The first major test for television occurred when the British Broadcasting Corporation pitted Baird against EMI to choose who would provide the TV broadcast station for the London area. EMI won. Its 405-line (202½ interlaced) 50Hz system was adopted even though the contest was unequal. The laws of motion were against Baird. Inertia made it difficult to control the rotating equipment at a broadcast station, moreover, it was impractical to make the receiving equipment synchronise with the broadcast signal. An exclusively electronic system needs forces only to bend an electron beam. These forces are very small and the reaction time is negligible so the system is easier to control.

After the test, the BBC awarded EMI a contract to design, manufacture and install a TV station to serve the whole of London. A 200ft self-supporting tower was erected on the top of the existing tower at Alexandra Palace. The two transmitting aerials were mounted around the tower; one for vision, the other for sound. The two 25kW transmitters, operating on 41.5MHz for sound and 45MHz for vision, were lower down, inside the palace.

The General Post Office laid an 11-mile pressurised twin cable from Alexandra Palace to Broadcasting House, from where it continued to Buckingham Palace and along Whitehall to Parliament Square. It was equipped with amplifiers and equalisers so that camera signals could be transmitted from any access point along the route without being degraded along the way.

The mobile equipment consisted of a convoy of three Maudslay lorries. One was for the studio and camera; one was for the local transmitter and ac power generators; the third was a fire brigade truck which carried an aerial on its extended ladder. The convoy could either plug into the cable, or go to remote sites such as the Ranalagh Polo grounds or, for the Oxford and Cambridge boat race, the Thames.

One of the most important outside broadcasts was the Coronation of King George VI. It was scheduled for 3.00pm, and I was on duty at Broadcasting House. We lost the picture signal at 2.55pm. Panic ensued until we isolated the trouble to a defective jumper cable. A spare cable was plugged in just in time.

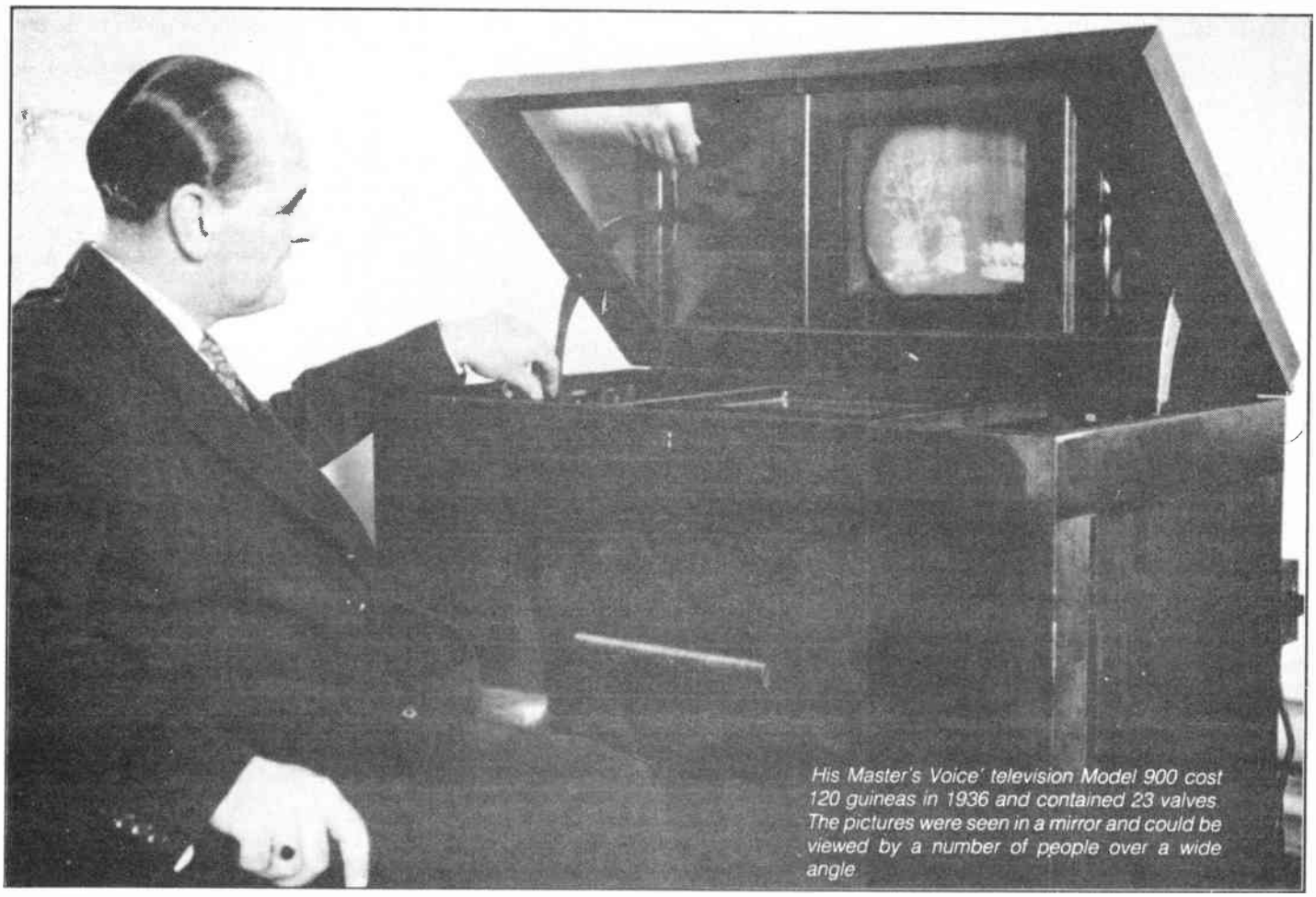
The BBC contract freed television manufacturers to put their versions on the market. At the time of the coronation, there were more than 100,000 receivers in the London area.

In the auditorium at Hayes, EMI demonstrated a set which projected a picture the size of a cinema screen, but the picture tube had a short life as the phosphor screen was burned by the high voltages required.

Among the products that Marconiphone offered was a home projection set with a picture about 20 × 30 inches. 'Father' Agate, who was one of the executives, had one in his home. Unfortunately, his cat crawled underneath when it was working, and was electrocuted. Thereafter, all sets were equipped with screens to prevent a similar occurrence.

The BBC had plans to extend the service to other parts of Britain. EMI carried out a path survey for the installation of repeaters to carry programmes to an additional transmitter that was to be set up in Birmingham. Sadly, all this came to an end with the outbreak of war in 1939. Even worse, perhaps, were the untimely deaths of Alan Blumlein and C O Browne in an air crash. Had they lived, British TV might have been in operation much sooner after the war.

I worked at EMI for seven years. I treasure most of all my association with some of the best brains and personalities in Britain. RAW



His Master's Voice' television Model 900 cost 120 guineas in 1936 and contained 23 valves. The pictures were seen in a mirror and could be viewed by a number of people over a wide angle

JULY 1988 £1.65

Radio & Electronics World

The communications and electronics magazine

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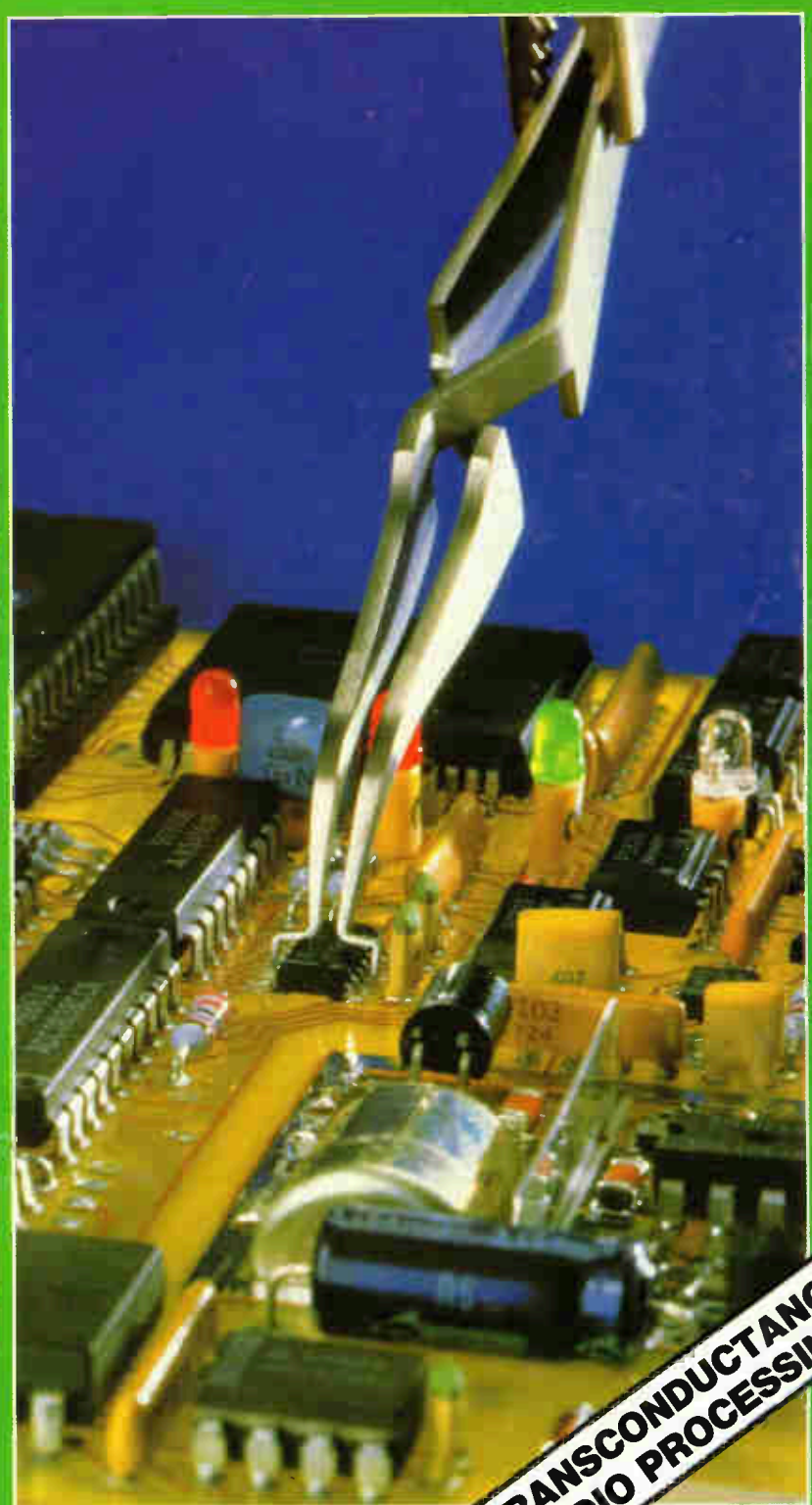

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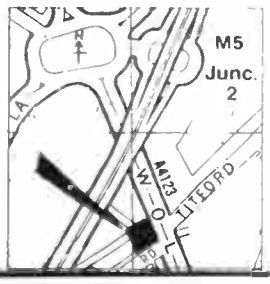

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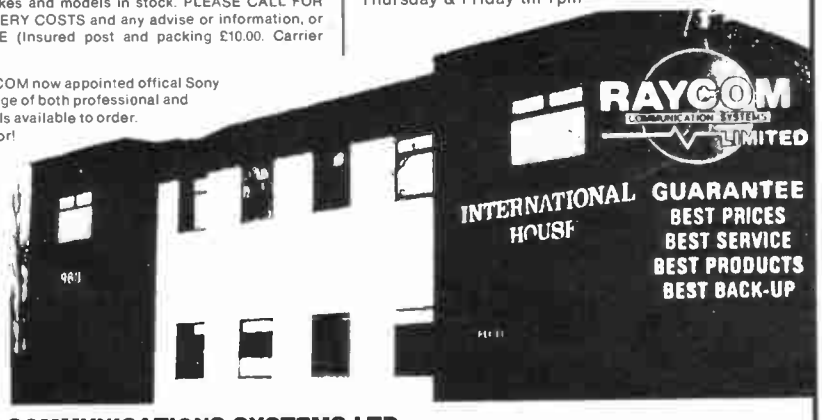

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When building any constructional project, bear in mind that sometimes high voltages are involved. Avoid even the slightest risk – safety in the shack please, at all times.

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BANDS IN COLUMNS

DEPARTMENTS

NEXT MONTH

■ **Cover date August 1988, on sale Thursday 14th July**
Photographing Oscilloscope Traces
Hyperbolic Aids to Navigation

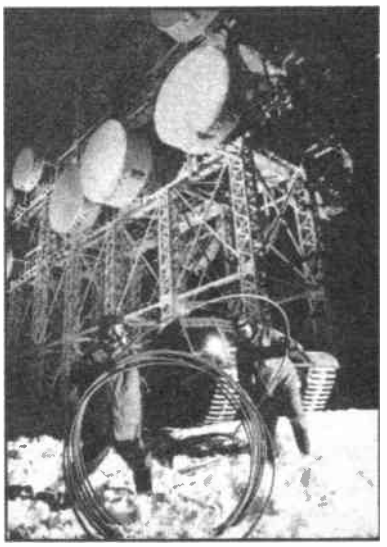
ON THE COVER

This month's cover shows one of a range of SMD electronic tools from Ceka Works Limited.

The pliers and cutters within the range are all box jointed and feature moulded-on grips. Each of the tweezers in the range is manufactured from antimagnetic, acid-resistant stainless steel and has a fine satin polished antiglare finish. The side cutter range includes mini-, straight- and bent-tip variants for cutting in confined spaces and two reverse-angle cutters.

There are nine tweezer variants. The example shown is a gripping cross-pattern tweezer with reverse action for extracting components and micro packages when desoldering.

Full details on (0758) 612254.



At the pole? – p24

Polarity rotator – p10

PUBLISHER'S ANNOUNCEMENT

You may have noticed that *REW*'s cover price has increased. This has been made necessary because of continually increasing paper and production costs.

As we are publishing a very specialised magazine, appealing to a dedicated band of readers, we are subject to higher unit production costs than other magazines of more general appeal.

Our research indicates that the magazine content is what you have asked for, so in order to continue publishing *REW* for you, we need to charge an economic cover price

I hope you continue to enjoy the magazine.

Best wishes

Peter Williams
Publisher

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AC141K	0.34	BC208B	0.20	BD434	0.55	BFR88	0.30	OC23	9.80
AC142K	0.45	BC212	0.09	BD436	0.45	BFR90	1.50	OC25	1.50
AC176	0.22	BC212L	0.09	BD437	0.75	BFR91	1.75	OC26	1.50
AC176K	0.31	BC213	0.09	BD438	0.75	BFT42	0.35	OC28	5.50
AC187	0.25	BC213L	0.09	BD510	0.95	BFT43	0.35	OC29	4.50
AC187K	0.28	BC214	0.09	BD518	0.75	BFW10	0.55	OC32	5.50
AC188	0.25	BC214C	0.09	BD520	0.65	BFW11	0.75	OC42	1.50
AC188K	0.37	BC214L	0.09	BD534	0.45	BFW16A	1.15	OC44	1.25
AD142	2.50	BC237B	0.15	BD535	0.45	BFW61	0.50	OC45	1.00
AD143	2.50	BC238	0.15	BD538	0.65	BFW92	0.85	OC70	1.00
AD149	0.70	BC239	0.15	BD575	0.95	BFX29	0.30	OC71	0.75
AD161	0.50	BC251A	0.15	BD587	0.95	BFX84	0.25	OC72	2.50
AD162	0.50	BC252A	0.15	BD588	0.95	BFX85	0.32	OC75	1.50
AF106	0.50	BC258	0.25	BD597	0.95	BFX86	0.30	OC81	1.00
AF114	1.95	BC258A	0.39	BD695	1.50	BFX88	0.25	OC84	1.50
AF121	0.50	BC284	0.30	BD698	1.50	BFY18	1.35	OC139	12.50
AF124	0.65	BC300	0.30	BD701	1.25	BFY50	0.32	OC171	4.50
AF125	0.35	BC301	0.30	BD702	1.25	BFY51	0.32	OC200	4.50
AF126	0.55	BC303	0.25	BD707	0.90	BFY90	0.77	OC201	5.50
AF127	0.55	BC307B	0.09	BDX32	1.50	BLY48	1.75	OC205	10.00
AF139	0.40	BC327	0.10	BDX53B	1.65	BR100	0.45	R20008B	1.45
AF150	0.50	BC328	0.10	BF115	0.35	BR101	0.49	R2009	2.50
AF178	1.95	BC337	0.10	BF119	0.55	BR103	0.55	R2010B	1.45
AF239	0.42	BC338	0.09	BF127	0.39	BR303	0.95	R2322	0.58
AU106	5.95	BC347A	0.13	BF154	0.20	BRC4443	1.15	R2323	0.65
AY102	2.95	BC461	0.35	BF177	0.38	BRY39	0.45	R2540	2.48
BC107A	0.11	BC478	0.20	BF160	0.27	BSW64	0.95	RCA16029	0.85
BC107B	0.11	BC527	0.20	BF173	0.22	BSX60	1.25	RCA16039	0.85
BC108	0.10	BC547	0.10	BF158	0.22	BT100A/02		RCA16161	0.85
BC108B	0.12	BC548	0.10	BF178	0.25		0.85	RCA16334	0.90
BC109	0.10	BC549A	0.10	BF179	0.34	BT106	1.49	RCA16335	0.85
BC109B	0.12	BC550	0.14	BF180	0.29	BT116	1.20	RCA16572	0.85
BC109C	0.12	BC557	0.08	BF181	0.29	BT119	3.15	S2060D	0.95
BC114A	0.09	BC558	0.10	BF182	0.29	BT120	1.55	SKE5F	1.45
BC115	0.85	BC639/10	0.30	BF183	0.29	BU105	1.95	T602IV	0.45
BC116A	0.55	BCY33A	19.50	BF184	0.35	BU108	1.59	T6027V	0.45
BC116A	0.80	BD115	0.30	BF185	0.20	BU124	1.25	T6029V	0.45
BC117	0.19	BD124P	0.59	BF194	0.11	BU125	1.25	T6036V	0.55
BC119	0.24	BD131	0.42	BF195	0.11	BU126	1.50	T9002V	0.55
BC125	0.25	BD132	0.42	BF197	0.11	BU204	1.55	T9011V	0.75
BC139BC	0.20	BD133	0.40	BF198	0.16	BU205	1.30	T9015V	2.15
BC140	0.31	BD135	0.30	BF199	0.14	BU208	1.39	T9034V	2.15
BC141	0.25	BD136	0.30	BF200	0.40	BU208A	1.52	T9038V	3.95
BC142	0.21	BD137	0.32	BC240	0.20	BU208D	1.85	THY15/80	2.25
BC143	0.24	BD138	0.30	BF241	0.15	BU326	1.20	THY15/85	2.25
BC147B	0.12	BD139	0.32	BF245	0.30	BU326S	1.50	TIP25	0.40
BC148A	0.09	BD140	0.30	BF256LC	0.35	BU407	1.24	TIP29C	0.42
BC148B	0.09	BD144	1.10	BF257	0.28	BU408	1.50	TIP30C	0.43
BC149	0.09	BD150C	0.29	BF259	0.28	BU500	2.25	TIP31C	0.55
BC153	0.30	BD159	0.55	BF271	0.28	BU508A	1.95	TIP32C	0.42
BC157	0.12	BD160	1.50	BF271	0.25	BU526	1.90	TIP33C	0.95
BC159	0.09	BD166	0.95	BF273	0.18	BU807	2.25	TIP34B	0.95
BC161	0.55	BD179	0.72	BF335	0.35	BUY20	2.15	TIP41A	0.45
BC170B	0.15	BD182	0.70	BF336	0.34	BUY69B	1.70	TIP41C	0.45
BC171	0.09	BD201	0.83	BF337	0.29	BUY71	2.50	TIP42C	0.47
BC171A	0.10	BD202	0.55	BF338	0.32	BUV41	2.50	TIP47	0.55
BC171B	0.10	BD203	0.78	BF355	0.37	MJ3000	1.98	TIP48	0.55
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BY184	0.35	1N4448	0.10		
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BY199	0.40	1N5402	0.14		
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NEWS DESK

Telling bone

Customers at four of The Royal Bank of Scotland's 850 branches should now have completed a three-month trial of a new banking service called Phoneline.

