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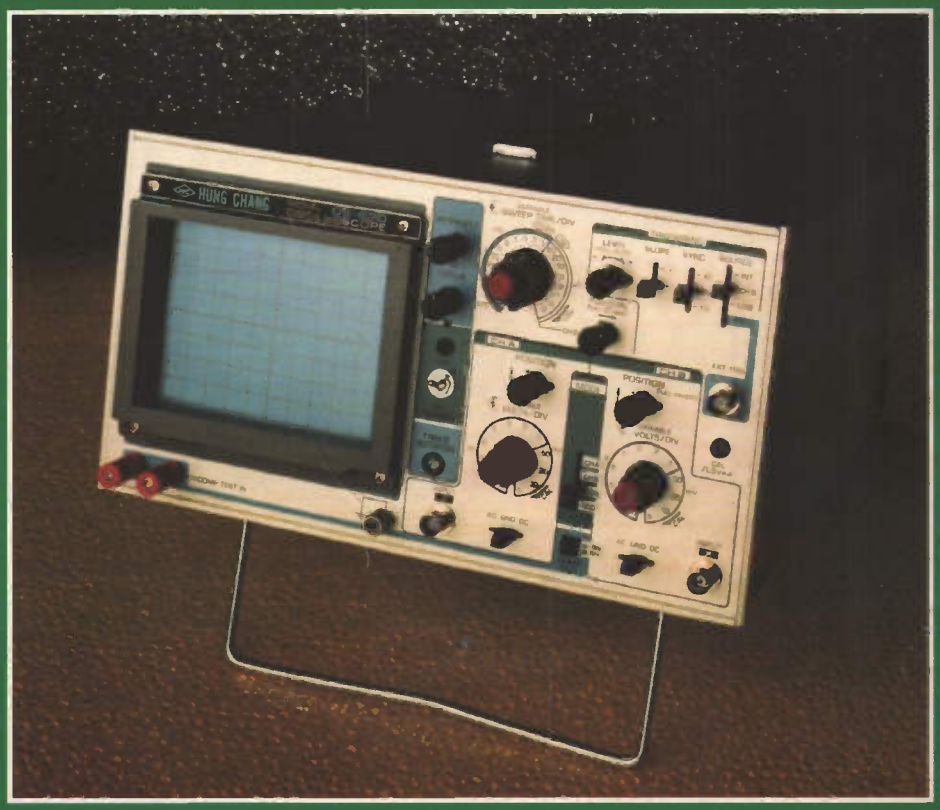
Radio & Electronics World

The communications and electronics magazine



SPECTRUM RTTY: COMBINED CW/ RTTY DECODER

ICOM IC-R7000: UNDER CAREFUL SCRUTINY

CONVERSIONS: FROM 11m CB TO 10m AMATEUR

UP IN THE AIR: AVIATION ELECTRONICS

DATA FILE: LM10 APPLICATIONS

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★ ICOM MICRO 2E 2MTR 2.5W EXT RX	£229.00	£10.00
★ ICOM IC28E 25W MOBILE EXTD RX	£349.00	£10.00
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YAESU FT727 5W DUAL BAND H/H	£395.00	£10.00

NEW YAESU ★FT211E, FT757GX MK2, ★FT23R/FT73R/FT727R subject to availability, price depending on version/nicad/charger. Several extended and special versions available. Please telephone and discuss your requirements. We always have a comprehensive range of new YAESU & ICOM models in stock.

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YAESU FRG9600 MK3 100KHZ-950 MHZ	£625.00	P/P £10.00

YAESU FRG9600 MK3 PACKAGE: Mk3 Receiver, ICOM AH7000 Super Discone Antenna, PA4C AC Adapter, 1/2 size G5RV. Complete H/F-UHF Broadcast/Amateur/PMR Receiving station. £725.00 Inc carriage. Options: PAL Video Unit @ £27.50, BBC CONTROLLER PROG, £49.50 inc post. SAE or phone for more details.
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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 Hung Chang series of oscilloscopes from Blackstar, featured last month

Bottom – Nevada high power variable capacitors, available from Telecomms – p10

SPECIAL FEATURES

REGULARS

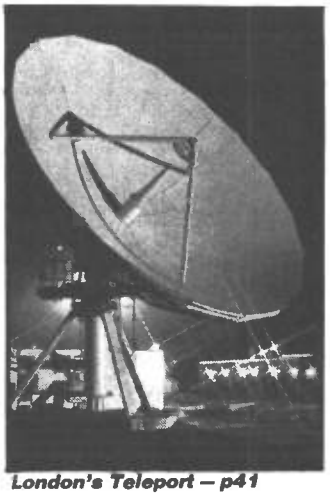
READER SERVICES

NEXT MONTH

☐ **Next Issue**
Cover Date August 1987, on sale Thursday 9 July

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

We regret to inform readers that due to constantly rising production costs, and to enable us to maintain the high standard of content in *Radio and Electronics World*, the price of the magazine will be £1.40 from this issue. Turn to page 24 for your last chance to subscribe at the old rates.



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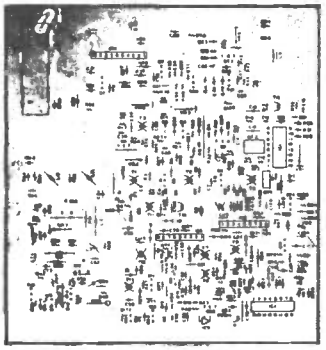

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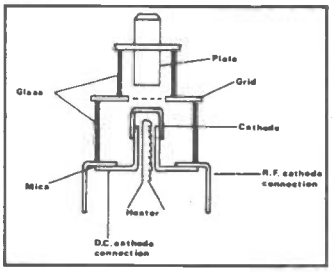

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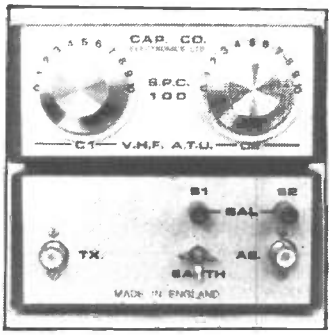


Cap Co's latest – p8

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

CAPACITANCE METER

The CM200 precision digital capacitance meter is now available from Thurlby Electronics. Using a 4½-digit display capacitance can be measured to as low as 1pF and up to 2500μF.

Ease of use is combined with a reading rate of three per second and virtually instantaneous settling. Together with the long scale length, this means the value of an unknown capacitor can be determined quickly and simply.

A basic accuracy of 0.2% of reading is achieved using a crystal-controlled oscillator with ultra high stability reference resistors. Long battery life and rugged compact design enables the meter to be moved continuously between locations and to work in the toughest environments. The typical battery life is 500 hours and a low battery indicator warns when replacements will be needed.

The inputs are fuse protected against charged capacitors. Up to 25pF compensation for test leads can be achieved using a front panel zero control. The high technical specification and low cost makes the CM200 an ideal instrument for all areas where precision component testing is required such as goods inwards, quality control and production. The CM200 digital capacitance meter costs £89 + VAT.

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

DIGITAL MILLIOHMETER

A new addition to the Telonic stable of test and measurement equipment is the Adex digital milliohmeter model AX124.

The AX124 is capable of very low resistance measurement down to 10μohms by means of a 1kHz ac signal. As a synchronous detection method is used, the instrument measures pure resistance only, even when series inductance exists. As the open terminal voltage is less than 20mV, oxidised membranes on contacts will not be broken down. Other features include 4 terminal operation, fast sample rate of 12.5 times/sec and a built in comparator system for GO or NO GO testing. A printer is available as an option.

The instrument is suitable for contact resistance measurement on relays, switches, connectors etc and for internal resistance measurement on batteries.

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

SIGNAL GENERATOR

The Crotech type 2016 signal generator offers an accurate signal output with just 0.05% sinewave distortion (500Hz to 20kHz), and a toneburst output for use in precision measurement test setups.

With a total frequency coverage from 1Hz to 1MHz in six decade ranges, the type 2016 produces continuous sine and square wave outputs with the useful addition of a sinewave burst mode – suitable for the testing of high performance audio frequency equipment.

Sine wave distortion into 600 ohms rises to just 0.5% from 50Hz to 500kHz and a reasonable 1.0% at 1MHz. Square wave overshoot is 2% at maximum output (3V p-p). The sine wave burst facility is aimed at obtaining more meaningful testing of the dynamic performance of audio equipment – amplifiers, filters, loudspeakers, etc. Burst options include 4 cycles on/4 cycles off, 4 cycles on/12 cycles off and 8 cycles on/8 cycles off. Leakage during the off period is within 2%.

Frequency response is substantially flat (±0.3dB) into 600 ohms, up to 100kHz. Output control range is from −70 to 0dBm with a step attenuator and variable level control.

The type 2016 signal generator can form part of an audio test system including an AF output power meter and distortion analyser, which assembles into a complete AF test bench. Recommended retail price for the type 2016 is £180.00, excluding VAT.

Crotech Instruments Ltd,
2 Stephenson Road,
St Ives,
Huntingdon,
Cambs PE17 4JW.
Tel: (0480) 301818.

HF ANALYSER

A full colour, 16-page brochure from Solartron highlights the new 1255 frequency response analyser, which extends frequency response measurement to 20MHz with good accuracy and frequency resolution.

The 1255 is equally at home in laboratory and production environments and is designed for easy operation, featuring non-volatile key-switch-protected storage of test routines, comprehensive data management facilities and RS423 and IEEE-488 interfaces as standard.

Two independent channels operate in parallel and offer basic gain and phase accuracy of 0.02dB and 0.2°. Input signals are digitised to 15-bit resolution using Solartron's patented pulse width technique, which, we are told, ensures data integrity and provides a stable five-digit display.

Solartron Instruments,
Victoria Road,
Farnborough,
Hants GU14 7PW.
Tel: (0252) 544433.

LOW COST SCOPE

The new GOS-522 dual-beam oscilloscope is now available from Flight Electronics Limited. A highly sensitive instrument, it offers good price performance and a resolution of 1mV/div with better than 3 per cent accuracy.

The scope has a 6in screen with an internal graticule CRT. Available functions include chop/alternate and hold-off timebase. The timebase range spans 0.2 microseconds to 0.5 seconds. Both channels have an alternate triggering function. A separation circuit provides TV synchronisation. Channel one has a signal output at the rear of the instrument.

The unit is easy to operate and ideal for general purpose work in education, service and production. Trigger modes can be set at three levels, normal, automatic and single.

Frequency bandwidth is ac/dc 10 to 20MHz. Rise times are 17.5ns (20MHz) and 23ns (15MHz). Chop frequency is around 250kHz. Overall dimensions are 460 × 310 × 170mm. Standard unit price is £299. With two switchable probes the price is £319.

Flight Electronics Ltd,
Flight House,
Ascupart Street,
Southampton SO1 1LU.
Tel: (0703) 227721.

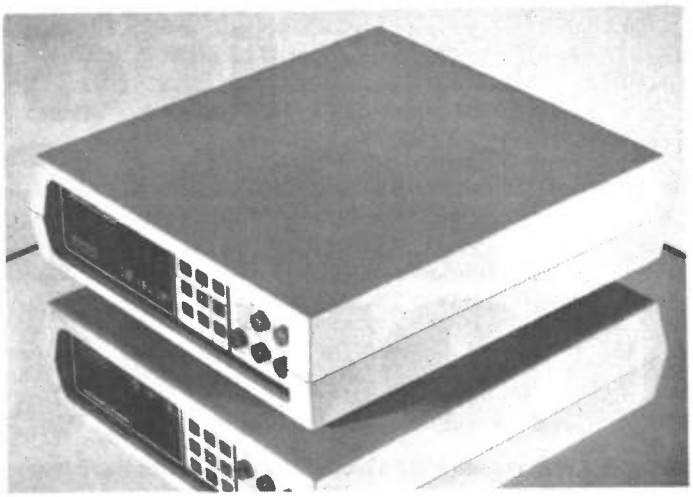
6½- DIGIT DMM

New from PPM Instrumentation is the Prema 6000, a high resolution digital multimeter with IEEE 488 interface, costing £975.

Offering an input resistance of 1Gohm up to ±2V, and with 100nV resolution, the 6000 has an excellent price/performance ratio. True RMS values are determined for alternating voltage, alternating current and temperature measurements with PRTs conforming to IEC 751. Four mathematics programs allow the display of offset corrected values, per cent deviation, dB and dBm.

The unit features a four-pole ten-channel scanner as an option. This offers a measuring points selector switch, activated from the front panel or via the IEEE 488 bus. The switching contacts have low resistance and small thermoelectric EMFs. They are rated for current values up to 2A.

High stability amplifiers and a precision ADC permit uninterrupted averaging.



This means no disturbing breaks for continual automatic zero corrections, even with 100nV resolution which is achieved after only one second integration time. For alternating voltage measurements the RMS value is determined with dc-coupling of the input sockets. Two and four pole resistance measurements can be made with a resolution of 1mohm.

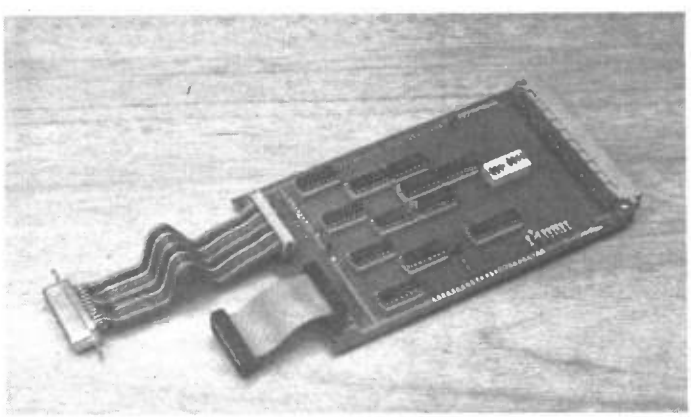
Voltage ranges are 0.2V to 700V ac (five ranges), and 0.2V to 1000V dc (five ranges). Current ranges are 2mA to 2A ac/dc. Six resistance ranges offer coverage from 200 ohms to 10 Mohms. Temperature range is −200 to +850°C.

PPM Instrumentation Ltd,
7 Riverside Business Centre,
Walnut Tree Close,
Guildford,
Surrey GU1 4UG.
Tel: (0483) 301333.

PRINTER INTERFACES

Wasec have announced the introduction of the 4885 series of GPIB printer interfaces to their range of equipment. Comprising a single height standard Eurocard, the 4885 provides a range of interfaces between the IEEE 488 bus and most Centronics compatible printers, including the Epsom M150 series. This low cost combination brings high quality print output to a wide range of GPIB compatible instrumentation, providing hard copy output for applications as diverse as data logging and ATE reporting.

The 4885 functions as a listener on the IEEE 488 bus, either being addressed by the bus controller or as a user configured listen only device. Both data and commands are transferred to the printer, affording full access to the many features of these mechanisms: multiline buffer, double height printing, text and graphics modes. Facilities also exist for manual control of reset and paper feed functions. The 4885 series comprises both +5V dc and 240V ac powered variants. An optional panel mounting kit and free standing enclosure are available. All variants are supplied with a standard GPIB connector, mounting studs and address switch.



Wasec,
PO Box 161,
Wallington,
Surrey SM6 8BA.
Tel: 01-668 5400.

STATIC PROTECTION

A new all-in-one static protection kit suitable for most personal computers and terminals has been announced by SMS Computer Supplies.

The kit includes a static dissipative mat, high quality one piece cover, an anti-static spray and a comprehensive guide to static protection.

SMS claim that the kit is a major step towards eliminating data loss and machine failures, which cost a lot of money in repair bills and recovery time.

SMS Computer Supplies,
Quarry House,
3 The Down,
Alveston,
Avon BS12 2PH.
Tel: (0454) 416859.

FIRSTCADD

Rototechnic recently announced a drafting and design package set to spearhead an expansion of CAD into the business and educational markets. It is also being targeted at beginners in the professional CAD market who will be able to use it as an entry level training product.

To be known as FirstCADD, the new package provides simple yet sophisticated two dimensional CAD facilities and is priced at £49.95 plus VAT. Robotechnic claim that it is the lowest cost, full

Thanet Electronics is dead

LONG LIVE ICOM (UK) LTD.

As from the 16th march 1987 Thanet Electronics Ltd have been trading under the new banner of ICOM (UK) LTD.

Nothing else has changed, still top quality ICOM equipment and service from one of the UK's leading Amateur radio importers.

To celebrate our name change we are offering to those persons who selected the following badge numbers at N.E.C. this year a gift from the ICOM range. To claim your prize just send your winning badge to ICOM (UK) LTD and we will send you the fantastic ICOM Micro 2, 2 metre handportable. Naturally this does exclude those persons who persons who already claimed their prize at the N.E.C. The numbers are 1271/2751/3200

This summer ICOM (UK) LTD will be one of the sponsors for Richard Branson's Transatlantic Balloon Challenge. They will be using ICOM communication equipment.

IC-275E/475E 25 Watt 2 metre/70 cm. Multimode Transceivers.

***Tech Talk from ICOM:* THE EXCITEMENT OF SATELLITE COMMUNICATIONS**

An ever increasing number of radio amateurs are joining the excitement of Phase 111 – type satellite communications. This new medium combines the communications range of the 20 and 80 metre bands with the line-of-sight reliability of 2 metres. Its equivalent to a totally new band, and a vast technical background is not necessary for enjoying the action.

ICOM is able to help you enjoy the fascinating new capabilities of OSCAR and future amateur satellites. Its all mode 2 metre and 70cm base transceivers bring the operating conveniences of low band units to the VHF and UHF amateur bands. They can be used for local FM operations via repeaters or for SSB/CW communications via Phase 111 satellites. The IC-1271E all mode 23cm transceiver is in a class of its own, providing mode L satellite uplink capability. (Mode L: 1269MHz uplink, 436 downlink) (Mode U 435 uplink 145 downlink).

Satellite relayed signals are somewhat weak in nature and the IC-275E's low noise/high sensitivity receiver gives the highest performance for hearing everyone regardless of their uplink performance. The noise blanker prevents pulse type electrical interference from masking desired DX signals, the selectable AGC can follow fast fades associated with spin modulation. There are also the 99 mode memories which can be used for inter-mixed FM repeater and SSB/CW operators. When the IC-275E is equipped with the optional mast mounted AG25 GaAsFET pre-amp, it becomes a satellite operations dream come true.

ICOM's IC-475E 70cms transceiver has a continuously front panel adjustable power output to allow for daily signal variations. This overcomes the practice of overloading a satellites on-board receiver. The IC-475E also includes 99 all mode memories for the ultimate in operation flexibility.

Using the ICOM CT16 satellite communications interface these base stations will track together via the ICOM CI-V system. If you are interested in joining todays most excitement era of amateur communications, ie. OSCAR and future Phase 111 satellites, ICOM is the logical choice for top performance equipment.

ICOM 70cm Promotion

Due to our new range of equipment we are able to offer the following equipment only while stocks last.

ICOM IC-471E	25 watt Multimode Base Station	£650.00
ICOM IC-471H	75 watt Multimode Base Station	£759.00
ICOM IC-47E	25 watt FM Mobile	£349.00
ICOM IC-U12	12 Channel 450-460 MHz Handportable, uses existing ICOM handheld accessories, details on how to get onto 70cms provided. Supplied as radio body only	£115.00

ICOM

THE HOTTEST ITEMS THIS SUMMER

VHF/UHF FM Handportables
If you want a handheld with exceptional features quality built to last and a wide variety of interchangeable accessories, take a look at the ICOM range of FM tranceivers. all ICOM handportables come with a nicad battery pack. AC wall charger, flexible antenna and wrist strap.

Micro 2E/4E
These new micro-sized 2 metre and 70 centimetre handportables give the performance and reliability you've come to expect from ICOM.
Measuring only 148 x 50 x 30 the Micro fits in your pocket as easily as a cassette tape. The Micro 2E 4E features an up/down tuning system for quick frequency adjustments. 10 programmable memories, a top panel LCD readout up to 2.5 watts of output (optional).

IC-2E 2 metre Thumbwheel Handportable
This popular handheld from ICOM is still available.
For those amateurs who require a straightforward and effective FM transceiver the IC-2E takes some beating. Frequency selection is by means of thumbwheel switches (with 5Khz up switch) simplex or duplex facility. Power output is 1.5 watts or low 150 milliwatts (2.5 watts possible with BP5A battery pack).

IC-02E/04E 2 metre and 70cm Keypad Handportable
These direct entry CPU controlled handhelds utilise a 16 button keypad allowing easy access to frequencies, memories and scan functions. Ten memories store frequency and offset, these handhelds have an LCD readout and power output is 2.5 watts or low 0.5 watt. 5 watts is possible with the IC-BP7 battery pack or external 13.8v DC.

IC-12E 23cm Handportable
Similar in design and style to the 02E/04E this 1296Mhz handheld utilises ICOM's experience in GHZ technology, gained by the excellent IC-1271E base station. Power output is 1 watt from the standard BP3 nicad pack. external 13.8v DC powering is available to the top panel jack. With the growing number of repeaters on 23cm. The IC-12E makes it an ideal band for rag chew contacts.

ALSO AVAILABLE FOR ICOM HANDPORTABLES ARE A LARGE RANGE OF OPTIONAL EXTRAS INCLUDING A VARIETY OF RECHARGEABLE NICAD POWER PACKS, DRY CELL BATTERY PACKS, DESK CHARGERS, HEADSET AND BOOM MIC, LEATHERETTE CASES AND MOBILE MOUNTING BRACKETS.

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Mon-Fri 09.00-13.00 and 1400-17.30

This is strictly a helpline for obtaining information about or ordering ICOM equipment. We regret this service cannot be used by dealers or for repair enquiries and parts orders. Thank you.

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Dept REW, Sea Street,
Herne Bay, Kent CT6 8LD.
Tel: 0227 363859.

featured CADD system available on the UK market.

FirstCADD allows the user to draw quickly and professionally on an IBM PC/XT/AT and compatibles, including the Amstrad PC, using a mouse or cursor keys. Floor plans, flow charts, organisational charts, graphs, presentations, forms, product drawings, etc can be drawn using a complete set of objects. These include points, lines, circles, rectangles, polygons, ellipses and true B-spline curves. 256 layers and colours are available and can be individually changed as required. Automatic precise dimension and area calculations are obtained in imperial or metric units.

Objects can be moved, scaled, copied or rotated and stored in a library ready for retrieval, or you can use the menu and fonts provided or create your own.

Robotechnic Ltd,
19 Queen Street,
Mayfair,
London W1X 7PJ.
Tel: 01-499 9746.

MORE COMPUTERS

Levell Electronics have added IBM-compatible computers to the range of products in their catalogue, from market leaders Amstrad and Tandon.

These products are seen by Levell as good value for money. Peripherals for computers including modems and printers are also held in stock, and a wide range of software to suit all IBM-compatible computers is available.

The company hopes that the latest extension to their catalogue will enable a far more comprehensive range of products to be purchased from one source.

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

NEW MODEM

To complement its extensive range of modems, STC Electronic Services has introduced the new Dowty Microtelex modem, a combination of a modem and a software system for the IBM PC and other compatible computers.

The Microtelex enables the operator to use a standard PC as a powerful multi-feature telex terminal which provides a cost-effective alternative to purchasing or leasing a dedicated telex terminal. The computer is able to perform standard tasks such as word processing, spreadsheets and data processing whilst also receiving incoming telex.

The menu-driven system is word processing compatible; alerts the user to incoming telex irrespective of the software being run; stores 500 frequently dialled numbers; features 'automatic retry' if the destination terminal is engaged and logs complete detail on telex use.

The Computer Products Group,
STC Electronic Services,
Edinburgh Way,
Harlow,
Essex CM20 2DF.
Tel: (0279) 26777.

VHF ATU

A new VHF ATU from Cap Co, the SPC-100, will tune any HF dipole, long wire, vee beam, G5RV, rhombic, inverted vee, existing VHF beam or vertical antenna. It is, however, unsuitable for use on trapped dipoles or trapped HF beams because of the highly inductive traps used within them.

The SPC-100 also has provision on the rear of the unit to accept the very low loss use of 600 ohm and the better quality 300 ohm ribbon feeder, ie the slotted type. It can also, via the SO239 socket, accept unbalanced feeder like H100 RG8 or similar.

As most two metre equipment is solid-state broadband final PA gear having to operate across a 2MHz bandwidth, it is virtually impossible to expect the output to be 50 ohms. Couple this to a linear amplifier of corresponding PA and you have a double unit with varying impedances which are then able to cause severe interference problems because they will be non-linear emitting strong second and third harmonic problems.

Besides being an ATU, the SPC-100 has the added advantage of having a Pi network circuit within, enabling it to become an extension of the final amplifier's output network. Instead of being a fixed or passive output, it becomes a tunable active Pi tank and a good low pass filter, affording as much as 30dB attenuation of the strongest harmful harmonic, thereby reducing the possible cause of TVI.

According to Cap Co, it is virtually impossible to have an antenna that is going to have an SWR of 1 to 1 across its entire bandwidth, from 144MHz to 146MHz. It is more likely to have a 1 to 1 SWR over a small bandwidth of at the most 200kHz. Therefore, if the SWR rises, all that is happening is that the wasted RF is heating up the feeder. But, by using the ATU an SWR of 1 to 1 can be achieved across the whole 2MHz band with minimum adjustment to the unit.

The SPC-100 is available at a price of £59.95 inc VAT plus £3.00 p&p.

Cap Co Electronics Ltd,
63 Hallcroft, Birch Green,
Skelmersdale,
Lancs WN8 6QB.
Tel: (0695) 27948.

NEW TRANSCEIVERS

Recently introduced by Amateur Electronics are the new Yaesu FT757GX Mk II multimode HF transceiver and the FT211RH synthesized 45W 2m FM transceiver.

The FT757GX II combines the best features of its predecessor, the FT757GX, with new developments in response to technological advances and to the most popular requests from serious HF operators.

This mobile/base compact unit now has new digital features, plus an improved CAT (Computer Aided Transceiver) system for simplified programming and more advanced control by external computer. Ten memory channels store mode and frequency together with auto-resume loop scanning between dual VFOs and special clarifier memory. Operator selectable, mode dependent tuning steps are also now standard.

Other features of this 100W PEP multimode include: 40dB notch filter with adjustable IF shift; wideband AM and narrowband CW IF filter; switchable RF amplifier and 20dB attenuator; adjustable noise blanking pulse width (narrow to wide); full break-in QSK with custom integral keyer; AF speech processor. Optional accessories are available.

Also making its debut is the FT211RH, a compact synthesized 2m FM mobile/base transceiver. One salient feature making the FT211 suitable for mobile use (or base use) is its reversible sloped front panel, allowing convenient mounting. It also includes soft green back lighting of keys and controls. The large liquid crystal display incorporates bargraph and power/S-meter.

Copied from the micro miniature FT23R handy are certain operating features: push-button and knob memory selection and tuning in selectable steps; ten memory channels storing repeater splits; one touch repeater reverse and call channel recall; band, memory and partial memory auto resume scanning.

All the memories store independent T/R frequency, seven hold any shift and all accept automatically programmable ±600Hz shifts.

When the optional FTS-12 tone squelch unit is installed, any of 37 standard CTCSS (subaudible) tone frequencies can be displayed, selected and programmed into any memory channel for either silent monitoring or encode-only operation.

Amateur Electronics,
504 Alum Rock Road,
Alum Rock,
Birmingham B8 3HX.
Tel: (021) 327 1497/6313.

SUPER ROTATORS

South Midlands Communications recently announced two new rotators for the amateur and commercial markets. The Kenpro KR800SDX and KR1000SDX are full specification rotators with the following features:

1) 450 degree rotation (enabling amateurs to reach those awkward beam settings, fast) and speed decrease before braking, thus offering longer brake life and super accuracy.

2) Variable speed rotation settable between 43 seconds for the smaller antennas or light wind loading to 93 seconds for larger antennas with greater inertia.

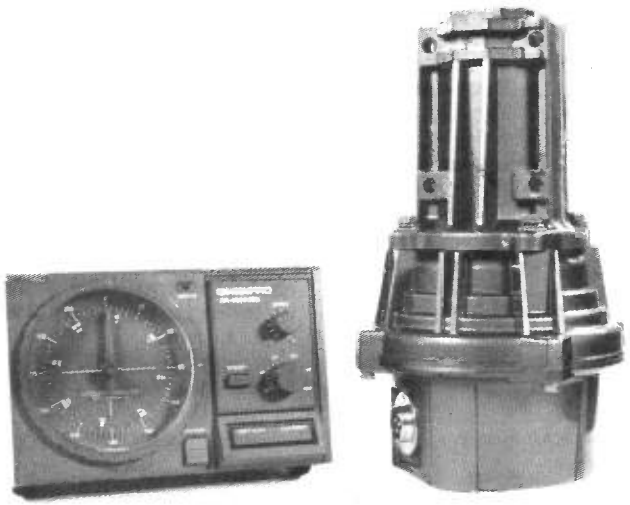
3) Switch positioning is provided plus a preset direction control with single push-button operation.

Vertical loading on both units is 200kg, and the brake torque is 4000kg/cm on the KR800SDX and 50% greater at 6000kg/cm on the KR1000SDX. Motor voltage is 20V dc and the position graticule is fully adjustable, providing null setting to the operator's choice.

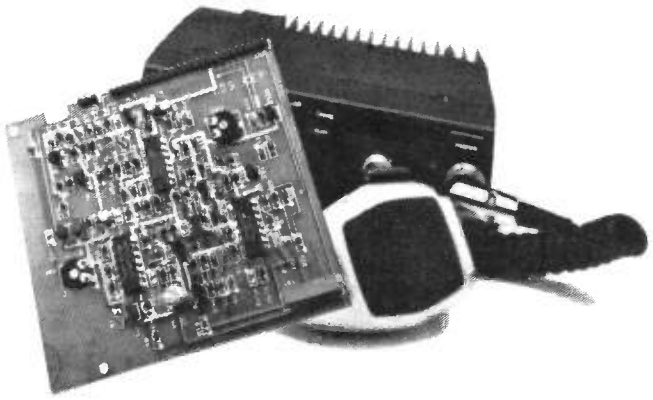
Full auto-stop is provided (limit switch).

KR800SDX and KR1000SDX are £325.00 and £368.00 inc VAT respectively.

South Midlands Communications Ltd,
S M House, School Close,
Chandlers Ford
Industrial Estate,
Eastleigh,
Hampshire SO5 3BY.
Tel: (0703) 255111.



CTCSS PANEL



Communication Development Specialists have designed and now manufacture a full feature continuous tone controlled squelch system for the Marcom V series of Canadian Marconi two-way radio equipment.

The CTCSS panel plugs directly into the option socket provided. The additional functions can be programmed in or out by implementing the shorting plugs provided.

Additional functions include: carrier lockout, busy engage warning tone, PTT timer, timer timeout warning tone and PTT unkey delay for squelch tail elimination.

This panel combined with the Marcom V makes the package a very cost effective full function mobile radio.

Communication
Development Specialists,
PO Box 83,
Basingstoke,
Hampshire RG25 2PX.
Tel: (0256) 83528.

MAPLIN MARKET

New Heathkit products featured in *The 1987 Maplin Buyer's Guide to Electronic Components* include the novice CW transceiver, HW-99. Designed for the first time amateur radio hobbyist, this powerful radio kit provides good performance at a cost of £299.95. A matching station speaker, SP-99, featuring a 3in communications receiver speaker costs £29.95.

Also new is the VLF converter, HD-1420, which enables broadcasts below the standard AM band to be received. Battery powered, the cost is £49.95. An active audio filter, HD-1418, is available at £79.95, along with a DTMF DTMF decoder, HD-1530, a touch tone decoder which eliminates any messages not intended for the user, at £79.95.

Three new antenna accessories are also included in the catalogue – a remote co-ax switch, HD-1481, which will remotely operate up to 4 antennas at £79.95; an active SWL antenna, HD-1424, suitable for use in locations where an outside antenna is not available costs £49.95, and the antenna matcher, SA-2550, which operates both CW and phone segments in a band from one antenna is priced at £149.95.

The Heathkit range of educational courses and products includes a digital techniques trainer, ET-3200B, at £109.95 kit form or £184.95 fully assembled.

A digital circuit design course (EE-1004) plus a laser technology course (EE-110), both at £99.95, will meet what Maplin see as the growing demand for courses on these key hi-tech subjects.

New to the Maplin Heathkit range is the microprocessor course (EE-3404), which at £49.95 covers all 6809 chip concepts.

A computer maintenance course (EC-2003) at £69.95 provides practical guidance on how to troubleshoot and maintain digital and microprocessor systems.

Maplin Electronic
Supplies Ltd,
PO Box 3,
Rayleigh,
Essex SS6 8LR.
Tel: (0702) 552911.

PRODUCT NEWS

RX SOFTWARE

Technical Software have announced an improvement in their successful Spectrum RX-4 program.

The program has proved popular with SWLs and licensed amateurs as it requires no interface, needing only a single lead connecting the radio to the computer. This system is cheap and simple and produces some excellent results. The computer noise conducted along the lead and the absence of audio filtering prevent the reception of weak and fading signals and those suffering strong interference, frequent problems on the short wave bands.

Most receivers do not have a facility for narrowing the IF passband below the usual SSB width, except for a possible CW filter which is unsuitable for receiving RTTY or Amtor. A new version of this program is now available, using an interface adaptor board which plugs into the back of the Spectrum and accepts an interface or terminal unit.

The company's TIF1 interface has been designed to reduce computer noise and it has effective 2-stage filtering for reception of RTTY, CW and Amtor under noisy and crowded band conditions. SSTV reception is also improved by the reduction in computer noise.

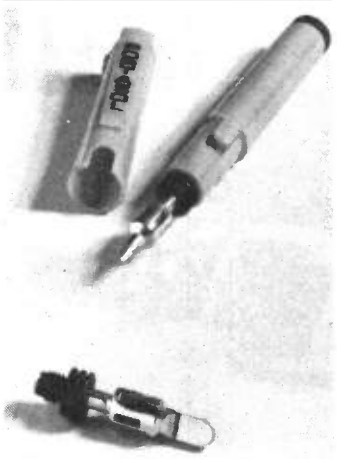
The interface adaptor board comes assembled and tested with the new program for £40. Users of the existing RX-4 program can upgrade to this version for £21 if they return their old program. The TIF1 interface costs £15 as a kit (assembled PCB, cables and connectors) or £25 ready-made, boxed with all connections.

This version of the program will run on any 48K or 128K Spectrum, including the Spectrum + 2, as it does not use the ear socket.

Both versions of this program are currently available. The original version costs £25.

Technical Software,
Fron,
Upper Llandwrog,
Caernarfon,
Gwynedd LL54 7RF.
Tel: (0286) 881886.

IT'S A GAS



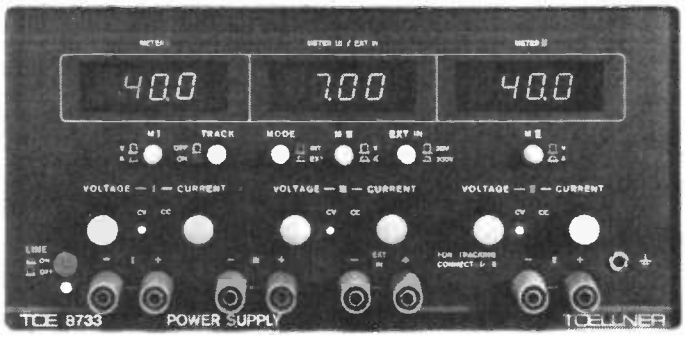
The unique Portasol gas soldering iron can now be used with a knife tip which is primarily designed for cutting nylon rope and sails. It will, however, find many other suitable applications as sales grow.

The blade shaped tip is 40mm long inclusive of heat-sink when in the iron, and the actual blade is 7mm wide with a thickness that tapers down to 0.5mm.

Instant cutting and sealing of edges is achieved and using the Portasol gas iron it can be carried out in all weathers.

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

TOELLNER PSUs



The Toellner range of power supplies from Fieldtech Heathrow Ltd offers many different units – single, dual triple and quintuple versions – with various voltage and current capabilities.

The new range of instruments is classified into three series, namely the TOE-8030, TOE-8430 and the TOE-8730. These power supplies are compact, rugged and favourably priced.

All devices can be used as voltage regulators as well as current regulators. Changeover from one mode to the other is accomplished automatically, the actual mode being indicated by a light-emitting diode. Several devices may be interconnected in serial or parallel configurations.

Power supplies in the TOE-8030 series are principally designed according to the proven fundamental conception of the TOE-8430/8431 series. By additional circuitry the internal power dissipation is considerably reduced and, simultaneously, the O/P power is increased.

In the tracking mode the variable O/P voltages are internally connected in series, so a positive and negative voltage with a zero reference common to both voltages is available. When the negative is readjusted the positive voltage will be 'tracked' by a proportional level.

The adjustment of O/P voltage and O/P current is provided with all versions. This is accomplished with high-resolution ten-turn potentiometers.

Fieldtech Heathrow Limited,
Huntavia House,
420 Bath Road,
Longford,
Middlesex UB7 0LL.
Tel: 01-897 6446.

SMD TOOLS

A range of tools for SMD soldering and desoldering, designed for attachment to the Oryx range of soldering irons and desoldering equipment, is available from Greenwood Electronics.

There is a rapidly increasing interest in surface mount tools. However, most users are reluctant to spend large sums of money on tools they might only use occasionally. The Oryx range is designed to offer low cost tools for prototype, low volume production and re-working applications.

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

VARIABLE CAPACITORS

The new high power variable capacitors available from Telecomms were designed by Ernie Quinnell G4JEV in response to the demand for a low cost, rugged capacitor capable of withstanding very high RF voltages.

Construction is of brass, ultra high grade aluminium with gold anodizing and high voltage acrylic.

These capacitors are suitable for use in antenna matching units up to 2kW or high power amplifier output stages. The TC500 is 13pF-500pF variable and the TC250 is 13pF-250pF variable.

Telecomms,
189 London Road, North End,
Portsmouth PO2 9AE.

AMATEUR KITS

Now available from FJP Kits is a large range of ham radio kits and many components.

Products include a semi-built power supply kit, a 400mA nicad charger kit, a Morse practice oscillator and more.

All products are available by mail order only. For a complete list of the range plus price details contact Mr F J Powell at the address below.

F J P Kits,
2 Market Street,
Hednesford, Staffs.
Tel: (05435) 6487.

For the very latest communications and electronics products, read *Radio & Electronics World*.

NEWS DESK

Safe cellular

British Telecom have welcomed assurances by the Secretary of State for Trade and Industry that the proposed pan-European digital cellular radio system would not be jeopardised by the Government's decision to allocate, on a temporary basis, 40 additional channels to Racal-Vodafone.

Racal-Vodafone had requested 120 of the channels reserved for the European system. British Telecom opposed this application on the grounds that such a move could have seriously impeded what is seen as a major European initiative to which the UK is firmly committed. Now the Government has granted Racal 40 channels on the clear understanding that they should be returned by 31st December 1987.

Cellnet is now launching a major marketing campaign, timed to exploit its greatly enhanced capacity.

Data by satellite

Trials of a new satellite business communications service, which can send computer data both ways through small dish aerials on customers' premises, were started by British Telecom in May.

The service will allow users at terminals in many distant locations, in Europe as well as the United Kingdom, to exchange data easily and cheaply by satellite with their companys' central computers. It means that communications links can be set up quickly, and their continuity maintained when terminals are moved to new locations.

The trial service is to be based on the technology of VSAT (very small aperture terminals) and will use dish aerials of 1.2m (4ft) or 1.8m (6ft) diameter. It will be centred on British Telecom's London Teleport – its satellite communications earth station in the heart of London's dockland (see *Spectrum Watch*).

Special equipment supplied by Comsat Technology Products for the trials is being installed at the Teleport to act as the network hub. Customers taking part will link their central computers to the hub over British Telecom Kilo Stream digital private circuits.

The hub will convert the data to the form used by the network for transmission from the Teleport earth terminal to an Intelsat V satellite. This will then transmit the data back to earth to be received by the appropriate distant VSAT, where it is converted to its original form and directly connected into the user's local private network.

Any remote site may communicate with the hub, or to any other authorised VSAT via the hub.

Applications to be evaluated during the six months' trial include the distribution of news and images for information services, internal company electronic mail and other interactive corporate data communications.

European collaboration

An agreement between Thorn EMI Instruments and West German company Metrawatt GmbH was signed recently for greater collaboration between the two.

Both companies are renowned for high quality instrumentation with powerful brand names recognised all over the world. Whilst acknowledging that there is competition between them in some product areas, the companies say that there is also much within both companies product ranges that is highly complementary.

Thorn EMI Instruments believe that it makes sense in the current market climate to pool resources, providing the user with a comprehensive range of products, while channelling the development resources of each company into more specific areas.

