £2.95
Dual adaptors (2 from one socket) £3.95
Cord terminating with B.T. plug 3 metres £2.95

Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 BT extension sockets £11.50

MINI MONO AMP on p.c.b. size 4" × 2" (app.)

Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of **£1.15 each, or 13 for £12.00.**

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MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day or night. Haywards Heath (0444) 454563. **Bulk orders:** phone for quote.

TWO POUNDERS*

- 2P2 –Wall mounting thermostat, high precision with mercury switch and thermometer
- 2P3 –Variable and reversible 8-12v psu for model control
- 2P4 –24 volt psu with separate channels for stereo made for Mullard UNILEX Amplifiers
- 2P6 –100W mains to 115V auto-transformer with voltage tappings
- 2P7 –Mini key, 16 button membrane keyboard, list price over £12, as used on PRESTEL
- 2P8 –Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
- 2P9 –Time and set switch. Boxed, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters
- 2P10 –12 volt 5 amp mains transformer – low volt winding on separate bobbin and easy to remove to convert to lower voltages for higher currents
- 2P11 –Power amp module Mullard Unilex EP9000 (note stereo pre-amp module Unilex 9001 is BD216
- 2P12 –Disk or Tape precision motor – has balanced rotor and is reversible 230v mains operated 1500 rpm
- 2P14 –Mug Stop kit – when thrown emits piercing squawk
- 2P15 –Interrupted Beam kit for burglar alarms, counters, etc.
- 2P17 –2 rev pr minute mains driven motor with gear box, ideal to operate mirror ball
- 2P18 –Liquid/gas shut off valve mains solenoid operated
- 2P19 –Disco switch-motor drives 6 or more 10 amp change over micro switches supplied ready for mains operation sh
- 2P20 –20 metres extension lead, 2 core – ideal most Black and Decker garden tools etc.
- 2P21 –10 watt amplifier, Mullard module reference 1173
- 2P22 –Motor driven switch 20 secs on or off after push
- 2P24 –Clockwork operated 12 hour switch 15A 250V with clutch
- 2P26 –Counter resettable mains operated 3 digit
- 2P27 –Goodmans Speaker 6 inch round 8ohm 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 – 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 ulnused 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.
- 2P42 –Tubular heater, 60 watts per ft, unusued but slightly storage soiled, made by G.E.C. Perfect order (must be collected by appointment as 12ft long)
- 2P43 –Small type blower or extractor fan, motor inset so very compact, 230V
- 2P46 –Our famous drill control kit complete and with prepared case.
- 2P47 –Joy switch kit complete as previously sold.
- 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 both ends
- 2P62 –1 pair Goodmans 15 ohm speakers for Unilox
- 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 & 86.3v 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 & Mecky 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 × 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.

NEXT ISSUE

Radio & Electronics World
The communications and electronics magazine

ASTRID

Ken Michaelson enthuses about this new UoSAT receiving system

SPECTRUM CAD

Op-amp filter design on the Spectrum from R S Nutt

PLUS ALL THE USUAL FEATURES!

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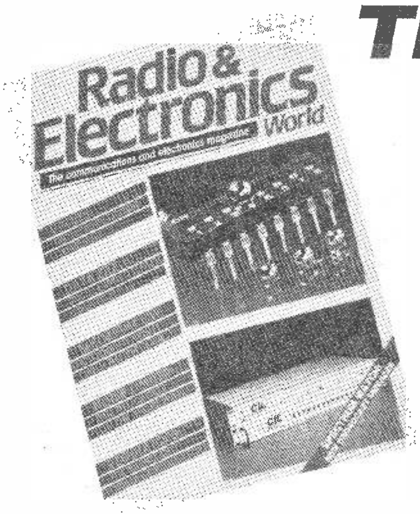

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On these pages we present details of interesting contacts from clubs and individuals. We would be happy to receive any similar items from readers

Contest working

On 12 May the South Cheshire Amateur Radio Society will be hosting a talk on contest working by G4APA. It takes place at the Crewe LMR Sports Club, Goddard Street, Crewe, at 8.00pm. All amateurs and SWLs are welcome.

Further details are available from: *The Secretary, Chris Wieman G1PUV, 14 Whiteridge Road, White Hill, Kidsgrove, Stoke-on-Trent, Staffs ST7 4TH. Tel: (07816) 73185.*

Bristol RSGB Group

The City of Bristol RSGB Group meets on the last Monday of the month (unless the date falls on a bank holiday, when the meeting is brought forward by one week). The meetings take place in the Small Lecture Theatre, University of Bristol, University Walk, Clifton, Bristol, and start at 7.30pm.

On 19 May there is a talk on DX on the HF bands by Don Field G3XTT, on 25 May there is a mobile picnic and a month later, on 25 June, there is a talk on Receiving WX Satellite Pictures by the Rev James Brown.

For further information contact the Honorary Secretary, Colin Hollister G4SQQ. Tel: (0272) 508451.

Swindon rally

Swindon and District Amateur Radio Club is holding its annual rally on Sunday 11 May at Oakfield School, Marlowe Avenue, Swindon, Wiltshire. Doors open at 10.00am and there is an admission fee of 50p.

There will be a large variety of equipment and components for sale on the trade stands and many RSGB books will be available on the club stand. There will also be a bring-and-buy stall.

The British Amateur Radio Teleprinter Group and local repeater groups will be in attendance. It is hoped that there will also be Morse testing but this was not certain at the time of writing.

A bouncer castle, mini motorcycles and a free cartoon show should ensure a good day out for all the family.

Further details can be obtained from: *K A Saunders G8SFM, 'Tamarisk', Tetbury Lane, Leighterton, Gloucestershire GL8 8UP.*

Amateur Radio Rally

The Southend and District Radio Society will be holding an amateur radio and electronics rally on Sunday 1 June at the Rocheway Centre, Rocheway, Rochford, Essex.

There will be a talk-in on S22, RTTY, trade stands, a bring and buy, refreshments and a licensed bar as well as many other attractions which will cater for the whole family.

For further details about the rally or the regular meetings contact Ron G6SOH or Brian G4RDS.

Special Event Station

On 7 June the Dunstable Portable Amateur Radio Group will be operating the special event station GB4LAD in conjunction with the Dunstable Downs Radio Club.

The station will run during the Luton and Dunstable Hospital Fete and is being sponsored on the numbers of contacts made. All proceeds will go to the hospital to help buy a much needed extension unit for their surgical laser.