Speech recognition techniques establish the identity of telephone callers and interpret their spoken commands. A local-charge telephone call allows customers to ask for the balances of their accounts, obtain details of their last six transactions, request a cheque book or statement, pay bills or transfer money between accounts. The computer will acknowledge requests and answer queries using a natural-sounding voice.

Phoneline operates from ordinary telephones, and no additional equipment need be purchased by customers.

Triple-bank Single-card

Switch is a new debit card which enables customers to make payments electronically in retail outlets.

Midland Bank, National Westminster Bank and The Royal Bank of Scotland expect to be operating the scheme this autumn. It differs from other card systems as the processing will be entirely electronic. ATM/cheque guarantee cards issued by the member banks will be swiped through point-of-sale terminals which store the details of the transaction after verification by customer signature.

The information is subsequently passed to the member banks on tape or via telecommunication links. It is then possible for the appropriate debits and credits to be completed in the normal cheque clearing cycle.

Sales above the £50 cheque card limit can be guaranteed as retailers can obtain authorisation for higher transactions via the terminal or over the telephone.

Improved musicassette

Leading recorded music companies have joined forces in a European initiative to improve the quality of the musicassette. The Music Cassette Quality Commitee (MCQC) of the German Phonographic Industry Association will seek the involvement of leading hardware manufacturers and testing institutes to develop generally accepted international standards of evaluation and tolerances.

Recorded cassette sales initially suffered compared with LPs because cassette sound quality was poorer. Recent improvements to cassette sound quality have helped sales to grow. MCQC research has revealed the great influence of the cassette housing on final sound quality. Many musicassette customers apparently underestimate the effects of cassette construction on playback quality.

Azimuth deviation is the degree of misalignment of the tape with respect to the playback head. Azimuth deviation can cause diminished sound quality. Cassettes which are welded, instead of screwed, together tend to have smaller azimuth deviations, hence they sound better.

THOR hammered

Using a laser beam, Tandy claims that THOR-CD (Tandy high optical recording) can repeatedly record, playback, store and erase music, data or video on a disc that can be used with all existing CD audio and CD-ROM players. It is not yet for sale, though some expect it to be cheaper than alternative digital audio formats such as digital audio tape.

The new playback technology follows the same technique used in conventional optical discs: a laser beam reads a series of microscopic pits in a light-reflecting disc. The difference is that the pits can be erased, allowing editing and re-recording, over and over again.

However, a recent article in *New Scientist* (May 12, 1988) suggests that the technology is very similar to that disclosed in patents filed by Optical Data. The substrate in which the pits are created and erased looks similar to an ICI product.

The record industry is likely to fight erasable CD very hard, possibly even harder than DAT.

A band in the hand

Jonathan Clark, chairman of the Federation of Communication Services, today welcomed the government statement reaffirming the allocation of VHF Bands I and III to the mobile radio industry.

'I am delighted the Government has ended the damaging period of uncertainty for the industry. Once again the way is clear for the terrific expansion that has characterised mobile radio.

'We estimate that the industry will provide at least 10,000 new jobs over the next five years having by then grown five-fold since 1985. The guarantee of spectrum will allow our members to continue their forward drive into Europe and the rest of the world. The British mobile radio industry already has a substantial lead over foreign competitors in terms of technology and operating experience.

'FCS has waged a tough and uncompromising campaign to persuade the Government not to allocate the spectrum to the broadcasting industry. The effort has paid off.'

Mobile growing pains

This year's Mobile Radio Users' Association (MRUA) conference at New Hall, Cambridge, began with a speech about the growth of services and widening spectrum availability.

Peter Lawrence, speaking for Industry and Consumer Affairs Minister, John Butcher MP, cited the launch of Band III. He proposed that common equipment standards aim to ensure competition between network operators and between infrastructure suppliers. In particular, common standards ensure fair and open competition between mobile radio suppliers, according to the minister.

He warned against assuming that there will be less pressure to find more efficient ways of getting mobile radio messages across or that a new spectrum will make it easier to meet future demands. Traditional PMR services do not yet appear to be moving to Band III where most of the initial traffic is new services.

Pressing advantage

British Telecom has provided an innovative link between Prestel, its national videotex service and Westminster Cable Television.

The new link gives its 6,500 customers access to interactive videotex services via existing remote control keypads and TV sets. The services are charged on a pay-as-you-view basis – seven pence a minute.

In addition to business, travel and leisure information offered via the link, customers will be able to obtain electronic banking, teleshopping and on-line stocks and shares information.

Westminster Cable Television uses BT Vision's switched-star network, developed by Mr Bill Ritchie who has been awarded the Martlesham Medal for his work.

Switched-star networks approach the cost of tree-and-branch networks and have all the advantages of star networks. In tree-and-branch networks all the services are sent from the head end to each subscriber. Subscribers buy an unscrambler which unscrambles only those services that they have paid for. In a star network only those services requested by the subscriber are cabled from the head end to the subscriber. In a switched-star network there are trunk data highways which carry traffic to switching points. From these switching points the subscribers are cabled with

only those services they have requested. The switching points manage traffic on the highways and channel information to the subscribers.

Westminster Cable customers access Prestel via the new X25 gateway link without any special additional hardware on their premises. Currently the numeric keypads used by customers are not able to access the full range of Prestel services although there are plans to offer alphanumeric keypads with this ability.

Satellite navigation

Shipmate Marine Electronics Ltd now markets integrated navigation packages that take advantage of improvements to the network of global positioning system (GPS) satellites – GPS is now available in the UK around 12 hours per day. By 1990, mariners should be able to get a GPS position no matter where they are at sea.

A typical system consists of a GPS receiver, Decca receiver, Transit satellite navigator and a video plotter. In one version, both GPS and Decca tracks are simultaneously plotted, monitored and compared to select the more appropriate track for a particular purpose.

Shipmate claims that its most recent software consistently gives better accuracies than either Decca or Loran C. The company also operates a GPS journal where predictable navigation periods are updated on a daily basis. Anyone can obtain this information just by calling Shipmate's technical office (021-552 1718).

Inmarsat buys its fourth

The Inmarsat International Maritime Satellite Organisation (Inmarsat) has exercised an option to order a further Inmarsat 2 communications satellite from the Space and Communications Division of British Aerospace.

The contract is for Inmarsat 2 F4, the fourth satellite to be ordered from British Aerospace. In April 1985, Inmarsat placed an order for three satellites, valued at US $150 million, with an option to supply a further six.

Inmarsat 2 F4 and the other three satellites will comprise Inmarsat's second generation space segment providing a global maritime mobile communications service. Operating at C- and L-band frequencies it will provide important ship-to-shore and shore-to-ship communications.

The Inmarsat 2 series of satellites are based on the successful Eurostar three-axis stabilised platform design and have a design life of 10 years. Inmarsat 2 F4 will be launched in 1991.

The Inmarsat Organisation's first generation space segment currently operates Marecs communications satellites also supplied by British Aerospace.

Marketing radio

BBC Enterprises is setting up a new radio marketing section within its home entertainment department.

Sue Anstruther, who heads the section, will be working with a producer and an assistant to increase revenue already raised by BBC Enterprises from radio-related products, such as books and records, as well as through merchandising. Profits will be reinvested in future BBC programmes.

The Radio Collection, is a series of classic programmes on audiocassette. This will be launched in the autumn at the BBC Radio Show, Earls Court. *The Lord of the Rings* cassettes have already sold over 15,000.

As well as looking at the archives, the section will be examining how to exploit radio technology. This could extend, for example, to looking at a range of uses for the transmitter network's spare capacity.

What's on Where

16 June: Video film presentation, 'SWLs in the Early Days of Radio'. Barry College of Further Education Radio Society, The Annex, Barry College, Barry to Bonvilston Rd, Barry, South Glamorgan, 7.30pm

17 June: Talk on Planning Permission. Blackwood & District ARS, Oakdale Community College, 7pm. For further details contact Brian Mathews: (0495) 243858

22 June: VHF field day review, Farnborough & District RS, Railway Enthusiasts Club, 103 Hawley Lane, Farnborough, 8pm. For further details contact Tim Fitzgerald: (0276) 29321

23 June: Talk on Antenna Surgery, Edgware & District ARS, Watling Community Centre, 145 Orange Hill Rd, Burnt Oak, Edgware. For further details contact Ian Cope: (07072) 65707

23 June: Natter Night, North Wakefield Radio Club, White Horse Pub, Fall Lane, East Ardsley. For further details contact Steve Thompson: (0532) 536633

26 June: Longleat Amateur Radio Rally, Longleat House, Warminster, Wilts. For further details contact Brian: (0272) 848140

27 June: Talk on VHF DXpeditions. Felixstowe & District ARS, Scout Hut, Bath Rd, Felixstowe, 8pm. For further details contact Paul Whiting: (0473) 642595

28 June: Talk on Practical Power Supplies, Verulam ARC, RAF Association Headquarters, New Kent Rd, St Albans, 8pm. For further details contact Hilary: (0727) 59318

29 June: Eileen Medley DF Cup, Wirral & District ARC, Irby Cricket Club, Irby Mill Rd, Irby, Wirral, 8pm. For further details contact Alan Griffiths: 051-677 7517

1 July: An evening of popular lectures. 'How Should a Mathematician Think About Shape?' by Professor DG Kendall, 7.30pm. 'Chaology' by Professor MV Berry, 9pm. London Mathematical Society, Great Hall, Sherfield Building, Imperial College, Exhibition Rd, London SW7. Admission is free, by ticket obtainable in advance from Miss Oakes, London Mathematical Society, Burlington House, Piccadilly, London W1V 0NL, not later than 22 June. Please send an SAE. The same lectures will also be held on 11 July at 2.30pm and 7.30pm in the Eleanor Rathbone Theatre, The University of Liverpool. For tickets write including an SAE to Dr IR Porteous, Dept of Pure Mathematics, University of Liverpool, PO Box 147, Liverpool L69 3BX, before 30 June.

2-8 July: A Special Event Station will be established at an International Girl Guide camp at Aikerness, Evie, Orkney; callsign GB2ACO. Operation will be on HF, SSB, 80, 40, 20 and possibly 15m, primarily in the evenings. The WAB area is HY32 in the Orkney Islands. For further details contact Anne GM6WPA or Bill GM3IBU QTHR

3-9 July: GB75MAL will be used by the Scarborough Special Events Group to celebrate the 50th anniversary of the steam locomotive Mallard's record breaking 126MPH run. Operation will be around 3725/7055kHz and 2m FM. For further details contact G4SSH, QTHR

6 July: Lecture – When the Wind Blows, Fareham & District ARC, Portchester Community Centre, Westlands Grove, Portchester, Hampshire, 7.30pm. Details Bob: (0705) 250830

13 July:Night on the air. Derby & District ARS, 119 Green Lane, Derby, 7.30pm. For further details contact Kevin Jones (0332) 669157

14 July: Video film presentation – 'DXpedition to VP8 Land'. Barry College of FE RS, The Annex, Barry College, Barry to Bonvilston Rd, Barry, South Glamorgan, 7.30pm

15,16,17 July: RSGB 75 – National Convention, NEC, Birmingham. For further details see *RadCom*

THE EARLY DAYS OF TELEVISION

by P G Forsyth

The earliest reference that I know of is a disclosure by a Mr Campbell in 1911. He described the idea of breaking up a picture with a flying spot of varying light intensity. The spot would scan the picture line by line from top to bottom. That is what present day television is based upon. Like many ideas, it predated the practical realisation because the techniques were not yet developed.

Nothing much happened until the mid 1920s. World War 1 stimulated interest in communications using crude vacuum tubes and wire telegraph equipment. Commercial interest in overseas and marine communications, along with the telephone, led to increased production of vacuum tubes on an empirical basis. Broadcasting on a limited scale started about 1922 using crystal receivers.

Simple vacuum tube equipment came into use later on. When facsimile picture transmission on wire lines at very slow scanning rates was introduced, it was mostly used by newspapers. The pictures were scanned line by line and encoded digitally: black was represented by a one, a mark; and white was represented by a zero, a space.

Research and development gradually became more organised and it began to receive commercial backing and direction. Mechanical devices had to be made more precisely to provide finer control in fields as diverse as printing presses, ship's engines and watches. A great deal of theory about servomechanisms and precise controls stems from this period, and electrical devices that we now call electronic devices started to evolve out of vacuum tubes.

All this activity led to research into high-vacuum physics for photocells, neon lighting, X-rays and an understanding of the behaviour of electrons, which coincided with breakthroughs in atomic physics by scientists such as Niels Bohr and Lord Rutherford.

Nevertheless, the moment was still waiting for someone to demonstrate that television was indeed possible. That is why we owe so much to John Logie Baird who doggedly developed a method suitable for a scanning disc or a mirror drum. More importantly he caught the eye and ear of the general public. Enthusiastic amateurs have described home-made equipment they used for receiving Baird whenever he was transmitting from Crystal Palace.

The idea of satisfying a consumer market took hold in the late 1920s. EMI at Hayes, Middlesex, had revolutionised gramophone recording and had assembled a fine team under the leadership of Alan D Blumlein. In fact, Alan Blumlein was already thinking of stereo high-fidelity records on a better material than shellac, and was also aware of the advantage of FM radio transmission.

EMI was looking for further investments; it decided to make a full-scale effort to develop television and appointed Alan Blumlein as chief engineer. It was his ability, knowledge and infectious enthusiasm that made it a success. Eleven laboratories were set up:

Chemical Lab: to find and prepare electroluminescent materials for picture tube phosphors

Spectrographic Lab: to analyse the colours emitted by the fluorescent materials and mix them to produce a white light

Glass-blowing Lab: to fabricate camera tubes (iconoscopes), laboratory glassware, and picture tubes (kinescopes)

Electron Gun Lab: to investigate electron lenses and design the guns for transmitting and receiving picture tubes

Picture Tube Lab: to assemble and test picture tubes and to assist in developing large-scale production methods

Photocell Lab: to develop and make TV camera tubes for the studio and mobile cameras

Circuit Lab: to design the line, frame, and synchronising circuits that are necessary to form the TV picture on the picture tube

Radio Frequency Lab: to develop techniques for measuring RF to the required degree of accuracy and to design and measure antennas, feeder cables, and RF equipment

Transmitter Lab: to develop modulator circuits to drive the high-power transmitters, both video and sound (the transmitters came from Marconi Wireless Telegraph in Chelmsford)

Cable Lab: to develop and design amplifiers, equalisers and cables for video transmission by underground cable

Workshop: over 50 mechanics made all the hardware, cabinets coil winders, and parts for the laboratories

Drawing Office: to design all television system assemblies

In those days, the only parts that were readily available were those used in making radio receivers and gramophones. Everything else was made from raw materials and chemicals, mostly by hand. The glass for picture tubes came from Pyrex as plain glass conical 'bottles'.

The EMI Team (1931-1939)

Chemical Lab	JW Strange
Spectrographic Lab	SF Henderson
Glass-blowing	H Neal
Electron guns	FH Nicol
Picture Tube	LF Broadway (development) Mr Colbourne (production)
Photocell	JD McGee Mr Freeman
Circuit	M Bowman (manifold) JF James and others
RF	EC Corke JL Pawsey * EW Lawrence
Transmitter	CO Browne *
Workshop	Dave Canfield
Administrator	GE Condliffe
EMI Director of Research	I Schoenberg
TV Chief Engineer	Alan D Blumlein *

* Deceased

CABLE TELEVISION

by Jim Slater

Various forms of cable television have been in existence for almost as many years as broadcast television. They have only received considerable attention in this country since the government's recent enthusiasm for using cable television to further information technology.