The first result of the agreement was announced recently with the launch of Metrawatt's M2000 series of multimeters under the AVO brand name. The reciprocal arrangement could see some Thorn EMI Instruments products being marketed by Metrawatt GmbH in the near future.

10th anniversary

British Aerospace celebrated its 10th anniversary on 29th April.

The company was formed in 1977 by the amalgamation of British Aircraft Corporation, Hawker Siddeley Aviation, Hawker Siddeley Dynamics and Scottish Aviation – companies whose antecedents can be traced back to the pioneering days of British aviation.

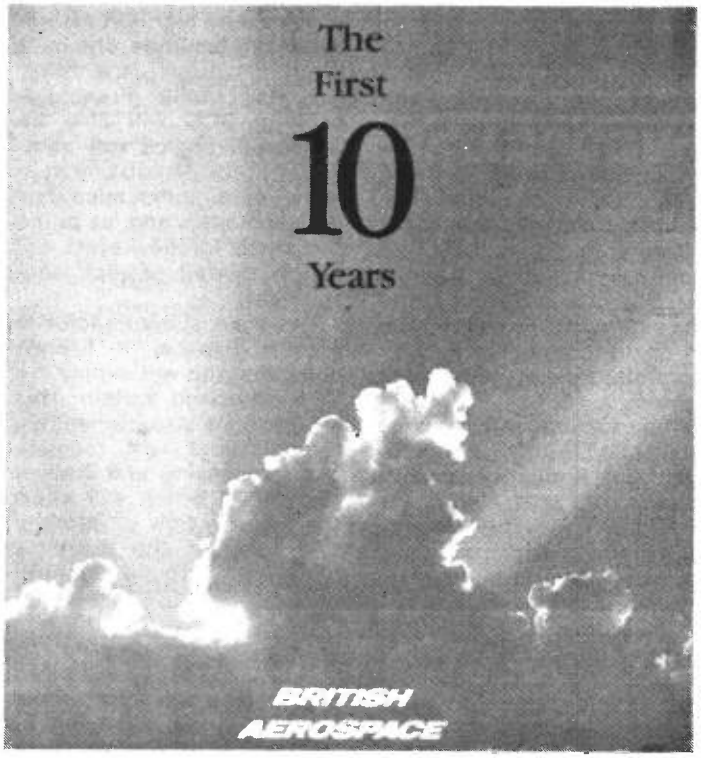
Today BAe is the UK's largest exporter of manufactured goods, with a current order book approaching £10 billion. By comparison, the order book in 1977 stood at £2 billion. Then, sales were £800 million, of which £530 million were exports. Today the respective figures are £3.1 billion and over £2 billion.

Its portfolio of products includes underwater systems, ship-launched missiles, ground-launched missiles, military aircraft and air-launched missiles; also civil airliners and business aircraft, satellites for communications and scientific research.

A significant decision was taken in 1978 when BAe joined Airbus Industrie, the European consortium developing a family of airliners, as a 20% partner with the role of wing-maker. Two other important decisions taken that same year were to launch the BAe 146 and Jetstream 31 airliners, the 146 with risk-sharing partners in the US and Sweden.

BAe missiles had prominent success in 1980, with the US Air Force signing a £140 million agreement for the Rapier surface-to-air missile system to be stationed at its bases in Britain, and the Swiss Government ordering £200 million worth of the same type.

Today some 13 countries have ordered Rapier worth more than £2,800m.



A demonstration of the Pye communications system

Ambulance comms

The official opening of the new Essex Ambulance Service headquarters performed in May by the Lord Lieutenant of Essex, Admiral Sir Andrew Lewis KCB JP, brings into operation a new advanced mobile radio communications system commissioned from Pye Telecom, together with computer-assisted ambulance scheduling equipment.

The mobile radio control equipment is installed in the Ambulance Service's new headquarters at Broomfield Hospital, near Chelmsford and links vehicles and staff from 30 ambulance stations located throughout the area. The contract, worth more than £300,000, was awarded to Pye Telecom by the North East Thames Regional Health Authority.

The new system provides the technology required to keep ambulance crews in constant touch with their controllers, even when they have to leave their vehicles to attend patients. Mobile VHF/UHF radio repeaters in the 54 accident and emergency ambulances overcome the problems created by the presence of high-rise blocks in Essex, relaying signals between headquarters control and the two-way hand-portable radios carried by the crews.

These PF85 Pocketfones are among the smallest and lightest portables on the market and can readily be attached to a harness or belt to give ambulance crews 'hands-free' communication when attending patients such as domestic heart-attack victims.

Automatic status reporting on the mobile repeaters allows an ambulance crew to transmit their vehicle's status to one of the eight M87 control positions at the control centre by simply pressing a button which indicates, for example, whether they are 'en route to an emergency', 'at the hospital' or 'available for further duty'.

TCR for EUTELSAT

EUTELSAT, the European Telecommunications Satellite Organisation, recently signed a contract with Logica with an initial value of £6.3 million to supply the telemetry, command and ranging (TCR) facilities for in-orbit control of up to three EUTELSAT II satellites. The initial system is scheduled for delivery in April 1989. The contract includes options worth a further £700 thousand for extensions so that a total of up to 6 satellites may be controlled using the same system.

The system will provide EUTELSAT with a cost effective and highly responsive means of controlling the EUTELSAT II satellites, the first of which will be launched in late 1989. The more technically advanced EUTELSAT II satellites will gradually replace the EUTELSAT I satellites, and will be used primarily for television transmission, telephony and business services.

The facilities supplied by Logica will include a satellite control centre (SCC), located in Paris, and two TCR station baseband facilities, one near Sintra (Portugal), the other near Rambouillet (France). A back-up SCC will also be delivered. Logica will additionally provide equipment to allow data communications between sites, and, as prime contractor for the project, will supply overall project management.

The main subcontractor is Alcatel Espace, a French company who will supply the TCR baseband system. This system consists of telemetry, telecommand and ranging, data-processing and modem equipment which will allow the two-way flow of information between the satellites and the ground control network.

Going underground

A £100,000 communications system for a new 2.5km tunnel in Hong Kong, designed by Philips Radio Communication Systems in association with EB Communications, will enable police and security officials to broadcast emergency messages to drivers in the tunnel over their standard car radios, as well as providing normal radio reception. Warnings can be given on road conditions or emergencies on the road ahead.

The communications system forms part of an £8 million contract recently awarded to Philips Hong Kong. The complete contract, which is for equipment in the longest road tunnel yet to be built in Hong Kong, also includes computerised supervisory systems and a lighting system. By 1989 the tunnel will link Shatin and Tsuen Wan, two of the fastest-growing satellite towns in the New Territories.

Two communications networks are to be installed – one for service and security use, the other the re-broadcasting facility for emergency messages. Both networks use a radiating feeder system to transmit messages underground. This is a special cable which overcomes the problem of transmission at great depth by leaking radio frequencies along its length. Normal radio signals disappear as vehicles enter the tunnel. The radiating feeder system reconstitutes the signals via off-air receivers to provide unbroken signals and, of equal importance, to allow the rebroadcasting 'break-in' circuits to be activated for transmission of emergency messages. A complex combining system is used to ensure that minimal interference occurs between the large number of base stations.

The Hong Kong system comprises 12 Philips F4002 base stations linked to two M82 controllers strategically located in the tunnel. Ten vehicles used by service and security personnel are equipped with M294 mobile radios, while 12 Philips PF85 portable two-way pocket radios are used for on-site communication by maintenance and emergency service personnel.

Phone box preservation

A decision by the Department of the Environment to list a further 400 telephone kiosks as being of special architectural and historic interest has been welcomed by British Telecom.

The Department of the Environment and British Telecom are to work with English Heritage to identify a representative sample of post-1939 kiosks worthy of preservation.

BT say that their kiosk modernisation programme – providing more vandal-resistant housings which give easier access for the elderly and disabled – has always allowed for the retention of the most worthy red telephone boxes in special locations. About 175 pre-1939 kiosks have already been listed.

It is expected that about 400 more kiosks judged to enhance their surroundings, sited near listed buildings or in attractive town and country locations will be listed for preservation.

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

As we reported in this column last month, the International Amateur Radio Union Region 1 Triennual Conference was held at Noordwijkhout, Holland from April 10th to 17th, and your scribe had the pleasure of attending as one of the RSGB's delegation.

The conference was very well attended, over 160 delegates from 44 countries being present. Among the guests of honour were J Jipguep, Deputy Secretary-General of the International Telecommunications Union; the Burgomaster of Noordwijkhout, Mr F Winkel; the President of VERON, Jan Hordijk PA0AJE; and Richard Baldwin W1RU, President of the IARU.

The conference was officially opened by Ir C Wit, Director General of the Netherlands PTT. The opening address was delivered by Mr Jean Jipguep. He said that apart from his professional interest in the conference activities he felt a certain personal involvement, in so far as his country, like all the African countries, is a member of Region 1 IARU, and that in spite of the difficulties afflicting his continent, and the resulting problems which African radio amateurs encounter in purchasing equipment, the 16 African amateur radio associations currently affiliated to the IARU represented 38% of the countries in Region 1.

Mr F Winkel, Noordwijkhout's Burgomaster, made the interesting suggestion that as he was also President of the Federation of Esperanto Associates in the Netherlands, he should be allowed to deliver his address in Esperanto. That was not possible, however, as English is the common language of the IARU and of the conference. He spoke briefly of the advantages of Esperanto and mentioned that there is in fact an international Esperanto movement specifically for radio amateurs, namely the Internacia Ligo de Esperantistaj Radio-Amatoro, ILERA, which was founded in 1970 and now numbers about 250 members and publishes a quarterly magazine.

Another interesting point was made by Mr C Wit, Director General of the Netherlands PTT, in his opening address: 'One of the mainstays of the amateur service is the care for order within the amateur community. Without orderly use of the ether, the amateurs cause interference to each other or to other radio services. The other radio services will therefore keep a watchful eye on the amateur service. Considerable pressure is being exercised by these services to obtain more frequency bands, because the ether is playing a continuously more important role in society. The fact that 8% of the total frequency range has been reserved for the amateur service for conducting experiments is not always understood by others'.

Similar references were made by Case van Dijk PA0QC, Chairman of the VHF/UHF Committee, who in his opening remarks said the main task of the IARU and the Region 1 organisers must be to defend our bands against encroachment by other services. Some bands were already threatened. There had been success at the last WARC in 1979 and new HF bands had been obtained. Another WARC could be expected around 1992 when there would be another division and allocation of frequencies. It would need much preparation. Many other services were clamouring for more frequency space so our first and foremost task must be to defend our bands.

One of the major considerations of this conference was the drafting of a new constitution and byelaws. The old constitution was drafted some twenty years ago and is now inadequate in view of the many extra activities. This item on the agenda naturally took up a considerable amount of time.

Your scribe's main interest in the conference was concerned with matters affecting the amateur satellite service. One interesting paper submitted by the Italian Radio Society was entitled *The Desirability of more Involvement of Member Societies in the Amateur Satellite Service*; a title which said it all! The recommendations coming out of the discussions on this topic were that societies should be encouraged to make continuous efforts to publicise satellite techniques in order to encourage their use and that steps should be taken to try to get more articles on satellites into the radio media, particularly those suitable for beginners.

An interesting recommendation relating to QSL cards was that conformity should be encouraged in expressing the date on QSL cards by using the two-digit system, ie year/month/day, for example 87/4/28, the system used in astronomical circles. Some interesting discussion took place on standardising QSL cards in other respects. It was proposed, for instance, that a lower margin on the card should have an 'information-strip', with the amateur's callsign for electronic sorting. Apparently both the Germans and the Japanese already have equipment for doing this.

Direction finding contests are not at present very popular in the UK. Years ago they were, however. Radio clubs usually included them in their summer programmes. Your scribe was quite an ardent participator then; when Top Band or eighty metres were the frequencies used and all the gear was home-brewed. These events usually turned out to be quite fun and would conclude with tea laid on specially for the occasion at the local teashop, to which the XYLs and girlfriends were invited. Recently, however, little activity in this direction has been heard in this country.

This is not so, however, in other countries in Europe. The ARDF (Amateur Radio Direction Finding) Working Group certainly had much to discuss at the conference. It was quite surprising to learn that ARDF World Championships are held, the rules and arrangements for which are taken with the greatest seriousness. The terrain over which they are held was discussed in detail, as was the equipment used. There was even an item on their agenda dealing with national anthems being played and national flags being hoisted during the awards ceremony for the IARU ARDF champions. Needless to say, there has to be an international jury to look into protests! It was suggested that the next ARDF championships should be held in England, but this was rejected on the grounds that ARDF in England did not yet have enough interest to stage such an event. Switzerland accepted the request, saying they could stage the event in Lucerne or Berne in August/September 1988.

Band planning and its numerous problems naturally took up much space on the agenda. Repeaters and beacons came in for their share of discussion. Contests (more of or less of?) and when to hold them were keenly debated.

On the technical side, packet radio naturally came in for a lot of consideration, and discussion on what frequency

band ATV should take place was well to the fore. EMC (Electro-Magnetic Compatibility, ie, electrical interference) meteor scatter and propagation studies were a few of the technical topics.

It was not all work, however; the social scene was well to the fore in the evenings, with pride of place surely going to the Royal Omani Amateur Radio Society for their A4 Omani Hour, where delegates in their national costume served up dates and sweetmeats.

The non-delegate ladies present spent their time on organised visits to the shops in Amsterdam and coach tours to see the picturesque Dutch scenery, and the whole conference was treated to a day long visit to the fantastic storm-surge barrier in the mouth of the Eastern Scheldt. This is a truly remarkable piece of civil engineering. Altogether a hectic week for all, tiring but enjoyable.

We have devoted the whole of this column this month to the conference, because it seems to me to be a typical example of one of those 'backroom' activities which get little publicity.

Behind our hobby, there is a large and efficient administration which is working continuously to keep our hobby viable. Those who give their time voluntarily to keeping the wheels turning get little thanks for their efforts, so maybe this very sketchy account will help to bring attention to their efforts. Only a small number of the matters dealt with at the conference have been touched upon here, perhaps only those which were a little 'offbeat'. The bulk of the work concerned very routine matters, not so interesting but essential if we are to continue to enjoy our hobby. REW

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7905/12/15/24 plastic ..... **50p** 100 + **27p**
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MISCELLANEOUS
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TD3-12 4.00
TP25 1.50
TSP4 7.00
TT11 1.50
TT21 45.00
TT22 45.00
TT100 69.00
TTR-31MR 65.00
TY2-125A 85.00
TY4-400 85.00
TY8-600W 365.00
TYS2/250 375.00
U18-20 2.75
U19 11.95
U24 2.00
U25 0.90
U26 0.90
U37 9.00
U41 6.95
U50 2.00
U82 3.00

U191 0.70
U192 1.00
U193 0.65
U251 1.00
U801 0.75
UABC80 0.65
UAF42 1.00
UBF80 0.60
UBC41 2.25
UBC81 1.50
UBF89 1.00
UBL21 1.75
UC92 1.20
UCC84 0.70
UCC85 0.60
UCF80 1.00
UCH21 1.20
UCH41 2.50
UCH42 2.50
UCH81 1.00
UCL82 1.75
UCL83 2.50
UF85 1.20
UF41 1.15
UF42 1.15
UF80 0.80
UF89 2.00
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UL41 5.50
UL44 3.50
UL84 0.85
UU5 3.50
UU7 8.00
UU8 9.00
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VU29 4.50
VU39 1.50
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W739 1.50
X24 1.00
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XC25 0.50
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ZM1020 6.00
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Y602 12.00
Y4070 130.00
YD1100 75.00
YJ1060 265.00
YL1000 9.50
YL1020 42.50
YL1030 59.50
YL1060 95.00
YL1070 195.00
YL1071 195.00
YL1290 59.50
Z77 1.20
Z303C 9.00
Z359 9.00
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Z520M 4.00
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Z749 0.60
Z759 19.95
Z800U 3.00
Z803U 18.95
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ZA1000 12.50
ZA1001 1.50
ZA1002 1.50
ZC1040 8.00
ZM1005 8.00
ZM1020 8.95
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ZM1041 14.00
ZM1082 9.00
ZM1084 10.00
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ZM1202 55.00
ZM1263 4.00
ZM1612 3.00
1A3 4.50
1AC6 1.50
1B3GT 1.95
1B22 10.00
IB27 55.00
1B35A 45.00
1C5GT 2.50
1FD1 2.50
1G3GT 2.50
1K3GT 2.50
1N1 4.50
1N2 4.50
1P28 25.00
1N5GT 2.50
1P28 25.00
IRS 1.20
1S2 0.55
1S5 0.70
1T4 1.00
1U5 1.00
1X2B 1.40
1Z2 8.95

2AS15A 11.50
2B22 69.50
2C39A 32.50
2C39BA 39.50
2C40 37.00
2C42 29.50
2C51 0.75
2CY5 1.50
2B7 1.50
2D21 1.95
2D21W 3.15
2E22GY 45.00
2E26 7.95
2J42 93.00
2K25 35.00
2K25 Ray 75.00
2K26 95.00
2K29 250.00
2K56 250.00
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3A/107B 12.00
3A/109B 11.00
3A/110B 12.00
3A/141K 11.50
3A/147J 7.50
3A/167M 10.00
3A2 3.95
3A3A 3.95
3A4 1.10
3AL5 0.95
3AT2 3.35
3AU6 0.65
3B2 3.00
3B4 7.00
3B7 4.50
3B24 10.00
3B26 24.00
3B28 12.00
3BZ6 1.50
3C4 2.50
3C45 24.00
3CB6 1.50
3CN3A 2.50
3CS6 0.95
3CY5 1.50
3CX3 2.50
3D6 4.50
3D21A 29.50
3E22 49.50
3EH7 1.95
3EJ7 1.95
3S4 1.25
3Q4 2.50
3W4GT 2.50
4B32 35.00
4B551B 115.00
4BQ7A 1.75
4BZ6 1.95
4-65A 65.00
4-125A 72.50
4-250A 79.50
4-400A 87.50
4C27 25.00
4C28 25.00
4CB6 1.95
4CX250B 49.00
4CX25OB EIMAC £59.50
4CX250BM 75.00
4CX250K EIMAC 95.00
4CX350A 95.00
4CX350F 79.50
4CX1500B 398.50
4GS7 2.25
4GV7 2.25
4JC6A 2.95
4J52 75.00
4KT6 1.50
4X150A 35.00
5A/102D 9.50
5A152M 9.00
5A163K 10.00
5A170K 6.25
5A-206K 10.00
5A-180M 9.00
4AM8 4.15
5AM8 2.15
5AN8 1.20
5AR4 2.00
5AU4 1.50
5B.110M 10.00
5B-254M 14.50
5B-255M 19.50
5B255M 19.50
5B/256M 15.00
5B-257M 15.00
5B-258M 14.50
5C22 125.00
5R4GB 5.50
5R4GY 4.95
5T4 5.95
5U4G 2.95
5U4GB 3.50
5V4G 1.50
5Y3GT 1.95
5Z4GT 1.50
6/30L2 0.70
6A/203K 9.00
6A7 4.95
6A8G 1.50
6AC7 2.00
6AF4A 2.50
6AG5 1.50
6AG7 1.95
6AH6 2.50
6AJ4 2.00

6AJ7 2.00
6AK5 1.95
6AK6 2.50
6AL5 0.60
6AM4 3.25
6AM5 6.00
6AM6 1.95
6AN5 4.50
6AN8A 3.50
6AQ5 2.15
6AQ8 0.85
6AR5 5.95
6AS5 1.50
6AS6 2.50
6AS7G 4.50
6AT6 0.75
6AT8 1.75
6AU4 2.00
6AU6 0.95
6AV6 0.75
6AW8A 2.50
6AZ8 4.50
6B7 2.80
6B8G 1.50
6BA6 0.95
6BA7 4.50
6BA8A 3.50
6BC8 1.00
6BE6 0.95
6BG6G 3.00
6BH6 1.95
6BH8 1.50
6BJ6 1.50
6BK4 4.00
6BK7A 1.95
6BL8 1.15
6BM8 0.58
6BN4 1.65
6BN6 1.65
6BN7 4.50
6BN8 3.95
6BQ5 0.75
6BQ7A 0.72
6BL7GTA 3.95
6BL8 1.15
6BR5 0.70
6BR7 4.95
6BR8 2.15
6BR8A 2.15
6BS7 5.50
6BW4 1.50
6BW6 5.35
6BW7 1.50
6BW8 4.00
6BX6 0.48
6BX7GT 3.50
6BZ6 2.50
6BZ7 2.95
6C4 1.25
6C5 1.95
6C6 2.50
6C8G 1.50
6C11 2.50
6C18 2.50
6CA4 4.95
6CA7 3.50
6CB5 3.95
6CB6 1.95
6CD6GA 4.50
6CF6 1.50
6CG7 2.25
6CH6 6.95
6CL3 3.95
6CL6 3.25
6CL8A 2.00
6CM5 1.60
6CM7 2.95
6CS6 0.75
6CS7 0.95
6CW4 6.50
6CY5 1.00
6CY7 2.95
6D6 2.50
6DC6 2.95
6DJ8 0.95
6DK6 1.50
6DQ5 6.95
6DQ6B 2.50
6DW4 2.15
6EA4 4.95
6EA7 2.50
6EA8 2.50
6EB8 1.75
6EM5 2.50
6EM7 2.50
6EU7 £1.95
6EU8 1.75
6EV7 2.95
6EW7 4.50
6EW6 1.50
6F1 2.00
6F5 4.95
6F7 5.50
6F6G 2.00
6F12 1.50
6F13 3.00
6F14 1.00
6F17 2.75
6F21 2.50
6F23 0.60
6F24 1.25
6F25 1.25
6F28 1.25
6F32 1.25
6F33 17.00
6FH8 12.50
6G6G 5.50
6GH8A 0.80
6GK5 1.50

6GK6 1.95
6GM6 0.95
6GS7 2.15
6GV7 2.50
6GW8 0.80
6H1 9.50
6H3N 2.50
6H6 1.95
6H6GT 1.95
6HB7 0.95
6HF5 5.50
6HF8 2.50
6HS6 4.95
6HS8 1.95
6HZ6 2.65
6J4 2.15
6J4WA 3.15
6J5 2.50
6J6 2.05
6JB6A 3.95
6JE6C 6.50
6JM6 3.95
6JS6C 6.50
6JU8 2.50
6J7 2.50
6K7G 2.00
6K8Y/G 3.00
6KD6 6.50
6KM8 2.50
6KT8 2.95
6KZ8 1.95
6L1 2.50
6L19 3.95
6L6GAY Sylvania 5.50
6L6GC Phillips £6.50
6L6GC 2.95
6L6GC Phillips 6.50
6L6GC (GE) 5.75
6L6GT 1.95
6LF6 7.50
6LJ8 2.50
6LQ6 6.50
6L15 3.15
6MJ6 4.95
6N7 2.50
6N7GT 2.50
6P15 1.50
6P25 4.00
6P26 4.00
6P28 2.00
6Q7 1.75
6Q7GT 1.20
6R7G 3.15
6S4A 1.50
6SA7GT 1.35
6SC7 1.50
6SG7 2.50
6SH7 1.35
6SJ7GT 1.35
6SK7 1.35
6SK7GT 1.35
6SL7GT 0.85
6SN7GT 1.35
6SQ7 1.35
6SS7 1.95
6U4GT 1.75
6U8 1.15
6U8A 1.50
6V6GT 1.50
6X2N 1.00
6X4 1.50
6X5GT 1.00
6X5GTY 1.00
6X8A 2.25
7A6 4.50
7A7 2.00
7AD7 1.75
7AU7 1.50
7B6 3.50
7B7 2.50
7C6 2.50
7E7 2.50
7J7 5.50
7V7 4.15
7Y4 2.50
8B10 2.50
8BQ5 1.95
8D8 2.50
8EQ7 1.95
8298A 8.50
83A1 7.50
85A8 1.50
10D2 1.25
10DE7 2.50
10F1 0.75
10GK6 1.95
10P14 2.50
10P18 0.70
10LD12 0.65
11E3 55.00
12A6 3.95
12AD6 1.50
12AG8 1.50
12AL5 1.00
12AT6 1.25
12AT7 1.15
12AT7WA 2.50
12AU6 1.95
12AU7 0.65
12AV6 1.95
12AX7 0.85
12AX7S 7.95
12AX7WA 2.50
12AY7 3.95
12AZ7A 1.95
12B4A 4.50

12BA6 1.50
12BH7A 2.95
12BE6 1.95
12BH7A 2.50
12BL6 1.75
12BY7A 2.75
12CA5 1.95
12CX6 1.20
12DQ6B 3.50
12DW4A 3.50
12DW7 2.50
12E1 17.95
12E14 38.00
12GN7 4.50
12HG7A 4.50
12J7GT 3.50
12K5 1.95
12K7GT 1.50
12K8 1.95
12SA7GT 1.95
12SG7 4.75
12SH7 1.95
12SK7 1.95
12SJ7 1.50
12SN7GT 1.85
12SQ7GT 1.95
13D3 3.20
13D7 3.20
13D7 2.50
13D9 3.20
13DR7 2.95
13EI 145.00
13EM7 3.50
7BR3 3.95
17EW8 0.95
17DW4 2.50
17DW4A 2.95
17JZ8 4.50
18D3 6.00
19AQ5 3.50
19AU4GT 2.50
19G3 17.00
19H5 33.50
19Q6 9.00
20A2 10.50
30D1 0.70
20LF6 3.50
20L1 0.95
20P1 0.55
20P3 0.60
20P4 1.95
20P5 1.15
21JZ6 3.15
21LU8 3.75
24B1 39.50
24B9 39.50
25L6GT 1.75
25BQ6 1.75
29C1 19.50
29KQ6 6.50
30C17 0.40
30C18 1.48
30F5 0.95
30FL1 1.00
30FL2 1.35
30FL12 0.95
30FL13 1.10
30FL14 1.25
30L1 0.45
30L15 0.60
30L17 0.80
30P4MR 1.00
30P12 1.00
30P18 0.60
30P19 1.00
30PL1 2.50
30PL13 0.60
30PL14 1.75
31JS6A 5.50
33A/158M 19.50
35A5 4.50
35L8GT 2.00
35W4 0.70
35Z3 1.85
38HE7 4.50
40KD6 5.50
42 6.95
47 6.00
50A5 1.50
50C5 0.95
50CD6G 1.15
50EH5 1.50
52KU 2.00
53CG 15.00
60B5 1.00
60JY6 2.96
61SPT 4.50
75B1 3.50
75C1 2.50
83 8.50
83AI 9.00
84 3.00
85A1 6.50
85A2 2.50
90AV 15.00
92AG 19.50
92AV 15.00
95A1 6.50
108C1 1.50
150B2 6.50
150C2 2.50
150C4 2.15
185T 1.50
274A 15.00
307 5.00
328A 15.00
388A 17.50
404A 10.95
425A5 8.00

431U 4.50
572B 55.00
5636 1.50
6146A 7.50
6158 3.20
6386 14.50
6883B 9.95
6973 5.95
705A 8.00
725A 275.00
7527 89.50
7703 395.00
803 14.95
805 39.00
807 2.50
810 85.00
811A 15.00
813 27.50
813 Phillips 35.00
829B 14.50
832A 14.50
833A 95.00
866A 6.50
872A 20.00
873 60.00
884 5.50
927 15.00
930 9.95
931A 17.50
954 1.00
958A 1.00
1299A 0.60
1619 2.50
1625 3.00
1626 3.00
1927 25.00
2050 5.50
2050W 6.95
3545 4.00
4313C 4.00
4328D 9.00
5642 9.50
5651 2.50
5654 1.95
5663 1.95
5670 3.25
5672 4.50
5687 4.50
5692 3.50
5696 4.50
5704 3.50
5718 6.15
5725 2.50
5726 2.50
5727 2.50
5749 2.50
5750 1.85
5751 2.95
5763 4.95
5814A 3.25
5829WA 6.50
5840 3.50
5842 11.00
5847 10.95
5879 5.00
5886 13.95
5894 39.50
5899 4.50
5963 2.00
5965 2.25
6005 1.85
6012 16.00
6021 3.65
6057 3.75
6058 3.95
6060 2.25
6062 4.50
6063 2.00
6064 2.95
6067 7.00
6072 4.20
6080 7.95
6132 10.00
6146B 9.50
6155 72.00
6156 72.00
6688 6.50
6887 9.50
6080 7.95
6080WA 9.50
6096 5.50
6132 10.00
6136 2.50
6146B 9.95
6155 72.00
6156 72.00
6157 2.50
6201 6.45
6211 2.50
6267 2.25
6550A GE 10.95
6550RCA 15.00
6350 3.50
6688 6.50
6870 11.50
6887 9.50
6873 4.50
70255 6.95
7189 3.50
7199 7.50
7239 17.50
7247 4.95
7360 13.50
7527 85.00
7586 15.00
7591A 6.50
7868 5.95
7815 72.95

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ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

The exhibition season is with us again and it is at these events that I seem to pick up some of the best gossip and information for writing this column. Certainly, it is on the BATC stand that people grab me by the throat and ask why I don't print more slow-scan news. The answer is always the same – because *you* don't write any! So please let me have some more details of the SSTV scene (assuming there still is one!). OK, that's my little joke over, so on we go to the serious stuff.

First the good news. As I said last time, the BATC could not afford the RSGB's rates for a stand at its National Amateur Radio Exhibition held around Easter time at Birmingham's National Exhibition Centre. However, the RSGB has now relented and welcomed affiliated societies such as ours back to the fold. I think this means they have realised that society displays are a necessary antidote to all those identikit commercial stands offering exactly the same Japanese black boxes.

Speciality modes such as ours are one of the few things which add a bit of individuality to our hobby, and folk who have travelled from the four corners of the country to the NEC probably expect to see some specialist society stands there. Furthermore, the National Amateur Radio Exhibition is an important showcase for amateur television, so it is fitting that we should fly the flag there.

REPEATER LIST

Austria
OE5XLL (JN67CC) 434.25 AM in, 1280 AM out

Germany
DB0TT (JO31SK) 1242.5 AM/1275 FM in, 434.25 AM/2334.5 FM out
DB0TW (JO42GA) 1241.25 AM in, 434.25 AM out
DB0KO (JO30JX) 434.25 AM in, 1280 AM out
DB0QJ (JO40CW) 1246.5 FM in, 434.25 AM out
DB0CD (JO31MO) 1270 FM in, 434 AM out
DB0BM (JO30EW) 434.25 AM in, 1285.5 AM out
DB0DN (JN57JQ) 434.25 AM/2343 FM in, 1285.5 AM out
DB0DP (JO43JC) 434.25 AM in, 1285.5 AM out
DB0FS (JO43XO) 433 AM/1252.5 AM in, 1285.5 AM out
DB0QP (JN68HI) 434.25 AM in, 1285.5 AM out
DB0NC (JO43AE) 434.25 AM/1242.5 AM in, 1278.5 AM out
DB0RV (JN37TO) 434.25 AM/2335 FM in, 1285.5 FM out
DB0NL (JO32OH) 1252.5 AM in, 434.4 AM/1278.5 FM out
DB0EL (JO41AI) 1252.5 AM in, 434.25 AM/1278.5 FM out
DB0TS (JO42AE) 1245.7 FM in, 2372 FM out
DB0GY (JN47RR) 2343 FM in, 1285.5 AM out
DB0LO (JO33RF) 434.25 AM/1242.5 AM in, 2335 FM out
DB0TV (JO40FF) 1252.5 in, 1285.5 out (planned)
DB0NF (JN69IH) 434.25 AM in, 1285.5 AM out
DB0RG (JO44SQ) 434.25 AM in, 1285.5 AM out
DB0NK (JN39TE) 1252.2 in, 1285.5 out
DB0YQ (JN69CQ) 1252.5 in, 1285.5 out
DB0PA (JN68OW) 2322 in, 2405 out
DB0JJ (JN48DS) 1285.5 in and out (store and forward repeater)
DB0IV (JN58JH) 2395 FM in, 1275 FM out
DB0OV (JO43FM) 2335 FM in, 1285.5 AM out
DB0TY (JO40BC) 1247.75 FM in, 2405.5 FM out

Great Britain
GB3CT (IO90WX) 1249 FM in, 1318.5 FM out (Crawley)
GB3GV (IO92IQ) 1249 FM in, 1318.5 FM out (Markfield)
GB3TV (IO91RU) 1249 FM in, 1318.5 FM out (Dunstable)
GB3UD (IO83VC) 1249 FM in, 1318.5 FM out (Mow Cop)
GB3UT (IO81UJ) 1276.5 AM in, 1311.5 AM out (Bath)
GB3VR (IO81LD) 1249 FM in, 1318.5 FM out (Brighton)

Luxembourg
LX0ATV (JN32AL) 1252.5 FM in, 434.25 AM out

Netherlands
PI6ATR (JO31JW) 1252 FM in, 1285.5 AM out
PI6EHV (JO21TH) 434.25 AM in, 1252 FM out

All frequencies are in MHz

QRO on 24

At the Sandown Park VHF Convention, the ATV stand (run admirably by the Home Counties ATV Group) turned into a meeting place and talking shop for the video fraternity. Mike G8LES brought with him his latest 'baby', a high power PA for 24cm. This was very much a DIY job – even the tracks on the PCB were cut by hand with a Stanley knife – but the result was a 40 watt solid-state amplifier at a cost much lower than the commercial unit mentioned last month.

Mike has used two of the new Mitsubishi SC-1040 hybrid 'black brick' modules in a parallel configuration. This achieves 32 watts output for 2 watts in or 40 watts with an input of 4 watts – not bad for solid-state. In fact, this is comparable with a single 2C39 valve amplifier, with far less constructional work involved.

You need an 8 amp power supply, but that is not so difficult to arrange. Mike indicated that a very good heatsink is required, together with protection against overvoltage, bad SWR and lack of output load. All this is achieved in his design and we hope he will write up the whole project.

One or two onlookers said that supplies of the SC-1040 were unavailable, but this applies only to Thanet Electronics, or Icom UK as they now prefer to be called, and probably only for a short while. I was informed that these modules are definitely available ex-stock from Mitsubishi's distributors – don't ask me which, though, as I have forgotten the names. I am sure Mitsubishi at Watford will help.

On (and off) the air

Dave Crump G8GKQ says Swaffham, where he lives, is a bit of an ATV desert, but he tries to maintain a sked on 70cm every week with south London. Most weeks they get a picture through, with just 10 watts peak sync power at each end. Nick Harrold G4IMO is *not* on the air at the moment because the wind 'did for' his antenna mast. Until the insurance loss adjuster comes to inspect the damage he cannot do much from home.

He has been trying low power 24cm mobile TV with an F3YX-type outfit. Despite the low power level (about half a watt) results were distinctly encouraging. Martello has, incidentally, moved to the north side of the River Crouch, and is causing a little aggro on 24 from time to time. According to G4HCL, and he should know, the Cambridge television repeater has already been finished and potential users await the big day with baited breath (especially if they get the kilowatt ERP they want!).

Finally, a query from Jerry G4GGL, who

hails from Aldershot. He bought one of the Saba SECAM-PAL transcoder modules from Garex at one of the rallies. These assemblies were intended to fit in PAL television receivers and make them dual standard, but Jerry would like to build the module into a stand alone unit. Has anyone achieved this, and if so, how?

BATC and EARWIG

May 3rd saw this year's BATC Convention at Crick, probably the biggest and best ever. If you didn't manage to visit this show, it's a shame because you missed a grand event. Fifty trade tables were provided in a large marquee, while other exhibitors took up station in the main hotel building. A novelty was a five table-long bring-and-buy stall, run in aid of the new Rugby TV repeater. This seemed to be extremely popular and many bargains were to be had – I am sure it will re-appear next year.

The Hamer-Smith consortium had an enlarged display of DX-TV goodies, including a new video guide to identifying the various modes which give abnormal propagation of TV. For devotees of 405 lines there was a fascinating demonstration of old cameras and monitors, giving some cracking good pictures. Many other traders had new items to show, as did the ever-resourceful Worthing and Bristol repeater groups. The BATC sales stand did a roaring trade, particularly in some surplus professional video gear.

Coincident with the BATC's convention, but no coincidence, was the second annual meeting of the European ATV Working Group, familiarly known as EARWIG.

Everyone made a special effort to get to Crick and a total of 17 foreign visitors made the journey. Countries represented were France, Germany, Belgium, the Netherlands, Switzerland and Italy. Only our Austrian representative was unable to attend.

Considerable progress was reported in the international co-ordination of ATV operations, particularly in the field of contests and bandplans. From next year, the annual international ATV contest will be officially recognised and adopted by the IARU, and the national British ATV contests will be arranged to coincide with similar contests on the Continent, which are already co-ordinated. Germany and Switzerland are the only other European countries with ATV clubs, so it was with some pleasure that we heard F3YX – 'the Pope of ATV' as one delegate called him – announce that a French society for ATV was being formed.

Repeater list

As I write this column we are in the middle of a mini-heatwave, with some openings to match. We have had an excellent spring this year, albeit late, so perhaps we'll get some more tropo lifts (no harm in being optimistic!). That being the case the repeater list included here may come in handy. NEW

NETWORK 934

Andy Emmerson G9BUP

This month's article, as previewed, is devoted to new trade items. It is some time since we had some new goodies to talk about, but here is a bumper bunch of offerings from the two leading suppliers, Telecomms and Selectronic.

Masthead power

One of the inescapable problems of UHF radio is power loss in cables. No matter how much you spend on coaxial feeder, some signal power is lost in the feeder, meaning that received signals are weaker in your radio than they were when received at the antenna and some of your transmitted power is lost before it even reaches the aerial. To make up for the loss in incoming signals many of us use masthead preamplifiers, and you may also ask why we don't use amplifiers to give the transmitted signal a final boost at the antenna as well. The technique is used in some professional radio applications and by some amateurs, and it is also applicable to 934MHz, too.

What you would need is a combined masthead power amplifier (PA) and preamplifier, and indeed there used to be such a product on the market, made by Crestbyte. In fact, I had a review of the device ready for this column, but the product was withdrawn from the market. In some ways that was no bad thing, for while the power amplifier was excellent, the preamplifier side was in need of improvement. Now, however, there is a new model.

Known as the Nevada model HL910R, it is supplied by Telecomms of Portsmouth and costs £199. It is made by Tokyo Hi-Power, who make some of the best preamplifiers for 934MHz, and the new unit apparently improves on the performance of these (which I considered fine) with a substantially lower noise figure. Gain is approximately 20dB, which is about 5dB more than necessary.

On the transmit side the HL910R incorporates an 8 watt power amplifier, which needs 3 watts to drive it to full output – obviously you'll need to feed 13.8 volts up to it as well, otherwise it is just bypassed.

Three watts is what reaches the aerial in most people's systems, assuming 5 watts out of their transceiver and about 30 feet of so-so cable between transceiver and antenna. Eight watts is the legal maximum that can be applied to the antenna; in practice, if you hit the PA with more than 3 watts, you get a bit more than 8 out! A full 5 watts into the PA would produce about 11.5 watts out and the PA limits at this output level. In practice, however, it is unlikely that you would have more than 4 watts at the top of your feeder, however good it was. This new unit will be a consolation to people with longer cable runs, because even with just 2 watts drive you can put 5 watts into the antenna.

On the receive side the preamplifier will help. The device is provided with a remote control switch enabling either preamplifier or PA to be switched off independently of one another. The HL910R draws between 2 and 5 amps on transmit and flea power on receive. Mike Devereux of Telecomms says the unit was produced in response to the demand from many users who wanted to have the full legal power available at the antenna.

I have not yet had one to test but when I did try the previous Crestbyte model I found the idea to be very satisfactory. As I said earlier, the performance of the current manufacturer's preamplifiers is first rate, and their amateur equipment is highly regarded too. I therefore expect this product to be a winner. Whilst I am not sure of its status in relation to type approval regulations, it is clearly not in breach of the spirit of those regulations and is therefore not likely to upset anybody.

The Nevada range has also been enhanced by a new antenna, the PA15 high-gain collinear, priced at £79. This is manufactured by Maspro to a high standard and has a gain of 12dBi. This antenna is not the same as the PA15 sold by Selectronic incidentally; the code just means Personal (radio) Antenna with 15 elements, and several Japanese manufacturers end up with (predictably) similar designations for their products.

You can get more information on all Nevada products from Telecomms at 189 London Road, North End, Portsmouth PO2 9AE or by ringing (0705) 662145. Or better still send £2 for their new catalogue (with £2 worth of vouchers).