Activity will be on 144.375MHz, 14.300MHz and 1.930MHz±QRM. It is hoped to make contact with all of the twin towns during the event.

Further details can be obtained from Tony G0COQ, tel: (0582) 508259.

South Manchester RC

The club meets every Friday at the Salemoor Community Centre, Norris Road, Sale. Meetings start at 8pm with a talk on various aspects of amateur radio.

Anyone wanting further information should contact Dave Holland G3WFT on (061) 973 1837.

Wirral ARS

We have just received Wirral Amateur Radio Society's programme of forthcoming events. Meetings are usually held at the Clubroom, Ivy Farm, Arrowe Park, and start at 8pm.

On 21 May there is a repeat of the acclaimed talk 'A Programmable Electronic Keyer' by Brian Jordan G4EWJ.

On 4 June there is a talk on regulated power supplies by Alan Upton G3UZU. A keen constructor working with limited facilities, Alan has spent considerable time experimenting with this subject.

For further details contact: *RE Bridson G3VEB, 14 Zig Zag Road, Wallasey, Wirral.*

FAX is...

The Coventry Amateur Radio Society meets every Friday at 8pm at Baden Powell House, 121 St Nicholas Street, Radford, Coventry. Visitors are always welcome.

On 9 May there is a talk on FAX and Packet Radio by G6VHI. This will start at 7.40pm.

For further details contact: *Robin Tew G4JDO, 4 Chetwode Close, Coventry CV5 9NA. Tel: (0203) 73999.*

The Growley Box

The latest issue of RADIAL, the newsletter published by the Radio Amateur Invalid and Blind Club, contains an interesting and extremely useful construction article entitled 'The Growley Box'.

The box is, in fact, an audible RF indicator for blind operators. The device enables the user of an amateur radio transmitter to tune for maximum output by ear.

If you are interested in the growley box or indeed in the RAIBC itself, contact the organisation's headquarters at: *9 Conigre, Chinnor, Oxfordshire OX9 4JY.*

South Bristol AR Club

The South Bristol Amateur Radio Club meets every Wednesday at the Whitchurch Folk House, East Dundry Road, Whitchurch, Bristol.

On 4 June there is a talk on modifying CB radios for 10 metres and on 11 June there is an HF activity night.

For further details contact Len Baker G4RZY, tel: Whitchurch 834282.

Dear Sir,

I was wondering whether it is possible to find any information concerning a recently acquired valve ship-to-shore Rx-Tx system through your magazine.

This system comprises of three units, all in immaculate condition. The receiver, which I have managed to work, operates well, but the external wiring to the transmitter (supply lines etc) is missing, thus preventing me from restoring the system to its original working condition.

The Coastal system 350, as it is called, was made by Curlew (CR Ltd, Edinburgh) probably in the 1950s. The PSU is unit No 350, the Rx unit No 351 and the Tx unit No 352.

I have tried to obtain information on this system, without success. If any of your readers has a wiring/circuit diagram, or knows where I can obtain one, I would be very grateful.

D Page, Penrith, Cumbria.

Dear Sir,

I am a very keen radio enthusiast, and I am taking the RAE at home.

My problem is that I am seriously disabled and virtually bed-bound. To follow my hobby of SW listening I need to erect a simple long wire: I have all the necessary materials, ie wire, insulators etc, but I am incapable of doing the job myself.

If anyone could spare a few hours to assist me in erecting the antenna I would be very grateful. Please contact me on (01) 390 2650.

N Porter, Surbiton, Surrey.

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DEADLINE AND CONDITIONS

Advertisements will be inserted in the first available issue on a first come first served basis. We reserve the right to edit and exclude any ad. Trade advertisements are not accepted.

FOR SALE

■ Redifon HF transceiver type GR410/T includes SSB, IF and audio boards, 100 watts output, 2-16MHz. Needs VFO, £50. Includes 24V PSU and comprehensive info, buyer collects. Also data cassette recorder, suits most home micros, £25. C A Crabb G4HNH, 41 West Drive, Edgbaston, Birmingham B5 7RR. Tel: (021 472) 3845.

■ Sommerkamp FTDX500 HF bands transceiver with fitted CW filter, £150 no offers. Murray, 9 Aynsley Close, Cheadle, SOT ST10 1DP. Tel: (0538) 752838.

■ ■ 50MHz spectrum transverter, 20W output, 28MHz IF, £95 (worked W, VE, LA, CT etc). A McCann, 105 Todd Lane North, Lostock Hall, Preston, Lancs PR5 5UP. Tel: (0772) 37815.

■ Alphacom 32 thermal printer for Spectrum, Spectrum + or ZX81. Complete with power supply, instructions and spare paper. Still under g'tee. £35! Also Casio VLI portable electronic organ with 2.5 octaves, envelope shaper, (ASDR), various rhythm generators, demo on ROM and memory. Also has built-in calculator. Instructions, music and case, £13!! Gordon Jackson (01) 907 2253.

■ Realistic DX-160 5 band communications receiver 240 volt or 12 volt 160-10 metres vgc. Despite age hasn't been used very much, £75. More details from Mr M Richards, c/o Bridleways, Aughton, Collingbourne, Kingston, Nr Marlborough, Wilts.

■ Lattice mast, three section, 30 foot heavy duty with 17 inch sides, climbing steps up one side. No reasonable offer refused, base plate needs slight attention. Buyer collects or carriage arranged at cost. D Martin, 11 Kent Road, Parkstone, Poole, Dorset BH12 2EH. Tel: (0202) 745185.

■ Commodore MPS801 dot matrix computer printer. Suits Commodore 64 or Vic 20 computer. Excellent condition, as new. Cost £200 new, will sell for £110. Also, 'Easyscript' word processing software package to suit Commodore 64 computer, only £15. For further details contact Jeremy on Bakewell (062981) 2517 (after 6pm on weekdays).

■ Eimac valves, 2 off, brand new in boxes, 4CX250B. Purchased for linear project but never used, £40.00 the pair. Sorry, no bases. Also 7107 DVM chips (Maplin) and displays to match, 7107 chip, £3.00. Four displays £3.00. Purchased together £6.00, includes p&p and details for use. C J Barker, 52 Spode Street (West End), Stoke-on-Trent, Staffs ST4 4DY.

■ Heathkit HW8 QRP Tx/Rx, 80m to 15m, CW only with RIT SWR, PWR counter o/p, full details on request. Complete with solid-state HF linear, broadband no tuning, 80m to 10m, vari power output. Also Coutant 13.8V dc power supply included. New price £280+, will exchange for 2m multimode or 70cm equip or WHY, or sell for £160 ono. All documentation available, bargain. G0AYZ, 22 Vale Grove, Gosport, Hants PO12 4PS. Tel: (0705) 589560, any time.

