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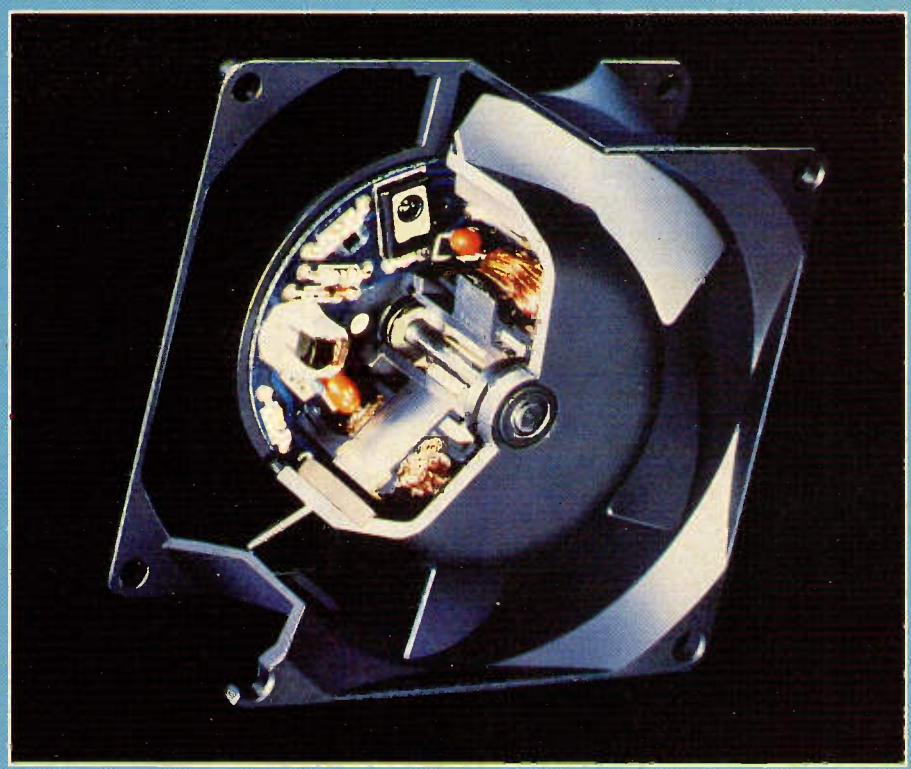

SPECTRUM WATCH:
NEWS ACROSS THE BANDS

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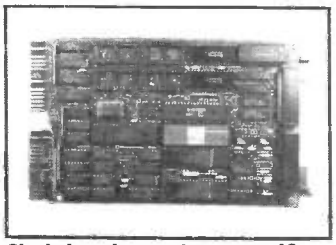
Safety in the shack

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

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

Cover Photographs
Top – One of the new Series III Multifan range from Papst (p16)
Bottom – The German satellite recieving station at Usingen

SPECIAL FEATURES



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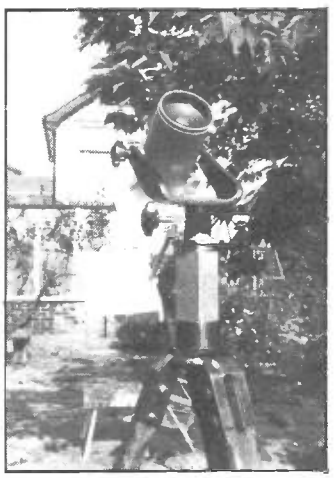

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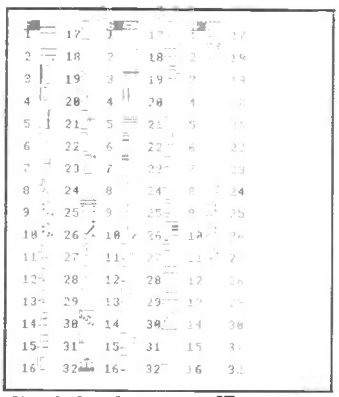

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NEXT MONTH

☐ **Next Issue**
Cover date July 1985 on sale Thursday, 19 June

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

Birmingham bash – page 60

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 OSCILLOSCOPE

Available ex-stock from Thurlby Electronics is the Hitachi VC6041 digital storage oscilloscope. Suitable for analysis and observation of high-speed signals, the instrument samples at 40MHz providing digital storage of 10MHz single-shot events and 40MHz repetitive waveforms.

The VC6041 features a large capacity memory of 4096 words per channel, enabling a horizontal resolution of 400 steps per division. A portion of the stored waveform can be magnified up to 100 times for detailed observation. With the total memory capacity of 24K 8-bit words, the VC6041 can store up to four waveforms simultaneously without any loss of resolution.

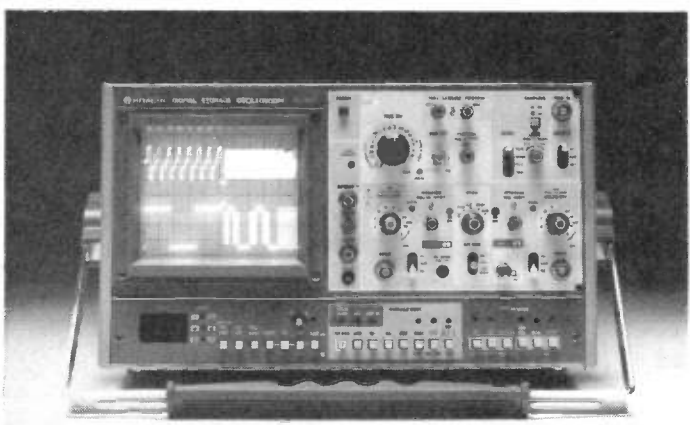
A wide range of acquisition and display facilities are offered, including a signal average function which allows the user to select the number of waveform samples averaged before display, a roll mode which provides a continuous plot of low frequency events, and a variable pre-trigger which displays events occurring before the trigger point.

The VC6041 has a six inch internally-graduated cathode-ray tube (CRT) screen to ensure a high-accuracy, high-resolution display free from measurement errors caused by parallax.

Other features include a ground reference display which facilitates verification of the ground potential, and an X-Y display function to enable accurate phase shift measurements. Two channels of displayed waveforms may be simultaneously recorded using an external pen recorder, and a dc offset function compensates for a dc component when measuring waveforms.

When not used in its digital storage mode, the VC6041 can function as a conventional 40MHz real-time oscilloscope.

Thurlby Electronics Ltd,
New Road, St Ives,
Cambs PE17 4BG.



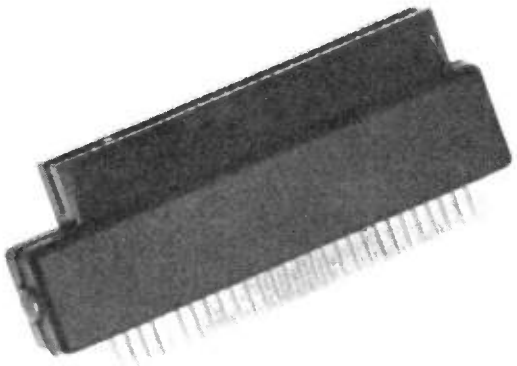
SPECTRUM RESET

According to Nidd Valley Micro Products Ltd, switching the power off on the Spectrum to cure a program crash is about as nonsensical as switching off the National Grid to change a light bulb, and the company has therefore introduced a reset and peripheral extender.

The Z80 processor is provided with a proper reset line which gently resets the system to zero. No power is lost to the computer or peripherals. Therefore by using this facility there is less likelihood of damage to microdrive programs etc. Furthermore, programmable interfaces (joysticks, etc) remain programmed so only the game or program needs to be reloaded – not the entire set-up routine.

The Nidd Valley reset and extender offers such a reset facility in a neatly packaged, slim (14mm) connector casing. A small unobtrusive red button supplies the reset. The unit plugs into the user port and provides extension for other peripherals.

Its size is such that as an extender it makes up for the lack of space for fitting keyboards etc to the Spectrum, and enables add-ons to be fitted correctly into the very limited space provided on the Spectrum +.



The unit is priced at £4.95 including VAT and delivery.

Nidd Valley Micro Products Ltd,
Stepping Stones House,
Thistle Hill,
Knaresborough,
North Yorkshire HG5 8JW.
Tel: (0423) 864488.

A/D CONVERTER

Just introduced by Burr-Brown is a complete 12-bit analogue-to-digital converter with integral 10V reference and clock that can be used with 8, 12 or 16-bit microprocessor bus structures.

Known as the ADC574A, the new converter offers improved performance over other 574A type ADCs.

For example, maximum conversion time is only 25μS and the bus access time is 150nS

Stability with temperature change is ensured by supplying the clock oscillator from a constant current source and by using a buried laser trimmed Zener to provide the reference voltage. All full scale and offset errors can be externally trimmed to zero and selectable input ranges (0 to 10V, 0 to 20V, ±5V and ±10V) are provided by internal scaling resistors.

The ADC574A is housed in a hermetic 28-pin side-brazed ceramic DIP. It utilises a state-of-the-art CMOS laser trimmed die designed for freedom from latch-up and optimum ac performance. Additional features available include TTL compatible three-state parallel format output and a digital interface for microprocessor control.

Burr-Brown International Ltd,
Cassiobury House,
11-19 Station Rd,
Watford,
Herts WD1 1EA.
Tel: (0923) 33837.

BREADBOARD UNIT

The new Model CDA-1 from Global Specialties is a UK-manufactured solderless breadboard unit with an integral triple-output dc power supply.

The new unit, which is equally applicable to professional laboratory or educational use, allows circuit designs to be easily implemented, tested and altered without the need to commit to soldered interconnections.

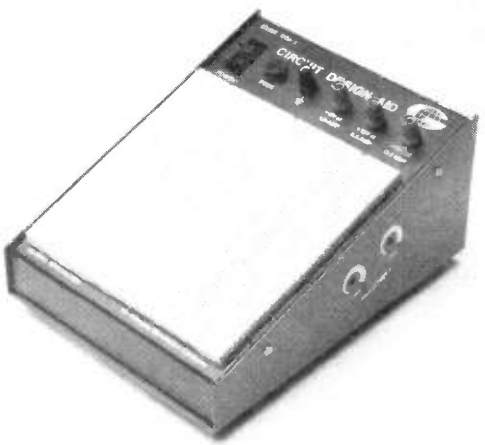
The breadboarding area on the CDA-1 includes 202 pairs of five common spring contacts each, plus 24 bus strips each containing 25 common contacts, allowing up to 27 14-pin integrated-circuit packages to be easily fitted.

The fully regulated professional power supply provides one fixed output of +5V dc and two externally adjustable outputs of ±5 – 15Vdc. Maximum current is 1A for the 5V output and 0.5A for the 15V outputs. Load regulation is less than 1%; line regulation is typically 0.15% @ 1 amp; and ripple is less than 4mV for the 5V output and 10mV for the 15V outputs.

The CDA-1 is housed in a strong metal cabinet with a user-friendly sloping front panel, and all metal parts are earthed to meet the most stringent safety regulations. The unit incorporates fuse protection and an ac mains switch with a built-in pilot light.

The CDA-1 is available fully assembled at a cost of £99.50 (plus VAT) or in kit form as the CDA-1K at a cost of £89.50 (plus VAT).

Global Specialties Corporation,
Shire Hill Industrial Estate,
Saffron Walden,
Essex CB11 3AQ.



COAXIAL CONNECTORS

Advid Electronics have announced the introduction of a new range of coaxial connectors.

This new concept is presented as a one piece precision made plug which gives a neat appearance and is capable of being fitted with ease and without the use of special tools.

The S6 British designed and manufactured plugs have been developed for the aerial and cable TV industry and are available with a polished aluminium or nickel plated brass body. The plug conforms to BS3041:1958 with new easy cable fixing by means of a tapered screw covered by patent no 8411988.

The quantity trade price starts at 7.5p each for the S6-A plug (polished aluminium body) and 16p each for the S6-B plug (brass nickel plated body). The company believes that the savings in cost and in fitting time makes its use very attractive.

Advid Electronics have been appointed the sole distributors for the United Kingdom.

Advid Electronics,
17a Mill Lane,
Welwyn,
Herts AL6 9EU.
Tel: (0483) 832641.

NEW TRANSCEIVER

A new single sideband transceiver, designed for use in the Third World and developing countries where telecommunications are either limited or non-existent, has been introduced by Eddystone Radio Limited of Birmingham, part of Marconi Communication Systems Limited.

Designated the Orion 5000 it is a compact, rugged, go-anywhere transceiver with an output of 150 watts PEP over the frequency range 2MHz-16MHz.

Up to 8 channels are available, and operation is on upper or lower sideband in simplex or semi-duplex.

Plug-in printed circuit boards are used, providing ease of maintenance and maximum security against loss of service. Operation directly on 13.6V dc permits the transceiver to be simply connected to an automobile battery, without the need of a power supply or converter. An ac version, operating from 115/230V, is available for fixed station use.

The unit is extremely compact, measuring some 30cm x 25cm x 10cm. When used as a fixed station it can be supplied panel mounted for fitting into a standard 19in rack.

The comprehensive range of accessories supporting this transceiver make it suitable for mobile or base station use by police forces, government departments, survey teams, relief organisations, shipping companies, in fact by any group requiring long-distance communications.

A version is also available which is approved for fitting in yachts and small craft, and it can be supplied with an in-built radio telephone alarm generator.

Eddystone Radio Ltd,
Alvechurch Road,
Birmingham B31 3PP.

256K DRAM

Motorola Memory Products Division has introduced the MCM6256, a 262,144-bit high speed dynamic random access memory (DRAM), featuring extended page mode. Triple-poly technology and laser fuse redundancy, with advanced direct-step-on wafer manufacturing technique, combine to ensure high performance, improved reliability and low cost by maximising yield.

Page mode operation allows random column accesses of up to 512 bits within a selected row with page access times as fast as 50 nanoseconds (nS) maximum and page cycle times of 100nS maximum for the MCM6256-10 device. Maximum page access times for the MCM6256-12 are 60nS, and for the MCM6256-15 75nS. Page cycle times specify 120nS for the MCM6256-12, 150nS for the MCM6256-15.

All MCM6256 inputs and outputs, including clocks, are fully TTL compatible. Complete address decoding is performed on-chip with latches incorporated. Data out (Q) is controlled by CAS (column address select), enhancing system flexibility.

The MCM6256 features RAS (row address strobe) only and automatic CAS before RAS refresh modes, three-state data output, 256 cycle, 4 millisecond (mS) refresh and early write common input/output (I/O) capability. Operation is from a single +5 volt (±10%) power supply with low maximum current drain of only 4.5 milliamperes (mA) standby, 70mA active.

A row and column address multiplexing scheme uses only nine address lines in a JEDEC standard 16-pin, 300 mil wide, plastic dual-in-line (DIP) package. This high performance, low cost memory is suitable for upgrading present 64K systems.

Motorola believes that this 256K DRAM will have significant applications in integrated computer automated manufacture (ICAM), robotics, graphics systems, high resolution CAD/CAM and complex expert systems which require the combination of high density, performance and flexibility incorporated in the MCM6256.

Motorola Memory Products Division,
3501 Ed Bluestein Blvd,
Austin, Texas 78721.

ICOM
GREAT SETS...

Isn't it about time you switched to Icom?

IC-751

The IC-751 could be called the flagship of the ICOM range as it features 32 memory channels. full HF receive capability, digital speech synthesizer, computer control and power-supply options. The 751 is fully compatible with ICOM auto units such as the AT-500 and IC-2KL. The IC-751 now has a remote push-button frequency selector pad.

Standard features include: a speech processor, switchable choice of J-FET pre-amp or 20dB pin diode attenuator and two VFO's, marker, 4 variable tuning rates, pass band tuning, notch, variable noise blanker, monitor switch, direct feed mixer in the front end, full break-in on CW and AMTOR compatibility.

The first IF is 70.045 MHz. Any XIT and RIT adjustment is shown on the display. The transmitter features high reliability 2SC2904 transistors in a low IMD (-32dB@100W) full 100% duty cycle. For more detailed information on this excellent set, please get in touch with us.

IC-3200E

A new exciting set is the ICOM IC-3200E FM Dual-band transceiver (144-430/440 MHz). This is the smallest transceiver available.

The IC-3200E employs a function key for low-priority operations to simplify the front panel. LCD display is easy to read in bright places, showing frequency, VFO A/B, memory channel duplex mode and S/RF meter information.

Other features include a 10 channel memory able to store operating frequencies, Simplex or Duplex. A memory lock-out function allows the memory scan to skip programmed channels when not required. The IC-3200E has a built-in duplexer and can operate on one antenna for both VHF and UHF. Options include: IC-PS45 DC. power supply, HS-15 mobile mic, SM6 and SM8 desk mics. SP-10 external speaker and UT-23 speech synthesizer. A great future is predicted for the IC-3200E.

Soon to be announced...

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

ICOM GREAT VALUE

IC-505, 50MHz A New Dimension for the U.K.

At last, permits are now available in the U.K. for the 50MHz (FM) band. If you wish to use this less crowded amateur frequency the IC-505 SSB CW portable transceiver has already gained an excellent reputation world-wide.

The IC-505 features microprocessor frequency control, dual VFO's and 6-channel memories with memory scan. LCD ensures clear visibility even in sunlight. The 505 accepts a standard dry-cell pack, rechargeable nicad battery pack (BP10) or 13.8V external power supply.

Standard accessory circuits such as split switch, noise blanker, squelch and CW break-in are incorporated in the 505.

Other accessories available include the EX-248 FM unit, BC-15 charger unit and the LC-10 carrying case.

All these features make the IC-505 a great transceiver that will enable you to operate on the 50MHz band, after all the rest of the world does!

You can get what you want just by picking up the telephone. Our mail-order dept. offers you: free, same-day despatch whenever possible, instant credit, interest-free H.P., telephone Barclaycard and Access facility and a 24 hour answering service.

Please note that we now have a new retail branch at 95, Mortimer Street, Herne Bay, Kent. Tel: 369464. Give it a visit, BCNU.

Authorised Icom dealers in the UK

Alexian Electronics Ltd. Edinburgh. 031-554 2591.
Alyntronics. Newcastle. 0632-761002.
Amateur Radio Exchange. London (Ealing). 01-992 5765.
Amcomm. London (S. Harrow). 01-422 9585.
Arrow Electronics Ltd., Chelmsford Essex. 0245-381673 26.
Beamrite. Cardiff. 0222-486884.
Booth Holding (Bath) Ltd., Bristol. 02217-2402.
Bredhurst Electronics Ltd., W. Sussex. 0444-400786.
Dressler (UK) Ltd., London (S. Harrow). 01-558 0854.
D.W. Electronics. Widnes Cheshire. 051-420 2559.
Hobbytronics. Knutsford Cheshire. 0565-4040. Until 10pm daily.
Photo Acoustics Ltd., Buckinghamshire. 0908-610625.
Radcomm Electronics. Co. Cork. Ireland. 01035321-632725.
Radio Shack Ltd., London NW6. 01-624 7174.
Scotcomms. Edinburgh. 031-657 2430.
Tyrone Amateur Electronics. Co. Tyrone. N. Ireland. 0662-2043.
Reg Ward & Co. Ltd., S.W. England. 0297-34918.
Waters & Stanton Electronics. Hockley Essex. 0702-206835.

Listed here are authorised dealers who can demonstrate ICOM equipment all year round. This list covers most areas of the U.K., but if you have difficulty finding a dealer near you, contact Thanet Electronics and we will be able to help you.

Cue Dee Antennas Special Offer!

CUE DEE antennas are designed to last for decades – the best possible aluminium alloy for this purpose is used (SIS 4212-06).

The booms are made of 28mm tubing with 1.5mm wall, with colour marks clearly indicating where to fit the elements. By using tubular boom, and a synthetic guy wire on the long yagis, the windload is reduced by a factor 0.66 compared to using square shaped material for boom and guying.

The driver element is made of 12mm tubing and features a PTFE (Teflon) insulated gamma match which is pre-tuned at the factory and made for 50 ohm feeder with a PL 259 type connector. No further adjustments or power consuming balun needed. This matching system ensures a clean radiation pattern and transfers the power without losses.

The parasitic elements are made of 6mm solid rod and mounted to the boom with the aid of a CUE DEE element washer, boom to element part and a screw. This, together with our intelligible assembly manual, makes an extremely easy and solid assembly which assures the long life of a CUE DEE antenna.

2 metre Yagis.
4144A – 4 element, 8dBd gain £19.00.
10144 – 10 element, 11.4dBd gain £37.00.
15144 – 15 element, 14dBd gain £49.00.
Order now while stocks last.

.. IC-735 New Compact HF and R7000 VHF/UHF Receiver.

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

Thanet Electronics
Dept RW143 Reculver Road, Herne Bay, Kent
Tel: (0227) 363859

BARCLAYCARD ACCESS

PRODUCT NEWS

AERIAL TRAPS

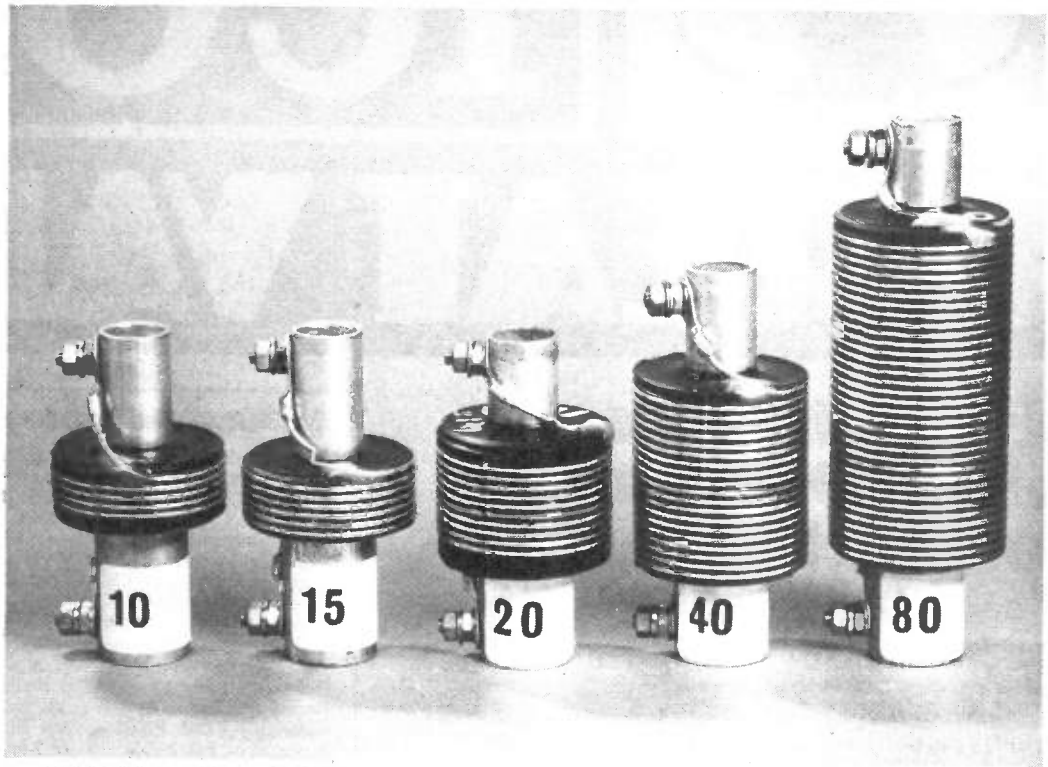
New from the G2DYM stable, makers of the well-known anti-TVI trap dipoles, is a full range of aerial traps for 10, 15, 20, 40 and 80 metres.

Available in pairs for trap dipoles or singly for trap unipoles, the capacity is obtained by very accurately setting the aluminium tubes concentrically in epoxy resin cement. The formers are later cast and machine threaded, and the coils are wound with 1.5mm lacquered copper wire.

10, 15 and 20 metre traps are available at a price of £9 each, 40 metre traps cost £10 each and 80 metre traps are £12.50 each, all plus £1.00 p&p (£1.50 for two).

Special frequencies can be made to order.

G2DYM,
Uplowman,
Tiverton,
Devon EX16 7PH.



NEW CASES

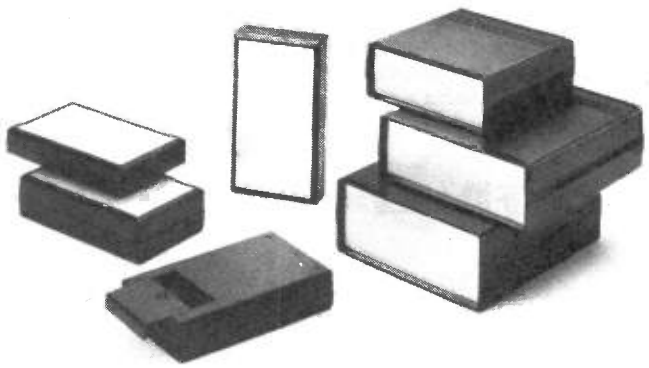
West Hyde have expanded their range of small cases designed for hand-held or desk-top applications.

The Novara is a good size and shape for hand-held instruments and has the option of a battery compartment which will hold one PP3 or two AA cells. The case is moulded from black ABS in two halves held together with self-tapping screws and is trimmed with an aluminium fascia panel which fits into the shallow recess on the top. Three different sizes are available.

The second new addition is the Verona case. This inexpensive case is designed for portable or bench-top equipment and is moulded in a choice of black or grey ABS. Each case half has bosses to support a PCB or chassis as well as slots for vertical boards.

The case is supplied complete with aluminium panels which slot into recessed grooves at the front and rear. The Verona is available in six separate sizes.

West Hyde Developments,
Unit 9,
Park Street Industrial Estate,
Aylesbury,
Bucks HP20 1ET.
Tel: (0296) 20441.



MICROAMTOR PATCH

ICS Electronics Ltd of Arundel, West Sussex, have now upgraded their popular 'Micropatch' combined terminal unit and software package for the CBM-64 and VIC-20 computers to incorporate AMTOR as standard.

For owners of these popular home computers, this represents a cheap and reliable way to get on the air with send/receive capability in all of the new data transmission modes: AMTOR, RTTY, CW and ASCII. The only additional items required to get on the air are a transceiver and a 12 volt power supply.

Both software and hardware are fully integrated into one package, which plugs into the expansion port of the computer. The high quality terminal unit circuitry provides separate mark/space channel filtering together with a tuning indicator. Phase locked loop demodulation is not used.

The software is triple split screen, user friendly, incorporates message handling, on screen time of day clock and operates with tape, disc and printer.

The MicroAMTOR Patch is available for £189.85 plus £1.50 p&p.

ICS Electronics Ltd,
PO Box 2,
Arundel,
West Sussex BN18 0NX.
Tel: (024 365) 590.

LED DPM

A new LED DPM recently introduced by Lascar Electronics is claimed to be the world's smallest DPM with 14mm (0.56 inch) digits.

Measuring only 72 x 36mm, the DPM has a total depth of only 21mm behind the panel. The high efficiency LEDs are fitted behind a circularly polarised filter giving an excellent high contrast display which can be read at distances up to 10 metres. Standard features include +5V dc supply, auto-zero, auto-polarity, external band-gap reference and programmable decimal points.

The DPM 56 can be programmed by the user to read amps, volts or many other engineering units.

Lascar Electronics Ltd,
Module House,
Whiteparish,
Salisbury, Wiltshire SP5 2SJ.
Tel: (07948) 567.

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BC147/8/9	–10p	BC212,212L	–10p	BFX88	–15p
BC157/8/9	–10p	BC327,337,337L	– 12p	BSX19	–12p
BC547/8/9	–8p	BD135,136	–25p	BSX20	–15p
BC557/8/9	–8p	BD137,138,139	–25p	2N2926	–7p
BC182L	–10p	BF195,7	–12p	2N3055	–50p
BC183	–10p	BCY70	–15p	TIP31A,32A	–30p

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2.2/35,4.7/25,10/6 – 15P 4.7/35,6.8/16.....16p
10/16,10/25,22/6 – 20P,15/25,22/16,33/10.....30p
ELECTROLYTIC CAPACITORS. (Mfds/Volts)
1/25, 1/50, 2.2/25, 2.2/50, 4.7/25, 4.7/50, 10/16, 10/25, 10/50.....5p
22/16, 22/25, 22/50, 47/16, 47/25, 47/50, 33/10 – 6p. 100/16, 100/25.....7p
100/50 – 12p, 100/100 – 14p. 220/16 – 8p. 220/25, 220/50.....10p
470/16, 470/25 – 11p. 470/35 – 12p. 470/40 – 15p. 1000/16.....15p
1000/35 – 22p. 1000/40 – 35p. 2200/10 – 8p. 2200/25.....35p
Carbon Film resistors ¼W 5% E24 series 0.51R to 10MO.....1p
100 off per value – 75p, even hundreds per value totalling 1000.....£7.00
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Mixed metal/carbon film resistors ½W E12 series 1RO to 10Mo.....1½p
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01, 015, 022, 033, 047, 068 4p. 015, 022 6p. 0.33 & 0.47.....8p
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1000p to 8200p – 3p.01 to 068 mfd – 4p. 0.1 5p. 0.12 & 0.15.....6p

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2% 1.8 pf to 47 pf – 3p. 2% 56 pf to 330 pf – 4p. 10% 390p – 4700p.....4p
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400/1A 1N4004 5p. 1250/1A BY127 10p. 30/45mA OA90 6p. 30/15A OA47.....8p
Zener diodes E24 series 3V3 to 33V 400 mW – 8p. 1 watt.....12p
L.E.D's 3 & 5mm Red 10. Green, Yellow 14p. Grommets 3mm – 2p, 5mm.....2p
20mm fuses 100m A to 5A. Q/blow 5p. A surge 6p. Holders pc or chassis.....5p
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NC11C	Charger FT 290R	5.95	1.00
YO 901P	Multi scope FT902 S/S	295.00	5.00
HALF WAVE	Telescopic ant. for FT208R	5.95	1.00
FT ONE AM	Filter 6KHZ	13.95	0.75
FT ONE FM	Unit	34.95	1.50
FT 101ZD	AM Unit	9.95	1.00
FT 902 + FT	ONE DC lead + ADPT. each	5.00	1.00
VALVES 572B		29.95	2.50
VALVES 614B		5.95	1.50
NICADS 1.2V	1.2V 2AH FT 290R etc	each 1.75	0.25

ICOM		PRICE	P&P
ICHM8	Keyboard mic with touch tone	14.50	1.50
ICHCM11E	Scan mic	14.95	1.50
ICFL34	10.75 A filter (IC720A)	19.95	1.00
ICCPI	Mobile charger lead IC2E/4E	2.95	1.00
ICLC3	Leather case IC2E/4E	2.50	1.00

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	PRICE	P&P
Van Gorden H1Q-1 Balun transformer	5.95	0.90
Van Gorden trap formers for home base antennas pair	4.95	0.50
SMC PSU 4-5 amps	11.95	3.00
Dummy load VHF/UHF 150W	24.95	1.00
Datong direction finder complete	129.95	3.50
Dipole centre piece c/w fittings + PL259 etc	6.00	1.00
Antex soldering irons c/w stand etc	6.00	1.00
Antex spare bits small, med, large each	0.50	FWA

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	PRICE	P&P
SWR 200 3.5 – 150 MHZ 2KW	42.50	2.00
SWR 145 144 – 145 MHZ thru line type 250W	34.95	2.00
427 H 1+8 – 150 MHZ auto SWR/peak power	62.95	2.50
Toyo YM 11E 3.5 – 150 MHZ 200W	17.95	2.00
SST T-1 random wire antenna tuner	16.95	1.50

A well known + trusted Japanese name this 2 mtr. Hand held similar to IC2E comes compete with flexible Ant, charger, earphones, and carrying strap.

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KT 200EE		145.00	3.75
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Speaker Mic		14.95	F.W.A.
Mobile Ch/Lead		7.95	F.W.A.
Spare Batt/Pack		17.95	F.W.A.

F.W.A. = Free with above

AZTEC UHF/VHF ANTENNAS		PRICE	P&P
HB9CV	2 Ele Yagi complete 2 mtr	4.50	1.50
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AZ2FD	Slim Jim kit complete	3.50	1.00
AZ2FD	Slim Jim assembled	6.00	1.00
AZ2Y5	3 Ele Yagi 2 mtr kit complete	6.50	2.50
AZ2Y5	5 Ele Yagi complete	9.50	2.50
AZ2Y8	8 Ele Yagi 2mtr kit complete	6.00	3.50
AZ2Y8	8 Ele Yagi 2mtr complete	14.00	3.50
AZ2Y10	10 Ele Yagi 2mtr kit complete	14.00	4.00
AZ2Y10	10 Ele Yagi 2mtr complete	16.00	4.00
AZ2Q6	6 Ele quad 2mtr kit complete	12.95	5.00
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AZ70Y17	17 Ele Yagi 70cm complete	13.50	2.75
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Pan Spyder	for h/brew HF triband quads 8 pole	9.95	3.00
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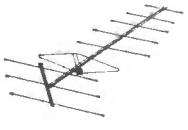

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BK100	Mechanical bug	17.95	2.00

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Oscar 15SE	15 mtrs fold over	11.95	1.50
Oscar 20SE	20 mtrs fold over	12.95	1.50
Oscar 78F	2 mtrs 7/8 fold over	10.95	1.50

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KG5	2 mtr Co/lin	9.95	1.50
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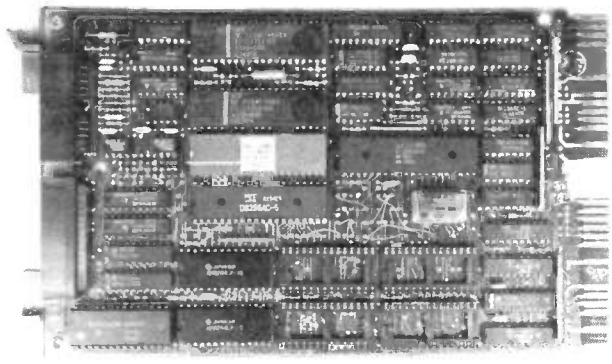
PRODUCT NEWS

SINGLE BOARD COMPUTER

Rapid Recall now stock Digital's new PDP-11 16-bit single board computer, the Falcon-Plus, said to be the smallest SBC on the market.

An enhanced version of Falcon, this Falcon-Plus board features a 16-bit T11 microprocessor (which executes the PDP-11 instruction set), 16Kbytes of static RAM and four 28-pin memory sockets supporting up to 32Kbytes of additional RAM or ROM.



Also contained on the single 13.2cm x 22.8cm dual-height board are two asynchronous serial I/O ports, a 24-line parallel I/O port, a Q-Bus interface and a 50, 60 or 800Hz real-time clock.

Features for system designers include a multiple interrupt structure, four different memory maps and a 64Kbyte direct addressing capability. In addition to Macro-11, Falcon-Plus can also run Micro-Power/Pascal for ROM or RAM based applications and RT11 for general purpose RAM orientated environments.

A user's guide, EK-SBC01-UG, is available for the Falcon-Plus. It documents the configuration of the Falcon-Plus and describes its operation. The manual also includes a full set of schematic drawings, a listing of the KXT11-A5 EPROM set, and describes how to use the Falcon-Plus in place of the earlier Falcon module.

The board will operate as a stand-alone module; a physical Q-Bus backplane is unnecessary if both power and ground are supplied at the module fingerpins. Power requirements are 5V at 2.8 amps maximum, 12V at 0.1 amps maximum.

Rapid Recall Ltd,
Rapid House,
Denmark Street,
High Wycombe,
Bucks HP11 2ER.
Tel: (0494) 26271.

MICRO SYSTEM

The Adtek IDS7000, from Thandar Electronics Ltd, is a portable universal microprocessor development system, supporting the Z80, 8085, 6809 and 8048 microprocessor families.

A Z80A host computer using the CP/M operating system gives users access to an extensive range of application software, including powerful editors, assemblers and compilers essential to the development system environment.

An emulator with 64Kbytes of RAM can be mapped in 256 byte pages; each page can be write-protected. There is a 2K x 40 bit trace memory and 256 x 32 byte register trace which can be controlled by three hardware and one software trigger pointers. The emulator is also capable of in-line assembly, step executions of user programs and control of all interrupts and DMA.

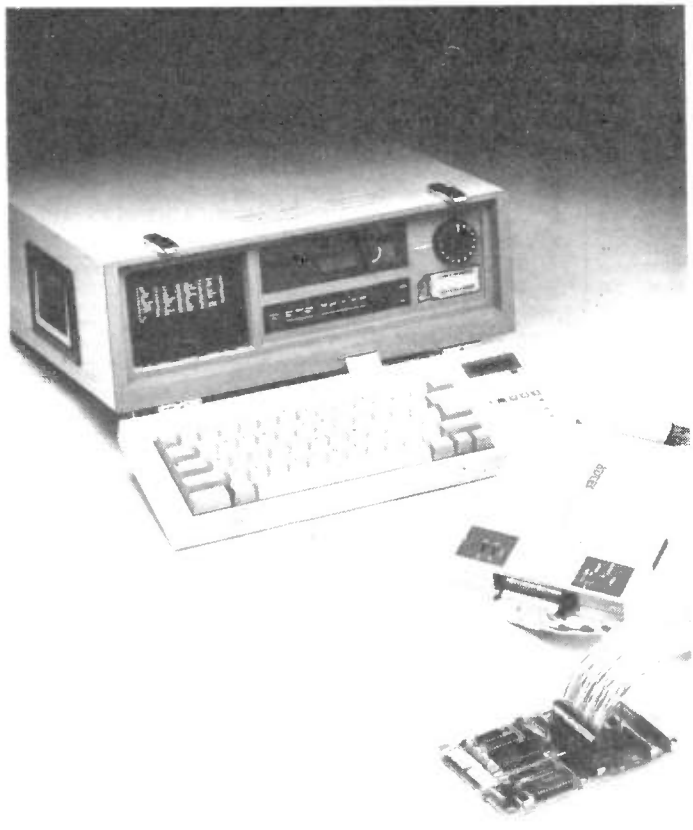
The integrated system also includes a 5¼in 640Kbyte floppy disk drive, an EPROM programmer and eraser, a target CPU frequency counter and HEX calculator with real-time clock.

Thandar Electronics Ltd,
London Road,
St Ives,
Huntingdon,
Cambs PE17 4HJ.

LASER PRINTER

Recently announced by Rapid Terminals is Digital's new tabletop non-impact page printer, the LN03.

Featuring the latest laser xerographic technology, this quiet high-speed machine has an operational noise level of only 54dBA while printing text at 8 pages/minute (333 char/S). Resolution is excellent at 300 x 300 dots/inch and the printer also has pixel graphics capability, enabling the production of simple business graphics (such as pie and bar charts) at up to 150 dots/inch.



The LN03 has a standard RS232 serial interface and can be used for a variety of office/commercial applications: as a printer for single user word processors and personal computers; as a shared resource for Micro PDP-11 and MicroVAX users; or as a remote printer for clusters, LANs and networks.

To cater for quantity throughput the LN03's adjustable paper feed cassette will hold 250 sheets (20lb of paper) and it has a 250 sheet collated output.

Cut sheet sizes can be 8.5 x 11 inches or A4 and the machine will also print on transparencies and labels.

Other features of the LN03 include a 96Kbyte (expandable) buffer as standard; extensive software support; self-test diagnostics with error codes and status printout; and easy low-cost maintenance by the user via self-installed component kits.

The laser printer measures 53 x 41 x 33cm and weighs 28Kg. Operation is from 220-240 volt ac supplies, 50/60Hz.

Rapid Terminals,
Rapid House,
Denmark Street,
High Wycombe,
Bucks HP11 2ER.
Tel: (0494) 26271.

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PRODUCT NEWS

CAPACITANCE METER

Now available from Thurlby Electronics Ltd is the CM200 digital capacitance meter. Combining a maximum settling time of 0.65 seconds to the first valid reading with a 3 per second reading rate, the instrument can determine the value of an unknown capacitor faster than most autoranging meters.

The CM200 measures capacitance between 1pF and 2500μF to an accuracy of 0.2%. It has a 4½-digit liquid crystal display with a maximum reading in excess of 25,000 counts.

A feature of the instrument is a special input socket arrangement which allows for the direct connection of a wide variety of capacitors or standard test leads. A zero calibration control enables the user to null out up to 25pF of test lead capacitance.

Lightweight and easily portable, the CM200 is designed for use in such areas as development, production, quality control and component inspection. Operation is via an ac line adaptor or batteries with a life in excess of 500 hours. The instrument is housed in a rugged case with built-in tilt stand.

Supplied with operating instructions and an ac line adaptor, the CM200 costs £89 plus VAT.

Thurlby Electronics Ltd,
New Road,
St Ives,
Huntingdon,
Cambs PE17 4BG.

DECmate III

Just introduced by Rapid Terminals is Digital's new full-function word processor and integrated office terminal – the DECmate III.

This compact 96K byte machine is designed for managers, clerical workers and other professional users who handle large amounts of text but also require full communications. It features the same keyboard and 12 inch monochrome monitor as the DECmate II office workstation, but the use of gate array technology has enabled Digital to produce its smallest-ever system unit containing two 5.25 inch floppy disc drives (totalling 800K bytes of storage) and three option slots. The footprint is only 30 x 28cm.

A complementary member of the DECmate family, DECmate III offers professional 'Gold-Key' word processing (one or two keystrokes for virtually all editing functions) as well as many of the DECmate II features. The DECmate/WPS software package – which combines the multitasking operating system and list processing, maths and communication applications packages in one – allows communications from DECmate to DECmate, DECmate to Digital multi-user systems, and from DECmate to external databases.