Essex extras

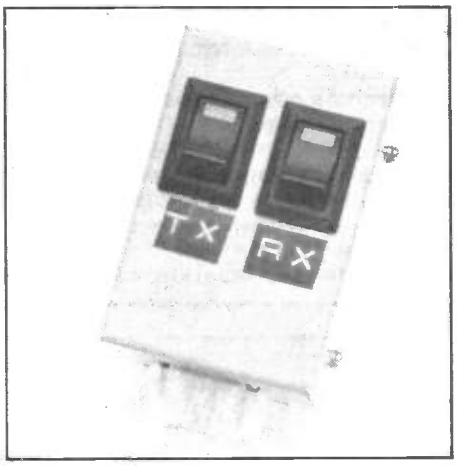
From Selectronic of Canvey Island we have the Musen Elite masthead preamplifier (£135). This is a tough, weatherproof unit intended to be clamped to the pole next to the aerial. It

Nevada's new masthead power amplifier/pre-amp and remote control switch. Note the hefty heatsink for the PA and the partial shielding for the connectors.

A good amount of Tandy's co-ax-seal 'Goop-on-a-roll' type will complete the water-proofing, yet will be easy to unpeel at a later date

is fitted with N-type connectors and a shrouded damp-proof connection for the separate power lead. It uses low noise GaAsFET technology and claims −20dB gain, which is a bit strange. It sounds as if it would make an excellent attenuator, unless of course this is a misprint and the gain is positive!

Incidentally, some folk have questioned why all Japanese preamplifiers intended for external use have a separate wire for the power supply. Why can't they feed the 12 volts up the co-ax feeder as the German preamps do? I am indebted to Chris Bartram of muTek for the answer to this question: his firm also makes preamps and uses the separate power feed philosophy. The reason is that if any dampness gets into the system, the constant flow of 12 volts will rapidly cause electrolytic corrosion.



Also, the blocking capacitors and chokes necessary at each end of the feeder cable for separating the RF currents and the dc power inevitably interfere with the transmitted power and cause some losses. So now you know!

Other new(ish) items from Selectronic are the Tonna 23 element beam antenna with 15.9dB gain over a dipole (£59.95), the three-pole interdigital filter (£65), the Puma P7 'Sky Fly' set-side preamplifer (£99.95) and the Adonis AM 303G base station microphone (£53). This last is a high quality condenser mike for use in the shack, with locking PTT button and a handy up/down facility to remote control channels on your Delta One or Commtel. Further details are available from Selectronic, 203 High Street, Canvey Island, Essex SS8 7RN (telephone: (0268) 691481).

Sign-off

That's it for this time: the offer still stands, if there are any technical points you'd like cleared up, don't hesitate to drop me a line care of the Editor. And you should have worked some DX during the openings of early May, so let me have your activity reports, distance records, in fact all your comments and letters. REW

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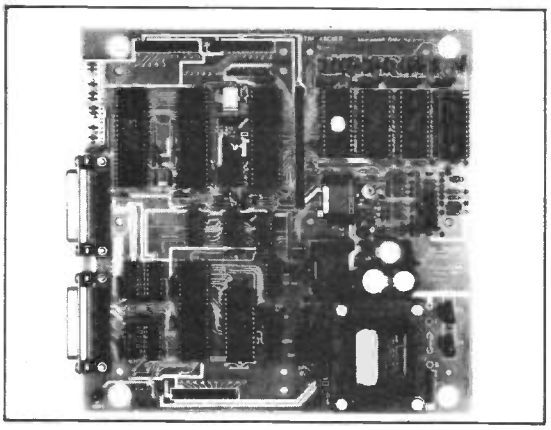

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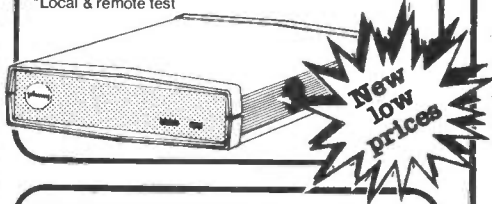

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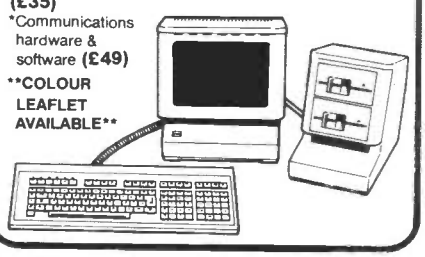

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AVIATION ELECTRONICS

1. Air Traffic Control and Communications

The first part of an occasional series by

Brian Kendal, AMRAeS, MRIN, G3GDU

Looking upwards into a clear blue sky on a warm sunny day, the motorist may well feel jealous of the aviator apparently surrounded by miles of empty space stretching in all directions. Such feelings are, however, a misconception, for the airspace over Western Europe, and in particular over the United Kingdom, is extremely busy with over 970,000 flights being handled by the London Air Traffic Control Centre alone during 1986/7, with the number expected to exceed one million this year.

Problems are further compounded by the inability of fixed wing aircraft to stop in flight, aircraft cruising speeds which vary from 100 knots for a small aircraft to five times that speed for a large passenger jet, and the fact that the closing speed of two jet aircraft on opposing courses may be so high as to preclude avoiding action.

If such aircraft flew on uncontrolled, random courses, the probability of collision would be so high as to totally prevent civil aviation. Over the years, however, a world-wide system of air traffic control and radio navigational aids has been developed which has converted this potentially disastrous situation so that air transport is now the safest and fastest means of travelling from one place to another. To achieve this level of safety, most commercial aircraft fly within controlled airspace under the direction of an air traffic control authority.

Division of airspace

Airspace is divided into Flight Information Regions (FIRs) which are designated areas under the jurisdiction of a single Air Traffic Control Centre (ATCC).

Each FIR comprises two types of airspace: controlled and uncontrolled.

In uncontrolled airspace, the pilot may fly at any height, speed or course he desires, provided that the visibility remains better than certain laid down limits (Visual Meteorological Conditions). This does not apply at night. Should the weather deteriorate below these criteria, his height must be related to his track (Instrument Meteorological Conditions). At all times in uncontrolled airspace, the pilot is totally responsible for maintaining his separation from other aircraft.

To assist in this, many air traffic authorities provide a service which will advise the position of other aircraft known to be in the vicinity. However, this is not always based on radar surveillance, so in such cases the advice given will only include aircraft which have chosen to notify their presence.

In contrast, aircraft flying in controlled airspace must proceed at the height, track and speed designated by the air traffic control authority who, in return, ensure that the flight is expeditiously performed whilst maintaining adequate separation from other aircraft.

To achieve this task, a number of different types of airspace are designated, the most basic of which is the airway. The airway can be considered to be the motorway of the air. It comprises a volume of airspace ten nautical miles wide and of defined vertical extent, stretching between two designated points, usually airfields or Terminal Movement Areas (TMAs).

The route of the airway is defined by VHF Omni-Range beacons (VOR), Distance Measuring Equipment (DME) and/or Non-Directional Beacons (NDB) along its length.

The confluence of several airways is termed a Terminal Movement Area

Tower controllers at Vancouver International Airport

(TMA), through which aircraft are usually directed under radar control.

The final type of controlled airspace is the aerodrome control zone (CTZ) which is a designated area stretching from ground level to a few thousand feet which is under the jurisdiction of the aerodrome air traffic control authority. As a TMA or airway does not reach down to ground level, it is quite possible to locate a CTZ beneath either. As an example of this, there are no less than six principal airports located beneath the London TMA.

As it is necessary to fly at defined heights when above 3000ft in IMC or in controlled airspace, for convenience, the aircraft altimeter adjustment is always set to a sea level pressure of 1013.2 millibars. Aircraft heights are then quoted as 'flight levels' which are the indicated heights in hundreds of feet. When approaching for landing, the altimeter is reset to the pressure at airfield level and consequently indicates the aircraft's height above the airfield. This is known as the QFE.

Communications

At all times whilst flying in controlled airspace, the aircrew are in direct radio contact with the air traffic control authority, usually on VHF AM.

Due to the relatively short range of this mode, it is quite possible for an aircraft to transit the coverage of a single ground station in only ten or twenty minutes. If each ground station was on a different frequency, the constant retuning of the aircraft VHF equipment would add an unacceptable burden to the pilot's workload. This was recognised as early as 1947 when 'Area Cover Schemes' were introduced. In these, successive transmitters covering an area or airway were arranged to operate on closely adjacent frequencies, so chosen that all were within the aircraft receiver bandwidth, but sufficiently far apart to eliminate heterodyne whistles. The action of the system is that the strongest received signal controls the AGC action of the receiver, attenuating the others, so that as far as the aircrew are concerned, they are working a single station throughout a large sector of the flight.

As almost all air to ground communications are line-of-sight, transmitter power levels are often quite low with only 5-10 watts being radiated from the ground station aerial. These sites, however, are carefully selected and, in consequence, even this power often gives ranges of up to 300 miles to high flying aircraft.

The cost of providing the buildings and masts for ground stations is high and therefore for economic reasons a station may well operate on a number of channels simultaneously. To obviate the need for a forest of aerials, equipment is coupled to common aerials via high-Q cavity resonators. By this means is it frequently only necessary to provide four aerials – main and standby, each for transmit and receive. These are normally wideband vertical dipoles mounted above each other in order to minimise interaction.

Many amateurs are surprised when they hear of the relatively high muting (squelch) levels used on ground station receivers. This may be as high as 2-3 microvolts (S8). However, line-of-site signals are almost invariably very strong and weak signals usually emanate from aircraft outside the normal range of the station. Such muting levels ensure that any signals received have a high signal to noise ratio and that the controllers experience 'armchair copy' at all times.

The aircraft installation usually comprises two independent transmitter-receivers, each under synthesizer control and capable of operating on any of the 720 channels between 118.0 and 135.975MHz of the VHF aeromobile band. Various models of equipment radiate between 5 and 25 watts into a whip or blade unipole or suppressed aerial.

HF

Although VHF is the preferred means of air to ground communication, the vast distances involved in many FIRs overseas, particularly in Africa, the Pacific and across the Atlantic, necessitate the use of HF, although almost everywhere VHF is used whenever possible.

The mode used is upper sideband SSB on a number of wavebands between 3 and 17MHz in the HF spectrum. The band is use at any one time is dependent upon HF conditions, time of day and range required. Thus any one service may use up to half a dozen channels in any twenty-four hour period.

The HF ground stations use transmitters of between 1 and 5kW PEP output power, feeding wideband omnidirectional aerials. Standard HF communications receivers are employed for reception. A number of different channels are frequently in operation at any one station, so it is normal to separate the transmitting site from the receiving site by a distance of several miles in order to minimise cross modulation effects.

Due to the frequency of channel changing necessary to cater for changing conditions, etc, remote control of both transmitters and receivers is a normal practice. In earlier times this was achieved by installing a separate transmitter and receiver for each frequency used. In the more modern generations of equipment, however, more comprehensive remote control, together with automatic or preset tuning facilities, enable equipment frequency changes to be achieved from the operator's position without intervention by the station technical staff.

Broadcast transmissions

In addition to direct air to ground communications, there are a number of broadcast transmissions on both HF and VHF aeromobile bands.

These are of two types: Volmet and ATIS. The former radiate essential meteorological information for a number of airports within the service area of the transmitter. This includes altimeter pressure settings, visibility, temperature, cloud cover and forecast variations.

The ATIS (Aerodrome Terminal Information Service) transmissions are usually associated with a single airport and provide such essential information as runway in use, pressure settings, equipment serviceability and any limitations in airfield facilities (such as a taxiway under repair, etc).

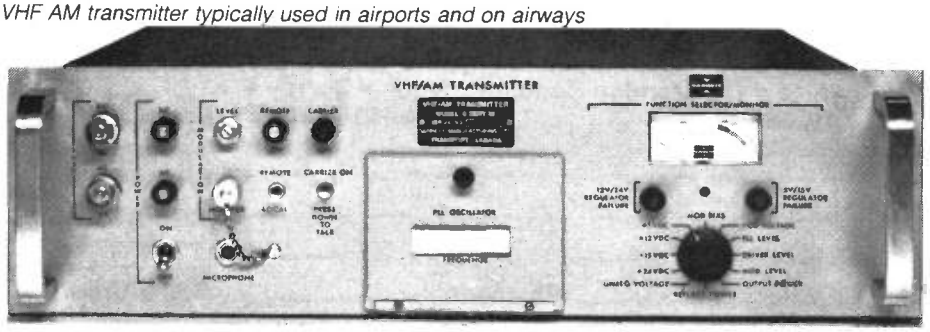
For many years the modulation for these transmissions has been derived from a number of prerecorded magnetic tape loops operating in sequence and in many parts of the world this system survives.

These systems suffer from certain disadvantages, however, such as variable recording levels, noisy replay and regional accents causing difficulties to some foreign aircrew. More recently some authorities have developed equipment using digital recording held on solid-state memories, but possibly the most elegant and efficient has been developed by Marconi Secure Radio Systems which completely automates the system.

The meteorological reports are originated at airports and passed to the Volmet transmitting station by teleprinter using a standard format. Here the incoming message is examined by the computer, decoded and reassembled into the order in which it will be broadcast. The computer then extracts the required words from a digital store and feeds the message at the correct time to modulate the transmitter.

The vocabulary software was developed by recording each word in context in a typical sentence, cutting it out by a computer working to an accuracy of a few milliseconds and then

VHF AM transmitter typically used in airports and on airways



fitting it by an iterative technique to every other word with which it may be associated.

Words which might occur at both the middle and end of a sentence were recorded twice with the appropriate cadence. The software also includes several periods of silence for use in various contexts. A male voice was chosen for the recording, for it permits greater fidelity for less digital storage. The speaker was chosen for the clarity, consistency and lack of regional accent in his voice, thus making it easier for aircrew from other countries to understand.

A further advantage of this fully automated system is that, compared with manual systems which may need up to fifteen minutes to decode and re-record an incoming message, this system transmits without delay and it is even possible for the amended broadcast to commence before the end of the incoming teleprinter signal has been received by the computer.

The result of this technique is uncanny, for the author, who knows the person who made the original recordings well, still finds it is impossible to detect that the transmission is other than a live broadcast.

This Marconi System is now in use for all UK Volmet broadcasts in Italy and will shortly come into service in several other countries.

Company communications

It is often necessary for an aircraft in flight to directly contact its company offices. This may be to notify of unserviceabilities, operational messages, passenger requirements, etc. Theoretically, it would be possible to pass such information via the air traffic control authorities, but in practice the air traffic channels are already heavily loaded and the addition of such would add an unacceptable burden. For this reason, discreet frequencies in the VHF aeromobile band are allocated to airlines for their private traffic.

Similarly, there are a number of HF stations around the world which will relay messages to companies or even provide phone-patch facilities.

An example is the station at London's Heathrow Airport, operated by British Airways, which claims that it can work any HF equipped British Airways aircraft in flight anywhere in the world at any time.

All HF frequencies are heavily used by many different ground stations, and without special arrangements the aircrew would find the constant background noise unacceptable. HF equipment is therefore equipped with SELCAL.

This is a system in which the aircraft receiver is muted until such time that it receives a transmission preceded by a predetermined series of tones. The combination of tones is unique to each aircraft, thus the pilot's attention need not be distracted except by transmissions directly intended for his attention.

Other frequencies

Despite over 700 frequencies being available in the VHF aeromobile band, still more are required on major airports, for intermodulation and cross modulation effects can make many unusable. For this reason, the 450MHz FM band is being increasingly used by the vast number of ground personnel necessary for the efficient operation of a modern airport. Such users may include police, customs, immigration, ground handling agents, maintenance and a host of others.

The direct voice communication between an aircraft and the air traffic control authority is possibly the most important aid to the safe transit of aircraft. Even so there are many other elements in the system, which I will describe in future articles. REW

DATA FILE . . .

Ray Marston looks at more applications of the LM10 high performance op-amp/voltage-reference IC.

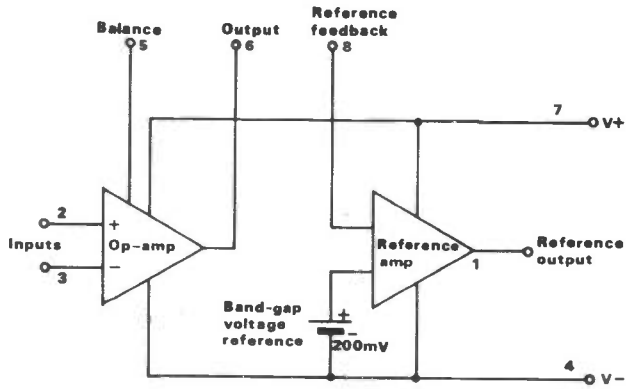


Fig 1 *Functional diagram of the LM10*

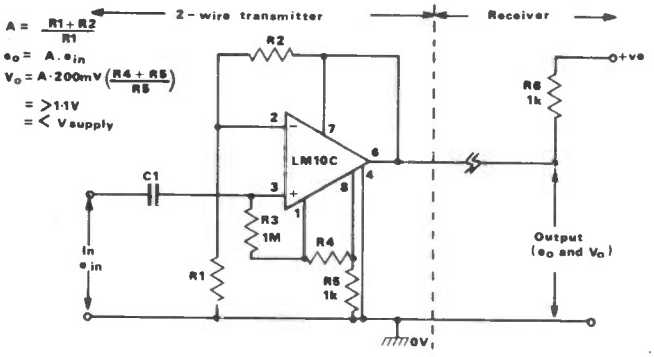


Fig 2 *Shunt-connected non-inverting ac amplifier or '2-wire transmitter'*

In last month's edition of *Data File* we looked at the basic details and simple applications of the LM10, a unique bipolar linear IC that is produced by National Semiconductor Corporation and houses a high performance op-amp plus a precision 200mV band-gap voltage reference and a 2-input buffer amplifier in a single 8-pin TO5 package. To help refresh the reader's memory, *Figure 1* shows the functional diagram and pin notations of the LM10.

In this month's edition of 'The File' we continue the LM10 applications theme by first looking at basic ways of using it in the 'shunt' or 2-wire transmitter mode, and then going on to look at ways of using the device in astable multivibrator and voltage regulator applications.

'Transmitter' circuits

The op-amp section of the LM10 features a number of unusual characteristics, including an ability to operate over a very wide range of supply voltages (1.1 volts to 45 volts in the case of the LM10C), and a supply voltage signal rejection ratio value of 96dB (meaning that 1 volt of supply line causes only twenty microvolts of ripple to appear at the op-amp output).

The combination of these two characteristics enables the device to be used in a unique 'shunt' or '2-wire transmitter' mode (briefly described last month), in which the op-amp output is shorted directly to the supply line terminal and thus controls or modulates the circuit's supply line current, as shown in the ac amplifier circuit of *Figure 2*.

To understand the operation of the *Figure 2* circuit, compare it with the LM10 functional diagram of *Figure 1* and note the following points. The actual op-amp (using input pins 2 and 3 and output pin 6) is wired in the non-inverting mode, with its signal-voltage gain ('A') determined by the ratios of R1 and R2. The input signal is ac coupled to the non-inverting terminal (pin 3) of the op-amp, which is dc biased (via R3) with a voltage taken from the pin 1 output terminal of the internal reference amplifier. This bias voltage has a value determined by the ratios of R4 and R5 and provides the op-amp with an output offset bias voltage (V0) that is 'A' times greater than the basic bias voltage.

In practice, the *Figure 2* component values are usually chosen so that the pin 6 output terminal takes up a quiescent value that is half-way between the +ve supply value and the 1.1 volts minimum operating voltage of the IC, thus enabling the largest possible undistorted output signals to be generated.

The most important thing to note about the *Figure 2* circuit is that its pin 6 output

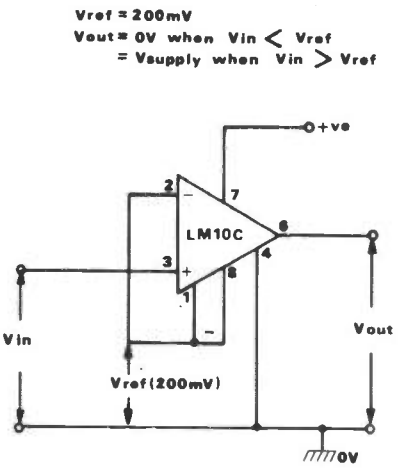


Fig 3 *Basic fixed-value (200mV) voltage comparator*

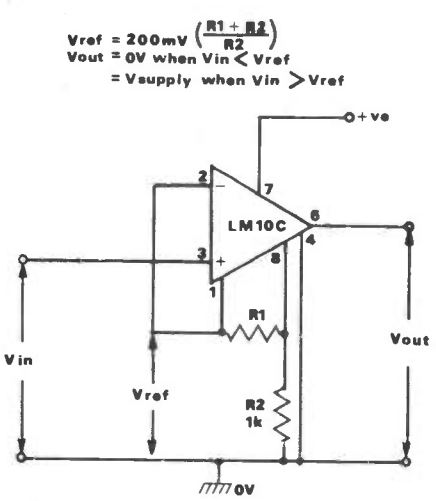


Fig 4 *General purpose voltage comparator*

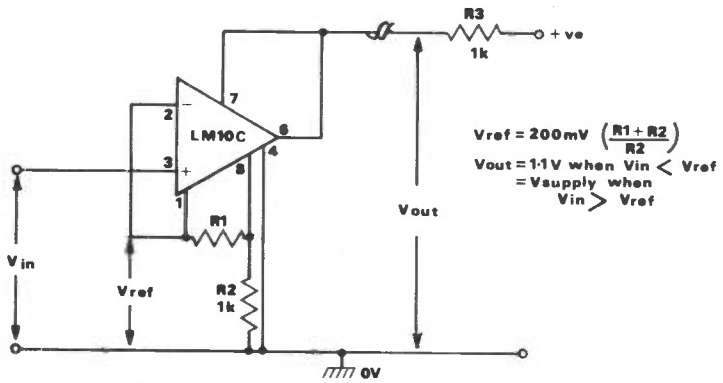


Fig 5 *Shunt-connected voltage comparator*

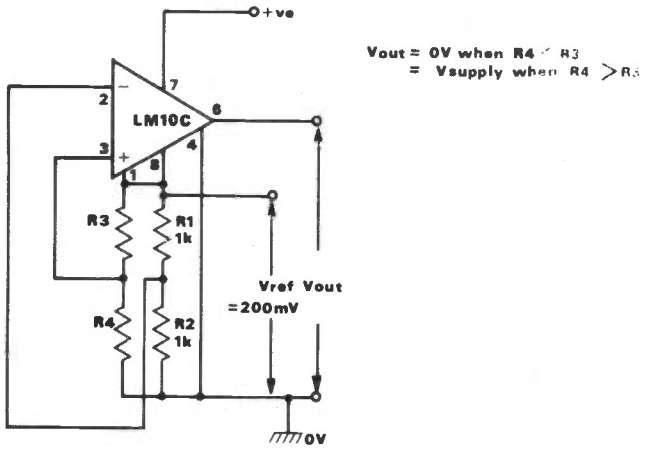


Fig 6 *Basic resistance comparator for circuit*

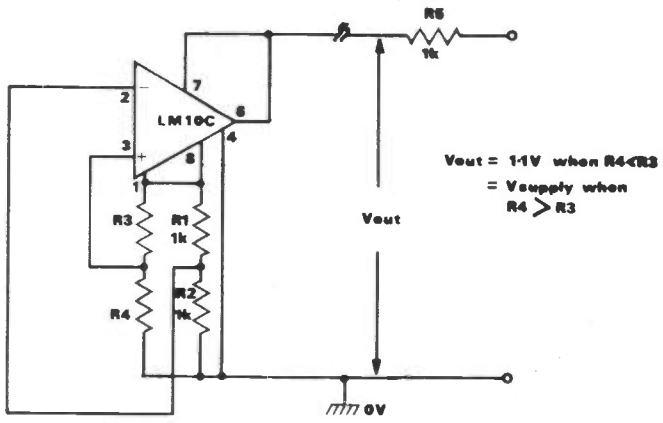


Fig 7 *Shunt-connected resistance comparator*

and pin 7 supply terminals are shorted together, enabling supply and signal currents to flow along the same wire via R6. Thus, the circuit to the left of the dotted line can be regarded as a signal amplifying 'transmitter' that is connected to the 'receiver' (to the right of the dotted line) via only two wires (or via only a single wire if a common earth return is used). This '2-wire' type of circuit thus offers a very simple and inexpensive way of remote monitoring a microphone or vibration sensor, etc. We'll show some practical examples of such circuits in a future edition of *Data File*.

Comparator circuits

The fact that the LM10 incorporates both a precision voltage reference and high performance op-amp enables the device to be used in a variety of conventional and shunt-connected voltage comparator applications. *Figures 3* to *7* show examples of some basic circuits of these types.

Figure 3 shows the basic circuit of a fixed-voltage (200mV) voltage comparator, in which the output switches high when the input voltage exceeds a 200mV reference value. Here, pins 1 and 8 of the IC are shorted together so that a precision 200mV is generated on pin 1; this voltage is applied to the pin 2 non-inverting input terminal of the op-amp and acts as the circuit's 'reference' voltage.

The circuit action is such that the op-amp output is low (at near zero volts) when the pin 3 input voltage is less than the 200mV reference value, and switches high (to full positive supply rail value) when the input exceeds the 200mV reference value; the circuit thus acts as an over-voltage switch.

If desired, the action of the above circuit can be reversed, so that it acts as an under-voltage switch that generates a high output voltage when the input voltage is less than the reference value, by simply transposing the pin 2 and pin 3 connections.

Alternatively, the *Figure 3* circuit can be modified so that it acts as a general purpose voltage comparator with a reference voltage value in the range 200mV to 40 volts by using the connections shown in *Figure 4*. Here, the reference voltage value is simply controlled by the relative values of R1 and R2, which are wired to pins 1 and 8.

2-wire transmitter mode

Figure 5 shows how the circuit can be wired in the shunt of '2-wire transmitter' mode, so that an input voltage can be easily monitored from a remote point.

Figure 6 shows how the LM10 can be used as a precision resistance comparator, in which the output switches high when the R4 value exceeds that of R3 (which can range from about 100 ohms to 10 megohms). Here, the R1 to R4 network is wired as a Wheatstone bridge that is powered via the precision 200mV 'reference' output of pin 1, and the R1-R2 junction is taken to the op-amp's inverting input terminal and the R3-R4

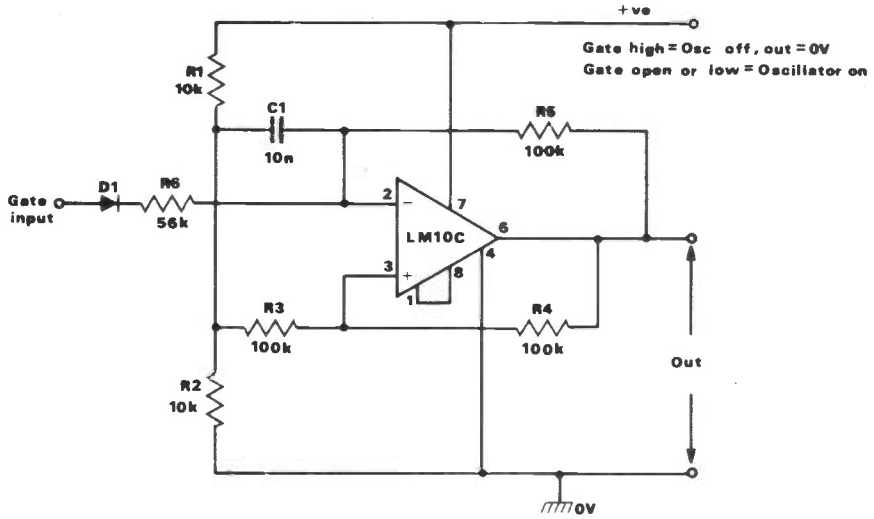


Fig 10 *An alternative version of the gated astable*

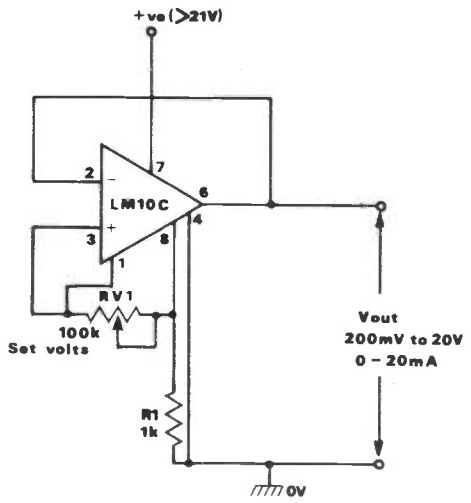


Fig 11 *Precision 200mV-20V voltage regulator*

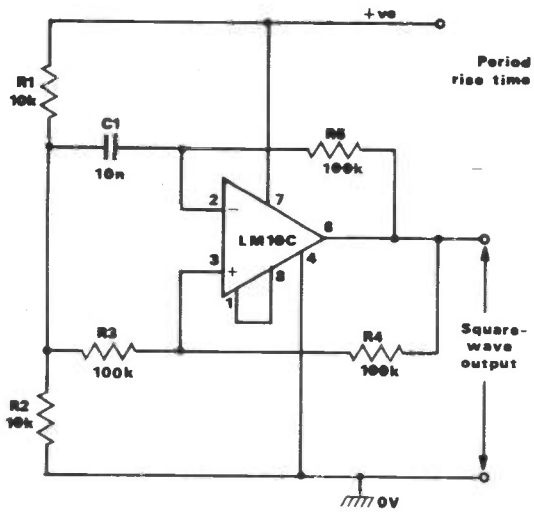


Fig 8 *Basic astable multivibrator with typical component values*

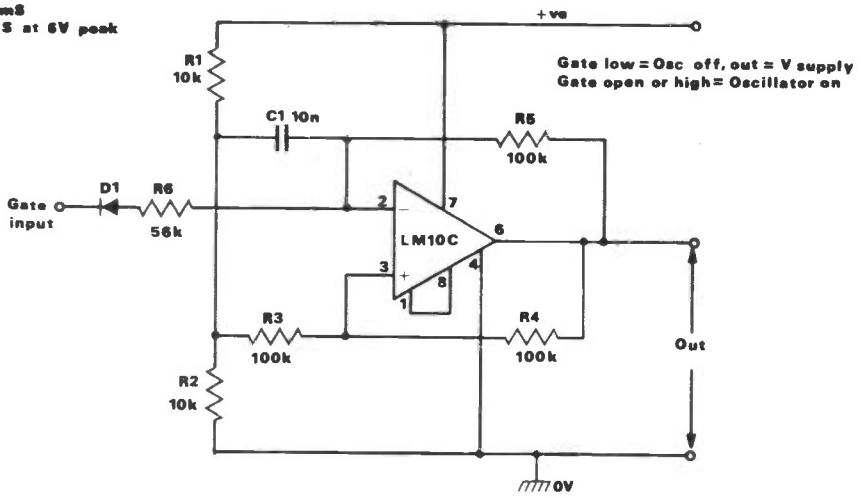


Fig 9 *Gated astable multivibrator (above)*

junction is taken to its non-inverting input terminal to give the necessary 'comparator' action. Note that the sensitivity of this circuit can be increased by raising the reference voltage above the basic 200mV value, but that the total output current of the reference must not be allowed to exceed 3mA.

Finally, *Figure 7* shows how the above comparator can be wired in the shunt or '2-wire transmitter' mode; note in this case that the reference voltage should not exceed 1 volt. Also note that in practice R4 (or R3) may take the form of a thermistor, a light-dependent resistor (LDR) or some other type of resistive transducer, thus enabling this circuit to remote-monitor temperature or light levels, etc.

Astable circuits

The LM10 can be used in a variety of waveform generating applications, and *Figures 8* to *10* show some simple ways of using it in the astable multivibrator or square-wave generator mode.

Figure 8 shows the basic astable circuit, which is a fairly simple development of the standard 'dual supply' op-amp astable, with R1 and R2 acting as a potential divider that sets the 'common' point of the R3-R4 divider and C1-R5 timing networks at half-supply volts. Because of the poor slew-rate characteristics of the LM10 the circuit gives a rather poor square wave output, with typical rise and fall times of about 80μs when used with a 6 volt supply. The circuit is, nevertheless, very useful in low frequency applications (up to a couple of kHz) as a simple alarm tone generator or LED flasher, etc.

Figures 9 and *10* show alternative ways of gating the above astable on and off via an external control signal.

Note that gate resistor R6 must have a value that is small relative to the R5 timing resistor. We'll be showing practical applications of these

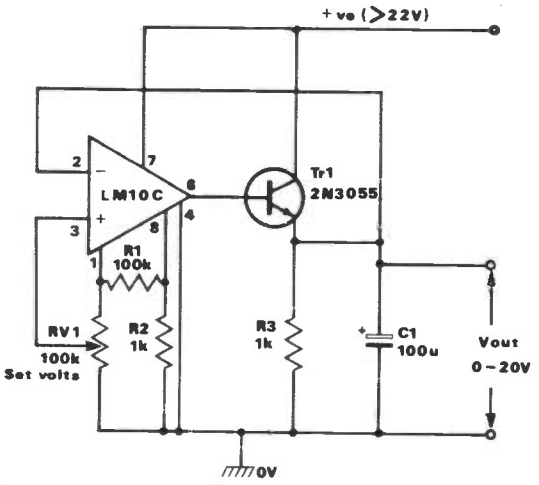


Fig 12 *Precision 0-20V regulator with boosted output*

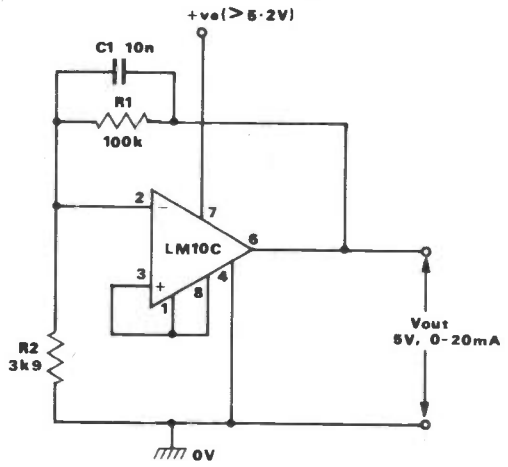


Fig 13 *Precision 5 volt reference generator*

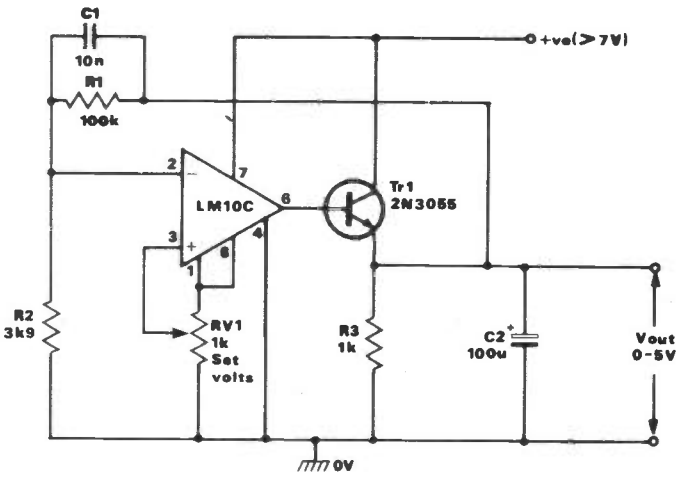


Fig 14 *Precision 0-5 volt regulator*

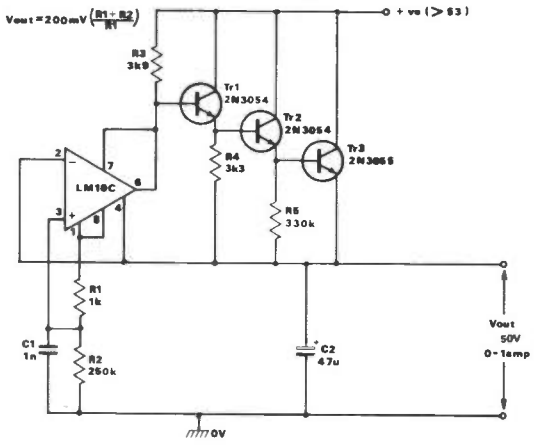


Fig 15 *Precision 50 volt regulator*

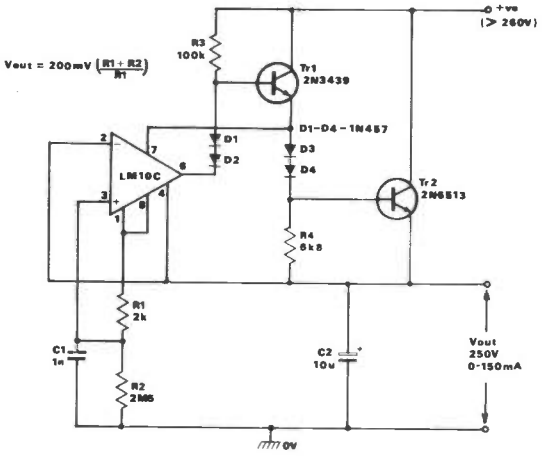


Fig 16 *Precision 250 volt regulator*

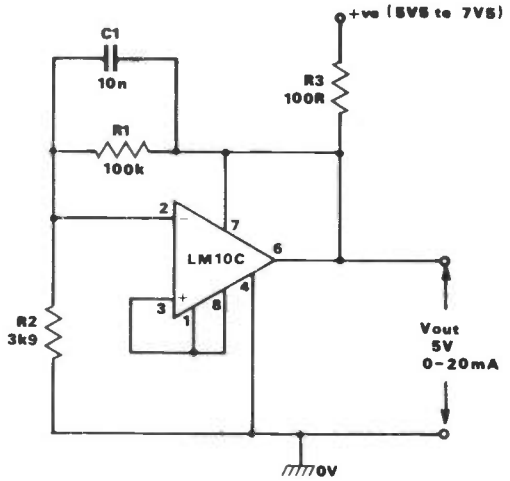


Fig 17 *A 5 volt shunt regulator*

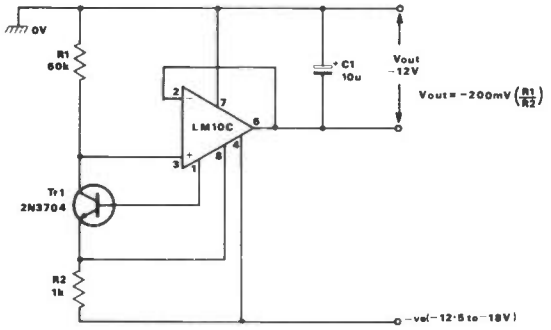


Fig 18 *A 12 volt negative volt regulator*

circuits in a future edition of 'The File'.

Voltage regulator circuits

Because of its built-in precision voltage reference and op-amp, the LM10 is ideally suited for use in a variety of voltage regulator applications. To conclude this edition of *Date File, Figures 11* to *18* show a few practical circuits of this type.

Figure 11 shows the circuit of a simple low power (up to 20mA output) precision 200mV to 20V voltage regulator. Here, R1 and RV1 are used to generate precision 200mV to 20V reference voltage fed directly to the non-inverting input terminal (pin 3) of the op-amp, which is configured as a unity-gain voltage follower and boosts the available output current to about 20mA.

Figure 12 shows how the above circuit can be modified so that its output voltage can be varied all the way down to zero volts and its output current can be boosted to several hundred milliamps. Here, R1-R2 generate a fixed 20 volts on pin 1 of the IC and across RV1. The op-amp and power transistor Tr1 are configured as a composite unity-gain voltage follower, which directly boosts the 0-20 volt output of RV1 to current levels of up to several hundred milliamps.

An alternative approach to regulator design is shown in *Figures 13* and *14*, in which the op-amp is configured as a non-inverting ×25 amplifier. In the *Figure 13* circuit the op-amp input is taken directly from the fixed 200mV reference, to give an unbuffered 5 volt output.

In the *Figure 14* circuit the input is fully variable from zero to 200mV via RV1 and the available output current is boosted via Tr1, thus giving a high current 0 to 5 volt output.

Figures 15 and *16* show how the LM10 can be used in the 'floating' mode (in which pin 7 operates at less than the full supply voltage value and pin 4 operates at above the zero volts value), to generate high output voltages. Note in both of these circuits that the IC is used in the shunt mode, with load resistor R3, and that only a few volts are developed across the LM10 itself.

In *Figure 15* the volt drop is limited to less than 2 volts by the series-connected base emitter junctions of Tr1 to Tr3; in *Figure 16* the drop is limited to a similar value via D3-D4 and the Tr1 base-emitter junction.

Finally, to complete this edition of *Data File*, *Figure 17* shows a simple example of the use of the LM10 as a low current (up to 20mA) shunt-type 5 volt regulator, and *Figure 18* shows how the IC can be made to act as a negative voltage regulator. In the latter case Tr1 is configured as a constant-current generator in which a precision 200mV is developed across R2, thus causing R1 to pass a fixed current of 200μA and thus generate a reference voltage of −12 volts on input pin 3 of the op-amp, which is wired as a unity-gain voltage follower.