■ Eddystone 830/9 HF Rx, AM, CW, SSB, 300kHz, 30MHz, £170. AOR2001, £260. Yaesu FRG7 digital SSB filter, £150. Will exchange WHY. Good HF Rx wanted, solid-state. Poss exchange with above. Tel: Leeds 677101.

■ President Grant CB rig converted to 10 metres. Perfect, SSB/AM, etc. Complete with mike, £35. Pye cassette tape recorder, brand new, boxed, £14.50. Shure mike type 201, hand-held, £6. Yaesu mike, £5.50 new. A Walton, 40 Rooley Crescent, Bradford BD6 1BX. Tel: (0274) 728219.

■ Have BBC computer with cassette recorder user guide and some games. 12 months old, in mint condition. Will exchange for HF transceiver in good condition with ATU. Would consider 2m or 70cm base transceiver WHY? Tel: (0606) 550258, after 6pm or weekends.

■ Technics ST3050 hi-fi AM/FM stereo tuner. Good condition. Really good sensitivity. Fine rotary analogue tuning. Offers or swap for 40ch CB portable. D Head. Tel: (0438) 62179.

■ Active antenna, Sony AN-1, comprising telescopic aerial with FET, low noise amp for SW reception and ferrite bar antenna for receiving MW, and LW control box with connecting leads and 40 feet of co-axial cable, brand new, boxed, unused, £48.00. Mr T Manning, 24 Croftdown Road, London NW5. Tel: (01) 485 4251.

■ Racal RA17L gc, £150. RA17/2 vgc, £165. Both good performance. Buyer collects. Regency air band scanner. 108-136MHz. 16 channel. Prog search, prog scan, £125. Matching AR88 speaker, £15 plus p/p. G1NNE. Tel: (0388) 777398.

■ Heathkit 'Mohican' gen cov comms Rx, 550kHz to 30MHz and 144 to 146MHz. Fitted with 12V rechargeable battery and LCD frequency DDU, mint condition, comprehensive manual, £95. French 'Radialva' portable comms Rx, 150kHz to 27MHz. Bandspread and BFO vgc and performance, £48. Pye 'Vanguard' AM25/B highband radio-telephone, mint, £20. Collection pre-war wireless mags, valves, components. SAE for list. K W Clark (G3WIF), 16 Goldney Road, Clifton, Bristol BS8 4RB. Tel: (0272) 293738.

■ Ex-hobbyists clearout: all components new or in good condition. 200 resistors, £1, 100 capacitors, £2, 100 semiconductors, £2 (inc 20+ ICs), 20 10/10μF tant cap, £1. 3kg packs of larger items (inc pots, switches, transformers, relays etc), £10. F J Wakeman, 46 Poynder Rd, Corsham, Wilts SN13 9LZ.

■ Tektronix scopes, 545A, £120 ono, 545B £150 ono. Both excellent ex-TV service shop with manuals and many spare valves. 25MHz bandwidth, dual trace. Many features, delayed sweep, delayed intensifier, etc. Keith Franklin, 50 Abingdon St, Burnham on Sea, Somerset. Tel: (0278) 784205 after 6.30pm.

■ Free! Some transformers, TV type, lots of electronic hardware, wire – all sorts but no components. A little bit heavy so please send £1 to cover p/p. If sending coin place between cardboard. Everything by post only. Martin, 7 Griffin Crescent, Littlehampton, Sussex.

■ Levell Test Meter TM11 leather case, high voltage probe TP1/BNC, RF probe TP2, 'T' connector, current 50A shunt TP5. Price for the lot, £135. Holdway, 20 Studland Close, Millbrook, Southampton, Hants.

■ Two professional antenna tripods, (a feat of engineering), also mounts and parabolic dishes F/D ration 0.2, diameter 1.2m. Included are two 12GHz launchers, price £325 each. Mobility 360° horizontal, approx 70° vertical, these will not blow over and are extremely heavy. Would have to be seen to be appreciated. Also adjustable for unlevel ground, with built-in spirit level. Bruce Lamb, 44 Maple Road, Brooklands, Manchester M23 9HW. Tel: (061) 962 3726.

■ Hitachi TRQ2-REX micro cassette recorder, 2-speed, unwanted gift, £30 ono. Tel: Peter Jones, (043277) 428.

■ Sixteen 4116 4N 16K DRAM chips, £16 including p&p or £8.50 for eight. Unused chips. Manufacturer and date code: STC8415. All untested but bought from a regular supplier (Rapid Electronics). P Siedlecki, 5/66 Redditch Road, Kings Norton, Birmingham B38 8QS.

■ Some electronic components, valves and some circuit boards, made up and working. Something for everyone. Please send stamp for list (emigrating). Martin, 7 Griffin Crescent, Littlehampton, West Sussex.

■ In circuit transistor tester. Unused small battery powered npn, pnp, LED indicators, complete with test hooks. For high density component board testing. Snip at £20 inclusive post and packing. Write to 7 Park Road West, Sutton on Sea, Lincs LN12 2NQ.

■ Marconi signal generator, 12-470MHz, type 801B (separate carrier and modulation meters), £75. Furzehill sensitive valve voltmeter, 10mV – 1000V 4½in meter, £20. Philips valve voltmeter, 10mV – 300V type GM6017 (6in scale built-in calibration) £25. Michael Usher, 85 Bromham Road, Bedford. Tel (0234) 54767.

■ Dragon 32+extra handbook, games, £60.00. HF linear amp (2×4CX 250B) 10W in, 400W out, £80.00. Both items ono or would exchange with cash adjustment for HF transceiver or receiver, working or not. Glenesk Craig-yr-Eos Rd, Ogmore-by-Sea, Mid Glam CF32 0PH, S Wales (GW4KWV QTHR). Tel: (0656) 880723 after 6pm.

■ Scopes: Tektronix 533A 15MHz dual trace, £65. 555 30MHz dual beam, £90. 581A dual trace, £85. Marconi 8010/8 AM signal generator, 10 to 485MHz, £75. RC oscillator TF1101, 20Hz to 200kHz, £30. Advance HI AF generator, sine and square o/p, £35. Many other items of test gear and components. Send sae for list. Pye Olympic low band AM, £59. AVO 7, £25. G4YVT Beal, 115 Southdown Road, Portslade, East Sussex BN4 2HJ. Tel: Brighton 416963.