Wandering the hillsides

Cable television initially provided pictures and sound to people living in areas where satisfactory signals could not be received because the broadcasting authorities had not yet provided enough transmitting stations.

Radio and electrical dealers, who were keen to expand into the newly arrived television business, rapidly realised that they would not be able to sell receivers unless customers could pick up satisfactory signals. Many dealers experimented by wandering over nearby hillsides, trying to find a spot where good pictures could be received with suitable aerials.

These pioneers then went on to tackle the problems of buying a small piece of land on which to put the receiving equipment, obtaining permission to run cable down the hillsides and along the streets of many a small town, and putting wires into the home of everyone who could be persuaded to subscribe.

Even now, when places like the United Kingdom have television coverage approaching almost 100% of the population, there are large numbers of very small communities which are geographically isolated or hidden away in hollows where they are screened from any incoming television signals. These areas rely on signals being fed to them by wire.

Popular choice

Entrepreneurial dealers discovered that some of their aerials could pick up television broadcasts from transmitters intended to serve other areas. Generally speaking they could provide one or more extra programmes from the regional Independent Television companies around the country. In the border country of Wales, they could also offer their customers a choice of English or Welsh BBC transmissions. Although this choice was very popular, it proved politically controversial, so regulations were introduced to restrict cable services to supplying one extra programme, and generally they were not allowed to provide locally inserted material.

In spite of this unhelpful regulatory climate, cable services remained popular in a few areas, even after the transmitting authorities built local transmitters, because the cable operators could provide a wider programme choice. These systems are the forerunners of sophisticated cable services that are going to expand in the next few years.

Networks of the future

The wired networks of the future will be able to receive signals from many different parts of this country, and by satellite will be able to pick up and redistribute signals from all around the world. Local news and information, either as text or in audiovisual form, will be available 24 hours a day. Modern cable systems are two-way, so the viewer can talk back to the program provider, and take part in teleshopping and home banking. These services can be provided by almost any well-engineered cable network; the technology used is by no means crucial.

Major divisions

The two major divisions are usually MATV and CATV.

MATV, master aerial television, generally refers to small distribution systems providing a service to blocks of flats and maisonettes, to office blocks, and even to small housing estates. Although early MATV systems used VHF distribution, UHF transmissions have recently become the norm in the UK. As UHF equipment has improved in performance, more and more new MATV cable system builders are choosing the simpler option of distributing television signals at UHF, without frequency conversion, for their small and medium-sized systems.

Even with these small systems it sometimes proves necessary to change to different frequencies within the UHF band. This is to avoid strong interfering signals or problems with pre-imaging, a form of ghosting caused by signals picked up directly off the air. This tends to happen in areas close to a transmitter broadcasting the same programme. If the off-air signals are slightly displaced in time from the cable signals, then pre-imaging will occur. The problem is commonly encountered when installing MATV systems in hotels and apartment blocks of many major cities. Provided that too many programme channels do not have to be converted, it is usually possible to eliminate the problem by finding alternative UHF cable channels which are not affected by the off-air signals.

CATV, community antenna television, is the term applied to fairly large systems which distribute television signals to large numbers of homes in towns and villages. CATV systems usually contain special compensating equipment so that picture quality is not degraded over the many miles signals sometimes travel. CATV used to be known colloquially as television relay. Cable television usually refers to CATV systems, even if CATV is not mentioned specifically.

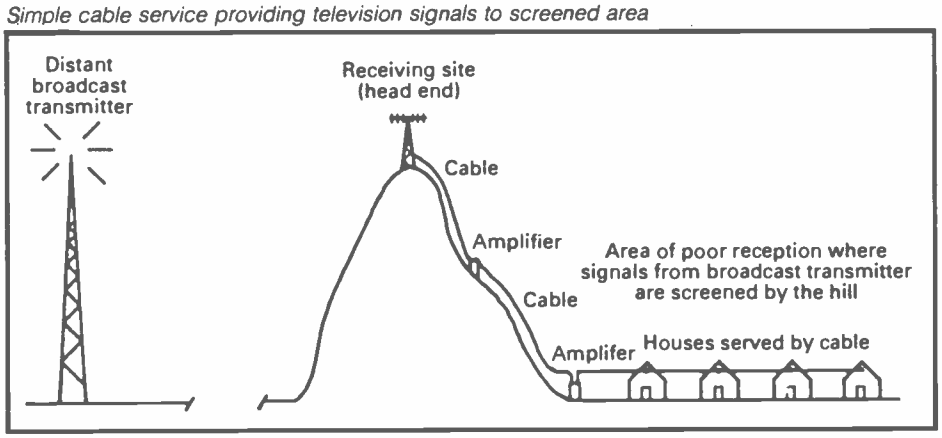
Communal television is a term used in countries such as India. It applies to systems which use a master antenna to feed one or more centrally located television receivers set up in public places so that villagers can gather to watch the programmes. This should not be confused with CATV.

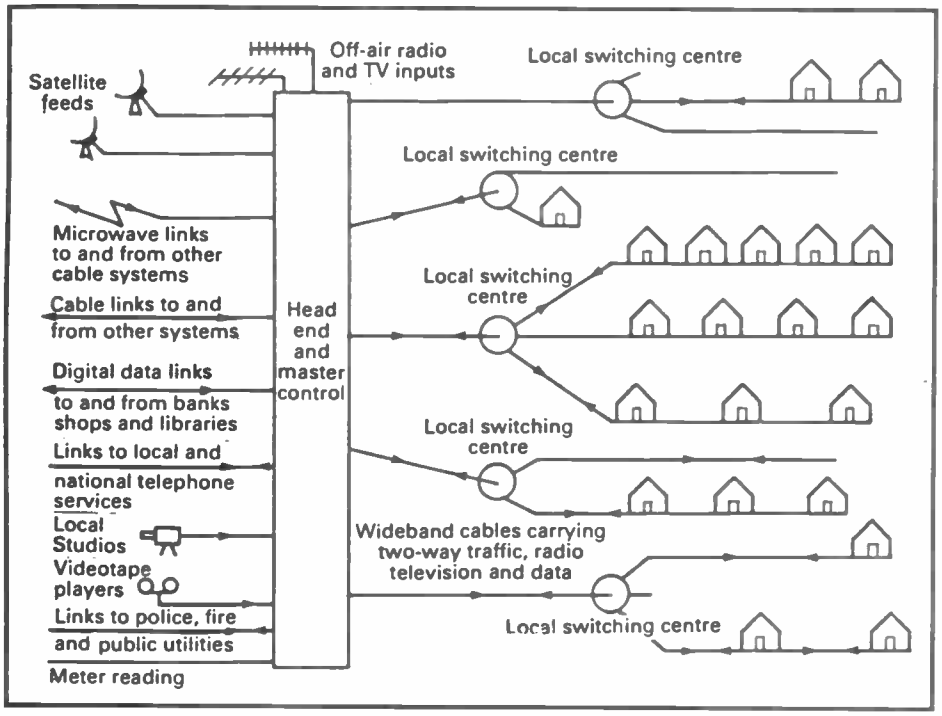
Closed-circuit television

Another acronym is CCTV. This stands for closed-circuit television, any system where television signals are generated, distributed and received entirely within the users' own premises. Such systems are frequently used for security in major office complexes and on factory sites. The pictures, often of a lower quality than broadcast television, are sent along cables to where the security guards sit, enabling them to maintain constant surveillance over many parts of the site.

Cameras responsive to infrared radiation are sometimes used to survey potential intruders without their knowledge. CCTV systems often monitor traffic congestion on motorways and at busy road intersections, and systems have even been developed which can read the number plates of moving

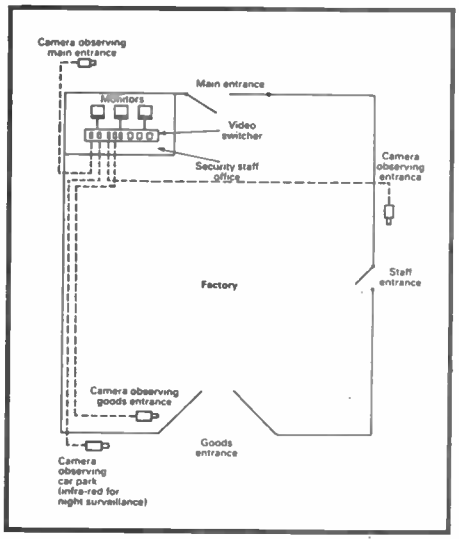
Simple cable service providing television signals to screened area





Wired network of the future

vehicles. Closed-circuit systems may have pictures of lower quality, but they are not unsophisticated; many were among the first fibre-optic cable systems. We shall not consider CCTV any further.



CCTV security system to guard factory premises

Distribution technologies

There are four major cable distribution technologies to be considered: the old HF (high frequency) systems, VHF (very high frequency) systems, UHF (ultra high frequency) systems, and technology significant for future cable systems, optical transmission.

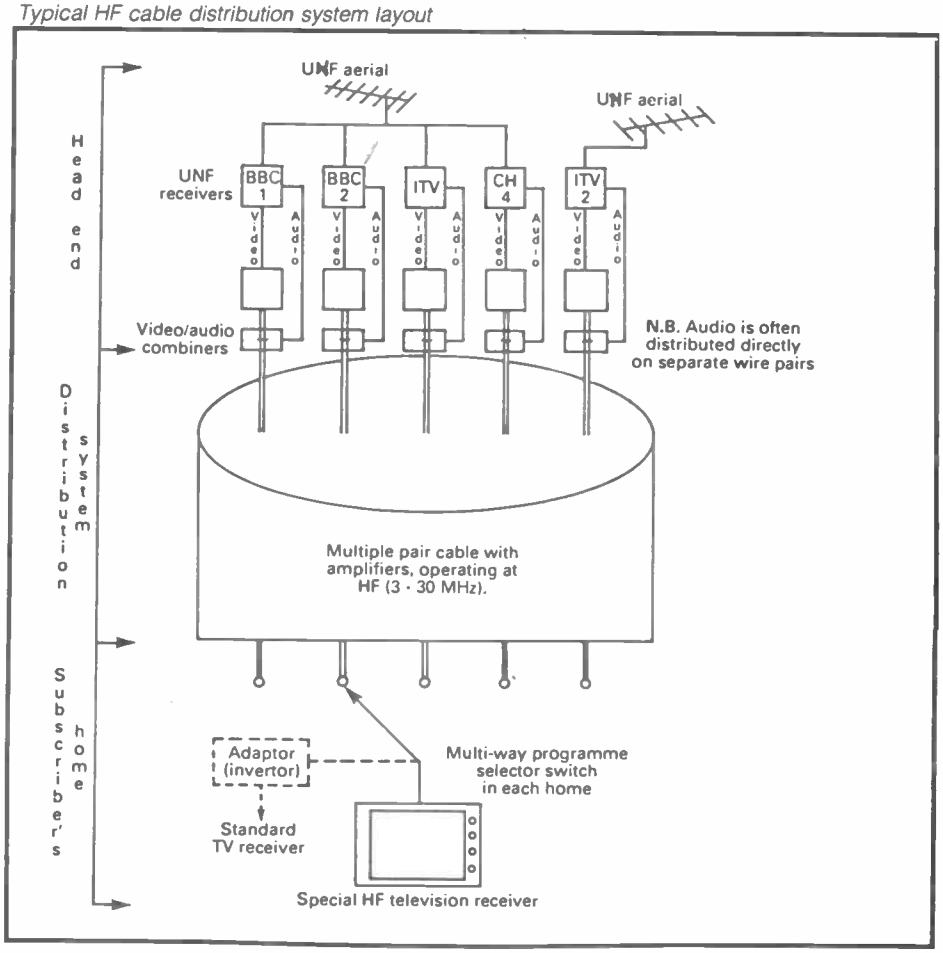
HF multipairs

Each of the television signals received at the master aerial, or head-end, as the combination of aerials and their associated amplifiers is often known, is translated from the incoming UHF or VHF frequency to a frequency in the band between 3 and 30MHz, usually around 10MHz. Each programme is carried on its own discrete balanced pair of wires in a multiway cable which normally contains up to 12 pairs. Each uses the same high-frequency carrier. If four programmes are being distributed, four pairs of wires need to be taken into each viewer's home. The viewer selects the wanted channel using a switch connected to the pairs of wires. the switch is often remote from the receiver and sometimes contains the mains switch and a volume control.

The receiver in the viewer's home once had to be a non-standard model which could receive the HF carrier signals. This initially caused unhappiness in the retail trade. Dealers felt that customers who were connected to one of the HF cable systems had little choice but to buy or rent the special HF receiver from the cable operating company, thereby limiting their own chances of selling conventional receivers. Eventually it became usual for the cable operator to offer an adaptor, sometimes called an invertor, so that standard UHF television receivers could be used.

HF systems can translate sound signals to an appropriate HF frequency and handle them in the same way as the pictures. Sometimes extra sound radio programmes are carried over the same

Typical HF cable distribution system layout



pair of wires. However, television sound signals are more often distributed directly at audio frequencies on a balanced pair of wires.

HF distribution systems provide excellent sound and vision, and are very good for covering large areas. This is because cable signal losses are generally very low at the frequencies used, and the number of repeater amplifiers is therefore kept to a minimum. The main restriction on the number of channels which can be transmitted is the number of pairs of wires available in the cable. It is not usually a practical proposition to increase the number of available channels once the system has been installed. This channel limitation, the need for fairly complex head-end equipment with frequency convertors and filters, and the unpopularity of having to use non-standard receivers or adaptor boxes, have led to HF systems no longer being constructed.

VHF systems

Radio frequency signals received at the head-end, whether VHF or UHF, are converted to frequencies in the VHF band between about 45 and 225MHz, then are fed to the distribution network of coaxial cables. These days VHF distribution systems are usually used only on extensive CATV systems. The main reason for converting to VHF is that VHF signals of this type can typically travel distances of up to a kilometre or more along coaxial cables without amplification. This means it is usually more economical to use VHF in terms of the provision of equipment instead of UHF, where cable losses will be much higher and amplification equipment will be required at much shorter intervals along the cable.

The distribution frequencies used in a system have to be agreed with the Home Office. This minimises the possibility of interference between users. Ten VHF distribution channels are officially recognised in the United Kingdom (see *Table 1*). These frequencies may be slightly varied to avoid interference, and there are special techniques to allow the distribution of more channels. *Table 1* shows that the television sound transmissions are allocated carrier frequencies 6MHz above the vision frequencies. Normally cable distribution services of this type also provide a choice of VHF sound radio programmes which are distributed on their original Band II VHF frequencies. The European over-air channel allocations for Bands I, II, III, IV, and V are detailed in *Table 2*.

VHF Band I	Television	41-68MHz *
VHF Band II	FM sound radio	87.5-108MHz
VHF Band III	Television	174-225MHz *
UHF Band IV	Television	470-613MHz
UHF Band V	Television	615-890MHz

* Not used for TV in the UK

Table 2

UHF television channels are 8MHz apart in the UK, which uses CCIR system I (*Table 3*). Different countries use different systems which may well involve different channel spacings, so it is important to establish the system parameters before trying to design a cable network. In the USA transmissions normally use system M which has a 6MHz channel spacing. 7MHz is the common channel spacing over much of Europe, where various systems are used.

Table 4 shows how the USA spectrum from 54 to 400MHz is divided into different segments, often referred to just by its upper frequency limit. The system in the table would be called a 400MHz system, or a 52-channel system. Channels 2 to 13 were the first channels to be used; the others were added later. Channels 2 to 13 are known as the standard VHF channels, and can be received on any standard television receiver; no convertor box needs to be added at extra cost.

Table 1

Channel Code	Vision Carrier Frequency	Sound Carrier Frequency
A	45.75MHz	51.75MHz
B	53.75MHz	59.75MHz
R1 (B+2MHz)*	55.75MHz	61.75MHz
C	61.75MHz	67.75MHz
D	175.25MHz	181.25MHz
E	183.25MHz	189.25MHz
F	191.25MHz	197.25MHz
G	199.25MHz	205.25MHz
H	207.25MHz	213.25MHz
I	215.25MHz	221.25MHz

Channels may be offset to reduce interference. They should then be referred to as channel A+0.5MHz, for example.
* Channel R1 was adopted before large offsets became common and is not usually specified for new systems

This is a powerful argument for restricting systems to 12 channels, particularly for small operators. The original 12 channels were chosen to minimise the chance of interference from their intermodulation products. With more than 12 channels the selection is far more complicated.

Dual-cable system

A fairly simple method of providing more than 12 channels without becoming involved in all manner of frequency extension problems is to put two 12-channel cables around the network, instead of one. The two cables work independently of one another, and each carries a different set of 12 programmes on the same standard frequency channels. The customer has a two-way switch in his home, which allows his receiver to be connected to either of the two cables, thus doubling the choice of programmes. This system is widely used in the United States, although the maximum of 24 programme channels is rarely provided. Strong off-air VHF transmissions can interfere with some of the cable channels. A few of these off-air transmissions are quite common, so cable systems in many areas wisely avoid using these channels for distribution, and a maximum of about 20 programme channels is normally offered.

Another advantage of the dual-cable system is that once the simple and cheap two-way switch has been installed, the viewer can receive all the programmes on a standard receiver, whereas special convertors are required for an extended frequency band. The dual system can also cope with customers who only require or can only afford 12 channels. The second cable is not really a back-up for the first, since both carry different programmes. Nevertheless, if problems develop in one of the cables, a restricted service can still be maintained by using the other one. This should keep viewers far happier than if they were left totally without a service. It also gives the cable operator breathing space to carry out repairs or essential maintenance, without having to shut down the system completely.