In next month's edition of *Data File* we'll look at a further selection of LM10 application circuits. REW

POWER SUPPLIES AND HOW TO DESIGN THEM

BY DAVID J SILVESTER

PART TWO

We begin Part 2 of this article by taking a look at constant current supplies for PSUs.

All of our previous items have been about where constant voltage supplies have become constant current as a safety measure for both the supply and the load. In some cases it is necessary to provide a constant current supply and in these it is the maximum supply voltage that provides the safety limit.

Figure 5 shows a method of providing a constant current supply using an op-amp, for preference a JFET or MOSFET input type, and four other components. Tr7, Tr8 and R20 simply give a higher current output than is possible with the op-amp alone, although a more modern idea would be to use a power MOSFET as the current pass element. The current passing through the load (I_{sink}) passes through the resistor R21, the microscopic current through the gate of Tr7 and the input current of an FET input op-amp being ignored. This current through R21 develops a voltage according to Ohm's law and this voltage is compared to the input voltage V_{in}. Once again, the circuit operates in a stable mode when the two inputs are equal and hence:

$$I_{sink} = \frac{V_{in}}{R21}$$

Obviously the op-amp must in this case be capable of operating with the input voltages very close to the low supply potential and the author would choose a CA3140 as the op-amp for this application. If a current source is needed for any reason, then the circuit can be inverted to operate from the positive supply, and in this case Tr7 becomes a p-channel FET and Tr8 a pnp transistor. Also the CA3140 cannot work with its inputs close to the positive supply rail and in this case the author would choose an LM351 op-amp.

The second alternative (as in most electronics problems there are always a large number of alternatives) is to use one of the three terminal regulators, see *Figure 6*. Since 1.25V is impressed across R22 in this circuit, the current through R22 must remain constant until the regulator is unable to deliver sufficient voltage to send the required current through the load, due to a lack of unregulated input voltage. The current in the load is:

$$I_{load} = 65\mu A + \frac{1.25}{R22}$$

The added value of 65μA comes from the current from the adjust terminal of the regulator, but the value of 65μA is a typical value only and may vary between 50 and 100μA.

The ac input

Having now covered the main regulator systems it is time to get to grips with the unregulated supply, and I shall only deal with the simple transformer, bridge and reservoir capacitor system that is the basis of almost all linear power supplies.

If we look at *Figure 7* it does not matter whether we are discussing the single supply or split supply system as the same calculations apply.

The transformer

Irrespective of the source of the transformer, whether surplus, catalogue bought or specially made, it is essential to determine the correct secondary voltage and current needed. If the voltage is too high then extra voltage and therefore extra power will need to be dissipated by the pass transistor. Not only do we have to supply this power from the transformer, but it may be impossible to dissipate this extra power with reasonable sized heatsinks. If the voltage is too low then it is likely that the regulator will be unable to control the output at the required voltage. Consider our 723C circuit in *Figure 2c* for a 15V output voltage. In this case the minimum input voltage from the transformer

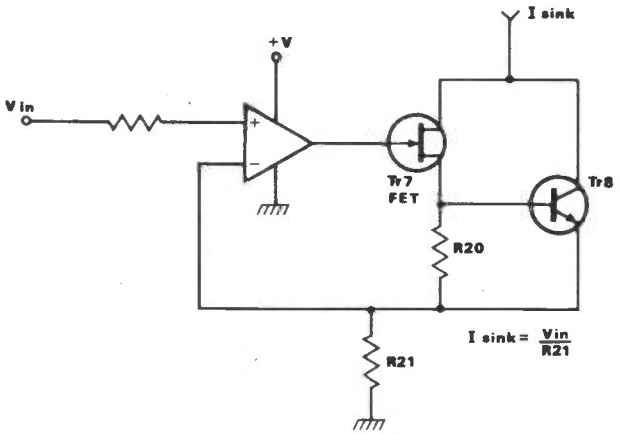


Fig 5 *Constant current supply (current sink)*

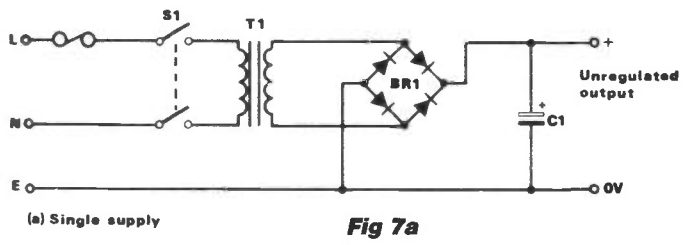


Fig 7a

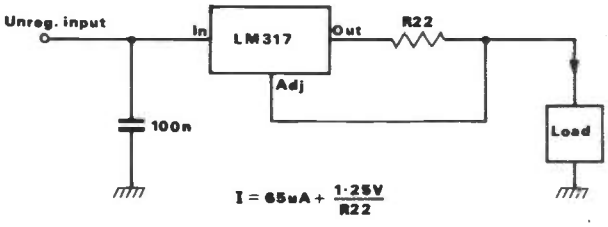


Fig 6 *Three terminal constant current (source)*

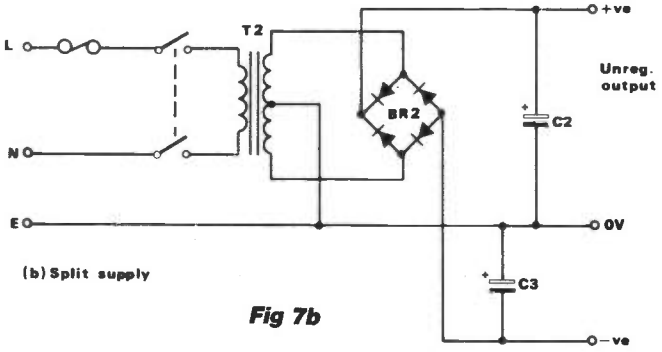


Fig 7b

must be the sum of:

Output voltage	15.0V
Volts drop across R9 at limit	0.7V
Pass transistor base/emitter potential	0.7V
723C minimum input/output differential	3.0V
ac ripple on reservoir capacitor	3.5V
Bridge rectifier volts drop	2.0V
Total	24.9V

Please accept for the moment the value of ripple on the reservoir capacitor as 3.5V; the explanation follows shortly.

Converting from peak to RMS we get 24.9/1.414 = 17.6V on load.

The question of the transformer's power rating is not as straightforward as would first appear. Let us assume we have a transformer which is marked 18V. 2.77A gives 50 watts. This transformer is actually a dual 9V by 2.77A toroidal transformer available in many component catalogues. The primary of the transformer will be sized for the 50W total output, but let us do some calculations on this transformer after it is used in the circuit of *Figure 7a*. The average voltage across the capacitor would be:

$$18 \times 1.414 - 3.5 \times 0.5 = 23.7V$$

The 3.5V is the assumed capacitor ripple and the bridge drop has been ignored for simplicity. But 23.7 by 2.77A equals 65.6 watts and the primary would be very overloaded. Because of the waveform that charges the reservoir capacitor, the transformer needs to be derated to 65% of the value printed on it and our nice 2.77A transformer can only reliably give 1.8A for the same transformer heating, an amp less than we expected. Note that we have been using the on-load voltage in our calculation but there is another factor to take into consideration. When the transformer is open circuit or operating into a high resistance then the voltage increases by another factor, the regulation. This added factor for our transformer has a value of about 13% and means that the off-load voltage across the capacitor may be 28.8V; there is no ripple to consider in this case.

The rectifier

Generally the rectifier used will be a potted bridge for the circuits of *Figures 7a* and *7b*. The rectifier diodes only conduct for half of the time at a maximum but, because of the high peak currents that flow in a reservoir capacitor charging circuit, the current rating of the bridge should be taken as the current rating of the individual diodes, the value stated normally for the bridge. Whether individual diodes or bridges are used when high current supplies are contemplated, the rectifier heating must be taken into consideration. A 10A current passing through a bridge rectifier generates 20W that must be dissipated, and any failure to do so efficiently will destroy the bridge. The voltage rating of the bridge must be twice the calculated maximum value of voltage across the reservoir capacitor at no-load, and with our maximum of 28.8V the bridge will be 100V, being the next highest value. At the peak of the cycle in which the diode is non-conducting the anode will be at −28.8V whilst the cathode is at +28.8V.

The reservoir capacitor and ripple

I stated earlier that the value of peak to peak ripple across the reservoir capacitor is 3.5V, and now is the time to justify that statement. With the bridge capacitor charging circuit of *Figure 7* the capacitor receives a recharging pulse at twice the mains frequency, ie at 100Hz or every 10ms. During this 10ms period the capacitor supplies the regulator circuit and its voltage falls at a rate of I/C volts per second, where I is the current taken from the regulator in amps and C is its capacitance in Farads. I realise that the discharge curve is actually exponential, but over the short time between charges the linear approximation is sufficient. From this we can show that the peak to peak ripple on the capacitor is:

$$\text{p-p ripple} = I \times t / C$$

where the added item 't' is the 10ms time between the charging pulses passing to the capacitor. A quick calculation shows that this equates to 3000μF per amp of current drawn into the regulator and it is this quick rule that is used to calculate the capacitor value needed. As to the voltage rating for the capacitor, the dc voltage developed by the transformer will in simple terms be 1.4 times its ac voltage rating and the capacitor must be higher than this value. Exceeding 3000μF per amp for the capacitor or having a voltage rating much higher than that calculated is simply a waste of money.

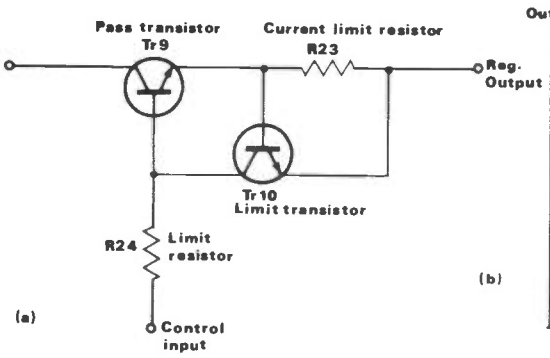


Fig 8a

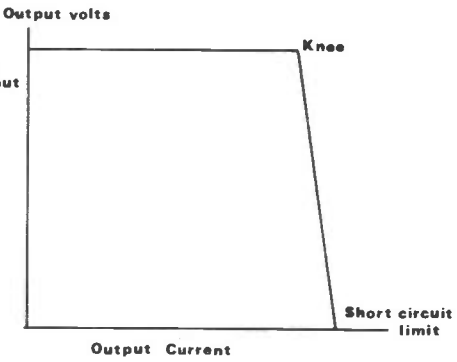


Fig 8b

Foldback current limiting

Foldback current limiting is an interesting and rather complicated protection device so let us consider it in some detail. *Figure 8* shows the simple limiter circuit used with the 723C and the output that would be obtained in the limiting condition. Remember that Tr10,the limit transistor, is internal to the 723C. If the current through R23 is below that which will produce a voltage sufficient to turn on Tr10 then the control signal will pass directly to Tr9, the pass transistor, and the output will be stabilised. If, however, the current drawn is sufficient to turn on Tr10, then Tr9 will be robbed of drive and the output voltage will fall at a constant current.

The knee current and the short circuit current will be nearly identical under these limiting conditions. The transistor Tr9 will need to radiate the power equivalent to the full unregulated dc supply times the short circuit current, and for safety the transistor heatsink will need to be massive to cope with this overload power. If it can be arranged for the current to fall beyond the knee we can save on transistor heatsinks, as the power under limiting conditions will fall as the current falls, even though the voltage across the transistor rises. This is precisely the use of foldback current limiting. *Figure 9* shows the circuit and output diagram. From *Figure 9b* the reason for this being called foldback current limiting can be seen. As *Figure 9a* shows, the circuit is more complicated, as is to be expected with the extra facility it offers.

Let us look at the circuit itself as shown in the abbreviated form in *Figures 9a* and *9b*. At the point when the limit transistor Tr12 begins to conduct and cut off the drive current, the voltage across its base-emitter junction will be 0.65V. *Figure 9c* looks at the knee condition with an output voltage of 15V and a limit current of 1.5A. The current sensing resistor R26 is larger in value than that for the simple limiting system, being 2.2 ohms and developing 3.3V. Under just limiting conditions the output from the pass transistor Tr11 at the emitter will be 18.36V and the actual current limit is 1.53A. The 18.36 volts are split between two resistors, R27 and R28, down to earth. The values are chosen to give 15.65V at Tr12's base which will be just sufficient to turn Tr12 on. The values calculated are 390 ohms and 2.2kohms for R27 and R28 respectively. Under the knee condition the power transistor Tr11 dissipates 23W.

Now look at the short circuit condition. In this case the output is at zero by definition and the junction of the resistors R27 and R28 is at 0.65V, just sufficient to turn Tr12 on. This leads to

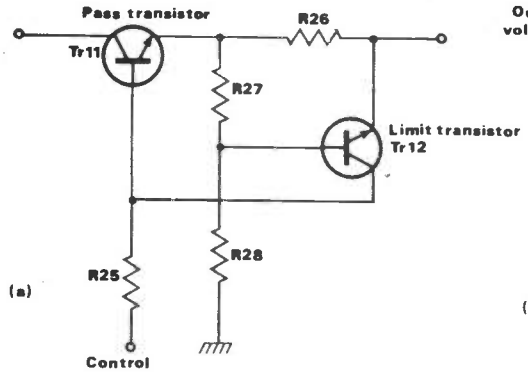


Fig 9a

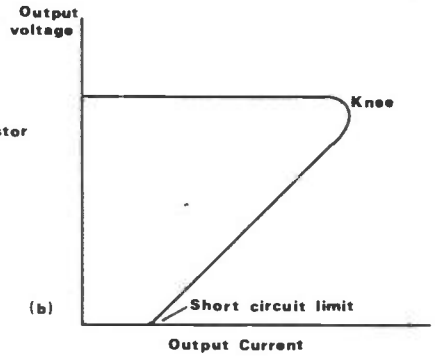


Fig 9b

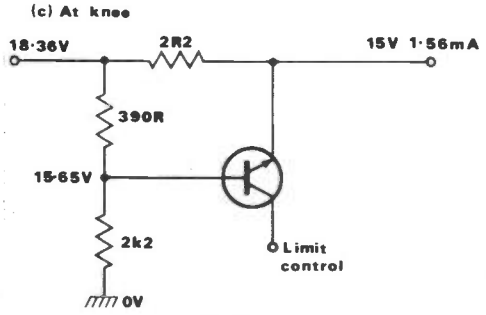


Fig 9c

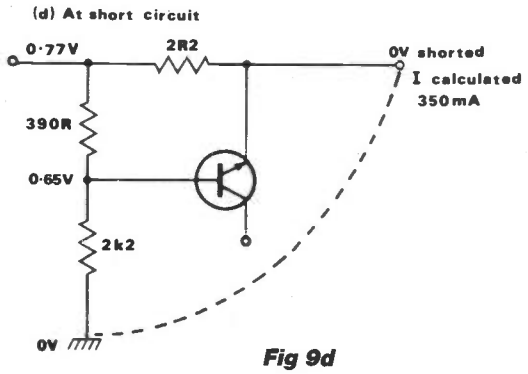


Fig 9d

Tr11's output being 0.77V with a limit current of 350mA. The transistor power dissipation is about 10W, a considerable saving over a power dissipation of 53W for the non-foldback system. Since, in the worst case, we now only have to dissipate 23W, the heatsink can be both smaller and cheaper than for the non-foldback design.

Incidentally, the maximum heat dissipation now occurs at a point on the output voltage/output current graph where most power supplies spend only a very small portion of their time. For a system that only takes short pulses of high current, say an audio amplifier, it will be possible to use the short circuit power dissipation limit of 10W as the design criteria for heatsink selection, remembering that 10W from Tr11 equates to a continuous current of 920mA at 15V output. If we assume a 28.8V input to the collector of Tr11 the heat dissipated is equal to:

$$(28.8 - 15) \times 0.92 = 10 \text{ watts}$$

Heatsinking

The question of heatsink size is often ignored, although the calculations are quite simple. Heatsinks are defined in terms of their thermal resistance to atmospheric temperature. Just as electrical resistance is defined by Ohm's law so thermal resistance is defined in terms of degrees centigrade rise per watt of heat dissipated. The simple function of the heatsink is to keep the transistor chip working below its maximum operating temperature. Figures for the maximum temperature are quoted in the data sheets for the device, but a simple value to use for safety is 150°C and the data sheet is not always to hand. As to the thermal resistance from junction to case, θjc, every catalogue gives a value for the maximum power dissipation of the transistor, but this assumes that the case of the transistor can be held at 25°C. We are told that the TIP41 used as the pass transistor in our supply will dissipate 65W, and if we assume 150°C maximum junction temperature we can calculate θjc as:

$$\theta jc = (150-25)/65 = 1.9°C/W$$

A quick look at any catalogue shows that heatsinks without additional fan assisted cooling are available from 0.5°C/W up. To simplify matters we shall take as an example a 1.9°C/W heatsink (Redpoint 2W-1) used for our TIP41 in the TO220 case and dissipating the 23W of the power supply discussed above.

Using the above conditions we can calculate the junction temperature from

$$Tj = Ta + (\theta jc+\theta cs+\theta sa)\times P$$

where Tj and Ta are the junction and ambient temperature in degrees centigrade and θjc, θcs and θsa are the thermal resistances from junction to case, from case to the heatsink and from the sink to ambient. P is the power dissipated by the transistor in question. For our TIP41 transistor, θjc will be 1.9°C/W, θcs from the mica washer and silicone grease will be 0.5°C/W, and let us take ambient temperature as 30°C, a very hot summer's day, and our heatsink of 1.9°C/W. Tj calculates to 131°C, which is close to the limit but satisfactory. In higher power dissipation situations it may be advisable to consider the use of two transistors on one heatsink as there is a reduction by half of the thermal resistance from junction to sink with two transistors. The value of thermal resistance of the heatsink itself remains the same in the two transistor application.

The three terminal regulators present more of a problem for heatsinking as the junction temperature is limited to 125°C and the thermal resistance from junction to case is 5°C/W. Without any heatsink the junction to ambient thermal resistance of the TO220 package is 60°C/W, and this value must be assumed for the 78XX regulator mounted on a PCB and supplying only small currents.

Reference voltages

I have rather ignored the use of discrete voltage regulators, by which in this case I mean regulators using just transistors or including op-amps rather than dedicated regulator chips. In some applications, mainly in variable voltage supplies, it may be better to use the discrete option to make the supply. In this case it will be necessary to construct a stable reference voltage. *Figure 10* shows some of the possibilities. Zener diodes exhibit a small change in voltage with current in the Zener region due to inherent internal resistance, and to give a stable output the current must remain constant.

Figure 10a with a simple resistor feed will show a substantial 100Hz ripple if the resistor is simply connected to the unregulated supply. For fixed supply output voltages the resistor R29 can in fact be connected, not to the unregulated input, but to the regulated output, providing the Zener voltage is lower than the output voltage. Thus the Zener receives a stable current supply and gives a stable output voltage. The unregulated supply ripple rejection is due to the supply rejection ratio of the op-amp used, which will typically be 100μV/V.

If we are making a variable supply then we have to use other methods of Zener current stabilisation, such as those shown in *Figures 10b* and *10c*. In *Figure 10b* we use the fact that a junction FET with its gate and source shorted together will act as a constant current source,

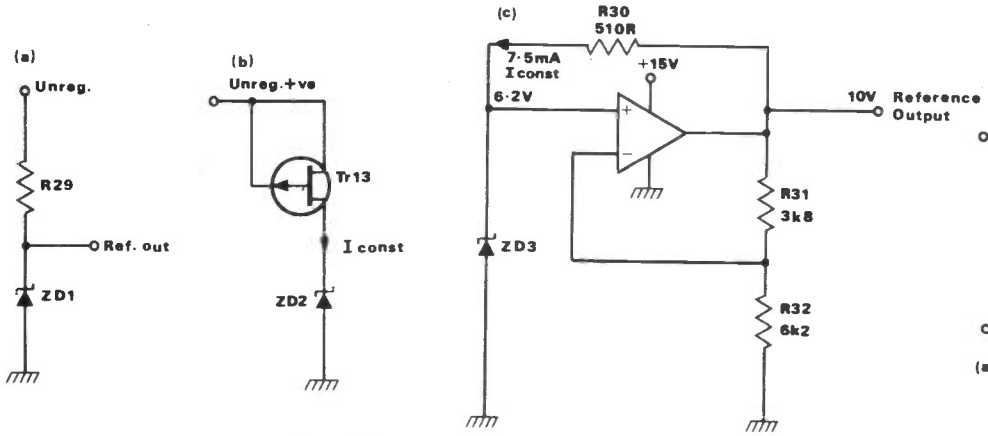


Fig 10 *Reference supply*

whilst *Figure 10c* uses an op-amp to achieve the same end, there being a constant current through R30. Hopefully, the reader will also have thought of the possibilities of using the three terminal adjustable and fixed regulators for Zener stabilisation.

Overvoltage protection

If the constructor is considering connecting the new power supply to an expensive piece of equipment, then it is essential for the equipment's safety to add some form of overvoltage protection to the supply. Most pieces of equipment will stand a small overvoltage without damage, but failure of the pass transistor will leave the full unregulated supply across the equipment with disastrous results before the fuse blows.

Electronic overvoltage is the only thing that acts fast enough to protect delicate equipment. The protection can be of two types, the latching (crowbar) system using a thyristor, *Figure 11a*, or the clamp using a transistor. With the latching system, when the SCR fires the output is virtually shorted to ground and in a very short time the fuse blows, and in any case the SCR holds the output voltage at a very low level. The clamp restricts the output voltage to 0.65V greater than the Zener voltage of ZD4 and providing the current limit is set below the fuse rating, the system will restabilise when the overvoltage ceases. The problem with the clamp method is that the clamp transistor will dissipate high power when it conducts and will need to be fitted to a heatsink. The most common failure of a PSU is the emitter/collector short of the pass transistor and in this case with either system the fuse will blow in short order.

Parallel pass transistors

In some applications it may be necessary to use more than one pass transistor, either because a single transistor cannot carry the full output current or for reasons of heat dissipation, discussed earlier. If we are using junction transistors then each transistor will need a separate emitter resistor, *Figure 11c*, of a value such that the voltage across the resistors is about 0.5V at the maximum current of each transistor. Junction transistors have a positive thermal coefficient and if one transistor starts to become warmer than the others, then without the resistors the hotter transistor will carry a greater share of the current, which will make the transistor even hotter until eventually it fails due to thermal runaway. Power MOSFETs have a negative thermal coefficient and do not need the resistors. Indeed, with high current PSUs it is usual to split the supply out and sense return circuits so that the effects of supply cable resistance can be overcome.

Safety

Although safety is the last item in this article, it must never be the last thing on the constructor's mind. Under no circumstances would the author think of making a PSU without a transformer, although I am aware that some commercial equipment uses transformerless PSUs. It is also the reason that switched mode PSUs have not been included. Most switched mode PSUs rectify raw mains and use this to charge up a capacitor to 325V. The switching circuit runs at perhaps 100kHz, then transforms this down to the required voltage with a feedback loop controlling the pulse-width and stabilising the output. The SMPSU is not really suitable for amateur use, due to the lethal voltages from the rectified mains.

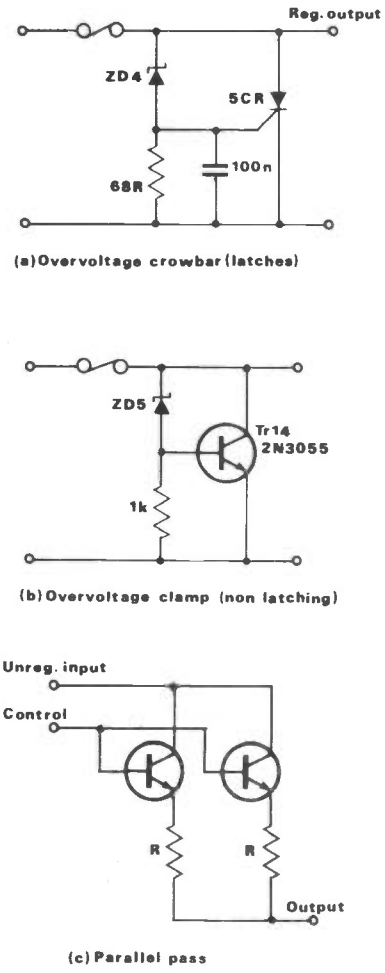
Large capacitors can hold sufficient charge to cause serious damage to the anatomy if discharged through a ring or watchstrap. All capacitors should have discharging resistors which will dissipate the charge about 5 seconds after switch off.

As all of the problems of safety are to do with the mains voltage present, there are a few essential items in this input side of the transformer. The incoming mains should be fused at the PSU itself; do not rely on the fuse in the mains plug, and of course some mains plugs do not have fuses anyway. The mains should pass through a double pole switch, not a single pole. It is too easy to get the wires crossed and switch the neutral line instead of the live.

Lastly earthing. The metal parts of the PSU case *must* be earthed securely and, unless there is some definite reason why the output must float, then one of the output rails should also be earthed.

Power supplies are an essential part of electronics construction and it is important to understand how they work to be able to design a reliable unit. With this information you should be able to design and build any PSU you want. Just have a go. REW

Fig 11 *Miscellaneous (all overvoltage inputs must be fused in the regulated output line)*



ERRATA

Readers may have noticed that all eleven figures were included in last month's instalment of ***Power Supplies*** in error. We apologise for any confusion this may have caused.

A COMBINED MORSE AND RTTY DECODER FOR THE ZX SPECTRUM

by Colin Tallis

This article is an extension of the Morse decoding system described in the June 1986 issue of *Radio and Electronics World*. Readers who have built the interface described previously may have felt a need to decode another type of signal found on the high frequency bands, namely RTTY (radio teletype).

The present system is extremely simple to build and operate, essential requirements being a ZX Spectrum, a short wave receiver with BFO and a reasonable aerial system. An oscilloscope is also an extremely useful instrument for identifying RTTY signals and adjusting the receiver for the best results.

The system comprises two distinct units: a tone decoder identical to that described in the earlier article and an RTTY/Morse interface, assembled on a plug-in board for convenience. The board uses address lines A5, A6 and A7 for interfacing with the Spectrum, so there is no conflict with the ZX printer.

The two machine code sub-routines can be placed anywhere in the memory, but of course the USR addresses will have to be altered accordingly.

In order to change from Morse to RTTY and vice versa, a simple Basic program is used with a 'break' sub-routine in each machine code program. *Listing 1* is of the Basic program. The program should be saved with the instruction 'SAVE "comms" LINE 150' which will ensure that the program self-runs on subsequent LOADing.

The break routine in each machine code program is identical, and checks for key 'Q' being pressed, returning to Basic if the condition is met.

No other features are included in the interests of simplicity, but no doubt machine code buffs will be able to elaborate the program further.

Circuit description

Figure 1 is the tone decoder circuit. The only modifications to this circuit are the inclusion of a coarse/fine centre frequency adjustment and a bandwidth control.

Listing 1

```
  10 REM Communications
  20 PRINT AT 5,9;"COMMUNICATION
S"
  30 PRINT AT 10,13;"© 1987    "
AT 15,10;"C.E. TALLIS"
  40 PRINT AT 20,0;"PRESS R FOR
RTTY; M FOR MORSE"
  45 INPUT I$
  50 IF I$="R" OR I$="r" THEN FL
ASH 1: PRINT AT 15,0;"press '0'
to return to Basic": PAUSE 50: F
LASH 0: CLS : PRINT USR 30000
  60 IF I$="M" OR I$="m" THEN FL
ASH 1: PRINT AT 15,0;"press '0'
to return to Basic": PAUSE 50: F
LASH 0: CLS : PRINT USR 30500
  70 GO TO 20
 150 LOAD ""CODE 30000,1000
 160 RUN
```

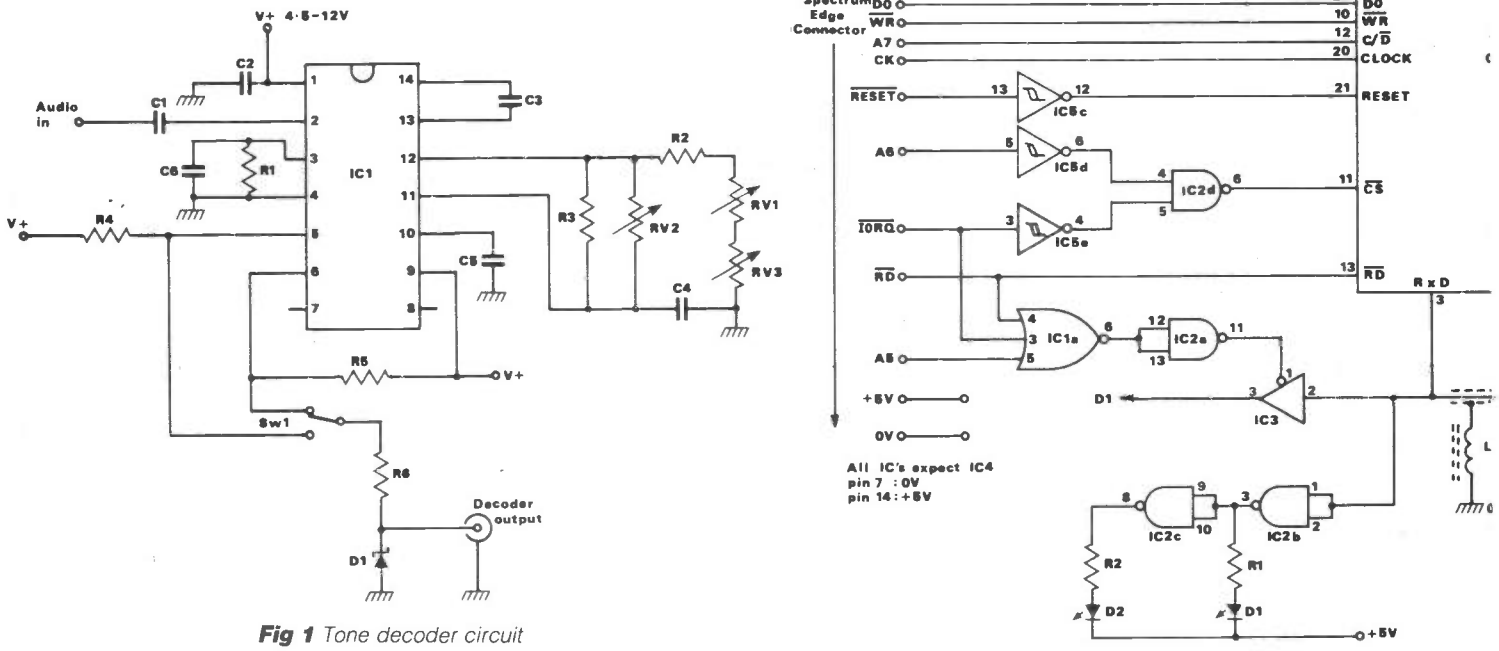


Fig 1 *Tone decoder circuit*

The circuit of the main interface board, which plugs into the rear of the Spectrum by means of a 23 way connector, is shown in *Figure 2.* The function of the Morse decoder section has been described previously and is carried out by IC1a, IC2a and IC3, whilst RTTY is handled by IC2d, IC5 and IC4d. IC2b and IC2c are common to both sections and give a visual indication of the incoming signal.

No further details of the Morse decoder will be given here but the revised machine code listing is shown in *Table 1.* The RTTY circuitry is outlined in some detail below.

RTTY decoder

The heart of the decoder is the 8251A chip which is a USART or Universal Synchronous/Asynchronous Receiver/Transmitter, manufactured by Intel. At less than £4 this represents excellent value for money. Only a few extra ICs are required for the present application.

The 8251A is available from several mail order suppliers, including Maplin, who will also provide a useful data sheet on this device. For anyone considering expanding the system to include the transmission function or changing the command or mode words, this is essential reading. Several Z80A microprocessor applications books also contain useful programming information on this device.

For ease of construction, the decoder was designed to receive 5 bit Baudot code at a fixed rate of 50 baud, since this is one of the most commonly encountered modes of transmission. Other rates such as 45.5 can also be accommodated by altering the clock frequency, but program changes would be needed to receive 7 bit ASCII code.

Circuit operation

Most of the 8251A pins are connected directly to the Z80A buses and are self-explanatory. The all important baud rate clock is generated by the IC5a Schmitt inverter, buffered by IC5b and fed to pin 25 of the 8251A. The same clock output can be used to control the transmission frequency (pin 9, not shown).

Data is fed into the USART at pin 3, at TTL logic level of 5 volts. Additional buffering is not required.

As well as the baud rate clock, the 8251A requires another clock input. This clock is for internal timing purposes and is connected directly to the Z80A clock bus. The data sheet suggests a minimum clock period of 320 nanoseconds (3.1MHz) for this input, which would imply that the Spectrum clock running at 3.5MHz would be too high. However, the system operates quite happily at this frequency with no problems.

The RESET pin 21 is connected to the Z80A bus via the inverter IC5a since the 8251A requires this pin to be low for normal operation.

The logic circuit IC2d and IC5d/5e ensures that the chip is only enabled when A6 and $\overline{IORQ}$ go low together. A7, which is connected to pin 12 (C/$\overline{D}$), sets the USART to either the control or data modes.

Programming the 8251A

For obvious reasons, Basic cannot be used to program the USART and therefore a short machine code routine is required. Two 'words' are needed to set

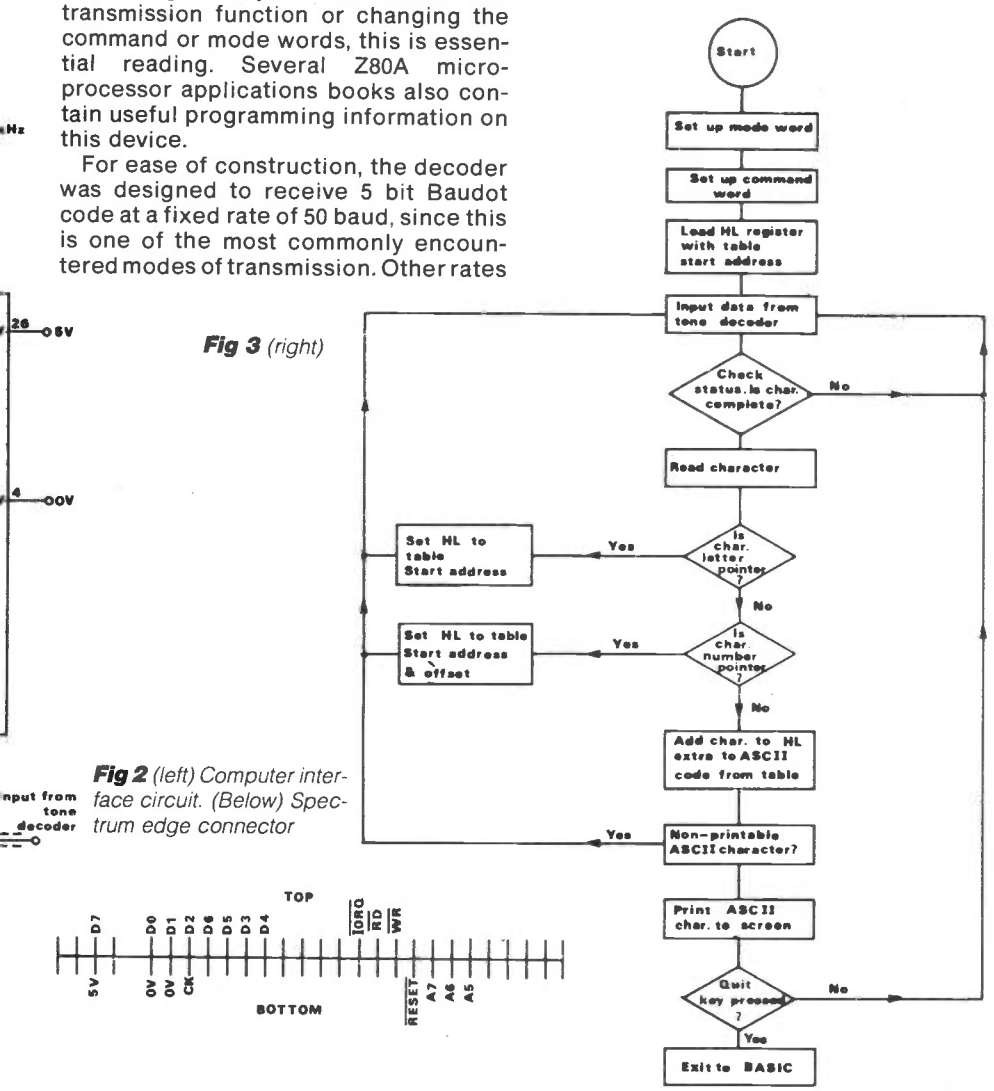


Fig 3 (right)

***Fig 2** (left) Computer interface circuit. (Below) Spectrum edge connector*

COMPONENTS LIST

Tone Decoder

C1 0.1μF
C2 0.1μF
C3 0.047μF
C4 0.01μF
C5 0.1μF
C6 0.1μF

R1 470KΩ
R2 15KΩ
R3 270KΩ
R4 10KΩ
R5 10KΩ
R6 2.2KΩ

VR1 5KΩ lin
VR2 1MΩ lin
VR3 25KΩ lin

D1 BZY88 4V7

SW1 SPDT

IC1 XR2211

Computer Interface

C1 0.47μF

R1 1KΩ
R2 1KΩ
R3 440Ω (220 + 220)

VR1 220Ω preset

D1, D2 LED

IC1 74LS27
IC2 74LS00
IC3 74LS125
IC4 8251A
IC5 74LS14

L1 20 turns of enamelled wire wound on a 9mm dia ferrite toroid (see details in previous article)

Veroboard, IC sockets, etc

Edge connector 2 × 23 way

Table 1 *Morse program*

```
7720 00 00 00 00 11 00 00 01
7728 01 0C 21 00 00 CD B9 77
7730 30 34 24 7C CB 3F CB 3F
7738 CB 3F B8 38 07 CD B9 77
7740 30 E5 18 F9 CD B9 77 38
7748 E9 2C 78 CB 3F BD 38 0C
7750 CD B9 77 30 F4 7C 85 67
7758 2E 00 18 D6 7C CB 3F B8
7760 CB 11 26 00 18 09 2C 7D
7768 CB 3F CB 3F B8 30 18 CD
7770 B9 77 30 F2 24 78 CB 3F
7778 BC 38 09 CD B9 77 38 F4
7780 7D 8C 6F 26 00 18 DF 79
7788 FE 01 28 06 CD D1 77 CD
7790 D1 77 2E 00 26 00 CD B9
7798 77 30 F9 24 78 CB 3F BC
77A0 30 F4 18 A0 78 CB 3F 80
77A8 BD 38 07 78 85 DB 3F 47
77B0 18 03 CD D1 77 2E 00 18
77B8 88 C5 06 05 0E 00 DB 40
77C0 E6 02 81 4F 16 C8 15 20
77C8 FD 0F 10 F2 79 FE 05 C1
77D0 C9 C5 E5 79 01 32 00 21
77D8 FB 77 ED B1 01 32 00 09
77E0 7E F5 3E 02 CD 01 16 F1
77E8 D7 E1 C1 0E 01 C5 01 FE
77F0 FB ED 78 FE BE CA EE 1C
77F8 C1 C9 00 01 06 17 15 0B
7800 03 1D 09 1F 07 18 0A 1B
7808 04 05 08 19 12 0D 0F 02
7810 0E 1E 0C 16 14 13 30 38
7818 3C 3E 3F 2F 27 23 21 20
7820 2E 6A 2D 4C 35 6A 7A 73
7828 47 47 55 52 37 00 20 41
7830 42 43 44 45 46 47 48 49
7838 4A 4B 4C 4D 4E 4F 50 51
7840 52 53 54 55 56 57 58 59
7848 5A 31 32 33 34 35 36 37
7850 38 39 30 3D 2E 2F 2C 23
7858 2D 3C 3F 3A 3B 29 22 2A
7860 00 00 00 00 00 00 00 00
```

up the 8251A; a mode word and a command word after which the chip will continue to decode the incoming data until either the 'Q' (quit) key is pressed or the computer is reset.