■ Sony ICF2001 synthesized receiver, continuous coverage 150kHz to 30MHz, plus VHF band, AM, CW, SSB, FM, £60. Carriage extra. R Middleton, 49 Wolseley Road, Stafford ST16 3XW.

■ EPROM blower ITT and eraser. Blows 10 at a time, offers, might exchange for 2m hand-held or 70cm. Also Commodore SX64 portable computer, built-in disk drive, plus colour monitor, only 2 months old £425 (purchased 128D). Olivetti photocopier £450. Offers or swaps considered for above with ham gear or satellite TV station, cash either way. Tel: Leicester (0533) 715160 anytime. (G4JKP not QTHR).

■ You may have tried the rest, now try the best. Will exchange BBC B computer and data recorder in pristine condition, with some games, for HF transceiver 901 or 902. Would consider communications receiver or 2m/70cm portable multimode FT290 or 790. Also have AR40 rotor 2m 10-el beam and 15m UR67 cable. Will swap for 2m/70cm hand-held. WHY? Tel: John, (0606) 550 258 (Cheshire) after 6pm.

■ CBM C16 with recorder, PU, tapes and manual, new, £50. J Galvin, tel: Crudwell (06667) 7820 (Wilts)

■ Eagle RX80 communications receiver, 0.5-30MHz, £60. Pre-amp, 2.30MHz, £15 including postage. Two metre base station receiver, £50, xtalled R1, R2, R6, R7, S-10, S-12. Eddystone EA12 and SX200N for spares, £25 the pair. Manual for EA12, £5. Tel: Jane, (01) 946 2967 or 674 0513, or contact Mike, 14 Doverfield Road, Brixton, London SW2 5NB.

■ Yaesu FT707 HF transceiver, good cond, £275 ono. Standard C58 2m multimode with Nicads, charger & carry case, £185 ono. Heathkit MW101 HF transceiver, 80-10m, 100W o/p, £185 ono. Icom ICX215 FM 2m mobile portable, £85 ono. Tel: (0782) 46440.

■ AR2001 VHF/UHF scanning Rx, 25-550MHz. Powered from 12V or mains, covers military & aviation frequencies. In excellent condition and a bargain at £250. Tel: Gary, (021) 705 9351.

■ Eddystone 830/9 HF Rx, £175 mint, will exchange for HF Rx, working or not, PR155, RA117, what have you? May be able to deliver or collect. Also AR2001 25-550MHz, possible exchange for solid-state HF Rx. Tel:Leeds 677101.

■ 2m rig Icom IC25E, £75. Creed 7B teleprinter, £35. Can anyone help with circuit etc for JVC Nivico CCTV camera mod TK66 (Ex Rank Organisa-

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tion)? Mr R Seymour, 63 Steddys Court, Bryant St, Chatham, Kent ME4 5QT.

■ Valves: 6K6GT, 6K7M, 6U7G, 6Q7, 6F6M, ditto 12V types. Lots of others. UX, 5-pin, yanks, British, TV. ECC84 6/30L2 etc. Unused in all cases, sae for lists please. No fancy prices. Want urgently data on Seavoice VHF. Marine Tx/Rx. Also Kelvin Hughes Forland VHF Marine Tx/Rx. G3HWD, 42 Dennis Road, Padstow, Cornwall PL28 8DF. Tel: Padstow 532723, evenings only

■ Electronic goodies: one tea chest full of thousands of parts, must be sold owing to retirement of enthusiast who has done hobby for 40 years. Sorry no list of items available, but am convinced that first to see will buy. Could be particularly suitable for a beginner. We estimate the value to be over £250, but will let it go to good home for £49. Tel: (021) 472 3688 to view

■ Kenwood Trio 830S HF transceiver in mint cond, also AT230 and SP230 in mint cond, Morse key, 30 feet of black low-loss co-ax, 27 foot horizontal antenna and low-pass filter 30MHz. Will not sell separately, bargain at only £850 ono. Colin Sheldrake on (01) 669 7534, or David Sheldrake on Epsom (Surrey) 28595

■ National Panasonic RF8000 24-band FM/AM/CW broadcast receiver. Two banks of 12-button frequency shift controls, each bank on separate turret displays including clutch for turret change. 30-230MHz VHF, LW/MW, 1.5-30MHz in 1MHz steps, tuning by tracking system. USB/LSB control, ANL, battery clock etc. Two VHF 8-section telescopic aerials and one rotating loop aerial. Sound will surpass any SW receiver on the market. Weight approx 43 pounds. Cost £1700, sell for £900 or would consider exchange for modern communications receiver in the Icom R71E range or similar. H M Carroll, 135 Newbridge Road, Bath BA1 3HG. Tel: (0225) 337145

■ Component packs, new, containing the following: BC108 trans, UA741 ICs, NE555 ICs, 8-pin & 14-pin sockets, 1N4148 diodes, red LEDs TIL 209. £5.25 per pack. I only have 6 packs so only one each please. D Martin, 7 Griffin Crescent, Littlehampton, W Sussex

■ HF mini beam, 2-element, 6 months old, good condition. Ron GI4VOD. Tel: (0762) 42870

■ Icom 720A gen cov Tx/Rx, 100kHz-30MHz, complete with Icom power supply. As new, boxed, £650. G4WFJ. Tel: (051) 342 1354, ask for Dave

■ Pace Nightingale and Commstar for BBC micro, £90. Dragon 32K with joysticks and Berserk cartridge, £30. Specdrum by Cheetah for ZX Spectrum, £18. 2m FM transceiver, Trio TR7600 with remote control RM76, scans 2m in 5kHz steps. Bought from Lowe last May, £100. muTek voxbox for BBC/Atom, £30. I need HF rig, pref with gen coverage rcvr WHY? Will swap, haggle etc! Dave Garland G0DYI, 15 Durban Road, Peverell, Plymouth PL3 4LG. Tel: (0752) 263276

■ Exchange Trio 9R59DS receiver, Gaf 64 cine camera, small personal FM/AM stereo radio plus, for portable receiver covering short waves, FM, air band. BFO essential. Flaherty, 10 Joseph Parry Court, Merthyr, Mid Glamorgan CF47 8HN. Tel: Merthyr 75025 after 5.30pm

■ Apple II Europlus 644. With Sanyo color monitor + 2 drives + Panasonic printer KX-P109D + cards + lots of games. Can buy all or separate. Nurudin Javeri, 17 Ch Vert, Vandoeuvres 1253, Geneva, Switzerland. Tel: 022/50 10 96