This dual-cable system has become so popular with cable operators, because of its lack of technical complications, that many consultants now recommend two cables from the outset for systems using underground cable ducts. The cost of the extra cable is miniscule compared with the cost of digging up the ground to insert larger ducts, or of pulling extra cable through existing ducts. Even though the operator of a new network may have no intention of increasing its capacity, history has shown a growing demand for more channels, and a little forethought can save a great deal of money in the long run.

Since the beginning of 1985 there have

System	Lines	Channel width (MHz)	Vision bandwidth (MHz)	Vision/sound separation (MHz)	Vestigial sideband (MHz)
B	625	7	5	+5.5	0.75
G	625	8	5	+5.5	0.75
I	625	8	5.5	+6.0	1.25
M	525	6	4.2	+4.5	0.75

Table 3

Description	Channel number/letter	Frequency range (MHz)	Number of channels
Low Band	channels 2-6	54-88	5
Mid Band	channels A-I	88-174	9
High Band	channels 7-13	174-216	7
Super Band	channels J-W	216-300	14
Super Band	channels AA-QQ	300-400	17
Total number of bands			52

Table 4

been no over-air television transmissions broadcast on VHF in the UK, and part of Bands I and III are now allocated to mobile radio services. Other European countries will continue to transmit television programmes on VHF Bands I and III as well as on UHF Bands IV and V. Recent suggestions indicate the UK government may change its mind and allow parts of the VHF bands to provide more terrestrial TV channels in the future.

VHF signals presented no real problems in the days when dual-standard VHF/UHF receivers were readily available in the UK. Now that single-standard UHF receivers are the norm it is necessary to use an adaptor, commonly called an upconvertor or translator, to provide a satisfactory signal for the UHF television receiver. When upconvertors are used, even greater care than usual must be taken to see that signal levels available at the system outlets are kept within strictly defined limits, since the whole system has a reduced effective dynamic range, ie the range of signal levels it can cope with. In those countries that use Systems B and G for television transmissions, such as Austria, West Germany, and Switzerland, receivers are fitted with VHF/UHF tuners as standard, so the need for convertors does not arise.

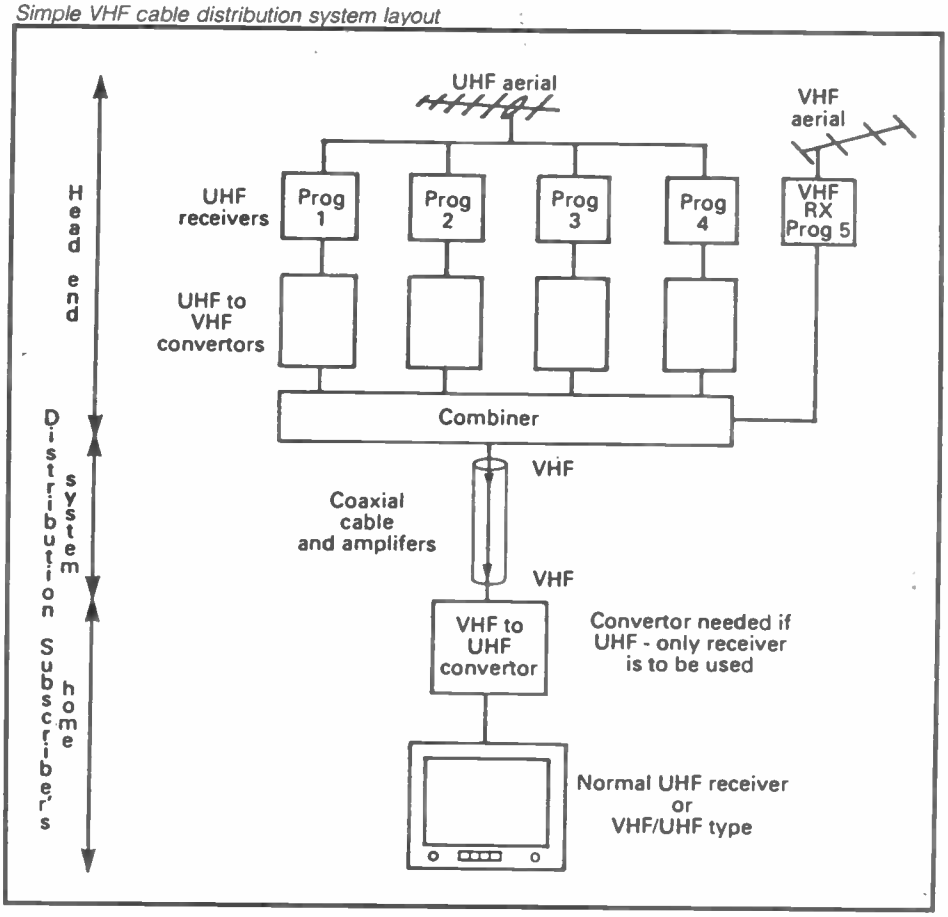
British Standard BS6330:1983 6.2.3. recommends that systems using conversion to VHF to overcome the problems of cable losses over long transmission systems should be designed to reconvert the signals back to UHF at local distribution points, using channels that are not in use for local off-air signals. Such a reconversion would allow standard UHF only receivers to be used.

Even in large CATV systems the demarcation lines between VHF and UHF are less rigid than they used to be. Although the increase in cable attenuation at higher frequencies makes it significantly more expensive to operate above about 450MHz, some modern systems do use the whole of the VHF and UHF spectrum, right up to about 860MHz. A system in Vienna even uses twin cables for the long-distance trunk feeders. These carry 47-300MHz VHF signals which are converted by multiplexing them in substations. This makes the signals available to subscribers over just one cable which carries as many as 18 TV and 14 FM radio signals in the frequency band from 47 to 860MHz.

VHF systems have translation equipment at the head-end and in the viewers' homes; UHF systems do not. VHF systems have greater distances between repeater amplifiers than UHF systems, otherwise, modern UHF and VHF systems have layouts which are almost identical.

In the next part we shall look in detail at a fairly typical modern wired system, which could equally well use VHF and/or UHF frequencies for television distribution. The extra equipment needed for VHF systems will be discussed when we come to the appropriate parts of the network.

Simple VHF cable distribution system layout



DATA FILE

Ray Marston continues his investigation of IC audio processing circuits by looking at the use of OTA devices in amplitude-control applications

Using transconductance

All the audio processing circuits we have looked at so far have been designed around conventional voltage-in/voltage-out operational amplifiers (op amps). A voltage-in/current-out type of op amp can also be used in many audio processing applications. The gain of these devices, known as operational transconductance amplifiers (OTAs) is externally variable via one control terminal.

Figure 1 shows the standard circuit symbol and basic operating formula of the OTA. The device has conventional differential voltage input terminals, which accept inputs e_1 and e_2, and gives an output current that equals the difference between these signals multiplied by the OTA's transconductance (g_m) value, which in turn typically equals 20 times the external bias current. Thus, the gain can be controlled by the bias current which, in practice, can easily be varied over a 10,000:1 range.

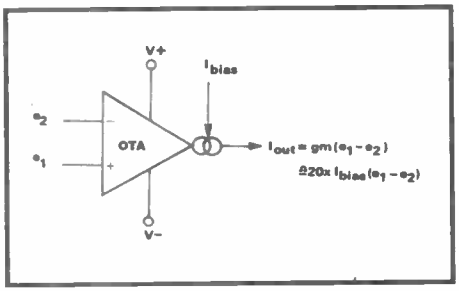


Fig 1 *Symbol and basic formulae of a conventional OTA*

OTAs are reasonably versatile devices. They can be made to act like voltage-in/voltage-out op amps by simply feeding their output current into an external resistor, which converts the current into a voltage. The OTA's gain can be voltage-controlled by applying the control voltage to the device's control terminal via a series resistor, which converts the voltage into a current. By using these techniques, the OTA can be used as a voltage-controlled amplifier (VCA), as an amplitude modulator, or as a ring modulator or four-quadrant multiplier.

DIL OTAs

The two best-known versions of the OTA are the CA3080 and the LM13600. The CA3080 is a simple first-generation device that can accept bias currents in the range 100nA to 1mA and can operate from split power supplies in the 2 to 15V range; the device is housed in an 8-pin DIL package (*Figure 2*). A minor defect of this IC is that it generates a certain amount of signal distortion.

The LM13600 is an improved second-generation version of the OTA, and incorporates linearising input diodes that greatly reduce signal distortion, plus a coupled output buffer stage that can be used to give a low-impedance output. The LM13600 is actually a dual operational transconductance amplifier, see *Figure 2*.

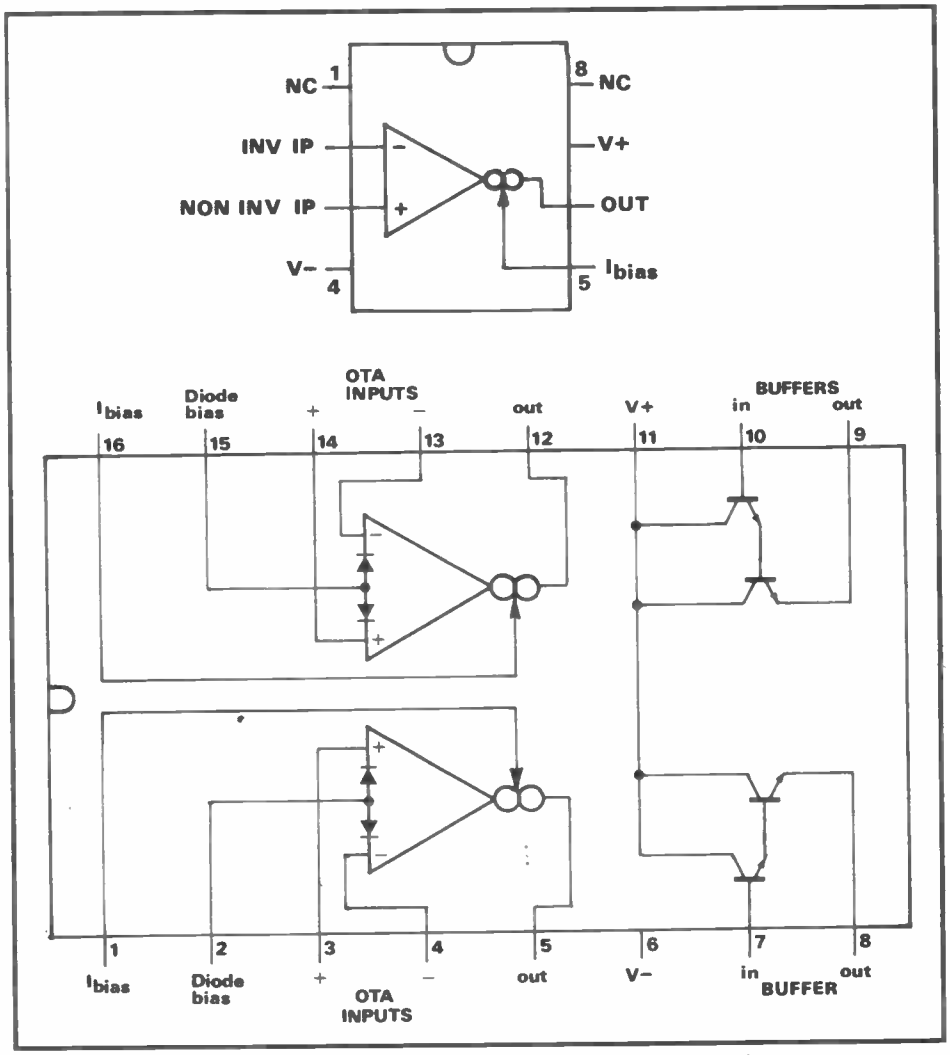


Fig 2 *Outline and pin notations of the CA3080 (top) and LM13600 (bottom)*

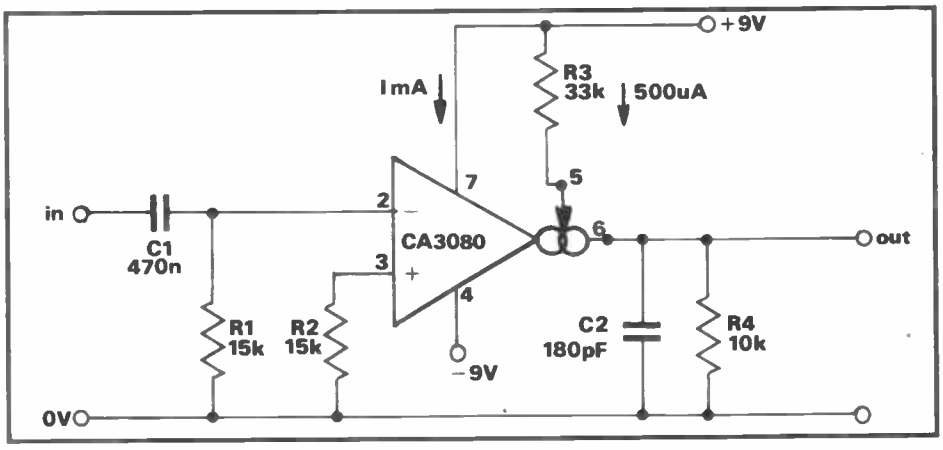


Fig 3 *AC-coupled 40dB inverting amplifier*

Basic OTA circuits

The CA3080 and LM13600 are very easy to use. This section is about fixed-gain ac amplifier applications. First the CA3080, its pin-5 I_{bias} terminal is actually connected to the pin 4 negative supply rail

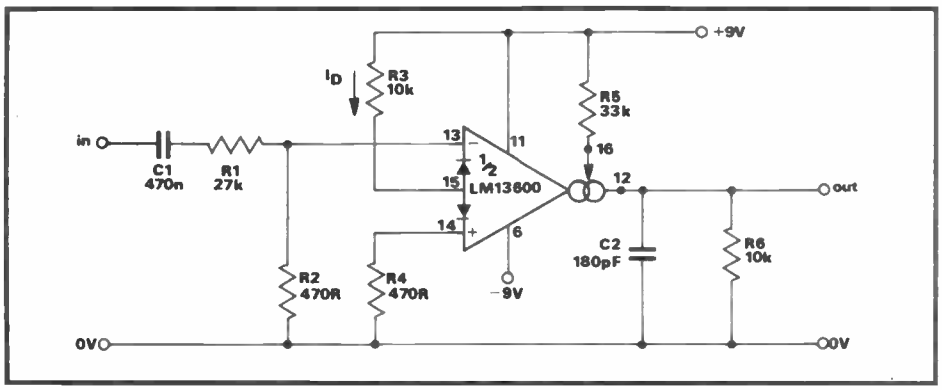


Fig 4 *Inverting ac amplifier with near-unity overall voltage gain*

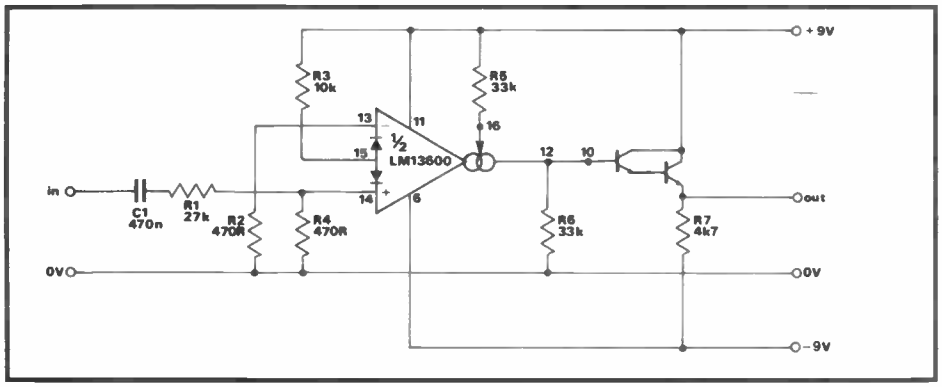


Fig 5 *Non-inverting ac amplifier with buffered output*

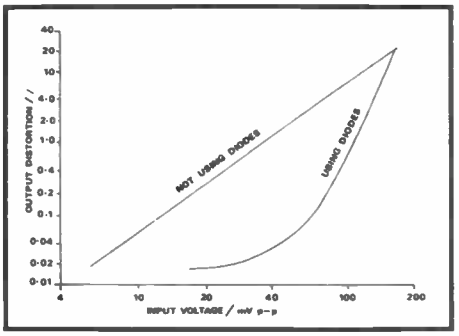


Fig 6 *Typical distortion levels of the LM13600*

obtained by connecting pin 5 to either the common rail or the positive supply rail via a current-limiting resistor of suitable value.

Figure 3 shows a simple but instructive way of using the CA3080 as an ac-coupled inverting amplifier with a voltage gain of about 40dB. The circuit is operated from split 9V supplies, so 17.4V are generated across bias resistor R3, which thus feeds roughly 500µA into pin 5 and thus causes the IC to consume 1mA (20 times I_{bias}) from its supply rails.

At a bias current of 500µA the g_m of the CA3080 is about 10mmho. The output of

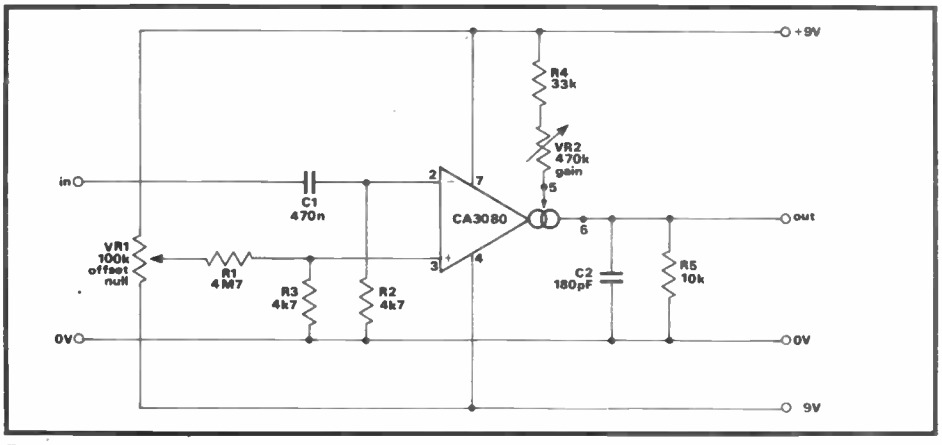


Fig 7 *×5 to ×100 gain ac amplifier*

via an internal base-emitter junction, so the biased voltage of pin 5 is about 600mV above the pin 4 voltage. I_{bias} can thus be

the *Figure 3* circuit is loaded by a 10k resistor R4, and thus gives an overall voltage gain of 10mmho × 10k = x100, or 40dB. The peak current that can flow into this 10k load is 500µA (equal to I_{bias}), so the peak available output voltage is ±5V. The output is also loaded by a 180pF capacitor C2, which limits the circuit's output slew rate to about 2.8V/µs.