Table 2 *RTTY program*

```
M
Monitor
T7530

7530 3E 83 D3 BF 3E 14 D3 BF
7538 21 77 76 C5 01 FE FB ED
7540 78 FE BE CA EE 1C D1 DB
7548 BF E6 02 28 EE DB 3F FE
7550 1F 28 19 FE 1B 28 1A E5
7558 85 6F 7E E1 FE EE 28 DB
7560 F5 3E 02 E5 CD 01 16 E1
7568 F1 D7 18 CF 21 77 75 18
7570 CA 21 97 75 18 C5 C9 EE
7578 45 EE 41 20 53 49 55 20
7580 44 52 4A 4E 46 43 4B 54
7588 5A 4C 57 48 59 50 51 4F
7590 42 47 EE 4D 58 56 EE EE
7598 33 EE 2D 20 22 38 37 0D
75A0 EE 34 EE 2C 25 3A 28 35
75A8 EE 29 32 60 36 30 31 39
75B0 3F 40 EE 2E 2F 3D EE C9
```

A flow chart for the program is shown in *Figure 3* and the machine code listing in *Table 2*.

Construction

The prototype was assembled on a piece of VeroDIP board type V-Q 200-21084E. This material is convenient to use as there are no tracks to cut. *Figure 4* shows the positions of the various ICs, though no doubt other layouts would be as effective. Sockets should be used throughout and all wiring double checked before applying power.

Operation

Assuming that construction has been satisfactory, the Basic program and the two machine code listings should be LOADed and RUN. Check the Morse decoder first, since this part is easily verified. Check the operation of the 'Quit' key, then select the RTTY function. Adjust VR1 to set the clock frequency to 3.2kHz (50 baud). This is best carried out with the aid of a 'scope, but if a suitable instrument is not available, then set VR1 to its mid-position and adjust by trial and error. If the component values are not too far removed from those shown in *Figure 2*, the required frequency will be obtained. Locate a strong RTTY signal; again an oscilloscope will be helpful in identifying a 50 baud transmission (20 millisecond pulse-width).

At this stage characters should be appearing on the TV screen. If they make sense, fine, otherwise change the phase by means of S1 on the tone decoder unit. If the output is still garbage, the clock frequency may need some adjustment or the transmission may be in a format other than 5 bit Baudot code and therefore cannot be decoded. With practice, recognition of RTTY signals becomes easier and provided reception conditions are good, there are always interesting transmissions to be heard on the HF bands. REW

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BC108B	0.15
BC108C	0.15
BC109	0.18
BC108B	0.18
BC109C	0.18
BC182	0.12
BC182B	0.12
BC183	0.12
BC183B	0.12
BC184	0.12
BC212	0.12
BC212B	0.12
BC213	0.12
BC213B	0.12
BC214	0.12
BC327	0.16
BC337	0.16
BC548	0.12
BCY70	0.22
BCY71	0.22
BD131	0.60
BD132	0.60
BC135	0.34
BD136	0.35
BD239A	0.60
BF258	0.60
BFX85	0.40
BFX88	0.40
BFY50	0.37
BFY51	0.37
BFY52	0.39
TIP31	0.42
TIP31A	0.48
TIP31B	0.56
TIP31C	0.54
TIP32A	0.42
TIP32C	0.42
TIP33A	1.00
TIP41A	0.63
TIP42A	0.55
TIP3055	0.76
TIP2955	0.76
ZTX300	0.17
ZTX500	0.17
2N3053	0.60
2N3054	1.60
2N3707	0.12
2N3703	0.12
2N3705	0.12
2N3771	1.40
2N3904	0.15
2N3906	0.15

DIODES

IN4001	0.05
IN4002	0.05
IN4003	0.06
IN4004	0.06
IN4007	0.08
IN4148	0.06
IN4448	0.06

OPTO ISOLATORS

TIL111 transistor o/p	1.10
TIL113 Darlington o/p	1.20
3021 Triac driver	1.50

LEDS

T1¾ 5mm	
Red	0.18
Yellow	0.18
Green	0.18
Super bright T1¾ 5mm	
Red	0.35

TRIACS

TIC206D 3 Amp 400V working	max 0.75
TIC225D 8 Amp 400V working	max 0.90

ZENER DIODES

BZY88C 500m W	
4V7	0.10
10V	0.10
12V	0.10
BZX55C 500mW	
24V	0.10
BZX85C 1.3 Watt	
4V7	0.20
10V	0.20
12V	0.20
24V	0.20

VOLTAGE REGULATORS

LM317T +1.2V to 37V	1.50
LM341P +5V	0.60
LM7905 –5V	0.70

BRIDGE RECTIFIERS

WOO4 1.5A	0.50
6005 6A	0.90

CAPACITORS

Electrolytic		
47uF	25V	0.10
100uF	25V	0.12
470uF	25V	0.28
1000uF	25V	0.36
Axial or Radial		
10uF	25V	0.08
220uF	25V	0.15
Tantalum		
0.1uF	35V	0.10
0.22uF	35V	0.10
0.47uF	35V	0.10
1uF	35V	0.10
2.2uF	35V	0.15
4.7uF	35V	0.20
Ceramic		
220pF	500V	0.06
470pF	500V	0.06
1000pF	100V	0.06
220pF	100V	0.06
4700pF	100V	0.06
10nF		0.05
22nF		0.06

RESISTORS

Metal Film 5% ⅓ Watt
2p each

100R 680R 1K 2K2 4K7 5K6 6K8
10K 12K 15K 22K 27K 33K 39K
47K 56K 68K 82K 100K 120K
150K 180K 220K 270K 330K
390K 470K 560K 680K 820K 1M

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Values:- 100R 220R 470R 1KQ 2K2 4K7 10KQ 47KQ 100KQ 220KQ 470KQ 1MQ 0.19

LINEAR ICs

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NE556	0.65
LM301	0.28
NE5532	1.20
NE5534	0.80
ZN414	0.90
ZN416	1.60
LM308	0.70
TL081	0.50

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24 PIN DIL	0.20
40 PIN DIL	0.30

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THE ICOM IC-R7000

VHF/UHF General Coverage Receiver

It was with particular interest that I received a recent offering from Icom of Japan, as the IC-R7000 VHF/UHF general coverage receiver has a frequency range right up into the Gigahertz band and I had never before had the opportunity to use a receiver going into the UHF and SHF bands.

The coverage is from 25 to 999.999MHz, although this can be extended from 1025MHz to the limit of the receiver's range, 1999.999MHz. However, it would appear that the receiver is designed to copy amateur signals between 1240 and 1300MHz, as I did not receive anything above that.

When the receiver arrived, it was accompanied by an antenna specially designed for the job, also made by Icom. This was the AH-7000 super wideband omni-directional antenna, a discone type which I shall describe later.

The receiver itself is 303mm wide by 127mm high by 319mm deep, and weighs approximately 8.0kg. There are three modes of reception: AM, FM and SSB. Between 25MHz and 999.999MHz the sensitivity varies according to the mode in use. Looking at the modes in sequence, FM, FM (wide), AM and SSB, the sensitivities are less than 0.5μV and 1.0μV for 12dB sinad for FM, and less than 1.0μV and 0.3μV for 10dB S/N for AM and SSB. When one uses the highest frequencies, the sensitivities for FM and FM (wide) are less than 0.2μV and 2.0μV for 12dB sinad, for AM less than 2.0μV and for SSB less than 0.3μV for 10dB S/N.

The operation of a slide switch on the rear panel gives, in effect, three bandwidths for the FM mode; when used in conjunction with the front panel mode switch it gives a choice of 15kHz or 6kHz bandwidth in its first position and 150kHz for FM or 15kHz for FMn when moved to its second position. This switch, however, is very fiddly to use, and has to be operated with the user's fingernail.

The stability is excellent according to the manufacturer's figures, being ±5ppm at 0°C to approximately 50°C in the range 25 to 999.999MHz and only 10ppm for the same temperature range for a frequency coverage of 1240 to 1300MHz. In the range 25 to 999.999MHz for FM, AM and SSB the unit acts as a triple conversion superheterodyne, but in the FM (wide) mode over this range it acts as a double conversion superheterodyne. In the extended frequency range of 1240MHz to 1300MHz in the FM, AM and SSB modes it runs as a quadruple conversion superheterodyne and in the FM (wide) mode at this frequency range, as a triple conversion superheterodyne. The choice of USB or LSB has to be made from a slide switch at the back, as though this facility was introduced as an afterthought. However, it does not affect the operation of the receiver and is easy to find.

The second and third intermediate frequencies are the same throughout the range 25MHz to 999.999MHz, but the first IF is 778.7MHz for the range 25MHz to 512MHz and is altered to 266.7MHz from 512MHz to 999.999MHz. The third IF is not utilised throughout the whole range when in FM (wide) mode as the receiver then acts as a double conversion superheterodyne.

The frequency control is a CPU based 100Hz/step digital synthesizer, and there are 99 memory channels available, the top nineteen of which can be automatically written into the memory as a separate entity.

This 'auto write' facility is quite interesting. When this facility is selected, it switches the receiver into the 'programmable scan' mode. The receiver will operate on 117, 220 or 234 volts ac and needs 1.7 amps at maximum audio output. When squelched, however, it only requires 1.4 amps. The antenna impedance is the usual 50 ohms.

There are a great number of facilities available for the operator's use. The scan speed can be controlled and the time for which the receiver stops at each transmission can be altered.

There is a VSC facility, which stands for voice scan control, and this is one that I have not come across before. When this switch is depressed it means that the scan, when operating, will only stop at received signals carrying voice or audio. A switch labelled 'meter' alters the operation of the S-meter from a lefthand scale to a centre scale (for FM reception) when pressed in. The S-meter itself is calibrated with two scales, the upper one reading from S1 to +60dB and the lower one showing 'centre' marked with '+' and '−' for the reception of FM.

Other controls include set, set/reset and clear switches. There is a phone socket (a normal ¼in jackplug), a record output socket, and AF gain and squelch controls.

In the centre of the front panel is the frequency display, which gives the actual frequency to the nearest 100Hz and shows whether the 1GHz switch is operating, the mode in use (AM, FM, FMn or SSB), whether the auto write facility is switched in and the memory channel being used. The display shows 'P' when the priority scan facility is being used.

The main tuning knob is, in my view, an excellent piece of engineering. It is beautifully smooth to operate without any play in the shaft, and has an indentation in the front for quick finger turning. The frictional drag can be adjusted from below by means of a small screw.

The operation of the dimmer switch reduces the illumination of the display if desired, the attenuator cuts the signal by approximately 20dB in every mode, and the remote switch allows the use of the wireless remote controller (model RC-12) which can be obtained as an extra but was not supplied with the review unit.

A control labelled 'Mem-Set' is used to temporarily transfer the displayed frequency and mode information to new memory channels, and a 'speech' facility initiates voice reproduction of the displayed frequencies when the IC-EX310 voice synthesizer unit is used (an optional extra).

Another switch acts as an electrical lock for both the tuning control and memory channel selector.

The memory channel selector is a rotary control which shows the memories in sequence (1, 2, 3, etc or 99, 98, 97, etc) on the display, and it is a simple matter to recall any frequency in the memory.

A second rotary control is one that I like very much, the 'tuning step selector'. It allows you to select frequency steps in six different increments for all four operating modes.

They are 0.1kHz, 1kHz, 5kHz, 10kHz, 12.5kHz and 25kHz, and I think this facility is a great help in the operation of the receiver.

by Ken Michaelson G3RDG

The top switch in the middle of the two rotary controls is the 'write' switch. When this is pressed the frequency and information shown on the display is automatically transferred to a vacant memory channel.

A lithium back-up battery is provided, the service life of which is approximately five years, so that if the set is switched off at its own power switch or disconnected from the mains supply, the data stored in the memory remains intact.

A socket is included for connection to an external speaker (a speaker with an impedance of 4-8 ohms is recommended), and 2 others are for recorder remote (which is connected internally to the squelch circuit so that as soon as the squelch is opened with a signal the recorder is started) and remote. The latter socket is a communications port which can be utilised with a personal computer. It accepts and transmits serial data using one signal line and ground. I used the serial control system JT602, manufactured by Jaytee Electronic Services, with this input/output port, and I will describe the results later.

On the back panel there are two phono sockets, the right-hand one of which outputs 10.7MHz second IF signals which are superimposed on the 9V dc level. One has to be careful when using this socket because of the output of the dc voltage. The left-hand phono socket is available as a spare. I used this socket to connect the output for the S-meter reading when using the JT602 computer interface.

Also located at the back is a substantial grounding post connector, the antenna connector (a 50 ohm N type socket), the fuse carrier, using a 500mA fuse, and the IEC mains socket.

The AH-7000 antenna

The assembly of the AH-7000 antenna was a straightforward operation, requiring the 820mm elements to be inserted into the centre rod to make the cone and then the shorter (280mm) elements for the disc. Then on went the loading coil and the top whip. A ready made length of co-ax cable was provided with 50 ohm N type plugs soldered on at either end. This had to be connected to the antenna socket before assembling the 820mm elements to avoid damaging the N connector.

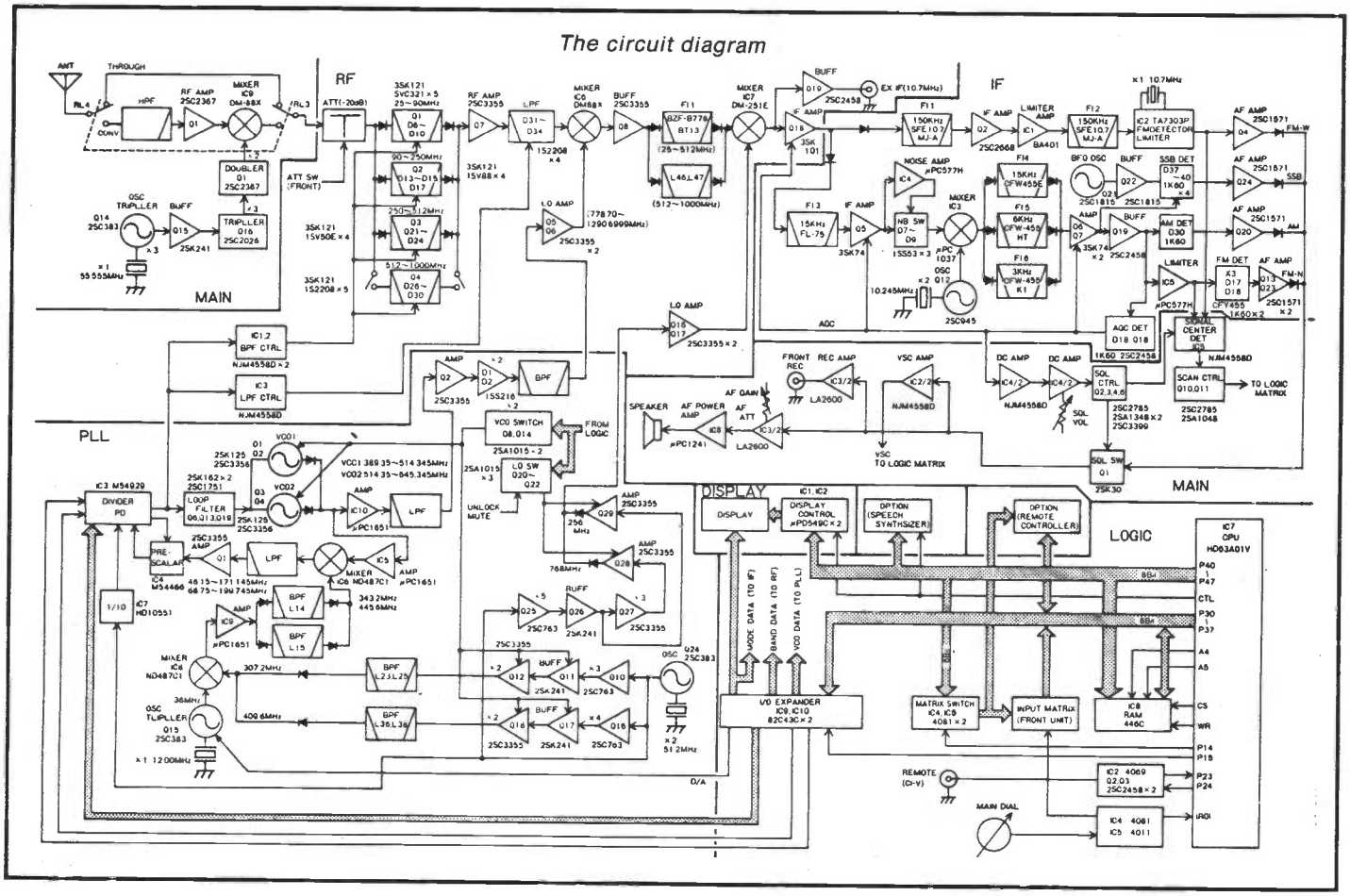
Having erected the antenna, connected it to the receiver and switched on, I tried the 2 metre repeater on 144.650MHz. This was received with no difficulty, although nothing was heard on 433.250MHz until around 1700, when I copied the mobiles.

The FM broadcast programmes were received with what I considered to be quite reasonable quality at 150kHz bandwidth. The unit does not pretend to be hi-fi, but the audio was clear and clean. TV sound was also of listenable quality. I noticed, however, that there were clicks from the synthesizer when the background noise was low. These were most severe on the 25kHz steps, but were relatively inaudible at 100Hz. It was possible to use the tuning control from whatever memory position I switched in as a VFO. If I had the SSB calling frequency 144.300MHz on a memory channel, I could call that up and tune anywhere either side of it by using the tuning knob. Very convenient.

The interface

I also had the opportunity to use the Jaytee JT602 serial interface, which allows the IC-R7000 to be used with the BBC computer. Connection is made to the micro via the RS423 port and analogue socket, the interface being housed in the cover of the analogue connector. Connection to the R-7000 is made by a 3.5mm jackplug which plugs into the communications port.

The circuit diagram



The program was supplied on disc. This gave me the choice of the control program or the QRA-QTH converter program. I decided to examine the former.

I will not list all the control program commands using the Beeb keyboard, but it is sufficient to say that there are twenty-five different operations which can be carried out with this control system. With the version 1.2 software now available, there are two methods of scanning, SCAN-P and SCAN-W. SCAN-P pauses when a signal is detected and resumes scanning after a preset period and SCAN-W waits when a signal is detected and does not resume scanning until that signal ceases.

The mode initially selected would be SCAN-P and this is changed to SCAN-W by using the ':' key. This key has a toggle action and the modes can be changed from one to the other during scanning. This gives almost unlimited flexibility.

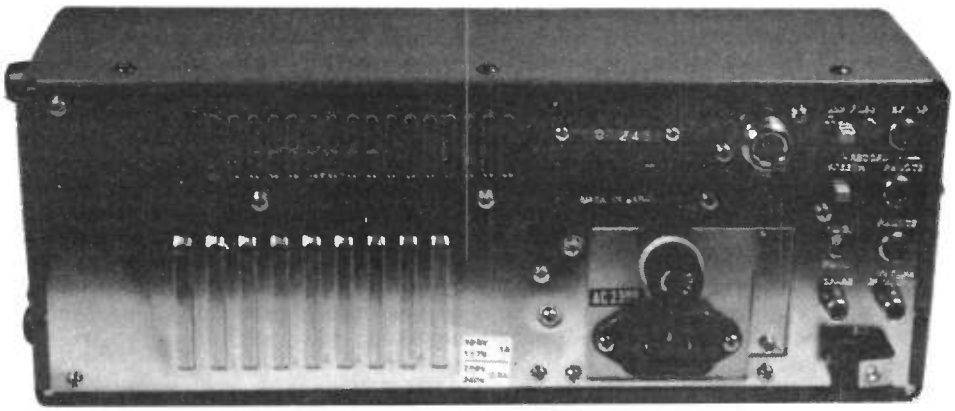
The program is written in Basic and is entirely unprotected to make it easier for a purchaser to make any changes that he/she might think fit. In fact, Jaytee Electronics say that they welcome 'piracy' on the grounds that Icom users are likely to benefit from idea swapping. I must say that I was very impressed with this control system.

Conclusion

The IC-R7000 is, in my opinion, a beautifully made piece of electronic gear. The various push on/push off switches are positive in action, and the display of the frequency together with all the other information shown is very helpful. I had the receiver, antenna and JT602 control system for about a month and spent all my time just listening to this previously undiscovered part of the spectrum. All in all a fine receiver, and when the JT602 control system is added one has the lot. The prices of the various units are as follows, all including VAT and carriage:

IC-R7000 general coverage receiver – £957.00; AH-7000 super wideband antenna – £82.00; RC-12 wireless remote controller – £62.00; IC-EX310 voice synthesizer unit – £44.00; JT602 serial interface – £19.95.

Thanks are due to Thanet Electronics Ltd for the loan of the IC-R7000 receiver and the AH-7000 antenna, and also to Jaytee Electronics for the loan of the JT602 interface for the purpose of this review. REW



SPECTRUM WATCH

by John Andrews

You may be as surprised – and gratified – as I was to learn that more than 600 lives have been saved since 1982 with satellites belonging to SARSAT, the international search and rescue operation. The USA currently has two SARSAT birds, while the Soviets have three in operation.

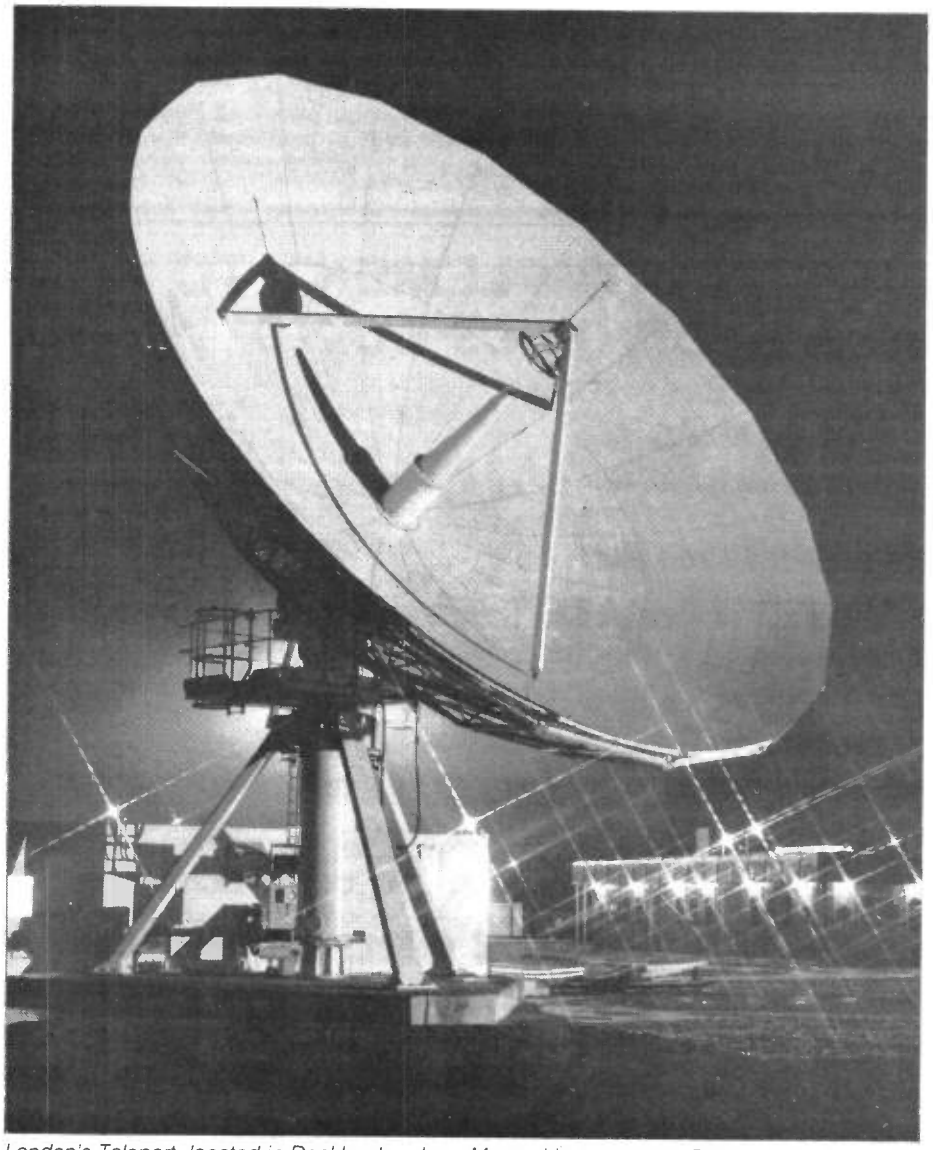
Only six days after launch and less than 24 hours after being put into operation, the SARSAT tracking equipment on board an NOAA-10 satellite picked up the first distress signals from a downed aircraft. This led to the rescue of four Canadians who crashed in a remote part of Ontario. The new satellite relayed their distress signals to Canadian rescue forces, while a Soviet satellite verified the distress signal.

These birds operate in low polar orbit to detect and locate transmission from distress beacons operating at 121.5 and 406MHz (put these in your scanner?). These beacons are frequently carried on aircraft, ships and boats, as well as by people whose activities take them to remote or hazardous locations on land. SARSAT activities are co-ordinated by INMARSAT, the international maritime satellite organisation based in London.

News from Chelmsford

Marconi Communication Systems has been awarded a contract worth more than £70,000 to upgrade one of British Telecom's television earth terminals at the London Teleport. The new equipment includes a 2kW transmit amplifier on 14GHz which meets the requirements of Intelsat V and VI as well as Eutelsat.

Marconi Mobile Radio has completed a contract to supply and install its latest mobile radios in 98 of the West Midlands Ambulance Service's front-line ambulances. These VHF-FM sets give two-way communication between the ambulance and headquarters and also to a hand-portable set which can be carried by an ambulance man. This extension device can be most useful if he has to leave the vehicle to attend an injured person in a block of flats and needs to summon assistance from the vehicle.



London's Teleport, located in Docklands, where Marconi is to augment BTI's existing transmitters and receivers (photo: British Telecom)

Microwave TV?

In North America many viewers receive additional TV channels, not by satellite or cable, but by microwave distribution. Well-sited transmitters operating at about 2.5GHz beam premium programmes mainly to hotels and apartment blocks, but also to hobbyists who build converters to receive these programmes. MMDS is the name given to the system, and these multipoint microwave distribution services look like turning up over here. Whether they will be on frequencies as easily received as 2.5GHz and unscrambled like their stateside counterparts remains to be seen.

The Irish minister for communications, Jim Mitchell, has decided to legalise MMDS in Eire, and his department is currently drawing up a national frequency plan and technical specifications. UK cable operators are pressing the Government too, as they believe the use of MMDS will help them expand coverage and generate cashflow faster. MMDS, they say, could be used on a temporary basis in outlying areas not yet reached by cable and where cable is uneconomic. Homes might install their own aerials and downconverters or share a local master antenna.

Croydon Cable, in south London and Surrey, has also applied to the DTI for the right to use microwave frequencies for distributing programmes to the various head-ends of cable systems across London. This could enable cable operators to swap news film and make a composite London-wide local news channel.

The only snag is that only British Telecom and Mercury currently have the right to use these microwave frequencies, and cable operators want this right for themselves as well. The Cable Authority is interested in the plan and may recommend it to the Government.

Radio down under

The age-old tradition of surf life-saving in Australia has taken on a high-tech look with the development of waterproof communication equipment. A Shinwa portable two-way radio enables life-savers to communicate up to 10km in conjunction with controlling crowds on

the beach and directing surf rescues, either from the beach or aboard the inshore rescue boats.

Telecom Australia has launched its cellular mobile phone system in Sydney and will extend this to most other state capitals by the end of this year. By 1990 fifty other cities and towns will have the service, which supplements the old mobile service, already at capacity limit in Sydney.

Video developments

A picture-taking radar acting as a remote TV camera could one day give air traffic controllers actual pictures of aircraft on their 'scopes. The University of Pennsylvania's Valley Forge research centre has developed a radar system capable of producing near photo-quality pictures of aircraft passing over the site and has been dubbed the 'radio camera' by its inventors.

The images produced reveal outlines of wings, cockpits and engines and are said to be sufficiently detailed to distinguish a Boeing 727 from a Lockheed L-1011. The system uses a standard radar transmitter and a 'highly unconventional' receive system plus novel computer processing to achieve these results. The image is composed from a large number of discrete radar signals.

Microwave Networks Inc has introduced a video modem which allows a 1.5Mbit/s T-1 data channel to be integrated with an analogue broadcast signal for transmission through the same microwave radio channel. The video modem system transmits on a 23MHz bandwidth using the company's MicroNet 23 RF equipment. The modem costs $3000.

More whizzo gadgets

The Magnavox Corporation recently displayed a portable satellite communications system in London, the MX2400T. Using the INMARSAT geostationary satellite network, the MX2400T (which packs into two travel cases) can provide a simple voice telephone link or access to Telex, Prestel or other data networks. Fairly similar MANSAT equipments are made by Ferranti for the Ministry of Defence.

British Telecom's radiopaging customers are to be offered a single pager capable of operating both in the UK and in major towns and cities of the USA and Canada. This follows an arrangement with the American company Metrocast, whose customers' pagers will also work in the UK. The new frequency-scanning paging receivers will have an alphanumeric readout, similar to BT's Message Master units.

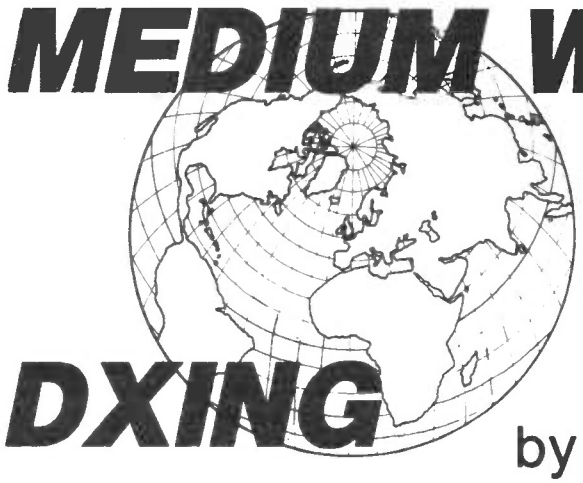
In the new service, paging signals will be sent from the UK to Metrocast's San Diego control centre for onward transmission. To overcome international time differences, messages can also be held there until a pre-arranged time. This international service is due to start later this year. The dream of a similar pan-European service has not yet been achieved, mainly because radiopaging is carried on different frequencies and with differing coding in European countries.

Can't get enough?

If you'd like more news on up-to-date radio developments and have Prestel, you should see *Waveguide*. This section of the database, reached by keying ★258# and then 7, has copious coverage of broadcast (and amateur) radio and TV. It is particularly strong on the latest news affecting independent local radio and the offshore transmitters.

For the latter you should also see the enthusiast magazine *Monitor*, which is by far the best of its kind. You can get the latest copy by sending £2 to *Monitor*, 31 Avondale Road, Benfleet, Essex. REW

MEDIUM WAVE DXING



by Steve Whitt

This month I'll be letting DX in its truest sense take a back seat, since I'll be focusing attention on the very low power special event stations that will be operating during the coming summer months. Mind you, hearing these micro-power stations will in itself be quite an achievement if you live anywhere more than a mile or two from the transmitter.

Special event stations

We can now turn our attention to the latest in the world of special event stations which has been one aspect of local or community radio in the UK that has gone largely unreported. For those readers not familiar with special event radio, this is all part of a two year experiment by the Home Office to provide an extremely local radio service for festivals, conventions, county shows, sporting events and the like, and it is intended that during 1986 and 1987 around 25 licences per year will be issued in circumstances where radio would form the best means of communication at a particular site.

Special event radio stations are presently allocated MW frequencies and are only permitted to use an absolute maximum of 50 milliwatts (yes, 50mW) effective monopole radiated power. This very low power, coupled with the fact that stations will not be on the air for more than a fortnight at a time (in fact stations have operated for periods ranging from a few hours up to two weeks), makes them rather difficult DX targets.

This year one special event station that will be operating for an extended period is Radio Silverstone, 'The Voice of Racing'. Reader John Koenig of Banbury has very kindly supplied me with some info about this station, for which he will be acting as DJ/announcer this summer. Radio Silverstone is licensed to operate at the Silverstone race track on race days only to provide information and commentary together with music, commercials and outside broadcasts. It operates on 1602kHz with a meagre 40mW driven into a 30 foot high monopole aerial with an inverted V element, which also doubles up as guy wire. However, despite the restrictions of the licence it seems that under favourable conditions R Silverstone has been logged as far as eight miles from the race circuit.

While most special event stations are independently organised, a few are run by existing IBA stations. Hereward Radio in Peterborough, for example, will be operating a station at several events held at the East of England Showground, though quite which events will have stations depends on the availability of a sponsor to collect the bill! The station that Hereward constructed last year radiated only about 5mW, so this time around their engineers are planning to increase the power into their inverted L aerial system at the showground so that a better signal is heard.

In a similar vein, Capital Radio in London will be operating a station in Battersea Park for its Capital Venture Day, an event that last year attracted 750,000 visitors. Although Capital will be operating an outside broadcast feed from the park back to its main studios in Euston Tower, it will also be providing a separate portable studio to generate about 6-7 hours of local programming for the transmitter in the park.

In addition to these examples there are a number of other events coming up soon, as you will see from the table.

As you can see from the list there are many operations that can benefit from special event radio, so it is somewhat surprising that this facility has gone relatively unpublicised. Indeed, obtaining accurate details about these stations is a task in itself since, depending on who you talk to, there are a number of contradictory sources of information. Another curiosity is the restriction of stations to MW operation, since this has a couple of distinct drawbacks over low power VHF operation. On MW it is generally harder to build efficient temporary aerials and to properly match them to the transmitter, whereas both these tasks are much simpler at VHF frequencies. In addition, MW signal propagation being what it is, special event stations can only operate during daylight hours due to interference which seriously limits the usefulness of the service at night.

Headline news

Belgium: BRT English Service until 26th September 1987 is at 1730-1755 and 2100-2125hrs UTC on 1512kHz. This transmitter is currently running only (!) 300kW instead of its normal 600kW due to budget restrictions.

Canary Isles: R Popular de Las Palmas on 837kHz operates Canary Tourist Radio in several languages. In the past it had German, English and Swedish on Sundays around 1500hrs but I have no current information – are any *Radio and Electronics World* readers going here on holiday.

Falkland Isles: The Services Sound and Vision Corporation who run British Forces Broadcasting Service have bought a new 10kW MF transmitter. It is expected to arrive at Mare Harbour some time in July and will be deployed later this year at Bush Rincon, a location just a few miles from the new Mt Pleasant Airfield. Currently the only broadcast transmitters on the islands are either on SW or VHF/FM and this new transmitter is intended to overcome a number of existing problems.

It will, in fact, replace some VHF facilities located on almost inaccessible mountain tops which are cut off by minefields and which need to be regularly refuelled by helicopter. Furthermore, in order to extend programmes to the Royal Navy (and presumably the extensive fishing fleets) the transmitter will have a coverage of about 150-200 miles thereby covering the Falklands exclusion zone. The new transmitter, operating on 550kHz, will carry a mix of programmes from the local Falkland

Events at which special event stations will be operating

Date	Location	Frequency
17th May	BMS Rally, East of England Showground, Peterborough	1602
21st – 23rd May	Turkish Community Radio Festival, Lea Valley Park, London	1386
23rd – 24th May	Airfete 1987, RAF Mildenhall, Suffolk	1386
23rd – 24th May	Race Meet, Santa Pod Raceway, Bedfordshire	1602
6th – 7th June	Triumph Sports Car Rally, East of England Showground	1602
7th June	Capital Radio Venture Day, Battersea Park, London	1503
11th – 14th June	Castle Radio, Castle Park, Colchester, Essex	1575
26th – 28th June	Castle Radio, Castle Park, Colchester, Essex	1575
27th – 28th June	Race Meet, Santa Pod Raceway, Bedfordshire	1602
7th – 12th July	R Silverstone, Silverstone Race Course, Northants	1602
21st – 23rd July	East of England Show, East of England Showground	1602
30th July – 2nd Aug	British Motorcycle Grand Prix, Donnington, Leicester	1602
13th – 15th August	R Silverstone, Silverstone Race Course, Northants	1602
5th – 6th Sept	R Silverstone, Silverstone Race Course, Northants	1602

Islands Broadcasting Station (FIBS) and from BFBS.

Germany FRG: Westdeutscher Rundfunk (WDR) has undergone some radical operational changes and has an entirely new programme structure on 774 and 1593kHz. The station also has plans to go commercial – it will be the last German station to do so, and up to 90 minutes per day of commercials will carried from November 1987.

United Kingdom: The planned merger between R Orwell/Saxon R and R Broadland has been called off after staff protests and local opposition to the plan, but further south Capital Radio has recently bought out Devon-Air. When ILR stations first applied for their franchises it was with the express undertaking that they would serve the local community and provide local news and programmes as well as catering for minority interests.

That promise, made at a time when it was expedient in order to secure a franchise from the IBA, is now clearly being broken throughout the ILR network with the full conivance of the Independent Broadcasting Authority. All over Britain stations have whittled away at their news facilities, for example, until barely a skeleton service remains.

Additional information

A number of organisations operate recorded telephone information services. These, of course, can be updated in just a matter of minutes, but in practice most are changed weekly.

01-400 8282: *TX Magazine* operates this one; a headline news service about the pirate radio scene in London.

(0707) 59312: RSGB Headline News: 3 minute recording mainly on amateur radio but including information on radio propagation.

(0536) 514437: Now Radio Newsline; news about UK broadcast scene. Line open *only* 1400hrs Saturday to 0900hrs Monday.

(07372) 41510: Caroline Movement Infoline; news about Radio Caroline.

(0795) 510764: Anoraks-UK Infoline; recorded news of pirate radio, certainly the authoritative source of information on Irish radio.

0101-1-303-497-3235: The National Bureau of Standards in Boulder CO USA operates this service, providing detailed solar and ionospheric information updated every three hours (remember this is an international call).

DX file

Unfortunately not too much to report in this area from my own log since time for DXing has been rather limited of late. However, I recently purchased a Sony ICF2001D receiver and I have so far tried it out in Southern Spain and here in Ipswich. I have yet to give it a thorough test on the MW band, but I must say that I am very impressed with the versatility of this convenient portable receiver. Its SSB and synchronous detection process really does put it head and shoulders above any other portable receiver on the market and I wouldn't mind betting that it will give many so-called communications receivers a good run for their money.

In Spain, using just the internal ferrite rod of the ICF2001D, I was surprised to be able to hear the Caribbean Beacon in Anguilla on 1610kHz and back in Ipswich reception of CJYQ from Newfoundland on 930kHz was just possible without an external aerial. This receiver is already used by a number of other accomplished MW-DXers who rate it very highly. Incidentally, a full review and technical performance report has been published by *Radio Database International* as part of their series of 'White Papers'. The ICF2001D White Paper is available for £4.50 inc p+p from Interbooks, Lynton, Stanley, Perth PH1 4QQ, Scotland (phone: (0738) 828575). Please mention who sent you! REW

CB CONVERSIONS

Part One

How to modify the Binatone Route 66 rig for 10 metre amateur operation

by Roger Alban GW3 SPA

During April 1981, the Home Office published a specification (MPT1320) which covered the minimum performance requirements for equipment operating on the UK Citizens Band.

This specification differed markedly from the specification for the American equipment which many illegal CB operators were using. When the UK CB service was legalised on 1st November 1981, CB enthusiasts were forced to discard their American equipment and purchase equipment designed to meet the requirements of the new specification. This action may, at first sight, have appeared to be hard-hearted; however, there are some good reasons which will soon become apparent.

Forty channels

Forty channels were released on the 11 metre band. These forty channels did not coincide with the popular American AM channels, which extend from 26.965MHz to 27.405MHz. The reason for this choice was to separate the legal from the illegal user. The UK specification called for the equipment to operate on Frequency Modulation as opposed to the American Amplitude modulation in the hope that interference to domestic appliances and commercial equipment would be reduced.

When the British specification was issued in April 1981, there was interest shown by a number of set manufacturers who were keen to have CB sets ready to sell when the Government finally declared the legal use of CB equipment conforming to the new specification. Many manufacturers were hoping to make a large profit from the sale of legal sets.

Options available

However, there were problems to be overcome by the set manufacturer. Firstly, the latest version of the American CB set using the customised phase locked loop chip containing a unique Read Only Memory (ROM) type LC7120 could not be converted to operate on the new British frequencies specified. This was a deliberate act to ensure that existing American sets already in the country could not be easily converted to operate on the new frequencies.

Another option open to the set manufacturer was to convince the integrated circuit manufacturers, Sanyo in particular, that the volume sales anticipated would be large enough to warrant the manufacture of a customised phase locked loop (PPL) chip to meet the requirements of the British CB specification. However, the timescale available to design, manufacture and market a CB set containing a customised PLL chip was considered by some set manufacturers to be too long, with the possibility of missing the as yet unknown start date for CB in the UK plus the anticipated sales bonanza of CB sets. (The dedicated PLL chip that eventually left the stables of Sanyo was the type LC7137, which in fact appeared in a small number of CB sets available on the legal CB launch date of 1st November 1981.)