■ Cheap electrical components being cleared out by hobbyist, please write for a list of the things I am trying to sell. Many different types of resistors, ICs, switches, connectors etc. Everything virtually unused and very cheap. Also pack of assorted components, mostly new and unused, all working, will be great value for money. Please enclose phone number. Peter O'Donoghue, 7 Hillingdon Avenue, Sevenoaks, Kent TN13 3RD

■ Datong D70 Morse tutor, as new, £35 or exchange for mint condition Racal RA17 cabinet. Norman Varnes. Tel: (0963) 32389 (Somerset)

■ Cirkit digital frequency meter and prescaler kits, unopened, cost £75, accept £50. Sinclair 16K ZX81 computer, £15. Computer compatible cassette player, unused, £10. Yaesu YO100 monitor scope kit, allowed to be used on receivers with IF of 9MHz, £10. Tel: St Albans 39333

■ RCA ET-8010A transmitter, 1943, 355kHz-500kHz in 5 fixed channels, 115 volt, 200 watt. RCA ET-8019E transmitter, 1949, 2-22.4MHz, 200 watt, as used in WWII Merchant Marine? TU5B tuning units from BC375 transmitter. BC614E speech amp. TG10F keyer. Test set 210. BC906D. Eddystone S640, S504. Valve testers etc. Open to offers, swaps. Tel: John, (01) 833 3008

■ Racal RA1217 transistorised professional HF communications receiver, complete in table cabinet, £450, no offers. Datong auto woodpecker blanker, almost new, £65. Datong VLF converter, almost new, £20. Uher report 4000 mono professional portable tape recorder, complete with Nicads, almost new, £395. Tandberg Model II professional portable with leather case, almost new condition, £225. All carriage extra. B J Whitty, 'Fourways', Morris Lane, Halsall, Ormskirk, Lancs L39 8SX. Tel: (0704) 840328

■ AKG D509 dynamic microphone, £20. Film Industries ribbon microphone, £10. Racal dual diversity unit MA168B with handbook, £45. Minimitter low-pass filter, 30MHz, £10. Pair of Quad ESL63 loudspeakers, almost new, £995, no offers. Pair of Spender loudspeaker stands, £18. Dual 10-band professional graphic equaliser, new, £195. 10-output line distribution amplifier, new, £180. Allen & Heath ADT unit, new, £195. All carriage extra. B J Whitty, 'Fourways', Morris Lane, Halsall, Ormskirk, Lancs L39 8SX. Tel: (0704) 840328

■ Trio TS430S HF Tx/Rx with AM filter fitted, with ATU. As new, boxed, £600 ovno. Yaesu FT790R with Nicads, charger, carrying case, mobile 2 × ⅝λ with gutter mount, 3 × ⅝λ base collinear, Wood & Douglas built but not tested 70PA5 pre-amp and 70LIN10 power amp with case and 70cm SWR meter, £260 the lot. Tel: Gordon G8WWD QTHR, (0527) 402557

■ Various baluns by Hatfield Instruments, ie 50Ω to 600Ω, 200kHz to 100MHz, £2.75 each inc p&p. 58 Old Torquay Road, Preston, Paignton, Devon. Tel: (0803) 24226

■ Centronics 306 printer, parallel interface, large, £60. New VDU case for 14in tube, £10. Computer PSU, +20V, −20V, +5V, 5A, £5. Cathode ray tubes, 5FP7A, £5 each. 12 inch green monitor tube, 90°, £5. 12 inch uncased monitor, separate syncs and video, £6. All ono. B Hitchen, 31 Langham Road, Blackburn. Tel: (0254) 580983 after 6pm

■ Linear amplifier. Pair 4CX250B air cooled tubes, very heavy PSU in same case, 19in rack mount, spares including mains transformer, max 80W, drive required. Large tank with 6-position switch and taps, £250 ono. J5 2m Jaybeam collinear with 100 feet of RG8U and N-conn, £20 ono. Two 12 foot lengths 2in OD alloy tubes with 18in joiner clamp, £10 ono. Two stand-up 19in racks, commercially built, £15 each. Mr O English, 7 Erroll Road, Romford, Essex. Tel: Romford 23040 7-8.30pm

■ Heathkit lab scope, never used, requires 240V mains Tx, has 110V MTx, offers. RCA Institute's small screen scope, never used, has 100V MTx, offers. Heathkit voltmeter model IM18 in perfect order, new MTx, £50. Buyer collects, retired and moving forces sale. P Trayers, 6 Woodfield Road, Bebington, Merseyside L63 3DX. Tel: (051) 334 5109

■ Marconi video oscillator TF885A/1, £15. Solartron CD1740 oscilloscope with CX1741 and CX1744 plug-ins, spares or repair, £55 ono. Hewlett Packard mains transformer 9100-1472, £15. Tel: (01) 868 4221

■ Dual trace 15MHz Tektronix oscilloscope, £105. Oscillograph thermal paper recorder (as new), diodes and transistors (new) OA7 10p, 1N4148 3p, 2N3119 £5 pair, 2N3904 20p, 2N3906 20p. Vast collection of valves including 807 – cheap, Tektronix spares, manuals, probes, trollies. Marconi LCR bridge, £65. Hewlett Packard delay line, type 1100A, £85. Diablo printer with power supply, £165. Cintel delayed pulse and sweep generator, £15. Tel: (01) 868 4221

■ Yaesu 7700, £250. FDK 141-171MHz hand-held receiver, a bit deaf, cost £159, sell £100. Tandy DX400, cost £220, sell £110. Two metre base receiver, £35. Tandy hand-held CB, £70. Fantavox airband converter, £10. CB base station, £70. Portable colour TV, £75. Metal detector, £15. Black and Decker drill, £12. Sony 7600D, £100. Mike, 14 Doverfield Road, Brixton, London SW2 5NB. Tel: (01) 674 0513 6-9pm Thursdays

■ Shack clearout, C42 Tx/Rx 36-60MHz, £50. R216 Rx 19-157MHz AM/FM/CW, £95. R210 2-16MHz Rx, £35. All mint condx. Monitor 9in b/w, £16. Racal 811R freq meter, VHF, £15. Marconi TF1101 oscillator, £45. Marconi V322 studio camera, £45. Marconi TF1102 amplitude modulator, £10. Philips V200/01 3-tube colour camera, £160. Marconi TF912 RF wattmeter, £8. Marconi TF995A/2 AM/FM sig gen, £85. All ono. Sae list. Ray Hill, 7 Willowbrook, Greytre, Ross-on-Wye WR9 7JS