DECmate III will emulate the VT102 terminal as standard; VT125 emulation will soon be available. Shortly to be announced are two option cards: the 8-bit auxiliary processing unit will allow the addition of DECspell, Digital's spelling verifier and corrector based on the 70,000 word Houghton-Mifflin American Heritage dictionary. The Z80A card will allow the system to run CP/M-based office applications, including spreadsheets such as Multi-Plan for the production of business graphics on Digital's LQP02 and LQP03 daisy-wheel printers.

Included in the price of DECmate III is the DECmate/WPS software package, documentation, training manuals, 12 months on-site warranty and telephone support (provided by Digital's Customer Information Centre).

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

LCD MULTIMETER

A hand-held digital ac/dc volts and ac/dc amps multimeter, type DM30, from Selectronix has a half-inch high LCD digital display and easily operated rotary function/range switch.

Nine functions and twenty-nine measuring ranges are provided by this tester. Resistance ranges are from 200 ohms to 20Mohms. Accuracies are good – V dc 0.5%. The unit is 4¾ inches (120mm) tall, fits easily in the hand and weighs 200 grams.

Battery life is 300 hours with an automatic Lobat warning in the LCD panel when battery life is down to 10%. Other features include an h_{fe} transistor tester, diode test and overload protection on all ranges.

Supplied with two test probe leads, battery, spare fuse and soft carrying case, the DM30 multitester is available at a single unit price of £39.00 (£46.57 inclusive of VAT, post and packing).

Selectronix,
Tower House,
Lower Kings Road,
Berkhamsted,
Herts HP4 2AB.
Tel: (04427) 74973.

AA117	9p	BD682	45p	OC35	100p	3N128	55p	ECL80	57p	4520	51p	74LS148	120p	MB3712	180p
AA119	9p	BDX32	100p	OC36	120p	3N143	65p	ECL82	59p	4521	100p	74LS151	45p	MB3730	280p
AAY32	9p	BDX65	89p	OC45	80p	**DIODES**		ECL84	57p	4522	90p	74LS153	90p	MB3756	280p
AC107	28p	BDY92	100p	OC71	30p	AA119	9p	ECL85	57p	4526	57p	74LS154	180p	MC1327	70p
AC126	17p	BF180	18p	OC72	80p	BY100	40p	ECL86	49p	4527	57p	74LS155	85p	NE555	20p
AC127	16p	BF181	18p	OC200	180p	BY103	32p	EF80	31p	4528	57p	74LS156	85p	NE556	40p
AC128	18p	BF183	20p	R2008B	180p	BY126	8p	EF85	34p	4529	100p	74LS157	35p	SAS560	110p
AC128K	23p	BF184	20p	R2010B	100p	BY127	8p	EF89	43p	4532	82p	74LS158	80p	SAS570	110p
AC141K	30p	BF185	20p	TAG4443	75p	BY133	8p	EF183	45p	4551	84p	74LS160	85p	SN76003N	140p
AC142K	30p	BF194	8p	TAG4444	75p	BY184	40p	EF184	45p	4553	230p	74LS161	85p	SN76013N	140p
AC153K	23p	BF195	8p	TIP29	18p	BY176	85p	EL34	180p	4555	80p	74LS182	85p	SN76023N	140p
AC176	18p	BF196	8p	TIP29A	22p	BY179	35p	EL36	80p	4556	47p	74LS163	90p	SN76033N	180p
AC176K	20p	BF197	7p	TIP29C	28p	BY182	32p	EL84	50p	4557	230p	74LS164	85p	SN76110N	70p
AC187	18p	BF198	7p	TIP30	28p	BY184	32p	EL95	50p	4583	85p	74LS165	85p	SN76115	70p
AC187K	20p	BF199	6p	TIP30C	30p	BY187	32p	EL500	80p	4584	42p	74LS166	120p	T2800D	82p
AC188	17p	BF200	16p	TIP31A	24p	BY196	20p	EL504	100p	4585	89p	74LS168	120p	TA-7120	89p
AC188K	23p	BF240	16p	TIP31C	30p	BY206	11p	EY86	31p			74LS169	90p	TA-7137P	83p
ACY18	48p	BF241	10p	TIP32	24p	BY207	11p	EY87	31p	**74 SERIES**		74LS170	120p	TA-7148P	400p
ACY19	48p	BF255	12p	TIP32A	24p	BY208	18p	EY88	42p	7400	22p	74LS174	85p	TA-7193P	400p
AD142	60p	BF256	18p	TIP32C	28p	BY210	22p	EZ35	48p	7401	18p	74LS175	85p	TA-7200	200p
AD149	45p	BF257	18p	TIP33	80p	BY223	72p	EZ80	50p	7402	18p	74LS190	70p	TA-7201	200p
AD161	23p	BF258	18p	TIP34	80p	BY225	120p	EZ81	55p	7403	22p	74LS191	85p	TA-7203	180p
AD162	23p	BF259	18p	TIP41A	22p	BY226	18p	GZ34	180p	7404	40p	74LS192	80p	TA-7204	110p
AF124	25p	BF262	25p	TIP41C	28p	BY227	18p	PC97	100p	7405	10p	74LS193	73p	TA-7205	80p
AF125	25p	BF263	25p	TIP42A	22p	BY228	32p	PCC85	43p	7406	40p	74LS194	88p	TA-7210	200p
AF126	25p	BF270	18p	TIP42C	28p	BY296	30p	PCF80	58p	7407	40p	74LS195	80p	TA-7222AP	120p
AF127	25p	BF273	18p	TIP47	40p	BY298	28p	PCF200	135p	7408	25p	74LS196	72p	TA-7310P	100p
AF139	22p	BF311	21p	TIP48	40p	BY299	28p	PCF801	110p	7409	30p	74LS197	85p	TA-7609	270p
AF239	22p	BF324	28p	TIP50	60p	BY476	90p	PCF802	87p	7413	35p	74LS221	75p	TAA550	18p
AL112	70p	BF336	20p	TIP51	120p	BYX10	15p	PCF806	115p	7414	45p	74LS240	90p	TBA120S	48p
AL113	80p	BF337	20p	TIP52	120p	BYX55/350	30p	PCH200	100p	7417	32p	74LS241	72p	TBA395	80p
ASZ15	100p	BF338	20p	TIP53	120p	BYX55/600	30p	PCL81	64p	7420	22p	74LS242	78p	TBA396	80p
ASZ17	100p	BF355	28p	TIP54	140p	BYX55/800	32p	PCL82	63p	7421	28p	74LS243	78p	TBA520	100p
AU110	110p	BF362	30p	TIP105	65p	BYX70/300	29p	PCL84	50p	7425	15p	74LS244	90p	TBA530	100p
AY102	180p	BF367	13p	TIP106	65p	BYX70/500	32p	PCL85	58p	7430	25p	74LS245	90p	TBA540	100p
AY106	180p	BF371	17p	TIP107	85p	BYX70/800	36p	PCL86	58p	7437	28p	74LS247	80p	TBA560	100p
BA145	10p	BF414	18p	TIP110	47p	BYX71/600	80p	PCL805	55p	7442	45p	74LS248	80p	TBA750	100p
BA148	10p	BF420	16p	TIP111	80p	OA47	6p	PFL200	85p	7447	60p	74LS249	80p	TBA800	35p
BA154	9p	BF421	18p	TIP112	48p	OA90	4p	PL36	80p	7450	22p	74LS251	30p	TBA810S	80p
BA157	12p	BF422	21p	TIP115	48p	OA91	4p	PL82	48p	7451	10p	74LS253	85p	TBA820	78p
BB101	13p	BF423	18p	TIP116	48p	OA200	7p	PL83	32p	7454	25p	74LS256	85p	TBA920	100p
BB103	16p	BF440	16p	TIP117	80p	OA202	7p	PL84	50p	7470	30p	74LS257	80p	TBA950	100p
BB105B	18p	BF451	17p	TIP120	43p	IN.914	2p	PL95	140p	7473	30p	74LS258	80p	TBA990	100p
BB205B	24p	BF455	14p	TIP121	46p	IN.4001	4p	PL500	110p	7474	40p	74LS259	80p	TCA270	40p
BC107	7p	BF458	19p	TIP122	47p	IN.4002	4p	PL504	98p	7475	25p	74LS260	85p	TCA800	200p
BC108	7p	BF459	19p	TIP125	47p	IN.4003	4p	PL508	170p	7481	90p	74LS266	28p	TCA940	100p
BC109	7p	BF461	60p	TIP126	58p	IN.4004	4p	PL519	450p	7482	70p	74LS273	80p	TDA1170	100p
BC115	10p	BF462	62p	TIP127	58p	IN.4005	4p	PY81	70p	7485	45p	74LS279	85p	TDA1412	80p
BC118	11p	BF469	30p	TIP141	90p	IN.4006	4p	PY88	48p	7486	90p	74LS280	180p	TDA2002	80p
BC140	19p	BF470	28p	TIP142	90p	IN.4007	5p	PY500A	160p	7489	100p	74LS290	90p	TDA2003	180p
BC141	19p	BF471	28p	TIP145	68p	IN.4148	2p			7490	38p	74LS293	90p	TDA2020	140p
BC142	19p	BF479	30p	TIP146	90p	IN.5400	9p	**CMOS**		7492	45p	74LS365	44p	TDA2030	140p
BC143	19p	BF493	18p	TIP147	100p	IN.5401	10p	4000	20p	7493	35p	74LS366	44p	TDA2522	80p
BC147	9p	BF494	16p	TIP2955	42p	IN.5402	10p	4001	20p	7495	48p	74LS367	44p	TDA2530	100p
BC148	9p	BF595	16p	TIP3054	45p	IN.5403	11p	4002	20p	7497	80p	74LS368	42p	TDA2532	100p
BC149	9p	BF595	16p	TIP3055	42p	IN.5404	11p	4006	65p	74107	30p	74LS373	85p	TDA2540	100p
BC157	9p	BF597	10p	TIS43	45p	IN.5405	12p	4007	23p	74111	52p	74LS374	85p	TDA2560	100p
BC159	9p	BF615	30p	TIS44	40p	IN.5406	13p	4008	52p	74116	85p	74LS375	70p	TDA2593	100p
BC182	9p	BF758	41p	TIS61	18p	IN.5407	13p	4009	40p	74119	85p	74LS399	85p	TDA2690	100p
BC182L	9p	BF869	22p	TIS88A	45p	IN.5408	13p	4010	50p	74122	40p	74LS670	130p	UPC-555H	90p
BC183	9p	BF870	22p	TIS90	18p	**ZENERS**		4011	20p	74123	20p			UPC-556H	90p
BC183L	9p	BF872	22p	TIS91	18p	400MW		4012	23p	74125	40p	**LINEAR IC'S**		UPC-575C2	100p
BC184	9p	BF960	35p	TIS93	20p	BZY88 Range		4013	30p	74126	45p	AN-214P	300p	UPC-577H	64p
BC184L	9p	BF963	40p	VK1010	88p	2V7 to 39V	9p	4014	50p	74132	42p	AN-240P	180p	UPC-592H2	98p
BC212	9p	BF964	38p	VN.10KM	60p	1.3W Zeners		4015	42p	74141	55p	AN-360	120p	UPC-1001H	220p
BC212L	9p	BF966	40p	VN.46AF	88p	BZX61 Range		4016	30p	74145	70p	AN-7110	140p	UPC-1025H	230p
BC213	9p	BFR40	25p	VN.66AF	100p	2V7 to 39V	12p	4017	43p	74153	45p	AN-7114	180p	UPC-1026C	108p
BC213L	9p	BFR51	21p	VN.88AF	118p	**JAPANESE TRANSISTORS**		4018	45p	74155	45p	AN-7115	180p	UPC-1028H	80p
BC214	9p	BFR62	21p	VN.89AF	110p	2SB324	55p	4019	50p	74157	45p	AN-7120	140p	UPC-1031H2	180p
BC214L	9p	BFR79	25p	ZTX107	11p	2SB507	65p	4020	72p	74160	50p	AY3-1270	680p	UPC-1032H	70p
BC237	7p	BFR90	52p	ZTX108	11p	2SB554	90p	4021	52p	74164	50p	AY3-1350	300p	UPC-1155H	200p
BC238	7p	BFR91	99p	ZTX109	12p	2SC495	60p	4022	52p	74167	35p	AY3-8910	300p	UPC-1156H	140p
BC300	18p	BFX29	20p	ZTX212	27p	2SC1060	99p	4024	24p	74173	50p	AY3-8912	400p	UPC-1181H	118p
BC301	18p	BFX84	20p	ZTX300	13p	2SC1061	200p	4025	35p	74174	70p	AY5-3600	570p	UPC-1182H	180p
BC302	18p	BFX85	20p	ZTX301	16p	2SC1096	75p	4026	22p	74175	65p	CA270	40p	UPC-1185H2	250p
BC303	18p	BFX87	18p	ZTX302	16p	2SC1161	110p	4027	75p	74176	45p	CA3046	80p	UPC-1350C	180p
BC327	9p	BFX88	18p	ZTX303	24p	2SC1172	180p	4028	36p	74180	50p	CA3048	180p		
BC328	9p	BFX89	50p	ZTX304	17p	2SC1306	90p	4029	40p	74182	45p	CA3060	280p	**COMPUTER ICS**	
BC337	9p	BFY17	30p	ZTX320	25p	2SC1307	100p	4030	55p	74192	40p	CA3080E	70p	2114	200p
BC338	9p	BFY18	40p	ZTX326	25p	2SC1678	120p	4031	30p	74196	40p	CA3086	85p	2516	200p
BC557	9p	BFY41	25p	ZTX500	13p	2SC1969	130p	4032	120p	74197	45p	CA3089E	180p	2532	370p
BCY32	180p	BFY50	14p	ZTX501	12p	2SC2028	75p	4033	64p	74393	70p	CA3090AQ	300p	2716	300p
BCY33	180p	BFY51	14p	ZTX502	14p	2SC2029	120p	4034	118p			CA3130E	90p	2732	400p
BCY34	180p	BFY52	14p	ZTX503	15p	2SC2078	120p	4035	140p	**74LS SERIES**		CA3130S	100p	2764	425p
BCY42	20p	BFY56	20p	ZTX504	25p			4036	90p	74LS00	24p	CA3140E	38p	27128	900p
BCY56	18p	BFY57	25p	ZTX550	24p	**LOW PROFILE SOCKETS**		4037	220p	74LS01	24p	CA3189E	250p	4116	75p
BCY70	18p	BFY64	25p	2N.696	26p			4038	100p	74LS02	24p	CA3240E	90p	4164	300p
BCY71	18p	BFY90	48p	2N.697	22p	8 pin	5p	4039	98p	74LS03	24p	HA-1156W	110p	6116	400p
BCY72	18p	BLY48	85p	2N.698	40p	14 pin	8p	4040	220p	74S04	24p	HA-1197	180p	6264-15	2000p
BD115	26p	BLY49	88p	2N.699	45p	16 pin	8p	4041	52p	74LS05	23p	HA-1306W	170p	6502	320p
BD124P	50p	BR100	14p	2N.706A	22p	18 pin	12p	4042	40p	74LS08	24p	HA-1319	250p	6802	220p
BD124	110p	BR101	43p	2N.708	22p	20 pin	14p	4043	47p	74LS09	25p	HA-1339	17p	6809	600p
BD128	35p	BR103	37p	2N.914	22p	22 pin	16p	4044	42p	74S10	25p	HA-1342	170p	6821	180p
BD131	25p	BSX20	18p	2N.918	36p	24 pin	18p	4045	48p	74S11	25p	HA-1366WR	180p	6840	320p
BD132	25p	BSX26	18p	2N.930	16p	28 pin	20p	4046	98p	74LS12	25p	HA-1368	160p	6850	130p
BD135	20p	BSX29	18p	2N.1131	28p	40 pin	25p	4047	55p	74S13	30p	HA-1377	220p	8080A	400p
BD136	20p	BT106	90p	2N.1132	28p			4048	55p	74S14	40p	HA-1389	140p	8085A	530p
BD137	20p	BT109	90p	2N.1613	24p	**VOLTAGE REGULATORS**		4049	48p	74LS15	24p	HA-1392	230p	8155	470p
BD138	20p	BT116	80p	2N.1711	24p	7805	35p	4050	33p	74LS20	24p	HA-1397	250p	8156	380p
BD139	20p	BT119	100p	2N.2102	50p	7812	35p	4051	30p	74LS21	24p	HA-1398	240p	8250	880p
BD140	20p	BT120	100p	2N.2160	300p	7815	35p	4052	67p	74LS22	24p	LA-1201	85p	8251	470p
BD144	90p	BT138/600	80p	2N.2218A	24p	7818	35p	4053	88p	74LS24	47p	LA-1352	120p	8253	580p
BD150	30p	BT146/750	98p	2N.2219	24p	7824	35p	4054	54p	74LS26	24p	LA-1365	140p	8255	600p
BD157	35p	BT151/650	88p	2N.2221	23p	78L05	28p	4055	74p	74LS27	24p	LA-3301	120p	8288	1000p
BD158	38p	BT151/800	88p	2N.2222	23p	78L12	28p	4056	75p	74LS28	24p	LA-3350	120p		
BD166	30p	BTY79/500	140p	2N.2369	15p	78L15	28p	4060	60p	74LS30	24p	LA-3361	115p		
BD175	30p	BU100A	110p	2N.2484	20p	78L18	28p	4063	78p	74LS32	24p	LA-4030	200p		
BD177	30p	BU104	100p	2N.2646	40p	78L24	28p	4066	38p	73LS33	26p	LA-4031	140p		
BD179	32p	BU105	80p	2N.2904	20p	79L05	40p	4067	220p	74LS37	24p	LA-4032	140p		
BD181	45p	BU108	100p	2N.2905	20p	79L12	40p	4068	24p	74LS38	24p	LA-4050	130p		
BD182	50p	BU110	110p	2N.2906	18p	79L15	40p	4069	24p	74LS40	24p	LA-4051	180p		
BD183	50p	BU111	140p	2N.2907	18p	LM309K	100p	4070	23p	74LS42	48p	LA-4100	180p		
BD201	33p	BU124	90p	2N.2926	8p	LM317K	220p	4071	23p	74LS47	78p	LA-4101	100p		
BD202	38p	BU126	70p	2N.3019	28p	LM317T	180p	4072	23p	74LS48	78p	LA-4102SK	140p		
BD203	42p	BU204	75p	2N.3053	15p	LM323K	420p	4073	23p	74LS51	24p	LA-4112	250p		
BD204	42p	BU205	70p	2N.3054	35p	LM723	32p	4075	23p	74LS54	24p	LA-4125	210p		
BD222	31p	BU208	75p	2N.3055	35p	78HGKC	570p	4076	60p	75LS55	24p	LA-4140	70p		
BD225	31p	BU208A	80p	2N.3055H	50p	78HO5KC	520p	4077	24p	74LS73	28p	LA-4201	120p		
BD232	31p	BU208D	100p	2N.3440	58p	78GU1C	190p	4078	24p	74LS74	33p	LA-4220	120p		
BD234	32p	BU325	85p	2N.3442	85p	79GU1C	215p	4085	85p	74LS75	36p	LA-4400	180p		
BD235	28p	BU326	85p	2N.3702	9p	79HGKC	670p	4086	75p	74LS78	28p	LA-4420	140p		
BD236	30p	BU406	85p	2N.3703	9p			4089	110p	74LS83	55p	LA-4422	130p		
BD237	31p	BU406D	95p	2N.3704	9p	**VALVES**		4093	32p	74LS85	75p	LA-4430	130p		
BD238	24p	BU407	75p	2N.3705	9p	DAF96	80p	4094	85p	74LS86	32p	LA-4460	170p		
BD244	50p	BU407D	95p	2N.3706	9p	DF96	50p	4095	85p	74LS90	45p	LA-4461	180p		
BD245	50p	BU408	85p	2N.3707	9p	DL92	47p	4098	70p	74LS91	55p	LA-5112	120p		
BD433	28p	BU408D	95p	2N.3708	9p	DY86	50p	4099	70p	74LS92	50p	LM301	28p		
BD434	30p	BU409	95p	2N.3771	85p	DY87	50p	4501	34p	74LS93	48p	LM311	35p		
BD435	31p	BU426	120p	2N.3772	90p	DY802	45p	4502	50p	74LS95	80p	LM324	35p		
BD437	28p	BU500	110p	2N.3773	100p	EABC80	50p	4503	36p	74LS96	80p	LM325	45p		
BD438	38p	BU526	90p	2N.3819	22p	EB91	44p	4504	72p	74LS107	38p	LM339	40p		
BD439	40p	BU801	95p	2N.3866	65p	EBF80	45p	4505	340p	74LS109	38p	LM348	80p		
BD440	40p	BU806	120p	2N.3903	11p	EBF89	50p	4506	80p	74LS112	40p	LM380	100p		
BD441	40p	BU807	95p	2N.3904	11p	ECC82	40p	4507	34p	74LS113	32p	LM381	180p		
BD442	40p	C106D	22p	2N.3905	11p	ECC83	43p	4508	110p	74LS114	42p	LM382	130p		
BD533	50p	MJ2500	100p	2N.3906	11p	ECC84	40p	4510	82p	74LS122	68p	LM387	100p		
BD534	38p	MJ2501	110p	2N.4031	28p	ECC85	40p	4511	48p	74LS123	70p	LM709 DIL	80p		
BD535	38p	MJ2955	88p	2N.4036	28p	ECH81	48p	4512	53p	74LS124	98p	LM723	40p		
BD536	38p	MJ3000	118p	2N.4037	25p	ECH84	52p	4513	130p	74LS125	38p	LM741 DIL	18p		
BD537	40p	MJ3001	118p	2N.4058	13p			4514	100p	74LS126	42p	LM741 MET	45p		
BD538	40p	MJE29A	30p	2N.4443	76p			4515	100p	74LS132	63p	LM747	58p		
BD675	40p	MJE30A	30p	2N.4444	76p			4516	83p	74LS133	46p	LM748	35p		
BD676	40p	MJE340	25p	2N.5061	20p			4517	208p	74LS136	38p	LM1458	33p		
BD677	38p	MJE350	80p	2N.5294	30p			4518	48p	74LS138	47p	LM3900	30p		
BD678	40p	MJE520	30p	2N.5296	30p			4519	32p	74LS139	48p	M-51513L	180p		
BD680	40p	MJE2955K	90p	2N.6106	40p					74LS145	90p	M-51515BL	270p		
BD679	40p	OC28	100p	2N.6107	40p					74LS147	130p	M-51516	280p		
BD681	48p	OC29	90p	2N.6109	40p							M-51517L	280p		

AY3-1015	280p
AY5-3600	570p
SPO256AL2	580p
Z80ACPU	280p
Z80BCPU	500p
Z80ADMA	650p
Z80AP10	280p
Z80BP10	600p
Z80ACTC	280p
Z80BCTC	600p
Z80AS10	980p
Z80AS10/1	700p
Z80AS10/2	700p
Z80ADART	980

LED

LED 3mm RED	5p
LED 3mm YEL	10p
LED 3mm GRN	10p
LED 5mm RED	8p
LED 5mm YEL	10p
LED 5mm GRN	10p

OPTO ELECTRONICS

2N.5777	40p
OCP71	100p
ORP12	65p
ORP60	100p
DRP61	100p

DISPLAYS

MAN.72	115p
MAN.74	115p
MAN.4640	180p
MAN.8910	230p
DL.747	180p

TRIACS PLASTIC

TIC206D-4A/400V	80p
TIC225D-6A/400V	88p
TIC226D-8A/400V	88p
TIC236D-12A/400V	85p
TIC246D-18A/400V	90Sp
TIC253D-20A/400V	180p
TIC263D-25A/400V	200p
T2800D	82p

THYRISTORS

2N.5081-0.8A/60V	20p
2N.5062-0.8A/100V	22p
2N.5064-0.8A/200V	20p
C106D 4A/400V	23p
TIC116C 8A/300V	68p
TIC116D 8A/400V	70p
TIC116M 8A/600V	78p
TIC126D 12A/400V	78p
TIC126M 12A/600V	80p
2N.4444	78p
BT106	80p
BT116	80p
BT119	100p
BT120	100p
TIC44	22p
TIC45	27p
TIC47	32p

BRIDGE RECTIFIERS

W005 1A/50V	18p
W01 1A/100V	18p
W02 1A/200V	18p
W04 1A/400V	21p
W06 1A/600V	22p
W08 1A/800V	22p
BR81D 2A/100V	35p
BR82D 2A/200V	38p
BR84D 2A/400V	42p
BR86D 2A/600V	54p
BR88D 2A/800V	58p
BR32 3A/200V	68p
BR34 3A/400V	68p
BR36 3A/600V	78p
BR62 6A/200V	100p
BR64 6A/400V	80p
BR251 25A/100V	180p
BY164	40p
BY179	35p

ELECTROLYTIC CAPACITORS

4700UF-16V CAN	80p
4700UF-40V CAN	90p
*4700UF-40V CAN	92p
*6500UF-50V CAN	100p
6800UF-40V CAN	89p
10000UF-16V CAN	83p
10000UF-25V CAN	87p
*15000UF-10V CAN	89p
33000UF-16V CAN	89p
47000UF-6.3V CAN	89p
2000+2K/35V CAN	89p
2200UF-40V CAN	35p
2350+2350-63V CAN	125p
*2800UF-100V CAN	92p

*Computer Grade Types
Computer grade types have screw terminals. Other types are tag terminal.

SONY THYRISTORS

SG613	550p
SG264	480p

CRYSTALS

FREQ IN MHZ

1.0	280p
2.00	200p
2.45760(L)	180p
2.45760	180p
2.5	200p
2.662	200p
3.276	118p
3.5795	98p
4.0	110p
4.194	130p
4.43	98p
4.606	180p
4.9152	180p
5.0	130p
6.0	118p
7.0	128p
8.0	128p
8.867	128p
10.0	140p
10.50	200p
10.70	180p
11.0	250p
12.0	120p
14.0	128p
14.138	120p
14.756	200p
15.0	180p
18.0	130p
18.0	130p
18.432	130p
19.969	130p
20.0	180p
24.0	250p
48.0	180p

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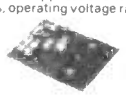

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MM 100G - As MM 100 except inputs are for 2 guitar + microphone. £10.95 + V.A.T.

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AF1 – A small audio amplifier board consuming very low quiescent current. The unit is intended to complement the CWF1 CW fitter where it would act as an audio buffer. The board also boasts an externally activated mute circuit.

Details of these and other new products are included in our 1985 catalogue. This will be posted to you on receipt of an A5 stamped self-addressed envelope. Kits are usually available by return of post but please allow 28 days for any unforeseen shortages. Place your order by post or by telephone using your credit card. Please include £1.00 to cover order handling and postage.

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NEWS DESK

SPACE 'MTR' compiler

SPACE (System Process Analysis and Control Engineering Ltd) aims to licence one thousand UK sites to use its 'MTR' logic design language.

Software designers using the SPACE MTR compiler can convert their programs to any desired language by simple menu selection. The option to select the target language protects the users' design effort, because the designer is no longer locked into one language. Assembly languages can also be selected so design engineers are able to switch micro-processor architecture at any time during or after the development.

Designers may have several versions of the same program up and running in parallel, but because there is only one master MTR program any changes to the MTR will automatically be implemented in all target language versions.

The SPACE MTR compiler runs on any Intel Series III or Series IV development system and currently produces ADA, PASCAL, CORAL 66, and ASM 80 target languages.

For further information telephone (06846) 3626.

Tatung Einstein

Kuma Computers Ltd have further expanded their range of application software for the Tatung Einstein (reviewed in *R&EW*, December 1984) with the release of *Communications with Viewdata*.

This powerful package enables the Einstein user to access electronic mail and information services such as Prestel and Telecom Gold. To operate the Einstein as an electronic mail terminal the user only requires this package, a modem and a subscription for the service of his choice.

No computer skills are required to run this program, since it is menu driven. In addition, a comprehensive, step-by-step manual is supplied with the package. The parameters of the program are preset for Prestel, although these can easily be altered by following the detailed instructions given.

Communications with Viewdata can be used to Save, View and Print Prestel files, download Telesoftware and access Telecom Gold. It is therefore useful to both home and professional users of the Einstein.

The package costs only £39.95 including VAT and is available from all good microcomputer retailers.

Other Kuma titles for the Einstein include *Word Processing, Spreadsheet, Database, Forth, Pascal, ZEN Assembler* and a selection of entertainment packages. For further information on this package and the complete range of Kuma products for the Tatung Einstein, contact: *Kuma Computers Ltd, 12 Horseshoe Park, Pangbourne RG8 7JW. Tel: (07357) 4335.*

Still on the subject of the Einstein, another software distributor, Xitan Ltd, has been appointed as the authorised distributor of CP/M software for this computer.

Its range for the Tatung Einstein includes software from Digital Research, Ashton-Tate, Sorcim/IUS and Microsoft.

Further information is available from: *Xitan Ltd, Xitan House, 27 Salisbury Road, Totton, Southampton. Tel: (0703) 871211.*

Life after TAU

After the sudden demise of TAU Systems Ltd, we have received news of the formation of ATUs UK of Cap Co Electronics Ltd, formed by Tony Johnston (G4OGP) and his XYL, Helen. Tony was the founder of TAU Systems, the inventor of the open wire clip-on feeder spacer and the designer of the SPC-3000 ATU.

Cap Co Electronics Ltd plan to start where TAU finished, producing the whole range of ATUs and associated components, as well as their latest design, the SPC300.

This ATU is suitable for low power operation up to 300 watts PEP. It is the same design as its big brother, the SPC3000, and even uses the same coil size. However, the much smaller new capacitors and mainframe mean that the unit now only measures 9 inches wide, 3 inches high and 9 inches deep. The unit will tune 1 to 30MHz with no gaps.

A new more reasonable price structure on the whole range has been devised, for example, the SPC3000 module will now be sensibly priced at £99.00 approximately and the new SPC300 module will be £75.00 approximately.

All enquiries may be made by phoning Tony or Helen on (0695) 27948.

DEC Village moves

Rapid Recall and the Digital Equipment Corporation are joining forces again this year to stage a combined exhibition and series of seminars. Known as DEC Village, the event has been moved from London to the Solihull Conference and Banqueting Centre and will be held on 10 and 11 June.

DEC Village provides an opportunity to discuss, inspect, try out and learn about the full range of Digital small computer systems and terminals from the Rainbow personal computer to the MicroVAX and from the LQP03 daisywheel printer to the new LN03 laser printer.

Subject to Digital's prior announcement in the States, DEC Village will provide the first opportunity in the UK to view the new MicroVAX 2, which is an improved version of the MicroVAX 1 announced about a year ago.

DEC Village will be of value to individuals from a wide range of disciplines including industrial control, commerce and personal computing.

There will be four simultaneous seminars at which 28 papers will be presented. The papers cover all aspects of computing with Digital and include the entire spectrum from in-depth technical dissertations to over-view papers on products and using computers.

The exhibition will include stands by Digital, Rapid Recall and Rapid Terminals as well as invited OEMs who will be demonstrating various products using Digital computers.

One stand will be devoted to plug-in boards for both industrial and commercial use and it is anticipated that several new boards will be announced at the show.

Admission to DEC Village is free by ticket only. For a ticket application form and a brochure describing the event in more detail contact: *Rapid Recall Limited, c/o BCA, 58 London Road, Southborough, Tunbridge Wells, Kent TN4 0PR. Tel: (0892) 38414.*

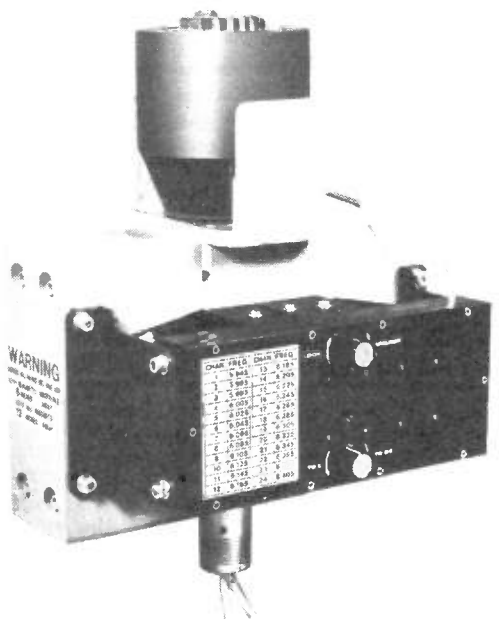
NEWS DESK

Thomson-CSF at the NAB

Following a long-standing tradition, the Electron Tube Division of Thomson-CSF of Basingstoke will be present at the annual US broadcast rendezvous, the NAB show 1985, with a selection of its range of TV broadcasting and radio broadcasting tubes.

The new star in the Thomson-CSF line of UHF-TV tetrodes will be unveiled in the American arena after its recent European debut: the TH563, which delivers 50KW. Also on display will be the TH558, a tetrode designed for short wave radio broadcasting transmitters, capable of delivering over 500KW and operating at frequencies up to 30MHz.

Both of these tubes incorporate the Thomson-CSF patented Hypervapotron cooling and Pyrobloc grids, without which such performances would be difficult to obtain.



The NAB this year will also be the showcase for some Thomson-CSF microwave tubes for satellite-uplink earth stations, which are becoming increasingly popular in broadcast applications. In particular, the TH2417CA, a 6GHz klystron delivering 3.35KW, and the TH3639A, a 14GHz TWT delivering 160 watts for small (and even mobile) earth stations, are two new tubes especially adapted to this growing market.

They represent the growing families of Ku-band and C-band tubes for satellite uplinks, which now count over fifteen different tubes in each band.

Series III fans

Papst Motors Limited of Andover showed a wide range of ac and dc equipment fans at the All Electronics Show at Olympia last month. Products in the new Series III Multifan range of 80 and 92mm brushless dc fans were included. All fans in this range have a depth of only 32mm and yet are capable of airflows up to 80m³/h.

Fitted with precision ball bearings, Series III fans are driven by new 4-pole brushless dc motors which feature polarity protection and automatic restart. The use of a positive temperature coefficient resistor in the drive electronics allows the fan to start with a very slow ramp-up voltage.

The show also marked the publication of Papst's 40-page *Fan and Blower Catalogue,* which contains detailed information on many new products and accessories and features a revised and comprehensive introduction to fan technology, with selection charts and other useful information for the design engineer.

Also on display was a comprehensive selection of fan accessories, including the new LZ120 Daisy Chain connectors which are now available with 2, 3, 4 and 6 connector heads and are proving extremely valuable in many applications requiring the interconnection of multi-fan assemblies on fan trays. The vast majority of these accessory products are designed and manufactured in the UK at Papst in Andover to BS specifications.

Soldering machine

Quadpacks, chip-carriers and other surface-mounted components can be mounted and soldered by the new Farco F120FP machine from Dage Intersem. Because the machine is developed from TAB principles, it offers exceptionally high placement accuracy, bringing precision mounting techniques to complex large-scale ICs. The system will place the surface-mounting components onto boards which are already populated and will also desolder components.

It takes just a couple of minutes to set the machine up for a production run. Components for placement and soldering are placed in a workholder. They are picked up from here and taken to the PCB by means of a pick-and-place arm; users simply program the exact location by manually moving the loaded arm until the positions match the solder pads on the PCB, and then flipping a switch to fix the co-ordinates in memory.

The F120 can place and solder 120 ICs per hour. ICs are soldered onto the PCB by means of a rectangular thermode element which contacts the leads, reflowing the solder and bonding them all into place simultaneously. A cleaning and lapping station ensures that the thermode remains in good condition throughout a production run. Use of reflow soldering techniques ensures a high bond reliability.

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

Fibre optics by IEE

A new lightwave system has been demonstrated by researchers at the AT&T Bell Laboratories in the USA, using the very high transmission capacity that has been developed. This performance opens up great possibilities for fibre optic transmission systems leading to, for example, 400 separate colour television programmes being sent along 68Km of fibre without any repeaters. An alternative way of describing the potential of this system, which represents an order of magnitude improvement over current performance, is that it corresponds to 21 million voice channels – kilometres.

This improvement in performance has been achieved by taking full advantage of the fibre bandwidth by multiplexing ten channels closely spaced in wavelength at the minimum loss region of the fibre.

The results are described in the 31 January 1985 issue of *Electronics Letters* (Vol 21, No 3, pp 105-6) published by *The Institution of Electrical Engineers, Savoy Place, London WC2 0BL. Tel: (01) 240 1871.*

UoSAT news

According to UoSAT Bulletin No 112, information on the newest Russian spacecraft is filtering through.

It appears that work is complete on RS-9 and it is undergoing bench tests in Moscow. RS-9 is a Mode A satellite with a beacon on 29.400MHz and is scheduled for launch late this year with RS-10, which is still under development.

RS-10 will have a Mode A capability but will also have a new mode, Mode K – a 15 metre uplink and a 10 metre downlink.

We also hear that there are opportunities for research fellows, assistants and technicians to work on the UoSAT Spacecraft Programme at UoS. For further information contact the UoSAT Spacecraft Control Centre at the University of Surrey.

SPECTRUM WATCH

NIGEL CAWTHORNE G3TXF

The Mobile Radio Users Association was formed in 1953, following the government's decision to throw mobile radio networks out of Band III in order to make way for the great unknown: Independent Television. More than thirty years later, land mobile radio services in the UK are on the verge of regaining frequencies which have (according to mobile radio users at least!) been 'on loan' to TV broadcasters!

The MRUA conference held in Oxford during March brought together many different parties concerned with mobile radio in the UK. There were users of mobile networks, suppliers of mobile equipment, and very importantly there were also the regulators of the radio frequency spectrum, the Radio Regulatory Division of the DTI.

Band III: difficult assignments

Delegates heard from Rod Stewart, of the RRD's Mobile Services Section, how difficult frequency assignment for the new mobile services in Band III is going to be. The problem is that the UK will be the European odd man out in Band III for many years to come. The UK's close neighbours, France, Ireland, Belgium and Holland, all use Band III (174-223MHz) for television transmissions, as indeed was the case in the UK up until the beginning of this year.

The new Band III mobiles and base stations (it has not yet been announced exactly how Band III will be allocated) will be relatively low powered when compared to the overseas TV transmitters, but there will be a large number of them. The siting of base stations will be critical to the avoidance of interference to overseas TV viewers.

Stewart told delegates that co-ordination agreements have been made with several of the UK's neighbouring administrations. It has been agreed that the combined signal strength from UK stations using frequencies corresponding to overseas TV channels will not exceed defined limits.

For Band III mobile radio users in the south of England it is the French TV transmitter network that is the most significant. Band III frequency planning in this area will avoid the use of French TV carrier frequencies. A number of specified 'test points' along the French coast have been agreed, and the signal strengths received at these points will have to be taken into account by the RRD when assigning frequencies in Band III for land mobile services.

In practice this means that the job of assigning frequencies is made much harder than normal. Each assignment that is being considered will have to be checked not only against possible mutual interference problems within the UK, but also to ensure that the signal strength limits at the test points along the French coast are not exceeded. To do this the RRD uses computer prediction techniques, since each assignment will involve calculating predicted field strengths at up to 20 test points.

More news soon

The mobile radio industry is still eagerly awaiting announcements from the DTI on exactly how Band III will be used. Unlike the 1953 decision, which removed mobile radio users from Band III without any consultation, the present decision making process has involved consultation with all the interested parties.

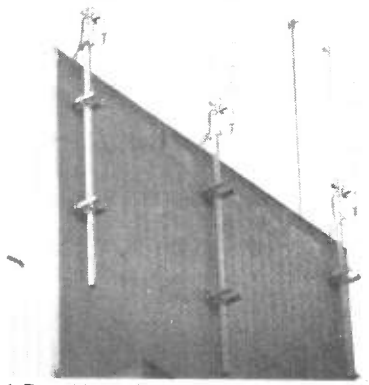
Last May the RRD issued a consultative document to which over 60 replies were received. Ian Jones, head of the Licensing Branch of the RRD, told MRUA conference delegates that there had been a lot of useful consultation but that 'consultation takes time'. Jones said that it was better to wait for a few weeks or months with no decision rather than to have a hasty decision which would later be regretted. Whatever is decided for Band III now will have to hold until early in the next century.

Delegates were told that decisions concerning Band III would be announced on a piecemeal basis rather than in one all-embracing announcement. A further important announcement could be expected in 'late spring or early summer'.

The choice widens

The widening choice that faces the prospective mobile communications user was the theme of the MRUA conference. Reflecting this theme, Paul Gregory of Storno outlined the six major options which are currently available in the UK professional mobile communications field:

1. PMR (private mobile radio) networks such as those used by taxi operators, which require an individual licence and have local or possibly regional coverage. Pressure has meant that channel sharing has had to become a common evil. Users often have to put up with the inconvenience of having another company on the other side of town using the same frequency. With private systems there are no call charges, but there will be equipment costs and incidental charges such as site rental and the leasing of a land-line if the transmitter is not sited at the offices.



A Racal-Vodafone cellular radio installation with one transmit and two receive antenae

2. Message handling services may have local, regional or national coverage. The radio side of the business is handled by the service provider. The term 'service provider' will soon be heard more often in the mobile radio industry, since much of Band III will be allocated to service providers rather than directly to end-users. The customer pays a periodic service charge, but does not have to obtain a licence himself.

3. Common base stations or community repeaters normally offer only local coverage, but mean that users can have access to an operating system directly without having to apply for a channel or install their own infrastructure.

4. The BT Radiophone System 4 network is the car telephone service which operates at 160MHz. It provides direct access to the public telephone network and has virtually national coverage. System 4 will be kept running in parallel with competing cellular services for several years to come, although the wide area coverage of each base transmitter and the relative lack of frequencies means that the capacity of Radiophone System 4 is severely limited in city areas.