The only other option available to the set manufacturer was to use one of the older types of PLL chip used in the early days of American CB, discarded by the FCC because they are easily convertible to operate on other frequencies. This is possible because the sample frequency input F_{in} to the PLL chip is only capable of operating up to approximately 5MHz. Therefore, to operate on the CB bands, down-mixing is required using a separate crystal oscillator. If the frequency of the crystal oscillator is tampered with it is possible to move the operating frequencies of the voltage controlled oscillator and therefore the operating frequency of the CB set. Techniques used in CB sets can be obtained by reading my series of articles published by *Amateur Radio* magazine (from December 1984-June 1985).

The two most popular PLL chips used are the PLL02 and the Motorola type MC145106. The main disadvantage as far as the set manufacturer is concerned in using these PLL chips is that the manufacturing cost of the CB set is bound to be higher than that of a set manufactured using the customised Sanyo PLL chip. However, the set manufacturers were determined irrespective of cost to have sets available for sale on the start date.

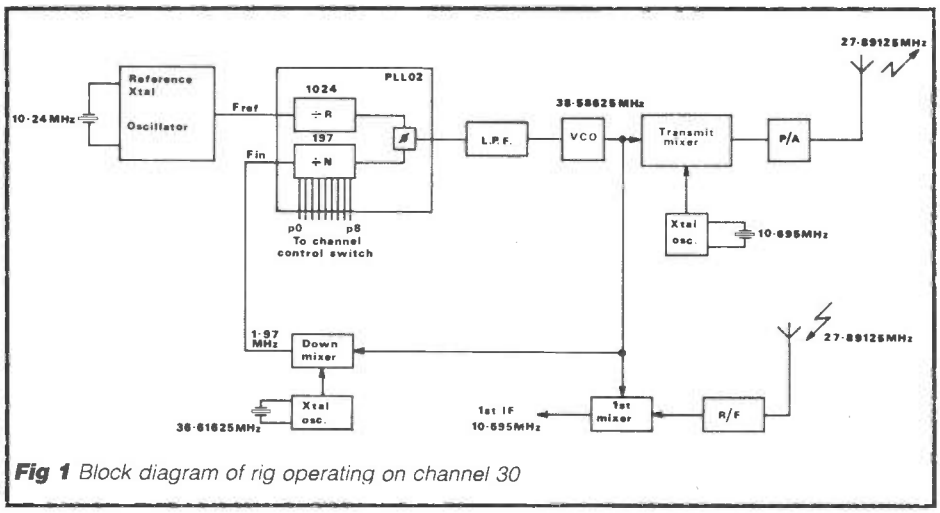


Fig 1 *Block diagram of rig operating on channel 30*

Binatone Route 66

One of the CB manufacturers who opted to use the early American PLL chips was Binatone, whose company motto is 'You can afford tomorrow's world – today'. This company produced the Route 66 set which was available for sale on 1st November 1981. It is important to note that the model number of this set is 01/8538 which uses the PLL02A phase locked loop. Later, Binatone changed the design of the set to incorporate the Sanyo LC7137 PLL chip to reduce the manufacturing cost, and the model

number of this set is 01/8538A. The model number can be found stamped on the back of the set. We will be dealing with the model 01/8538. The other set cannot be modified in the way described in this article.

The phase locked loop

The block schematic diagram is shown in *Figure 1* and all frequencies illustrated refer to the unmodified rig operating on channel 30. The 10.24MHz reference oscillator is fed to pin 3 of the PLL02 chip which is the input to the fixed reference frequency divided by 1024, which produces a frequency of 10.24MHz divided by 1024 which equals 10kHz at the phase detector. To obtain a locked condition for the phase locked loop, we require 10kHz to appear at the output of the programmable divide by N counter.

From observing *Table 1*, it will be seen that for channel 30 the programmable divide by N number will be 197. The frequency at F_{in} will be 197 multiplied by 10kHz which equals 1.97MHz. The down-mixer crystal oscillator is operating at a frequency of 36.6162MHz. The frequency at the input of the down-mixer and therefore the operating frequency of the voltage controlled oscillator (VCO) will be 1.97MHz plus 36.61625MHz which equals 38.58625MHz. The output of the VCO is fed directly to the receiver mixer. The first receiver intermediate frequency amplifier is operating on 10.695MHz. Therefore, the receiver frequency will be 38.58625MHz minus 10.695MHz which equals 27.89125MHz, corresponding to channel 30 of the legal CB band.

The VCO is also fed into the transmit mixer which when on transmit causes a 10.695MHz crystal oscillator to operate to produce the transmit frequency of 27.89125MHz, channel 30.

The output of the PLL02 phase detector is fed via a low pass filter to the VCO. The frequency of the VCO is primarily controlled by a capacitance diode whose capacitance depends upon the output voltage of the phase detector. Therefore, under locked condition the output voltage from the phase detector is held at a constant value. If the frequency of the VCO should drift, then the frequency at F_{in} will be proportionate to the drift and consequently the input frequencies to the phase detector will not be the same; therefore, there will be a corresponding change in output voltage from the phase detector to correct the frequency drift of the VCO, resulting in 10kHz being presented to both inputs of the phase detector. The low pass filter acts as a damping factor on the loop and prevents any sudden changes such as unwanted noise and transient from upsetting and unlocking the loop.

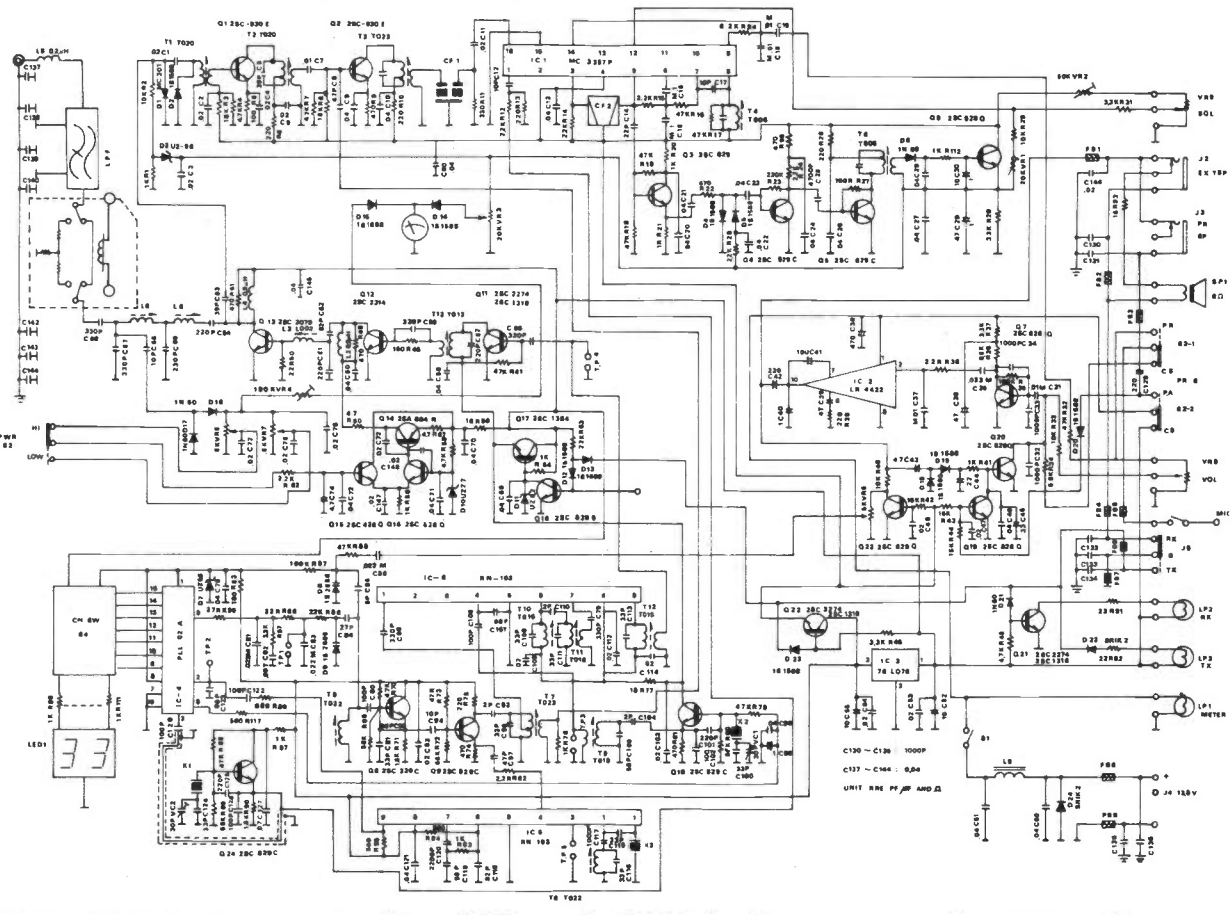
When the channel select switch is rotated to select channel 31, the programme code will be changed to select a divide by N number of 198. *Table 1* shows the relationship between channel numbers and the programme code presented to the PLL chip. If you carry out the frequency calculations for the PLL you will discover that the set is now operating on a frequency of 27.90125MHz which is 10kHz higher in frequency than for channel 30. It can be seen that the operating frequency of the set will change in 10kHz steps when the channel select is altered. This is because the phase comparator will become locked when it sees the divide by R reference frequency at the output of the divide by N divider, namely 10kHz.

The receiver circuit

Figure 2 shows the full circuit diagram of the set. On the receiver side Tr1 is the RIF amplifier feeding Tr2; the receiver first mixer ceramic filter CF1 is centred around the first intermediate amplifier frequency of 10.695MHz. The output of the ceramic filter is fed to pin 16 of the Motorola MC3357 integrated circuit. This integrated circuit contains a mixer, oscillator, demodulator and squelch trigger circuit.

The first intermediate frequency is fed

Fig 2 *Full circuit diagram*



to the mixer on pin 15 and mixed with the frequency of the crystal reference oscillator Tr24 which is injected on pin 1. The output of the mixer appears on pin 3 and is fed to the input of a ceramic filter centred on the receiver second intermediate frequency of 455kHz. The output of the ceramic filter is fed via pins 5 and 6 to the input of a limiter amplifier which removes any unwanted amplitude modulation from the signal.

Part of the output of the limiter amplifier appears on pin 7, which is fed via a quadrature coil T4 to the input of the demodulator on pin 8. The audio output appears at pin 9 and is fed via the volume control VR8 and Tr7 finds its way onto the input of the audio amplifier on pin 2. The squelch circuit comprises Tr3 which samples the output of the 455kHz ceramic filter which is fed to a noise detector comprising Tr4, Tr5 and Tr6. The output of the noise detector is fed via the squelch control to pin 12 of the MC3357 which is the input to the squelch trigger circuit which provides audio mute by placing pin 9 to earth when pin 14 is connected to the output of pin 9.

Phase locked loop circuit

The 10.24MHz reference frequency is generated by a crystal oscillator comprising Tr24 and is fed to pin 3 of the IC4, the phase locked loop chip, the input to the divide by R counter. The output of the phase detector appears at pin 5 and is fed to a resistance capacitance network starting at R96 and finishing at R66 forming the low pass filter. The output of the filter is fed to the cathode of the capacitance diode D9. The VCO oscillator comprises transistor Tr8 whose output is buffered by Tr9 and fed to the input of the down-mixer pin 4 of IC6. The AN103 or equivalent TA7310P integrated circuit comprises a mixer and high gain radio frequency amplifier. The down-mixer crystal is connected to pin 1, the input of the high gain amplifier. T8 and C116 provide the tuning for the crystal oscillator, which is internally coupled to the mixer.

The output of the down-mixer appears at pin 9 and is fed to the divide by N counter input of the PLL chip at pin 2, IC4. The output of the VCO is also fed to the receiver first mixer via T7 to the base of Tr2. The output of the VCO is also fed to the transmitter mixer IC5, pin 1, which is also an AN103 integrated circuit. The output of the transmit crystal oscillator Tr10 is fed to pin 4 or IC5. The output of the mixer at pin 9 is fed via T12 to Tr11, the pre-driver of the transmitter, which in turn feeds the driver transistor Tr2 and the power amplifier Tr13.

Frequency modulation

Frequency modulation of the carrier is achieved by another capacitance diode, D8, forming part of the VCO tuned circuit. Audio from the microphone is fed on transmit to the input of the audio amplifier pin 2 of IC2. The output of the amplifier is fed via VR5, which sets the maximum deviation, to the cathode of D8. The capacitance diode is coupled to the VCO tuned circuit by only a small 5pF capacitor, C85.

On transmit

Between the set transmitting and receiving, transistor switching is employed to activate either transmitter or receiver. For example, on transmit, when the hand mike switch J5 is pressed, the base of transistor Tr22 via diode D23 is earthed causing the transistor to stop conducting and removing supply voltage to the receiver. It also removes voltage from the base of Tr23 and allows the output of the audio amplifier to feed audio onto the capacitance diode D8 to provide frequency modulation. Voltage is also removed from the base of Tr18 and in turn allows Tr17 to conduct to provide voltage to drive the transmitter and transmitter crystal oscillator Tr10 and transmit mixer IC5.

On receive

On receive the hand mike switch J5 connects the loudspeaker to earth and the absence of an earth on the base of Tr22 results in power being supplied to the receiver. Tr23 conducts and prevents receive audio from frequency modulating the VCO. The transmitter power is removed because Tr17 is no longer conducting.

Transmitter power output

The output power of the transmitter is regulated by controlling the amount of drive received by the power amplifier. This is achieved by automatically adjusting the voltage fed to the driver transistor. Transistor Tr14 acts as a pass transistor in a regulated power supply, comprising Tr15 and Tr16, with diode D10 providing the reference voltage. The high/low power switch S3 connects either VR6 or VR7 to the base of Tr15. Output power is rectified by D16 and controls the voltage on Tr15, which in turn controls the emitter voltage of Tr16, which affects the emitter current of Tr14 and hence the output voltage which feeds the drive transistor. Therefore, it is possible to preset both low and high power settings for the transmitter.

Audio AGC

The gain of the audio amplifier is also controlled under transmit conditions. A portion of the audio output is rectified by diodes D18 and D19 which control transistor Tr20, which is connected across the input of the audio amplifier causing the audio level presented to the input of the amplifier to be controlled.

Common faults

If the set is purchased second-hand it is possible that the suicide diode D24, which is connected across the input of the power supply, may have been

Fig 3 *Block diagram of modified rig operating on Channel 30*

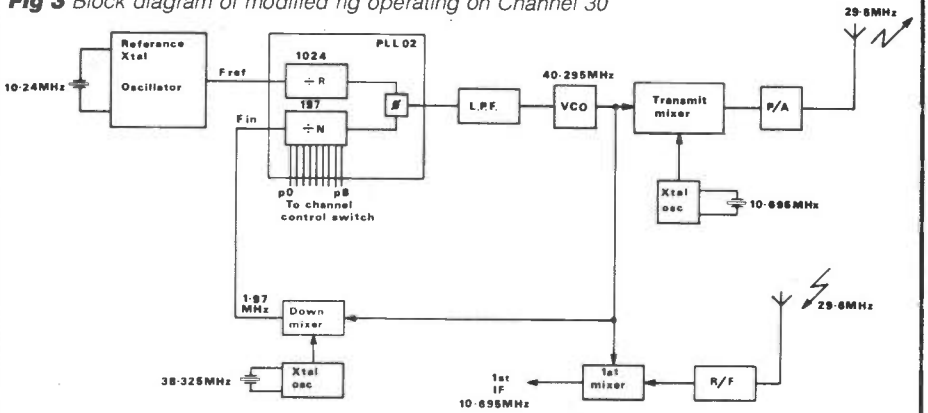
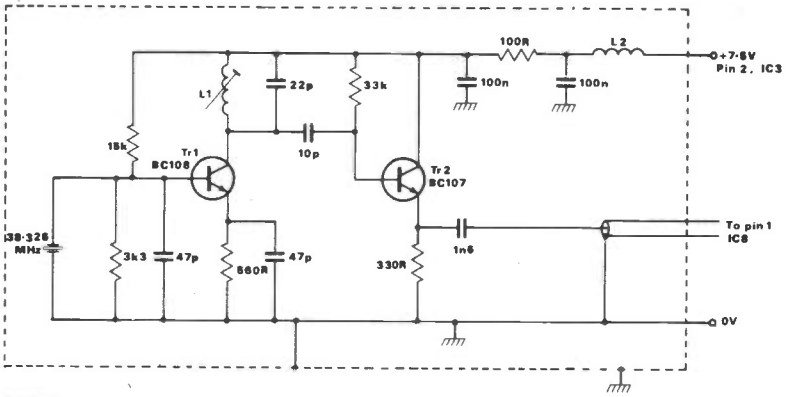


Fig 4 *Circuit diagram of overtone oscillator and emitter follower buffer*



damaged. This diode protects the set from being incorrectly connected to the power supply. Under such conditions the diode becomes forward-biased, which blows the in-line fuse and results in the diode being destroyed, placing a permanent short circuit across the supply input of the set. This is a very common fault with CB sets because they are used by members of the public with little or no technical knowledge. When the diode blows short circuit, the set cannot be used until the diode is either removed from circuit or replaced. What seems to happen is that the owner is no longer able to use the set and is encouraged to sell it. The cost of repairing the rig can be more expensive than buying a new CB.

Another common fault with CB sets is again attributed to the lack of experience of the owner. Sometimes the set is connected to an untuned aerial system and the unfortunate result is a damaged power transistor, Tr13. If the set will receive but not transmit, suspect transistor Tr13 as the cause.

Metering

Metering of the received signal level and transmit relative power output is indicated by the front panel meter. Diode D14 rectifies via VR3 the output of the receive noise detector and gives a reasonable indication of the receive carrier level.

The transmit output is sampled via a 10pF capacitor C66 and rectified by D16, and via VR4 provides a relative indication of power output. If VR4 requires to be adjusted, I would suggest that the set should be connected to a 500 ohm dummy load.

To change the operating frequency of the set it is necessary to alter the down-mixer crystal frequency. From the block diagram for the rig given in *Figure 1* it is necessary to retain F_{in} at 1.97MHz for channel 30. If we decide to make channel 30 the calling channel at 29.6MHz, then channel 40 will correspond to 29.7MHz, the top end of the 10 metre band, and channel 1 will correspond to 29.31MHz. If channel 30 in the modified set is to correspond with a frequency of 29.6MHz then the VCO will be operating at a frequency of 29.6MHz plus 10.695MHz, which equals 40.295MHz.

To maintain an F_{in} of 1.97MHz, the down-mixer crystal oscillator will be required to operate at a frequency of 40.295MHz minus 1.97MHz which equals 38.325MHz. Don't rush out to buy this crystal, though, as further alterations will be made to improve the performance of the rig later in the article.

Table 1 *Channel number with corresponding program codes*

Ch	Frequency	FVCO	F_{in}	IC terminal no									÷N no
				2^0 15	2^1 14	2^2 13	2^3 12	2^4 11	2^5 10	2^6 9	2^7 8	2^8 7	
1	27.60125	38.29625	1.68	0	0	0	1	0	1	0	1	0	168
2	27.61125	38.30625	1.69	1	0	0	1	0	1	0	1	0	169
3	27.62125	38.31625	1.70	0	1	0	1	0	1	0	1	0	170
4	27.63125	38.32625	1.71	1	1	0	1	0	1	0	1	0	171
5	27.64125	38.33625	1.72	0	0	1	1	0	1	0	1	0	172
6	27.65125	38.34625	1.73	1	0	1	1	0	1	0	1	0	173
7	27.66125	38.35625	1.74	0	1	1	1	0	1	0	1	0	174
8	27.67125	38.36625	1.75	1	1	1	1	0	1	0	1	0	175
9	27.68125	38.37625	1.76	0	0	0	0	1	1	0	1	0	176
10	27.69125	38.38625	1.77	1	0	0	0	1	1	0	1	0	177
11	27.70125	38.39625	1.78	0	1	0	0	1	1	0	1	0	178
12	27.71125	38.40625	1.79	1	1	0	0	1	1	0	1	0	179
13	27.72125	38.41625	1.80	0	0	1	0	1	1	0	1	0	180
14	27.73125	38.42625	1.81	1	0	1	0	1	1	0	1	0	181
15	27.74125	38.43625	1.82	0	1	1	0	1	1	0	1	0	182
16	27.75125	38.44625	1.83	1	1	1	0	1	1	0	1	0	183
17	27.76125	38.45625	1.84	0	0	0	1	1	1	0	1	0	184
18	27.77125	38.46625	1.85	1	0	0	1	1	1	0	1	0	185
19	27.78125	38.47625	1.86	0	1	0	1	1	1	0	1	0	186
20	27.79125	38.48625	1.87	1	1	0	1	1	1	0	1	0	187
21	27.80125	38.49625	1.88	0	0	1	1	1	1	0	1	0	188
22	27.81125	38.50625	1.89	1	0	1	1	1	1	0	1	0	189
23	27.82125	38.51625	1.90	0	1	1	1	1	1	0	1	0	190
24	27.83125	38.52625	1.91	1	1	1	1	1	1	0	1	0	191
25	27.84125	38.53625	1.92	0	0	0	0	0	0	1	1	0	192
26	27.85125	38.54625	1.93	1	0	0	0	0	0	1	1	0	193
27	27.86125	38.55625	1.94	0	1	0	0	0	0	1	1	0	194
28	27.87125	38.56625	1.95	1	1	0	0	0	0	1	1	0	195
29	27.88125	38.57625	1.96	0	0	1	0	0	0	1	1	0	196
30	27.89125	38.58625	1.97	1	0	1	0	0	0	1	1	0	197
31	27.90125	38.59625	1.98	0	1	1	0	0	0	1	1	0	198
32	27.91125	38.60625	1.99	1	1	1	0	0	0	1	1	0	199
33	27.92125	38.61625	2.00	0	0	0	1	0	0	1	1	0	200
34	27.93125	38.62625	2.01	1	0	0	1	0	0	1	1	0	201
35	27.94125	38.63625	2.02	0	1	0	1	0	0	1	1	0	202
36	27.95125	38.64625	2.03	1	1	0	1	0	0	1	1	0	203
37	27.96125	38.65625	2.04	0	0	1	1	0	0	1	1	0	204
38	27.97125	38.66625	2.05	1	0	1	1	0	0	1	1	0	205
39	27.98125	38.67625	2.06	0	1	1	1	0	0	1	1	0	206
40	27.99125	38.68625	2.07	1	1	1	1	0	0	1	1	0	207

Down-mixer crystal oscillator

The existing down-mixer crystal oscillator consists of a crystal X3 which is connected to a high gain amplifier forming part of IC6. I experienced problems with the existing crystal oscillator circuit, as I found it difficult to encourage other crystals to reliably oscillate. In fact, on a number of occasions the existing crystal failed to oscillate when power was restored to the set for no apparent reason. At first I thought it was another case of 'sleeping sickness', a disease where the crystal activity decreases with age. To overcome these problems I decided to build a separate crystal oscillator, illustrated in *Figure 4*, and inject the output of the crystal oscillator into the input of the high gain amplifier pin 1 of IC6.

Crystal oscillator

The crystal oscillator was constructed on Veroboard and consists of an overtone oscillator Tr1 and an emitter follower buffer amplifier Tr2. L1 consists of 5 turns of 36 swg copper wire on a Toko coil former, tuned with a 10 to 20MHz pot core. L2 consists of approximately 100 turns of 36 swg wound on a quarter watt solid carbon resistor. The completed Veroboard is mounted inside an insulated tin base, 3in long by 1½in wide and ¾in deep, constructed from an old tin can. The sides of the base are soldered together and the inside insulated with insulating tape. It is tuned for maximum output on the desired frequency of 38.325MHz.

The supply and signal leads are taken from the tin box through a grommit hole. A wire is soldered to the inside of the box and connected to the earth rail of the circuit. Finally the lid is soldered on. Thin coaxial cable of the shortest possible length, to avoid any unnecessary signal radiation, is taken from the emitter of Tr2 and soldered in place of crystal X3. The supply is taken from pin 2 of TC3 which is a voltage regulator supplying 7.5 volts. The location of the components on the set PCB is shown in *Figure 5*. Connect a

dc to 50MHz oscilloscope or RF valve voltmeter to test point 5, ie to pin 3 of IC6, and adjust T8 for maximum output.

VCO tuning

Don't worry if the PLL is not locked at this stage. Remember that from *Figure 1* and *Figure 3* the VCO frequency has increased by approximately 2MHz. The next step is to tune the VCO so that it will operate successfully over the 40 channel range of the set.

The VCO tuning coil T6 is located towards the front of the set near IC4. In my set the coil former was a type 5m with the tuning core locked with glue, and consequently I was unable to adjust the inductance of T6. The coil former and screen can were unsoldered from the printed circuit board. T6 was replaced with a larger Toko coil former, type 10K. Five turns of 36 swg wire was wound onto the new coil former and covered with a pot core before the metal case was replaced. Electrical contact with the printed circuit board was achieved by extending the terminals and earth screen connection of the Toko coil former.

Set the channel switch to channel 1 receive, and connect a digital voltmeter to test point one, ie the digital voltmeter connected across C83. Adjust the tuning core of T6 to obtain a voltage reading of 2 volts plus or minus 0.3 volts. Switch through the forty channels and observe that the voltage reading changes for each channel selected. This can best be observed by connecting a dc oscilloscope across test point one. The loop circuit should now be locked. Pin 6 of IC4 is set at ground potential when the loop is not locked.

Under lock condition it will be at a positive potential somewhere around 5 volts. When the loop is not locked the transmit mixer oscillator Tr10 is prevented from oscillating by pin 6 of IC4 grounding the base of Tr10, therefore preventing the transmitter from radiating an unknown frequency and causing interference to other services. It is worth checking after adjusting the VCO tuning coil T6 that pin 6 or IC4 is at a positive potential greater than 4 volts. Having satisfied oneself that the loop is locked, with a lighted candle allow a small amount of wax to secure the tuning coil of T6. This will prevent any vibration that the set may experience from adjusting the tuning of the VCO.

To obtain the maximum VCO output voltage at the input of the wideband amplifier of IC5, connect a radio frequency voltmeter or high frequency oscilloscope to pin 1 of IC5 and adjust T7 for maximum input with the set tuned to channel 20. T7 can be located directly behind T6.

Receiver front end tuning

To complete the receiver tuning, it is necessary to tweak up the front end T1 and T2 of the receiver. T1 and T2 are located near the centre of the printed circuit board. With either a signal generator or another modified CB set used as the signal source, inject 29.50MHz into the input of the set tuned to channel 20 and adjust the input level until it is just audible, adjusting T1 and T2 for maximum audio. It may be necessary to further reduce the injected signal, having first tuned T1 and T2 and again adjusting them for maximum audio. Repeat several times until you are satisfied that the receiver front end is now fully tuned.

Transmitter tuning

To tune the transmitter it is necessary to connect an SWR meter and 50 ohm dummy load to the aerial socket of the set. These are essential items and you should not attempt to tune the transmitter without the use of a 50 ohm dummy load if a clean signal is to be produced on transmit and interference to other users avoided.

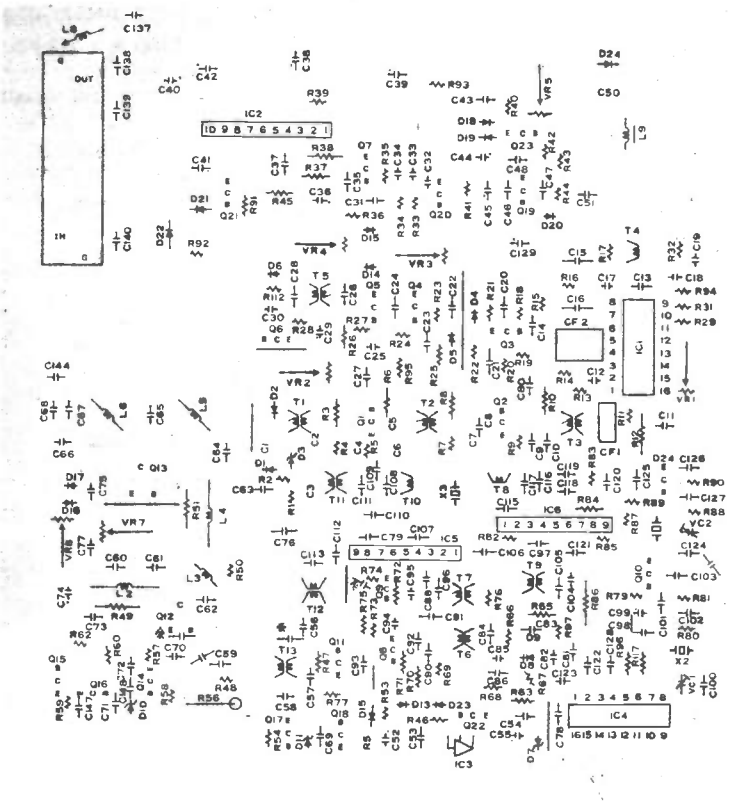
Key the transmitter with the set tuned to channel 20. Connect an oscilloscope to test point 4 and adjust T11 and T12 for maximum signal. Set the sliders of RV6 and RV7 at the earth end of the slider track. Adjust T13, L3, L5 and L6 for maximum output indicated as the forward reading on the SWR meter. With the power level switch S3 set to high, adjust VR6 for an output power of 4 watts. With the power level switch S3 set to low, adjust VR7 for an output power of 0.4 watts. In the low power switch position, the output power can be adjusted to suit the input power requirements, for example, of a suitable linear amplifier.

On the air tests

The set was tested on a local 10m FM net and reports were received that there was a clicking noise on modulation peaks. It was first thought that the deviation control VR5 had been set too high. However, adjusting VR5 did not cure the problem. By accident it was discovered that when the power output switch S3 was set on low power, the problem disappeared. Further investigation revealed that RF was finding its way back into the audio circuit and being rectified by D18 and D19. This was affecting the automatic level control ALC.

The problem was solved by placing a radio frequency choke between the wiper of VR5 and C86, and a 0.1μF capacitor is connected between the wiper of VR5 and earth. The capacitor is attached to the back side of the printed circuit board. The radio frequency choke is constructed by winding thirty turns of 36 swg wire onto a 1Mohm, half watt resistor. REW

Fig 5 *Bottom view of the PCB with components layout*



The concluding part of Roger Alban's article will appear next month – don't miss it!

BEYOND THE TRIODE

PART 3

Valves for special purposes

At ultra high frequencies the inter-electrode capacitance and the inductance of internal leads will determine the maximum operating frequency at which the valve may be efficiently used.

At low frequencies the time it takes for an electron to travel between cathode and anode is not important, but at ultra high frequencies the journey time between cathode and anode can be a small fraction of the cycle time. The upper limit of useful operation of a conventionally designed valve is around 150MHz. For higher frequencies the valve has to be specially designed.

About the only way available of reducing inter-electrode capacitance is to reduce the physical size of the various electrodes. This in turn will reduce the power handling capability of the valve. However, it is possible to reduce the internal lead inductance by reducing lead length and by using two or more leads in parallel from the electrode.

In some types of valve the electrodes are provided with up to five separate leads which may be connected in parallel externally. In the double lead type of valve the anode and grid electrodes are supported by heavy single wires which run entirely through the envelope, providing terminals at either end of the valve glass envelope.

Disk seal valve

In the disk seal valve, the anode, grid and cathode are assembled in a parallel plane as shown in *Figure 9*, instead of being coaxially constructed as in the conventional triode valve. The terminals of the disk seal valve practically eliminate lead inductance. The close spacing between the electrodes reduces the electron transit time.

Modern disk seal valves are available for power dissipations of up to 100 watts with forced air cooling, and the operating frequency range can vary between 500 and 6000MHz. As a result of the design constraints it is not possible to have high power and high frequency operation simultaneously.

Velocity modulated valves

In the conventional type of valve the grid voltage during a negative half cycle of applied signal will tend to reduce the velocity of the electrons. However, during the positive half cycle, the positive voltage on the grid will serve to accelerate the electron stream. Over a complete cycle of applied voltage the electron stream will appear to separate into two distinct groups of electrons.

The electrons leaving the cathode during the negative half cycle will be collectively slowed down, while those leaving on the positive half cycle will be accelerated. The electrons, after passing the grid on their way to the anode, will be overtaken by the faster moving electrons. At some point between the grid and the anode the electron stream will be sub-divided into regions of high and low density. This effect is turned to advantage in velocity modulated valves, so that the input signal voltage on the grid is used to change the velocity of the electrons in a constant current electron beam rather than to vary the intensity of a constant velocity current flow, as is the method used in the conventional valve.

The klystron

In the klystron valve the electrons leaving the cathode have to pass through an electrostatic field established by a voltage applied to a grid. If an electron is accelerated whilst passing through the electrostatic field it will take energy from it. If the speed of the electron is retarded by the electrostatic field, then the electron will give energy up to it.

The two rhumbatron cavities shown in *Figure 10* surround the valve and buncher grids are positioned at either end of these cavities. When the cavities oscillate an electrostatic field will exist between the two grids of each cavity. This field will be continuously reversing at the frequency of resonance of the cavities.

When the valve is first switched on, a stream of electrons will be accelerated along the valve by the high positive voltage applied to the grid closest to the cathode and the cavities will be shocked into oscillation. Electrons arriving at the first rhumbatron grids, when the electrostatic field is retarding them, will give up energy to the cavity and will be decelerated. Electrons arriving when the electrostatic field has reversed will take energy from the cavity and will be accelerated. Therefore, the net expenditure of energy over one cycle is zero.

In the drift space between the two rhumbatron cavities, the faster electrons will catch up with the slower moving ones to form dense electron bunches. By adjusting the second rhumbatron frequency, it can be arranged for the electron bunches to arrive when the second cavity electrostatic field is in a retarding direction. The bunches of electrons will therefore give up their energy to the cavity, thus maintaining oscillation. A feedback loop is provided between the two rhumbatron cavities to maintain oscillation and ensure that the two cavities oscillate at the same frequency. The anode serves only to collect the spent electrons.

The resonant frequency will depend upon the electrode voltages and on the shape of the cavities. Therefore, the

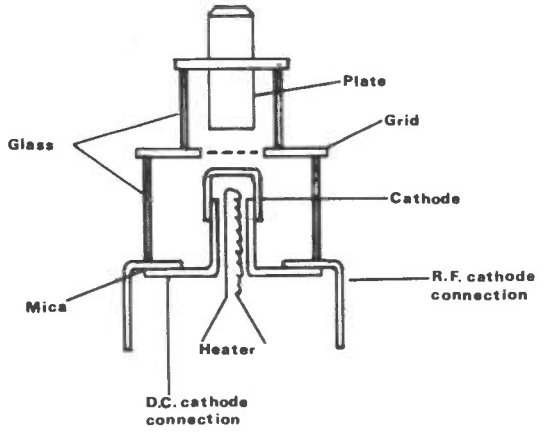


Fig 9 *Sectional view of the disk seal valve construction*

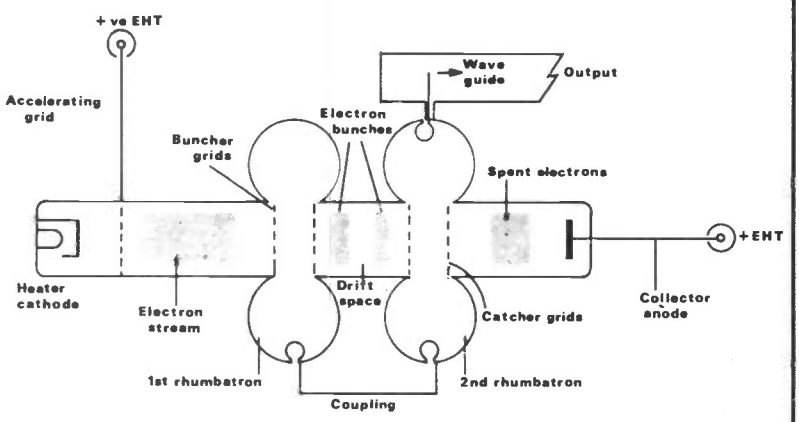


Fig 10 *The double rhumbatron klystron*

operating frequency may be adjusted by either varying the supply voltage or by altering the dimensions of the cavities by adjusting a tuning screw.

Klystrons are employed as low power local oscillators in high frequency superheterodyne receivers. Typically the output power is normally under 100mW and the klystron is capable of oscillating continuously in the 10 to 3cm bands.

The magnetron

A magnetron is fundamentally a diode valve with cylindrical electrodes placed in a uniform magnetic field, with the lines of magnetic force parallel to the axis of the electrodes. A moving electron subjected to a magnetic field will have its velocity unaffected, but will acquire a component of force which is at right angles to the direction of movement. Therefore, the electron moves in the direction determined by Fleming's left hand rule.

In a diode valve, electrons leaving the cathode take a straight line path to the anode, the velocity of the electron being determined by the potential difference between the anode and cathode, which is also the intensity of the electrostatic field. If a magnetic field is created between anode and cathode, the electrons leaving the cathode will take a curved path to the anode. The amount of curvature will be dependent upon the strength of the magnetic field. As the magnetic field is increased, the curvature will increase until the electrons finally miss the anode completely. This is known as the Hull cut off point, or critical value of magnetic field strength *(Figure 11)*.

A solitary electron subjected to a critical value of magnetic field will return to the cathode after following an opisometric path. However, where millions of electrons are involved the electron would not be able to return to the cathode because of the retardation effects of the space charge surrounding the cathode. When the electron velocity is reduced the magnetic field will have less effect on the movement of the electron. A balanced state of affairs ensues where the electrons rotate around the cathode. The electrons rotate in different orbits known as shells. The further a shell is from the cathode, the greater the electron velocity since the electrostatic field effect is greater nearer the anode.

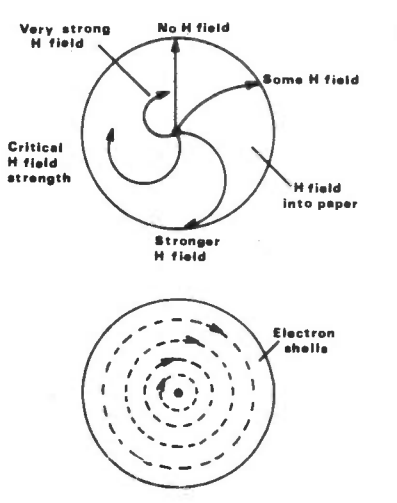
The anode of the magnetron consists of a solid copper anode block with an even number of hole and slot cavities drilled in it, as shown in *Figure 12*. A heavy duty combined heater and cathode assembly is mounted in the centre of the anode block. The EHT of about 15kV is applied to the anode, producing a strong electrostatic field between anode and cathode. A large electromagnet produces a high intensity electromagnetic field down through the anode/cathode space. The magnetron is sometimes referred to as a cross field device.

When the EHT is applied, the resonant cavities in the anode block will be shocked into oscillation and an electrostatic field will be established across each cavity slot, as shown in *Figure 12*. The simplest mode of oscillation is shown where alternate segments will have the same polarity. This is the mode normally used and is commonly known as the P_1 or one hundred and eighty degree mode. The polarity of the electrostatic field changes at a rate depending on the frequency of oscillation, and therefore appears to rotate with a certain angular velocity.

The electron space cloud is composed of electrons rotating around the cathode in orbits determined by the strength of the magnetic field. However, electrons entering the electrostatic field across the cavity lips will be either accelerated or retarded. Those accelerated will be greatly affected by the electromagnetic field and will be repelled towards the cathode, leaving the space cloud with the spiked shape as shown.

Electrons in one of the shells will be rotating at the same angular velocity as the rate of changing electrostatic field across the cavity slots. This shell is known as the synchronous shell. Electrons in shells nearer the anode will therefore be rotating faster, and will be coming into contact with the electrostatic field across the cavity slots. Some of these electrons will be retarded and will give up their energy to the cavities to maintain oscillation, while others will instead strike the anode block to produce the mean magnetron current. To ensure that the magnetron oscillates in the correct mode, alternate segments between the cavities are electrically strapped together as shown, by means of metal rings of differing diameters.