Each of the two OTA devices housed in the LM13600 package can be used in exactly the same way as the CA3080 shown in *Figure 3*. One of the main features of the LM13600 is the linearising diodes that help reduce signal distortion, therefore each half of the device is best used as an inverting ac amplifier by wiring it as shown in *Figure 4*. The two input diodes are biased via R3 with current I_D which flows to ground via R2 and R4.

Note that in this circuit the input signal is applied to the non-inverting input terminal via R1. Also note that R1 and R2 form a voltage divider that attenuates the input signal, and that the circuit consequently gives an overall voltage gain of slightly less than unity. The gain of this circuit is in fact proportional to the value of I_{bias} /I_D , and can thus be varied by altering the value of either I_{bias} or I_D .

The above circuit can be made to act as a non-inverting amplifier by modifying the input circuitry as shown in *Figure 5*, which also shows how it can be made to give a low-impedance output using one of the IC's internal buffer amplifiers. This modification enables the R6 value to be increased to 33k, so the overall voltage gain increases too.

The graph of *Figure 6* shows the typical signal distortion figures that are obtained from the LM13600 when used with and without the internal linearising diodes. With an input signal voltage of 20mV peak-to-peak the device generates less than 0.02% distortion with the diodes; about 0.3% without them. At 40mV input these figures rise to 0.035% and 1.5% respectively.

CA3080 variable-gain circuits

Figure 7 shows how the basic *Figure 3* inverting amplifier circuit can be modified so that its gain is variable from ×5 to ×100 via RV2, which enables I_{bias} to be varied from 12.4µA to 527µA. In this type of application the input bias levels of the IC must be balanced so that the output dc level does not shift as the gain is varied. This is achieved via offset-nulling preset pot RV1. Set RV2 to its minimum (maximum gain), then trim RV1 to give zero dc output.

The *Figure 7* circuit can be converted into a voltage-controlled amplifier (VCA) by removing R4 and RV2 and connecting the V_{in} voltage-control input to pin 5 of the CA3080 via a 33k series resistor. In this case the circuit will give a gain of ×100 when V_{in} equals the voltage on the positive supply rail, and will give almost zero gain when V_{in} is 600mV above the voltage on the negative supply rail. To give the full range of gain control, V_{in}

must be referenced to the negative supply rail.

Figure 8 shows a more useful VCA circuit, in which V_{in} is referenced to the common (zero) supply rail rather than the negative rail. The 741 op amp and Q1 are wired together as a linear voltage-to-current converter (with a 100µA/V conversion rate) which responds to positive V_{in} values only. When V_{in} equals zero or less, the VCA gives almost zero gain. When V_{in} equals 5V, the VCA gives a basic gain of ×100. Rx is wired in series with the signal input line. Rx and R2 form a potential divider that reduces the pin 2 input signal amplitude (hence the overall voltage gain) of the VCA circuit. In practice, the Rx value should be chosen to limit the pin 2 signal voltage to a maximum of 20mV peak-to-peak. This minimises signal distortion.

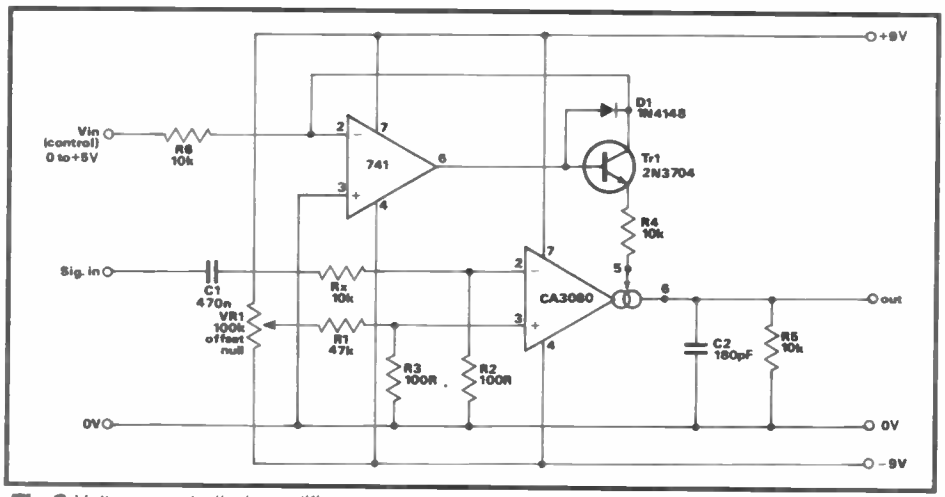


Fig 8 *Voltage-controlled amplifier*

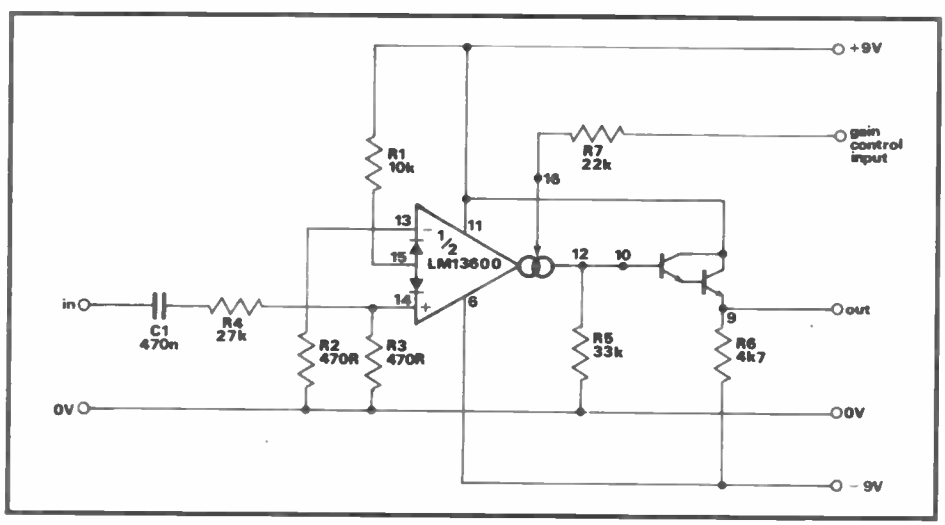


Fig 9 *Voltage-controlled amplifier*

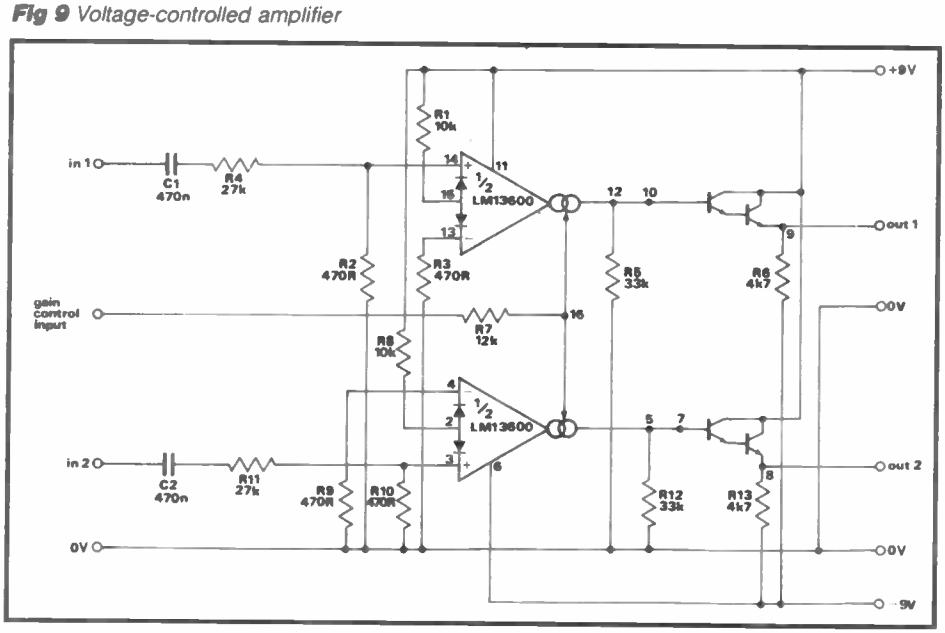


Fig 10 *Stereo VCA*

LM13600 variable-gain circuits

The LM13600 OTA can be used (with or without its linearising diodes) in any of the basic variable-gain amplifiers described above. *Figure 9* is an example of a VCA using linearising diodes. The gain control voltage is referenced to the negative supply rail. This circuit gives a gain of ×1.5 when V_{in} equals the voltage on the positive supply rail. It gives an attenuation of 80dB when V_{in} equals the voltage on the negative supply rail.

Figure 10 shows how two of the *Figure 9* circuits can be joined together to make a stereo VCA unit controlled by a single input voltage. This voltage can be derived from a volume control pot wired between the two supply rails, in which case a 10µF capacitor can be wired across the lower half of the pot so that the circuit acts as a noiseless volume control system.

Amplitude modulation

A VCA circuit can be used as an amplitude modulator (AM) circuit by feeding a carrier signal to its input terminal and using a modulating signal to control the output amplitude via the gain-control input terminal.

Figure 11 shows a CA3080 used in a dedicated version of such a circuit.

The *Figure 11* circuit acts as an inverting amplifier; its dc gain is fixed by R4 and R6, but its ac gain is variable by signals applied via C2. Input bias resistors R1 and R2 have low values to minimise the noise levels of the IC and eliminate the need for external slew rate limiting. Offset biasing is applied via R3-RV1. The carrier input signal is applied to pin 2 of the IC via potential divider Rx-R1; when Rx has the value shown, the circuit gives almost unity overall voltage gain with zero modulation input; the gain doubles when the modulation terminal swings to +9V, and falls to almost zero (actually −80dB) when the terminal swings to −9V.

Finally, *Figure 12* shows an LM13600 version of the amplitude modulator circuit.

Instantaneous polarity

In *Figures 11 and 12* the instantaneous polarity of the output signal is deter-

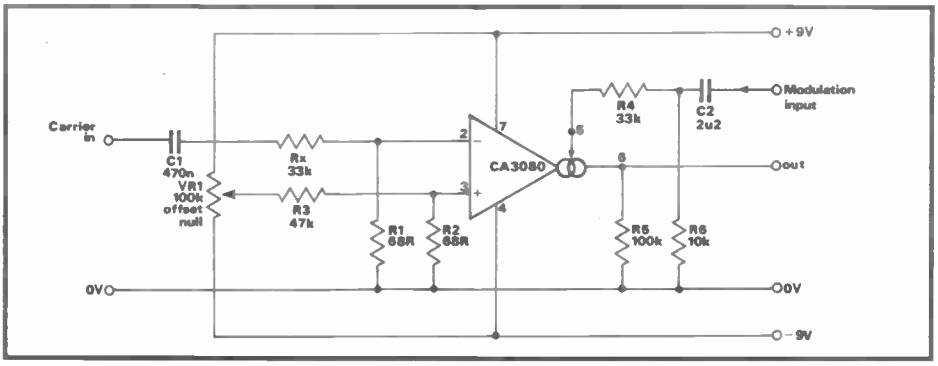
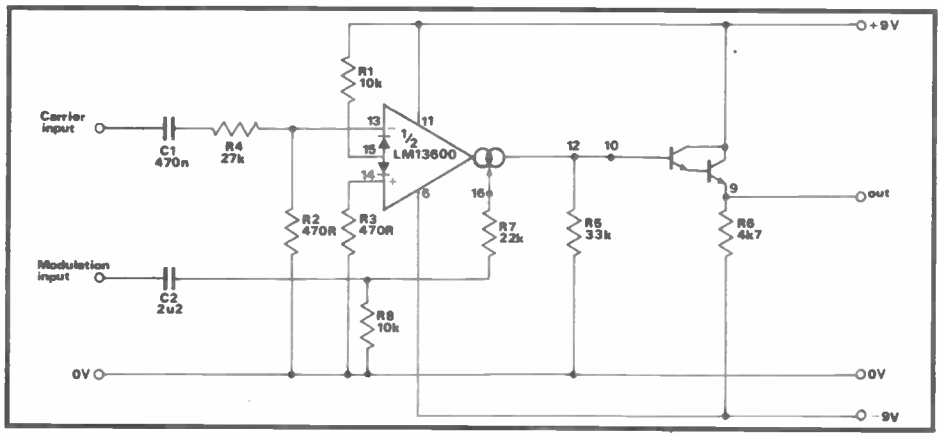


Fig 11 (right) *CA3080 amplitude modulator.*
Fig 12 (below) *LM13600 amplitude modulator*



mined entirely by the instantaneous polarity of the carrier input signal, which has two possible states (positive or negative). The instantaneous polarity is independent of the modulation signal, which has only one possible state (positive). This type of circuit is thus known as a 2-quadrant multiplier. There is another type of modulator circuit, known as a ring-modulator or 4-quadrant multiplier, in which the output signal polarity depends on the polarities of both the input signal and the modulation voltage. Practical examples of these will feature next month.

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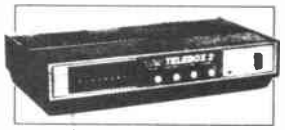

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THE TELEVISION CAMERA

What Lies Behind the Lens?

by Dr C J D Catto

Widespread use of lightweight TV cameras for security and surveillance, in home VCR systems and even in vehicles has tended to make us take for granted the TV camera tube and its derivatives.

In the early days of broadcasting, it was the electronic image pick-up tube, developed at EMI's laboratories, that won against the Baird system. It is obvious, with hindsight, why the mechanical scanning arrangement of the Baird system was ousted by an electromagnetically scanned tube: image quality and equipment size. See *Figure 1.*

A descendant of EMI's original Emitron camera is the vidicon tube, which remains the workhorse of industrial systems. It is a rugged device, produced in quantity for a modest cost.

Optics

The correct choice of lens is very important when building a TV camera. This may well require motorised iris and focus in a surveillance application. The iris diaphragm copes with the wide range of light levels encountered and should have at least seven stops, eg f1.4 to f16, equivalent to an illumination range of 128:1. *Figure 2* shows how the light entering the TV pick-up tube via the lens must have a spatial resolution of about 0.02mm for a tube target of ⅔in diameter, and the faceplate of the latter must be made of optically flat glass. A good quality lens is essential to reduce vignetting, an effect similar to that seen in Victorian photos where the image becomes extinct towards the edges. Even so, TV tubes tend to contribute some 'shading' of their own, and electronic compensation of the video signal is sometimes added to reduce it.

Fig 1(a) *Baird's System;* ***(b)*** *Method used by RCA and EMI*

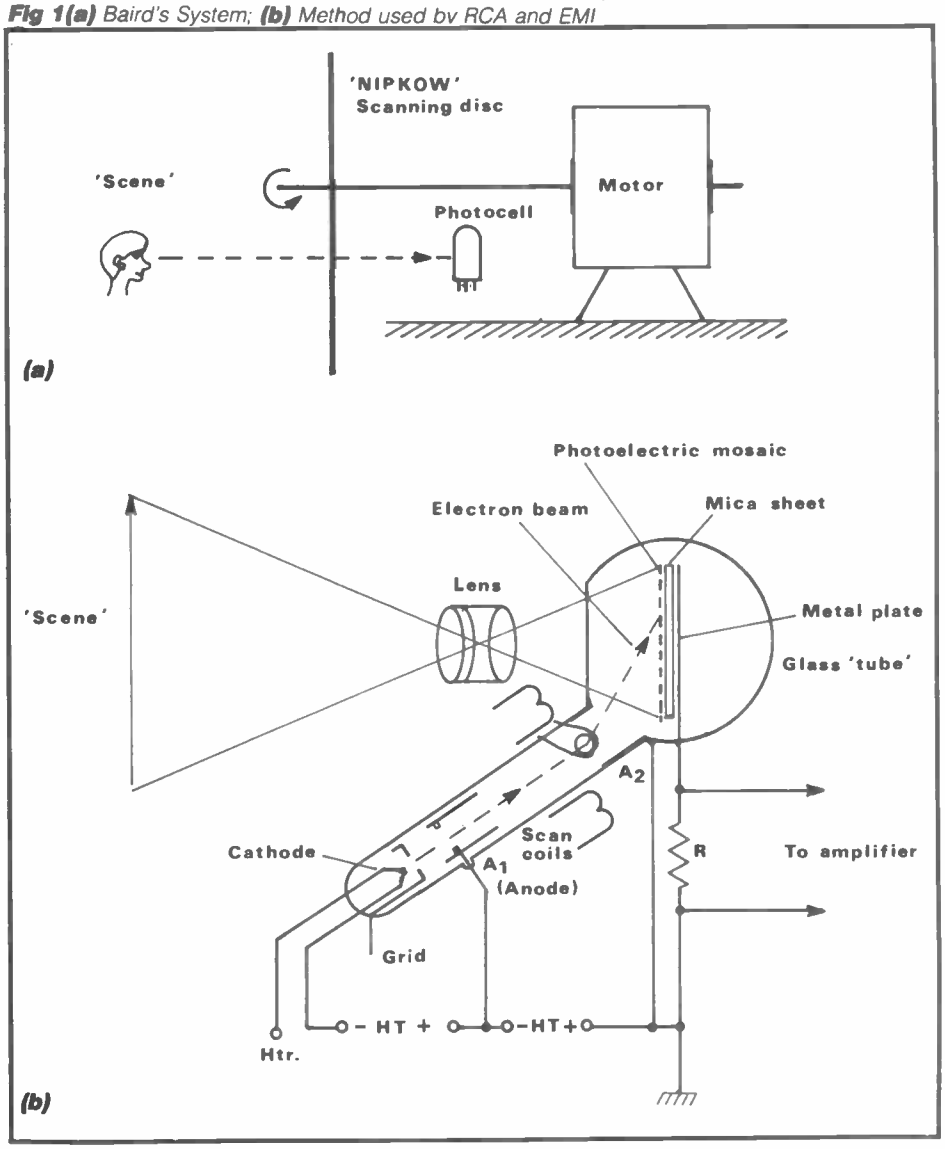
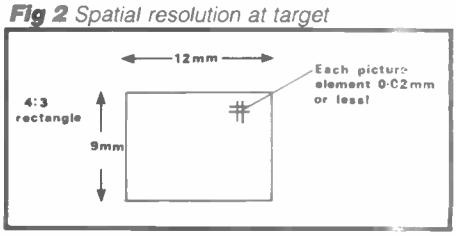


Fig 2 *Spatial resolution at target*



Photosensitive surfaces

In the vidicon, the surface that detects the incoming light is generally selenium oxide, deposited onto the inside of the glass faceplate. The Philips Plumbicon employs lead oxide, as this offers better sensitivity and reduction in lag. Light from the incident scene is integrated on the target during one TV frame, ie the total number of photoelectrons received per picture element from one framescan to the next are allowed to discharge the local capacitance. This charge is restored by the scanning beam and a current proportional to the local brightness enters the video amplifier. This is repeated from one picture element to the next, thereby building up the complete image.