5. Radiopagers are developing rapidly from being 'tone-only bleepers'. The latest generation of pagers includes alpha-numeric message facilities. Pager

networks may be local, regional or national, and the latest systems allow users to send short messages directly to the recipient. Paging systems have been described as 'poor man's cellular radio'! The portability, wide area coverage and message transmission potential of paging systems warrant their inclusion in any listing of mobile communication options.

6. Cellular radio is the newest of the options available to the potential mobile radio user. Coverage of the two national networks is being rapidly extended across the UK. Future developments in cellular radio will provide mobile data transmission facilities in addition to the present 'office telephone in the car'.

Trunking

Each of these different types of mobile communications requires the use of parts of the radio frequency spectrum. A method of increasing the efficiency with which frequencies are used is called 'trunking'.

The classic mobile radio network consists of a base station and a number of mobiles all operating on the same frequency. The frequency is permanently assigned to one user in one area. The idea behind trunking is to achieve a more efficient use of the spectrum by having a number of channels assigned to an area, so that a station can automatically request and be assigned a working frequency according to what is available at the time of the request.

This requires more complex mobile radio equipment, but the logic necessary can easily be incorporated into a chip. Future mobile radio systems on Band III in the UK will make use of trunking techniques.

The advantages to be gained from trunking are greater capacities and a better utilisation of the spectrum. The disadvantages are that the equipment has to be more complex, and under heavily loaded conditions a mobile might have to wait to be allocated a clear channel. Trunking systems require a signalling system so that frequency changing data can pass between the base and the mobile.

There are two types of trunking. 'Message trunking' is where the two stations in contact stay on the same frequency for the duration of the message exchange, which might involve several transmissions from either side. Only when the entire message is complete will the mobile revert to standby on a signalling channel, ready to be moved to a clear channel when another exchange of messages is required.

In 'transmission trunking' frequencies are changing more often. At the beginning of each transmission a new frequency will be assigned. The different types of trunking and the different signalling protocols involved are an important part of the current discussions on the future uses of Band III.

Sub-band	Type of use
A	Short range mobile telemetry and telecontrol links
B	Fixed links for telephony, telemetry and telecontrol (up to 36 telephone channels or equivalent in frequency division multiplex)
E	Fixed links for telephony, telemetry and telecontrol (up to 8 telephone channels or equivalent in frequency division multiplex)
F_1, F_2	Fixed links for telephony, telemetry and telecontrol (single or 1 + 1 telephone channels)
G	Unidirectional, mobile and transportable links
X	Reserved band
F3	Fixed links for telephony, telemetry and telecontrol (single or 1 + 1 telephone channels) *(Use of the F3 sub-band is subject to Home Office confirmation)*

Cellnet

Bernard Mallinder, General Manager of Cellnet, informed MRUA delegates that Cellnet had more than 4,000 users on their network and that there had already been over 1,000,000 calls made. Interestingly, he added that the peak traffic time is just before and just after noon. There is still a remarkable lack of use of cellular radio at the weekend, when very much reduced rates apply. During weekday office hours calls cost 25p a minute, whereas at the weekend they are only 8p a minute.

1.5GHz links

Since January 1979, the DTI has issued no new licences for fixed point-to-point radio links in the 450MHz band. Such links might typically be those between an in-town office and a remote base transmitter site on a convenient hill.

There are two ways of connecting the office and the radio base station. A land-line can be rented or a private radio link can be installed. Peter Kiddle of Plessey argued that in many cases a radio link was preferable to a land-line. The main argument in favour of a radio link is that with your own radio link you are in direct control of your communications and not dependent on others, as is the case with a rented land-line.

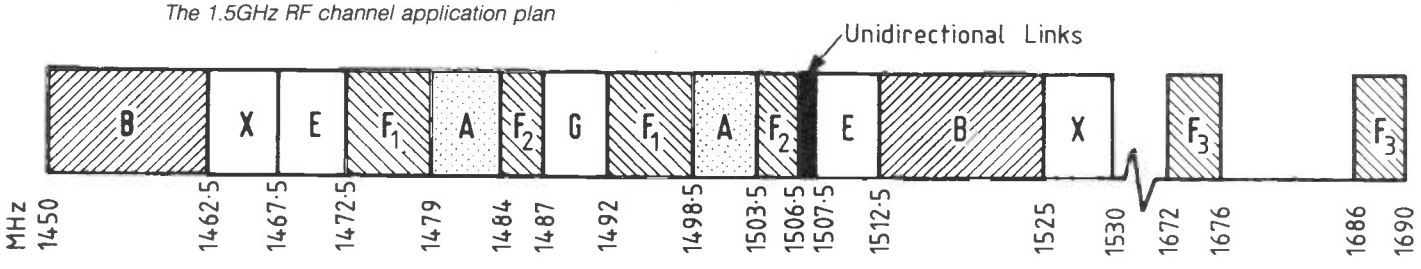
A commonly used frequency band for point-to-point fixed radio links in the UK is the 1.5GHz band.

The diagram below shows the allocations for private user fixed and mobile radio services in the band 1450MHz to 1690MHz.

Spectrum Watch: USA

Next month's *Spectrum Watch* will be coming to you from the US. We will be reporting on important spectrum developments 'across the pond', including the new US amateur band at around 900MHz and the possibility of using satellites directly for land mobile applications, as well as taking a close look at those US cellular networks that operate at 800MHz.

The 1.5GHz RF channel application plan



EAST CORNWALL COMPONENTS

INTEGRATED CIRCUITS (£) EACH

AN240P	3.42	TA7108P	3.20	TBA970	4.05	4000	0.24	4503	0.40
AN214Q	3.88	TA7120P	2.20	TCA160C	3.90	4001	0.24	4507	0.48
AN715Q	2.90	TA7129AP	3.65	TCA270S	4.00	4002	0.26	4508	1.30
CA3065	1.75	TA7130P	1.65	TCA270SA	4.02	4007	0.25	4510	0.55
CA4031P	2.88	TA7172	1.80	TCA800	3.10	4011	0.24	4511	0.55
CA4102	3.30	TA7193	5.50	TCA940	1.90	4012	0.24	4512	0.55
CA4250	3.60	TA7172P	1.80	TDA440	3.80	4013	0.56	4514	1.15
CA4400	2.96	TA7176	2.50	TDA1002	1.90	4014	0.60	4515	1.15
CA4422	3.07	TA7202P	4.18	TDA1003A	5.50	4015	0.60	4516	0.55
LC7120	5.33	TA7204P	1.86	TDA1004	3.75	4016	0.40	4517	2.70
LC7130	5.26	TA7205AP	1.80	TDA1006A	2.40	4017	0.60	4518	0.48
LC7137	5.16	TA7208P	3.25	TDA1035S	4.50	4018	0.60	4020	0.53
LM380N	1.85	TA7210P	.50	TDA1044	4.30	4020	0.85	4521	1.15
LM1303N	2.52	TA7222P	2.12	TDA1170S	3.00	4021	0.65	4522	1.25
HA1151P	3.12	TA7223P	3.68	TDA1190	3.50	4022	0.60	4526	0.80
MC1307P	1.85	TA7227P	5.80	TDA1200	2.98	4023	0.35	4527	0.65
MC1310P	1.85	TA7310P	1.80	TDA1270Q	3.70	4024	0.60	4528	0.68
MC1312P	2.25	TA7609P	4.28	TDA1327A	1.68	4025	0.24	4531	1.30
MC1327P	1.75	TA7611AP	2.88	TDA1352A/B	1.56	4027	0.48	4532	0.65
MC1330P	0.83	TAA263	2.46	TDA1412	1.20	4028	0.48	4536	2.65
MC13449P	1.85	TAA310A	2.68	TDA2002	2.80	4029	0.75	4538	0.60
MC1350P	1.20	TAA550	0.50	TDA2020	4.60	4030	0.35	4539	0.90
MC1351P	2.50	TAA570	1.99	TDA2030	2.78	4031	1.30	4541	0.90
MC1352P	1.50	TAA611A12	3.50	TDA2140	5.90	4033	1.25	4543	1.25
MC1357P	.88	TAA611B12	2.85	TDA2521	4.10	4034	1.48	4549	4.00
MC1358P	1.30	TAA630S	3.90	TDA2523	3.50	4035	0.70	4553	2.45
MC1496L	1.15	TAA661B	1.70	TDA2530	2.70	4036A	2.75	4554	1.92
ML231B	2.10	TAA700	2.80	TDA2540	3.80	4038	0.75	4555	0.35
ML232B	2.10	TAA840	3.38	TDA2541	3.80	4039A	2.80	4556	0.55
ML237B	2.30	TAD100	2.80	TDA2560	3.50	4040	0.60		
NE555	0.35	FM FILTER	1.20	TDA2571A	5.75	4068	0.24		
C-mos 555	0.88	TBA120A	1.00	TDA2581	3.20	4069	0.24		
NE556	0.80	AS,S,SA,SB	1.30	TDA2590	3.20	4070	0.25		
SAA1024	5.35	Q,T,U,UQ	1.32	TDA2591	2.98	4071	0.24		
SAA1025	5.40	TBA120B	1.38	TDA2593	2.98	4072	0.25		
SAS560A	2.50	TBA231	1.45	TDA2610	3.20	4073	0.25		
SAS560S	1.85	TBA281	2.65	TDA2611A	1.94	4075	0.68		
SAS570S	1.85	TBA395	1.20	TDA2640	2.90	4076	0.68		
SAS580	2.85	TBA480Q	1.50	TDA2680	3.40	4077	0.25		
SAS590	2.82	TBA400	2.30	TDA2690	3.50	4078	0.25		
SC9503P	1.10	TBA510	2.60	TDA3950/A/B	2.60	4081	0.25		
SL432A	4.00	TBA510Q	2.60	UPC554C	1.32	4082	0.25		
SL901B	5.20	TBA520/Q	1.60	UPC557H	0.90	4085	0.68		
SL917B	6.25	TBA530/Q	1.30	UPC566H	2.95	4086	0.58		
SL1327Q	1.10	TBA540/Q	1.40	UPC575C2	3.20	4089	1.25		
SN76003N	2.44	TBA550/Q	1.52	UPC1018C	1.10	4093	0.37		
SN76013N	1.90	TBA560C	1.70	UPC1025H	2.90	4094	0.95		
SN76023ND	2.90	TBA560CQ	1.60	UPC1032H	0.90	4095	0.95		
SN76033N	2.48	TBA570	1.50	UPC1156H	4.20	4096	0.99		
SN76110N	1.12	TBA651	2.80	UPC1158H	0.76	4097	2.65		
SN76115N	2.00	TBA673	2.40	UPC1163H	0.98	4098	0.80		
SN76131N	1.68	TBA700	2.85	UPC1181H	1.60	4099	1.05		
SN76226DN	1.80	TBA750	2.80	UPC1185H2	3.75	4161	0.96		
SN76227N	1.10	TBA800	1.60	UPC1212C	1.30	4162	0.96		
SN76530P	1.40	TBA810P	1.10	UPC1230H	3.90	4163	0.96		
SN76533N	1.60	TBA810S	1.20	UPC1350C	4.25	4174	0.96		
SN76650N	1.06	TBA820	1.60	UPC1367C	3.40	4175	1.00		
SN76660N	0.75	TBA890	3.88	UPC1378H	4.40	4194	0.99		
SN76666N	0.80	TBA920/Q	3.00	UPC2002H	2.80	4501	0.38		
STK015	6.50	TBA950/2A	3.06			4502	0.38		

MICRO

2764-250n/s	5.80
Z80A-CPU	3.70
Z80A-CTC	3.30
Z80-ADNA	9.00
Z80-AP10	3.40
Z80-AS10/0	8.75
Z80-AS10/2	8.99

IC SOCKETS

Dil to Dil	
8 pin	0.08
14 pin	0.10
16 pin	0.11
18 pin	0.14
22 pin	0.21
24 pin	0.25
28 pin	0.30
40 pin	0.34

BRIDGES

1½A 50V	0.27
200V	0.32
600V	0.50
3A 100V	0.52
600V	0.67
6A 100V	0.68
600V	0.80
10A 50V	2.20
400V	2.80
25A 50V	2.08
400V	3.20

TELEPHONE SPECIAL

BT Approved Telephone Plug + 3m Lead 1.25
BT Approved Master Socket Inc. Wiring Instrns 2.85
BT Approved Secondary Socket 1.95
BT 4-Core Cable 1M. .15
100M. 12.00
BT Telephones now available.

SERVICE AIDS

ALL SERVISOL PRODUCTS	
Switch Cleaner	0.98
Circuit Freezer	1.14
Foam Cleanser	0.96
Aero Klene	0.90
Silicone Grease (Aerosol)	1.64
Silicone Grease Tbe	1.60
Antistat Spray	0.98
Plastic Seal	1.08
Excel Polish	0.92
Fire Extin 640g	2.86
Video Head Cleaner	0.86
Super 40 Moisture Repellant & Lub	1.62

VEROBOARD

0,1in Clad,	
2½ x 3¾"	85p
2½ x 5"	1.00
3¾ x 3¾"	1.05
3½ x 17"	3.25
3¾ x 17"	4.10
4¾ x 17¾"	4.96
0,1in PLAIN.	
3¾ x 5"	95p
3¾ x 17"	2.70
DIP Board	3.85
Vero Strip	1.25
Pkt. of 100 pins	50p
Spot face cutter	1.48
Pin insert tool	1.83
Vero Wiring Peg + spool	4.50

SOLDA MOP

Std.	0.72
L/Gauge	0.72
Indust.	2.90

Additional P&P on above — 30p. each.

ZENNER PACK

400mW - 5 each value -55 off **£3.60 per kit**

PLASTIC BOXES

3x2x1"	0.35
3x2½x2"	0.55
4x3x1½"	0.70
4½x4x1½"	0.83
6x4x2½"	1.15
8½x5x3¼"	2.15

VIDEO PROJECTION UNIT

Brand new, complete & working but no instruction manual.
Supplied complete with Projector, Tuner & Screen.
Price: Normally over £2,500
Our Price: **£1,200**

CERAMIC CAPACITORS

ALL 50V. 1pf to 10pf **4p each**
100 for £2.75
CERAMIC KIT - 5 off each value - 25 values - total 125 Caps for **£3.60**

NI-CAD

Universal NI-Cad charger, charges PP3, AA, C,D
Price **£6.00**

RECHARGEABLE BATTERIES

AA HP7	0.85	10/0.75 each.
C HP11	1.75	10/1.65 each.
D HP2	2.05	10/1.95 each.
PP3	3.80	10/3.70 each.

Terminal Blocks

2 amp 12 way	0.19
5 amp 12 way	0.20
15amp 12 way	0.48
32amp 12 way	0.92

FUSEHOLDERS

20mm Panel Mounting	0.28
20mm Chassis Mounting	0.06
¼in Panel Mounting	0.35
¼in Chassis Mounting	0.342
Carline 1¼in Mounting	0.10

COPPER WIRE

Tinned & Enamelled - 2oz Reels.
14 to 38 swg **£1.00 per Reel**

RESISTORS — CARBON FILM 5%

¼W 1R0 to 10M (E12 Range)	2p each. 15p/10. 75p/100
½W 2R2 to 10M (E24 Range)	2p each. 15p/10. 75p/100
1W 10R to 2M2 (E12 Range)	7p each. 65p/10. 6.00/100
2W 10R to 2M2 (E6 Range)	8p each. 70p/10. 6.00/100

RESISTOR KITS — each value individually packed

¼W pack 10 each value E12—10R to 1M 610 pieces	5.00
¼W pack 5 each value E12—10R to 1M 305 pieces	3.00
½W pack 10 each value E12—2R2 to 2M2 730 pieces	6.00
½W pack 5 each value E12—2R2 to 1M 365 pieces	3.00
1W pack 5 each value E12—2R2 to 1M 353 pieces	15.00
2W pack 5 each value E6—10R to 2M2 317 pieces	18.00

RESISTORS — WIREWOUND Generally 5%

2-5W 0-22 to 270R Available in preferred values	0.20
4W 1R0 to 10K. Available in preferred values	0.21
7W 0.47R to 22K. Available in preferred values	0.25
11W 1R0 to 22K. Available in preferred values	0.29
17W 1R0 to 22K. Available in preferred values	0.37

FUSES

1¼in Quick Blow 100 150 250mA £1.30 1 1.25 1.5 2.5 3 10 15A
55p 1¼in Time Delay 100mA **£3.50** 150mA **£2.25** 250 300 500 600 750 850mA **£1.84** 1 1.25 1.5 1.6 2A **£1.74** 2.5A 3 3.15 3.5A **£2.82 20mm Quick Blow** 100 125 160 200 250 315 400 500 600 800mA 1 1.25 1.5 2 2.5 3.5 4.5 6 6.3A **40p 20mm Time Delay** 100 125 150 200mA **£1.80** 750 300 400 500 600 800mA **£1.00** 1 1.25 1.5 2 2.5 3 3A **85p 1in Mains** 2 3 5 7 10 13A **85p**
Manufacturers please note – we can offer very competitive production quantities of 20mm Quick Blow & Time Delay range – apply for quotation

Soldering Section

XS25 Watt Iron Kit/complete with stand & plug attached	7.20
CS 18 Watt as above	7.00
ANTEX 15W IRON	5.00
ANTEX 18W IRON	5.00
ANTEX 25W IRON	5.20
ANTEX ELEMENTS	2.00
ANTEX BITS	0.95
ANTEX STANDS	1.90
SOLDERSUCKER	4.50
500gm SOLDER	6.80
SOLDA MOP	0.70
ANTEX SOLDERING STATION complete with Iron – 30W or 40W	49.95
Spare nozzles for Solder-sucker	0.45

PLUGS & SOCKETS

Metal Co-ax Plug	0.11
Plastic Co-ax Plug	0.14
Single Junction Socket	0.80
Plastic Phono	0.10
FM Plugs	0.20
PL259	0.38
Reducer	0.15
2.5mm Plug Metal	0.15
2.5mm Plug Metal	0.16
2.5mm Chassis Socket	0.10
3.5mm Chassis Socket	0.10
2 pin ¼in Mono Chassis Socket	0.14
4 pin ¼in Mono Chassis Socket	0.20
6 pin ¼in Mono Chassis Socket	0.30
4mm Banana Plug	0.15
4mm Banana Socket	0.15
PP3 Battery Connectors	0.08
PP9 Battery Connectors	0.16

ZENER DIODES

400mW Plastic 3V-75V **8p each 10/75p**
1.3W Plastic 3V-200V **15p each 10/£1.40**
1.5W Flange 4.7-47V **£1.26 each**
2.5W Plastic 75-75V **64p each**
20W Stud 75-75v **£1.35 each**

MIN T CONNECTORS

		9way	15way	25way	37way
PLUS	Solder	.52	.65	.88	1.45
	Lug	.89	1.34	1.98	3.48
	R Angle	.78	.98	1.33	2.48
SOCKETS	Solder	1.18	1.78	2.70	4.15
	Lug	.95	.95	.98	1.00
COVERS	R Angle				

POTENTIOMETERS

Carbon Track Rotary 0.25W Log & Lin values. All ¼in Spindle, 20ml body dia, Sahft 2" long.

4K7-2M2 Single Gang Log	.30 10/3.00
1K — 2M2 Single Gang Lin	.32 10/3.00
5K — 2M2 Single Gang DP Switch Log	.75 10/7.00
5K — 2M2 Double Gang Log & Lin	.86 10/8.25

TRANSISTORS DIODES

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC126	0.35	BC108	0.10	BC302	0.32	BD244A	0.65	BF258	0.30	BT101/300	1.15	BYX36/150	0.22	TIP32	0.40
AC127	0.30	A B or C	0.12	BC303	0.32	BD375	0.32	BF259	0.32	BT101/500	1.25	BYX36/600	0.28	TIP32C	0.60
AC128	0.30	BC113	0.14	BC307	0.10	BD410	0.78	BF262	0.30	BT102/300	1.35	BYX48/300	0.72	TIP33A	0.63
AC128K	0.34	BC114	0.12	BC308A	0.10	BD434	0.68	BF263	0.30	BT102/500	1.68	BYX49/300	0.47	TIP34A	0.72
AC132	0.55	BC115	0.12	BC323	0.99	BD436	0.68	BF270	0.30	BT106	1.50	BYX55/350	0.29	TIP41C	0.48
AC141	0.26	BC116	0.15	BC327	0.14	BD437	0.76	BF271	0.26	BT108	1.30	BYX55/600	0.33	TIP42A	0.52
AC141	0.26	BC117	0.22	BC328	0.14	BD438	0.75	BF273	0.18	BT109	1.18	BYX71/600	1.18	TIP47	0.60
AC141K	0.40	BC118	0.17	BC337	0.12	BD439	0.68	BF274	0.32	BT116	1.25	BYZ12	0.42	TIP110	0.68
AC142	0.26	BC119	0.30	BC338	0.12	BD507	0.48	BF323	0.92	BT119	3.62	C106D	0.80	TIP2955	0.60
AC142K	0.48	BC125	0.12	BC350	0.14	BD508	0.53	BF336	0.26	BT120	3.60	E1222	0.40	TIP3055	0.60
AC151	0.45	BC140	0.28	BC440	0.30	BD509	0.54	BF337	0.26	BT121	3.02	E5024	0.30	TIS43	0.32
AC152	0.45	BC141	0.42	BC441	0.32	BD510	0.48	BF338	0.26	BT138/600	1.30	GET872	0.48	TIS88	0.40
AC176	0.28	BC142	0.30	BC461	0.32	BD517	0.56	BF355	0.42	BT151/560R	0.90	ITT44	0.04	TIS90	0.25
AC176K	0.48	BC143	0.30	BC547	0.12	BD520	0.66	BF363	0.82	BT151/300R	1.15	ITT2002	0.11	TIS91	0.28
AC187	0.42	BC147	0.08	BC548	0.12	BD699	1.25	BF367	0.24	BTY79/400R	2.80	ME0402	0.20	ZTX108	0.12
AC187K	0.48	A or B	0.10	BC549	0.12	BD707	0.88	BF371	0.27	BU100A	2.30	ME0404/2	0.24	ZTX109	0.12
AC188	0.44	BC148	0.08	BC550	0.18	BDX18	2.35	BF422	0.38	BU104	2.00	MEU21	0.60	ZTX212	0.28
AC188K	0.50	A or B	0.10	BC550C	0.18	BDX32	2.10	BF450	0.38	BU105	1.20	MJ400	1.25	IN4001	0.05
ACY40	0.88	BC149	0.09	BC557	0.12	BF115	0.32	BF457	0.33	BU105/02	1.56	MJ2955	0.90	IN4003	0.05
AD142	1.10	BC157	0.10	BC558	0.12	BF117	0.54	BF458	0.36	BU108	1.80	MJ3000	1.98	IN4004	0.06
AD143	1.10	BC158	0.10	BCX34	0.27	BF119	0.82	BF459	0.44	BU124	1.75	MJE240	0.60	IN4006	0.07
AD149	0.96	BC159	0.10	BCY70	0.15	BF120	0.38	BFR39	0.22	BU126	1.25	MJE340	0.54	IN4007	0.07
AD161	0.42	BC160	0.30	BCY71	0.17	BF123	0.40	BFR40	0.22	BU133	1.80	MJE370	0.68	IN4148	0.05
AD162	0.42	BC161	0.30	BCY72	0.18	BF125	0.42	BFR41	0.22	BU204	1.35	MJE520	0.48	IN5400	0.12
AD161/AD162	0.96	BC168B	0.12	BCZ10	1.68	BF127	0.38	BFR51	0.30	BU205	1.30	MJE2955	0.99	IN5402	0.15
AF106	0.48	BC169C	0.10	BCZ11	1.45	BF152	0.16	BFR61	0.32	BU206	1.70	MJE3055	0.70	IN5405	.16
AF114	2.10	BC170	0.14	BD124P	0.80	BF154	0.23	BFR62	0.28	BU208	1.55	MPSLO1	0.28	IN5406	0.18
AF115	2.10	BC170B	0.12	BC130Y	0.68	BF157	0.40	BFR88	0.34	BU208A	1.63	OA47	0.10	IN5408	0.20
AF116	2.10	BC171	0.10	BD131	0.34	BF158	0.22	BFR90	1.72	BU208/02	2.05	OA90	0.08	IS920	0.08
AF117	2.10	BC171	0.10	BD132	0.34	BF159	0.24	BFT41	0.38	BU326S	1.75	OA91	0.09	2N697	0.55
AF118	0.85	A or B	0.08	BD131/BD132	0.96	BFR160	0.23	BFT43	0.36	BU407	1.65	OA95	0.18	2N706A	0.33
AF121	0.62	BC172	0.08	BD135	0.32	BF167	0.30	BFW10	0.79	BU407D	1.80	OA200	0.06	2N2904	0.28
AF124	0.48	A or B	0.12	BD136	0.36	BF173	0.25	BFW44	0.76	BUX80	3.70	OA202	0.15	2N2906	0.24
AF125	0.48	BC177	0.20	BD137	0.36	BF177	0.42	BFX29	0.28	BUY20	1.75	OC25	2.10	2N2926G	0.10
AF127	0.48	BC178A	0.22	BD138	0.38	BF178	0.30	BFX30	0.30	BUY69A	2.60	OC26	1.70	2N3053	0.22
AF139	0.68	BC182	0.08	BD139	0.38	BF179	0.32	BFX80	3.56	BUY69B	1.98	OC28	1.50	2N3054	0.68
AF178	0.68	A B or C	0.09	BD140	0.38	BF180	0.35	BFX84	0.24	DBY101	0.48	OC29	2.47	2N3055	0.45
AF239	0.68	BC182L	0.09	BD144	160	BF181	0.35	BFZ85	0.26	BY118	1.10	OC35	1.75	2N3702	0.10
AF279S	0.72	A B or C	0.09	BD145	1.82	BF182	0.32	BFX86	0.26	BY122	0.68	OC36	1.75	2N3704	0.10
AL100	2.50	BC183	0.09	BD150A	0.51	BF183	0.32	BFX87	0.26	BY126	0.12	OC42	0.72	2N3708	0.10
AL102	5.90	A B or C	0.10	BD159	0.65	BF184	0.32	BFX89	0.65	BY127	0.10	OC42K	1.40	2N3772	1.90
AL113	2.20	BC183L	0.08	BD160	1.65	BF185	0.32	BFY50	0.21	BY133	0.16	OC44	0.72	2N3773	2.70
ASY80	1.75	A B or C	0.12	BD165	0.45	BF194	0.08	BFY51	0.21	BY135	0.25	OC45	0.58	2N3904	0.16
AU110	1.40	BC184	0.10	BD175	0.60	BF195	0.10	BFY52	0.21	BY164	.44	OC71	0.50	2N3906	0.16
AY102	4.32	A B or C	0.10	BD182	1.00	BF196	0.10	BFY57	0.40	BY179	0.68	OC72	0.52	2N5294	0.48
BA102	0.34	BC207	0.15	BD183	1.10	BF197	0.10	BFY90	0.90	BY182	0.87	OC81	0.68	2N6107	0.71
BA110	0.67	BC208	0.16	BD184	1.20	BF198	0.14	BFY90S	1.34	BY184	0.40	OC200	2.45	2N6126	0.68
BA121	0.40	BC212	0.09	BD201	0.72	BF199	0.16	BR100	0.20	BY187	0.72	OC202	2.20	2SB337	1.60
BA129	0.38	A B or C	0.10	BD202	0.87	BF200	0.48	BR101	0.44	BY189	4.75	ORP12	0.85	2SC1172Y	2.90
BA148	0.16	BC212L	0.08	BD204	0.80	BF222	0.48	BR103	0.58	BY198	0.44	R2008B	1.50	2SC1173Y	0.82
BA154	0.08	A B or C	0.10	BD222	0.80	BF224	0.20	BRC443	1.76	BY199	0.47	R2010B	1.52	2SC1302	1.40
BA155	0.10	BC213	0.09	BD225	0.86	BF224J	0.16	BRY39	0.38	BY206	0.24	SHG1.5	0.40	40251	0.95
BA156	0.08	A or B	0.10	BD232	0.45	BF240	0.20	BRY56	0.42	BY207	0.24	TAG1/100	1.40	40361	0.58
BA157	0.28	BC213L	0.10	BD233	0.60	BF241	0.26	BRY61	0.86	BY210/400	0.25	TAG3/400	1.78	40362	0.50
BA164	0.14	A or B	0.10	BD234	0.62	BF244	0.26	BSS17	0.68	BY210/600	0.26	TIC44	0.40	40411	3.72
BB104B	0.52	BC237	0.11	BD235	0.63	BF244A	0.28	BSS27	0.92	BY210/800	0.30	TIC45	0.45	40530	0.80
BB105B	0.30	BC236	0.12	BD236	0.63	BF244C	0.24	BSX19	0.34	BY223	1.20	TIC46	0.48	40673	0.80
BB105G	0.48	BC239	0.14	BD237	0.66	BF245A	0.26	BSX20	0.34	BY227	0.26	TIC47	0.70	40964	1.54
BB110B	0.42	BC251	0.12	BD238	0.56	BF254	0.15	BSX59	0.62	BY229	0.30	TIC106A	0.70	2SJ50	5.20
BC107	0.10	A B or C	0.14	BD241	0.60	BF258	0.40	BSX76	0.29	BY238	0.68	TIP30A	0.48	3SK88	0.68
A or B	0.12	BC301	0.30	BD243A	0.80	BF257	0.32	BT100A/02	0.94	BYX10	0.24	TIP31C	0.54	3SK125	5.20

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78L08	0.30
78L12	0.30
78L15n	0.30
78M05	0.50
78M08	0.50
78M12	0.60
78M15	0.50
78M24	0.60
7805	0.55
7808	0.68
7812	0.55
7815	0.55
7818	0.55
7824	0.55
7905	0.65
7912	0.65
7915	0.65
7918	0.65
7924	0.65
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723C	0.36
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SN74LSO2N	0.28
SN74LSO3N	0.28
SN74LSO4N	0.32
SN74LS14N	0.58
SN74LS20N	0.28
SN74LS27N	0.45
SN74LS32N	0.28
SN74LS38N	0.43
SN74LS40N	0.28
SN74LS42N	0.65
SN74LS48N	0.70
SN74LS51N	0.34
SN74LS55N	0.25
SN74LS74AN	0.38
SN74LS78AN	0.45
SN74LS90N	0.54
SN74LS123N	1.15
SN74LS138N	0.45
SN74LS164N	0.93
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SN74LS190N	0.98
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SN74LS245N	2.00
SN74LS247N	1.15
SN74LS283N	0.93
SN74LS353N	0.60
SN74LS367AN	0.60
SN74LS373N	1.20
SN74LS390N	1.40
SN74LS378N	1.15
SN74LS390N	0.89
SN74LS670N	1.62

VALVES

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ECC82	0.65
ECC83	1.10
ECC84	0.65
ECC85	0.90
ECC88	0.95
ECF80	0.90
ECH81	0.75
ECH84	0.75
ECL82	0.75
ECL86	0.98
EF80	0.85
EF86	1.85
EF183	0.75
EF184	0.75
EH90	0.54
EL34	3.25
EL84	0.69
EL509	7.85
EM87	2.65
EY86/87	0.67
EY500A	1.65
PCC84	0.60
PCC85	1.36
PCC89	0.74
PCC189	0.85
PCF80	0.75
PCF86	1.25
PCF200	1.85
PCF801	1.45
PCF802	1.00
PCF806	1.20
PCL82	0.90
PCL83	2.50
PCL84	1.30
PCL86	1.15
PCL805/85	1.35
PD500	3.75
PFL200	1.35
PL33	1.60
PL36	1.45
PL81	0.85
PL82	0.75
PL83	0.65
PL84	0.75
PL95	2.00
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PY88	1.80
PY500A	2.40
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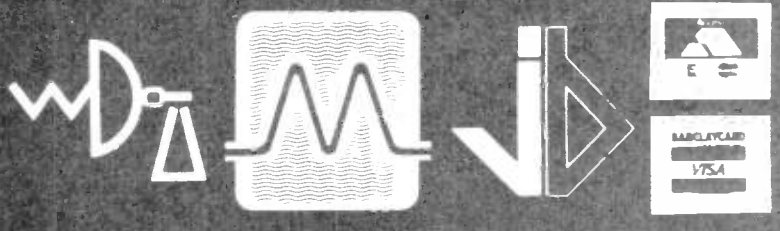

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COMPUTING INTERMODULATION PRODUCTS

BRIAN KENDAL G3GDU
AND JEFF HOWELL G4BXZ

How many times, when you have connected a converter to a receiver or completed construction of a double or triple superhet, have you tuned across the bands only to find one or more spurious signals making their presence felt?

The strong signals are usually relatively simple to identify – perhaps a harmonic of one of the oscillators – but the weak signals may well defy analysis, for the computation of all possible high order intermodulation products can prove a lengthy undertaking.

Such number-crunching, however, is the strength of the home computer, and this problem is the task which this month's program has been designed to solve. As usual, the program has been written in standard Microsoft BASIC and has been tested and run on both Sanyo and BBC (32K) computers. However, slight changes may be necessary to compensate for 'dialect' if any other machine is used.

Intermodulation products

The generation of intermodulation products is frequently misunderstood, and the newcomer may well be confused when the products appear to be the result of mixing between harmonics of the input frequencies. Although it can be appreciated that these will be present in the output of the mixer, it is not always evident why they should also contribute to the mixing process.

Any non-linear circuit will generate signals in its output circuit which are not present at the input. The number and strength of these are determined by the mathematical relationship between the input and output of the non-linear device and the frequency and amplitude of the input signals. In the vast majority of practical circuits (ie excepting parametric mixers whose reactances vary in a non-linear manner) the frequencies of the output signals will bear a simple relationship to those in the input circuit.

Most readers will be familiar with adding voltages and currents in electrical circuits under appropriate circumstances. Fortunately the mathematical representation of sinusoidal waveforms provides a similar set of rules which describes how frequencies are related in non-linear circuits.

Without going into great technical detail, let it suffice to say that the frequencies generated in the output signal can always be found by adding and subtracting the frequencies in the input signal.

The number of additions and subtractions required to derive a given frequency (starting from zero) is called the 'order' within a particular circuit. Where several calculation routes arrive at the same frequency, the product is considered to be of the order of the lowest order route.

In general, the higher the order of the product, the weaker it will be.

Now let us consider the practical case of the output of a simple mixer with input signals of frequency F1 and F2. Firstly, both F1 and F2 will be present. Secondly, there will be F1+F2 and F1−F2 and the second harmonics of the input signals, 2F1 and 2F2, which are all second order products. The third order products will be 3F1, 2F1+F2, F1+2F2, 3F2, 2F1−F2, 2F2−F1. By the time we reach the fourth order products the possibilities multiply much further, and when even higher orders are considered we realise why a computer is a distinct asset for their computation.

Whilst the calculation of the frequency of intermodulation products is relatively straightforward, the computation of their relative strength is far more complex and depends on many other factors. In consequence this is not attempted in this program.

The scope of the program

The program described this month may be used in the solution of two problems concerned with intermodulation products. Firstly it will help to locate the origin of a spurious signal observed within a piece of equipment, and secondly, where a signal of known frequency is received on a receiver tuned to a different frequency, the origin may be determined.

To perform the calculations the exact frequency of every frequency generated within the equipment must be known. These are the 'source frequencies' in the program, whilst the spurii will be considered the 'observed frequencies'.

The number of source frequencies which the program will handle has been limited to four, because beyond this number the amount of computation increases very rapidly.

Using the program

The program commences by clearing the screen and then asking the number of source frequencies present. This entered, the frequencies are requested. These should be entered with the highest possible accuracy, for any error will be multiplied in the calculations, perhaps to the point where a significant product may apparently fall outside the observed frequency range.

The lower and higher frequency limits of the band to be examined are next entered. This band should be rather wider than is really required in order to accommodate inaccuracies in the signal frequency determination and/or observing equipment calibration. If, on the initial run of the program, too many products are observed, it may be expedient to restrict the observed bandwidth to an area of more immediate interest.

The final figure to be specified by the user is the highest order product to be displayed. In practice, products higher than seventh order from a single mixer will be very weak and may be ignored with reasonable confidence. If, however, several mixers and/or frequency multipliers are present very high order products may appear, and the effect of every mixer and multiplier must be allowed for.

In such cases, if the signal flow is known it may be more convenient to perform the analysis in stages. For example, where a frequency tripler is in use specify the output rather than the basic oscillator frequency when considering that part of the circuit.

The nature of the problem is such that the number of calculations necessary can be computed in advance. From this it is possible to estimate the time necessary to run the program. The speed of calculation varies from computer to computer, so the figure given is really only a rough guide.

Interpreting the printout

On completing the data input the approximate calculation time will be displayed, followed by a subheading for each order of mixing product. Beneath each of these will appear a list of frequencies at which intermodulation products may be observed, and tabulated next to each will be a series of numbers. These correspond to the harmonic of each signal frequency involved in the production of a specified product.

For example, if the signal frequencies were F1,F2,F3,F4 and the numbers beside the intermodulation product were '1 3 −2 0', this is interpreted as a sixth order product comprising the fundamental of F1 plus the third harmonic of F2, minus

```
10 REM INTERMOD FREQUENCY CALCULATION
20 REM J.M.HOWELL DECEMBER 1984
30 CLS
40 PRINT
50 PRINT TAB(5);"INTERMODULATION PRODUCTS"
60 PRINT
70 PRINT "HOW MANY SIGNALS (2-4)?"
80 INPUT NS
90 IF NS<2 OR NS>4 THEN GOTO 70
100 PRINT "ENTER THE FREQUENCIES"
110 IF NS=2 THEN INPUT F1,F2
120 IF NS=3 THEN INPUT F1,F2,F3
130 IF NS=4 THEN INPUT F1,F2,F3,F4
140 PRINT "ENTER OBSERVED FREQUENCY RANGE"
150 INPUT FA,FB
160 IF FA>FB THEN GOTO 140
170 PRINT "HIGHEST ORDER PRODUCT?"
180 INPUT H
190 IF H<1 THEN GOTO 170
200 IF NS=2 THEN T=6+3*H
210 IF NS=3 THEN T=7+H*(6+H*2)
220 IF NS=4 THEN T=8+H*(8+H*(4+H))
230 PRINT "THIS WILL TAKE ABOUT ";INT(T*H/90)+1;" SECONDS"
240 FL=0
250 FK=0
260 FOR G=1 TO H
270 PRINT
280 PRINT "ORDER = ";G
290 JMAX=G
300 KMAX=G
310 ON NS-1 GOSUB 500,440,380
320 NEXT G
330 PRINT
340 PRINT "CALCULATION COMPLETE - RUN AGAIN (Y/N)?"
350 INPUT A$
360 IF A$="Y" THEN GOTO 30
370 STOP
380 FOR L=-G TO G
390 FL=F4*L
400 KMAX=G-ABS(L)
410 GOSUB 440
420 NEXT L
430 RETURN
440 FOR K=-KMAX TO KMAX
450 FK=FL+K*F3
460 JMAX=KMAX-ABS(K)
470 GOSUB 500
480 NEXT K
490 RETURN
500 FOR J=-JMAX TO JMAX
510 I=JMAX-ABS(J)
520 F=FK+J*F2+I*F1
530 IF FA>ABS(F) OR ABS(F)>FB THEN GOTO 600
540 IF F=0 OR I=0 AND F<0 THEN GOTO 600
550 Z=ABS(F)/F
560 PRINT Z*F;TAB(15);Z*I;TAB(19);Z*J;
570 IF NS>2 THEN PRINT TAB(23);Z*K;
580 IF NS=4 THEN PRINT TAB(27);Z*L;
590 PRINT
600 NEXT J
610 RETURN
```

the second harmonic of F3, with F4 and its harmonics having no effect.

Having determined a number of candidates for the observed spurious signal it should now, by a detailed analysis, be possible to identify the cause.

Program description

Conforming to our normal practice the program has been kept to its minimum length in order to reduce the possibility of typing errors, and in addition test examples are provided in order to confirm that it has been correctly entered.

Initially lines 30 to 60 print the title, whilst lines 70 to 190 accept the problem description. In these, NS (the number of signal frequencies) is used to control the amount of data read in at lines 110 to 130. A simple error check is incorporated at each stage in order to repeat the question should any response not be compatible with the program.

Lines 200 to 230 use an empirical formula to estimate the total time necessary to run the program. Should this prove excessive, the computer program interrupt facility could be used and the problem redefined in order to provide a less time-consuming solution. Should the estimated time vary considerably from the measured computation time, the factor 90 on line 230 can be changed to bring the estimate closer to the actual time.

The FOR-NEXT loop at lines 260 to 320 controls the processing of each mixer product order (G), from 1 to the maximum specified on line 180 (H). At this point it should be noted that lines 240 to 250 and 290 to 300 are only required when NS equals either 2 or 3, for when NS equals 4 they will be set up by the program. The appropriate subroutine is selected by line 310 to compute with two, three or four signal frequencies.

As previously mentioned in this article, every signal frequency and its harmonics interacts with every other. Thus the products of three signal frequencies will be the result of the products of a third signal interacting with those of the first two. Similarly, the products of a fourth signal will interact with those generated by the first three.

In such a problem an answer can be readily obtained by nesting the two-frequency solution inside the three-frequency problem, which in turn is nested within the four-frequency problem. The program is therefore written as three subroutines which call on each other as required. These start at lines 380, 440 and 500 respectively.