RF energy is taken from the magnetron by inserting a small loop of wire into one of the cavities and coupling it via a probe into a length of waveguide for outward transmission to the load. The efficiency of multi-segment magnetrons can be as high as 65 to 70 per cent. Magnetrons are used in situations where high power and



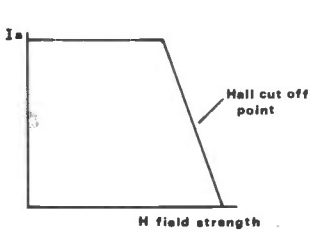


Fig 11 *The behaviour of a moving electron subjected to a magnetic field*

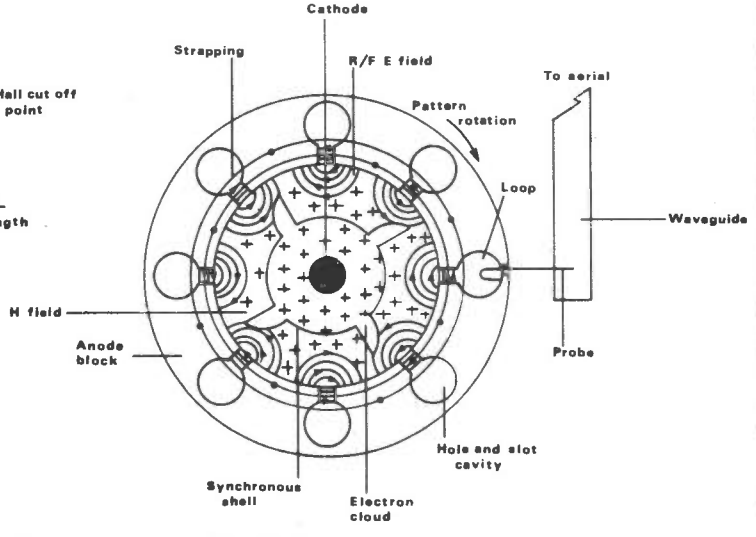


Fig 12 *The magnetron*

frequency is required, such as radar.

Conclusions

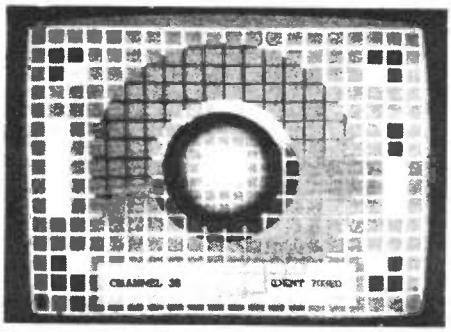
The design and development of the valve has come a long way since the first accidental discovery by Thomas Edison in 1883 of the effect of electron flow within a vacuum. Even today when semiconductor devices have replaced a large number of functions which were carried out by valves, the valve is still used in a variety of applications where it is found to be unsuitable to use semiconductor devices. Such an application is the use of valves in the power amplifier stages of transmitters where robust reliability is sought, together with high output power.

In the design of communication receivers, some designers still insist on using valves in the first RF amplifier to improve the performance of the receiver. Hi-fi enthusiasts insist on still using valves in audio amplifiers to improve the quality of the output.

Although the teaching of valve theory is no longer part of the syllabus for the radio amateur examination, the new amateur is likely to encounter equipment, new and old, which will contain valves. I hope that this article on valves will have equipped the reader with sufficient knowledge to be able to tackle any faults that may occur in equipment containing valve circuitry. See also my articles *Small Fires in Jam Jars!* (May and June 1986) and *The Triode Valve* (September and October 1986).

Finally, a word of caution. Remember, valve circuits usually operate at high voltages. Take care when investigating faulty valve equipment. REW

DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

March was a fairly quiet month for most long distance TV enthusiasts. Tropospheric DX activity was minimal with only a hint of reception on the 12th from Danish and French stations in Band III. The most productive band during the month was undoubtedly Band I, especially for those with ample time to make frequent checks for any activity.

DX-TV log for March

This month we are featuring Simon Hamer's log which reflects the general conditions noted by most enthusiasts.

7/3/87: SVT-1 (Sweden) on channel E2 received with the 'TV1 SVERIGE' PM5534 test pattern.

8/3/87: BR-1 (West Germany - Bayeriucher Rundfunk 1st network) on channel E3 radiating the FuBK test pattern with 'KREUZBERG' transmitter location identification.

9/3/87: YLE-1 (Finland) from the channel E3 Tervola outlet showing the 'YLE TV1' FuBK test pattern; TSS (Russia) with programmes and Cyrillic captions on channel R1.

11/3/87: CST (Czechoslovakia) with the 'RS-KH' EZO-type test pattern on channel R1; RTE-1 (Eire) on channel IB airing the 'RTE 1' PM5544; DR (Denmark) from the channel E3 transmitter at Fyn displaying the 'DR DANMARK' PM5534 test pattern; RAI (Italy) with programmes on channel IA.

24/3/87: RAI on channel IA carrying programmes.

25/3/87: SRG-1 (Switzerland – German language network) on channel E2 from the Bantiger transmitter radiating the '+PTT SRG1' FuBK test pattern; YLE-1 on channel E3 showing the 'YLE TV1' FuBK test pattern; TVP (Poland) from the channel R2 Warsaw outlet transmitting the dark background version of the Philips PM5544 test pattern.

26/3/87: TSS with programmes on channel R2; NRK (Norway) with the 'NORGE BREMANGER' PM5534 test pattern on channel E4.

Reception reports

Carl Ashton and John Motley have written in with details of their DX-TV successes noted in Sheffield. For reception in Bands I and III they use a home-made array whereas for UHF a Triax wideband BB grid aerial is used as well as a Fringe Electronics WB1222 array which covers channels 21 to 68. Two television receivers are used (a Panasonic Quintrix TC800G and a Ferguson TV with teletext facilities) in conjunction with a D-100 DX-TV converter. This handy unit is used to feed one of the two receivers via a Sharp V8300H video recorder.

Looking at their impressive log, not many European services have escaped their attention. Although their equipment is located at the bottom of a valley, Carl and John have managed to receive Russia, Spain, Czechoslovakia, Austria, Iceland, Finland, Italy, Sweden, Portugal, Poland, the Netherlands, Hungary, Yugoslavia, Norway, West Germany, Luxembourg, Switzerland and even Albania!

Bob Brooks of South Wirral saw Denmark on the 12th going onto programmes from the PM5534 test card on channel E10. A couple of weak unidentifiable programmes were also present on channels E3 and E4.

PHOTO FILE ● PHOTO FILE ● PHOTO

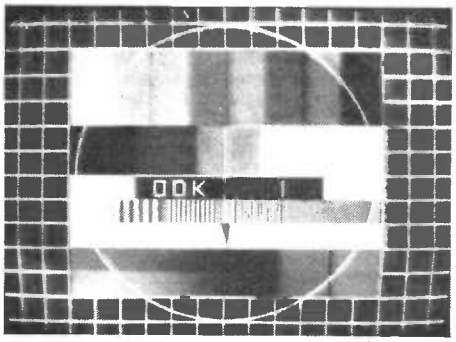


Fig 1 *FuBK test card radiated by CST in Czechoslovakia*

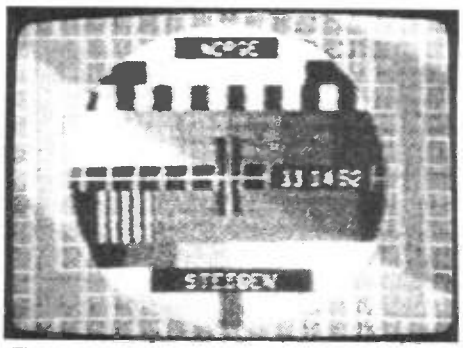


Fig 2 *PM5534 from Norway with transmitter indentification*

Fig 3 *Pattern transmitted from Tallim by Eeasti TV in Estonia*

Fig 4 *Identification caption broadcast by Canal Plus in France*

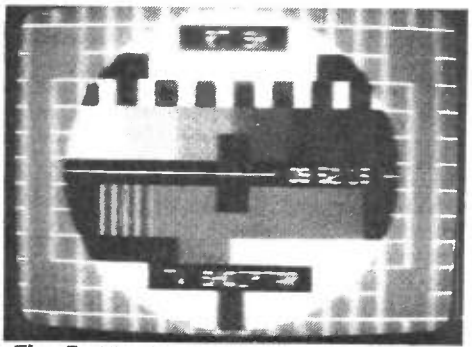


Fig 5 *Albanian test card with 'RTSH TV SHQIPTAR' ident*

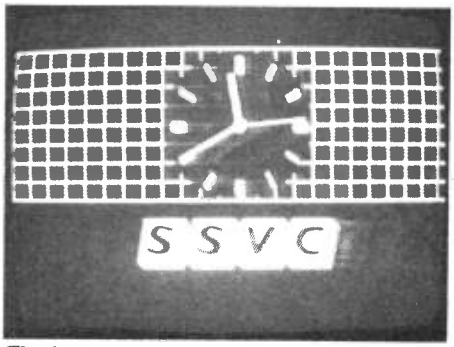


Fig 6 *Clock caption radiated by SSVC in West Germany*

DX-TV RECEPTION REPORTS

Kevin Jackson of Leeds noted French Band III signals during the same opening on the 12th from Canal Plus outlets on channels L5, L7 and L9.

Mark Dent, also of Leeds, went one better. He received Denmark on channels E8 and E10 as well as the French Bands III stations. The Danish signals were strong but faded away at 1400GMT.

Simon Hamer, located at New Radnor in Powys, successfully logged Finland twice during the month. Both dates (the 9th and 25th) produced the 'YLE TV1' FuBK test pattern on channel E3. Similarly, on the 8th, a West German signal from Bayerischer Rundfunk was identified by the 'KREUZBERG' transmitter location across the centre of the test pattern. Reception was on channel E3.

The 11th brought in a rather unusual signal for Simon. The Gort transmitter situated in Eire was noted on channel B (this has the same vision frequency as Italian channel IA) radiating the 'RTE 1' PM5544 test card. Simon reckons it could be backscatter DX rather than direct sporadic-E due to the short distance involved.

Iain Menzies of Aberdeen has described recent conditions as 'pathetic'. Apart from tropospheric DX on the 1st, the only other signs of activity came with a sporadic-E opening to Spain and Italy on the 8th and a couple of unidentified signals on the 19th and 21st.

Baby causes havoc

It would appear that a new threat to DX-TV reception is heading our way, thanks to a baby alarm unit which has just been launched in the UK. Our attention has been drawn to this new device by the well-known TV-DXer, Roger Bunney of Romsey. Apparently, Roger has been swamped by high level signals measured on 49.830MHz from a house about half a mile away. At first, the interference was assumed to have originated from an illegal cordless telephone system. In fact, the culprit was found to be an alarm unit made in Hong Kong.

The system is a crystal-controlled narrow-band FM transmitter which uses the domestic mains wiring as an aerial. In effect, the whole house has been turned into a huge illegal transmitter!

Roger has taken the matter up with the DTI as it would appear that the device is way out of the UK specification which demands that such devices have a maximum output power of 10mW. Unfortunately, according to Roger, many such baby alarms have been sold recently so the problem is likely to be felt by more DX-TV enthusiasts in the future.

DX-TV video

Many potential DX-TV enthusiasts often wonder what type of signals they can expect to encounter before actually splashing out on all the necessary equipment. After all, is it going to be worthwhile spending hard earned cash on a hobby if you are only likely to receive a couple of minutes of bullfighting from Spain during the summer?

In fact, sustained periods of reception are possible from virtually every European country, as this column regularly testifies. Colour and sound may be received during good sporadic-E and tropospheric openings. Signals from much further afield are possible during periods of high sun-spot activity with TV transmissions available from countries such as Dubai, Canada, the USA and even Australia. Daily reception from Europe is possible via meteor shower activity, though it should be said that signals tend to last for only a few seconds.

To help newcomers to DX-TV assess the potential of this fascinating hobby, a video cassette has been produced which features typical reception via the four main modes of propagation, namely sporadic-E, meteor-shower activity, F2 layer ionisation and enhanced tropospheric conditions.

The 33-minute cassette (available in either Beta or VHS format) does not always seek to show reception at its very best. Instead, typical reception is featured, warts and all! Although it is intended for newcomers to the hobby, more experienced enthusiasts should also find it interesting, particularly if they missed out on the last sun-spot maximum.

Programme notes accompany the cassette which comes complete with a library cassette box. It is available, price £14.50 including UK postage, from HS Publications, 17 Collingham Gardens, Derby DE3 4FS. Cassettes conforming to the VHS format will be sent unless Beta is specifically requested.

Service information

Malta: Viewers in Malta are currently able to tune into the new British satellite TV service, called 'Super Channel', entirely free of charge!

Although very expensive TVRO equipment is normally required to see programmes from this station, TV addicts in Malta are able to receive transmissions courtesy of the Italian pirate outfit known as 'Antenna Due'!

France: The uncertain futures of La Cinq and TV6 (the two latest privatised TV services in France) appear to have been resolved.

La Cinq (TV5) is to go into partnership with the Italian private TV networks of Italia 1, Rete 4 and Canale 5. TV6 is now under the control of Compagnie Luxembourgeoise de Télédiffusion which, for many years, has been responsible for the RTL TV services in Luxembourg.

The PM5534 test card is used by the sixth network with the identification 'TDF' at the top and 'RESEAU 6' in the lower black rectangle.

The anti-pirate station identifications superimposed over programmes from tf-1, A2 and FR-3 have been discontinued, at least for the time being.

A new identification has been noted on the FR-3 PM5544 test card. The channel 24 transmitter at Lille radiates 'TDF' at the top as usual, but 'DIFF.TV' at the bottom.

Netherlands: Television services are to undergo major changes in the near future if everything goes according to plan.

NOS-1 will radiate programmes from the various religious organisations whilst NOS-2 will broadcast material from the independent TV companies. The new third network (NOS-3) will transmit mainly minority interest programmes.

NOS-3 will be financed from commercials and the existing licence fee. Consequently, programme hours for NOS-1 and NOS-2 will be reduced accordingly. Due to technical problems, the third network (to be known as 'NEDERLAND 3') will not commence until next year. When it does begin, programmes will be radiated from all transmitters.

On a different topic, viewers living in Rotterdam are unlikely to rush out and buy expensive satellite TV equipment. They are currently able to receive satellite programmes via cable TV from Sky-TV, Super Channel, TV5 and Filmnet.

Zimbabwe: Programmes from ZTV-1 have recently been transferred from Band I to Band III channels. The non-commercial ZTV-2 service now occupies Band I which is bad news for many devotees of ZTV-1; most TV sets in Zimbabwe can only receive signals in Band I!

Iceland: A new private TV station has opened in Akureyri. It radiates the same programmes as the other new private station, 'Stöd-2' (which is based in Reykjavik) with the exception of news bulletins. Stöd-2 programmes from Akureyri are delayed by one week!

Stöd-2 programmes are transmitted on channel E12 with an effective radiated power of 20kW.

Poland: There is bad news on the horizon for DX-TV enthusiasts! All transmitters in Bands I and II, which currently radiate TVP-2 programmes, are to close down in favour of UHF outlets. In fact, these changes may well have already taken place. By 1992, TVP-1 transmitters operating in Bands I and II will also have transferred to UHF.

A new relay has opened on channel R5 serving Warsaw with programmes from the Russian TV service, TSS.

Our thanks to William Maries (Studley, Warwickshire), Alain Dutchâtel (France), Walter Gouder (Malta), Michael Summers Larsen (Denmark) and Gösta van der Linden (Rotterdam, Netherlands) for supplying this month's service information.

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MS11-LD Unibus 256kb Ram	**£850.00**
PDP11/05 Cpu Ram, i/o etc	**£450.00**
PDP11/40 Cpu, 124k MMU	**£1,850.00**
RT11 ver 3B documentation kit	**£70.00**
RK05-J 2.5 Mb disk drives	**£650.00**
KL8 JA PDP 8 async i/o	**£175.00**
M18E PDP 8 Bootstrap option	**£75.00**
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Also available less psu, with fans etc. Internal dim. 19"w, 16"d, 10.5"h. **£19.95. Carriage £8.75**

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"GANG OF EIGHT" intelligent Z80 controlled 8 gang programmer for ALL single 5v rail EPROMS up to 27128. Will copy 8 27128 in ONLY 3 MINUTES. Internal **LCD** display and checking routines for **IDIOT PROOF** operation. Only **£395.00** + pp £3.00.

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Data sheets on request

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Don't forget, ALL TYPES and QUANTITIES of electronic surplus purchased for CASH

QSO

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

Errata

Some readers may have experienced problems with Brian Kendal and Jeff Howell's *Versatile Continuity Tester*, published in the March issue.

Firstly, the circuit diagram should show the output of IC4 as pin 8. Also, IC pins 4 and 11 were omitted from the diagram and these should go to the positive and negative battery terminals respectively.

Secondly, the polarity of C1 should show the positive plate to R12/R13. In the text, the circuit description refers to IC1a, b, c and d instead of IC1, 2, 3 and 4. Finally, in the oscillator description, read pin 9 for pin 11.

We apologise to readers for any confusion resulting from these errors.

NARSA venue change

Readers will probably be aware of the Belle Vue exhibition which is organised each year by over 40 amateur radio societies in the north-west of England. This year marked the Silver Jubilee of the exhibition and was an overwhelming success, with an attendance of more than 3,500 people.

Unfortunately, the Belle Vue site has been sold, requiring a new venue to be found for 1988. The search for a large enough complex has been undertaken by NARSA (Northern Amateur Radio Societies Association) and only one site in the north-west has proved to be suitable for all aspects of the exhibition. This is the purpose built centre at the Norbreck Castle Hotel, Blackpool.

The NARSA exhibition is normally held in mid-March but this is not possible next year due to prior bookings of the new venue. Therefore, it has been necessary to bring forward the date by six weeks to January 31st.

For more details contact Peter Denton G6CGF on (051) 630 5790.

Meeting point

The Rugby Amateur Transmitting Society aims to provide a meeting point for all radio amateurs and SWLs in the Rugby area. The society consists of people with a wide range of interests and experience in all fields of amateur radio, and this is reflected in the various activities organised by members.

On 21st July there will be a direction finding competition, starting from the club house – the Cricket Pavilion outside Rugby Radio Station. This will be followed on the 28th by a home-brew evening, where members are invited to bring along their latest project.

The society meets every Tuesday at 7.30pm. Further information can be obtained from Kevin Marriott G8TWH on (0788) 77986.

On the downs

Members of the Dunstable Downs Radio Club are aiming to get out and about in July with an NFD contest 'on the Downs' arranged for 4th/5th July.

July 10th sees a junk sale, which will be held at 8pm at the club's regular venue, Chews House, High Street South, Dunstable, Bedfordshire. Club nights are every Friday.

Further details are available from the secretary, Phill Morris G6EES, on (0582) 607623.

Sussex Mobile Rally

The Sussex Mobile Rally is an annual event for radio amateurs and their families, with over 50 companies specialising in amateur radio and electronics exhibiting. Meanwhile the family can enjoy a day by the seaside and many entertainments.

The 1987 rally will again be at Brighton Racecourse, which can be easily found by visitors and has ample free car parking for the 2,000 people from all over the south-east who attend annually.

Always on a Sunday for everyone's convenience, the 1987 rally will be on 12th July. Entrance charges have remained unaltered at £1 per

Radiogram Winners!

The first two correct entries for last month's *Radiogram* were from Mr L Smithers of London and Mr G Wormald of Worcestershire. Both will receive a year's free subscription to *Radio and Electronics World*.

The answers are shown below.

S	O	F	T	W	A	R	E	V	B	E	N	Q	D	C	G
X	F	S	R	E	T	U	P	M	O	C	W	A	N	H	R
R	C	G	A	E	U	T	A	P	E	L	O	O	P	S	D
O	E	A	N	H	Q	B	Z	S	D	F	T	D	R	N	A
S	C	Z	S	V	B	U	R	F	I	Q	O	A	D	J	H
S	L	K	I	T	C	X	E	D	V	L	F	U	G	M	W
E	V	A	S	S	M	C	H	N	A	O	D	F	U	E	B
C	K	N	T	B	E	E	G	U	C	N	H	R	O	F	R
O	D	R	O	L	D	H	P	H	S	Y	T	B	E	Z	O
R	F	K	R	O	U	B	T	C	S	C	O	E	P	L	A
P	Q	F	H	L	W	S	G	N	E	Y	D	A	N	K	D
O	F	T	S	D	L	R	V	P	Y	B	A	U	E	N	C
R	A	X	O	G	T	C	S	U	A	S	D	L	K	W	A
C	S	L	A	T	S	Y	R	C	U	F	Y	B	E	H	S
I	M	Q	U	A	X	C	K	N	R	V	D	O	Z	F	T
M	P	S	R	E	T	L	I	F	L	A	T	I	G	I	D

Calling all club secretaries!

We are always pleased to receive news and details of interesting meetings from clubs and individuals. However, to help us to promote your organisation or event, please note the following:

1) Typed press releases on A4 paper are much more legible than scrawled notes on loo paper, and are less prone to misinterpretation.

2) Check that all the relevant information concerning an event is included, such as venue (with full address and directions if necessary), time and date.

3) A contact address, such as that of the club secretary, is essential. Please give a full postal address and phone number if possible.

4) Please bear in mind that we work two months in advance, so items for publication in a specific issue should be submitted at least three months before the event is due to take place.

adult (children under 14 years and disabled visitors are free).

The large racecourse buildings allow all stands to be under cover and refreshments, including hot meals, are available in the bars and the cafeteria. For the family a free minibus service runs regularly to and from the seafront throughout the day, and a number of other diversions are available on the rally site.

For disabled visitors, ramps, lifts and wide gangways ensure freedom of wheelchair access. Local clubs, societies and specialist groups are all represented, and a special event station, callsign GB2SMR, is on air to talk mobile visitors in from far afield. The rally is organised by members of six amateur radio societies from throughout Sussex.

For further details contact the secretary, Mark Spillett G4UAW, 26 Westlands, Rustington, Sussex BN16 3NW. Tel: (0903) 782594.

Ascension Island

The Lincoln Short Wave Club will host a lecture on 8th July entitled 'Fibre glass techniques – everyday use', by Ian Fulton G4XFC.

This will be followed by an RAE, CW, activity and construction night on the 15th and a talk on Ascension Island by Roger Hyde G3ZDW on the 22nd.

The venue for all these events is the City Engineers Club, Central Depot, Waterside South, Lincoln. For details of time or other information contact Pam Rose G4STO c/o the City Engineers Club.

Datacom

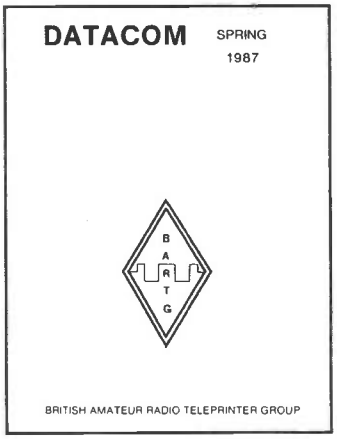
The spring edition of *Datacom*, BARTG's quarterly journal, features an article about adding an Amtor facility to BARTG's very popular ST5 terminal unit. The journal also lists the RTTY software available.

To make life even easier, BARTG also sells the connecting leads necessary for use with the radio, terminal unit and micro.

Datacom is sent to all members of BARTG, and full details of membership can be obtained from John and Pat Beedie, GW6MOK and GW6MOJ respectively, 'Ffynnonlas', Salem, Llandeilo, Dyfed SA19 7NP.

BARTG's annual rally aims to cater for those interested in RTTY and who like to build their own equipment. The 1987 rally will be held on Sunday August 30th at Sandown Park.

Further details can be obtained from: Peter Nicol G8VXY, 38 Mitten Avenue, Rubery, Rednal, Birmingham B45 0JB.



Slow-scanners

The Bath and District Amateur Radio Club is planning an evening devoted to slow-scan TV on 8th July, to be followed on the 22nd by an HF night on the air, with the club call G4TMH.

Both meetings will be held at the Englishcombe Inn, Englishcombe Lane, Bath at 8.00pm.

Details are available from H Welchman G6EIY on Bath 28010 daytime or 318128 evenings.

Beginners welcome

The Sheffield Amateur Radio Club now meets every Monday evening and non-members are especially welcome to come along and see what amateur radio is all about.

The club offers talks, visits, test gear, advice and tuition in Morse code and the Radio Amateurs' Exam. Because they are affiliated to the Radio Society of Great Britain, you can obtain discounts on books, etc.

The club meets on Monday evenings at 8.00pm (RAE class at 7.30pm) at the Firth Park Pavilion, Firth Park Road, Sheffield 5 (under the clocktower next to the library).

Non-members are asked to pay 25p admission. Joining fee is £1 and the annual subscription £1.50. Tea and coffee are available at 10p.

For further details, please contact the club secretary, Alan G8ZHG, at 3 Richmond Hall Crescent, Sheffield, South Yorkshire S13 8FN. Tel: (0742) 395287.

DF contest

The July schedule of the Coventry Amateur Radio Society is as follows: 3rd – Morse tuition and night on the air; 10th – 2 metre direction finding contest; 17th – night on the air.

The society meets on Friday evenings at 8.00pm at Baden Powell House, 121 St Nicholas Street, Radford, Coventry. Further details can be obtained from Bill Hahn G3UOL on (0203) 414684.

NOTES FROM THE PAST

Recollections from the days when you required a licence for your radio receiver

The punishment fits the crime

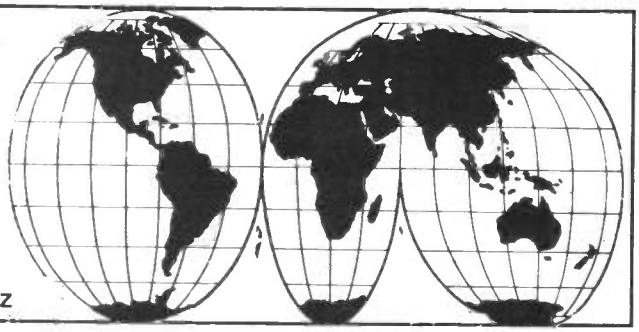
Most readers will have seen the newspaper accounts of the pirate listener of Hounslow who was fined a couple of pounds and had his receiver confiscated. The right of the GPO to apply to have the receiver impounded was not, until it was exercised on this occasion, generally realised. As a form of punishment it obviously varies in its deterrent effect. There is a world of difference between losing a 100-guinea radiogram and being relieved of a box of old junk you'd have to pay anyone else to take away!

When I heard the incident discussed by a couple of listeners, one brightly suggested getting a friendly neighbour to run in an extension speaker. To do this, of course, also requires a licence. The bright boys who make a living by devising regulations are sure to have prepared for a thing like that. Those who remember me telling the story of the start of relayed radio could tell you that at one time it was actually forbidden! At least, the bright boys found it was when they carefully checked over the regulations they had drafted.

Occasionally we get queries from readers about the licence position of portable receivers built for fitting to their cycles or cars. The licence for a fixed address also covers the use of a portable set, not only by the licensee but also by any member of his household. A receiver which is fitted in a vehicle is not considered to be portable in the sense that it is a 'portable receiver', and therefore an additional licence must be taken out.

It reminds me of an amusing experience told me by a reader. Every time he phones his girlfriend, he gets the Light Programme. I can only imagine it is picked up from a relay service wiring which might run parallel. I wonder whether he is entitled to listen to it without taking out a wireless licence!

SHORT WAVE NEWS FOR DX LISTENERS



By Frank A Baldwin

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

DXing Peruvian stations on and near the 60 metre band (4750 to 5050kHz) is not, apart from one exception, an easy matter. Most of the transmitters exhibit low power ratings, their frequencies and operating schedules often being at some degree of variance with those published.

Being private ventures, some are apt to vanish from the scene after a short period of life, this being due to lack of initial capital or, as is often the case, unavailability of spares subsequent to a breakdown of the equipment.

For the avid DX hunter there are Peruvian stations operating on the 90 metre band (**3200** to **3400**), to be dealt with later in this Peruvian series, and from **4004** up to **5776.9**, but utility (ute) interference is a major factor limiting reception of many of these transmitters by those residing in western Europe and the UK. Nevertheless such signals are reported by Euro DXers from time to time, especially during the 'season' for Latin American reception which is roughly from April through to August inclusive.

The signals from Peru proved to be extremely difficult to hear prior to, and for some years after, World War II. With the reception equipment available at that time, together with the fact that the low powered Peruvian transmitters are located behind the high Andean range, it was unlikely that such a log entry would be made.

Matters remained at that level until the emergence of more advanced receiver design and the advent of Radio Atlantida operating on **4790** with a power of 5kW in the clear during our late nights and very early mornings. Logging Radio Atlantida, Iquitos, is a relatively easy matter with respect to Peruvian stations; hearing the remainder is far from that level of endeavour.

Peru

The Republic of Peru is situated in West South America, the capital being the city of Lima lying amid a fertile plain with the main port of Callao being 7 miles distant.

The country may be divided into three regions, the narrow coastal plain, the Andes and the Montana, comprising the eastern slopes of the mountains and the Amazon lowlands. The Pacific coastal plain is desert terrain for some 1400 miles in which region much irrigation is required for agricultural purposes.

Bounded in the west by the Pacific, Peru is divided by two ranges of the Andes with a high altiplano lying between. The altiplano, except that area around Lake Titicaca, is a cold and barren region. Lake Titicaco, in the south on the Bolivian border is the largest in South America and shared with Brazil. The West Cordillera of the Andes includes the volcanoes El Misti and Huascaran. Many rivers from this range flow into the Pacific Ocean.

In the east are the rain forests of the west Amazon basin, the population of which is mostly Indian. There being only a rudimentary rail and road system, transportation in Peru is difficult.

About 50% of the total population of Peru is of Indian origin, the remainder being Mestizo (mixed Spanish/Indian), Oriental and European. The languages used are Spanish and Quechua, the former being the official language. The state religion is Roman Catholic.

Peru was the centre of the great Inca civilisation where every citizen had both work and food. In some respects it was far in advance of that imposed by the treasure seeking Spanish conquistadors who subjugated the Incas in the 16th century.

The last great Inca emperor, Huayna Capac, who died in 1533, divided his empire by leaving the recently conquered kingdom of Quito to his favourite son Atahualpa and the remainder to his legitimate heir Huascar. The resultant war between them weakened the Inca empire, making Francisco Pizarro's conquest much easier. The old Inca capital of Cuzco is located on the altiplano.

Peru proclaimed its independence from Spain in 1821. After a succession of military governments, democratic rule was established in 1980, present day Peru having a population totalling 19,000,000, governed by a Senate and a Chamber of Deputies.

Marker station

A reliable marker station providing an indication of Peruvian reception conditions is, as suggested above, Radio Atlantida. As a general guide, the most favourable time period is that from 2300 through to 0600.

On **4004.9** La gran estacion Radio Grau, la frequencia del amor y la Amistad (The grand station Radio Grau, the frequency of love and friendship), Radio Grau in Huancabamba operates from 0930 to 0200 with a power of 0.5kW. The nominal frequency is **4010**. Huancabamba is a pleasant city which attracts visitors to the Las Garinjas lagoons, famed locally for their medical properties.

Radio Frecuencia Popular in Rioja on **4025** is scheduled from 1100 to 0300 (Sunday from 1200 to 0100). This one identifies as La Voz de Rioja (The Voice from Rioja). The power is 0.5kW. Rioja is named after a region in northern Spain.

Radio Marginal, Tocache on **4039.3** is on the air from around 1000 to 0345 with a power of 0.5kW.

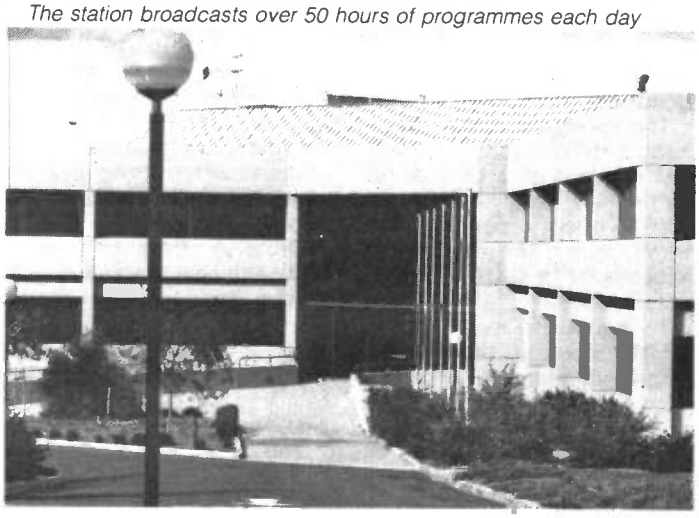
Radio Moderna in Celendin operates on **4300** with a power of 0.3kW from 1000 to 0305 (Saturday from 1000 to 0450) but varying the sign-off time to 0500 on occasions. Needless to say, it is rarely heard far from Celendin.

On **4458** is Villa Tropico in Villa Tunari operating in Spanish and Quechua from 1000 to 1400 and from 2100 to 0230 at 0.3kW.

R Norandina, in Celendin, operates around **4459.3** from 2200 to 0435 (Saturday from

Radio Australia's studios and offices at Burwood East, 20km south-east of central Melbourne. Facilities include 18 studio and control booth areas, news reading booths, a small production studio and a computerised switchroom.

The station broadcasts over 50 hours of programmes each day



2200 to 0450) with a power of 1kW. It identifies as La Nueva Imagen en Radio and is regularly reported by European DXers.

Radio Ayaviri, Ayaviri on **4606** with a power of 1kW is scheduled from 2000 to 0400 (Sunday from 2000 to 0215). The station identification is La Voz de la Hogar (The Voice from the Hearth).

Radio Huanta 2000, Huanta on **4755** opens at 1000 and is scheduled to close at 0300 (Saturday from 1000 to 0500). At 0.5kW, it is frequently heard and reported by European DXers.

Radio Inca del Peru, Lima on **4762** with a power of 5kW works to a 24-hour schedule on Saturday and Sunday (Monday to Friday from 1100 to 0500) with promos (promotions) such as Inca Cola often being heard. The city of Lima is the centre of Peruvian commercial, industrial and social life and has a university.

The seaside surburbs of Chorillas, Barranco and Miraflores house the more wealthy citizens whilst surrounding shanty towns, normal in Latin America, provide shelter of a sort for the poorer sections of the community.

On **4770** is Radio Andina de Arequipa, Arequipa operating around the clock with a transmitter with a power of 10kW. The city of Arequipa is the capital of the province of that name and a former Inca settlement.

Radio Tarma, Tarma is on **4774.9** at 1kW, being on the air from 0900 to 1400 and from 2000 to 0500. It is regularly featured in the SWL press world-wide.

Radio San Martin, Tarapoto on **4810** identifies as Una Voz Peruana para la Libertad (One Voice of Peru for her Liberty) and is scheduled from 0930 to 0300 (Sunday from 1100 to 0000) with a power of 3kW. It is often heard in Europe and the UK.

La Voz de la Selva, Iquitos is on **4825**, at which point on the dial it broadcasts to the local populace from 0955 to 0100. The sign-on time can vary to 0930, the power being 10kW. Iquitos was founded in 1863 and became an important port during the wild rubber boom of the early 20th century, being about 2300 miles from the mouth of the Amazon.

In the next issue this review of Peruvian stations on the low frequency ranges will be continued.

AROUND THE DIAL

In which are featured some of the loggings recently made here in East Anglia.

AFRICA

Ghana

Accra on **3350** at 0544, YL with announcements in English followed by a religious service. This is GBC1 with programmes in English and Hausa from 0500 to 0805 (Saturday and Sunday from 1730 to 2305). The power is 20kW.

Accra on **3366** at 2255, OM with the news in English, an epilogue followed by a choral rendering of the National Anthem and off at 2303. GBC2 radiates in English from 0530 to 0805 (Saturday and Sunday from 0805 to 0900) and from 1730 to 2305 with a power of 50kW.

Burkina Faso

Ouagadougou on **4815** at 0002, OM with the station identification in French, orchestral rendition of the National Anthem and carrier off. At 50kW, Ouagadougou is on the air from 0530 to 0855 (Saturday and Sunday from 0700 to 0755) and daily from 1700 to 0000 in French and vernaculars.

Cameroon

Garoua on **5010** at 0532, OM with a newscast in English of both local and world events. The schedule is from 0430 to 0800 (Sunday from 0630 to 0800) and from 1645 to 2315 in French, vernaculars and English. The power is 100kW.

CENTRAL AMERICA

Costa Rica

Radio Reloj, Irazu on **4832** at 0446 with a programme of popular songs and music in the local style. The schedule is from 2200 to 1000 with a power of 3kW. Being on a clear channel, Radio Reloj is heard and reported world-wide.

Honduras

La Voz Evangelica, Tegucigalpa on **4820** at 0444, announcements and religious songs in Spanish. LV Evangelica operates from 1030 to 0600 in Spanish (Sunday from 1100 to 0700 in Spanish and English). The power is 5kW.

SOUTH AMERICA

Brazil

Radio Liberal, Belem on a measured **3325.4** at 0542, OM with a sports commentary in Portuguese. R Liberal is on the air around the clock with a power of 5kW.

Colombia

Radio Sutatenza, Bogata on **5095** at 2313, folk songs and music in the local style, OM with announcements in Spanish. R Sutatenza has a 24-hour schedule and a power of 50kW.

Equador

HCJB Quito on **3220** at 0415, slow sombre orchestral music and some announcements in Spanish. HCJB on this channel programmes in Quechua from 0830 to 1430 and from 2100 to 0200, in Spanish from 0200 to 0500. The power is 10kW.

Guatemala

Radio Cultural, Guatemala City on **3300** at 0546, dance music European style, announcements and then the station identification. At 10kW, Radio Cultural operates from 1000 (Sunday from 1100) to 1300 and from 2130 to 0630 in Spanish except for an English transmission timed from 0300 (Sunday from 2345) to 0430.

PACIFIC

Australia

Melbourne on **7120** at 1524, OM with the station identification, Waltzing Matilda and sign-off after the Cantonese programme to South-East Asia scheduled from 1430 to 1530.

EUROPE

Portugal

Radio Renascenca, Lisbon on **9680** at 1443, announcements and light orchestral music during the Portuguese transmission for Europe, timed from 1400 to 2000.

Spain

Madrid on **9570** at 1117, a talk about Madrid during the Spanish programme for Europe scheduled from 0930 to 2130 daily.

CLANDESTINE

Voice of the Feda'i on **3940** at 2135, OM with a harangue in Farsi (Persian). Voice of the Feda'i (Seda-ye Feda'i) supports the establishment of a People's Democratic Republic and commences each transmission with the Internationale. Announcements purport the station to be that of the Feda'iyan Khalq-e Iran guerillas.

NOW HEAR THESE

Emisor Regional da Huila, Angola, on **4820** at 2213, OM with a talk in Portuguese followed by African music in the fast rhythmic style typical of the locality.

This 10kW transmitter operates in Portuguese and vernaculars from 0500 to 2302. Listen on this channel after the 50kW Radio Botswana signs off at 2100.

Radio Revolution, Bujumbura, Burundi on **3300** at 0425, OM with a talk in vernacular, the transmission being subjected to severe utility interference.

With a power of 25kW, Bujumbura is on the air from 0300 to 0700 (Sunday from 0300 to 0600) and from 1600 to 2100 in French, English and vernaculars. It is seldom heard and reported by virtue of the almost continuous co-channel utility interference.

NOW LOG THESE

Radio Madre de Dios, Peru, on **4950** at 2256, YL and OM with a discussion in Spanish followed by some trumpet dance music in the local style and then a talk. This 5kW transmitter entertains the locals from 1030 to 0200 and programmes entirely in Spanish.