■ 350 sheets of double-sided printed circuit board, 6 × 10in, each in plastic sleeve, £150 the lot, no offers, buyer collects. Tel: D R Foster, Chelmsford (0245) 87356

■ Bearcat 250F scanner receiver, covers 32-50MHz, 146-174MHz, 420-512MHz, good condition, with manual and instruction book, £125 ono. Also Fairmate A532320 scanner, covers 110-161MHz, 296-367MHz, AM/FM, £95 ono. Tel: Dave, (01) 560 0194 during work hours

■ Isolating transformer, 110V Woden 3kVA, wall mounting, 240-250V input, £25. Tel: (0543) 262382

■ Heathkit model 10-12u laboratory and general purpose oscilloscope, over 20 years old and not in working order. Comes complete with manual, circuit diagrams and transformer and needs only two capacitors to get it working. Offers around £35. Please reply in writing to Timothy Wilson, 'Wilcote', High Street, Harwell, Didcot, Oxon OX11 0EX

WANTED

■ Military equip: receivers R107, R109, TCS12, command sets including R28 (100-156MHz), TCS12 transmitter, 38AFV set, command transmitters including T23 (100-156MHz), 19 set PSU. Working or for spares. Also mounting bases, grilles, canvasses, manuals, spares etc for above equip. AR88D loudspeaker, other military receivers, transmitters, equipment etc considered. Can possibly collect. Tel: Tyneside (091) 410 3706

■ Circuits or copy of manual for Loran indicator and receiver APN4 (not operating instructions). Also circuits of indicators NO6A, NO6D, BC1151 and BC929A. J A Brown, 57 Mountbatten Road, Braintree, Essex CM7 6EY. Tel: (0376) 45023

■ Drive motor for Telefunken KL85B reel to reel tape recorder, or complete non-working machine with serviceable motor. R Prior, 65 Town Green Road, Orwell, Royston SG8 5QJ. Tel: (0223) 207485

■ *Television* magazine 1967-82, also new/used UHF tuner and sync panel for early Plessey dual-standard TV, ie RGD 622-5, Regentone 193-6, Peto-Scott TV960, Cossor CT1964/77-8, Defiant 9A48F-56U, 3A54U-60U. J L Thomson, 56 Gannochy House, North Street, St Andrews, Fife KY16 9AJ. Tel: (050) 846 364

■ A pen pal with whom to trade hardware (cheap) and software (games) for Apple II computers. Nurudin Javeri, 17 Ch Vert, Vandoeuvres 1253, Geneva, Switzerland. Tel: 022/50 10 96

■ Wanted for HRO MX comms receiver: 1 PSU, 2 manual (for sale or to copy), reasonable offers made, can collect. Tel: (01) 668 6845 (Purley)

■ Eddystone panoramic display unit type EP20 or EP17, working preferred but complete non-working accepted. Can be collected in north-west. Cash paid. Also Tasco CWR 610E telereader, cheap. Tel: Ted, (0706) 218290 after 7pm

■ National company original manuals and catalogues for all radio and associated equipment. Also Sinclair ZX80 computer. Tel: St Albans 39333

■ Valve receivers, HRO National, Hammerlund, Hallicrafters, Collins, BC312, BC348, R390A etc. Valves: triode output like PX4, PP3/500, 300A, 350, early collectors valves etc. Early quality hi-fi such as Quad, Lowther, Leak, Radford, Tannoy, Ortofoh, Sugden, Decca, Wharfedale, Stentorian, Goodsell, Williamson, Pamphonic, Avantic etc. Compact wartime equipment and clandestine 'Spy-Sets' in any condition. Also manuals, accessories. Tel: John, (01) 833 3008

FREE CLASSIFIED ADS

■ Racal Syncal 20 watt transceiver. Good condition, sensible price. B J Whitty, 'Fourways', Morris Lane, Halsall, Ormskirk, Lancs L39 8SX. Tel: (0704) 840328

■ Hitachi 2310ST cassette recorder, working or not. State price and p&p. P Trayers, 6 Woodfield Rd, Bebington, Merseyside L63 3DX. Tel: (051) 334 5109

■ PF2UB, SP400 or 401 speaker for FRDX400. B Hitchen, 31 Langham Road, Blackburn. Tel: (0254) 580983 after 6pm

■ Original microphone for KW Electronics KW 2000, and any old valve receivers/transmitters, working or not. A Nightingale, 'Amorique', Robergerie Road, St Sampsons, Guernsey, Channel Islands. Tel: (0481) 49112

■ Manual for Fantavox airband converter. Mike, 14 Doverfield Road, Brixton, London SW2 5NB. Tel: (01) 674 0513 6-9pm Thursdays

■ Exchange FT290R, Nicads, case for QRP rig, SSB CW, FT7 or Argonaut S09. David, c/o Davis, 1 Milovaig St, Glasgow G23 5HY

■ Back copies of *Wireless World*, 1965, 1966, 1967, wanted by nostalgic OAP. J Willmot, 5 Southcourt Avenue, Bexhill TN39 3AR. Tel: (0424) 221636

■ Marconi Mercury 1017 receiver with ac PSU and handbook. Also Heath RA-1 receivers, alive, dead or dying, Codar 250/S power unit. Please write to Richard Marris, 35 Kingswood House, Farnham Road, Slough, Berks SL2 1DA

■ Lathe wanted by impecunious student, Myford ML 7 or similar; distance no problem. Tel: Edward, (051) 648 4166. 32 Cornelius Drive, Pensby, Wirral, Merseyside.

■ Old ship's Omega navigational receiver with manual, for propagation studies. Don't worry if not working. Good price paid. Woodhouse, Trendweth, Porthpean, St Austell, Cornwall PL26 6AU.

■ FT101Z or ZD circuit required. Also wanted 2m Txr small mobile type. Tel: Coventry (0203) 450476.

■ Wanted, dead or alive: complete rigs, HF, VHF, UHF, mobiles, hand-helds, PMR, FM, AM and accessories, eg mikes antennas, batteries, etc, eg Pye PE70, Europas, Olympics, Motophones, Westminsters, Cambridges, Vanguards, Mascots, Whitehalls, Reporters, Bantams, Burndept, Dymar, etc. Any amateur gear from the usual makers, eg Yaesu, Trio, Icom, KDK, Standard, Belcom, FDK, etc. No silly prices please. Also manuals. Details to G4YVJ Beal, 115 Southdown Road, Portslade, East Sussex BN4 2HJ. Tel: Brighton 416963.