The two-frequency problem is solved by testing all permitted combinations of the two signal frequencies within the FOR-NEXT loop at lines 500 to 610. Each resulting mixer product is checked, firstly that it lies within the band of observed frequencies (at line 530) and secondly that it does not duplicate a previous solution (line 540).

The result having been validated, the sense is determined at line 550 and the entry in the table is constructed in lines 560 to 590, the semicolons at the end of each line ensuring that the table entry is on a single line.

The parameter 'Z' calculated at line 550 is worthy of further explanation. As computed it will take the value 1 if the mixer product is positive and −1 if negative. There is nothing sinister about a negative frequency, for it only implies that the phase is inverted. However, for convenience they are converted to positive values. The mixing factors are similarly converted so that the product may be readily seen to derive from the constituent parts.

The test problems

The first example is given as a simple demonstration to show how two signals interact to give intermodulation products, and we have limited the calculation to a maximum of third order products. However, by running the program under different conditions it will soon be realised that the number of

possibilities is extremely large. In practice, due to limitation of the observed frequency range, only a small proportion will be shown.

The second example considers a receiver which picks up 27MHz CB transmissions when tuned to the upper end of the 28MHz amateur band. The receiver uses three oscillators operating on 19.25, 20.555 and 10.24MHz within a synthesiser. The spurious is due to a signal near 27.791MHz and is observed within the first IF passband at 10.7MHz.

The third example is a two metre transmitter which when tuned to 144.31MHz radiates a strong spurious signal between 145 and 145.2MHz. The signal frequency is generated by the combination of four oscillators, but the program finds three possible sources.

In the latter two cases, further tests had to be applied in order to find the true cause of the undesired response. These determined that the causes were third and eleventh order products respectively. In the third case, a detailed examination of the signal flow revealed that the product of mixing the first three signals fell within the passband of the filter preceding the final mixer and the spurious signal was generated as a fifth order product in the final mixer. REW

```
    INTERMODULATION PRODUCTS

HOW MANY SIGNALS (2-4)?
 2
ENTER THE FREQUENCIES
 3                4
ENTER OBSERVED FREQUENCY RANGE
 0                30
HIGHEST ORDER PRODUCT?
 3
THIS WILL TAKE ABOUT  1  SECONDS

ORDER =  1
 3                1   0
 4                0   1

ORDER =  2
 1               -1   1
 6                2   0
 7                1   1
 8                0   2

ORDER =  3
 5               -1   2
 2                2  -1
 9                3   0
 10               2   1
 11               1   2
 12               0   3

CALCULATION COMPLETE - RUN AGAIN (Y/N)?
Y

    INTERMODULATION PRODUCTS

HOW MANY SIGNALS (2-4)?
 4
ENTER THE FREQUENCIES
 19.25            20.555           27.791           10.24
ENTER OBSERVED FREQUENCY RANGE
 10.5             10.9
HIGHEST ORDER PRODUCT?
 7
THIS WILL TAKE ABOUT  47  SECONDS

ORDER =  1

ORDER =  2

ORDER =  3
 10.709           2   0  -1   0

ORDER =  4

ORDER =  5

ORDER =  6
 10.784           2   1  -1  -2
 10.634           2  -1  -1   2

ORDER =  7

CALCULATION COMPLETE - RUN AGAIN (Y/N)?
N

Break at 370
```

```
    INTERMODULATION PRODUCTS

HOW MANY SIGNALS (2-4)?
 4
ENTER THE FREQUENCIES
 12.005           8.905            7.801            115.6
ENTER OBSERVED FREQUENCY RANGE
 145              145.2
HIGHEST ORDER PRODUCT?
 12
THIS WILL TAKE ABOUT  322  SECONDS

ORDER =  1

ORDER =  2

ORDER =  3

ORDER =  4

ORDER =  5

ORDER =  6

ORDER =  7

ORDER =  8

ORDER =  9
 145.02           -2   6   0   1

ORDER =  10

ORDER =  11
 145.067          -3  -3  -3   2

ORDER =  12
 145.093          -2  -1   8   1

CALCULATION COMPLETE - RUN AGAIN (Y/N)?
N

Break at 370
```

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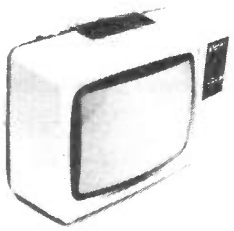

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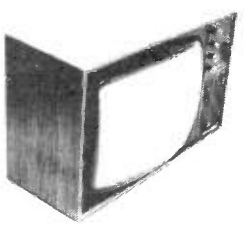

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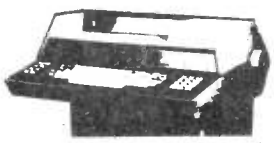

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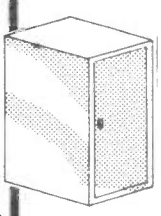

LARGE 19" equipment cabinet. Totally enclosed with locking front and rear doors. An internal sub fram 63" high is pre drilled for standard 19" equipment etc. Other features include internal 12" cooling fan, two-tone blue and grey finish with alloy trims. Mounted on 4 heavy duty castors, mains panel etc. And at a current cost from **IMHOFS** of over **£500** A snip at **ONLY £125**. Supplied in **NEW** or little used condition. Carriage £22.00.
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CONSTRUCTING POWER SUPPLIES

Roger Alban GW3SPA continues his series describing the design and construction of PSUs

The performance of the full-wave rectifier circuit described last month can be improved by connecting a capacitor in parallel with the load as shown in *Figure 7*. The voltage V_C across the capacitor is then obviously equal to V_L, the voltage across the load.

During the first few cycles of operation the capacitor will be charged by the currents I1 and I2 until a steady condition is reached in which V_L and V_C almost reach V_{max} at every peak of the supply. A considerable charge is then stored in the capacitor, and this prevents V_C and V_L from falling to zero when the alternating supply voltage reaches zero. Used in this way, the capacitor is called a 'reservoir'.

The resulting voltage and current distribution during one cycle of mains frequency is illustrated in *Figures 8d* and *8e*. *Figures 8a, 8b* and *8c* show the equivalent circuit of the rectifier corresponding the successive parts of the cycle.

The diodes D1 and D2 conduct alternately, but each for a period less than one half-cycle. While either D1 or D2 is conducting, the reservoir is recharged from the supply by I1 or I2. When both diodes are non-conducting the reservoir capacitor discharges through the load, providing the load current I2, which, however, falls exponentially as the capacitor loses charge.

A diode will conduct if its anode is positive with respect to its cathode. This will occur in *Figure 7* when the following conditions are met:

(1) Point A in the circuit is at a more positive potential than point C: D1 is conducting, D2 switched off.

(2) Point B in the circuit is at a more positive potential than point C: D2 is conducting, D1 switched off.

When neither point A nor B is more positive than point C both diodes are switched off.

The potentials (negative to earth) at points A and B in *Figure 7* are determined by the supply, as can be seen from *Figure 8e*, while the potential at point C is equal to V_L or V_C. Therefore, it may be said that either diode will conduct only when the appropriate supply voltage exceeds that across the load and reservoir capacitor. In *Figure 8e* the dotted lines show the waveforms of V1 and V2 and the full line shows V_L (which is equal to V_C).

Circuit action

The action of the circuit can now be traced in detail. As V1 increases from zero, eventually at point R (*Figure 8d*) it becomes equal to V_L and thereafter exceeds it, so that diode D1 conducts and current I2 flows to both load and reservoir capacitor.

After V1 passes its positive peak D1 remains conducting, but after point X V1 falls faster than V_C is able to do and V_C discharges into the load, maintaining the load current. The equivalent circuit is shown in *Figure 8b*: as the capacitor discharges, V_C, which remains equal to V_L, follows the path XS *(Figure 8e)*.

Eventually point S on the waveform is reached, after which V2 exceeds V_C. The equivalent circuit is then as shown in *Figure 8c* and diode D2 begins to conduct, charging the capacitor and raising V_L and V_C almost to V_{max} again.

After V2 has passed its peak value it soon reaches point Y, where point C on *Figure 7* becomes more positive than point B and diode D2 stops conducting, returning the circuit to the condition of *Figure 8b*. There is then a further interval when current in the load is maintained by the discharge of the reservoir capacitor, and the output voltage falls as shown by the line YT.

The action continues in this way, the diodes conducting alternately, each for a short period only near the positive peak of the corresponding supply waveform. During this short period the diode has to make good the charge lost by the capacitor during the previous discharge period. Thus, for example, from S to Y diode D2 has to supply as much charge as was lost by the capacitor from X to S.

To supply a relatively large charge in a relatively short time the current must be large, and typical waveforms of the currents I1 and I2 are shown in *Figure 8d*. This current waveform appears as short pulses. The waveform of load current I_L is shown in *Figure 8d* for comparison with the diode currents I1 and I2.

With a resistive load, I_L has a similar waveform to V_L. By using a large value of reservoir capacitor the fluctuations (ripple) in V_L can be made quite small.

The waveform of V_L will then be as shown in *Figure 9*, a small fluctuation, or

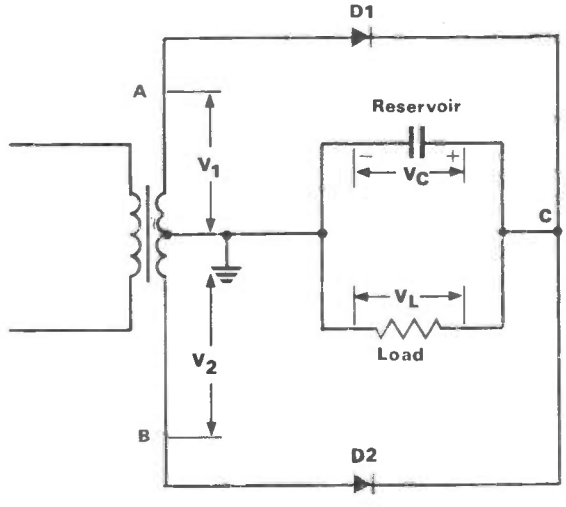

Fig 7 *Use of a reservoir capacitor*

ripple, superimposed on a dc output. It should be noted that in a full-wave rectifier the ripple has a frequency equal to twice that of the supply, whereas with a half-wave rectifier the ripple frequency will be the same as the supply.

Capacitor value

The amplitude of the ripple waveform can be reduced by increasing the size of the reservoir capacitor. However, there is a danger in doing this, because the rectifier may be damaged by the high current pulses required to recharge the capacitor. The rectifier must be able to pass a current much greater than the output current. The largest current which can be safely passed by a rectifier is called the peak current rating of the device.

To determine the value of the reservoir capacitor it is necessary to know the time interval (t) between the full-wave rectifier pulses (10 milliseconds) and decide on the maximum allowable ripple voltage peak to peak. An arbitrary figure would be approximately 3.5 volts peak to peak.

The formula for calculating the value of capacitance is given below:

$$C\ (\mu F) = \frac{I_L \times t}{V_{rip}} \times 10^6$$

Assuming a load current I_L of one amp, then:

$$C = \frac{1 \times 10 \times 10^3}{3.5} = 2{,}857\mu F$$

Therefore the rule of thumb says use 3,000μF/A of dc load. The capacitor voltage rating should be greater than the peak value of the transformer no-load voltage. The best type of capacitor to use is the computer grade with screw terminals, because of their high ripple current ratings. They can be obtained secondhand for a few shillings at your local amateur convention.

Voltage regulation

The power supply consisting of the parts described up to now will provide an unregulated dc voltage output with a ripple under load conditions of approximately 3.5 volts peak to peak. There exist a number of possible ways of providing voltage regulation, depending upon the load current required.

In designing power supplies that are to provide small load currents it is advisable to adopt a low cost approach and use a Zener diode. Zener diodes are constructed to operate reversed biased, ie positive voltage is applied to the cathode of the diode rather than to the anode.

There is a marked difference between a Zener diode and a conventional junction rectifier. The Zener diode operates well beyond the peak reverse voltage of the diode. When the Zener diode reaches peak reverse voltage, the normal high back-resistance of the diode

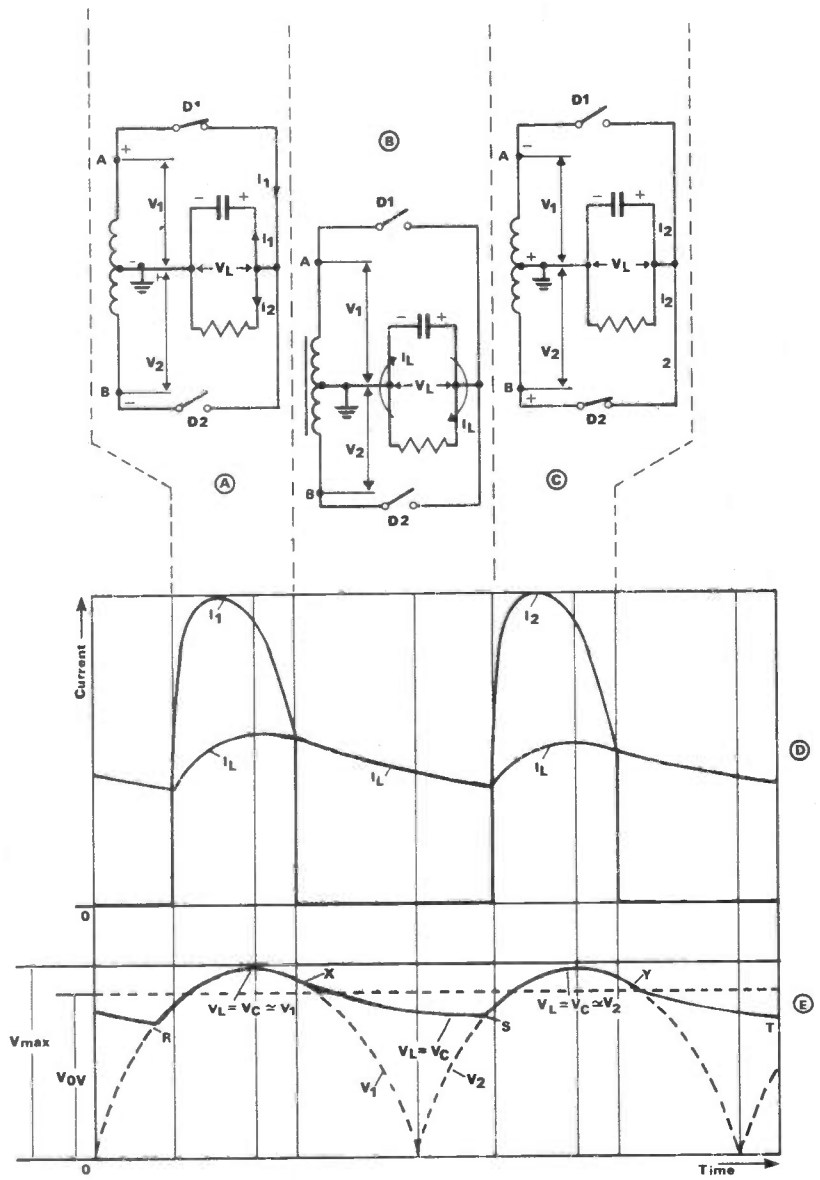

Fig 8 *Action of circuit with a reservoir capacitor*

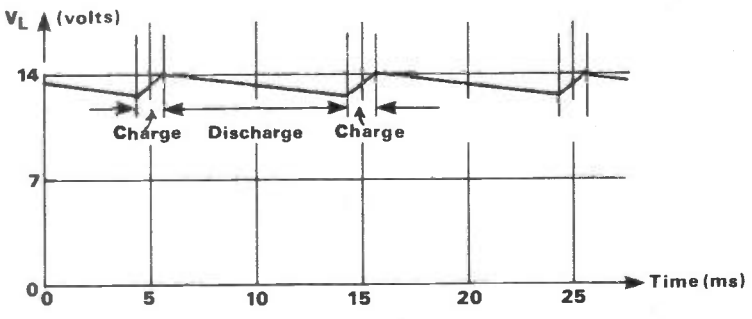

Fig 9 *Smoothing action of a reservoir capacitor*

drops to a very low value and therefore the current increases rapidly. The amount of Zener current is limited by a series resistance Rs placed between the diode and the voltage source.

The value at which the breakdown occurs is designed typically to range from as low as 2.7 volts up to 72 volts, and power dissipation ranges from half a watt up to 20 watts (quoting the RS Components catalogue).

From the characteristics described, the Zener diode can be used in conjunction with a series resistor to form a simple voltage regulator *(Figure 10)*.A rule of thumb can be used with respect to the ratio of minimum Zener diode current I_z and the load current I_L . For good regulation the ratio should be 10:1,ie I_z should be a tenth of I_L .

Calculating the value of Rs is quite straightforward using Ohm's Law. The voltage difference across Rs will be the value of the unregulated supply minus the Zener diode voltage value V_z . The amount of current flowing through the diode will be the load current plus the Zener diode current, which according to the rule of thumb will be a tenth of I_L .

$$\text{Therefore} \quad Rs = \frac{V_{unreg} - V_Z}{I_L + 0.1I_L}$$

When calculating the value of Rs use maximum possible values for I_L and V_{unreg}. The power rating of the Zener diode is calculated again by using the derivative of Ohm's Law, W = V×I. When V is the voltage across the Zener and I the current passing through it, viz $0.1\times I_L$, using the same formula the wattage rating of Rs can also be calculated, taking note that I_L plus $0.1\times I_L$ passes through Rs.

Another rule of thumb says it's a good idea after calculating the wattage rating of Rs and the Zener to multiply by a safety factor of 5. This will allow ample safety margin for continuous operation.

One of the main disadvantages of using this type of circuit is that if the load should ever become disconnected then the Zener diode will attempt to maintain the value of V_z. This means that the voltage drop across Rs will remain unaltered. However, prior to the load being disconnected I_L was passing through Rs. Therefore the Zener will now be passing a current of not only $0.1\times I_L$ but also I_L itself. The power dissipated in the Zener diode will increase instantaneously from $0.1\times I_L\times V_z$ to $1.1\times I_L\times V_z$. Under these circumstances the life of the Zener diode will be very short!

Extending the capability

Some of the limitations of using a Zener diode as a voltage regulator can be overcome by inserting a pass transistor between the diode and the load. The current gain, beta, of the pass transistor is utilised to reduce the current demands upon the Zener diode, and greater load currents can be catered for when using this circuit configuration.

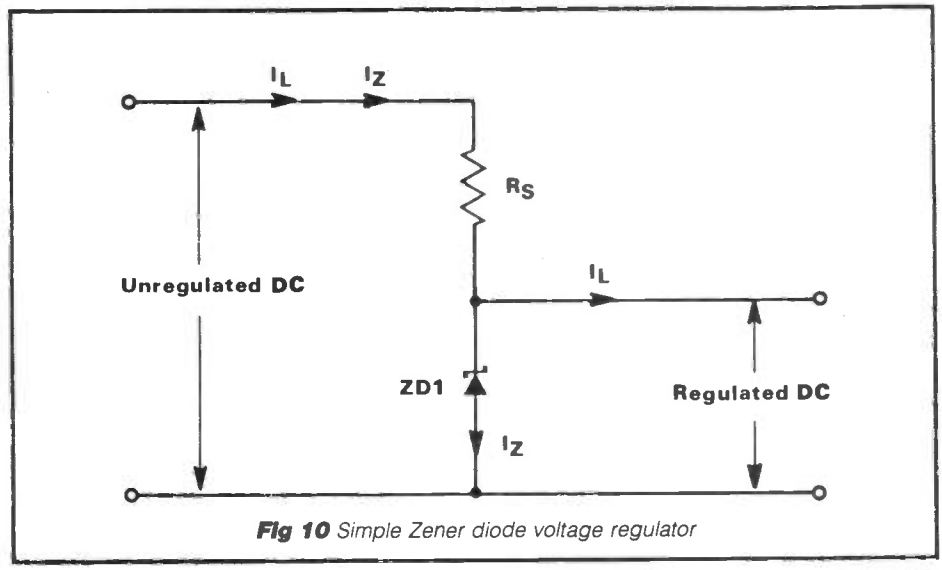

Fig 10 *Simple Zener diode voltage regulator*

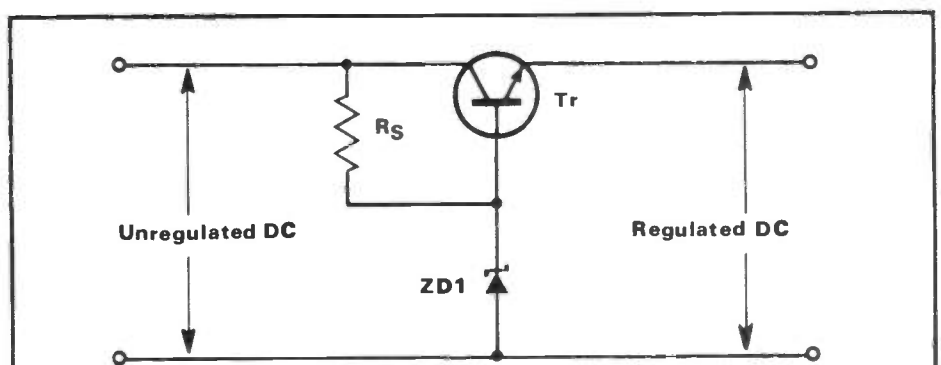

Fig 11 *Zener diode and pass transistor voltage regulator*

An additional benefit of using a pass transistor is that of reducing the power supply ripple.

The pass transistor performs as a simple emitter follower dc amplifier. It increases the load resistance seen by the Zener diode by a factor equal to the current gain of the transistor, and the diode is only required to supply the base current of the transistor. The load regulation and ripple characteristics are improved by a factor of beta.

Figure 11 shows the configuration of the circuit. The main weakness in using this type of circuit is that the pass transistor Tr1 is likely to be damaged if the power supply output is accidentally short circuited. Care must also be taken to ensure that the power dissipation within Tr1 is kept within the operating characteristics of the transistor. The greater the difference between the unregulated voltage and the regulated voltage output the greater the power dissipated by the pass transistor.

The value of Rs can be calculated in a similar way to the previous example of *Figure 10*. The current flowing through Rs will be the base current of Tr1, I_b, and the Zener diode current I_z. By using the rule of thumb used in the previous example I_z will be a tenth of the value of I_b.

The voltage across Rs will be the unregulated voltage minus the operating voltage of the Zener diode. The base current of Tr1 can be calculated from dividing the load current, I_L , by the typical current gain, beta, of the transistor Tr1 being used. The value of the regulated voltage will be the sum of the voltage across the Zener diode plus the voltage across the base-emitter junction V_{be} of Tr1. In power transistors this is likely to be in the order of 0.6 volts.

Capacitors are normally found across the unregulated dc supply and also across the output of the regulated dc supply to suppress transients and help prevent RF energy from entering the voltage regulator circuit.

Next month

Next month we look at how power supply design has been simplified in recent years with the introduction of purpose-built integrated circuits. Three-terminal regulators are examined, including modifications to external circuitry.

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Additional product introductions are calculators from Texas Instruments, Cooper Tools' Weller W12D soldering iron, plus new tools, kits and modules. Among the innovative new kits is a heart rate monitor, which will enable hobbyists to test their own fitness. The assembled unit provides audio/visual and analogue output which facilitates connection to a chart recorder, oscilloscope or personal computer.

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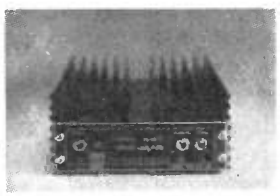

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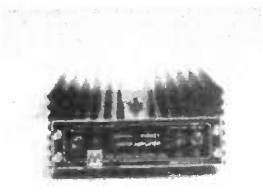

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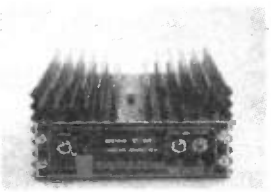

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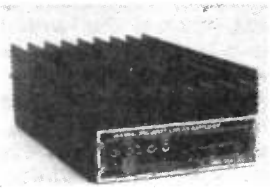

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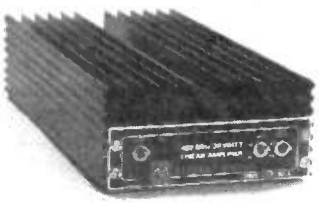

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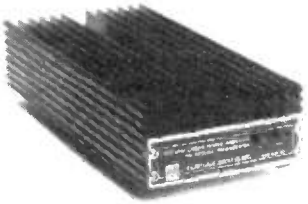

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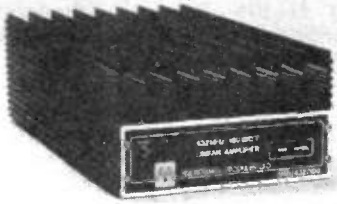

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DATA FILE . . .

In the last six editions of *Data File* we have taken a fairly detailed look at the general subject of 'opto-electronics' and at various types of opto-electronics devices and their applications. In the present (final) edition of this opto-electronics mini-series we conclude our survey of the subject by looking at brightness-control techniques and at miscellaneous device types and circuits.

Lamp-control basics

The brilliance of a dc-powered tungsten filament lamp can be varied in any one of three basic ways. The simplest way is to wire a rheostat and a ganged switch in series with the lamp as shown in *Figure 1*. Here, if RV1 has a maximum resistance value double that of the 'hot' resistance value of the lamp, then RV1 will enable the lamp power dissipation (and thus its brilliance) to be varied over an approximately 12:1 range, as explained below.

A tungsten lamp has a positive temperature coefficient of resistance, causing the lamp resistance to increase with operating temperature. Thus, the 'hot' or operating resistance (at which the filament is white hot) of a 12 volt 12 watt lamp is 12 ohms but the 'cold' resistance of the same lamp is typically only one quarter of this value (3 ohms), resulting in a fairly high 'inrush' lamp current at the moment of initial switch-on; the 'warm' resistance of the same lamp (at which the filament is a dull red) is typically about 6 ohms.

From the above, it can be seen that the operation of the *Figure 1* 'rheostat' circuit is moderately complex, as is made clear in *Figure 2*. Thus, when RV1 is set to the 'maximum brilliance' (zero resistance) position, the full supply voltage is applied to the lamp, which presents a resistance of 12 ohms and thus has a power consumption of 12 watts, as shown in *Figure 2a*.

When RV1 is set to the 'minimum brilliance' (maximum resistance) position, however, RV1 has a resistance of 24 ohms and the lamp presents a resistance of only 6 ohms, as shown in *Figure 2b*. Consequently, only 2.4V is developed across the lamp, which thus consumes only 960mW of power and produces very little light output. RV1 thus allows the lamp brilliance to be varied over a wide range.

A major disadvantage of the *Figure 1* circuit is that a great deal of power is wasted in RV1, which must have a substantial power rating and be capable of handling the 'cold' currents of the lamp. *Figure 3* shows an alternative brilliance-control circuit, which dissipates negligible power in RV1.

In *Figure 3*, RV1 acts as a variable potential divider which applies an input voltage to the base of emitter follower Tr1, which buffers (power-boosts) this voltage and applies it to the lamp. RV1 thus enables the lamp voltage (and thus its brilliance) to be fully varied from zero to maximum. The disadvantage of this circuit is that Tr1 must have a substantial power rating and be capable of handling the 'cold' currents of the lamp.

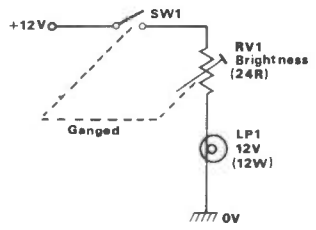


Fig 1 *'Rheostat' brightness-control circuit*

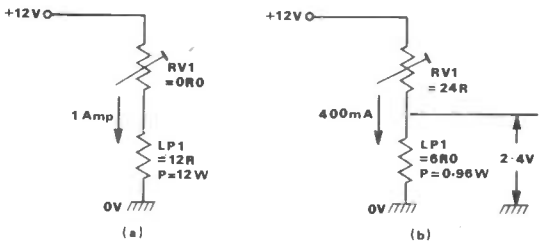


Fig 2 *Equivalent of the Figure 1 circuit at (a) maximum and (b) minimum brilliance levels*

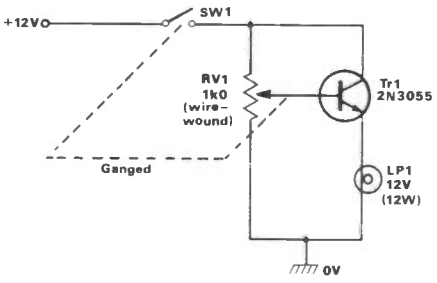


Fig 3 *'Variable-voltage' brightness-control circuit*

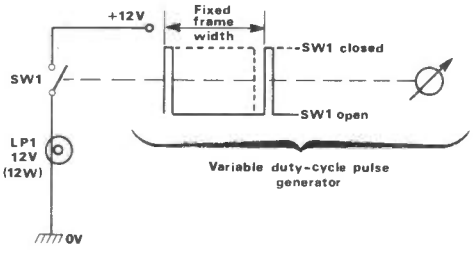


Fig 4 *Basic 'switched-mode' brightness-control circuit*

Switched-mode control

The third and most sophisticated method of controlling the brilliance of a dc-powered lamp is the so-called 'switched-mode' method, which is shown in basic form in *Figure 4*. Here, an electronic switch (SW1) is wired in series with the lamp and can be opened and closed via a pulse-generator waveform. When this pulse is high, SW1 is closed and power is fed to the lamp: when the pulse waveform is low, SW1 is open and zero power is fed to the lamp.

The important thing to note about the *Figure 4* pulse generator is that it generates a waveform with a fixed framewidth but with a variable mark/space (on/off) ratio or duty cycle, thereby enabling the *mean* voltage (applied to the lamp) to be varied. Typically, the M/S ratio is fully variable from 1:20 to 20:1, enabling the mean lamp voltage to be varied between 5% and 95% of the supply voltage value.

Because of the inherently long thermal time constant of a tungsten lamp, its brilliance responds relatively slowly to rapid changes in input power. Consequently, if the framewidth of the *Figure 4* waveform generator is less than roughly 100mS (ie, the repetition frequency is greater than 10Hz) the lamp will show no sign of flicker, and the lamp brilliance can be varied by altering the M/S ratio.

Thus, if the M/S ratio of the *Figure 4* circuit is set at 20:1, the mean lamp voltage is 11.4V and the consequently 'hot' lamp consumes 10.83 watts. Alternatively, with the M/S ratio set at 1:20 the mean lamp voltage is a mere 600mV, so the lamp is virtually 'cold' and consumes only 120mW. The power consumption of the lamp can thus be varied over a 90:1 range via the M/S ratio control. Note, however, that this wide range of power control is obtained with virtually zero power loss within the system, since power is actually controlled by SW1, which is always either fully on or fully off. The 'switched-mode' control system is thus exceptionally efficient.

Figure 5 shows the practical circuit of a switched-mode dc 'lamp dimmer' or brilliance control that is designed for use with a 12V lamp with a maximum power rating of 24W. The circuit enables the light intensity of the lamp to be smoothly varied from zero to full brilliance via 100K variable resistance control RV1, and operates as follows.

In *Figure 5* IC1a and IC1b (comprising one half of a 4001B CMOS quad 2-input NOR gate) are connected as an astable

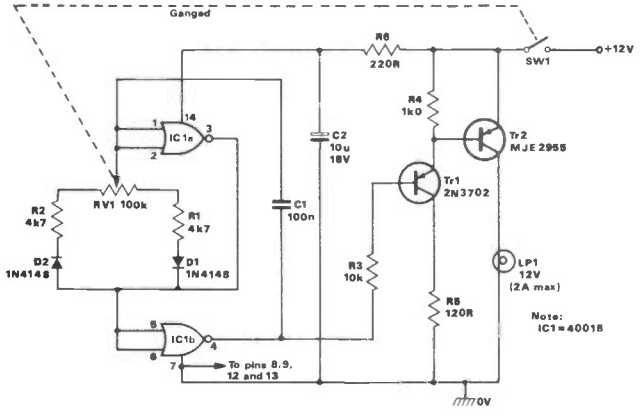


Fig 5 *Switched-mode dc lamp-dimmer (−ve ground version)*

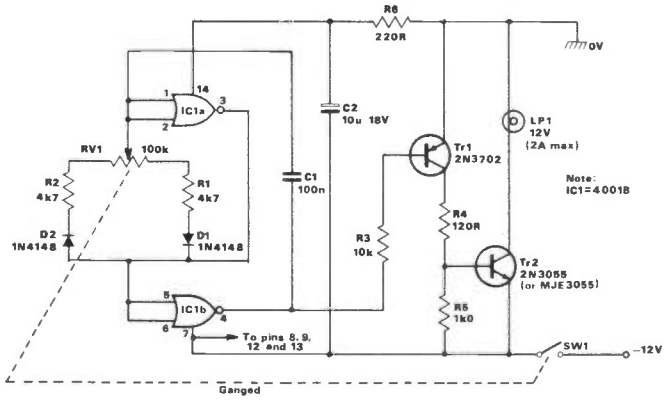


Fig 6 *Switched-mode lamp-dimmer (+ve ground version)*

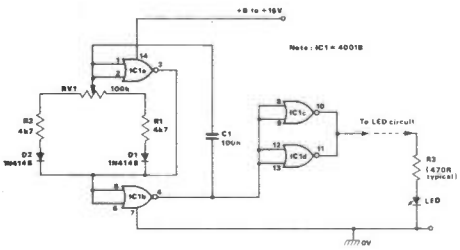


Fig 7 *Switched-mode LED brightness-control circuit*

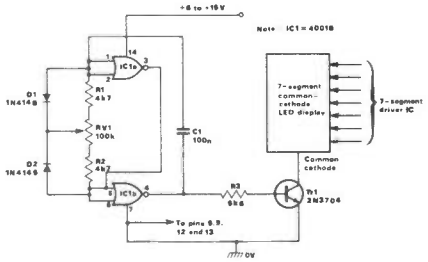


Fig 8 *Common-cathode LED brightness-control circuit*

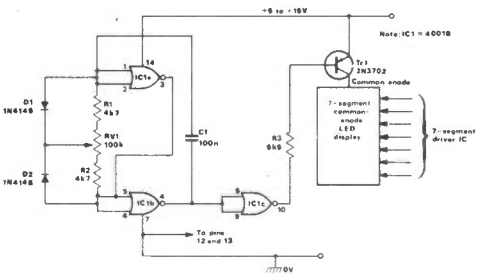


Fig 9 *Common-anode LED brightness-control circuit*

multivibrator or 'squarewave' generator in which one half of the waveform is generated via C1-D1-R1 and the right-hand half of RV1, and the other half is generated via C1-D2-R2 and the left-hand half of RV1, thus enabling the M/S ratio to be varied via RV1.

Thus when SW1 is closed, the astable multivibrator operates and feeds a switching waveform to the lamp via Tr1 and Tr2. The astable operates at a fixed frequency of about 100Hz, but its M/S ratio is fully variable from 1:20 to 20:1 via RV1, consequently enabling the mean lamp power to be varied over a 90:1 range. Note that on/off switch SW1 is ganged to RV1, so the circuit can be switched fully off by simply turning the RV1 brilliance control fully anti-clockwise.

The *Figure 5* lamp-dimmer circuit can be used for controlling the brilliance of virtually any low power (up to 24W) filament lamps that are powered by 12V dc supplies. Note, however, that if it is to be used to control car lights it can only be used in vehicles in which the 'free' ends of the lamps go to the +ve supply line via control switches, as is normal in vehicles fitted with 'negative earth' electrical systems.

The alternative circuit of *Figure 6* can be used to control the lights of vehicles in which the 'free' end of the lamp goes to the −ve supply line via control switches, as normally occurs in vehicles fitted with 'positive earth' electrical systems. Note in both the *Figure 5* and *Figure 6* circuits that R6-C2 are used to protect IC1 against damage from high-voltage transients that may occur on the vehicle's supply lines.

LED brightness control

The switched-mode technique can also be used to control the brilliance of solid-state light-emitting devices such as LEDs and 7-segment LED displays, etc.

These devices, however, give an instant response to changes in input power level, so the design technique must rely on the natural integrating action of the human eye (the 'persistence of vision') to ensure a 'flicker-free' brightness-control action.

At a frequency in excess of about 40Hz, the human eye sees changes in light level in terms of the 'mean' value of the light intensity. Thus in LED brightness-control circuits the variable M/S ratio generator normally operates in the range 50 to 100Hz.

Figure 7 shows a practical example of an LED brightness-control circuit, designed around a single 4001B CMOS IC. Here, IC1a-IC1b are wired as a 100Hz astable multivibrator, with M/S ratio variable from 1:20 to 20:1 via RV1, and IC1c and IC1d are connected in parallel to provide a medium-current (15 to 20mA) buffered drive to the LED, which is current-limited via R3.

Figure 8 shows how to apply switched-mode brightness control to a common-cathode 7-segment LED display. Here IC1a-IC1b are again wired as a 100Hz astable with variable M/S ratio, but in this case the output waveform is fed (via R3) to the base of Tr1, which functions as a medium-power 'switch' that is wired in series with the common cathode terminal of the display.

Figure 9 shows how to modify the above circuit for use with a common-anode display. Here, IC1c is used as an inverting buffer that connects the astable output signal to the base of pnp transistor Tr1.

In practice, many 7-segment LED driver ICs have a 'blanking' terminal (enabling the display to be turned on or off) which can be used to apply switched-mode brightness control to the LED display device. This terminal is usually designated 'BL' or 'BI'.

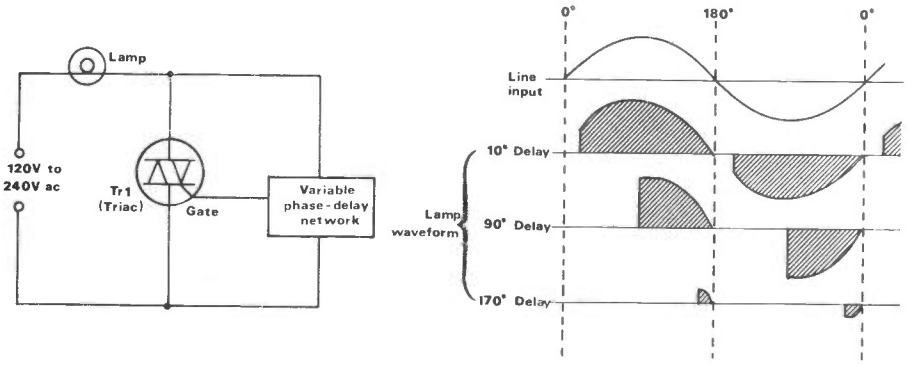


Fig 10 *Basic 'phase-triggered' ac brightness-control circuit and waveforms*

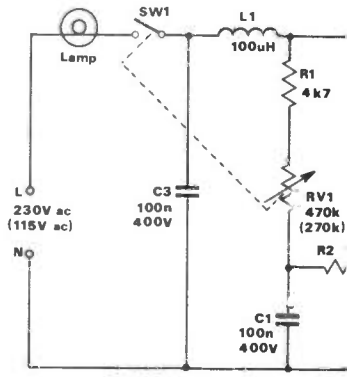


Fig 13 *Improved lamp dimmer*

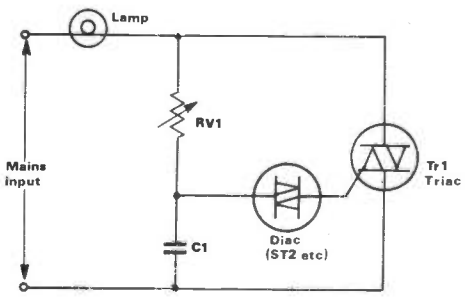


Fig 11 *Basic 'diac-type' variable phase-delay circuit*

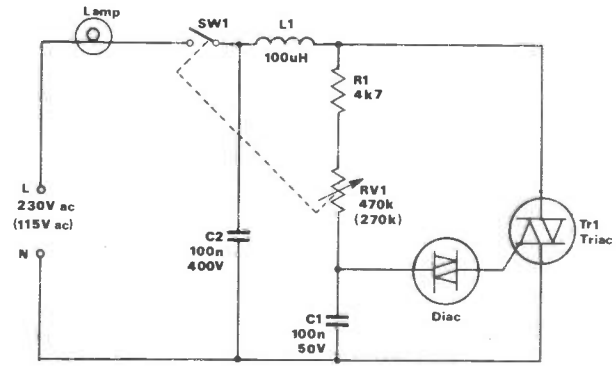


Fig 12 *Practical circuit of lamp dimmer with RFI suppression*

Fig 1

ac lamp-control basics

The brilliance of an ac-powered lamp can be controlled by using a triac and a variable phase-delay network to vary the power feed to the lamp, as shown in the basic 'phase-triggered' system of *Figure 10*. The triac is a bidirectional (ac) solid-state self-latching power switch that can be turned on by applying a trigger pulse to its gate, but which turns off automatically at the end of each power half-cycle as its main terminal currents fall to near zero.

Thus in *Figure 10* the triac is triggered via a variable phase-delay network that is interposed between the ac power line and the triac gate. Hence if the triac is triggered 10° after the start of each half-cycle almost the full available power is fed to the lamp load. If the triac is triggered 90° after the start of each half-cycle only half of the available line power is fed to the load. Finally, if the triac is triggered 170° after the start of each half-cycle (ie, 10° before the end of each half-cycle) only a very small part of the available power is fed to the load.

The three most popular methods of obtaining variable phase-delay triggering are to use either a line-synchronised UJT (unijunction transistor), a special purpose IC, or a 'diac' and an R-C network in the basic configuration shown in *Figure 11*.

The diac is a bilateral threshold switch which when connected across a voltage source presents a high impedance until the applied voltage rises to about 35V. At this point the device switches into a low impedance state and remains there until the applied voltage falls to about 30V, when it reverts back to the high impedance mode.