An advantage of the vidicon is that the sensitivity can be controlled simply by altering the target voltage. This is because the photo-induced charge is proportional to applied potential as well as to incident light.

Heater	6.3V	
Cathode	0V	normal +30 V blanking
Grid 1	−30V	normal −100 V cut-off
Grid 2	+300V	
Anode	+250V	adjust for focus
Target	+100V	for max sensitivity

Table 1 *Electrode voltages for vidicon*

Video-amp

Most modern TV cameras have a video amplifier with a FET input stage, since low noise is an important factor in such a wideband amplifier. Also, it is traditional to provide increased gain with frequency to compensate for target capacitance; this requires minimum device noise. A typical input section is illustrated in *Figure 3.* Since black-level clamping is employed in a TV camera, the video amplifier can be ac-coupled to reduce bias and drift problems. Circuits with discrete devices seem still to be preferred by many manufacturers. The output generally needs the addition of line and

field synchronising pulses and should have a 75Ω impedance – this means the 300mV sync and 700mV peak signal when correctly terminated will double if the load goes open-circuit. Note that many cameras now seem to omit the output coupling capacitor, so the dc level seen on an oscilloscope can be alarming. Any processing circuit or TV monitor therefore needs to be ac-coupled and black-level clamped, to allow for this possibility.

Electron gun

The key element in a TV tube, as opposed to a solid-state pick-up, eg a CCD camera, is the electron beam. This is produced by a hot cathode, as in a valve, but the physical size, as well as the emission current, must be closely controlled else the scanning spot will be unacceptably large.

The electrode structure that is shown in *Figure 4* generally uses magnetic focussing to maintain a spot of 0.02mm at the target. Magnetic focussing requires a solenoid winding which increases the size and weight of the tube, however, lighter electrostatic tubes are difficult to build with a resolution that is as good as the best electromagnetic types. Incidentally, generating the correct focus current is relatively easy using a constant current source of around 120mA *(Figure 5)*.

Deflection

Once again, resolution is best when the beam is deflected magnetically, generally by two sets of coils (horizontal and vertical) enclosed within the same assembly as the focus solenoid *(Figure 6)*. Generation of the requisite ramp current waveforms is quite simple with transistor circuits, and dedicated field-scan ICs now exist. To protect the tube it is a good idea to generate HT and horizontal scan together, ie with a line-output circuit *(Figure 7)*, however, care is needed to ensure adequate linearity. Resistive losses in the coils (and transformer) mean that a true current ramp is not obtained unless some correction is added.

Electrostatic

Where a very small camera is essential, for example the internal inspection of pipes, the all-electrostatic tube comes into its own; focus is maintained purely by circular and cylindrical electrodes and by meshes; deflection is by electrostatic plates. Quite high scan voltages are required, but these are well within the capabilities of appropriate transistors. A recent development is the mini-vidicon, where electrodes are evaporated onto the inside of the glass; this reduces size and weight, as well as minimising microphony (disturbance of the picture signal by extraneous vibration).

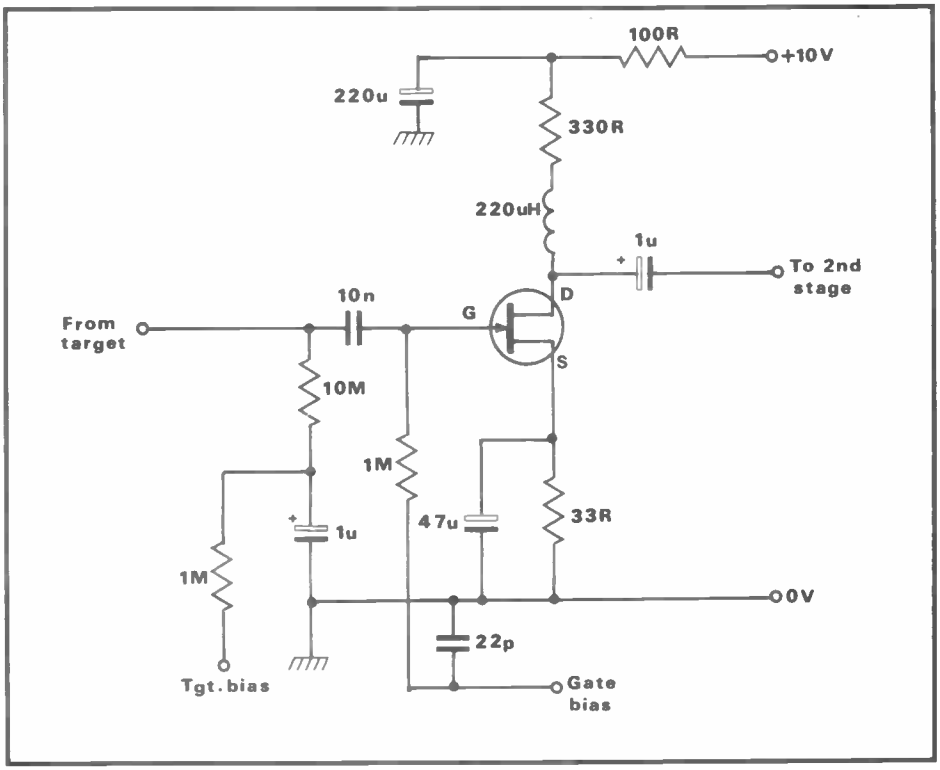


Fig 3 *Input section using JFET*

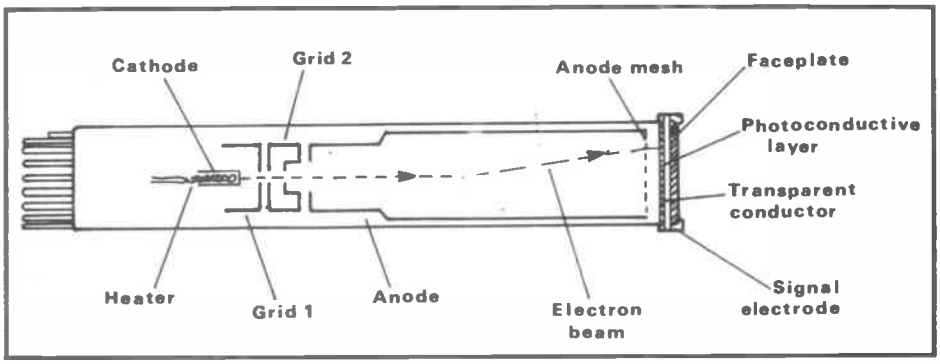


Fig 4 *Vidicon tube*

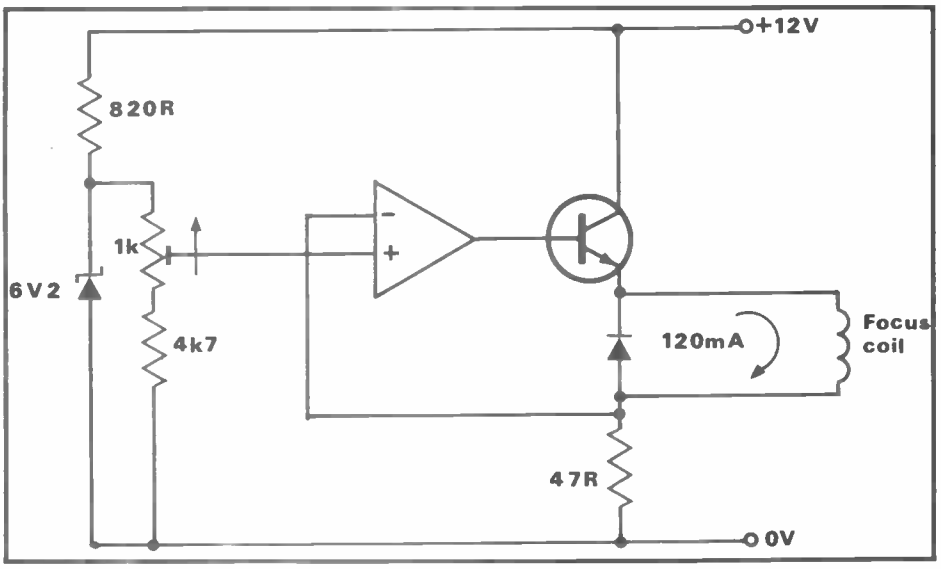


Fig 5 *Focus current source*

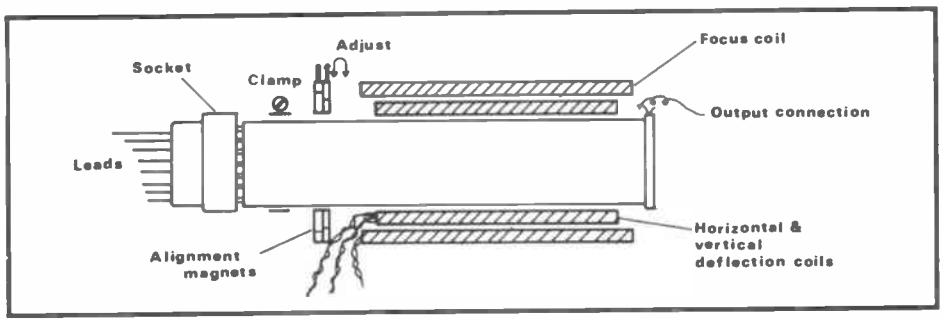


Fig 6 *Scan and focus coils*

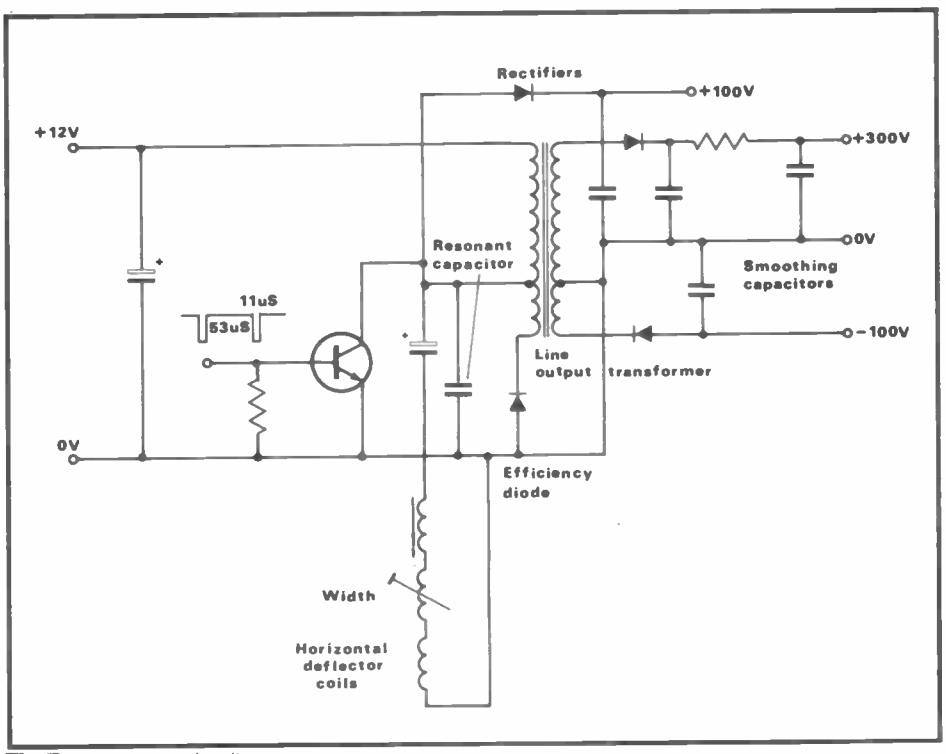


Fig 7 *Line output circuit*

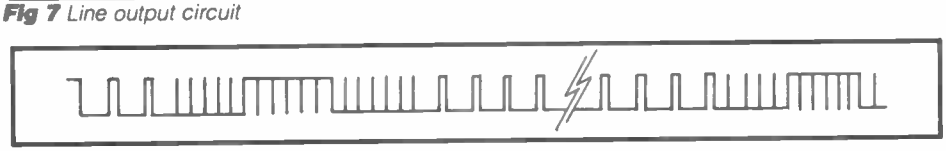


Fig 8 *Serrated field sync composite with line sync*

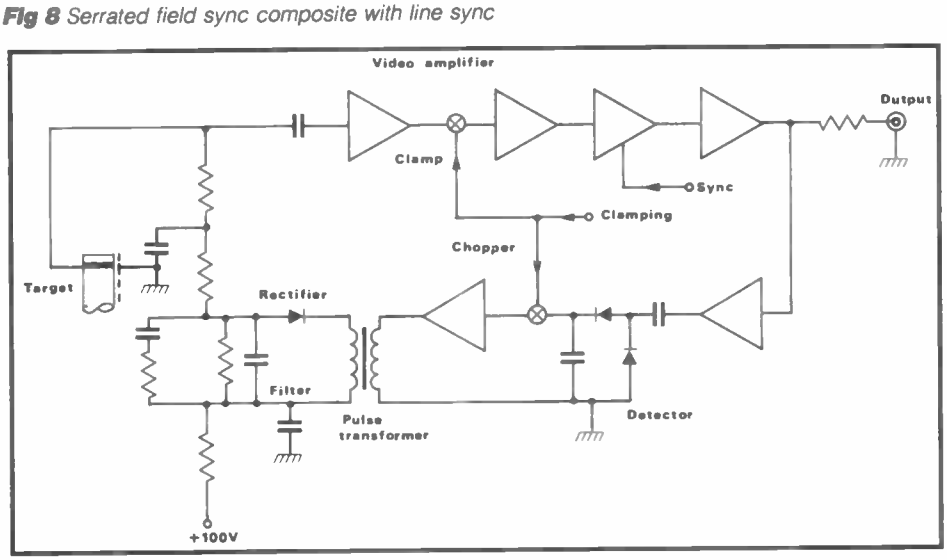


Fig 9 *Automatic gain (contrast) control*

High tension

As mentioned earlier, the HT is often generated along with the linescan – typical electrode voltages are given in *Table 1*. Focus voltage should be stable to ±0.1%, and focus current (where applicable) to ±0.05%. Some improvement in resolution, for example through reduced degradation of spot size by stray fields, can be achieved by higher voltage operation, but the increased insulation and power can be counter-productive; more power means more heat, and hence more drift.

Processing

The sync waveform should, strictly speaking, contain full equalising pulses (serrated field sync: see *Figure 8*), and this can be generated for the PAL, NTSC or SECAM standards by the Signetics SAA1043, for example. Since the video waveform may have suffered, owing to limitations of the tube itself, it is sometimes desirable to add some processing, such as crispening of the video output to enhance edge detail, and hence improve the perceived resolution. True image processing, on the other hand, requires operations in both X and Y directions, ie not just along the linescan. Prices of video A/D converters and RAMs have come down so much in recent years that it is possible to build a digital image-sharpening unit fairly economically. By operating on a 3×3 matrix of image pixels, lost detail can be rescued quite effectively.

AGC

TV cameras need to cope with enormous variations in light level. When there is nobody to adjust the lens iris, it is extremely useful to have some sort of automatic gain control (AGC). Vidicon AGCs are quite simple since the sensitivity of the tube depends on the bias voltage applied to its target. By varying this between 0 and 100V, a range of about 1,000:1 is obtainable. The block diagram of *Figure 9* shows how the peak video is detected, and a correcting signal fed back to reduce the target bias if the video amplitude is excessive. Correct time-constants are vital for acceptable response free from hunting. Where a pick-up device without controllable sensitivity is employed, other AGC methods should be considered. For example, the feedforward technique *(Figure 10)*. This has the advantage of a very rapid response – at the TV field rate, in fact – but the dynamic range is limited to about 20:1[1].