■ Trio 7010 or similar 2m SSB rig, also UHF Westminster and PF2UB pocketphone. Cash waiting, anything reasonable considered. Tel: Steve on (051) 334 4301.

■ Two valve holders, EIMAC SK-900. Swanton EI9W, Court House, Cork.

■ Circuit diagram of Rochar frequency counter A1149 and piezo transducer approx 30W pulsed at about 1MHz. Tel: J Galvin, Crudwell (06667) 7820 (Wilts).

■ Nevada 934MHz rig, SWR meter, Magnum aerial. Cheap two metre synthesized receiver or transceiver, 44MHz xtals for simplex. Tel: Jane, (01) 946 2967 or 674 0513, or contact Mike, 14 Doverfield Road, Brixton, London SW2 5NB.

■ Pye Olympic or Recorder. Mr P Smith, 5 Chester Avenue, Whitefield, Manchester M26 6DN. Tel: (061) 773 3989.

■ SSB adaptor for Grundig Satellit 2100 receiver. Please contact with price. Iceton, 5 Dorlcote Place, Norton, Stockton on Tees, Cleveland TS20 2PP. Tel: (0642) 559845.

■ Information on how to fit a new drive belt to a Grundig TK5 tape recorder. Also, where can paper and developer powder be obtained for a Plessey KD111 facsimile machine? All info acknowledged and postage refunded. A McCann, 105 Todd Lane North, Lostock Hall, Preston, Lancs PR5 5UP. Tel: (0772) 37815.

■ Want to buy satellite and DX-TV receiving systems. Need any other books, manuals, diagrams, product/technical data on the satellite and DX-TV systems and equipment. Please advise Mr S P Syed, One Stuart Road, Thornton-Heath, Surrey CR4 8RA.

■ RTTY machine code program for Oric 1 wanted on tape or print. Will pay all reasonable expenses or exchange for other useful Oric programs. Please write to Emmanuel Georgantas, 22 Esperou Street, Kifissia 145 61, Athens, Greece.

■ Realistic Mohican GR78 short wave receiver, working condition. Please write to Mr M Richards, c/o 'Bridleways', Aughton, Collingbourne, Kingston, Nr Marlborough, Wilts.

■ Sansui cassette recorder, model D95M. A Hodgkinson, Spurstow, Tarpoley, Cheshire CW6 9TF. Tel: Bunbury (0829) 260323.

■ CB rigs, not working, up to £2.00 paid for each one. C J Barker, 52 Spode St, (West end), Stoke-on-Trent, Staffs ST4 4DY.

■ If you are interested in short wave radio, you should join the DX Association of Great Britain. Receiver reviews, DX news, comment and much more. Write for sample magazine and membership details. Keep ahead of the rest with DX Association of Great Britain. DXAGB, Five Acres, Whiteditch Lane, Newport, Saffron Walden, Essex CB11 3UD. Tel: (0799) 40068.

■ ATU required for receive and QRP ops. Fair price paid for a unit which is unmarked in good condition. Phone (0536) 522007 or write 5 Centre Parade, Kettering, Northants NN16 9TL.

■ Will ham living at Coalville who phoned Tom on (0536) 522007 re advert in *R&EW* regarding ATU, please phone again as your phone number was lost. T W Foster, 5 Centre Parade, Kettering NN16 9TL. Tel: (0536) 522007.

■ Service sheets for ITT colour television type CK602/1/CVC-8. Also voltage multiplier for above, type CVC-8? F J Wakeman, 46 Poynder Rd, Corsham, Wilts SN13 9LZ. Tel: (0249) 714143 (after 7pm).

FREE CLASSIFIED AD ORDER FORM

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USE BLOCK CAPITALS (One word per box)
To avoid mistakes please write clearly and punctuate your ad

Name/Address Postcode/Telephone							

USE SEPARATE SHEET FOR MORE WORDS

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CONDITIONS: Your ad will be published in the first available issue. We will not accept trade advertisements. We reserve the right to exclude any advertisement.

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CROSSOVER NETWORKS – Active & Passive Components, Accessories etc
Expert advice via our enquiry service.
ELEKTOR/KEF PL301
Units, Networks & Components
Full details from
FALCON ELECTRONICS
Dept RE, Tabor House, Mulbarton, Norfolk NR14 8JT
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Radio & Electronics World
The communications and electronics magazine

SMALL ADS

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

RATES
per single column centimetre:
1 insertion £9.65, 3 — £9.15, 6 — £8.65, 12 — £7.75.

RADIO & ELECTRONICS WORLD SMALL AD ORDER FORM

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

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

COPY enclosed........☐ to follow........☐

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Cheques should be made payable to Radio & Electronics World. Overseas payments by International Money Order + Credit Card

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ADDRESS ....

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

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12JUNE 1986

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COUNTY GUIDE

RATES
BOXES ad sizes
20mm x 59mm single
40mm x 59mm double

Total prepayment rates	Ad space	3 issues	6 issues	12 issues
	single	£47.00	£88.00	£158.00
	double	£94.00	£176.00	£316.00

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TO: Radio & Electronics World · Sovereign House · Brentwood · Essex CM14 4SE · England · (0277) 219876

print your copy here ....

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NUMBER OF INSERTIONS REQUIRED

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Cheques should be made payable to Radio and Electronics World. Overseas payments by International Money Order + Credit Card

Conditions — Payment must be sent with order form. No copy changes allowed. Ads accepted subject to our standard conditions, available on request.

C P I

ADVERTISERS INDEX

Radio & Electronics World
The communications and electronics magazine

ADVERTISING RATES & INFORMATION

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
			series rates for consecutive insertions		
61 x 90	⅛page	£91.00	£86.00	£82.00	£73.00
128 x 90 or 61 x 186	¼ page	£160.00	£150.00	£145.00	£125.00
128 x 186 or 263 x 90	½ page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£560.00	£530.00	£475.00
263 x 394	double page	£1140.00	£1070.00	£1020.00	£910.00

COLOUR AD RATES

depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
		colour rates exclude cost of separations	series rates for consecutive insertions		
128 x 186 or 263 x 90	½ page	£420.00	£395.00	£375.00	£335.00
297 x 210	1 page	£810.00	£760.00	£730.00	£650.00

SPECIAL POSITIONS

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

DEADLINES

*Dates affected by public holidays

issue	colour & mono proof ad	mono no proof and small ad	mono artwork	on sale thurs
May 86	13 Mar 86	19 Mar 86	21 Mar 86	10 Apr 86
June 86	10 Apr 86	16 Apr 86	18 Apr 86	8 May 86
July 86	15 May 86	21 May 86	23 May 86	12 Jun 86
Aug 86	12 Jun 86	18 Jun 86	20 Jun 86	10 Jul 86

CONDITIONS & INFORMATION

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

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

Printed — web-offset.