Thus in *Figure 11*, in each mains half-cycle the RV1-C1 network applies a variable phase-delayed version of the mains waveform to the triac gate via the diac, and each time the C1 voltage rises to 35V the diac fires and delivers a trigger pulse to the triac gate, thus turning the triac on whilst simultaneously applying power to the lamp load and removing the drive from the RV1-C1 network. The mean power to the load (integrated over a full half-cycle period) is thus fully variable from near zero to maximum via RV1.

RFI

Note from the *Figure 10* waveforms that each time the triac is gated on, the load current transits abruptly (in a few microseconds) from zero to a value determined by the lamp resistance and the instantaneous mains voltage. These transitions inevitably generate radio frequency interference (RFI). The RFI is greatest when the triac is triggered at 90° and is least when the triac is triggered close to the 0° and 180° 'zero crossing' points of the mains waveform.

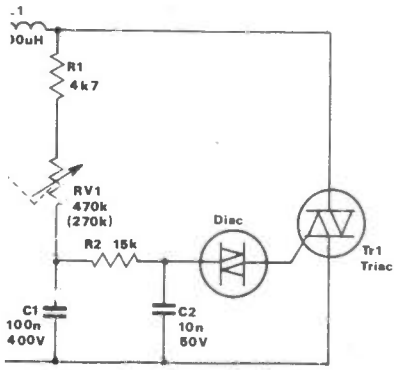
In lamp-dimmer brightness-control circuits, where there may be considerable lengths of mains cable between the triac and the lamp load, this RFI may be offensive. Consequently, in practical lamp dimmers the circuit is usually provided with an L-C RFI suppression network, as shown in the circuit of *Figure 12*. This circuit also shows how on/off switch SW1 can be ganged to brightness control pot RV1.

Note in *Figure 12* and all other triac circuits shown in this article that the diac can be virtually any commercial type (ST2, etc), that the triac type should be chosen to suit the mains voltage and lamp load values, and that the values shown in brackets are applicable to 115V (rather than 230V) mains operation.

Backlash reduction

The simple *Figure 12* circuit makes a useful lamp dimmer but has one rather annoying characteristic; RV1 has considerable hysteresis or backlash. If, for example, the lamp finally goes fully off when RV1 is increased to 470K (in the 230V circuit) it may not start to go on again until RV1 is reduced to 400K, and it then suddenly burns at a fairly high brightness. The cause of this characteristic is as follows.

The basic action of the *Figure 12* circuit is such that in the first part of each mains half-cycle C1 charges via RV1-R1 and the lamp etc to 35V, at which point the diac suddenly fires and starts to partially discharge C1 into the gate of the triac. As the triac turns on it switches the remaining part of the half-cycle to the lamp and simultaneously removes the mains drive from R1-RV1. This switching action only takes 2μS or so, but in this



mp dimmer with gate slaving

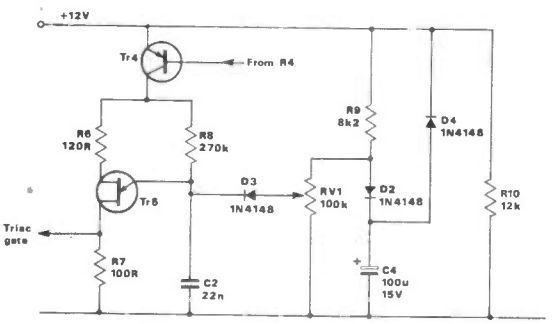


Fig 15 *Slow-start lamp dimmer circuit*

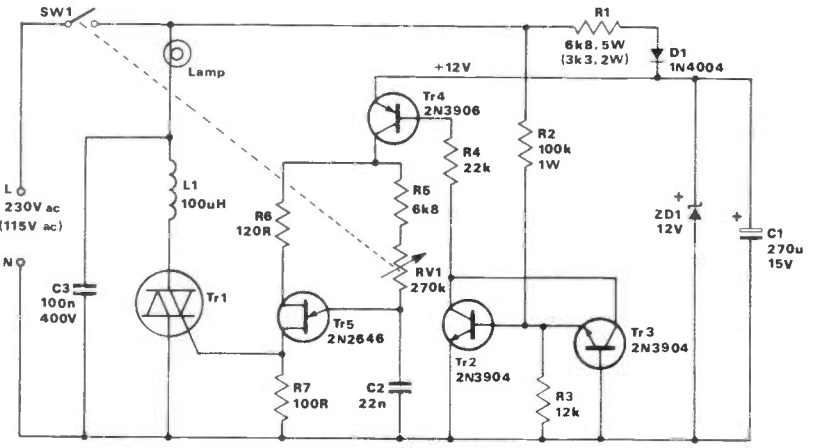


Fig 14 *UJT-triggered zero backlash lamp dimmer*

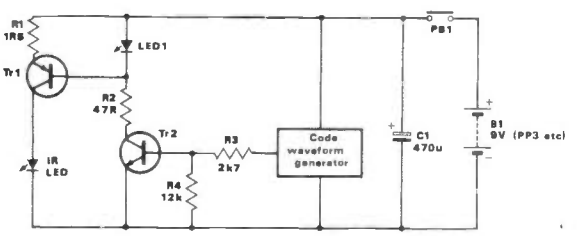


Fig 16 *Basic IR remote control transmitter*

brief period the diac is able (in the *Figure 12* circuit) to remove substantial charge (typically about 5V) from C1 and thus upsets the timing of the following half-cycle, thereby causing the annoying backlash characteristic.

One easy way to reduce this backlash is to simply wire a current-limiting resistor (47R to 120R) in series with the diac to reduce the amount of C1 voltage change that takes place in the 2μS triac switch-on period. Another way is to use the gate-slaving technique shown in *Figure 13.*

The *Figure 13* circuit is similar to that of *Figure 12,* except that the charge of C1 is fed to slave capacitor C2 via the relatively high resistance of R2. C1 is at a slightly higher voltage than C2, and C2 fires the diac once its voltage reaches 35V. Once the diac has fired it reduces the C2 potential briefly to 30V, but has little influence on the value of the C1 main-timing capacitor; the circuit backlash is thus reduced.

The backlash can be reduced even more by wiring a current-limiting resistor in series with the diac (as described above) to reduce the magnitude of the C2 discharge voltage.

UJT triggering

A lamp dimmer with absolutely zero backlash can be made by using a mains-synchronised variable-delay unijunction transistor (UJT) circuit to trigger the lamp-driving triac in each half-cycle of mains voltage. *Figure 14* shows such a circuit. Here, the UJT is powered from a 12V dc supply derived from the ac power line via R1-D1-ZD1 and C1.

The UJT is synchronised to the mains via the Tr2-Tr3-Tr4 zero-crossing detector network, the action being such that Tr4 is turned on (applying power to the UJT circuit) via Tr2 or Tr3 at all times other than when the instantaneous mains voltage is close to the zero-crossover point at the end or the start of each mains half-cycle.

Thus, shortly after the start of each half-cycle power is applied to the UJT circuit via Tr4, initiating the start of a UJT timing cycle, and a short time later (determined by R5-RV1-C2) the UJT (Tr5) delivers a trigger pulse to the triac gate, driving the triac on and connecting power to the lamp load for the remaining part of the half-cycle. The triac and the UJT circuit resets at the end of each half-cycle, and a new sequence then begins.

The *Figure 14* circuit generates absolutely zero control backlash and can be modified for use in a variety of non-standard applications. *Figure 15* shows a circuit that can be fitted in place of the existing UJT circuit to modify *Figure 14* so that it acts as a slow-start lamp dimmer. This simply causes the lamp brilliance to increase slowly from zero to maximum when first turned on, taking roughly two seconds to reach full brilliance. The circuit is intended to eliminate high turn-on inrush currents and to thus extend the lamp life. Circuit operation is as follows.

When power is first applied to the circuit C4 is fully discharged and acts like a short circuit, so C2 charges via high-value resistor R8 only; the UJT thus generates a long delay under this condition, so the triac is triggered late in each half-cycle and the lamp burns at low brilliance. As time passes C4 slowly charges up via R9, enabling the C2 charge to be supplemented via R9-RV1-D3 and thereby progressively reducing the UJT time constant and increasing the lamp brilliance until, when C4 is fully charged (after roughly two seconds), full brilliance is reached.

IR LED pulsing

Infra-red LEDs are often used in remote control systems. Here the IR LED is used to transmit a coded invisible-light signal, which is detected by a matching infra-red diode (and subsequently decoded) in a receiver system some distance away.

To give an adequate remote control range (up to ten metres) the IR LED must pass 'on' currents of several hundred mA, but for practical reasons the complete transmitter must be small enough to fit into the hand, be self-powered via an inexpensive battery, and be capable of giving many hours of continuous 'control' operation before needing battery replacement.

These conflicting requirements can be met by using the basic circuit of *Figure 16,* which is driven via the waveform shown in *Figure 17.*

The coded IR-transmitter signal comprises 1mS bursts of 20KHz pulses repeated at 51mS timebase intervals, ie at a 1:50 mark/space ratio. The transmitter generates peak IR LED currents of about 600mA, giving a mean current of 300mA during the 'mark' part of each transmitting cycle but a mean of only 6mA when averaged over the complete 51mS timebase period.

In the actual transmitter the coded waveform is fed to the base of Tr2 via R3. When the waveform is high Tr2 is driven to saturation, driving Tr1 and LED1 on and feeding roughly 600mA into the IR LED via R1; when the waveform is low, zero current feeds into the IR LED. Note that capacitor C1 acts as a low impedance energy-storage unit and provides the required high drive currents for the IR LED; these currents could not be provided by B1 alone. We'll be showing some practical examples of complete IR remote-control systems in some future editions of *Data File*.

Solar cells

Finally, to complete our opto-electronics mini-survey brief mention must be made of so-called 'solar' cells. These photo-voltaic cells actually convert light energy directly into electric energy.

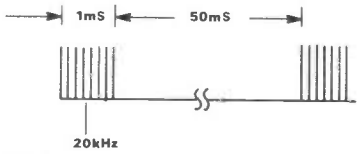


Fig 17 *Typical code waveform for Figure 16*

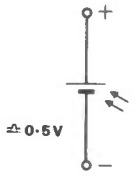


Fig 18 *Symbol for a single solar cell*

Figure 18 shows the symbol used to represent a single solar cell.

An individual solar cell generates an open circuit voltage of about 500mV when active. Individual cells can be connected in series to increase the available terminal voltage or in parallel to increase the available output current. Banks of cells manufactured ready-connected in either of these ways are known as solar panels. *Figure 19* shows how a bank of 16 to 18 cells can be used to auto-charge a 6V Nicad battery via a germanium diode.

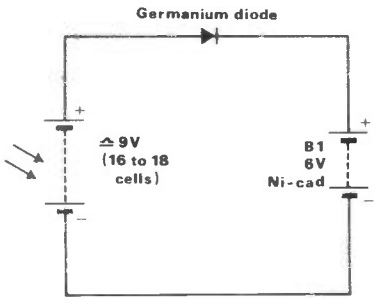


Fig 19 *Solar panel used to charge a 6V Nicad*

The available output current of a solar cell depends on the light intensity, on cell efficiency (typically only a few percent), and on the size of the active area of the cell face. It should be noted that available sea level light energy is typically in the range 0.5KW to 2KW per square metre on a bright sunny day, so there is plenty of 'free' energy waiting to be converted.

In next month's edition of *Data File* we start a new mini-series on the '555' range of 'timer' ICs, a versatile (and cheap!) range of chips.

TWO METRE AMPLIFIER

We present the first part of an article by David Silvester G4TJG on the design of 2 metre amplifiers. This month he covers the theory . . .

Transistors capable of providing useful amounts of RF power have been available for some considerable time, but very little information concerning the design of an amplifier to fit the needs of the amateur has been published. Many articles gloss over the problems of design, leaving the constructor wondering why his or her amplifier does not work to specification. We propose to give the full details for the design of a 2 metre FM amplifier using 1 watt input from the transceiver and delivering 15 watts to the antenna.

Amplifier types

Consider first the types of transistor amplifier available. *Figure 1* shows the three common classes of amplifier superimposed on the graph of collector current I_c against the base-emitter voltage V_{be}. Until V_{be} exceeds 0.6 volts I_c remains at a very low level (the leakage current), and from this point the value of I_c rises steeply as V_{be} is increased. The three main classes of transistor power amplifier are related to the bias conditions imposed on the transistor with no input signal.

In class A, V_{be} is held above 0.6V so that a collector current flows continuously. The addition of a low level signal will cause I_c to vary, but at no time does I_c drop to the leakage level. This is the most common type of transistor amplifier and is used at all frequencies from audio to RF, with variations only in the way the transistor is connected to the following stages.

As the collector current is always flowing the transistor will constantly be dissipating power as heat, and the efficiency of the amplifier will be low. Class A amplifiers introduce little distortion and are best suited to low power stages.

If V_{be} is reduced so that only a very small standing collector current flows we produce a class B amplifier. The collector current waveform will be the amplified positive half-cycle of the input waveform, with I_c flowing for 180° and the transistor cut off for the other half-cycle. Linearity has been lost because the transistor only amplifies half of the waveform, but because it produces power only when an input waveform exists the efficiency of the stage increases dramatically.

The linearity problem can be overcome by using two transistors in a push-pull arrangement, so that whilst one transistor conducts for one half-cycle, the other half-cycle is amplified by the second transistor. Two-transistor push-pull VHF amplifiers are not common, although valve circuits using this principal are frequently seen.

Class C is an extension of class B where the collector current flows for less than one half-cycle, since the transistor is biased well into the cut-off region by reducing V_{be} below 0.6V. Typically V_{be} is made 0V so that the input waveform must be capable of increasing the input voltage to above 0.6V before the transistor can amplify the signal. Although only suited to power amplifier stages for FM or AM transmitters, the efficiency of the stage is very high and the method of producing the necessary bias conditions is simple.

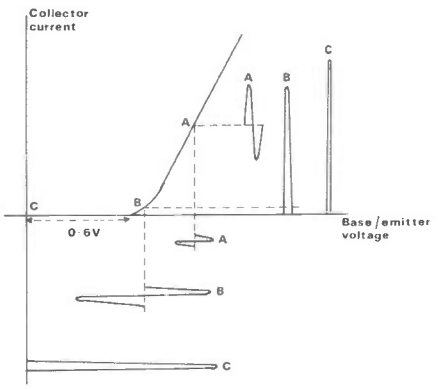


Fig 1 *Classes of power amplifier*

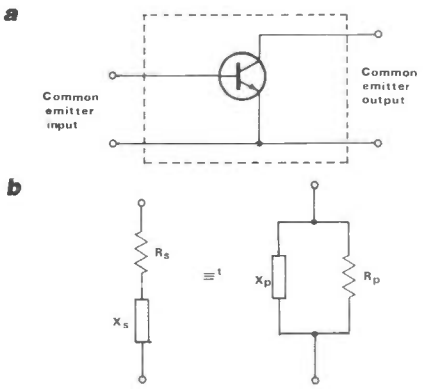


Fig 2 *Black box transistor representation*

The transistor at RF

Let us consider the transistor itself as used in a common-emitter amplifier stage. *Figure 2a* shows this common-emitter connected transistor as a 'black box' representation.

To anything outside the box the transistor input and output appear to consist of a resistor R_S and a reactance X_S in series, *Figure 2b*, caused by the transistor characteristics and its bond wires. By convention, when X_S is positive its value represents an inductor and when negative a capacitor.

It must be remembered that X_S is the value in ohms at the frequency being amplified, not the inductance in henries. However, it is also possible to represent the input and output impedance as reactance and resistance in parallel, and the formulae for these conversions are:

$$R_s = \frac{R_p \cdot X_p^2}{R_p^2 + X_p^2} \qquad X_s = \frac{R_p^2 \cdot X_p}{R_p^2 + X_p^2}$$

$$R_p = \frac{R_s^2 + X_s^2}{R_s} \qquad X_p = \frac{R_s^2 + X_s^2}{X_s}$$

Some manufacturers show their transistor characteristics with the parallel notation, and this will need to be converted to series for our purposes.

Impedances are usually written as a resistance + j.reactance, where j is $\sqrt{-1}$, basically showing that voltage and current are 90° out of phase. In this way 4−j2 is the representation of a 4 ohm resistor in series with a capacitor whose reactance at 145MHz is 2 ohms, ie a capacitor of 550pF. Similarly 4+j2 represents a 4 ohm resistor in series with an inductor of reactance 2 ohms at 145MHz, ie 2.2nH.

Matching networks

We must now consider the ways in which we can match the 50+j0 impedance from the transceiver to the 1.77+j0.60 input impedance of the transistor and again convert the −j2.02 transistor output reactance to 50+j0 for the antenna.

The possible matching circuits are shown in *Figure 3* along with the

associated formulae for calculation of the necessary component reactance values. The values used as R_1 and R_2 in the formulae are the resistive values only, the reactance of the input and output being ignored at this stage. The calculated value of X_{L1} in *Figures 3a* to *3c* is increased by the value of X_S if R_1 has a capacitive reactance ($-jX_S$) associated with it, or decreased by X_S if X_S is inductive. For *Figure 3d* the value of X_{L1} is corrected by the value of the reactance associated with R_1 and X_{L2} corrected by the reactance associated with R_2, as before.

The reactance values can then be converted to actual inductor and capacitor values by using:

$$L = \frac{X_L}{2\pi f} \qquad C = \frac{1}{2\pi f X_C}$$

with X_L and X_C in ohms, the frequency f in hertz, and the results of L and C in henries and farads respectively.

Transistor input power

The next item for consideration is the amount of input power, 1 watt in our case, which can be used effectively by the transistor.

Figure 4 shows a simple class C single stage amplifier for 144 to 146MHz, and it can be seen that V_{be} is held at 0V by the 15 ohm resistor. Without any input signal only the collector leakage current flows. The input matching system allows the 50 ohm transceiver input to be matched to the 1.77+j0.60 ohm input impedance of the transistor.

Figure 5 now shows a single cycle of the input waveform, and using some simple formulae we calculate that the maximum input voltage into 1.77 ohms is 1.33V. However, the transistor can only conduct when the input voltage is above 0.6V, and so of the 1 watt input represented by the total area of the waveform only the very small portion shaded actually does any useful work in the transistor.

If instead of a class C amplifier we had chosen a class B, the whole positive half-cycle would be used by the transistor and the usable power would be 0.5 watts, the remainder being lost.

To calculate the shaded area shown in *Figure 5* we must resort to some integral calculus and trigonometry. Sorry, but there's no choice! It's the only way to get the answers we need.

Firstly we must calculate the angle over which the shaded area lies, and in all of the following the angles are shown in radians (2π radians equals one complete cycle) with later conversions to degrees. The input waveform is a sinewave, and the voltage at any instant can be calculated from:

$$y = a \sin\theta \text{ (equation 1)}$$

where 'y' is the instantaneous voltage, 'a' is the maximum voltage, and θ is the angle from the point where the value of 'y' is zero and about to go positive.

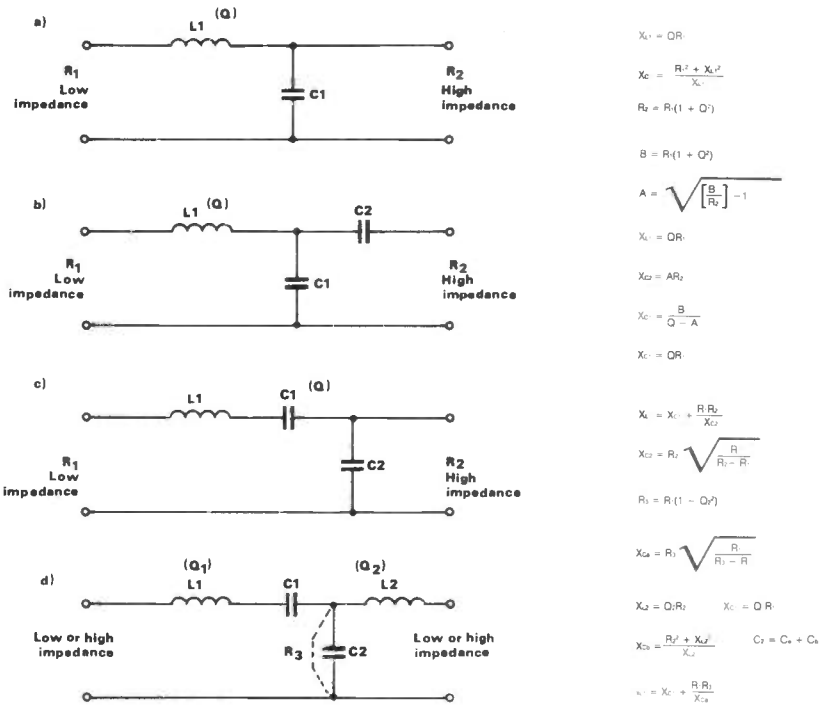


Fig 3 *Matching circuits*

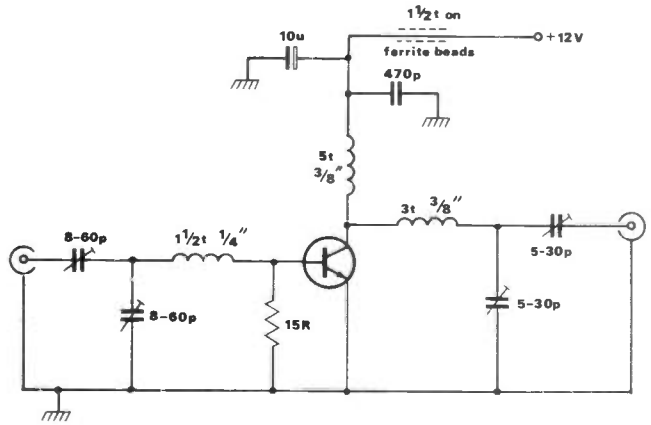


Fig 4 *Single stage 2 metre amplifier*

In our case the transistor conducts only when 'y' is greater than 0.6, with 'a' equal to 1.33. This occurs at:

$$\sin\theta = \frac{0.6}{1.33} \text{ (eqn 2)}$$

and we calculate θ= 0.47 radians or 27°.

As the waveform is symmetrical about $\pi/2$ (90°) the transistor conducts from 27° to 153°, a conduction angle of 126° or just over ⅓ of the complete cycle. We will need these conduction angles in radians later, and they are 0.47 and $\pi - 0.47 = 2.67$. These are referred to as θ_1 and θ_2 respectively.

To give a general formula we will let 'v' be the voltage required at the transistor input to cause a collector current to flow. In a bipolar transistor this is V_{be}, equal to 0.6V, but the equation we derive will be applicable to RF power MosFETs whose turn-on voltage V_{gs} will be between 2 and 6 volts.

In our case we require the area of the shaded portion of *Figure 5.* The general form of the conduction angle is:

$$\sin\theta = \frac{V_{be} \text{ (or } V_{gs})}{\text{max input voltage into transistor}} \text{ (eqn 3)}$$

The power input to the full half-waveform is 0.5 watts, and is given mathematically as:

$$\text{Power} = \text{area under curve}$$

$$= k\int_0^{\pi} \sin\theta \, d\theta \text{ (eqn 4)}$$

For the general case:

$$\text{Usable power} = k\int_{\theta_2}^{\theta_1} \sin - v \; d \quad \text{(eqn 5)}$$

Ignoring the in-between calculations, and as the shaded portion is symmetrical about $\pi/2$ or 90°, then:

$$\text{Usable power} = k[2.\cos\theta - v(\theta_2 - \theta_1)] \quad \text{(eqn 6)}$$

where 'k' is a constant.

This equation is valid for class B amplifiers when v=0, as the transistor is already turned on, or class C where for a bipolar transistor v=0.6 and for MosFETs v=4.

We can calculate the value of 'k' in our example assuming that we are using a class B amplifier where the usable power input is 0.5 watts, θ_1 =0 radians, θ_2 =π radians and v=0. Substituting:

$$0.5 = k[2.\cos 0 - 0(\pi - 0)]$$

In our case, k= 0.25.

Using the values of θ_1 and θ_2 calculated from equation 2, and putting these into equation 6 with our value of k and v = 0.6, we obtain:

$$\text{Useful power} = 0.25[1.783 - 0.6(2.67 - 0.47)]$$
$$= 0.115 \text{ watts}$$

Of the 1 watt input we are only using less than 12% of the available power as usable input to the transistor, and it is this aspect of RF amplifier design that is most frequently ignored in constructional articles.

A few interesting results appear from these calculations. At a slightly lower power level, the input voltage will never exceed 0.6V into 1.77 ohms and the transistor will never be able to amplify the signal. Doubling the input power gives much more than twice the usable power to the transistor, and the efficiency of the class C stage with regard to input power versus output power rises steeply. Alternatively, by using a transistor with a higher input impedance we achieve a greater useful input power to the transistor for the same 1 watt average input power.

The transistor load

The output load resistance presented to the collector of the transistor is not a simple case of R=V²÷W, as the power is delivered in pulses for 126° in each complete input cycle. In *Figure 6* we show the ratio of the peak of the collector current to the average value for various conduction angles, and *Figure 7* gives the output power for various inputs.

Knowing the average output we can calculate the average current, and by using *Figure 6* we can find the peak current. Using Ohm's Law we can calculate the resistance needed for the load so that at the peak current the voltage drop will be equal to the supply voltage less the transistor's minimum emitter/collector voltage, say 1 volt.

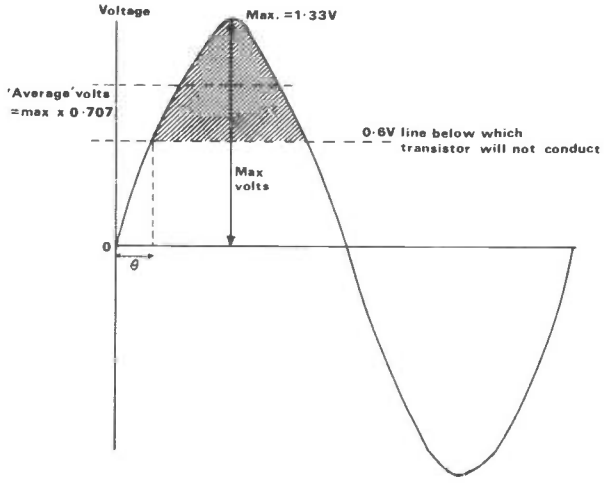


Table 5 *Transistor input waveform for 1W into 1.77 ohms*

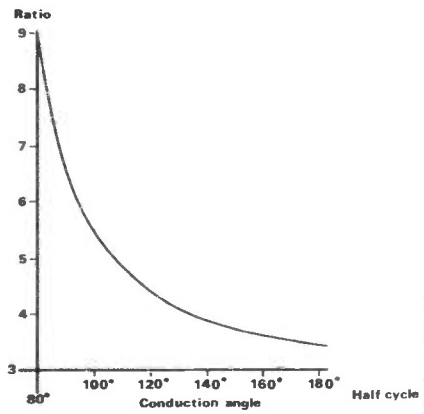
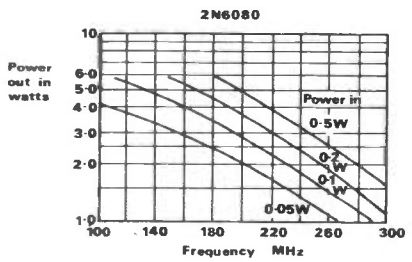
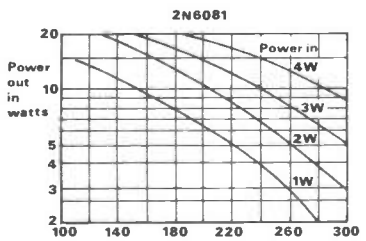


Fig 6 *Ratio of peak collector current/average collector current*



Frequency MHz	Z_{in} ohms	Z_{out} ohms
130	3.18–j4.30	9.50–j7.00
140	3.18–j3.70	10.11–j6.32
150	3.18–j3.10	10.70–j5.60
160	3.17–j2.50	11.30–j4.85
170	3.17–j1.96	11.94–j4.13
180	3.17–j1.35	12.50–j3.50



Frequency MHz	Z_{in} ohms	Z_{out} ohms
130	1.64+j0.15	3.90–j2.45
140	1.73+j0.44	4.03–j2.16
150	1.80+j0.76	4.18–j1.88
160	1.92+j1.00	4.32–j1.60
170	2.02+j1.31	4.45–j1.30
180	2.12+j1.62	4.60–j1.00

Fig 7 *Transistor characteristics (tables courtesy of Motorola Inc)*

For a 3 watt average output and a 13.8V power supply to the amplifier the average current is 0.234A, but for a 126° conduction angle. *Figure 6* shows that the peak current is 0.234 × 4.5 amps, ie 1.05A. Hence the output matching circuit needs to present 12.8÷1.05 ohms, say 12 ohms, to the transistor.

In addition to the transistor load the supply voltage is delivered to the transistor by a second inductor in the collector circuit. At operating frequency this inductor is designed to present a reactance of about 10 to 20 times the value of the load resistance, but at a low frequency the very low value of reactance presented to the transistor aids stability.

Using the equations in *Figure 3* it is now possible to calculate the necessary values of capacitance and inductance for the components shown in the simple amplifier in *Figure 4*.

Next month we move on to the design of a two stage amplifier. After a few calculations (just a few, honestly!) the finalised design is described. Coil winding details and the construction procedure are followed by alignment, which is simplicity itself.

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

It might be thought that right in the middle of sunspot minimum is hardly the time to write about sunspots. But maybe it is not a bad time to start thinking about them, because if you want to start recording and correlating them with radio propagation conditions, as quite a number of radio amateurs apparently do, now is the time to start so that you can gradually watch their build-up as the solar cycle progresses.

Observing sunspots seems to be quite a popular sideline to amateur radio, not only for the individual, but also as a team, group or club activity. The writer knows several radio amateurs who are interested in this topic and who own or are building small telescopes; the project does make an interesting and useful one for the radio amateur who likes to take a scientific interest in his hobby.

Until just recently the sunspot count was regarded as the prime index of solar activity and its effects on radio propagation. Recently however favour has been placed on 'coronal holes'. We will have more to say about these and their relationship with sunspots later.

If one examines the surface of the sun telescopically it will be seen to be granulated in appearance. This granulation appears to consist of innumerable relatively bright grains – like grains of rice – on a less bright background. They are normally circular in shape, and have a diameter of about 600 miles when measured in very good seeing conditions. The mean distance between the granules is about 900 miles. They are thought to have a temperature difference of 900 kelvins from the inter-grain surface.

All this refers to undisturbed regions of the sun. Extremely disturbed regions are often encountered, and in these the 'rice-grains' may be replaced by a tiny black spot. These black spots grow larger and darker until they appear to be completely black against the bright photosphere background. They are then called 'pores' and are in fact minute sunspots. When they grow to a considerable size they are termed sunspots.

Two large spots are generally formed from a single pore or small spot. Between these two a string of small spots may develop. This soon disappears, as well as the 'trailing' spot of the first two, leaving the 'leader' – the one which reaches the western rim of the sun first – to increase in size and become circular in shape. It eventually breaks up into a number of smaller spots from which new spots may form. The majority of pores never develop into spots, whilst some spots become many times greater in size than the Earth.

In fully developed spots two regions can be distinguished, the central region or *umbra*, whose surface is uniformly dark, and the *penumbra*, which surrounds the umbra. The umbra only appears to be dark by contrast with the surrounding photosphere; in reality it is extremely brilliant. Sometimes the umbra shows material in the form of 'bridges' dividing it. At times of great solar activity enormously large spots can be seen – up to 55,000 miles in diameter.

Greenwich Observatory began recording sunspots in 1874, and since then 16,000 spot groups have been recorded photographically. The daily area of each group is given in Greenwich publications, the unit of area being taken as one-millionth of the sun's hemisphere, ie 1,174,000 square miles. The largest group ever observed occurred in April 1947. It remained on the surface for three revolutions of the sun. At its maximum it covered 5,000 million square miles.

The spots are depressions in the surface of the sun, the average depth being about one third of the Earth's radius. If the spots remain long enough to survive a whole rotation of the sun it is seen that the sun's surface rotates once in 27 days. An astronomer named Schwabe discovered that the maximum of sunspot activity recurred every 11 years. R Wolf succeeded in collating all the sunspot observations since the time of Galileo and obtained a mean of 11.1 years. But it has since been established that there are larger periodic cycles superimposed on the 11 year one, of 22 to 23 years.

Solar flares

Associated with sunspots are phenomena called 'solar flares'. These emit enormous amounts of radiation, and it is this radiation – or some of it – which influences the ionosphere associated with radio wave propagation. Sudden Ionospheric Disturbances, or SIDs, are produced by some of these solar flares. It may be the X-ray radiation which causes SIDs. SIDs increase the absorption so that radio signals fade out very suddenly. They only occur when the flare faces the Earth, ie in daylight.

Ionospheric storms, on the other hand, are due to streams of charged particles deflected by the Earth's magnetic field towards the auroral zones and affect both day and night sides of the Earth. A decrease in ionisation of the F-layer results in loss of reflecting power. This starts suddenly, the radio operator being taken by surprise at the sudden change in conditions. If the route of the radio communication path is moved away from the auroral areas, conditions improve.

Within the sun exceedingly high temperatures produce nuclear reactions which in turn produce the energy that keeps the 'solar furnace' going. The exact process is not known, but it is most likely to be the conversion of hydrogen into helium. In this process energy is released as gamma rays – electromagnetic radiation of very short wavelength. As this travels up through the sun's material it loses energy and changes into longer and longer wavelengths. When it finally reaches the surface it emerges as X-rays and ultraviolet rays.

Above the photosphere are the chromosphere and the corona. They cannot usually be seen with the naked eye – they

can only be seen at times of eclipse when the much brighter photosphere is blotted out by the shadow of the moon.

Coronal holes

Dark, extended, open regions can be seen if photos are taken using the X-rays and ultraviolet rays of the corona instead of normal 'white light' photos of the sun's surface. The corona is that part of the sun's radiation which extends far out away from the visible light emitted by the sun. These open regions or 'coronal holes' as they are called emit the 'solar wind' – waves of solar radiation and particles which sweep down to the earth affecting our ionosphere. Study of these coronal holes is now proving very useful in predictions of how the sun's radiation will affect our radio communications and so on.

But back to our original theme. Sunspots and their occurrence still play an important role in predicting the sun's influence on events on Earth, and there is much interest to be found in a regular study of them. The photo shows the author's telescope with which he has recorded the sunspot cycle for a number of years.

It will no doubt be obvious to readers of this feature that one *never* observes the sun directly through a telescope. This is a sure way to burn one's retina out and suffer permanent blindness. The sun's image is projected onto a screen placed so that the image from the eyepiece can be viewed thereon. This screen can be seen in the photograph. The positions of the sunspots are then marked with a pencil on a piece of paper placed on the screen and kept as a record.

Those readers who are interested in this subject are advised to contact *Bert Chapman, 'Brindles', Mill Lane, Hooe, Nr Battle, East Sussex,* who runs a news sheet entitled *Solar News* and a society called the 'London Solar Committee', whose interest centres on this topic. There is also a regular net for radio amateurs interested in solar astronomy on Thursdays at 9.00am on 3650KHz SSB ± QRM. *Solar News* costs £3 per year for 4 issues.

World atlas

Folke Rosvall SM5AGM, who was one of the promoters of the new locator system, has produced an atlas which shows all 324 fields with individual pages showing 18 fields each, broken down into the grid squares. The writer has just acquired a copy, and it is a most useful item when using this new locator system. It is thoroughly recommended, and can be obtained by sending a 12 × 9 inch self-addressed envelope (without stamps) and 6 IRCs to *SM5AGM, Box 8037, s-191 08, Sollentuna, Sweden.*

Used in conjunction with the Sharp pocket computer PC-1245, which can be programmed to feature the calculation of worldwide QTH locators, it makes the ascertainment of locations by this new method simplicity itself (or see the December '84 ***R&EW*** for three Microsoft BASIC programs).

Satellites

Weather Satellites: NOAA 6, an evening spacecraft built for a two year life in 1979, is still going strong. Period 101.1241. Frequency 137.5MHz. Inclination 98.539.

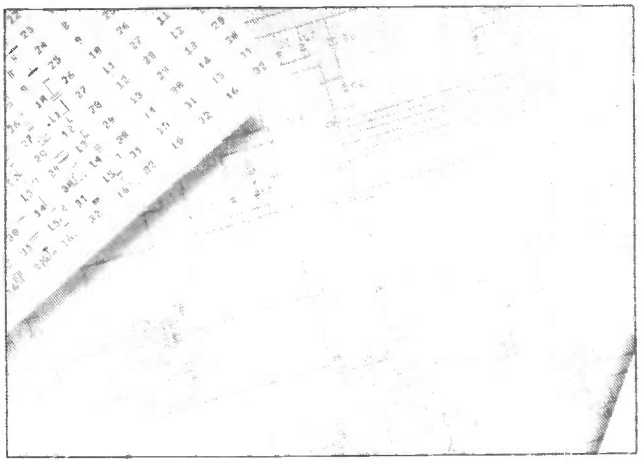
NOAA 9, an afternoon spacecraft. Period 102.0851. Frequency 137.62MHz. NOAA 7 is now switched off. NOAA 8 is also switched off and is defunct.

The next Phase 3C AMSAT Oscar satellite is now scheduled for launch around October 1986. It is proposed that it will have three transponders. One will be Mode B, similar to the present Oscar 10. Another may be a 13cm single channel FM. A liquid fuel kick motor is planned, and the launch is to be on the Ariane 4 rocket.

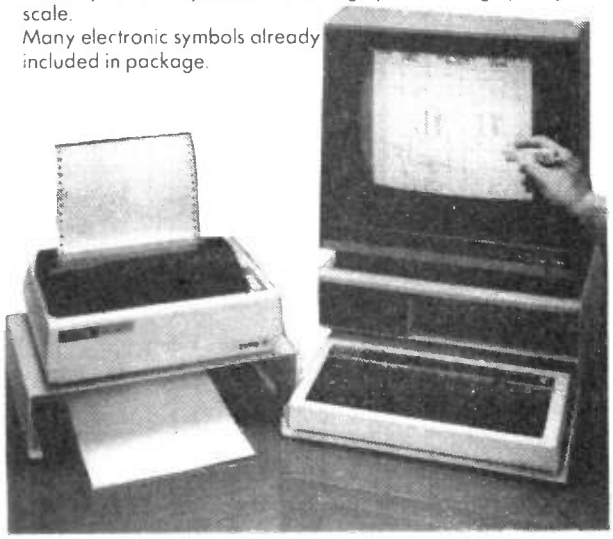
CIRKWIK

SCHEMATIC DRAWING ON THE BBC MICRO

A lightpen driven CAD package orientated to the production of schematic drawings, such as circuit diagrams, flow charts, pipework diagrams, fluid logic diagrams and many similar professional and engineering applications.



- ★ Lightpen driven
- ★ Virtual screen 8 x the BBC's mode 4.
- ★ Uses standard dot matrix printer in dual-density graphics mode to produce excellent quality diagrams.
- ★ Automatic parts list generation.
- ★ Up to 640 different symbols may be in use in any one diagram.
- ★ Total symbol library unlimited in size.
- ★ Create your own symbols with the lightpen on a highly magnified scale.
- ★ Many electronic symbols already included in package.



Datapen

CIRKWIK Program
Available on disc only
£19.95 inc. VAT & p/p
Datapen Lightpen
£25.00 inc. VAT & p/p

S.A.E. for details of lightpen, CIRKWIK and other programs.

DATAPEN MICROTECHNOLOGY LTD. Dept. REW; Kingsclere Road, Overton, Hants RG25 3JB Telephone: (0256) 770488

C M HOWES

COMMUNICATIONS
FUN TO BUILD KITS BY MAIL ORDER

139 Highview,
Vigo Meopham,
Kent DA13 0UT
England
Fairseat (0732) 823129

Get more fun out of amateur radio with one of our easy to build kits. How about building yourself a station around our CTX transmitter and DcRx receiver kits for portable and holiday use during the summer?
All HOWES kits come complete with a good quality printed circuit board that is drilled and tinned and has the component locations screen printed on it for easy assembly. All board mounted components are included, as are full, clear, instructions. The kits are also available ready assembled. This is an important part of our quality control. Because we assemble the kits for sale ourselves, we are continually checking that there are no design or component problems with the kits. You can be confident that our designs will prove a success in your station.

CTX80 QRP CW TRANSMITTER FOR 80 METERS.
The CTX80 is proving to be very popular indeed. Read the review by G3VTT in the March 85 issue of Shortwave Magazine. This straightforward CW transmitter will run up to about 5W RF output (the power is adjustable) and features key-click suppression and a five element low-pass output filter. The CTX80 is crystal controlled (one crystal supplied), but can be driven by our CVF80 VFO for full band coverage. Easy to build and great fun to use. There are hundreds of stations equiped for QRP CW on 80 Meters, there is no lack of contacts to be had! We will be producing versions of the CTX for other bands when time permits. The CTX80 works on 12 to 14V DC.
CTX80 kit £12.95. Assembled PCB module £18.95.

CVF80 VFO FOR 80 METERS.
This is a fully featured VFO for use with our cTX80 transmitter or other homebrew equipment. Stable FET oscillator, dual independent buffered outputs, onboard voltage regulator, IRT (clarifier) control etc. The circuit includes 9 transistors and can drive both a CTX80 and DcRx80 receiver for transceive operation. Requires a 50pF tuning capacitor for full band coverage. We can supply a suitable device giving just under full band coverage (no chance of inadvertant out-of-band operation) at £1.50. Versions of the CVF for other bands will be available later in the year.
CVF80 kit £9.30. Assembled PCB module £14.90.