Other sensors

This article would not be complete without mention of solid-state pick-up devices, ie those not employing an electron gun and vacuum tube. Early devices used scanned diode arrays, but these have been superseded by charge-

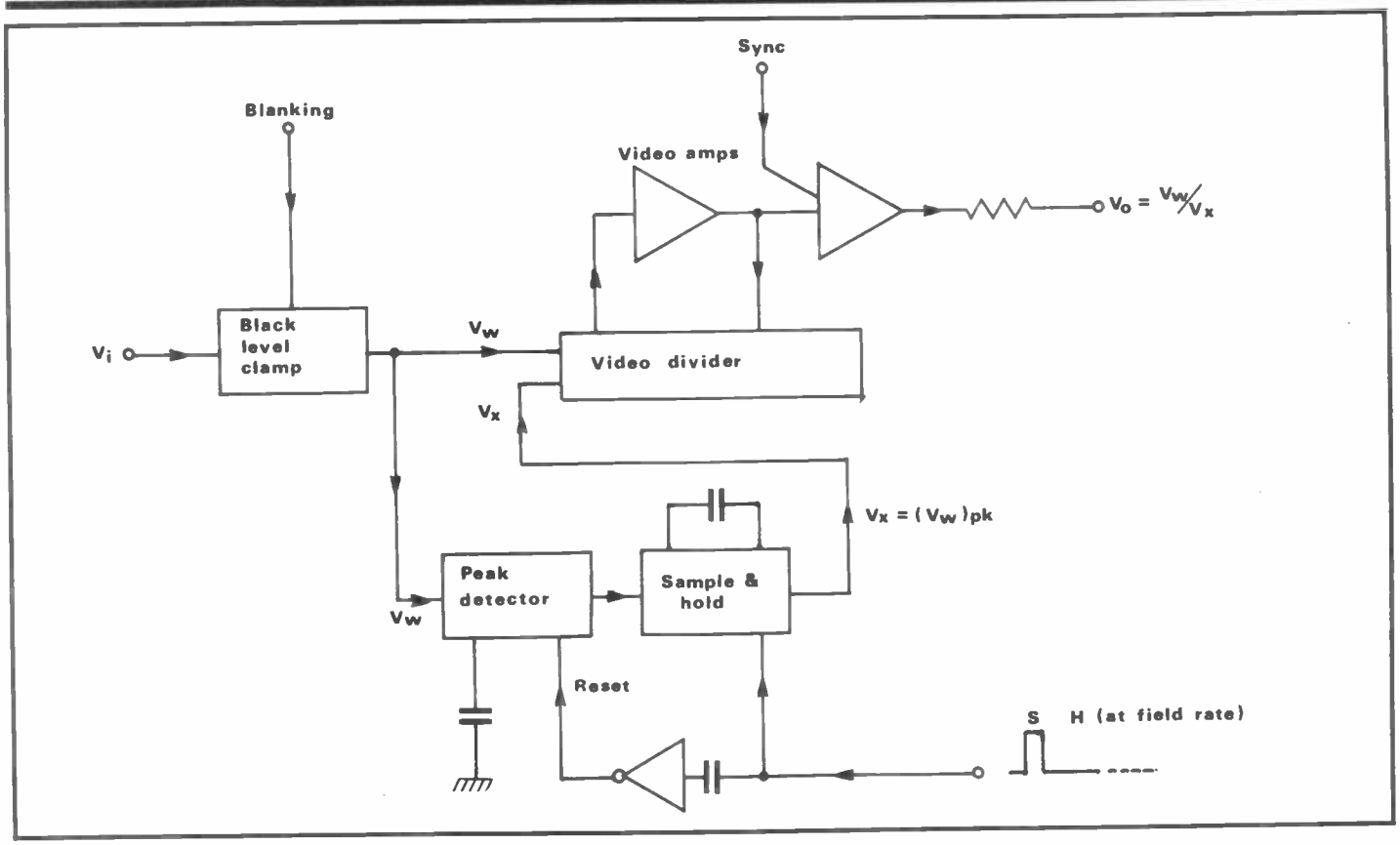


Fig 10: *Video AEG using feedforward*

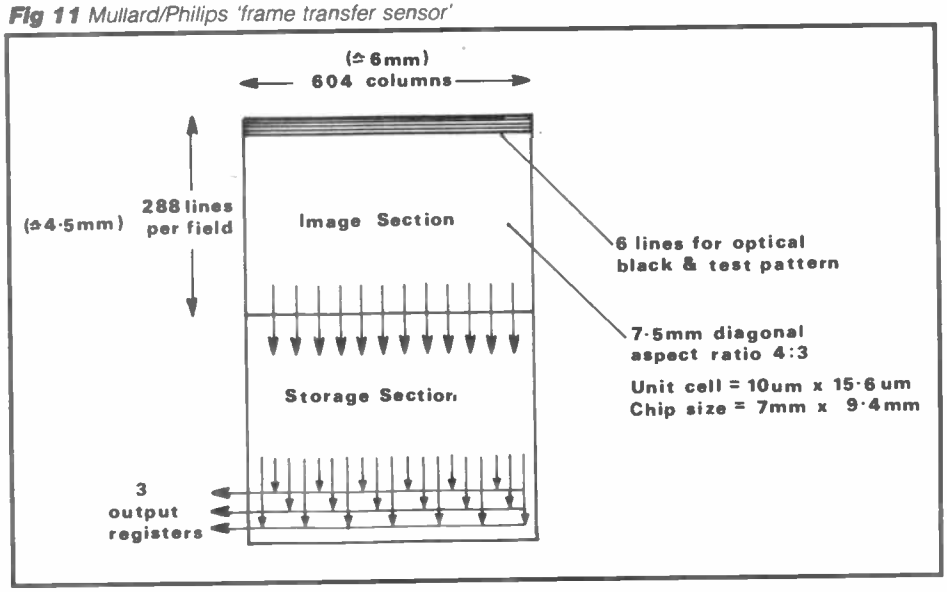
coupled devices, because of the requirement to fabricate 400×300-pixel sensors for TV. The CCD is best understood by first considering a linear array that uses a repetitive two- or three-electrode structure to shift the charge packets from the pixel sites to the output. The number of external connections is minimised. The transfer efficiency needs to be near 100%, or else too much picture signal is lost at each shift. In the full area device (such as the Mullard NXA1010, *Figure 11*), the structure is necessarily more complex, since field as well as line shifting is required.

Despite being difficult to manufacture, area CCDs offer remarkable performance. If their price falls as dramatically as have prices for many past semiconductor innovations, they will be strong competition for vidicon tubes. In addition to the savings in HT generation, the solid-state sensors obviously offer enormous savings in size and weight: in fact, miniaturisation of the drive electronics will soon mean that the lens is the bulkiest part of the assembly.

For colour cameras, reduction of sensor size is clearly important, and the recent trend is to replace the colour-splitting prisms by colour stripes directly in front of the array. This reduces resolution, but by an acceptable amount for many applications. Since the CCD in effect uses a discrete element or sampling process, the output should include a good lowpass filter; otherwise, unpleasant aliasing effects can ensue: these are similar to the Moire fringes produced when two grids or meshes are superimposed.

One other sensor is worthy of mention: the DRAM with a transparent lid. This device offers a very economical means of image grabbing for computers such as the BBC Micro, albeit at very limited grey-scale resolution.

Fig 11 *Mullard/Philips 'frame transfer sensor'*



Monochrome monitors

The TV camera tube is often taken for granted in today's digital world, but the chain of technology from object to image forms an interesting area of study for the hobbyist. Second-hand monochrome CCTV cameras and monitors may sometimes be picked up quite cheaply, and these can provide a rewarding new field of experimentation. NEW

Reference

(1) 'Video AGC reacts at TV field rate', CJD Catto, *Electronic Engineering*, February 1984.

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SPECTRUM WATCH

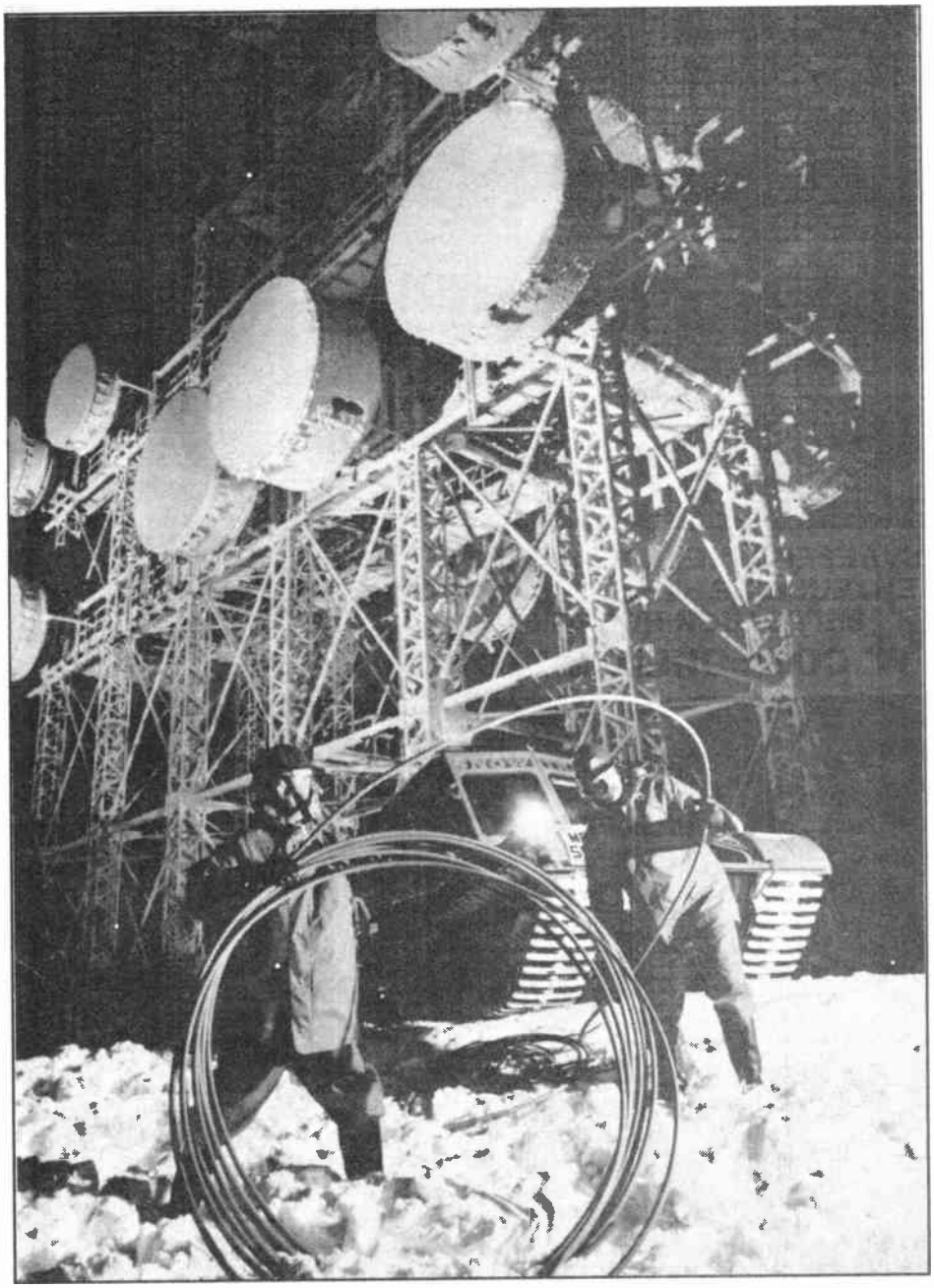
by John Andrews

Remote sensing looks Sharp

More details have emerged about the seemingly fanciful aircraft powered by radio waves. Called Sharp (stationary high altitude relay platform), it was demonstrated to the media at the Canadian Communications Research Centre at Shirley's Bay, near Ottawa.

The inaugural flight of the world's first microwave-powered fixed-wing aircraft was reported in the February issue of *Microwave Journal*. The plane is a test model and has a wingspan of 4.5m (15ft); the production model will have a 36.5m (120ft) wingspan and a fuselage 24m (79ft) long. On the test flight the craft was taken to a height of 91m (300ft) by battery power, the battery was turned off and, from then on, the aircraft was powered and controlled from a conventional 15ft–diameter parabolic dish on the ground. The transmitted power of 10kW in the industrial/scientific/medical band of 2.45GHz (the microwave oven band) enabled the plane to reach a speed of around 8 m/s (20mph).

A number of rectangular panels on the aircraft collect the microwave energy. The panels act as both antennas and rectifiers, so they are known as rectennas. They were first conceived in 1963 by William Brown of the Raytheon Company. The latest rectenna is said to have a power output per unit mass of 1kW/kg and an energy conversion effeciency of 80%.



No, it's not Ice Station Zebra, but it looks cold enough. This BT microwave relay station at Greenlowther, Scotland, is snow-bound for much of the winter, and the Snow-Trac in the background is the only way of reaching the station

There are many applications for pilotless remote-controlled aircraft such as this. They can operate at extremely high altitudes, unsuitable for normal aeroplanes, taking photographs for military surveillance or for monitoring agriculture, weather or pollution. They can be used to study carbon dioxide concentrations to gather information on the greenhouse effect. Other possibilities are radar sensing systems and communictions relays, including wide-area cellular radio for rural parts.

So far the Canadian Department of Communications has spent US$ 2 million on the Sharp project: to put a full-size operational device in the skies would cost almost $40 million more. If commercialised, the aircraft would cost $1 million each, plus $19 million for a dozen transmitters. Whether the project really takes off is anyone's guess, though the cost is said to compare favourably with that of communications satellites.

Military coup in America

Marconi Defence Systems' Secure Radio Division has been awarded a follow-up contract worth US$ 800,000 to supply mobile subscriber equipment to the US Army. The equipment is part of a mobile radio-telephone system being supplied to prime contractor GTE under a series of contracts placed with the Canadian Marconi Company.

The systems provide a continuously tunable FM radio relay which operates over line-of-sight links between sites of communication activity. Operation is on NATO bands I, II and III (220-400MHz, 610-960MHz and 1350-1850MHz). Similar equipment has been supplied to the British army under the Claymore name. Operation in Band II obviously has to avoid TV broadcasting and cellular radio, the primary uses of this band. The complete system provides fully secured, switched trunk telephone, telegraph and data communictions which can be reconfigured rapidly to suit changing tactical circumstances.

Eire waves

The Irish government has proposed the establishment of a nationwide independent alternative to state-run RTE programmes. The government has also proposed a network of commercial stations: two allocated to Dublin, one to Cork city and the remainder to each county nationwide.

The new stations will operate on both medium wave and VHF/FM, and must provide at least two hours a day of news

and public affairs, not 'wall-to-wall' music. Existing pirate stations will be allowed to participate if they comply with employment and taxation regulations. This will undoubtedly improve the present chaotic situation in parts of the FM band. It is far less clear whether all the pirates will shut down; they cannot all be licensed.

Repeaters in tunnels

It is generally agreed that cellular radio coverage of major cities is virtually perfect: most cell-site antennas now use the tilt-and-fill principle to improve the irradiation of the streets below. Early on it was found that antennas pointing horizontally at the horizon tended to cover a larger area than desired, as well as giving poor service close in (see the lighthouse effect in this month's Network 934). The antennas are not tilted downwards.

There are some places where the waves do not penetrate, such as long tunnels and large iron structures. The wavelength used by cellphones is quite short, about 33cm, so the waves penetrate short tunnels, such as the Kingsway Subway in London, quite well. Some situations require repeater transmitters, such as the repeater at Victoria Station for the on-board public trainphones. At Pittsburgh, in America, an elaborate system of three CMRF-800 repeaters has just been provided by the Peninsular Engineering Group for the Squirrel Hill, Fort Pitt and Liberty tunnels. These range in length from 3,600 to 5,900ft, and all three are busy with traffic during the rush-hours.

Though they are used particularly heavily, the new repeaters maintain their standard of service, and, since being installed, Pittsburgh Cellular Telephone has reported a 25% improvement in overall system-dropped-call performance. Each tunnel installation comprises a single repeater with a parabolic or yagi antenna directed towards the donor cell and a 9 or 12dB yagi aerial in each portal of the tunnel.

Hungary aims at tourists

Hungary is often regarded as the most westernised country in the Eastern Bloc, and further evidence is the continuing growth of Radio Danubius, the first commercial station in communist Europe.

Radio Danubius is aimed at tourists who visit the country as well as neighbouring areas of Austria and has expanded its air-time and coverage in the past year. Now it is planning a third transmitter at Sopron to extend 102.0MHz reception to the whole of the western half of the country and the Austrian borderlands. Last year two news programmes in English were broadcast daily, and it is reported that these transmissions may increase.

Dishes hit Poland

Although a mass-market for satellite dishes is unlikely for many years, given Poland's economic situation, a range of antennas is now available in the country's hard-currency shops for those lucky people who possess dollars. The prices of 1.5 and 2.0m dishes are equivalent to $1300 and $1600, reportedly more than four months, wages. Reception permits have to be cleared by the telecommunications authorities and the police. Available channels include the Soviet first channel, SAT-1, Screen Sport, Children's Channel, Cable News Network, RTL Plus and Music Box. The report, in *World Broadcast News* pointed out that viewers would also need a multi-standard TV receiver, since normal sets in Poland are for monochrome or SECAM colour only.