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

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

Overseas payments by International Money Order.
Commission to approved advertising agencies is 10%.

CONDITIONS
10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only.
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Brand new 3 channel pen recorders complete with charts. Full spec upon request once only price **£40** **£10 p&p + VAT**

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Excel Polish	1.12
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Aero Duster	1.48
Super 40	1.86
Video Head Cleaner	1.10
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Ditto Tube	1.66
Heat Sink Compound	1.10
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Ditto 0.08mm	0.76
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Antex 18W iron	5.50
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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 × 75mm × 70mm.

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¼W 1RO to 10M (E12 Range)	**2p each. 15p/10. 75p/100**
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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**
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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

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 **£5.10**

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, 3.15, 4, 5, 6.3A **40p. 20mm Time Delay.** 100, 125, 160, 200mA **£1.80.** 250, 315, 400, 500, 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**
35/129 6-12 volts + m/bracket 25mmx38mm	**80p each**	**10/£6.50**
35/016 6-12 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	.75
GY501	1.40
KT66(GEC)	18.00
KT88(GEC)	19.00
PCC189	.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	5.15
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
CA810CM	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
TBA560C	1.50
TDA800	0.80
TBA810S	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	0.39
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
4020	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	0.38
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	0.85
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 (£)	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	BFR160	0.23	BSX19	0.32	BYX36/150	0.40	TIS88	0.50
AC128K	0.34	BC141	0.28	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	0.18	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	0.05
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	0.30	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	0.88	BC169C	0.12	BD124P	0.70	BF241	0.30	BT138/600	1.30	MCR106/5	1.20	IN5406	0.17
AD143	0.88	BC170	0.16	BD129	0.90	BF244	0.34	BT151/560R	0.90	ME0413	0.70	IN5408	0.19
AD149	0.72	A B or C	0.16	BD130Y	0.68	BF244A	0.34	BTY79/400R	2.80	ME6002	0.26	IS44	0.06
AD161/162	1.20	BC171	0.10	BD131	0.36	BF257	0.22	BU100A	2.30	MEU21	0.62	IS920	0.07
AD162	0.52	A or B	0.10	BD132	0.36	BF258	0.26	BU104	1.80	MJ400	0.45	2N1306	0.34
AF114	1.20	BC172	0.10	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	0.44	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	0.12	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	L A L B L C	0.12	BD145	1.82	BF294	0.36	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	0.30	2N3773	2.80
AF178	2.28	A B or C	0.10	BD160	1.58	BF337	0.28	BU208	1.40	MPSU05	1.00	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	L A L B L C	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 C L L C L B	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	2.65	2SC1173Y	0.88
AY102	4.32	BC212L	0.09	BD232	0.45	BF457	0.36	BUY69B	1.98	OC35	4.75	2SC1279	0.50
B40C2200	1.03	L A L B	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	0.36	BY103	0.50	OC44	0.70	2SC1307	1.50
BA115	0.14	A B or C	0.10	BD236	0.38	BFR51	0.35	BY122	0.60	OC72	0.70	2SC1413A	2.70
BA121	0.40	BC213L	0.10	BD237	0.38	BFR61	0.36	BY126	0.10	OC81	0.68	2SC1449	0.60
BA129	0.38	L A L B L C	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	0.68	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
BB105B	0.30	A B	0.14	BD441	1.00	BFW44	0.88	BY179	0.56	R2540	2.71	2SC1923	0.30
BB105G	0.48	BC262	0.26	BD507	1.05	BFX29	0.28	BY182	0.80	TIC45	0.45	2SC1945	2.88
BB110B	0.42	A B	0.28	BD520	1.20	BFX48	0.78	BY184	0.38	TIC47	0.70	2SC21953	0.70
BC107	0.10	BC301	0.30	BD687	0.88	BFX80	6.46	BY187	0.65	TIC29	0.30	2SC1957	0.70
A or B	0.12	BC302	0.30	BD707	0.88	BFZ85	0.35	BY189	6.75	TIP30A	0.32	2SC1969	2.80
BC108	0.10	BC303	0.30	BDX18	1.00	BFY50	0.22	BY198	0.64	TIP31C	0.39	2SC2028	0.73
A B or C	0.13	BC307A	0.18	BDX32	1.48	BFY51	0.22	BY199	0.72	TIP32	0.35	2SC2029	2.70
BC109	0.10	BC317A	0.12	BF115	0.32	BFY52	0.22	BY206	0.14	TIP33A	0.55	2SC2078	1.05
A B or C	0.14	BC323	0.90	BF117	0.50	BFY90	0.80	BY207	0.16	TIP34A	0.70	2SC2091	0.70
BC113	0.42	BC327	0.16	BF119	0.82	BFY90S	1.34	BY210/400	0.21	TIP41C	0.42	2SC2098	2.90
BC115	0.12	BC328	0.16	BF120	0.38	BR100	0.24	BY210/600	0.24	TIP42	0.44	2SC122A	3.20
BC116	0.12	BC337	0.12	BF125	0.42	BR101	0.40	BY210/800	0.28	TIP47	0.42	2SC2314	0.80
BC117	0.22	BC338	0.12	BF127	0.41	BR103	0.50	BY227	0.22	TIP121	0.63	2SC2335	1.50
BC118	0.16	BC350A	0.24	BF154	0.14	BR303	2.75	BY228	0.46	TIP2955	0.70	2SK135	3.80
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- BC153 10p
- BC154 10p
- BC157a 10p
- BC158 10p
- BC159 10p
- BC160/16 25p
- BC171 10p
- BC172 10p
- BC173 10p
- BC174 10p
- BC183 10p
- BC184 10p
- BC204 10p
- BC207 10p
- BC212 10p
- BC213 10p
- BC214 10p
- BC237 10p
- BC238 8p
- BC239 10p
- BC250 8p
- BC251 10p
- BC252 10p
- BC262 10p
- BC263b 20p
- BC294 30p
- BC298 10p
- BC300 30p
- BC301 30p
- BC303 30p
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- IN4001/6 100 mixed £2.50
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