DcRx DIRECT CONVERSION RECEIVER.
This design was originally conceived to meet the needs of the newcomer to the hobby. It enables a simple, single band receiver, of surprisingly good peformance, to be built by a novice at a sensible price. The kit was reviewed in the May 84 issue of Shortwave Magazine by G3RJV and over the last few months since our CTX80 transmitter has been available, more and more experienced amateurs have been building these receivers as part of a simple low cost QRP setup. It took careful design to produce a simple receiver that would work this well. Compare the DcRx with that expensive black box that sits in your shacks. Not quite as good of course, but I bet you can still hear most of the stations you can receive on the other radio.
The DcRx is available for 20, 30, 80 or 160 Meters. It requires a 12 to 14V DC supply and will produce upto a watt of audio into a speaker or 'phones. Modes: SSB and CW. A case and two tuning capacitors are the ony major parts to add to finish your receiver. We have suitable capacitors for all but the 160M version at £1.50 each.
DcRx KR £14.80. Assembled PCB £19.90. PLEASE STATE WHICH BAND YOU REQUIRE.

AP3 AUTOMATIC SPEECH PROCESSOR.
The AP3 can add a really useful boost to your transmitted signal. The extra "punch" added to your modulation by the AP3 helps to cut through the noise and QRM, so enabling you to make contacts that are not possible without it. The AP3 was described in an article in the September 83 edition of "Ham Radio Today" by Dave G4KQH, and since then we have sold over a thousand units. The AP3 works from a 9 to 14V DC supply and automatically turns itself on and off from your microphones' normal PTT switch output. You simply select the amount of clipping you require (4 steps of approx. 6dB), and speak into the mic. The AP3 automatically compensates for changes in speech levels, so you can still work the DX even if you whisper! Ideal for multi-operator contests! The unit can be used with high or low impedance mics, and is very easy to build. Could an AP3 help your station make a bigger impact on the bands?
AP3 kit £15.90. Assembled PCB module £21.40.

CM2 QUALITY DESK/MOBILE MICROPHONE.
The CM2 is a good quality microphone kit that consists of an electret condenser microphone capsule and a small electronics module that incorporates a Plessey "VOGAD" chip to give automatic control of modulation levels. The unit produces a nice clear audio signal for your transmitter, no matter whether you talk loudly or quietly, near or further away from the mic, the modulation level is maintained correctly for you. Ideal for a desk microphone or for use in the car as a "hands free" unit. The CM2 can be remotely keyed by a foot or gear-stick switch if required. The unit will work on an 8 to 14V DC supply, drawing only about 30mA from a 9V battery, and then only in transmit mode. The electronics turn off automatically when switching back to receive, no separate on/off switch is required. The CM2 builds into a clean sounding microphone that you will be proud to use on the air. It is always nice to receive complimentary audio reports, especially when you can have the satisfaction of saying "I built it myself".
CM2 kit £10.25. Assembled PCB module + mic. capsule £13.75.

ST2 CW SIDE-TONE or PRACTICE OSCILLATOR.
The ST2 provides a nice sounding sine-wave note of approx 800Hz for monitoring your sending or Morse practice. It will produce up to 1W of output into an 8 Ohm speaker or 'phones. It can work by direct connection to your key, or by sensing the RF from your transmitter. Will work with HF QRP rigs of as little as half a watt!
ST2 Kit £7.30. Assembled PCB module £10.80.

If you would like more information on any product, simply drop us a line, enclosing an SAE. We have an information sheet on each kit.

PLEASE ADD 60p P&P to your total order value

Delivery normally within 7 days.

73 from Dave, G4KQH Technical Manager.

CIRKWIK

A circuit drawing package for the BBC Micro reviewed by Terry Weatherley G3WDI

Cirkwik is a disc-based drawing package for the BBC Microcomputer that assists the user in drawing neat circuit diagrams. Symbols are placed on the screen using a lightpen (not supplied) and the resulting drawing can be dumped to a printer.

The package is supplied on a 40 track disc and is accompanied by a twenty page spirally-bound booklet. Datapen, the suppliers, also produce an elegant lightpen which is ideally suited to the program.

The symbols used during 'designing' are stored in symbol tables on the disc. Up to 640 symbols can be stored on the supplied disc and an unlimited number can be created and stored on other discs. From there they can be transferred to the current disc library and used in the drawing. Facilities are also included to allow the user to print a list of the symbols used in a drawing and to produce a printout of the symbols available from the disc.

Using the program initially is akin to using a word processor for the first time. A little pre-study and some test drawings are essential to enable the user to at least produce something on the screen. It is not a case of if all else fails *read the manual* but rather *before* all else fails read the manual.

Booting up

The disc is booted up in the usual way, and a menu is presented. Choices are made with the lightpen. If option 1, 'create new diagram' is chosen the screen clears and the user is able to get used to the behaviour of the lightpen. The initial cursor is a cross. This should be moved over the word LINE and the button on the lightpen pressed. The cursor will then change to a dot.

Because the lightpen is working to pixel rather than character accuracy, and because of inaccuracies in pen, computer and TV, the dot jumps about in what is initially an alarming fashion. The accurate positioning of the cursor is achieved by using a special 'dragging mode'. The button on the lightpen is pressed, which fixes the cursor position temporarily. It will then slowly drag itself towards the current lightpen position. When in the correct location, a second depression of the button fixes it.

The cursor keys on the keyboard can also be used to finely position the cursor and I found these easier to use, but then I am left-handed.

From this fixed point a line will appear and will follow the cursor. The line end is fixed in a similar manner to the starting point. If one line is drawn at an angle to another the program will correct to the nearest 90 degrees. This facility allows squares and rectangles to be drawn very quickly. The line mode is exited by attempting to draw a line to any part of the menu.

To erase a line the cross cursor is placed over DRAW. This changes to ERASE and the cursor becomes a small box, which is then positioned on each end of the line to be erased. It is well worth spending some time doodling in this mode to get the feel of the pen and the system.

The symbols available are held in the symbol directory on the disc. At this stage it is useful to choose the print option and print out the contents of the symbol directory. Part of this directory is shown in the diagram, and will give the user some idea of the symbols available. If the required symbol or symbols are not in the directory it is quite easy to design one and add it.

Choosing the design option, one is presented with a sixteen by sixteen grid, and by using the lightpen the relevant squares are filled in. A correct size replica of the design is shown as the design progresses. The ***R&EW*** logo on the circuit diagram was drawn in this way. Practice should now be gained in using the symbols and joining them with the lines.

Create diagram option

The create diagram option is again chosen. The menu at the top shows the current symbol. This is changed by choosing the 'change symbol' option with the lightpen and entering the code for the chosen symbol. Once loaded the 'symbol' option loads the pen with that symbol.

To aid correct placement the symbol is located within two lines at right angles and again the dragging mode is used to position it correctly. Practice in matching up parts of symbols is necessary to ensure a neat finish. Where two lines touch, the pixel inverts in colour. A little experimenting is again valuable. Choos-