Radio Kigali, Rwanda on **3330** at 0545, songs in vernacular with music typical of the region. This one programmes in French, Swahili and vernaculars from 0300 to 0600 (Sunday from 0600 to 0900), from 0900 to 1200 (Saturday and Sunday from 1200 to 1330) and from 1330 to 2100. The power is 5kW. REW

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FOR SALE

■ Yaesu FT708, 70cm hand-held, complete with fast charger, 2 nicads, case, speaker mic. Good condition, first £150 cash secures, buyer collects. Tel: Gravesend 321797

■ SX200N VHF/UHF scanning Rx modified with 2.5mm jack socket for cassette recorder control. Perfect condition, £160 ono. John Wilson, 6 Holland Street, Aberdeen. Tel: (0224) 638179 or (0224) 722799 ext 139

■ Scanner users, I have photocopies of service manuals for the following: Tandy, Realistic PRO30, PRO31, PRO32 and PRO2021, Yaesu FRG9600 and combined AOR 2001-2002 (UK) version. All £5.00 each plus p&p 50p. Phillips. Tel: 01-743 0811

■ 5 inch Yyoko UHF/VHF System B/G/I for UK and Continental use, unwanted present, offers, cost £89.95. Tel: (0283) 221870

■ Yaesu FT One gen coverage tvr. All options with MD1 base scanning mic. G4NYC. Tel: (0529) 21327 after 9pm

■ 13.8V 25A PSU, £20.00. 13.8V 12A PSU, £15.00. 12V 3.5A Coutant PS module, £5.00. Advance H-1 AF 3 band sig gen with manual, £20.00. Electronic multimeter CT471 dc 1500MHz. RF probes & manual, vgc, £35.00. Marconi 1-30MHz 14ft loaded whip ae, £10.00. 10ft telescopic tank ae, £5.00. 4 off h/duty ribbed ceramic ae insulators, £3.00. SG Brown h/phones, £5.00. Incomplete HF Tx kit – 6146 valve & holder, tank former, RF chokes, wide spaced capacitor, hi-V capacitors, temp controlled xtal/osc, meters, dials, filters, ht trans, choke, etc £30.00 the lot. Box of quality signal components 100-1000MHz masthead amp & PSU. Rotary step attenuator, signal splitters, coaxial changeover relay (12V) coaxial switches, mostly new & unused. £15.00 the lot. Copies of *RadComm* mag, May '75 to Sept '76, £5.00. G4FZG QTHR. Tel: (0242) 580329

■ Vintage military 7 to 9MHz, type 38 walkie-talkie wireless sets in vgc, £50 for the pair. Taylor all wave multi-range signal generator model 65B in vgc, £25. Tel: Bookham (0372) 52569

■ Yaesu FR-101 communications receiver. Mint condition, £280. Trio 9R-59DS general coverage receiver, excellent condition, £90. Buyer collects. Lewis, 11 Drydales, Anlaby, Hull HU10 7JU. Tel: (0482) 652395

■ SX200N scanner, boxed as new condition, £180 ovno. Buyer to collect or carriage extra. Reason for sale purchased AR2001. Des Thompson, Four Winds, 131 St Johns Road, Exmouth, Devon EX8 4EW. Tel: Exmouth 26 5059

■ Oric Atmos 48K, complete with all leads, manuals, books, tape software. Includes Forth. Perfect condition, £55. Also, MCP40 four colour printer/plotter, £55. May swap for reasonable general coverage receiver. A French, 14 Orchard Hill, Faringdon, Oxon SN7 7EH. Tel: (0367) 20788

■ Yaesu FT270R 5 to 25 watt two metre radio with voice synthesizer. As new boxed, £175 ovno. Tel: 01-472 9056 after 6pm

■ Shack clearout: Drae VHF wavemeter. FX1 Lowe wavemeter. ZX81 16K RAM. Pye Cambridge 70MHz. RF Thru-line wattmeter, model T435 144-435MHz. Lowe VOX unit. Yaesu FF-501-DX 52Ω. 20 amp stabilised power supply, fitted with meter. Three Datong codecall 4096. Pye Westminster W15 FM suitable 50MHz. Mint condition. Signal generator (TE-20). Philips oscilloscope dual-trace 0-10MHz. Jaybeam VHF collinear aerial. Reasonable offers accepted. Tel: Sheffield (0742) 651289

■ RCA metal valves, new, boxed, 6 6SG7, 3 6J5, 2 6N7, 1 6SJ7, 1 6J7, 1 6K8, 1 6H6, £10. Eddystone formers 2½ inch. 6 TPI, £10. 813 valve, £10. Two new Ormond chrome var cap 500μF, £10. Valves ACP1, U30/250, MPT4, HL2, UU3, PM22A, UU5, VP4A, Acpen, VU120, £5. Twin gang 500μF, £5. Earl, 1 Mayfield Drive, Daventry, Northants. Tel: 702265

■ Standard CIII 2m hand-held with nicad battery pack, rubber duck and charger. Less than six months old. As a special export version it has extended coverage, £120 ono. Tel: 01-794 1984 (West Hampstead) after 6.30pm weekdays or any time weekends

■ Yaesu FT901DE transceiver, several fitted extras including Curtis keyer, FM board, FM filter. Excellent condition. Purchased from South Midland Communications three years ago, £460 ono. Tel: (0526) 306612 and ask for Sean. 34 Electric Station Road, Sleaford, Lincs

■ Retirement sale: loads of electronic goodies. Too varied to list so selling in large parcels by weight. 5lb for £8, 10lb for £13, 20lb for £19. Each contains a selection of new and used components, larger parcels may contain transformers, equipment, etc. Superb value. You will be delighted. Also over 1,000 new boxed valves. SAE with enquiries please (from only 5p each!). Mr K Bailey, 40 Seymour Close, Selly Park, Birmingham B29 7JD. Tel: (021) 472 3688

■ Antex TCSU-1 soldering station, CTC iron £45, Mega PL-1 photolab exposure unit, spare tubes, £40. Stone. Tel: (0872) 864183

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■ Teletype printer with keyboard, reader and punch. Suit RTTY or wire. 3 rolls paper and connection details. Used regularly, good condition, £25 offers. Pulse generator, 1Hz to 1MHz 40Vpp, good condition, £25. B J Frost, 8 Robinswood Drive, Ferndown, Dorset BH22 9RZ. Tel: (0202) 875743

■ Windrush 6800 system with EPROM programmer and developmental software. Canon AS100 computer with MSDOS and CP/M86 and additional software. Various electronics developmental testing equipment and components, including scopes, monitors, decade divider, logic analysers, power units and CAD PCB system. Miss V Thillai, 74 Forlease Road, Maidenhead, Berks SL6 1SD. Tel: (0628) 36121

■ Free: a number of components, about 6 small packs, please send one first class stamp to cover postage to Mr Lawrence, 7 Griffin Crescent, Wick, W Sussex

■ Pye 6ch 2m FM Cambridge, Pye 6ch 70cm FM Cambridge, both complete with xtals and manuals. PF1 Pye pocketphones. Marconi TF801A 10MHz-300MHz sig gen. Marconi TF643 20MHz-500MHz wavemeter. Sig gen 150kHz-220MHz. Qty blowers, offers please. Mr P N Ash, 9 Maple Grove, Rugby CV21 2QS. Tel: (0788) 76630

■ Video infra-red, full-function, remote-control for Grundig 2×4 super recorder. Consists of VIF-K1 combination, including TPV355 handset, and VIF-E1 plug-in receiver with new battery. Boxed, new and completely unused, only £18. Tel: Tyneside (091) 2630714

■ 1.8-30MHz ham bands only Rx. Home built double conversion valve set to G3RKK RSGB bulletin design. In large heavy case. In working order with circuit. Any reasonable offer, buyer to collect. Please telephone Leeds (0532) 866897

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■ Eddystone general coverage receiver, model 670A good condition. £60 ono. Tel: Portishead (0272) 846343

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Dials, variable capacitors. Most items for the vintage set builder. No lists but SAEs answered. R Jennings, 20 New House Close, Thanington, Canterbury, Kent CT4 7BQ. Tel: (0227) 65200

■ Set of PCB and memory chips with some components to make frame store for WX Rx, brand new unstarted project £40. 16K RAM board Apple, £10. Multi testmeter, volts, ohms, current with 50 and 75 ohm RF probes, strong case, £25. Similar for repair or spares with probes, £10. JVC min TV radio bands 1,3,5, ideal DX or ATV use, £60. Tel: Ben, Kidderminster 743253

■ Codar PR30 preselector, £10. Yaesu FRG-7 receiver, £125. Unused ZX Spectrum Plus £50. Scarab terminal unit, plus Spectrum RTTY interface and software, £60. Hallicrafter Super Skyrider receivers, £60 and £40. Tel: St Albans 39333

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■ ITT KS666 18W 4 ohms speakers. Will buy or part exchange with KS665 speakers. Will pay £25 ono. Collins, 47 Brunswick Road, Fair Oak, Eastleigh, Southampton, Hampshire SO5 7FF. Tel: Southampton 693743

■ Dust out your shacks and lofts, will pay these prices for National Company Malden equipment, original manuals, catalogues £5-£10, HRO speaker enclosures £15-£20. HRO PSUs £5-£10. HRO rack mounting combined PSU/speaker unit, £30. Rack mounting coil pack holders, £10-£20. German and Japanese WWII copies of HRO, £150. Also wanted, other national receivers, equipment, transmitters, HROs working, non-working models. Tel: St Albans 39333

■ Have Geloso G209R receiver. Want another working one with mains tranny, etc, ok. All crystals in place. Needed for spares to bring other one to full operating condition. Non-working receiver considered for parts only. Cannot pick up. Invalid. Quite willing to pay carriage. An Amperite 6H6 ballast valve used in circuit, not double diode valve, but amperite 'special'. Who knows where to get one? M J Shepherd, 66 Westerland Avenue, Canvey Island, Essex SS8 8JS

■ Urgent! Need CR100 bits for rebuild. Need chassis, cabinet, front panel, ant mixer, osc and HF coils for ranges 1 and 2, knobs, chokes, output trans, LF filter, lower round logging scale and attendant bits, round dial trim. Please, make it cheap, have short arms and deep pockets. Please write! Mr A Hawkins. 166C Kestrels View, Southgate, Runcorn, Cheshire WA7 2RX

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■ Sony 2001D or similar receiver, good condition essential. Also Datong AD270 or AD370 active aerial. Tel: (0823) 432909, Taunton area, before 10pm

■ Colour or b/w monitor with composite input. Condition does not really matter, but some life in it might help. Will pay up to £50 but under £30 would be nicer. Must be able to handle TV pictures, ie 625 line. Write to Aidan Corcoran, 24 Fairbrook Lawn, Rathfarnham, Dublin 14, Ireland

■ Regency digital flight scan 16 channel VHF scanner, must be in vg condition. Mr George Jacob, 23 Waterloo Gdns, Penylan, Cardiff CF2 5AA. Tel: (0222) 487299

■ Have Pye PF2UB UHF Tx/Rx in excellent condition, complete with mic/speaker antenna, new battery, plus leather carrying case. Swap for Tandy Pro22, or signal R528 h/held scanner. Tel: (0207) 544342, after 7pm eves/weekends

■ Mains power unit for 1155 or 1155 with power unit fitted. Also RS-232C board for Tandy TRS80 mod 1 computer modem and disc drives, word proc discs, anything for Tandy to help a beginner get started. Tel: (0977) 797063

■ Has anyone a Racal crystal calibrate they would sell an old aged pensioner, who is quite willing to pay a reasonable price. Please ring after 6pm, any day. Tel: (0303) 76230 Robert Boughton

■ Sony ICF2001D Rx service manual or full circuit diagram and info needed. Photocopy will do fine. All costs reimbursed. Please call Steve on (0473) 54405 evenings or (0473) 643367 office hours

■ Anything aeronautical – instruments, charts, manuals, etc. Godfrey G4GLM, 63 The Drive, Edgware, Middlesex HA8 8PS. Tel: 01-958 5113

■ Grundig Satellit 1400, 3400 professional communication Rx. Similar Rx considered but in any case must be in A1 condition. Trade will probably have to be done by post as I live in the back of beyond! If you can help please write to Victor McKaig, 15 Islandranny Road, Bushmills, Co Antrim, N Ireland BT57 8YE

■ Pilot PAL radio RDF marine receiver, VHF, Hi, Lo, etc. With handbooks and carry case circa 1960s. Please advise of price wanted. Can collect 200 mile radius. M E Mickels, 3 Gorslas North, Cornelly, Bridgend, Mid Glam. Tel: (0656) 745527

■ Instruction manual/circuit diagram (or copy of) for Binatone Phonecorder DeLuxe 3900. Will pay costs incurred. Please telephone Leeds (0532) 866897

■ Short wave receiver for less than £100. Any age or make, so long as it performs. Please write or phone Mike, 3 Cedar Road, Weybridge, Surrey KT13 8NY. Tel: (0932) 45364

■ Operating instructions for Yaesu FC301 antenna tuning unit – photocopy will suffice. Circuit diagram for same would also be appreciated. Contact John G0GPA QTHR, ex G6UGU on Doncaster (0302) 841530. Your price paid

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Marconi Automatic Amplitude Analyser Type 6500 incl: Coupler, Divider, Bridge and Detector Connector. Price Ex Factory: **£14193.00**
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EXTRACTOR FANS 5" square boxer type	**£7.00**
Motors 12v dc reversible geared 40rpm	**£15.00**
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Radio & Electronics World

The communications and electronics magazine

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.

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CREDIT CARD EXPIRY DATE ☐☐☐☐

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C P I

RADIO ENGINEER WANTED

Due to an ever increasing range of ICOM products, we are now looking to expand our service department.
Prospective candidates should have a sound background in radio and computer servicing techniques. They will be involved in all aspects of servicing using modern test equipment in extensive workshops at our main office.
If you are interested in joining our expanding company please contact us at the address below.

ICOM (UK) LIMITED
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Herne Bay, Kent CT6 8LD
TEL: (0227) 363859 ICOM

G4 DXX
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For Icom, Dray, Wells, DAIWA, Datong. N934 MHz equipment, logbooks, rotators, cable, etc.

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Constantly changing stock of interesting items for callers. Receivers, test equipment, components etc. Pye pocketfone PF1 TX units with battery and circuits £12 inc p&p. Ex Bt meters. Type Tester SA 9083 5V/50V/250V DC 250V Ac/50mA/5A DC. Low and high ohms run from 2AA batts £9 inc p&p. Type 2 12D 19 ranges 1-250V DC. 1-10,000.V AC -3 ohms ranges plus 0.05-1A DC, 20K ohms/V DC, 1K ohms/V AC £13 inc p&p. Type 3 SA 9083/14 electronic 5/50/250 DC .05/0.5/5A DC 250V AC. 3 low ohms amd 1M ohm range £16 inc p&p. All meter movements checked and supplied with leather case and jap leads.

WE'RE OFF AGAIN!

TO THE BIGGEST MOBILE RALLY IN THE SOUTH OF ENGLAND SUNDAY 12TH JULY 1987 FROM 10AM TO 4PM AT THE BRIGHTON RACE GROUND. HUGE "BRING & BUY" STALL. 20,000 SQ.FT. UNDER COVER EXHIBITION AREA. PLUS ATTRACTIONS FOR THE XYL AND CHILDREN AND RESTAURANT FACILITIES. THE RALLY WHICH CATERS FOR THE WHOLE FAMILY. TALK-IN ON S22 AND 3.5MHZ. ADMISSION £1. CHILDREN FREE IF ACCOMPANIED BY AN ADULT. FURTHER DETAILS RING:

0903 200572 EVENINGS

KITS, C.W. PRACTICE OSC
A2A Boxed £4.75p, 13.8V/10-25A psu Kit, £25 & £35
C.W./RTTY Software Prog. Filter Kit, Boxed £12.50p.
R.E.W. Projects, ICS, Caps, Res, Coils etc.
Details SAE to: **F.J.P. Kits, Components**
Hednesford, Staffs WS12 5AF. Phone 05435-6487
All VAT inc prices. Min P/P 35p Min Order £1.

FREE MEMBERSHIP to a new national electronics club. For details and a free pack of components worth over £10 send only £1 p&p to Dept REW, Woodside, Dowsett Lane, Ramsden Heath, Billericay, Essex CM11 1JL

THE SCIENTIFIC WIRE COMPANY
811 Forest Road, London E17. Telephone 01-531 1568

SWG	1lb	8oz	4oz	2oz
ENAMELLED COPPER WIRE				
8 to 34	3.63	2.09	1.10	0.88
35 to 39	3.82	2.31	1.27	0.93
40 to 43	6.00	3.20	2.25	1.61
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48	15.96	9.58	6.38	3.69
SILVER PLATED COPPER WIRE				
14 to 30	9.09	5.20	2.93	1.97
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14 to 30	3.97	2.41	1.39	0.94
Fluxcore Solder	5.90	3.25	1.82	0.94

Please add 15% VAT. Orders under £2 add 20p.
SAE for list of copper and resistance wire.
Dealer enquiries welcome.

PSSS....

ALL THE SUPER BARGAINS ARE ON THE INSIDE-FRONT COVER OF THIS MAGAZINE!!

JAPANESE Ic's (PART OF OUR RANGE)

AN301 £3.50, AN7140 £2.20, AN7145 £1.95, AN7146 £2.20, BA532 £1.60, BA536 £2.40, HA1377 £2.20, HA1398 £2.75, HA13001 £2.95, LA4460 £1.80, LA4461 £1.80, LA4507 £4.25, LC7137 £2.75, M51515 £2.50, M51517 £2.80, MB3705 £1.80, MB3712 £1.50, MB3722 £3.50, MB3730 £2.50, MB3731 £3.50, MB3756 £2.60, MB8719 £3.85, STK461 £7.50, STK463 £8.40, TA7205AP £1.00, TA7222AP £1.30, TA7229 £3.25, TA7240 £2.95, TA7607 £2.95, TA7614 £2.75, TA7628 £2.95, TA7640 £1.75, UPC575 £1.00, UPC1001 £2.20, UPC1031 £1.95, UPC1158 95p, UPC1181 £1.10, UPC1182 £1.10, UPC1185 £2.50, UPC1188 £2.75, UPC1230 £2.50, UPC1277 £2.75, UPC1365 £3.60
AOD 60p POST AND PACKING AND THEN AOO 15% VAT TO TOTAL

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ilea *Working in Education*

HACKNEY COLLEGE
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Electrical Engineering Technician

£9,813-£11,529 inc.

Grade 6. Responsible for the provision of a technician service within the Electronics Laboratories at the Keltan House site of the College. Duties include setting out equipment and ensuring its correct operation, and establishing security of equipment in the laboratory.

GRADE 6: Applicants should have at least ONC, OND, BTEC/TEC Higher Certificate, Advanced City & Guilds or equivalent qualifications in appropriate subjects, plus a minimum 9 years relevant experience (including training).
Closing date: 26th June 1987.

For further details and an application form, write to or telephone the college/school. Completed forms should be returned to PER/PS5B, Room 336a, The County Hall, London SE1 7PB.

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COUNTY GUIDE

RATES
BOXES ad sizes
20mm x 59mm single
40mm x 59mm double

Total prepayment rates	Ad space	3 issues	6 issues	12 issues
	single	£47.00	£88.00	£158.00
	double	£94.00	£176.00	£316.00

RADIO & ELECTRONICS WORLD COUNTY GUIDE ORDER FORM

TO: Radio & Electronics World · Sovereign House · Brentwood · Essex CM14 4SE · England · (0277) 219876

print your copy here .....

.....

.....

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NUMBER OF INSERTIONS REQUIRED

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 and 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 2307667 (England)

C P

ADVERTISERS INDEX

Radio & Electronics World

The communications and electronics magazine

ADVERTISING RATES & INFORMATION

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	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
Aug 87	11 Jun 87	17 Jun 87	19 Jun 87	9 Jul 87
Sept 87	16 Jul 87	22 Jul 87	24 Jul 87	13 Aug 87
Oct 87	13 Aug 87	19 Aug 87	21 Aug 87	10 Sept 87
Nov 87	10 Sep 87	16 Sep 87	18 Sep 87	8 Oct 87

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.

£1 BAKERS DOZEN PACKS

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

1 5 – 13 amp ring main junction boxes
2 5 – 13 amp ring main spur boxes
4 5 – surface mounting
5 3 – electrical switches, white flush mounting
7 4 – in flex line switches with neons
9 2 – mains transformers with 6V 1A secondaries
10 2 – mains transformers with 12V ½A secondaries
11 1 – extension speaker cabinet for 6½" speaker
13 12 – glass reed switches
17 2 – ultrasonic transmitters receivers with circuit
19 2 – light dependent resistors
25 4 – wafer switches – 6p 2 way, 4p 3 way, 2p 6 way, 2p 5 way, 1p 12 way small one hold fixing and good length ¼" spindle your choice
28 1 – 6 digit counter mains voltage
30 2 – Nicad battery chargers
31 1 – key switch with key
33 2 – aerosol cans of ICI Dry Lubricant
34 96 – 1 metre lengths colour-coded connecting wire
39 1 – long and medium wave tuner kit
41 8 – rocker switch 10 amp mains SPST
45 1 – 24 hour time switch mains operated (s.h.)
49 10 – neon valves – make good night lights
50 2 – 12V DC or 24V AC, 3 CO relays
51 1 – 12V 2 CO miniature relay very sensitive
52 1 – 12V 4 CO miniature relay
54 10 – rows of 32 gold plated IC sockets (total 320 sockets)
55 1 – locking mechanism with 2 keys
56 1 – miniature uniselector with circuit for electric jigsaw puzzle
60 5 – ferrite rods 4" × 5/16" diameter aerials
61 4 – ferrite slab aerials with L & M wave coils
63 1 – Mullard thyristor trigger module
66 1 – magnetic brake – stops rotation instantly
67 1 – low pressure 3 level switch can be mouth operated
69 2 – 25 watt pots 8 ohm
70 2 – 25 watt pots 1000 ohm
71 4 – wire wound pots – 18, 33, 50 and 100 ohm your choice
77 1 – time reminder adjustable 1-60 mins clockwork
85 1 – mains shaded pole motor ¾" stack – ⅛ shaft
89 1 – mains motor with gear box 1 rev per 24 hours
91 2 – mains motors with gear box 16 rpm
96 1 – thermostat for fridge
98 1 – motorised stud switch (s.h.)
101 1 – 2½ hours delay switch
103 1 – mains power supply unit – 6V DC
104 1 – mains power supply unit – 4½V DC
107 1 – 5" speaker size radio cabinet with handle
112 1 – heating pad 200 watts mains
114 1 – 1W amplifier Mullard 1172
115 1 – wall mounting thermostat 24V
118 1 – teak effect extension 5" speaker cabinet
120 2 – p.c. boards with 2 amp full wave and 17 other recs
121 4 – push push switches for table lamps etc
122 10 – mtrs twin screened flex white p.v.c. outer
124 25 – clear plastic lenses 1⅛ diameter
127 4 – pilot bulb lamp metal clip on type
128 10 – very fine drills for pcbs etc.
129 4 – extra thin screw drivers for instruments
132 2 – plastic boxes with windows, ideal for interrupted beam switch
134 10 – model aircraft motor – require no on/off switch, just spin to start
137 1 – 6½" 4 ohm 10 watt speaker
142 10 – 4 BA spanners 1 end open, other end closed
145 2 – 4 reed relay kits 3V coil normally open or c/o if magnets added
146 20 – pilot bulbs 6.5V 3A Philips
154 1 – 12V drip proof relay – ideal for car jobs
155 3 – varicap push button tuners with knobs
169 4 – short wave air spaced trimmers 2-30f
172 10 – 12V 6W bulbs Philips m.e.s.
178 3 – oblong amber indicators with filliputs 12V
180 6 – round amber indicators with neons 240V
181 100 – p.v.c. grommets ⅜ hole size
182 1 – short wave tuning condenser 50 pf with ¼" spindle
184 1 – three gang tuning condenser each section 500 pf with trimmers and good length ¼" spindle
188 1 – plastic box sloping metal front, 16 × 95mm average depth 45mm
193 6 – 5 amp 3 pin flush sockets brown
195 5 – B.C. lampholders brown bakelite threaded entry
196 1 – in flex simmerstat for electric blanket soldering iron etc.
197 2 – thermostats, spindle setting – adjustable range for ovens etc.
199 1 – mains operated solenoid with plunger 1" travel
200 1 – 10 digit switch pad for telephones etc.
201 8 – computer keyboard switches with knobs, pcb or vero mounting
206 20 – mtres 80 ohm, standard type co-ax off white
211 1 – electric clock mains driven, always right time – not cased
216 1 – stereo pre-amp Mullard EP9001
232 2 – 12V solenoids, small with plunger
236 1 – mains transformer 9V 1 amp secondary C core construction
241 1 – car door speaker (very flat) 6½" 15 ohm made for Radiomobile
241 2 – speakers 6" × 4" 4 ohm 5 watt made for Radiomobile
243 2 – speakers 6" × 4" 16 ohm 5 watt made for Radiomobile
244 1 – mains motor with gear-box very small, toothed output 1 rpm
245 4 – standard size pots, ½ meg with dp switch
249 1 – 13A switched socket on double plate with fused spur
266 2 – mains transformers 9V ½A secondary
267 1 – mains transformers 15V 1A secondary p.c.b. mounting
291 1 ten turns 3 watt pot ¼ spindle 100 ohm
296 3 car cigar lighter socket plugs
298 2 15 amp round pin plugs brown bakelite
300 1 mains solenoid with plunger compact type
301 10 ceramic magnets Mullard 1" × 3/8 × 5/16
303 1 12 pole 3 way ceramic wave charge switch
305 1 tubular dynamic microphone with desk rest
308 1 T.V. turret tuner (black & white T.V.)
310 2 oven thermostats
313 5 sub miniature micro switches
316 1 round pin kettle plug with moulded on lead
453 2 – 2¾ in. 80ohm loudspeakers
454 2 – 2½ in. 8ohm loudspeakers
463 1 – mains operated relay with 2 sets c/o contacts
464 2 – packets resin filler/sealer with cures
465 3 – 5A round 3 pin plugs will fit item 193
466 4 – 7 segment l.e.d. displays
470 4 – pc boards for stripping, lots of valuable parts
473 1 – 5" 4ohm speaker with built in tweeter Radio mobil
480 1 – 3A double pole magnetic trip, saves repairing fuses
498 4 – 1000uf 25V axial electrolytic capacitors

POWERFUL MOTOR (2 in. stack) fitted with gearbox with final speed 60 r.p.m. Mains operated. Suitable to operate garage doors etc. Price £4.00. Our ref. 4P15.

CAR STARTER/CHARGER KIT

Flat Battery! Don't worry you will start your car in a few minutes with this unit – 250 watt transformer 20 amp rectifiers, case and all parts with data £17.50 post £2

Ex-Electricity Board. Guaranteed 12 months.

VENNER TIME SWITCH

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

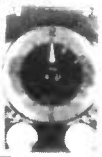
SOUND TO LIGHT UNIT

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

12 volt MOTOR BY SMITHS

Made for use in cars, etc. these are very powerful and easily reversible. Size 3½" long by 3" dia. They have a good length of ¼" spindle –
1/10 hp £3.45
1/8 hp £5.75. 1/6 hp £7.50

25A ELECTRICAL PROGRAMMER



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

THIS MONTH'S SNIP

3" floppy disc drive unit plug in and with all electronics. Japanese made, brand new. We are told that this is suitable for use with the BBC, Commodore, Amstrad and most other popular computers, and we supply with technical information. Special snip price £29.50 including post and VAT.

12V BATTERY OPERATED SIREN

(Or you can work this off a 24V transformer). Makes a shocking noise, will frighten away any intruder. Japanese made one 50p each, 2 for £1, ref RD106. American, storage soiled but unused and guaranteed perfect, only 20p each, 5 for £1, ref BD221

WONDERFUL BREAKDOWN VALUE – HAND HELD STEREO UNIT

Contains two beautiful miniature moving coil loud speakers. These could also be used as microphones, also contains many other useful parts including mini stereo amp, transistors, condensors, rocker switches etc. etc. To use this as a personal amplifier simply add a stethoset, only £1, ref B029.

SPIT MOTOR

Powerful mains operated induction motor with gearbox attached. Shaft has square hole which gives very easy coupling and quick release if required. Shaft speed 5rpm. Price £5, ref 5P54

NICKEL CADMIUM RECHARGEABLE BATTERY

The high capacity (4 Amp-hour) 'D'-size. £2 each. Our ref 2P141

20V–0–20V 1A MAINS TRANSFORMER

Upright mounting. Primary thermal cutout to interrupt the supply if transformer overheats. Price £2, ref 2P138.

4 BOOKS FOR £1

Book 1 describes the Mullard Unilex amplifier and gives details of a suitable cabinet. Book 2 describes several useful pieces of test equipment which could be quite easily constructed. Book 3 is electronic projects. Book 4 describes short wave receivers which can be easily constructed and is intended for mainly beginners. Our ref B0400.

TRANSFORMER IN WATERPROOF METAL CASE

24V 5A output. Ideal for garden lighting or to operate pond pump etc. Case has cable glands for mains in and low voltage output leads. Price £5 plus £1 post, ref 5P88.

MAINS RELAY

With transparent plastic cover. Could be pcb or clip mounted, has single 8–10A c/o contact. Real bargain 2 for £1, ref B0486

PANEL METERS

Engraved vu, approximately 1½" square. Luminate these from behind and you will have a really super looking panel. Real bargain 2 for £1, ref B0366

TRANSMITTER TUNING CONDENSOR

160pf made for a very famous RAF transmitter, only £1 each. Unused but mounting brackets will need a bit of cleaning up due to storage. Our ref B0424

MAGNETIC READ/WRITE UNIT

A read/write head mounted on a thumb operated lever is made to traverse magnetisable paper. The paper is held between top and bottom rollers which can be spun for localisation of the written message – new and unused only £1 each, B0381

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder – a complete mains operated kit which we guarantee is ten times more powerful than other popular kits. Price includes case and instructions. £9.50 plus £2.00 post.

TELEPHONE BITS

Master socket (has surge arrestor – ringing condenser etc) and takes B.T. plug £3.95
Extension socket £2.95
Dual adaptors (2 from one socket) £3.95
Cord terminating with B.T. plug 3 metres £2.95
Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 BT extension sockets £11.50
100 mtrs 4 core telephone cable £8.50

J & N BULL ELECTRICAL

Dept RE, 250 PORTLAND ROAD, HOVE. BRIGHTON, SUSSEX BN3 5QT

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. Brighton 0273 734648. **Bulk orders:** write for quote.

£2 POUNDERS*

2P2 –Wall mounting thermostat, high precision with mercury switch and thermometer
2P3 –Variable and reversible 8-12v psu for model control
2P4 –24 volt psu with separate channels for stereo made for Mullard UNILEX
2P6 –100W mains to 115V auto-transformer with voltage tappings
2P8 –Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
2P9 –Time and set switch. Boxed, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters
2P10 –12 volt 5 amp mains transformer
2P12 –Disk or Tape precision motor – has balanced rotor and is reversible 230v mains operated 1500 rpm
2P14 –Mug Stop kit – when thrown emits piercing squawk
2P15 –Interrupted Beam kit for burglar alarms, counters, etc
2P17 –2 rev pr minute mains driven motor, ideal to operate mirror ball
2P18 –Liquid/gas shut off valve mains solenoid operated
2P19 –Disco switch-motor drives 6 or more 10 amp change over micro switches supplied ready for mains operation
2P20 –20 metres extension lead, 2 core – ideal most Black and Decker garden tools etc.
2P21 –10 watt amplifier, Mullard module reference 1173
2P22 –Motor driven switch 20 secs on or off after push
2P26 –Counter resettable mains operated 3 digit
2P27 –Goodmans Speaker 6 inch round 8ohm 12 watt
2P28 –Drill Pump – always useful couples to any make portable drill
2P31 –4 metres 98 way interconnecting wire easy to strip
2P32 –Hot Wire amp meter – 4½ round surface mounting 0–10A – old but working and definitely a bit of history
2P34 –Solenoid Air Valve mains operated
2P38 –200 R.P.M. Geared Mains Motor 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc
2P43 –Small type blower or extractor fan, motor inset so very compact, 230V
2P46 –Our famous drill control kit complete and with prepared case
2P49 –Fire Alarm break glass switch in heavy cast case
2P51 –Stereo amplifier, 3w per channel
2P55 –Mains motor, extra powerful has 1½" stack and good length of spindle
2P62 –1 pair Goodmans 15 ohm speakers for Unilox
2P64 –1 five bladed fan 6½" with mains motor
2P66 –1 2Kw tangential heater 115v easily convertible for 230V
2P67 –1 12v–0–12v 2 amp mains transformer
2P68 –1 15v–0–15v 2 amp mains transformer
2P69 –1 250v–0–250v 60 mA & 86.3v 5A mains transformer + 50p post
2P70 –1 E.M.I. tape motor two speed and reversible
2P72 –1 115v Muffin fan 4" × 4" approx. (s.h.)
2P75 –1 2 hour timer, plugs into 13A socket
2P82 –9v–0–9v 2 amp mains transformer
2P84 –Modem board with press keys for telephone redialler
2P85 –20v–0–20v ½A Mains transformer
2P88 –Sangamo 24 hr time switch 20 amp (s.h.)
2P89 –120 min. time switch with knob
2P90 –90 min. time switch with edgewise engraved controller
2P94 –Telephone handset for EE home telephone circuit
2P95 –13A socket on satin chrome plate
2P97 –mains transformer 24V 2A upright mounting
2P98 –20m 4 core telephone cable, white outer
2P99 –500 hardened pin type staples for telephone cable
2P101 –15V mains transformer 4A upright mounting
2P105 –capillary type thermostat for air temperature with c/o switch
2P108 –mains motor with gear box giving 110rpm
2P109 –5" wide black adhesive pvc tape 33m, add £1 post if not collecting

OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's dozen range and you become entitled to a free gift with each dozen packs.

A classified list of these packs and our latest "News Letter" will be enclosed with your goods, and you will automatically receive our next news letter.

£5 POUNDERS*

5P1 12 volt submersible pump complete with a tap and switch, an ideal caravan unit
5P2 Sound to light kit complete in case suitable for up to 750 watts
5P6 12V alarm bell with heavy 6" gong, suitable for outside if protected from direct rainfall. Ex GPO but in perfect order.
5P12 Equipment cooling fan – mini snail type mains operated.
5P15 –Uniselector 4 pole, 25 way 50 volt coil
5P18 –motor driven water pump as fitted to many washing machines
5P20 –2 kits, matchbox size, surveilance transmitter and FM receiver
5P23 –miniature (appr. 2½" wide) tangential blow heater, 1-2kw
5P24 –¼hp motor, ex computer, 230V, mains operation 1450rpm. If not collect add £3 post
5P25 –special effects lighting switch. Up to 6 channels of lamps can be on or off for varying time periods
5P27 –cartridge player 12V, has high quality stereo amplifier
5P34 –24V 5A toroidal mains transformer
5P35 –modem board from telephone auto dialler, complete with keypad and all ICs
5P37 –24 hour time switch, 2 on/offs and clockwork reserve, ex Elec. Board loading up to 50A. Add £1 post
5P41 –5" extractor fan, very quiet runner (s.h.), gntd 12 mths.
5P48 –telephone extension bell in black case, ex-GPO
5P52 –mains transformer 26V 10A upright mounting, add £2 post
5P54 –mains motor with gear box, final speed 5rpm
5P58 –Amstrad stereo tuner FM and LM. AM
5P60 –OC Muffin type fan 18 to 27V, only 3W. Brushless
5P61 –drill pump mounted on frame, coupled to mains motor
5P62 –2½kw tangential blow heater, add £1.50 post if not collecting
5P73C high pressure mains operated gas or water valve with tube connection suitable soldering
5P74 6rpm 60W mains motor and gearbox with instant stop
5P79 30rpm 80 watt mains driven motor with gearbox
5P82 1 25rpm mains 60w motor with gearbox
5P84 1 delay time switch, adjust 0–20 seconds
5P89 1 light box size 14" × 12" for circuit tracing pcb's. Add £3 for postage and packing
5P72 1 turntable for vdu or scope
5P81 1 stepper motor bi-directional, 7.5° steps 12–14V coil
5P86 1 mains transformer with 2 × 100V 1A secondaries. Add £1.50 post
5P88 1 24V 5A mains transformer in waterproof case, ideal for garden lighting, pond pump etc.

LIGHT CHASER KIT motor driven switch bank with connection diagram, used in connection with 4 sets of xmas lights makes a very eye catching display for home, shop or disco, only £5 ref 5P56.

FREE!

Biofeedback/Lie detector Kit

Consists of:

- PRINTED CIRCUIT BOARD
- COMPONENTS
- FULL INSTRUCTIONS

Send only £1 to cover packing and postage. Please make cheques or postal orders payable to PGC. If you send coins, please sellotape them to a piece of card to prevent them from bursting through the envelope.

Only one kit per application. Offer applies only while stocks last.

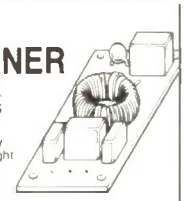
DON'T MISS YOUR CHANCE!

Send **NOW** to:
PGC, Craigo Farm
Trellech Road
Tintern Gwent

Complete Parts Sets for Top Projects

MAINS CONDITIONER

FEATURED IN ETI, SEPTEMBER 1986



It is astonishing how many people buy or build top-flight hi-fi equipment, and then connect it to a noisy, spiky mains supply. Rather like buying a Ferrari and trying to run it on paraffin, you might think. Expecting crystal clear sound, the poor music enthusiast ends up with a muddy, confused mush, and feels that he has somehow been cheated. Is this hi-fi? My music centre sounded just as good!

The domestic mains supply is riddled with RF interference, noise, transient spikes, and goodness knows what else. Computers crash, radios pop and crackle, tape recordings are spoiled and hi-fi sounds 'not quite right'. Why put up with it when the solution is so simple? The ETI mains conditioner is the lowest cost upgrade you will ever buy, and probably the most effective!

Our approved parts set consists of PCB, all components, toroid* enamelled wire, fixing ties, fast response VDR*, and full instructions.

ETI MAINS CONDITIONER PARTS SET ONLY £4.60!

*Note: the toroid and VDR supplied are superior to the types specified in the article.

TACHOMETER AND DWELL METER

FEATURED IN ETI, JANUARY 1987

MOTORISTS QUIZ

You are driving along the road one day when the sound of a horn makes you look behind. The driver of a milk float is cursing you for driving so slowly. A while later, an invalid carriage overtakes you, and just as you turn into your drive you hear a tractor driver mutter 'At last I can get out of first gear!'

Do you

a) Fit a £500 Pie-in-ear in-car stereo with digital flexi woofers and 24-band ramification?
b) Buy a set of fluffy dice and sticker saying 'My other car is a Macaroni'?
c) Give your car in part exchange for a milk float, invalid carriage, tractor?
d) Tune your engine.

The combined tachometer and dwell meter parts set contains: case with battery compartments, printed circuit board, all components, switches, plug, socket and test leads, battery connector, full instructions. The answer to the quiz, by the way, is: e) Buy a bright red Lotus Esprit.

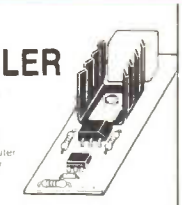
TACHOMETER AND DWELL METER PARTS SET

£12.90 (with terminals for external meter)

£16.40 (with self contained meter)

MAINS CONTROLLER

FEATURED IN ETI, JANUARY 1987



Have you ever wondered what people *do* with all those computer interfaces? 'Put your computer in control', say the ads. 'The Spectrabeeb has eight TTL outputs'. What on earth can you control with a TTL output? A torch bulb?

The ETI Mains Controller is a logic to mains interface which allows you to control loads of up to 500W from your computer or logic circuits. An opto-coupler gives isolation of at least 2 500V, so the controller can be connected to experimental circuits, computers and control projects in complete safety. Follow your computer interface with a mains controller and you're *really* in business with automatic control!

The mains controller connects directly to most TTL families without external components, and can be driven by CMOS with the addition of a transistor and two resistors (supplied).

Your mains controller parts set contains: high quality roller tinned PCB, MOC3021 opto-coupler, power triac with heatsink, mounting hardware and heatsink compound, all components including snubber components for switching inductive loads, transistor and resistors for CMOS interface, full instructions.

MAINS CONTROLLER PARTS SET £6.20

POWERFUL AIR IONISER

FEATURED IN ETI, JULY 1986

Ions have been described as 'vitamins of the air' by the health magazines, and have been credited with everything from curing hay fever and asthma to improving concentration and putting an end to insomnia. Although some of the claims may be exaggerated, there is no doubt that ionised air is much cleaner and purer, and seems much more invigorating than 'dead' air.

The DIRECT ION ioniser caused a great deal of excitement when it appeared as a constructional project in ETI. At last, an ioniser that was comparable with (better than?) commercial products, was reliable, good to build — and fun! Apart from the serious applications, some of the suggested experiments were outrageous!

We can supply a matched set of parts, fully approved by the designer, to build this unique project. The set includes a roller tinned printed circuit board, 66 components, case, mains lead, and even the parts for the tester. According to one customer, the set costs 'about a third of the price of the individual components'. What more can we say?

Instructions are included

DIRECT ION PARTS SET £9.50

MATCH BOX AMPLIFIERS

20W Single IC parts set £6.50

50W Bridge Amplifier parts set £8.90

L165V Power Amplifier IC, with data, £3.90

LM2917 EXPERIMENTER SET

Consists of LM2917 IC, special printed circuit board and detailed instructions with data and circuits for eight different projects to build. Can be used to experiment with the circuits in the 'Next Great Little IC' feature (ETI, December 1986).

LM2917 Experimenter Set £5.80

RUGGED PLASTIC CASE,

suitable for mains conditioner and mains controller

ONLY £1.35!

SPECIAL OFFER

Our best selling ioniser kit is now available with an elegant white case

WHITE IONISER PARTS SET ONLY £9.80!

Orders should be sent to Specialist Semiconductors at the address below including 60p towards postage and packing. Please allow up to 14 days for delivery. There is no telephone service at the moment, but all letters or requests for lists will be answered (at top speed if you send SAE!).

Specialist SEMICONDUCTORS

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