The main menu

```
CIRKWIK 1.1

SYSTEM MENU

1) Create new diagram
2) Extend existing diagram
3) Define/edit symbols
4) View/rearrange symbols
5) Save/Load symbols
6) Save/Load diagram
7) Print Menu
8) Perform garbage search/Move drawing
9) Catalogue disc/Adjust lightpen offset
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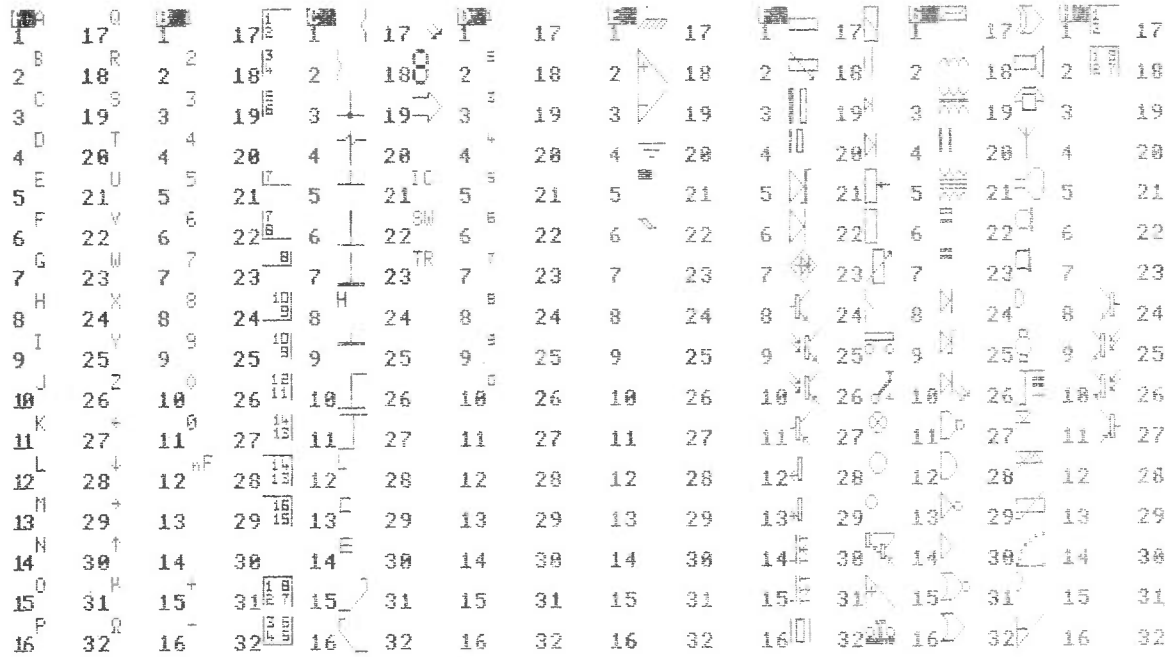


Part of the symbol directory

ing the 'option' from the menu allows the user to rotate the symbol through 90 degree turns.

The circuit diagram accompanying this article shows the quality of the drawing available from this package after only a very short while.

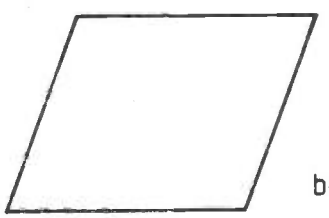
Obviously the layout could be improved upon style-wise, but the clarity of the diagram is self-evident.

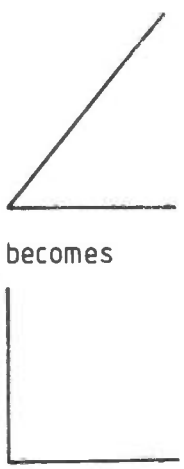
Finished or part drawings can be saved to disc, which enables the user to draw complex diagrams over a period of time. The printout is fast, and rotated through 90 degrees, leading to some interesting screen displays during printout. It is interesting to note that the drawing is stored in memory as a file of symbol references and line co-ordinates. Any erasures will leave 'holes' in the file. The garbage collection option tidies up the files and thus ensures the fastest possible printout.

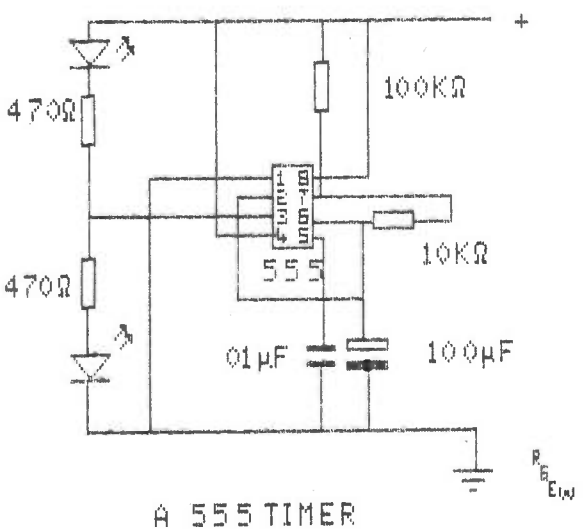
To sum up, Cirkwik is a useful package if you need to produce neat diagrams. Like a word processor, it takes a while for the user to become familiar with its operation. The package offers 'circuit processing' at reasonable cost, and using it I can produce neat diagrams; all I need now is a package to produce the PCB from it!

Cirkwik is produced by *Datapen Microtechnology Ltd, Kingsclere Road, Overton, Hants RG25 3JB.* Datapen also produce an excellent lightpen which complements the package.

All lines are corrected to the nearest 90°







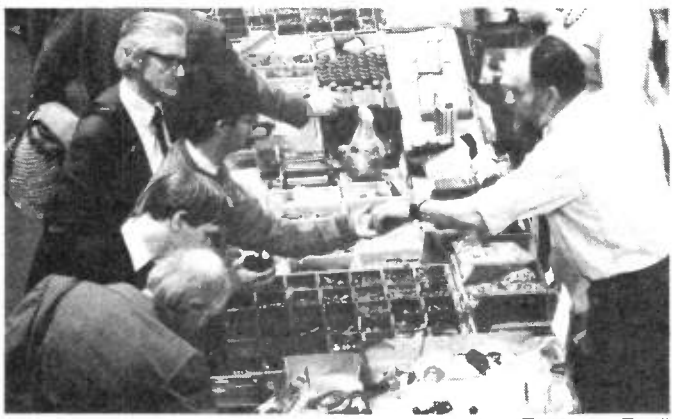
A 555 TIMER

A Cirkwik circuit (note logo)

QSO

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

1985 RSGB NATIONAL CONVENTION



***Top** – A happy man with bargain, coffee, and sore feet. **Bottom** – Trading was brisk at the floor stands*

This year's RSGB National Convention was held on 13-14 April at the National Exhibition Centre in Birmingham. The facilities offered at the NEC, coupled with the hard work of the RSGB Exhibition Committee in ironing out some of last year's problems, resulted in a generally successful weekend for all concerned.

The number of people attending the show over the two days reached a record 11,000, this figure being almost seven percent up on last year. There also appeared to be more seating and space between the trade stands than last year, although it must be said that – perhaps inevitably – there was still considerable congestion as the numerous 'punters' elbowed their way towards the bargains.

Indeed, the traders seem very pleased with the level of interest in their products, with many reporting a substantial increase on last year's sales. Lowe Electronics sold out of the Trio TH41E 70cm handheld, but continued to take several additional orders for this recently introduced 'tiny-talkie'.

The full range of amateur radio hardware was available, and between the main stallholders and the table traders there was certainly something of interest for all, no matter where their particular interest might lie.

Another trader who was kept very active at the show was R Withers Communications, who did particularly well with many recently introduced products. The new ARM Multi P6 mobile antenna sold extremely well, and the 10m modification board, first detailed in the March 1985 edition of ***R&EW,*** sold out completely.

Overall perhaps there did not seem to be as many new products on show, or as many genuine 'once-in-a-lifetime special prices' on offer, but throughout the hall, particularly amongst the table traders, there were many bargains to be had and rarities to be snapped up.

The lecture programme was a full one, and as usual they were very well attended. The subjects covered ranged from LF to VHF, from SWLing to moonbounce, and from low cost QRP to the latest developments in Packet Radio. It would appear that there was a talk, lecture, forum or workshop for almost everyone, no matter how much (or how little) experience they might have.

Lots and lots and lots of people

In conclusion . . .

So once again, the annual 'bash at Birmingham' has justified its position as one of the highlights of the amateur radio social (and business) calendar. It is true that it faces more and more competition as the standard of other local and regional rallies and exhibitions seems to get better every year, but credit is still due to the RSGB for producing a thoroughly enjoyable and smooth running event within the stark and somewhat inhospitable confines of the NEC.

Here we present details of interesting contacts, and would be happy to receive similar items from readers

Tyne-Wear repeater news

We have received news that both of the Tyne-Wear group's repeaters, GB3TW (channel R5, QTHL ZO12J) and GB3NT (channel RB0, QTHL ZO03A), are now operational.

GB3TW has had a complete rebuild by G4DWM (RF section) and G8YWK (logic system) and has given excellent service over the past year, suffering only two minor component failures in that time.

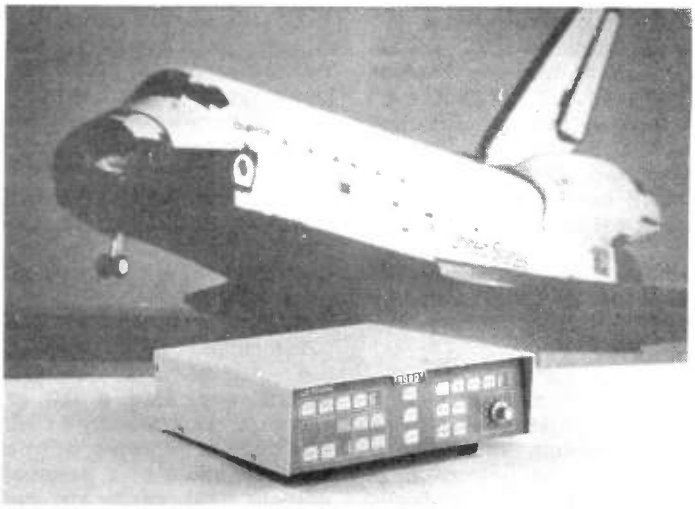
GB3NT is also completely new, employing the same logic design as its VHF brother, and since its commissioning in October of last year it has proved itself to be reliable. The group is awaiting approval for the resiting of this repeater.

Paid-up members of the group are being issued with a membership certificate which entitles them 'to grouse at any person found using the group's repeaters without having first paid the subscription'.

The secretary of the group, David Williams G6FGP, has asked us to remind you that all amateur repeaters are paid for by the members of the various repeater groups; there is no outside funding. The RSGB provides no financial assistance, so if you want the repeaters to continue to operate please join a group!

Anyone wishing to join the group should send the subscription (£2 minimum) together with an SAE to the secretary: *D S Williams G6FGP, Braeheads, Chopwell, Newcastle-upon-Tyne NE17 7JD.*

Copies of the group's newsletter are also available from the secretary in return for an SAE.



Slow-scan transmissions

It is planned that slow-scan television pictures will be transmitted from shuttle flight 51-F, which is expected to be launched in July, and the equipment chosen for these transmissions is the Robot 1200C high definition colour converter.

The 1200C colour system, using time multiplex component colour, is black and white compatible so the transmissions will be receivable on standard slow-scan equipment.

For those interested, this new Robot system is described briefly in Andy Emmerson's *ATV on the Air* column this month.

QSO

Golden Jubilee Award

To celebrate its Golden Jubilee in 1985 the Ipswich Radio Club, in association with the Ipswich Borough Council and Arrow Electronics, will present a special award certificate signed by the President of the club and the Mayor of Ipswich for contacts made during 1985 with Ipswich club members and stations in the county of Suffolk.

The rules are:

1. Only contacts made during 1985 will count for the award, which will be presented for 50 points, 25 of which must be for Suffolk and Ipswich Radio Club contacts. Contact with a G station will count 1 point, with a Suffolk station 2 points and with an Ipswich Radio Club member 3 points. Each contact with the club station (G4IRC, G1IRC, or GB2IRC) will count as 5 points. Several special event stations using these callsigns will be on the air during 1985. Details will appear in the radio press.

2. Contact may be on any amateur band by any mode of transmission. The same station may count for contacts on more than one band, but only once on each band irrespective of mode. Terrestrial repeater contacts will not count for the award. If applicants so wish, certificates will be endorsed for a single band and/or a single mode.

3. Contacts on bands above 1296MHz will count as double.

4. Applications for the award, enclosing a list of contacts confirmed by a club chairman or secretary or by a representative of a national society (QSL cards are *not* required and should *not* be sent with the application) should be forwarded with six IRCs (or £1/$2) to Alan Owen G4HMF, 102 Constable Road, Ipswich IP4 2XA, before 31 March, 1986.

SWLs may also apply for the award by supplying a similar list of QSOs heard between the appropriate G stations and others in their own country.

RNARS rally

This year the Royal Naval Amateur Radio Society celebrates its 25th anniversary and will be holding a mobile rally on 16 June.

The society hopes to share its celebrations with as many people as possible and the rally has therefore been designed as a real family occasion. Attractions will include steam trains, radio controlled model boats and racing cars, archery, marching bands, a field gun run competition, a flypast of RN historic aircraft, various amateur radio stands and a grand draw. Talk-in will be on 2m and 70cm.

The venue is HMS Mercury, Leydene, near Petersfield, Hants from 10.00am to 5.30pm. The entrance fee is 90p for adults with accompanying children free.

Further details are available from: *Tom Biddlecombe G3WAO, 3 Humber Close, Stubbington, Fareham, Hants (not QTHr). Tel: (0329) 665757.*

Special event station

We have recently been informed of the planned operation of a special event station, GB2CV, on the occasion of the 6th Citroen World Meeting being held at the Cheltenham Race Course, Prestbury Park, Gloucestershire from Saturday 27 July until Wednesday 31 July 1985.

This year it is the turn of the UK to stage this international event and the '2CV GB' club was asked to organise it on behalf of Citroen Cars (UK), naturally leading to the choice of GB2CV as the special event callsign.

Three local clubs, Gloucester ARS, Cheltenham ARA and Smiths Industries RS will jointly handle the arrangements for this special event station. Conditions permitting, all HF, 2 metre and 70 centimetre bands will be activated. It is hoped to include RTTY, SSTV and ATV operations.

Special QSL cards are being provided by Citroen.

Apologies

In the May issue of *Radio and Electronics World,* page 69, we incorrectly printed the telephone number of MG Books of Co Durham.

The number is (0833) 31130, *not* 31330.

Buxton Rally Group

The Buxton Amateur Radio Rally Group plan to hold their biggest and best rally to date on 30 June at the Pavilion Gardens, St Johns Road, Buxton in Derbyshire.

There will be over 60 trade stands, including an RSGB bookstall, as well as refreshments, a children's area, videos, a tombola, and local attractions like the natural spa, swimming pool and Peak Rail Steam Centre.

The rally is open from 10.30am to 5.00pm, admission 50p.

Great Western Society

The Great Western 150 celebrations steam into action at Didcot Railway Centre for two weeks from 18 May to 2 June, when the Great Western Society presents its major contribution to this anniversary year. Every day there will be steam trains in action and on display, including visiting locomotives from other preserved railways.

Amongst the other events planned during this fortnight are a radio station operated by the Vale of the White Horse Amateur Radio Society, who hope to speak to enthusiasts around the world using the callsign GB4GWR, craft displays on weekdays by Cogges Farm Museum, a special labelling of GWR wine by Lys Hall Wines of Chew Magna and the appearance on the final weekend of the British Rail Exhibition Train.

Didcot is on the original Great Western main line from London to Bristol and is easily reached by Inter-City 125 high speed trains. Didcot Railway Centre has full amenities including a well stocked refreshment room and on spring holiday weekend there will be a full luncheon service in the luxury of the Great Western super saloon carriages 'Princess Elizabeth' and 'Queen Mary'.

SARUG news

Paul Newman G4INP has sent us news of further developments within the Sinclair Amateur Radio User Group (SARUG).

Apparently, a growing number of SARUG members have enquired about the possibility of RAE-styled questions available using the Spectrum micro, and happily we can report that a program to fulfil this requirement is now obtainable.

'RAE' manipulates sets of questions on RAE topics, and comes complete with 100 text questions and a set of general questions involving circuits etc. The program checks answer choices and reviews incorrect answers, which may be printed for further reference. Further question sets may be entered by the user, up to 225 questions per set depending on question size, and there is no limit to the number of question sets. The program is tape and Microdrive compatible.

The RAE program, written for the Spectrum 48K only, is available for £7.50 on tape and £9.00 on Microdrive cartridge (£1.00 postage if outside the UK), although SARUG members will get a special discount.

For further details send an SAE to: *Paul Newman G4INP, 3 Red House Lane, Leiston, Suffolk IP16 4JZ.*

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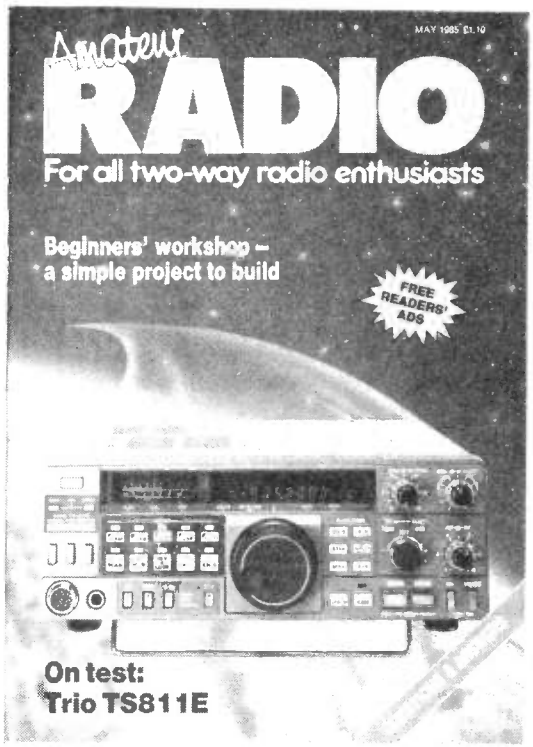

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ATV ON THE AIR

Presented by Andy Emmerson G8PTH

We are now well into the TV operating season, so it is timely to have another update on what's been going on. It's also the rally season, so I hope to meet some of you at the various events attended by the BATC. Remember I can only print the material I receive, so do share your news with the rest of the ATV community.

New stations and techniques

News is now coming in of pockets of keen 24cm activity springing up across the country. Signals through my local 'box', GB3TV, have also been much more plentiful, with weather satellite pix, calendar illustrations (!) and a roster of club events often visible. This must be a good thing . . .

Down in deepest Dorset John Fell G0API (ex-G8MCP) has been telling me of his local group. Regular contacts are Mervyn G4BGT (in the same village of Corfe Mullen) and Nick G4WHO in Wimborne. Despite relatively high power and good aerial arrays, John and Nick have difficulty in giving each other good reports due to an outcrop called Colehill covered with a lot of vegetation. They plan to try and overcome this with a pair of quad loops wired back to back in order to serve as a passive repeater at the obstruction.

It will be most interesting to see how this arrangement performs; the technique is very popular in the USA on the higher frequency microwave bands for extending links past places where no power is available for an active relay.

They are still looking for sites for the planned New Forest and Solent repeater – high spots considered so far include Boniface and Chillerton Downs on the Isle of Wight and Stoney Cross in the New Forest. The band still has its surprises: John has been making tests over the not unobstructed path between himself and Sid G4JQU in Southampton. John was able to give Sid a P4 report for a transmitted signal of less than 10mW!

Over in Kent things are buzzing too. Andy Rudd G6MRI in Herne Bay is organising a happy band including G4AYT (Whitstable), G6GHP (Westgate) and G6XYY (Herne Bay). Ron G6GHP is the first with a transmitter but the others are building too. He is putting around 8 watts into a 20 turn helical and is getting P5/Q5 vision and sound results on slope-detect at Chris G4AYT's hilltop location.

Ron's transmit line-up is a Fortop exciter, TRW black brick and Fortop tripler. For receive he has the BATC 70cm IF converter feeding a dual AM/FM system. He is now contemplating the *CQ-TV* GaAsFET pre-amp and separate antennae for Tx and Rx. This he thinks is cheaper than mast-head relay switching. It probably is, and what's more it is more reliable and offers the chance of 'look-through' when you work repeaters.

Preferred equipment among the other seaboard stations is that offered by Solent Scientific, mainly because it is so economical (and functional!). Several French stations have been sighted under lift conditions and the group is looking for a repeater site, having had some help from the Crawley repeater contingent. In the meantime simplex activity is hotting up and they would welcome contact from over the water in Essex.

Talking of the Crawley repeater, its originator, Jack G4TVC, tells me he has had several enquiries about his low-cost construction plans (send an SAE to Jack QTHr). There are plans to negotiate a much higher site.

While on the subject of moves Mike G8LES says he is hoping to move to a 700ft asl site soon. I shall not identify the location yet for fear of tipping off the existing resident and the planning authorities, who might not appreciate Mike's megamast and array. This should make Mike a really good signal, so here's wishing you good luck!

Mike says he has found a way of broadbanding the 1250MHz Tonna antenna so that it now has a VSWR of no worse than 1.5:1 at 1230 and 1330MHz. The only problem is that it's a total rebuild job, but is probably worthwhile nevertheless.

If you saw the radio controlled model helicopter at the last BATC event at Crick you must also have seen its constructor Brian Parkin G1EGD. If you didn't, you should have another chance this year. Brian says he has received some quite hairy video from the machine aloft and is now about to try 24cm FM, as the rotors are causing interference on the 70cm signals. He is also hoping to swap notes with VK5GO who, as mentioned in the last news round-up, is trying something very similar.

Slow-scan too

SSTV rules this time! Top of the pile is a letter from James Morecroft G8OOC, who is planning a comeback to SSTV. He is building the G3WCY converter on BATC boards and appreciated the article in *CQ-TV* by G4ENA. James hopes to modify the converter for colour by using a PAL encoder similar to that in the *BATC Handbook 2* and *Elektor* (February '83) which uses the LM1886/1889 chip combination. He would be pleased to hear from anyone who has tried this scheme, and can be reached on (01) 688 4061 (not QTHr).

Off now to Atherton in Manchester, where Dennis Anderson G6YBC writes to say that SSTV is alive and kicking in the north-west, despite the QRM from a group who regard 144.500 as their local net frequency and refuse to conform to the bandplan (I wonder if they also exercise their right to drive on either side of the road as they please?).

Dennis and Frank G8NSE have regular skeds with G3CCH and have also worked a whole host of other stations, many of whom are using Sinclair Spectrums (a real bargain now!). Dennis uses an SC77 homebrew version of the Robot 400; Frank has three of the latter and helped Dennis get things moving. Dennis closes by asking for new contacts!

The Essex net expands

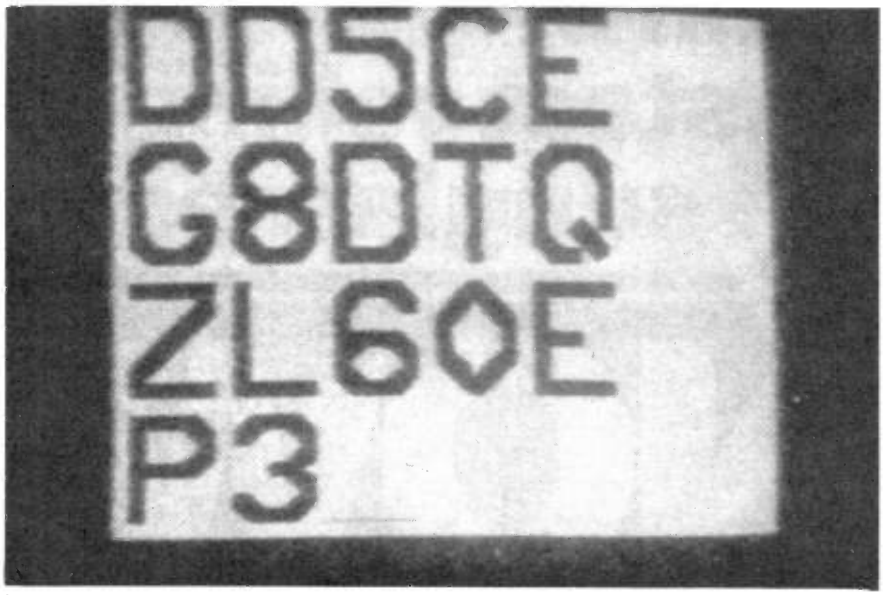
Dick G3LUI is no stranger to this column and reports that new stations are calling into the 'Essex Slow Scan Net'. Among these are G4PQP (Cromer), G4RRX (Norwich), G6CZE (Northampton) and G8LWA (near Brentwood). Wednesday nights at 2030 is the time to get in on this act and 144.500 is the frequency.

Jeremy G3NOX has recently acquired the latest Robot 1200C which he reports can do almost everything, though he has not yet found the tea-making button! Luckily the 8 second format has been retained, so the rest of us can still see the results, says Dick. With all the new formats such as 12.5, 16, 24, 32, 48 and even 70 second frames appearing on the market contacts on HF should prove interesting, if not frustrating, when conditions at last improve. Dick finishes by saying how much he enjoyed the last contest, even though conditions were flat and the contact rate slow.

Jeremy has also given me a run-down on the Robot 1200C, which has 64 grey levels and a 256 pixel line capability, and a 4:3 aspect ratio in some modes, producing near fast-scan type results. Come to think of it, many fast-scanners send mostly static test cards...

Anyway, G2BAR in Bristol is also using one and they both work CT1AKD in Portugal who makes up the threesome. On 20 metres they are sending standard 8 second field sequential RGB colour, with good results.

The new Robot system can also send chroma and luminance detail on the



same line, with automatic stop/start and error correction. In this mode Robot has finally got rid of the old square format in favour of the 'normal' 4:3 ratio, and the system is capable of robust, almost broadcast quality colour stills, even to ZS6BTD in Johannesburg (a 12,000 mile round trip).

Hi-tech Robot

Jeremy's Robot is hitched up to a BBC Micro via the RS423 port using software written by G4IJE and himself. Bursts of commands sent at 4800 baud enable the user to call up special facilities in the Robot, including coloured background, text overlays and colour bars.

The 72 second composite colour picture format enables the effect of noise to be minimised to just a few TV lines, similar to ignition noise on 'normal' TV. Quality is like fast-scan except that there is no interlace. The next project is to write software for parallel port operation, which will open the way to image processing and dynamic noise reduction by subsituting adjacent pixels for disturbed ones. Watch this space!

I know a lot of you have BBC computers and I should like to recommend a suite of programs I bought recently. Called 'Radiocalc', it is one of the best efforts I have seen for working out resonant L/C combinations, attenuator pads and all those other things which cause grief to people with rusty brains. Priced at just £2.50 on cassette, you can get it from *Martin Smith, 45 Stanhope Gardens, Cranbrook, Ilford, Essex IG1 3LQ.*

Any kind souls with a circuit for the Rigonda VL-100? If so please contact Alan Page G6WJJ who is QTHr in Handsworth Wood. Alan has built a skeleton horn antenna (as described in this column a few months back). Using 2ft 6in sides and a delta match, it functions well on 70cm.

Some late news courtesy of Ray Hill G6TSL; Mervyn the eyewig has passed the RAE and is now off to New Zealand to bring back some exotic video recordings. Ray also warns that the Texas Instruments character generator chip SN74S262 (used in BATC and other projects) is now obsolete. The last stocks (86 of them) are at Quarndon Electronics in Derby and the price is £13.20 plus VAT.

The 70cm section is pictures-only this time: it's to remind you of the lifts to come this year! One gives proof that Brian G8DTQ worked a German station; we present a clear computer display from ON6AR/T (they still use the suffix in Belgium); and ON7PO shows how you can make a smart callsign plate using (Belgian) car number plate stickers. All pix were taken in Holland by Ryn Muntjewerff.

That's it; if you think I'm ignoring your interests let me have some news for next time and address it to me care of *Radio and Electronics World.*

If you're into ATV, stay in the picture every month with Andy Emmerson

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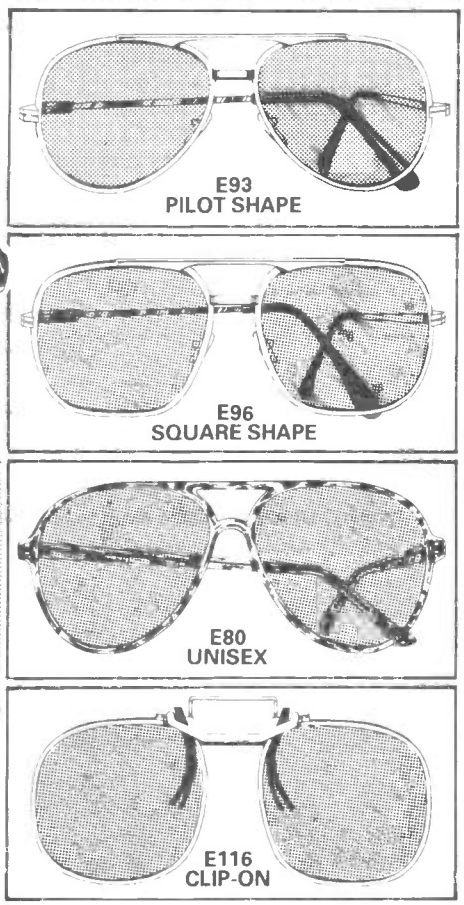

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DX-TV

RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

By the time you read this column the 1985 Sporadic-E season should just be commencing. If you have contemplated DX-TV as a hobby, now is the time to start. We will be discussing the practicalities a little later. Before then we'll take a look at the DX conditions noted during February.

There were two periods of enhanced tropospheric activity affecting Bands I through to V. The first occurred on the 4th and 5th of February with DX-TV reception from our closest European neighbours, namely France, Belgium, West Germany and the Netherlands. A similar event occurred towards the end of the month. There wasn't anything too spectacular, although the signal quality was good enough to keep DXers impressed. Sporadic-E activity plunged to a low level. Most of the DX seen throughout Band I was due to meteor shower (MS) reflections and consisted of brief glimpses of programmes and test cards.

DX log for February

This month we are featuring the DX-TV log sent in by Kevin Jackson of Leeds. All the reception was via enhanced tropospheric conditions.

4/2/85: France (TDF) with Antenne-2 signals on channels E39 and E48; France (1st network, TF1) on E42; France (3rd network, FR3) on E45; French 'Canal Plus' service on F5 and F7; Belgium (French-language service, RTBF) on channel E42; Belgium (Flemish-language service, BRT) on E43 and E46; the Netherlands (NOS-1) on E39.

5/2/85: TDF A2 on E21, E39; TDF TF1 on E42; Canal Plus F5; RTBF E8; NOS-1 E5, E29, E39; NOS-2 on E27, E31 and E45; West Germany (2nd network, ZDF) on channels E21, E26, E27, E31, E34, E35, E37; West Germany (WDR-1, Westdeutscher Rundfunk) E9, E30, E46; WDR-3 on E40, E48, E49, E50, E53, E60; West Germany (HR-1, Hessischer Rundfunk) on E7 and E56.

18/2/85: TDF A2 E21, E34, E39, E43, E48; TF1 on E27, E42, E46; FR3 E40, E54; Canal Plus on channel F5.

23/2/85: TDF Canal Plus on F5; BRT E43.

24/2/85: TDF A2 on E39; TF1 E42; FR3 E45; Canal Plus F5; ZDF E34, E35 and E37; WDR-1 E46; WDR-3 E40, E50; RTBF E8; BRT E43 and E46; NOS-1 E29, E39; NOS-2 on E27.

25/2/85: A2 on E39; TF1 E42; FR3 E32; ZDF E37, E39; WDR-3 E40, E46; NDR-1 (Norddeutscher Rundfunk, West Germany) on E53 and E56; NDR-3 E40 and E43; NOS-1 E6, E39; NOS-2 E27 and E45.

28/2/85: NDR-3 on channel E43; BRT E43; TDF Canal Plus on channel F5.

Our thanks to Kevin for sending his tropospheric log.

Reception reports

Simon Hamer of New Radnor near Presteigne took to the Welsh hills on the 3rd armed with a Hitachi multi-band portable TV and a log periodic UHF aerial. Many distant UK transmitters were logged such as Emley Moor, Waltham and Crystal Palace. Of more importance were the effects of the 405-line transmitter closures in Band III. Simon was able to resolve various RTE (Radio Telefis Eireann) outlets such as the RTE-1 channel F transmitter at Mt Leinster and Kippure on channel H screening 'Sunday Review' and an episode from 'Sergeant Bilko' around lunchtime. The RTE-2 network was showing the PM5544 test card from the same transmitting sites on channels I and J respectively.

Simon has also commented on the pirate radio station which has been operating in his area. Ludlow's 'Sunshine Radio' apparently went off the air due to 'transmitter problems'. A suspected raid by the Department of Trade and Industry has been denied.

Andy Webster of Billinge near Wigan is hoping that there will be no more spurious breakthrough in Band III from out-of-band sources. He has been using a two-stage wideband bipolar amplifier for head-end amplification. Unfortunately nearby PMR has been a severe problem, coupled as it is with undesirable effects from FM radio transmitted by Winter Hill. Attempts to counteract the problems by using various filtering techniques have failed, so a fresh approach was required.

A simple amplifier was constructed using a BF960 MosFET device. The results are said to be most encouraging. The amplifier has a tuned input, although the peak is broad enough for wideband operation.

Recently Andy decided to venture into Band III meteor shower DX. Perseverance on channel E5/R6 paid dividends with the appearance of various PM5544 test cards. Of real interest was a multi-burst pattern (vertical frequency gratings) similar to the one used by MTV in Hungary. Unfortunately, only a very low-power MTV outlet is operating on this particular channel (R6). Norway, Sweden and West Germany are three strong channel E5 contenders.

Harold Brodribb of St Leonards-on-Sea is an avid follower of weather charts and meteorological trends. As most DXers know, high-pressure systems usually herald tropospheric DX reception. Harold keeps a regular check on barometric pressure and finds it a useful indicator for DX-TV purposes.

A profusion of Band III signals appeared on the 4th with several French stations to the fore. Taking into account the direction in which his aerial was pointing, Harold reckons the following French 4th network transmitters were noted: Lille on channel F5, Paris channel F6, Rouen on F7 and Lyon F10. The latter station appears to carry material from the French 3rd network (FR3) from time to time. A caption reading 'FR3 et Specialise' was seen along with the weather forecast. Channel F7 was radiating a test pattern. Other French networks (TF1, A2 and FR3) were resolved at UHF on channels E21, E23, E34, E46, E48 and E51. Activity was so intense that even the local IBA channel 28 transmitter at only a mile away from Harold's location was disrupted by co-channel interference.

VHF DX-TV log

The following log is a combination of reception noted by the authors here in Derby and that recorded by Simon Hamer in Wales. Our thanks to Simon.

10/2/85: Fairly active conditions with meteor shower reception consisting mainly of programmes on chanels R1 and E2. A cartoon featuring a bear was noted on R1 during the morning due to a short Sporadic-E opening.

13/2/85: The Spanish 'GTE' colour electronic test card was noted at 1239 from the Navacerrada transmitter on channel E2. The Czechoslovakian EZO-type test card was seen on several occasions on R1 via meteor shower.

14/2/85: The West German FuBK test card was noted by Simon Hamer on channel E2 carrying the transmitter identification 'GRüNTEN'.

15/2/85: Spanish signals consisting of the colour test card and 'tve tve 1' identification on chanel E3 plus the 'RTVE' bar pattern before the start of programmes at 1247 GMT.

18/2/85: Old Czechoslovakian monoscopic test card seen on R2 by Simon.

19/2/85: Spain received on channel E3 with the GTE test card; SR-1 (Sweden) noted on E3 with the 'TV1 SVERIGE' PM5544 test card; unidentified colour bars noted by Simon on channel E3.

26/2/85: Czechoslovakia received with their standard EZO-type test card with

the identification 'RS-KH'. This signal was noted by Simon on channel R1.

DX-TV: getting started

Although we have discussed propagation and equipment requirements in past issues of ***R&EW*** it may be as well to recapitulate on the basics in order to encourage newcomers to the hobby.

Since Sporadic-E propagation (usually abbreviated to SpE or Es) is capable of providing high-level signals, budding enthusiasts are virtually assured of some success even with the most primitive of aerials. Reception via SpE is fascinating to the experienced DXer, let alone the novice. One reason for this is its completely random nature; one minute there's nothing and the next minute all channels are choc-a-bloc with broadcast television signals arriving from transmitters located hundreds or even thousands of miles away.

Reception via Sporadic-E takes place mainly between mid-May and early September, so now is the time to try for long-distance television signals. Activity is at its peak during the summer months, although 'openings' can present themselves at any time of the year. Openings can also occur at any time of the day or night, although whether signals will actually be received in the dead of night depends upon there being transmissions around for dedicated enthusiasts to spot!

Television reception is affected by the ionisation of the 'E' layer, which is located some 75 miles above the surface of the Earth. Broadly speaking this layer acts as a reflector, and signals which normally pass straight through this zone to be lost in space are directed back towards Earth. Actually the process is a combination of reflection and refraction.

The way in which the ionised E-layer bounces back signals causes a 'skip' or 'hop' distance to be involved. A typical skip distance is 600-800 miles. Consequently, countries such as Yugoslavia or Italy can be tuned in while closer neighbours are absent. Double-hop reception can, and indeed frequently does, take place resulting in Middle Eastern or African broadcasts appearing.

Non-enthusiasts will often ask why DXers go to so much trouble just to see programmes from other countries. But that isn't what DX-TV is all about. It's about the technical challenge and the satisfaction of receiving a television picture over a long distance via any one of a number of propagation modes. If the transmission is a test card or identification caption, then so much the better.

DX set-up

It is a fairly easy task to establish a DX-TV receiving station. The three essentials for reception are: a receiver capable of covering the frequencies affected by SpE; an aerial, which can be a simple dipole; and finally, the most important thing, a degree of patience. In fact a lot of patience is required initially since it is all too easy to lose confidence if you happen to experiment during a lull in activity. Occasionally such periods of inactivity can last a day or two. However, once you've received your first signal it's a fair bet that you will become hooked on the hobby like so many others!

Despite the use of several different TV transmission standards in Europe, they all have one characteristic in common. They all employ 625 lines with negative-going video (just like the system used in the UK), apart from the French who use positive-going video. As there is minimal reception from France on VHF via SpE we can largely ignore their transmission standard. Reception would be easy to recognise since the picture would appear in the negative form.

Band I (VHF) reception

Sporadic-E mainly affects Band I channels such as those vacated by the recently discontinued BBC1 405-line service on the old channels 2 to 5. The lowest vision frequency likely to be encountered from Europe is 48.25MHz. This coincides with the former British channel 2 sound carrier frequency. Several Western European television services still operate on this channel, including Spain, Norway and Sweden. A little HF of this is the channel on which Russia and most Eastern-Bloc countries operate. Throughout Band I there are actually six DX channels, some of which overlap. The biggest problem is finding suitable equipment to cover these frequencies at 625 lines VHF.

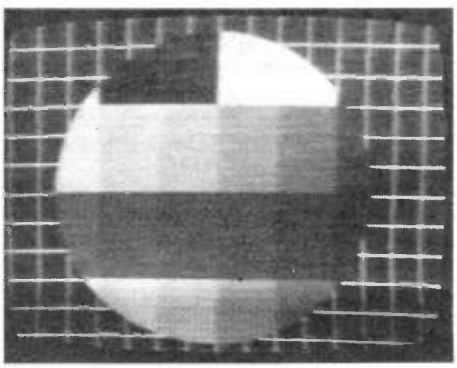
An old UK dual-standard set could be pressed into service once suitably modified. However, the age and likely working condition of such a receiver would have to be considered carefully. Certain modern portables can be purchased which are already equipped with multiband facilities. One major drawback here is the receiver's wide IF bandwidth. During busy openings signals on overlapping channels would be displayed simultaneously. Narrowing the IF bandwidth would help reduce the effect, as the receiver would become more selective. Unfortunately this involves modifying the receiver, which is by no means a straightforward task unless one is well acquainted with modifications of this nature.

A converter is currently available which has been specially designed for DX-TV use. Known as the D-100, it offers switchable IF bandwidths and is simply plugged into the aerial socket of virtually any UHF receiver. The tuning scales are calibrated with the various DX channels. This particular DX-TV converter also provides a convenient method for video-taping DX reception.

DX sound

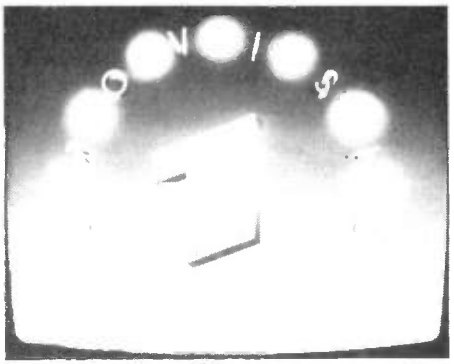
Receiving the sound can be a problem since there are three different inter-carrier standards in use throughout Europe. Eastern-Bloc countries employ 6.5MHz sound/vision spacing, Western Europe 5.5MHz, while the UK and Eire use 6.0MHz. However, unless you are well versed in foreign languages it may be better to concentrate on the vision, at least initially.

Another factor to be taken into account is the nature of Sporadic-E propagation. Phase distortion and bandwidth reduction often take place, especially on the lower channels. Under these conditions the sound may well not be present. Rapid fading of the signal is yet another characteristic of Sporadic-E. Sometimes just one channel can be active with a fairly steady signal while on other



An unusual electronic test card radiated by Canal Plus on channel 6

Caption used in W Germany during breakdowns of the ARD/ZDF teletext service



The latest ARD identification here incorporated into the Eurovision motif

occasions the entire band can be active with wide variations in signal strength and quality.

Aerials

A very simple aerial system consisting of a dipole with each element cut to 50 inches will suffice for initial experimentation. This roughly corresponds to the centre of the band. The dipole should be mounted externally if possible, and horizontally. Because signals arrive from the E-layer at an angle, aerial height isn't of too much importance. Some method of rotation is desirable for maximum signal pick-up, although a second or even third dipole could be mounted in different positions with simple switching arrangements to allow selection of the most productive aerial.

Recording DX

Keeping a reception log is important as it allows the enthusiast to compare notes on activity and conditions with fellow DXers. A photographic record of test cards and identification captions is another aspect of the hobby, although with the arrival of home video cassette recorders it is now possible to record DX-TV reception and play it back during periods of inactivity.

Books covering DX-TV reception techniques and test card identification are currently available, together with DX-TV converters, multiband tuners and weather-proof dipole junction boxes. Full details and free leaflets may be obtained from: *HS Publications, 17 Collingham Gardens, Derby DE3 4FS.* A 17p stamp or 2 IRCs should be forwarded for an information pack. Advice on receiving DX-TV signals can be obtained by telephoning (0332) 513399 outside office hours. So, if you have any DX problems, why not give the number a ring?

Service Information

United Kingdom: The familiar BBC1 globe caption has undergone a dramatic change. The old mechanical model of the world, turned by an electric motor and scanned by a simple monochrome camera, has gone. In its place has come a solid-state, fully digital device.

The hardware for displaying the new view of the world uses two 800Kbyte full-resolution frame stores to produce a full three-dimensional effect. The data is stored as eight-bit samples with the map data being stored in a separate memory of more than 4.5Mbytes. Erasable 128Kbyte memories are used for all data storage, and high-speed digital techniques are used throughout.

Each BBC regional centre has been equipped with the new digital globe caption and regional identification is included. BBC1 has used a rotating globe caption since the early 1960s. We hope to include a photograph of the new caption in the near future. Incidentally, the stylised identification used on the BBC1 digital test card 'F' has been changed to conform to the new-look service. Mind you, you'll have to get up at the crack of dawn to see it! The test card is only transmitted for a few minutes prior to 0600, at which time boring Ceefax rules the airwaves.

Netherlands: NOS are planning a third television network and transmitters will be at the following locations:

Lopik/Ijsselstein	E30	1000KW
Smilde	E44	1000KW
Markelo	E51	300KW
Roermond	E34	250KW
Wieringermeer	E42	300KW
Goes	E52	250KW
Arnhem	E40	30KW

Our thanks to Gösta van der Linden (Rotterdam, Netherlands) and the BBC (London) for supplying this month's service information. R&EW

MEDIUM WAVE DXING

by Steve Whitt

Welcome to the first edition of a new feature in *Radio & Electronics World* dealing with the world of medium wave DXing. Every month I shall present a page devoted to this subject, aimed at both the newcomer to this fascinating area of radio listening, and the listener with years of experience tucked firmly under his belt.

What is MW DX?

There are thousands of people around the world who regularly tune to the short wave bands listening with relative ease to stations that may be located on the other side of the globe. Many of these SW listeners also enjoy the hobby of DXing, which can be loosely defined as the art of hearing far-away radio stations.

Therefore, at first sight, MW DX is a contradiction in terms since the basic meaning of DX is distance and since the MW frequencies are generally used for local or regional broadcasting. However, what is a local station to one listener is a DX station to another.

At some stage every SW listener will have noticed that the SW broadcast bands are dominated by a small number of international broadcasters radiating a large number of high power signals. These stations try to plan their broadcasts so that listeners worldwide can hear programmes in their native language at convenient times of the day.

In complete contrast, the MW band is full of thousands of local stations situated the world over. Despite interference, it is possible to hear stations at distances well in excess of their normal coverage area. The medium wave frequencies provide a real challenge to the avid DXer wishing to hear countries and stations which, for a variety of reasons, could never be heard on the SW bands. It is often this challenge that will encourage the experienced SW listener to 'have a go' at MW DXing, and before long the MW bug will have bitten.

How to MW DX?

This is a question that even the most experienced DXer cannot answer exactly; nevertheless the aim of this column will be to make MW DXing easier and more rewarding.

One of the attractions of the medium waves is the ease with which one can start listening; even the most basic of domestic portable radios will receive stations from many countries in a variety of languages and programme styles. To master the art of MW DX the listener needs to develop a basic understanding of the various factors that allow reception of distant and not so distant stations, namely:

1. Propagation; ie how a radio signal gets from the transmitter to the receiver.
2. Receiver performance; particularly how a radio separates one signal from another.
3. Antenna design.
4. Broadcast schedules.

In future articles I am planning to provide useful tips on these subjects, hopefully striking a good balance between those of use to the novice and those intended for more experienced DXers.

Starting point

This section is devoted to helping those new to the world of MW DX to get started, and assumes that the only equipment available is a reasonable quality portable radio with a built-in ferrite rod aerial. One of the biggest failings of such radios is the poor calibration of their dials, which are usually of a simple cursor format.

Generally the longer the dial is the better, and if there is a logging scale this can be useful for setting the radio to a particular point on the dial. It is a good idea to mark the dial with calibration points based on known frequencies so that intermediate frequencies can be interpolated. Alternatively, if a logging scale is present it is possible to draw a calibration graph of station frequency versus logging scale position.

Deciding when to listen depends on what you wish to hear. Initially it will be possible to hear new and interesting stations both by day and night, but it will soon become apparent that after dark more stations located further away can be heard.

To learn more about how the MW band behaves it is a good idea to tune around the band randomly at various times of day and night listening to any interesting stations that might be heard. However, to start the ball rolling here are some suggestions (all programmes are in English, frequencies in KHz and times given in GMT/UTC are valid until October).

612KHz Dublin, Eire 0530-0050
873KHz AFN Frankfurt, Germany 24hrs
1179KHz R Sweden 2300-2330
1287KHz R Prague 2130-2200
1395KHz R Tirana, Albania 2200-2230
1467KHz TWR Monte Carlo 2200-2300
1512KHz BRT Brussels 2100-2155
1530KHz R Vatican 1950-2010

There are eight suggestions for this month that should be relatively easy to hear – do let me know how you get on. Next month I will provide some more suggestions and more tips for budding MW DXers.

Lastly before I close there are just a couple of points to make. Firstly, any and all contributions and suggestions for this column will be most welcome (when sending in logging information please use the format shown here and state what equipment was used). Secondly, if you have any problems I will do my best to answer them in this column – space permitting. And finally, until next month, good DXing. REW

DX FILE

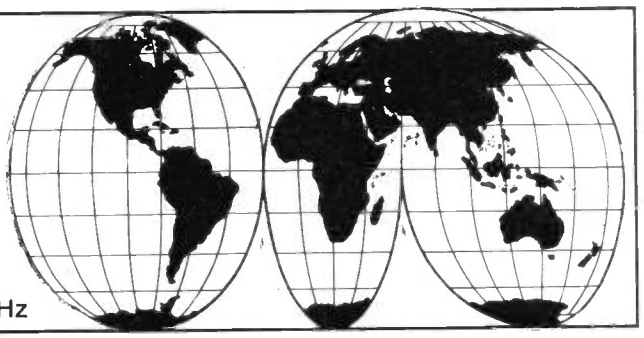
This section will be based on readers DX loggings each month (all reports sent to me will be most appreciated). This month, however, in the absence of any mail I shall rely on some extracts from my own logbook.

660 WNBC New York NY USA, ID pop Mx @0326 26 Mar
1050 WHN New York NY USA, ID C&W Mx @0037 27 Mar (amazing signal strength)
1140 CBI Sydney NS Canada, CBC Nx & sport @0200 14 Mar
1210 WCAU Philadelphia USA, phone-in @0038 25 Mar
1220 R Globo R J Brazil, Nx & Wx in PP @0100 5 Mar
1390 WCSC Charleston SC USA, ID @0157 27 Feb
1510 WMRE Boston Mass USA, sports @0048 27 Mar (massive signal)
1610 Caribbean Beacon Anguilla, Rel EE @0049 7 Mar.

Equipment used: R390A communications Rx plus 40cm square loop antenna.

Key: ID=identification, Wx=weather, Nx=news, Mx=music, Rel=religious, EE=English, SS=Spanish, PP=Portuguese, FF=French

SHORT WAVE NEWS FOR DX LISTENERS



By Frank A Baldwin

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

In most opening passages I usually bring to attention the stations currently broadcasting from a particular country or area of the world. Just for a change of diet a mixture of several subjects is tabled here.

Word processor

The mention of diets reminds me that there must be some readers of these columns who own a microcomputer and are seeking ways of turning their equipment into a menu optioned word processor at a reasonable price. I looked long and hard and eventually found a source of supply. Should you have a Commodore 64 then I suggest you contact *A and C Software, 75 Oakthorpe Gardens, Tividale, West Midlands B69 2LF* requesting information on 'Textfile', which is available on tape or disc – and don't forget to mention *Radio and Electronics World*!

All-time best DX

A regular reader recently enquired about the identification of some DX stations he had logged and also posed the pertinent question '...and what do you consider your best DX of all time?'

The reply didn't set me thinking or even scratching my head in deep thought. Undoubtedly it was the occasion some three years or so ago when on a Sunday morning just before breakfast I heard to my utter astonishment and initial disbelief signals from SIBS (Soloman Islands Broadcasting Corporation) Honiara on **5020** at 0745. A programme of Hawaiian music was heard with announcements by an OM in Pidgin and included a song in the same vernacular by a YL. The signal was perfectly audible if low in signal strength but faded out within some ten minutes of the initial reception.

It was all sheer luck of course; I just happened to be on the right channel at the right time, there was no skill involved, and this after some fifty-two years on the short waves. It just goes to show that Lady Luck or Sir Good Fortune is often more important in life than either intelligence or skill.

If you do ever tune to **5020** around the time mentioned and hear Hawaiian music then it is almost certainly Honiara.

Aerial arrays

Then there was the reader who wanted to know just what type of aerial I use when working over the 60 or 90 metre bands.

Although I have used all sorts of skywires in my time including (a) the galvanised wire which secured the garden fencing, (b) long wires of various complexities including one to which several copper cistern balls were attached, (c) assorted V-beams, (d) various bed springs, and (e) numerous verticals and whips.

The one that I have used for some years now is simply a 150 foot long wire of 14 guage plastic-covered hard drawn copper wire erected almost due east to west at a height of about 35 feet. This is fed into a switching arrangement catering for additional aerials and thence into an ATU (aerial tuning unit). The length of the aerial top is simply that which is convenient at the present location.

Cistern balls? Yes, this rather imposing array mentioned above was erected some 33 feet in length at a height of around 20 feet and was festooned with no fewer than six copper balls soldered at intervals to the top wire. This was in pre-war days of course, when such a commodity as copper cistern balls was commonplace.

Having read somewhere that the surface area of a conductor was of some importance with respect to signal strength, I took upon myself an enlargement of the total area by paying a visit to the local builders yard and cheaply availing myself of some secondhand and rather battered copper balls.

My brainchild didn't survive long. An extremely irate neighbour loudly proclaimed to the world at large, and to my parents in particular, that the 'waves' from my aerial were ruining his vegetable produce neatly planted in rows right next door. Result – down came the Copper Ball Special!

Short wave clubs

I am often asked about short wave clubs or societies based here in the UK which cater for broadcast band listeners.

Two that I am aware of are the International Short Wave League and the World DX Club.

The former is one that I have been a member of since its inception some thirty-eight years ago. It caters for both amateur and broadcast band listeners and has a monthly publication entitled *Monitor*, of which, incidentally, I was the founder and first editor. The address is *ISWL HQ, 88 The Barley Lea, Coventry CV3 1DY.*

The latter club produces the monthly journal *Contact*, which also caters for the broadcast and amateur bands and additionally the medium wave band. The address is *A Ward, 17 Motspur Drive, Northampton NN2 6LY.*

AROUND THE DIAL

Make yourself comfortable, switch on the reciever, adjust the dial or digits to the frequencies at the times listed here and you may log the following.

AFRICA

Algeria

Algiers on **11715** at 1003, OM with a newscast in the Arabic Domestic Service which may be heard on this frequency from 0000 through to 2310.

Cameroon

Radio Douala on **4795** at 0435, OM with the station identification in French and English, with announcements including the various frequencies occupied, then an orchestral/choral rendition of the National Anthem followed by drums and chants. The schedule is from 0430 to 0800 and from 1630 to 2300 with a power of 100KW. There is an English transmission from 1745 to 1845 Monday to Friday inclusive, Saturday from 1730 to 1845.

Central African Republic

Bangui on **5035** at 0514, OMs with folk song and guitar backing in the fast rhythmic local style. This one varies in frequency down to **5032** on occasion, and is on the air from 0430 to 0700 and from 1630 to 2300 with a power of 100KW.

Egypt

Cairo on **11665** at 0940, quotations from the Holy Quran in a programme of the Domestic General Service on this channel from 0400 to 1515 and from 1900 to 0030. Also logged in parallel on **11785** (0700 to 1515 and from 1700 to 0030) and on **12050** (from 0700 through to 2345).

Kenya

Nairobi on **4915** at 0405, OM with a newscast in Swahili. This is the National Service entirely in Swahili and it is on the air from 0255 (Sunday from 0330) to 0630 and from 1330 to 2010 (Saturday until 2110).

Libya

Voice of the Greater Arab Homeland, Tripoli on **3200** at 0152, OMs with a discussion in Arabic. The schedule is from 1745 to 0430, power unknown.

Malawi

Blantyre on **3380** at 0310,

African drums and chants. MBC Blantyre is on the air from 0255 to 1110 and from 1300 to 2210, these times being applicable from April through to September inclusive. The power is 100KW. There is an International Service in English and Chichewa from 1600 to 1800.

Mauritania

Nouakchott on **4845** at 1805, OM with a newscast in French. This 100KW transmitter operates in Arabic, French and local vernaculars and is scheduled from 0600 (Sunday from 0800) to 0900 and from 1800 to 2400.

Mozambique

Emissao Nacional de Maputo on a measured **11818** at 0257, interval signal repeated (seven note sequence on a Mbira – local xylophone), OM with the station identification in Portuguese, then OM and YL with the local news in Portuguese. The schedule is from 0255 to 1045 and from 1130 to a variable closing time around 1745. The power is just 7.5KW.

Nigeria

Lagos on **4990** at 0412, OM with news of local events. This Channel 1 programme was in English but vernaculars are also used during the schedule this being from 0430 to 1000 and from 1700 to 2310. The power is 20KW.

South Africa

RSA Johannesburg on **11900** at 2120, OMs with a discussion in English during a transmission for Europe and West Africa timed from 2100 to 2200.

Senegal

Dakar on **4890** at 2039, OMs with a discussion in vernacular during a National Service programme. The schedule is from 0600 to 0800 and from 1800 to 0100 with a power of 100KW.

Seychelles

FEBA (Far East Broadcasting Association) Mahe on **9510** at 1742, OM with a religious programme in Oromo directed to the Middle East and North-East Africa from 1733 to 1818 on Friday, Saturday and Sunday. At 1745 three pips time-check followed by OM with the station identification. Also logged in parallel on **11750.**

Transkei

Capital Radio, Umtata on **3930** at 0333, YL with a pop song, OM with promos. This one operates in English from 0300 (Sunday from 0400) to 0530 and from 1530 to 2300. The power is 50KW.

THE AMERICAS

Brazil

Radio Anhanguera, Goiana on **4915** at 0509, YLs with a local pop song, OM with promos in Portuguese. This 10KW transmitter is on the air from 0630 to 0400.

Radio Nacional de Amazonia, Brasilia on **11780** at 2158, OM with announcements and the station identification in Portuguese. At 250KW, this station is on the air from 0800 to 1600 and from 1800 to 0200.

Colombia

Caracol, Neiva on **4945** at 0511, OM with the local news in Spanish with several mentions of place-names in Colombia. A station of the Caracol Network, this one operates around the clock. The power is 20KW.

Cuba

Havana on **11710** at 2000, OM with the station identification in Spanish, chimes interval signal, then YL with the French programme for Europe, timed from 2000 to 2140.

Guatemala

Radio Tezulutlan, Coban on **4835** at 0035, OM with a talk in Spanish then into a programme of folk songs and music. This Guatemalan is on the air from 1100 to 1600 and from 2100 to 0230 with a power of 3KW.

ASIA

China

Radio Beijing on **11650** at 0955, YL with a song, YL with announcements in a Chinese programme directed at South-East Asia from 0900 to 1000.

India

AIR Delhi on **9545** at 1347, OM with a song in Hindi during an English programme for South-East Asia timed from 1330 to 1500.

AIR Delhi on **9665** at 1930, YL with station identification then OM with a news review during an English presentation for the UK and Western Europe, scheduled from 1845 to 2230.

Japan

Tokyo on **15235** at 0859, musical box interval signal followed by OM with the station identification and a programme in English intended for the Americas, Europe and the Far East, timed from 0900 to 0930 in the General Service.

Kuwait

Radio Kuwait on **11990** at 0730, YL with station identification and a newscast in Arabic. This is the Domestic/External Service which is on this frequency from 0600 through to 0015.

EUROPE

West Germany

Cologne on **3995** at 0424, OM with a talk in the all-German programme for Europe which is on this channel from 2200 to 0547.

Rumania

Bucharest on **11790** at 1412, YL with announcements during an Arabic transmission to the Middle East, scheduled from 1400 to 1430.

SOUTH-EAST ASIA

Australia

Melbourne on **9770** at 1427, YL with a talk about Hong Kong then OM with the station identification at 1430 during an English programme for the Far East, Papua New Guinea and South-East Asia, timed from 1100 to 1730 on this channel.

Indonesia

RRI Padang on **4003** at 1538, OM with a talk in Indonesian. The schedule is from 2300 to 0100 and from 0945 to 1615. The power is 10KW.

CLANDESTINE

Voice of the Feda'i on a measured **3941.3** at 1659, choral marching song, choral Internationale then OM with a harangue in Persian. The schedule is from 1700 to 1745, the policy being anti-Islamic Republic and favouring the setting up of a People's Democratic Republic.

NOW LOG THIS

Radio Iris, Esmeraldas on a measured **3382** at 0340, OM with promos, OM with a folk song in Spanish then OM with station identification, the National Anthem and off at 0400.

NOW HEAR THIS

Radio Madre de Dios, Puerto Maldonado on **4950** at 0119, OM with a political talk in Spanish. This 5KW transmitter is on the air from 1030 to 0230, both times being variable. The power is 5KW.

DOTS AND DASHES

Switching to the amateur bands from time to time does provide some excitement and a change from searching through the broadcast frequencies. This time we came up with the following. On Top Band (160 metres) CT4BD, EA5CF, IK2DUS, K3UA, LZ1BC, N4NX, OE1KM, OL6BID, OZ1W, RB4IMP, RW3AA, SM6EHY, SP7KTE, UA6WBU, UB5ZAY, UC2AC, UF6FDR, UQ2GNL, UR2AO, UT5AB, W1ODY, W4OO and W8AH.

On 7MHz the following emerged through the QRM: CE1ANF, CM5HL, CP6EE, J28EI, LU8BA, PY7GQ, UH8EAA and YV5JSS.

DX PROGRAMME GUIDE

This is the title of a new 12-page publication entirely listing stations, times and frequencies of broadcasts in English from around the world.

Available from the compiler, *Mike Evans, 120 Loughton Way, Buckhurst Hill, Essex IG9 6AR,* it costs 70p per copy (5 IRCs worldwide) and will be produced four times per year in accord with the annual seasonal schedule changes M, J, S and D. Annual subscriptions are not available. NEW

NEXT ISSUE

Radio & Electronics World

For all aspects of practical amateur radio

TWO METRE AMPLIFIER

The second part of David Silvester's article covers construction and alignment

SPECTRUM INTERFACE

Held over due to lack of space, this project from AP Dean is well worth waiting for

POWER SUPPLIES

Roger Alban moves into the realms of integrated circuit voltage regulators

MORSE DECODING

More apologies! Again, limited space has delayed the delivery of Dr Kiam-Laine's superb machine code program

PLUS all the usual features!
New products ● News ● Reception reports...
DON'T MISS the July issue – on sale **13th June**

To be sure of your copy of *Radio & Electronics World*, complete the newsagents order form in this issue or take out a subscription

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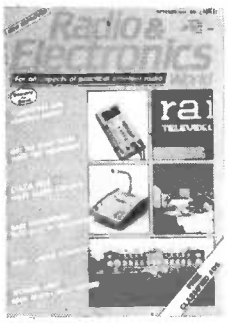
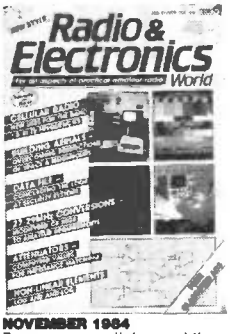
For all aspects of practical amateur radio

BACK ISSUE SERVICE

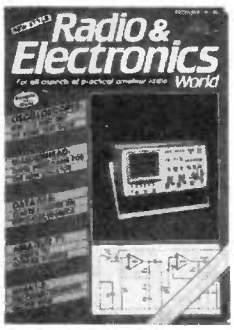
All issues from October 1981 onwards are still available, with the exceptions of January and February 1982, and December 1983. All orders must be pre-paid, the cost of each issue being £1.00 inclusive of postage and packing. A contents index spanning the issues from October 1981 to September 1983 is available on receipt of a stamped addressed envelope. To ensure that you don't miss any future issues, we suggest that you place a regular order with your newsagent or complete the subscription order form found in this issue.



OCTOBER 1984
Projects — Base Mic, construct this processor controlled accessory; One night's work, build an indoor UHF TV aerial.
Features — Modems, the link between computers and radio; Non-linear elements, a look at multipliers; Data File, continuing the look at alarm systems; SSTV for the BBC Micro, getting started in this mode; Testing! Testing! how to use your test gear: multimeters.



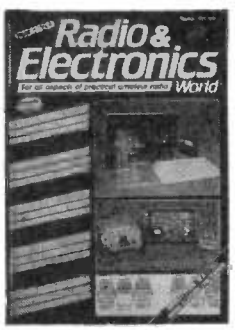
NOVEMBER 1984
Features – cellular mobile radio; computing attenuators for calculating resistance values; small aerials, coping with problems of space; 27-29MHz conversions; Data File, concluding the series on security systems; FETs – a beginner's guide; Non-Linear elements, log and anti-log; QSO, interesting contacts from clubs and individuals; ATV on the air, with a look at a range of aerials for the average pocket.



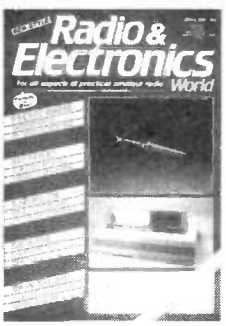
DECEMBER 1984
Features — Cable TV goes on the air; Simple speech processor, a simple device to increase a stations 'talk power', Uosat-2 telemetry, decoding satellite signals using this BBC Micro program; Tatung Einstein review; Testing! Testing! oscilloscopes; ATV — getting started; Data File, LED circuits and opto electronic principles; Morse test, self study course; Computing Maidenhead, three programs relating to the Universal (Maidenhead) Locator; QSO, club and event news; ATV on the Air, with news from the air waves.

JANUARY 1985
Features — Canal Plus, Europe's first VHF/UHF pay-TV service; Phased Vertical Arrays, a computer program for the design and modelling of antenna systems; Russian Satellites, the first part of a series looking at the equipment used to decode signals from the navigation satellites; RF small signal amplifiers, some of the obstacles encountered when constructing radio frequency devices; Principles of Z80 Morse Decoding; Data File, a look at LED sequencer and analogue-value indicator circuits.

FEBRUARY 1985
Features — Airborne TV, some fascinating experiments involving TV transmissions from an aircraft in flight: Direct Broadcast by Satellite, the systems of TV reception via satellite: Touch-sensitive joystick, zapping Klingons is made quicker and easier with this project: The Horseshoe Nail Syndrome, Brian Dale questions the policies of major manufacturers with regard to chip production: Long Waves Live on!, Nigel Cawthorne on long wave broadcasting: Low-pass Filter, clean up your signals with this relatively cheap high power project: Russian Satellites – Part two, the receive section: Data File, more opto-electronics from Ray Marston.



MARCH 1985
Features – Spectrum Watch, a survey of the latest developments in the radio spectrum; Russian Satellites, part three outlines the computing of the received data; Variable Frequency Ramp Generator, a circuit for testing bandpass filters; Electronic Lock, a cheap and versatile project; Data File, seven-segment display driving; Computing, inductance and capacitance values for circuit tracking; Frequency Translation, a follow-up project to November's CB conversion article.



APRIL 1985
Features – *RSGB* Convention preview; Spectrum Watch, progress with cellular radio, and French private TV; Synchronous Rectifiers, examining these and phase-sensitive devices; Amtext on HF, an experiment with Packet Radio; Weather Satellite Pictures, a ROM for the Beeb; Up in the Air, a cheap aid for VHF antenna experimenting; Data File, photo-diodes and LDRs; 934MHz – Dead or Alive, a look at civilised CB.

MAY 1985
Features – Spectrum Watch, news of European DBS and the MW broadcast band; RS232C Replacement, outlining a possible new standard for serial interfacing; Modifying the FRG-7, by adding a narrow-band filter and compensating for temperature variation; Power Supplies, Roger Alban on the design and construction of PSUs; UoSAT Programs, processing signals from Oscar 9 and 11; TV Reception, Ivor Nathan combines low-level signals; Data File, opto-coupler devices; 24cm TV Converter, Andy Emmerson builds and tests a budget-priced kit.

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■ Newdos 80 V2 for TR580 model 1, includes manual and articles. £50 (£120 new). Oric-1 481C computer plus some software £50. Various programs on tape and disk for TR580 model 1. Send SAE for lists. Also large quantity of books for TR580. TR580 model 4P portable and DMP110 printer, Scripsit, Visicalc, Newdos 80 V2 plus other programs: £1,000 or offers. Mr Berks, 43 Milford Court, Gale Moor Avenue, Averstoke, Hants PO12 2TN. Tel: Gosport 520204.

■ HRO with PSU and six coil packs covering 0.9 to 30MHz. BC221 HET freq meter, also radio and TV servicing vols 1 to 5 and six more volumes 1955 to 1963. Radio and TV Engineers Handbook, Radio and Electronics Constructor 1976 to 1979, all in good condition. Offers to Sam Preston 27191. Tel: Preston 27191.

■ Crusader X communication radio 12 bands, long, medium, 4 short, 5 VHF, UHF band, digital BFO, squelch, mains battery, portable de luxe, £150 as new. Eddystone marine receiver model 1004, 7 range plus pretuned channel 150-535KHz, 1.6-30MHz £75. Weale, 1 Candy Croft, Bookam, Surrey KT23 4BZ. TEl: Bookham 56741.

■ Aerial rotor. Fuba stereo 8 aerial. Plemi UHF TV aerial, 91 element. Ant-ference Band I/III aerial. All little used £60.00. Buyer collects. Tel: (027581) 4858 office hours (Bristol area). Also Fairmate A532320 mobile scanning receiver 110MHz to 161.995MHz and 296MHz to 367.9875MHz, £80.00. K L Jenkins, Old Fire Station, Pill, Avon BS20 0DH.

■ Five TVs, various. Eight record players, tape recorders, radiogram, music centre, several meters, burglar alarm and keyswitch, old vernier potentiometer. Various working orders, several kilos electro junk. Lot £60 ono. Must, repeat must, sell. Swap for scope? unused components? Good Combo amp? Someone make an offer! Would be a shame to dump everything but time is running short, junction 35 M1, then second right. S Harper, 8 Birchtree Road, Thorpe Hesley, Rotherham, South Yorks S61 1TH.

■ AR22R rotator, new £35. FT101 series workshop manual £20. Datong Morse tutor £25. FRG7700M £225. Triband 10/15/20 trapped vertical dipole £15. SX200N scanner £210. Polaroid 350 £50. Sentinel HF pre-amp £5. Minox B £50. Audio/visual IFR training course, approved fam. Projector, manuals, records £95. SM-D100 stereo mic £15. Record-a-call remote 80A telephone answering machine £100. Philips ultrasonic burglar alarm £10. Copley-Max, 'Upper Durford', Durford Wood, Petersfield, Hants GU31 5AN. Tel: (0730) 892143.

■ Collins R278 UHF Rx, 1800 channel 225.0 to 399.9MHz. Good condition, motor tuned, xtal controlled oscs mains input. With manual, working F/B, 19in rack cabinet heavy unit £85. Tel: Leeds 677101.

■ Tektronix scope 502, good condition, complete with manual £50. Surplus TV panels to clear, most makes and types available, going very cheap, also transporter valves, tubes etc. Mr A Boyskill, 129 Lyminster Road, Sheffield. Tel: (0742) 311191 after 6pm.

■ Major M588 multimode CB rig, AM, FM, USB, LSB works very well. Very good condition, needs only new crystals to enable use on ten metre band, £75. Tel: Milborne Port 250 526.

■ 123 spy set, perfect order with xtals, reformer handbook, clandestine aerial and headphones. All complete in original transit case. £95 carriage paid. Roberts. Tel: Hereford (0432) 267876.

■ Trio R2000 communications receiver with VC10 VHF converter 118 to 174MHz, very good conditon, £430 ono. J A Jones. Tel: (0405) 61872.

■ Pye audio oscillator, 20Hz to 20KHz old but working, Solartron oscillator 25Hz to 500KHz (large) (untested), Marconi electonic voltmeter TF2604 (untested), model 26 valve voltmeter old wooden case type (working), AVO allwave oscillator 95KHz to 80MHz (untested), Taylor model 45C valve testr and CRT box (untested), Greyshaw CR bridge CR50 (untested), Vidor 351 battery valve portable rado (working), 5 off PY500A valves, 6 off PL519 valves, offers. SAE to N Covington, 25 Ridge Road, Letchworth, Herts SG6 1PW (no callers). Tel: Letchworth 79681 (evenings).

■ Marconi Atlanta gen coverage, HRO, Marconi, Mercury, new, secondhand valves, CRTs. Jones plugs, sockets. WS48 for spares, offers or exchanges for WW2 gear. Mr D J Skilton, 40 Mid-Street South, Nutfield, Redhill, Surrey. Tel: Nutfield Ridge 2888.

■ 400 off 1000μF/50 volt tag end caps, 400 off FM aerial matching baluns (suit hi-fi etc), 75ohms to 300ohms with 6 inches co-ax and plug! 5 packets each of 10,000 6BA zinc plated plain washers, UABC80/50p each UCC85/50p each, ECH84/50p each, EF41/£2 each, ECC83/50p each, 2 off KT88 gold lion £18 each, 2 off KT66 USA £7 each, ZM1172 offers, B7G skirted 15p each, B9A skirted 20p each, UX5 ex-equip (suit 807) 25p each, post please estimate. SAE to N Covington, 25 Ridge Road, Letchworth, Herts SG6 1PW. Tel: 79681 (evenings).

■ TI99/4A software. Morse programs, random groups, plus plain language £5.00. QRA and Maidenhead Locator programs £5.00, 'Word Writer' word processor, extended basic £5. Daiwa 70cm masthead pre-amp, boxed unused £20.00. Philips 1500 video recorder, working, good video heads, 3 tapes, ideal for ATV £25. 13.8V power supply to match linear 2 £10. D G Hewitt, 311 London Road, Headington, Oxford OX3 9EJ. Tel: (0865) 67165.

■ Trio 2200G 2 meter, FM handy portable, fitted S19-23 R3-7 and Raynet. Complete with nicads, charger ER case shoulder strap and manual. Good condition £75. S Tubb, 11 St Andrews Road, Bexhill on Sea TN40 2BQ. Tel: Bexhill 215619.

■ £110 will buy you: Kenpro KR400RC rotator with cable and upper bracket, Jaybeam 10XY/2m two metre, ten element crossed beam, SA450 two way aerial switch, support pole and other bits and pieces. All in very good condition. Neil Billingham, 49 Lancaster Close, Gt Eccleston, Nr Preston, Lancs. Tel: (0995) 70927.

■ Icom R71E 4 months old, absolutely mint cond. Still under guarantee £550. Dressler ARA30 active antenna cost £86.00, never yet used, £70.00, first to see will buy. Save 21%. Tel: (01) 272 2465, any evening.

■ Sony ICE2001 general coverage receiver AM/SSB/CW with FM broadcast, PLL synthesizer, six memory, scanning etc. All complete with original packing and mains PSU little used. £90 ono. Everington, 73 Prospect Crescent, Whitton, Middx TW2 7DZ. Tel: (01) 894 7051.

■ Shack clearance, packs of assorted parts, large and small. Super selection contains at least 1 meter, 2 relays, 1 motor, 1 transformer, 250 new nuts, bolts, washers, 200 new solder tags plus resistors, capacitors, transistors, ICs etc. Guaranteed min weight 2Kg. Send £4.90 plus £2.10 postage to K Bailey, 40 Seymoor Close, Selly Park, Birmingham B29 7JD.

■ Icom ICR70 HF Rx mint and boxed with Yaesu FRT7700 tuner, £450, no offers. Tel: (0883) 43534.

■ Oscilloscopes: Telequipment D61a dual beam, probes etc, excellent condition £150. Cossor CDU130 portable batt/mains scope, new 4Ah nicads, service manual, probes, adaptors, leads. Vgc £140. Technicolor micro video, portable player/recorder, model 312E, mains adaptor-/charger/RF unit. All leads, camera-cables, strap manuals £250. Pioneer SR202W reverb pre-amp, as new, offers? Matthey video low-pass filters 1MHz and 2MHz, brand new, boxed £40 each. RCA monochrome CCTV camera with 8.5mm f1.5 and 25mm f1.9 lenses, incl mains cables and long video cable, good condition £50 ono. 3 RCA TC1020X CCTV cameras with 16mm f1.6 lenses, brand-new, unused for project, in original boxes, £150 each. Box of 10 KCA60 U-matic tapes-never used £70. This is a clearout of all my surplus equipment. I could arrange carriage at cost. Telephone after 6pm: Paul (0224) 895395.

■ Cossor scope mod 1071K double beam £30. Eddystome HF940 com/Rx set £95. Buyer collects. Also brand new comps. SAE list. All items fully working. Also DP7-5 scope CRT £5+ post. 2m Tx/Rx Storno 50 watts base station £49. X'tal CH, buyer collects. Tel: (0440) 705216 BEDE.

■ Standard C58 soft case nicads charger, boxed, manuals etc. CMB8 mobile bracket for above £210 ono. Icom IC2AT US version IC2E, base charger, 2 spare nicad packs. Spk-mic, leather case, boxed, manuals etc, £170 ono. Trio 9R59DS SW Rx, good cond, £10 ono. Deliver locally or carriage at cost. Phone after 6pm. D Bosworth G4NAC, 105 Kingsley ave, Kettering NN16 9ES. Tel: (0536) 523979.

■ Standard C146A handheld 2m R3, 6, 7, S20, 21 inc nicad charger etc, £60. Eagle AA2 stereo audio amp £20. G3PTU QTHr. Tel: (0484) 606506.

■ Sony ICF2001 digital comms receiver, covers 150KHz to 30MHz AM/CW/SSB and 76 to 108MHz FM plus AC122 power adaptor, £85. Tel: Mike, Medway 571537.

■ Icom R70 1984 as new boxed £370. Tel: Waltham Cross 32787.

■ Excellent receiver for short wave listener. Lafayette HA350, very good performance covers HF amateur bands. Good condition £55. I Watt GM4ZRR. Tel: (0224) 636828 after 4.30pm.

■ Sex! Now I have your attention does anyone want a 3½in reflecting telescope complete with all the bits that make life easy! It's in mint condition (that doesn't mean it's got a hole in the middle!). Would exchange for 2m rig or even a FT290R? Please write and let me know what you have. I'm not fussy. All letters answered. Philip Hawkes, 62 Charlotte Gardens, Collier Row, Romford, Essex RM5 2ED.

■ Trio TR530SP HF transceiver, £500. Six months old. D K Mathson, 2 St John's Rise, Restavon Park, Berrys Green, Biggin Hill, Kent TN16 3AT.

■ Sony ICF2001 fully synth FM/AM/SSB comms receiver 0-30MHz 76-108MHz, power supply as new, boxed £85. Pair of Skyfon NV7 handhelds Tx/Rx, single ch, crystalled for 10 metres, unused £40. Tel: (0704) 69410.

■ Datone D70 Morse tutor £35. 8X/Y Jaybeam (2m) with co-ax £25. CBM64 cassette interface £5. Tomi tuna PCB and mains t/former £5. CD45 rotator £110. FT480RW/shop manual £8. Kaytone £5. SMGS2 antenna switch £5. Rama powered hand mic £10. FT102, FC102, SP102 with AM/FM/CW filters, new PA valves £750. Absolutely no offers, would consider BBC/B DFS chips and disc drive as Px. John Lee, G4WSQ, 56 Slinn Road, Christchurch, Dorset BH23 3AL. Tel: Christchurch 482074.

■ Public address loudspeakers (three) for sale in wood acoustic enclosures 60in x 15in x 8in on stands, each with six Goodman 74/49 transformers and loudspeakers. £75 each. Tel: Portsmouth 263197 evenings.

■ Datong active antenna AD370, outdoor, new, tested, not used. £40 or exchange for general coverage receiver 9R59 or similar. Tel: (0602) 289753.

■ Marconi Atlanta general coverage Rx, Marconi Mercury 15KHz 4m double conversion, HRO. Offers or exchange for 2m linear, rotator, WWII gear. Mr. D J Skilton, 40 Mid Street, South Nutfield, Redhill, Surrey. Tel: Nutfield Ridge 2888.

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■ Butternut HF6V, American multiband vertical, brand new £85. Jaybeam quad eight, as new £35. Avanti PDLII, eleven metre quad beam, first class condition £45. Kenwood SP30 communication speaker, switched filters, brand new £30. AEA BT1 American handheld computerised Morse tutor, as new £45. Icom SM5 desk microphone, unused £25. All boxed with instructions, aerials, collect or carriage. Tel: 01-472 9058 evenings or weekends.

■ Eddystone EA12 160m – 10m. Some spare valves, used regularly, superb receiver £130 ono. KW204 160m – 10m. Some spare valves, £120 ono. Ideal separates combination for starter on HF. G4EUW. Tel: (020630) 3071.

■ Complete radio shack. Trio R2000 plus VHF converter. Super star 360FM for 10mtr. ATU. CB radios. Portable B/W. Hitachi radio cassette TV combined. Speakers. Electronic components. 50ohms co-ax plugs. Sockets, horn speakers, power supplies, car home antennae, SWR 27megs and 1.8-30 filters. Hand microphones, maps, books, tape recorders, resistors, capacitors, frequency counters and lots more to see. Tel: (0202) 824890 evenings after 7pm.

■ CB transceiver ST9 DX, FM, AM, LSB, USB, good condition £85. Stereo Hitachi cassette radio recorder, 4 bands new and boxed £150. Tel: 01-207 0706.

■ Rare Collins UHF airband base station receiver. Covers 222.0 to 399.9MHz in 100KHz steps with no gaps. Frequency selection made easy by means of preset channels and rotary channel selector switch. Audio output 3 watts into 600Ω. Full range of remote control facilities available, in excellent condition and full working order with comprehensive maintenance manual. Just £99 + post including Discone antenna. Tel: (0482) 864313 after 4.30pm.

■ Yaesu FT790R 70cm multimode. As new, forced sale. £240 ono. Tel: (0582) 62030. Weekends or 6pm to 8pm evenings.

■ Realistic DX150A 0.5KHz to 30MHz communications Rx, 4-band, mains or battery, £25. Cossor dualbeam CRO. £25. US Airforce BC453B Rx 190 to 550KHz (Q5'er) unused £20. Powerful horn-loaded loud speaker out-door type £25. 4-gang tuning capacitor for Marconi CR100 unused £5. 10p coin-op 30A electric power meter variable tariff £20. Buyers collect. All prices ono. Carriage extra where items have to be sent. Leon Charlish, 7 Cranbourne Ave, Windsor SL4 4ES. Tel: Windsor 64761.

■ FRG7 receiver, digital readout, 2.5 and 6KHz filters, FM, vgc with handbook, £130. MM2001 RTTY to TV converter, as new, £75. Global AT1000 ATU, as new, £20. Or sell the lot for £200. Buyer collects or pays postage. Steven Rake, 80 Cripps Ave, Tredegar, Gwent NP23PB.

■ SX200 scanner with power supply, excellent condition £160 ono. Tel: (0443) 492973 (S Wales).

■ Eumig 31XL sound/silent super 8 camera. Eumig super 8/standard 8 MkS,802D sound/silent projector. Kiron 80/200 zoom with Olympus OM1 body. All mint. Seagull 40 plus outboard, excellent. Acomms 27MHz 4ch radio control, unused. Exchange above, value for value for Icom 2m multimode base rig, Racal RA17, Eddystone 888 or WHY in multibanders with 2m module? Mint equipment only please. Icom Yaesu Trio preferred. Mr L R Williams, 37 Elm Drive, Brightlingsea, Essex. Tel: (020630) 4544.

■ Hallicrafter SX28 receiver. Original unmodified condition £50. AVO signal generator, AM/FM 450KHz to 230MHz, excellent condition £40. Wanted, all types of valved receivers, age and condition not important, urgently require microwave parts especially for 10 and 14GHz. Glen Ross. Tel: (0203) 616941 (Coventry).

■ Yaesu FR101D Rx with two and four metre internal converters fitted. AM, FM, CW and SSB filters. All 21 bands have crystals plus two extra crystals. Four fixed channel crystals fitted. Internal speaker. In excellent condition well worth £250 plus carriage. Tel: (0224) 643131 after 6pm.

■ Hammurlund SP400SX complete with handbook, ex-Cunard, Queen Elizabeth, no mods, historic receiver £200. Eddystone VHF receiver 770R coverage 19-165MHz £115. 'Call buoy' marine distress trans/rec unused (!) £125. Nicol, 5 Russell Hill, Purley, Surrey. Tel: 01-660 0794.

■ Ham international Concorde 3, latest model, this mobile rig has everything, 2 months old, £190 ono. Golden Eagle 26-30MHz mobile linear amplifier, input 4-12W, output 150-250W, 2 months old – hardly used, £60 ono. Tel: Tim, Hull 802531, evenings only please.

■ Complete ham station. Labgear LG300 Tx 150W, Eddystone 888A Rx, SWR meter, BC221 freq meter (mains operated), Tx/Rx switching unit, aerials, spare new 813 valve, complete set new valves for Rx, RSGB comm handbook, £150 ono. Gone QRT, G4AGY. G H Rippengill, 5 Bridge Farm Drive, Maghull, Liverpool L31 9AL. Tel: (051) 526 2782.

■ Yaesu FRG7700 plus FRT7700 ATU mint condition in carton £240 ono. Eddystone 840C Eddystone EC10, £65 each, good condition. Wanted Eddystone 940 in good condition, will deliver and collect NE England. Tel: Sheffield 585937.

■ Sell or swap – complete 2m station, Trio 9000 multimode matching BO9, SP120, PS-20, mobile mount, ⅞ whip, Oscar type, gutter clip, base colinear 3 x ⅝, rotator, beam, vgc. £475 or swap for FT77, Tentec Argosy or similar, WHY? Tel: Seaford (0323) 898515.

■ Icom R71E receiver, virtually brand new, approx 10hrs use, with unused 12V dc adaptor £570. Dresslar active antennae, never yet used, £70, or exchange best Zeiss 10x50 (west) binoculars, balance in cash. Tel: 01-272 2465 any time.

■ Dressler ARA30 active receiving antenna £45. Trio R1000 SP100 LS leads. Manuals 240/12V ex cond, £200. A Bradley, 2 Tenterden Close, Dorchester Road, Bransholme, Hull HU7 6BH.

■ Communications receivers – Trio, Lafayette, both complete with two metre converter, £65.00 ono each. Rotator AR1002, brand new, still boxed, £30.00. Buyer collects. Tel: John (0705) 261399.

■ Exchange or sell reception set R107 ZA 3050 serial number 8406. Ideal 80 metre reception set would like Nato 2000 or very similar. Tom Howard, Brynhadford, Llanerchymedd, Gwynedd, Anglesey, North Wales. Tel: Llanerchymedd 762.

■ VHF, UHF, FDK 750E and 430 expander 2m and 70cms mobile multimode FM SSB CW 1W & 10W, dual VFOs, repeater shifts, auto toneburst. Boxed, as new with handbook and mobile mount. Sold complete with diplexer and dual band mobile antenna £350. J Taylor G1EJE. Tel: Burntwood (05436) 72275.

■ QTH with 60ft versatower. Bungalow with third bedroom as shack. Long garden OK for ½ wave top band. Double garage and 8ft x 24in heated greenhouse. QTHr OK. G4DYP. Tel: Burntwood (05436) 6139. Price £51,500, freehold. Chasetown, Staffs.

■ FDK 750E 2 metre multi-mode. £250 or will swap for FRG7700 or a good general coverage Rx. Ask for Rick. Tel: (0302) 26080.

■ Radio-Electronics (American) March, April, May, June, July, November, December, 1983. Electronics and Wireless World January, April, July, August, September, October, November, 1983. Radio and Electronics World October 1982 to April 1985, excluding January February 1983. Ham Radio Today February, March, June, July, August, 1983, August 1984, April 1985. Television April, 1983 to April 1985 excluding May 1983. Offers per publication, not issue please. W M, PO Box 17, 23 Brentford, Middlesex TW8 9NF.

■ Cabin cruiser less outboard for sale, or exchange 2m SSB transcvr, or 70cms transcvr. Boat has good grp hull, wood deck house need painting. Intruder alarm systems, assembled, tested, to clear £30 each unit or £25 each for six. P G Robins, G8BSK, 290 Priory Road, St Denys, Southampton SO2 1LS.

■ One Trio JR310 receiver, good condition, £90.00 gets the 14, 7 and 3.5MHz bands. One SWL Lar omni-match ATU £30.00 and one Codar mains PR30 preselector good for 'dead' receivers ie receivers for less receiving, £10.00. Also one Revcone Discone £12.00. Tel: Wood, Clochen 378.

■ G3WW seeks offers on aerial installation 56ft Western 3HD tower, 205BA hy-gain beam, Moseley 10/15 and 2x16 tonnas, Emoto heavy duty rotator, separate co-ax & Emoto 70ft feedlines to shack. Two 240 ac motors gearboxed raise/tiltover tower. Also 56ft x 4in dia. Ali mast in two sections guyed 2 x 3. Tel: (0354) 740255 QTHr.

■ JVC PC-5L portable stereo hi-fi system. Includes radio-cassette, amplifier, tuner, cassette deck and speakers, can all be separated. 25 watts. Photo and aux terminals, twin telescopic antennae. FM MW LW SW, detailed manual included, cost £300, exchange for good hand-held scanner with airbands, ham and marine bands. Cannot deliver. Mr Scrase, 2 Queen's Rise, Ringwould, Deal, Kent CT14 8HJ. Tel: Deal 368284.

■ 2 metre FM Trio TR2300 with nicads, charger, mains power supply boxed £100. Eddystone RX770R, 19-165MHz good condition £100. Tower 3 section 65ft lattice hd £300. Contact Peter Eston Grange. Tel: (0642) 567249 10am-5pm, pref buyer collects.

■ Icom ICR70 Rx, as new, only 5 months old £400. Also FRT7700 ATU £25. Scarab RTTY unit (MPTU1) including BBC Micro software £45. All 3 units still with boxes. Buyer to collect please. Tel: (0494) 40001 (evenings only).

■ Dragon G4BMK RTTY transceiver, software with full instructions, only £6. Also 23 other Dragon games in good condition, all at less than half price. Good titles. Also 1 broken Dragon 32 for £20. Tel: Paul (0698) 285586 after 4.30pm.

■ 600 valves, octal American, UX types, brits, 5 and 7 pin bases, pre-war and post war types. Sae for lists please. Have BL348M int pwr pack, mains. £50 or offers. AE Jeffrey, 42 Dennis Rd, Padstow, Cornwall PL28 8DF.

■ RTTY free Creed 86R page printer plus tape punch in beautiful condition if you buy my American terminal unit (receive only). Full shift ranges, built in 2in monitor 'scope etc with circuit and loop supply unit. Yours for £45. Buyer collects. Also T20 ARC5, USA made 90 watt aircraft transmitter covers 80mtr band, great performer, yours for £25. Also RCA Nuvistors, new, plus bases £2 each. Nev Kirk G3JDK, 54 Allendale Road, Rotherham, Yorks S65 3BY. Tel: Wickersley 541606. QTHr.

■ IBM golf ball electric typewriter, as new, list price £840 with spare data golf balls and full box of 12 everlast ribbons. Will exchange for HF transceiver bands 1.8 to 30MHz inspection welcomed. 2nd hand Tx/Rx no obstacle, good working Tx/Rx is all that is required. R Haines, 24 Loyd Street, First Lane, Anlaby, North Humberside HU10 6UG. Tel: (0482) 658716.

■ Realistic DX160 general coverage receiver, fitted connection for digital unit, £40. Onyce FC155 SWR/power/FS meter with digital frequency readout, £25. Mizuho KX2 antenna tuning unit £15. All in good condition with manuals and boxes. C Head, 34 Lyte Lane, West Charleton, Kingsbridge. Tel: (054 853) 500.

■ Trio JR310 amateur receiver vgc £60. Would swap for Lowe SRX30 etc. I want general coverage Rx solid state. Prefer buyer to collect. Stan, 9 Park Square East, Jaywick, Clacton, Essex CO15 2NL.

■ Swan 100MX, 80-10, SSB/CW transceiver. Drae 24amp PSU, transmatch with Ezitune, junkers key, SWR bridge, wavemeter, dummy load, etc. Icom IC202, Packer W'meter, dummy load all in new to excellent condition, £375 ono. Will swap for a quality camera, scanning Rx or WHY. Tel: (0872) 70701 evenings.

■ 'Panda Cub' Tx for buying or copy. Your price. Dennis GW2BLW, No9 Lon Cymru, Llandudno, Gwynedd LL30 1SJ.

■ FT726R 2m, 70cm, sat, duplex, brand new, just two weeks old, unusual reason for selling it. Will consider part exchange for lap computer like NEC PC8201 plus cash or ring with a firm offer. Buyer to collect or arrange collection. Peter, tel: Witnesham 526, between 8am and 9pm.

■ Cobra 148GTL, 360 channel, 27MHz, AM, FM, SSB, CW, as new, still boxed £100 ovno. Avanti Spitfire 27MHz, 3 element beam, never used £25. Tel: (0246) 410409 between 9am-4.30pm Mon-Fri.

■ Wartime Admiralty radio working but needs some attention £60. Tel: (0622) 861998 evenings.

■ 80m QRP transceiver, VFO. Also 20m QRP transceiver, VXO. Both CW. Homebrewed to good standard. £35 each. J Jocys, 28 Vaudrey Drive, Timperley, Altrincham, Cheshire WA15 6HQ. Tel: (061) 969 0619.

WANTED

■ Any small communications receiver to 30MHz for a straight swap with a Ham International Concord II, covering 240 channels. USB, LSB, FM, AM, CW, mint condition. Manual, original box. Also book on 10m conversion. Only small receivers need apply. No furniture please. Also included with transceiver, Ham master desk mike 4200, as new, boxed. Tel: (0752) 777579.

■ Pre-war battery operated wireless sets wanted by private collector. Please tel: Reading 883799.

■ Service manual for receiver BC342J, include cost in reply. L D Thomas, 25 Goytre Crescent, Goytre, Port Talbot West, Glam SA13 2YD.

■ Ex ZS6 now aspiring to 'A' licence, wants Morse practice program for Oric atmos computer on cassette or manual entry. Expense will be reimbursed. Ed Myers. Tel: (0795) 842089 after 6.30pm.

■ Heavy duty tower wanted. Versa tower, Altron or similar design, 30 to 35ft high. Mr C Holmes, 4 Dovefields, Rocester, Nr Uttoxeter, Staffs ST14 5LT. Tel: (0889) 590664.

■ 52 set carrier, WS19 PSU, No 12 sender, WS29 set only, C12 PSU, WS21. Mr D J Skilton, 40 Mid-Street South, Nutfield, Redhill, Surrey. Tel: Nutfield Ridge 2888.

■ Min turret for Rigonda TV set or set for spares. Manual for USA Bendix RA1B receiver, cheap set for spares. Mr W A Yeomans, 13 Council Street, Walton, Peterborough, Camb PE4 6AQ.

■ Manual and instructions for Advance signal generator type D/D, state price. B J Rowlands, 8 Cambrian Avenue, Gilfach Goch, Mid Glam, S Wales CF39 8TB. Tel: (0443) 672280.

■ Literature wanted. If you don't know what to do with obsolete books, manuals, catalogues or any kind of publication covering any part of electronics, please send it to the address below and you can be sure it is going to reach the right hands, where needed most. Aleksic Vladimir Prelivacka, 125/63 Borca 11211 Yugoslavia.

■ Circuit diagram for WKS 1001 transceiver, to purchase or borrow, will pay postage. Please contact Mr Martin Fuller, 37 Green Field Close, Eccles, Nr Maidstone, Kent ME20 7HU, or tel: Maidstone 70485.

■ Crystal set, early type cats whisker. Tel: (0440) 705216 Bede.

■ 16mm Bell Howell GSAP gun camera, circa 1942/3. Magazine load cine cameras 24V dc WKG, any condition, also 16mm 'N9' American coaxial load cine cameras with 50ft or 200ft magazine, any condition. Have Bendix Rx circa 1940/44. Tel: (0225) 706795 Wiltshire.

■ Stoddart/Empire Rx panadaptor. Bob Wright, 249 Sandy Lane, Hindley, Wigan WN2 4ER. Tel: (0942) 55948.

■ 2 metre multimode, exchange Icom 02E, speaker mike never used. Tel: Tom (01) 348 3336.

■ General coverage receiver, prefer digital portable or base station and 144 nc/S portable or WHY. Exchange LAR HF omni-match and triple meter unit SWR watts mod readings rated 250W all bands incl WARC, also Panasonic stereo tape recorder vgc. £25. KW Ezee match vgc. £45. John Randall G3OAZ, 243 Paddock Road, Basingstoke, Hants. Tel: (0256) 465126.

■ 1400 Solartron CRO probes and manual for CX1441. Also required 30KV EHT meter; FM sig gen for domestic stereo FM; UHF TV sig gen; colour bar (PAL) gen. All must be solid-state. Manuals for these if possible. Contact R Duncan, Park Cottage, 7 Park Road West, Sutton-on-Sea. Tel: Sutton-on-Sea 41681.

■ Service manuals for: SB12b Spectrum analyser; RF7a tuning head; REC I converter; TTG2 two tone generator. All units made by Singer Metrics. Any technical info's welcome. Will pay and refund postage. Fritz Berrer VK6UZ, No 39 Third Avenue, Kensington 6151 WA, Australia.

■ Denco octal plug-in coils and Eddystone plug-in coils. Also coils as used in RSC short wave kit. Also wanted: HAC, RSC, Johnsons, Codar etc short wave sets etc (kits or built). Geoff Hanham, 7 Ashdown Road, Portishead, Bristol BS20 8DP. Tel: (0272) 844584.

■ Yaesu external VFO for FT101ZD Mk2 single lead type 901/902 etc. Reasonable price paid for good condition. Tel: (01) 789 1913 with offer, after 6pm, ask for Peter.

■ Amstrad CPC464 with or without monitor, in exchange for Acorn Electron plus software and books (excellent condition and nine months guarantee). Plus 16K ZX81 and software, including 8 channel I/O board (to control relays etc). Tel: Lichfield 55241 after 3pm.

■ Circuit diagram/service sheet of black and white Autovox television set NR991 Prestige, will cover all expenses. Write to: P Debono, 'Felci', Triq Risq, Misrah Kola, Attard, Malta.

■ Autek Qf-1A or similar AF filter unit. New or good condition s/h. K MacDonald, 19 Ashville Terrace, Edinburgh, Scotland EH6 8DD. Tel: (031) 554 6508.

■ Circuit or data for Sangamo-Weston model S75. Portable test set. Also electronic instruments model 26. Also working instructions and repair manual for AVO valve characteristic meter Mks 1 to 4, and repair manual for AVO models 7/9/40/36/47A/48A. Test set No 1 and AVO electronic test meter. G Jones, 32 Borough Street, Brighton, E Sussex BN1 3BG.

■ CT7001 or CT7004 (made by Caltex) or HCM7001 or HCM7004 (made by Fairchild) clock chip. S Shaw, c/o PO Box 342 Westonaria 1780, South Africa.

FREE CLASSIFIED AD ORDER FORM

Send to: Radio & Electronics World Classified Ads·Sovereign House · Brentwood · Essex · CM14 4SE

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

For Sale ..... ☐ Wanted ..... ☐

USE BLOCK CAPITALS (One word per box)
To avoid mistakes please write clearly and punctuate your ad

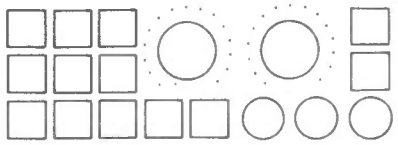
Name/Address Postcode/Telephone							

USE SEPARATE SHEET FOR MORE WORDS

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

CONDITIONS: Your ad will be published in the first available issue. We will not accept trade advertisements. We reserve the right to exclude any advertisement.

COUNTY GUIDE



CHESHIRE

DW ELECTRONICS G3 XCF
Amateur Radio Supplies
71 Victoria Rd, Widnes
Tel: 051-420 2559
ICOM
Open Mon-Sat 9.30-6 (closed all day Thurs)
We supply YAESU, ICOM, Tonna, Jaybeam,
Microwave Modules, Datongs etc

Glenbond (Videotel) Ltd
25, Stamford Street,Altrincham,Cheshire, WA14 1EX
Tel: 061 941 3057 **Telex: 666387**
Standard 2m and 70cm – Jaybeam – Ant Antennae
Antiference – Weltz – Sinclair computer spares
Colin G1 1ZD Gavin G1 1ZL
Your radio sold on commission basis

KENT

Thanet Electronics ICOM
95 Mortimer St, Herne Bay
Tel: 02273-69464
Open: Mon, Tues, Wed 9-5
Thurs 9-1, Fri, Sat 9-5.30
All mail order & service enquiries to head office, 143 Reculver Rd, Tel: 02273-63859

NOTTS

R.A.S.(NOTTINGHAM)
P Owen G8UUS
3 FARNDON GREEN; WOLLATON PARK
NOTTINGHAM: TEL: 0602 280267
Open: Tues-Fri 10-5.30 Sat 9-5
YAESU: FDK: ICOM: TONNA
HALBAR: WELZ: ANTENNAS & OWN GW5 H.F

SOUTH WALES

SANDPIPER COMMUNICATIONS
40 TREHAFOD RD, TREHAFOD,
PONTYPRIDD, MID GLAM.
AERIAL SPECIALISTS AMT RADIO, SATT & PMR
SAE FOR LISTS
TEL: PORTH 685515 and 0685/870425

SUFFOLK

Electro Tech Co
1 Dane Common, Kedington
CB9 7NU, Suffolk. Tel: **0440 705216**
Mail order RF/electronic Comps. SAE.
Free lists. Low prices. Trade quotes also.

SURREY

GUILDFORD COMMUNICATIONS
34 Aldershot Rd., Guildford
Open Mon-Fri 8am-6.30pm Secondhand wanted
Sat 8am-5.30pm
ICOM
FDK ASDEN
TRIO TO TSUKO
YAESU

WEST MIDLANDS

CENTRE ELECTRONICS
345 Stockfield Road, Yardley, Birmingham B25 8JP
Specialists in the sale and service of Ex Government and Vintage Radio and Test Equipment. (Many spares in stock).
Telephone enquiries to 0676 32560
Special delivery service
Shop open Thursdays, Fridays and Saturdays

COUNTY GUIDES

FROM ONLY £13.16 PER MONTH

Take advantage of this simple, economical and rewarding method of advertising by filling in the form below.

SMALL ADS

XXX ADULT VIDEO CLUB

For the genuine adult films. Available only from ourselves. Ring

0924-471811 (24hrs)

For the intimate details or write
ADULT VIDEO CLUB
P.O. Box 12, Batley, W. Yorks.

USED AMATEUR EQUIPMENT ?
I BUY, SELL & EXCHANGE!
My low overheads mean the best Possible Deal for YOU!
Whether Buying or selling Phone Dave on HORNCHURCH (040 24) 57722 ANYTIME, or send SAE for latest list to:
G4TNY ELECTRONICS
132 Albany Road, Hornchurch, Essex. RM12 4AQ.
New Equipment Supplied at Competitive Prices!
Marine Radio also Bought and Sold.

COUNTY GUIDE

Ad sizes
20mm x 59mm = single County Guide
40mm x 59mm = double County Guide

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

RADIO & ELECTRONICS WORLD COUNTY GUIDE ORDER FORM

TO: Radio & Electronics World · Sovereign House · Brentwood · Essex · CM14 4SE · England · (0277) 219876

print your copy here .....

.....

.....

.....

.....

NUMBER OF INSERTIONS REQUIRED

Single County Guide 3 ..... £47.00 ☐ 6 ..... £88.00 ☐ 12 ..... £158.00 ☐
Double County Guide 3 ..... £94.00 ☐ 6 ..... £176.00 ☐ 12 ..... £316.00 ☐

PAYMENT ENCLOSED £ —

Cheques should be made payable to Radio & Electronics World. Overseas payments by International Money Order

Conditions — Payment must be sent with order form. No copy changes allowed. Ads accepted subject to our standard conditions, available on request.

Registered No 2307662 (England)

C P I

NEXT ISSUE ON SALE
Thursday 14th June

Radio & Electronics World
For all aspects of practical amateur radio

SMALL ADS

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

RATES
per single column centimetre:
1 insertion £9.65, 3 — £9.15, 6 — £8.65, 12 — £7.75.

RADIO & ELECTRONICS WORLD SMALL AD ORDER FORM

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

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

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

COPY enclosed.....☐ to follow.....☐

PAYMENT ENCLOSED:..... £ — Cheques should be made payable to Radio & Electronics World. Overseas payments by International Money Order

CHARGE TO MY ACCOUNT.....☐

COMPANY .....

ADDRESS .....

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

.....

		C	P	I								

ADVERTISERS INDEX

Radio & Electronics World
For all aspects of practical amateur radio

ADVERTISING RATES & INFORMATION

ABC membership approved pending first audit Jan-Dec 1984

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
61 x 90	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

colour rates exclude cost of separations

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
128 x 186 or 263 x 90	½ page	£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
Jul 85	16 May 85	22 May 85	24 May 85	13 Jun 85
Aug 85	13 Jun 85	19 Jun 85	21 Jun 85	11 Jul 85
Sep 85	11 Jul 85	17 Jul 85	19 Jul 85	8 Aug 85
Oct 85	15 Aug 85	21 Aug 85	23 Aug 85	12 Sep 85

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%

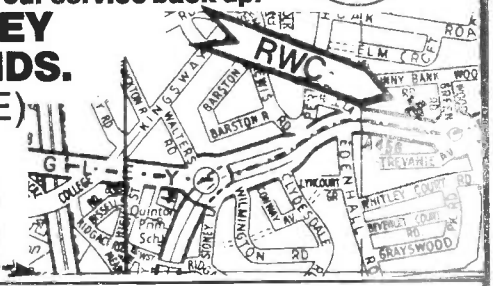
CONDITIONS
10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

R WITHERS COMMUNICATIONS

AUTHORISED YAESU

FULL RANGE OF MOST BRANDS IN STOCK! see all the other ads! then ask us about our service back up!

584 HAGLEY ROAD WEST, OLDBURY, WARLEY
B68 0BS (QUINTON, BIRMINGHAM) WEST MIDS.
Tel: 021-421 8201/2 (24 HR ANSWERPHONE)



Access **RWC SPECIAL OFFERS** VISA

PLEASE ASK ABOUT THE RWC CREDITCARD AVAILABLE NOW VIA LOMBARD TRICITY

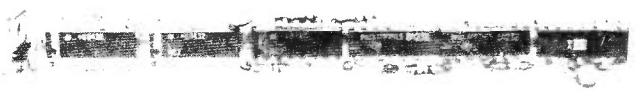
RAY G4 KZH **PHIL G4 OHK**

THESE PRODUCTS ARE EXCLUSIVE TO RWC

10 Mtr MOD BOARD – Remember who did it first!

This is a complete modification board designed to fit all CB radios that incorporate the SANYO LC7137 series of sythesizer chip, the unit comprises of a small pcb with six microchips and fits almost all current legal (CB 27/81) radios, the unit is supplied with full fitting instructions and can be fitted easily by most enthusiasts, with the current upsurge in interest in this band demand has been high as this means that over 90% of current CB radios can now be used on 10mtr amateur band.

PRICE £22.50 + £1.00 post and packing
Works excellent in Cybernet, Binatone Lowe TX40G etc. * Check if your radio has the Sanyo chip fitted. We will fit unit for you **£40.00** inclusive. P&P.

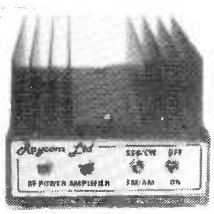


KIT OF PARTS AVAILABLE **£17.50 + £1 p&p**
* Only available from RWC see R&EW March 1985 for full circuit description etc.

RAYCOM MODULAR RF AMPLIFIERS

A complete range of linear and fm amplifiers for use with both VHF and UHF hand portables and multimode portables such as the YAESU FT290R and FT790R. Power output from 15W to 45W depending on model, (eight are available). All units feature Mitsubishi or Toshiba power modules as used in the majority of mobile and base radio transceivers. Two versions are also available for business radio applications.

PRICE from £39.50 for the 15W vhf model + £2.00 post



UHF UNITS (430-440MHz)

	ORDER CODE	PRICE
25W FM/CW	U25F	£79.50
15W FM/CW/SSB/AM	U15L	£69.50
15W FM/CW	U15F	£59.50

(FULL RANGE OF POWER MODULES IN STOCK)

VHF UNITS (144-149MHz)

	ORDER CODE	PRICE
45 FM/CW	V45F	£62.30
35 FM/CW/SSB/AM	V35L	£59.50
25 FM/CW	V25F	£48.50
15 FM/CW/SSB/AM	V15L	£49.50
15 FM/CW	V15F	£39.50

A.R.M. MULTI P6 ANTENNA

This is one of the most exciting new products to be launched by RWC and is the result of many months of development by Antenna Research Manufacture based in Devon.
The antenna has been designed to meet the growing popularity in multimode portable and mobile operation and is capable of being used on both vhf and uhf in both horizontal and vertical polorization modes, both portable and mobile. The antenna has the facility of being used as both omni-directional or directional modes as well as having capability of DF function. No ground-plane or radials are required and the antenna can therefore be used in a variety of applications on frequencies between 140-450 mhz. ★ See review in March Amateur Radio.
Further details are available upon application
PRICE £41.75 complete inc post
Colinear element **£4.75**

LOWE TX40G on 10 METRES – Exclusive offer

RWC are pleased to offer this very fine radio modified on 10 metres complete with repeater shift built-in. The unit has all of the features remaining except the high/low switch now controls the offset.
This high quality Japanese made unit hs RF gain control, RIT, P.A. facility, and has a very sensitive receiver, along with >4W RF output power, and typical deviation of 4Khz.
The unit comes complete with mobile mount, and is guaranteed for six months. This unit has the RWC mod board unit fitted and represents excellent value for money as this radio still sells for £33.00 on 27mhz. Was £79.00 originally

PRICE £52.50 + £2.50 carriage (price subject to increase when existing stocks are sold) – Hurry unrepeatable offer!

RWC also stock a comprehensive range of matching linears and antennas specifically designated for 10mtr operation.

COMING VERY SOON . . .

RWC WAVEMETER,
RWC PHASING HARNESS,
RWC DUAL BAND BASE ANTENNA (VHF-UHF)

ANNOUNCING THE SUPER YAESU FT757GX

Following the release of the RWC 10mtr MOD BOARD for the SANYO LC7136/7 series of cb sythesizer chip, and its successful launch onto the UK amateur radio market, the RWC design team are now ready to announce their latest innovation.

This new product is aimed at the world market and is a mofication for the popular YAESU FT757GX.

After over six months of development by our design team led by G3SBI, with G8FBX and G4KZH, and successful field trials, the modification has been perfected to enable installation by the end user.

The modification serves two major purposes:

(1) To improve VFO tuning and eliminate "VCO GLITCH"
(2) To decrease tuning speed from 10khz per dial revolution to 5khz per dial revolution (selectable on the 500khz step switch).

BRIEF DESCRIPTION

The unit comprises of a small pcb designed to fit onto the existing microprocessor (Q67) and has two microchips and some small components and only eight connections, three of which are connected to three of the micro pins direct. The other five wires easily connect to existing terminals on the main pcb, and also the display board. The modification can easily be installed by experienced constructors and will be available from selected dealers who will be able to offer a fitting service.

Each mod board will be supplied complete and tested (as per the RWC 10mtr. mod board) no kits of parts will be available. Registered design pending.

PRICES

UK price is £29.50 for the built and tested pcb with complete fitting instructions and £39.50 plus carriage for a unit factory fitted and tested. User warranty will not be affected on units supplied by RWC. All prices include value added tax at the current 15%. Export enquiries are welcomed.
(Instant fitting service available, please telephone)

All the above products have been designed and built in the UK and are exclusively available from:

EXCLUSIVE: DISTRIBUTORS FOR ARM PRODUCTS & RAYCOM LTD TRADE ENQUIRIES INVITED

R WITHERS COMMUNICATIONS LTD
584 Hagley Road West, Oldbury, Warley B68 0BS
Tel: 021 421 8201 (PBX) Telex: 334303 G TXAGWM

DEALER AND EXPORT ENQUIRIES ARE WELCOME

OVERSEAS CUSTOMERS WELCOME & WE SPEAK GERMAN & JAPANESE & LOCAL DIALECT + AUSTRALIAN

SAA5000A £1.50
SAA5012A £5.00
SAA5020 ..... £3.50
SAA5030 ..... £5.00
SAA5040 ..... £3.50
SAA5040A £4.40
SAA5050 ..... £3.50
SAF1032p £2.50
SAF1039 ..... £2.00
SAS560 ..... £2.00
SAS660 ..... £1.00
SAS670 ..... £1.00
SL901B £4.50
SL918 ..... £4.50
TA7122 ..... £1.15
TAA320A 50p
TAA470 ..... £1.50
TAA570 ..... 75p
TAA611B 50p
TAA621 ..... £2.00
TAA661 ..... 50p
TAA641 ..... £1.50
TA7117 ..... 50p
TA7120P 50p
TA7315AP 50p
TA7607AP 40p
TA7609P 50p
TBA120A 40p
TBA120AS 50p
TBA120SA 40p
TBA120B 40p
TBA120SB 40p
TBA120SQ £1.00
TBAS120U 75p
TBA120Q 30p
TBA120C 40p
TBA1441 ..... £1.00
TBA231 ..... 75p
TBA395Q 50p
TBA396Q £1.00
TBA396 ..... 75p
TBA440P £1.00
TBA1440C £1.00
TBA480Q £1.00
TBA520 ..... £2.00
TBA530 ..... £2.00
TBA540 ..... £1.00
TBA550Q £1.75
TBA560CQ £2.00
TBA570 ..... £1.50
TBA625 ..... 50p
TBA641 ..... £2.00
TBA651 ..... £2.00
TBA673 ..... £1.00
TBA720A £1.50
TBA750Q £1.50
TBA780 ..... £1.50
TBA800 ..... 50p
TBA810AP 60p
TBA810S 60p
TBA820 ..... 60p
TBA890 ..... £1.00
TBA900 ..... £1.50
TBA920 ..... £1.50
TBA920Q £1.50
TBA950 ..... £1.50
TBA990Q £1.00
TMS1000NL £2.00
TMS1943 clock chip £1.00
TMS9980 ..... £4.00
TMS9901 ..... £1.00
TMS2716JL £1.00
TMS3529 ..... £1.00
TMS3720ANS £3.00
TMS4014 ..... 70p
TX-012 ..... £1.00
TMS9902 ..... £1.20
ULN2216 ..... 75p
SN29848 ..... 50p
SN29770BN £1.00
SN29771BN £1.00
SN29772BN £1.00
SN7402N £1.00
SN7472N £1.00
SN74107 ..... £1.00
SN74167 ..... 70p
SN7472N 20p
SN75108AN £1.00
SN76001 ..... £1.00
SN76003 ..... £1.00
SN76013ND £1.50
SN76018 ..... £1.00
SN76008 ..... £1.00
SN76023N £1.50
SN76033 ..... £1.50

Diodes

BY127 ..... 10p
BY133 ..... 10p
BY134 ..... 10p
BY164 ..... 50p
BY176 ..... 25p
BY179 ..... 40p
BY184 ..... 25p
BY187 ..... 10p
BY190 ..... 40p
BY196 ..... 30p
BY198 ..... 10p
BY204/4 ..... 8p
BY206 ..... 8p
BY208/800 ..... 8p
BY210/400 ..... 5p
BY210/800 ..... 10p
BY223 ..... 60p
BY224/600:4.8A/ 600v bridge £1.00
BY226 ..... 15p
BY227 ..... 15p
BY228 ..... 20p
BY229/400 ..... 30p
BY237 ..... 5p
BY254 ..... 10p
BY255 ..... 30p
BY298 ..... 10p
BY299 ..... 10p
BY406 ..... 8p
BY527 ..... 20p
BY407a 10p
G11 470M/250V SP £1.00ea
Min 12 volt relays 75p

R 1038 ..... 40p
R 1039 ..... 40p
R 2009 ..... 80p
R 2010b £1.00
R 2029 ..... 50p
R 2210 ..... 60p
R 2257 ..... 60p
R 2265 ..... 50p
R 2305 ..... 50p
R 2306 ..... 50p
R 2322/2323 ..... pair 80p
R 2323 ..... 15p
R 2396 ..... 50p
R 2461 ..... 80p
R 2030 ..... 50p
R 2443=BD124 ..... 40p
R 2737 ..... 40p
R2738=TIP41 ..... 30p

R2775=TIP41c 40p
R3129=TIP47 ..... 40p
S2008b 80p

2SC940 ..... £1.00
BU 105/04 ..... 80p
BU 108 ..... £1.00
BU 124 ..... 50p
BU 126 ..... 80p
BU 180a 65p
BU 204 ..... 70p
BU 205 ..... £1.00
BU 206 ..... £1.00
BU 207 ..... £1.00
BU 208 ..... 80p
BU 208 on heat sink 70p
BU 208A £1.10
BU 208D 90p
BU 222 ..... £1.00
BU 326 ..... £1.00
BU 407 ..... 60p
BU 426V 60p
BU 500 ..... £1.10
BU 508A £1.20
BU 526 ..... 75p
BU 807 ..... £1.00
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BC125 ..... 10p
BC126 ..... 10p
BC139 ..... 10p
BC140 ..... 30p
BC141 ..... 25p
BC143 ..... 25p
BC147 ..... 10p
BC148 ..... 10p
BC149 ..... 10p
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
BC307 ..... 7p
BC308 ..... 7p
BC309 ..... 10p
BC327 ..... 10p
BC328 ..... 10p
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AC153K 15p
AC142K 15p
AC169 ..... 15p
AC176 ..... 15p
AC176K 15p
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BF137 ..... 20p
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BF161 ..... 20p
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BF180 ..... 20p
BF181 ..... 20p
BF182 ..... 20p
BF184 ..... 20p
BF194 ..... 10p
BF195 ..... 10p
BF196 ..... 10p
BF197 ..... 12p
BF198 ..... 10p
BF199 ..... 10p
BF200 ..... 20p
BF222 ..... 10p
BF224 ..... 15p
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