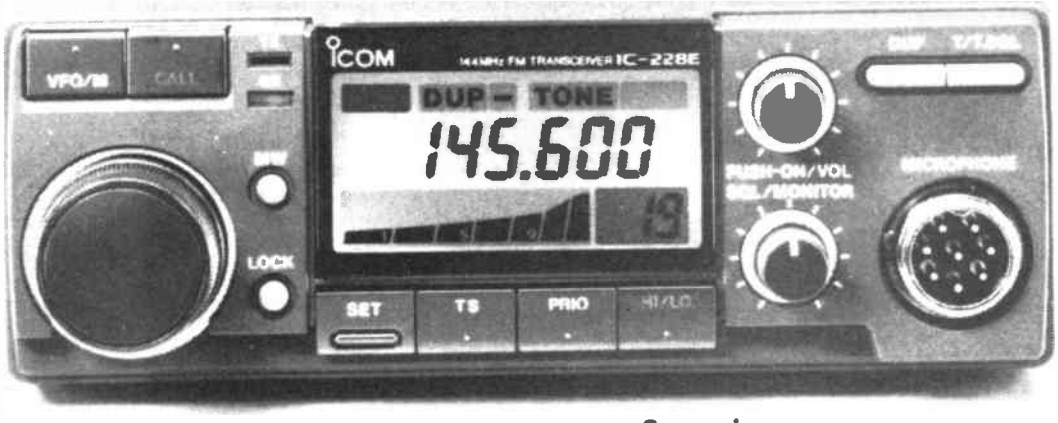
Compatible HD-TV

The USA's Federal Communications Commission is studying methods of making future high-definition TV transmissions compatible with existing sets to avoid them becoming obsolete. In the meantime the FCC has put a temporary hold on UHF TV channel allocations around the major cities. Some of the HDTV systems being proposed would occupy two normal TV channels to accommodate the signal, while the Stanford Research Institute is calling for the adoption of advanced compatible TV (ACTV), which requires no change to existing broadcast standards and would provide a 1050-line picture (twice the existing 525-line resolution of NTSC transmissions) to owners of advanced receivers. NEW

Microwave TV goes portable at Tower Bridge, London. A British Telecom engineer with backpack transmitter supports an electronic news gathering team from ABC-TV (USA)

ICOM

NEW! IC-228E 2 Meter FM Transceiver



Actual size

Features:

- **Multicolour Liquid Crystal Display.**
- **25 Watt output.**
- **20 Memory channels.**
- **Scanning.**
- **Call and priority function.**
- **Compact size.**
- **HM15 microphone supplied.**

Take a close look at this easy to use and compact VHF Mobile Transceiver. It's unique orange, red and green LCD highlights the numbers and letters for easy viewing. With a 25 watt output from a custom designed power module and a extra large heatsink, this transceiver does not get too hot under your dashboard.

Each of the 20 memory channels can store frequency, offset and direction, in fact all the information to work simplex or a repeater. The memory scan function will scan the memory channels and with the skip function miss those you choose. The program scan will scan all frequencies between two programmable limits. The call channel ensures that your favourite frequency is within easy reach, and with the priority watch the call channel or memory channels can be monitored every five seconds.

This transceiver provides you with so many features, its small compact size and simple front panel design make it a superb mobile transceiver. See the IC-228E or the IC-228H 45 watt high power version at your local ICOM dealer.

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NEW! IC-32E Dual Band VHF/UHF FM handportable

Features:

- **Full cross band duplex operation.**
- **5 Watt output with IC-BP7 nicad.**
- **20 Dual band memories. • Small size.**
- **Scanning. • Power saver circuit.**
- **Compatible with ICOM accessories.**

When are ICOM going to produce a dual band handportable? This has been the most asked question about new ICOM products for a long time. The IC-32E is the answer.

This exciting new handportable offers full crossband duplex operation, and with a built in duplexer allows single antenna operation. 3 Watt output is standard but with the BP7 high power nicad pack or external 13.8v, 5 Watts can be achieved on both bands. The IC-32E comes packed with features, such as the 20 memory channels which can store both a VHF and UHF frequency in one memory and also simplex duplex condition, offset direction and frequency.

There is a choice of five scanning functions, full programmed memory, memory band and priority. The die-cast frame gives a solid construction featuring rubber gaskets for splash-proof operation. The IC-32E is supplied with VHF/UHF a dual band antenna, BP3 battery pack and wall charger. OK, when are ICOM going to produce a new dual band mobile with full cross band duplex? The IC-3210E will be the answer.

NEW! IC-2GE 2 Meter FM handportable

Features:

- **Rugged and compact. • High power option.**
- **Power saver circuit.**
- **20 memories. • Scanning.**
- **Compatible with ICOM accessories.**

What's new on 2? ICOM's latest 144MHz FM handportable. The ICOM IC-2GE fulfils the most important criteria for a handheld transceiver, it is small, rugged and easy to operate.

The 3 Watt RF output is a compromise on battery life against power output, but for those who require extra punch, the set can deliver 7 Watts when used with the BP7 or external 13.8v DC. On receive the power saver circuit reduces current drain automatically, but can be overridden for packet operation.

The 20 memory channels can store all your favourite simplex and repeater frequencies, and with the programmed scan and memory scan functions, there is no need to manually search for activity. The IC-2GE utilises most existing ICOM handheld accessories plus a new line of carrying cases. If you are expecting to be outdoors this summer or looking for your first handportable transceiver, the ICOM IC-2GE will take a lot of beating

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Expanding the R&EW TVRO Satellite Receiver

by M J Ball G6EQX

The original design and construction were described by John Wood G3YQC (see *R&EW*, August 1986). Compared with other published designs, it is remarkably easy to put together as all the UHF circuitry is contained in two small ready-made units, the Astec AT-1020 and AT-3010. The AT-1020 converter is tunable from 950 to 1450MHz and plugs into the AT-3010 612MHz IF amplifier/demodulator which produces video output.

Don't be put off

At first sight, you might be put off constructing a satellite rather than an amateur TV receiver, because the original design has a tuning range of only 460MHz. The 11GHz communications satellite band extends from 10.95 to 11.7GHz, which is 750MHz wide. A suitable modern low-noise block downconverter (LNB) at the focus of the dish will contain a fixed 10GHz local oscillator, giving an intermediate frequency of 950 to 1700MHz, which should be the tuning range of an indoor unit (IDU).

A number of popular channels will be off the tuning scale of the unmodified receiver, but this can be remedied. The circuit board and kit are no longer obtainable from Comex as the company has ceased to exist, but AT-1020 and AT-3010 units can be bought from a supplier whose address is given at the end of the article. Other components are standard and can be obtained from several suppliers. A home-made PCB is feasible, otherwise the circuit can be built on Veroboard. Once you have built the original, you might like to try some of the modifications in this article.

Extending the tuning range

The AT-1020 tuning unit is normally tuned over 460MHz by a ten-turn potentiometer across an 18V (max) supply. Each local oscillator is labelled with its exact tuning range, for example: 2042MHz = 13.27V, 1582MHz = 1.67V. The output from the LNB downconverter at the dish is the incoming frequency minus the first local oscillator frequency. The first local oscillator has a fixed frequency of 10GHz, so the output from the LNB is the incoming frequency minus 10GHz. To convert the full range of the LNB output to the final IF of 612MHz, the variable local oscillator in the AT-1020 has to be extended far beyond its range.

Fortunately, the AT-1020 contains a divide-by-256 prescaler chip, so at each stage of the modification the exact frequency of the local oscillator can be monitored by attaching a digital frequency meter to pin 6. An accurate short wave receiver works perfectly well instead of a frequency meter. The unmodified unit will give an output on pin 6 of between 7.977MHz and 6.180MHz. To extend this, first look into the square hole beside the calibration label and locate a pin wound with enamelled copper wire. This is actually a primitive preset capacitor that was used to adjust the oscillator tuning. Remove the lid of the unit and carefully unwind the enamalled wire from around the pin, checking the full tuning range at each step.

You will also have to increase the voltage across the ten-turn potentiometer to 20V or even 22V. Instead of using another variable voltage regulator, you could try an 18V regulator and one or two red LEDs. Connect either one LED or two in series between the centre pin of the regulator and earth. The tab of the regulator must be insulated from the heatsink. The LEDs will need at least 150μF decoupling to eliminate hum bars. Some units only reach maximum capacitance when the solder around the base of the tuning pin has been sucked away and the pin has been bent flat to the board, so check the final frequency with the lid replaced. A final tuning range of 755MHz can often be achieved, allowing all eight Eutelsat channels to be covered with room to spare (see table). About four out of five units will give such a range. Hardest to modifiy tend to be those which contain varactor tuning diodes.

Tunable sound

The original design specified a 6MHz ceramic filter in the sound demodulator, as this is the most popular amateur TV sound subcarrier frequency. Unlike domestic television, satellite channels use various sound subcarrier frequencies between 5 and 7.5MHz, so the sound usually needs retuning when the channel is changed. Some channels broadcast additional sound subcarriers for stereo, digital sound and decoding information, as well as carrying BBC World Service and VOA relay channels.

There are several ways to modify the circuit for tunable sound. Though by no means the simplest solution, it is a good idea to add a tunable frequency changer. Retain the original as a fixed frequency sound demodulator. Replace the 6MHz filter with a 10.7MHz ceramic filter and change L4-C9 to a 10.7MHz IF coil and capacitor or a home-wound alternative. In theory C4 should be changed, but it made no difference. Use a separate piece of Veroboard to accommodate a tunable frequency changer such as the design by J&R v. Terborgh (see *Elektor Electronics*, November 1986). It uses an SO42P IC and home-wound inductors. No test equipment is needed to align the 10.7MHz circuitry; just sample the IF of a portable FM radio. The SO42P local oscillator frequency can be checked on a short wave receiver.

Band scanning

Band scanning gives audible and visible evidence that the dish is pointing

	Oscillator frequency	Tuning	LNB tuning	Pin 6 output
AT-1020	1582MHz	970MHz	10.97GHz	6.180MHz
	2042MHz	1430MHz	11.43GHz	7.980MHz
Modified AT-1020	1562MHz	950MHz	10.95GHz	6.100MHz
	2312MHz	1700MHz	11.70GHz	9.031MHz

at or near to a satellite. The AT-1020 local oscillator is swept across its range at about 15Hz using a saw-tooth wave generated by a 555 IC and amplified by an op amp (see *Elektor Electronics*, Jan 1987).

Pin 3 on the AT-3010 is intended to drive an S-meter. The dynamic range of this output is poor, so it is worth trying pin 2 (AGC) or pin 4 (signal sense) as alternative S-meter feeds, with or without the internal filter in circuit. An op amp may be used to amplify and/or invert the feed to the S-meter. The twin wire supplying the polarity rotator, described below, may also double as a remote S-meter feed during dish alignment. For accurate dish adjustments, it is better to take a small multimeter down the garden or onto the roof than to rely on shouted signal reports or subjective impressions from a portable TV set attached to yards of coaxial cable.

Flicker control

Many channels use a technique, called disperson, which scans the carrier wave across a few megahertz at frame frequency. This helps to avoid heterodyne interference and herring-bone patterns from land-based microwave sources, but sometimes produces an annoying flicker. To overcome the flicker, use a circuit similar to a dc restoration filter. These clamp the average voltage with a zener diode. Sometimes more than one of these circuits is needed. In fact, they did not work in my receiver, so I fitted a much simpler RC circuit between the video output and the UHF modulator (*Figure 1*). The time constant and modulation level adjustments are set so that there is neither flickering at one extreme, nor smearing of dark-light transitions at the other.

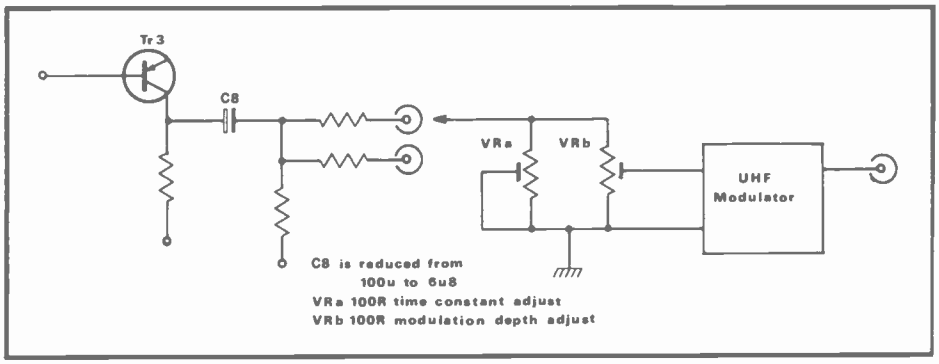


Fig 1 *Flicker control circuit*

TVRO units are still somewhat expensive; even without a dish, the Astec AT-1020 and AT-3010 together come to about half the predicted cost of a complete Astra TVRO receiver and dish. Until the satellite is in place and one can actually buy this promised bargain, Astec units remain the quickest and simplest solution for the home constructor, even if they're not the cheapest. They do all that is necessary to convert the LNB output into video and mixed syncs, and can alone directly feed a UHF modulator or TV monitor, but without sound, of course. The output pin of the AT-3010 will not stand an accidental overvoltage, as I found to my cost when I destroyed a demodulator IC, only to find that the manufacturers had carefully obliterated the type number. The importers could not help, but close inspection revealed the same pin connections as a Plessey SL1452. A repair took no time.

Results

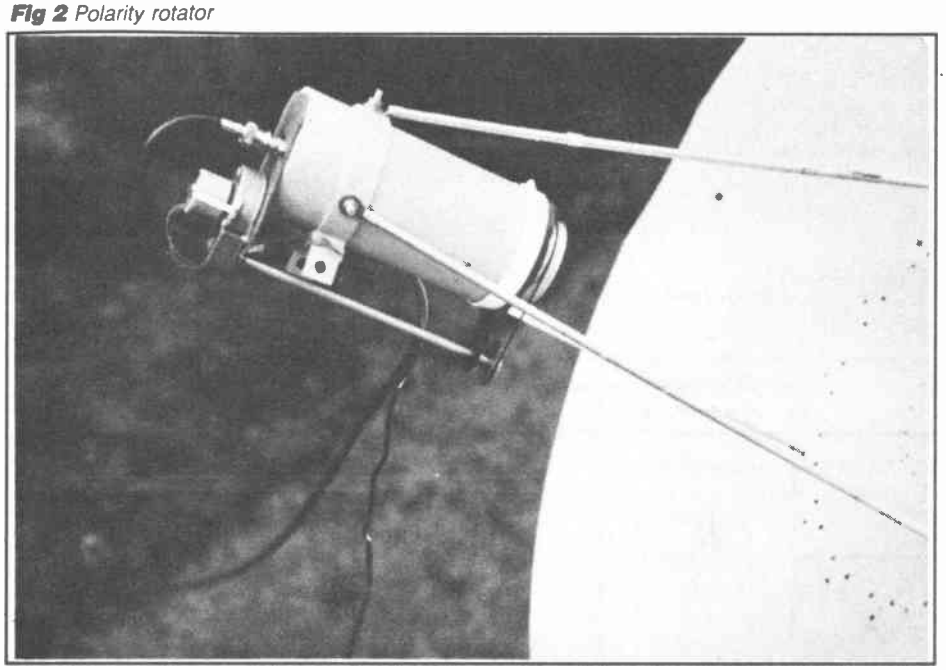
Using a 1.7 to 1.8dB LNB from South Midlands Communications (Eastleigh, Hampshire), a 3-ring scalar horn from Harrison Electronics (Cambridge) and nothing larger than a well-made 76cm (30in) surplus dish, the expanded receiver gave excellent pictures from Eutelsat. A small dish does prevent teletext being resolved. It also makes for a rather noisy picture when the Italian channel reduces power to allow an experimental channel to transmit.

Polarity rotator

To encourage the home constructor, I've included a picture of a home-made LNB mount and polarity rotator (*Figure 2*). The LNB is housed inside a 65 x 150 Securitainer (a bulk pillbox that local pharmacists discard by the dozen). The LNB is suspended at one end by the neck of the scalar horn and at the other by its coaxial connector, resting in slots in melamine endpieces. On these are mounted a geared motor, shaft, pulley wheel and synthetic rubber band drive around the scalar horn. Bearing surfaces and the coaxial plug are lubricated with silicone grease. Half a BNC plug is screwed to the F connector, and a crimped BNC in-line socket allows continuous rotation.

A tape recorder drive-band works well in all weathers. A standard programmer or time-switch motor with slow-speed reduction gears from a washing machine or other appliance is suitable if the small 240V drive motor is replaced with a 6V dc tape recorder motor. *This is essential for safety reasons, as 240V must not be taken outdoors to the dish.* If the shafts are of similar diameter, the same cogwheel can be used. The polarity is changed by nulling out a signal on the other polarity. Rotation should be in the direction that does not unlock the BNC spigot.

Fig 2 *Polarity rotator*



Focussing and protection

The Securitainer is gripped firmly by a plastic rainwater pipe-clip attached to the dish by three radial supports at 120°. The axial sliding fit allows the focus to be adjusted precisely. A polythene bag, cut diagonally and secured with clothes pegs, will keep out the weather without attenuating the signal.

Astec Units can be obtained from Thame Systems Ltd, Thame Park Road, Thame, Oxfordshire. Tel: (084421) 7676.

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

This month Arthur C Gee wonders how to attract young people to the RSGB and how to encourage them to become tomorrow's technologists. He also reveals what the DTI thinks about morse.

The Radio Regulatory Division of the Department of Trade and Industry recently appears to have adopted a very sympathetic attitude towards amateur radio. The *Young Amateur of the Year Award* and the many information sheets about amateur radio should certainly help encourage people to take up amateur radio as a hobby. This may not be unconnected with the realisation that electronics is now the mainstay of this country and every encouragement must be given to training new generations in this field. The national radio societies of both this country and the USA are very concerned at the fall in young members. Less than 150 RSGB members are under 18. The average age of RSGB members is rising rapidly and when older members die, rarely does anyone take their place.

Novice's Licence

A Novice's Licence for amateur radio transmitting facilities appears to be mere speculation. I hear on the grapevine that the idea could turn into a Student's Licence, maybe a step in the right direction. We hear too that proposals for this would require a very simple Morse code ability test, possibly about five words per minute needed to pass. Restrictions on the use of any form of telephony have presumably been suggested to prevent the sort of thing which took place in the heyday of CB radio.

Morse essential

It seems that all concerned with the Student's Licence are agreed that a knowledge of Morse is essential to the full enjoyment of amateur radio. Though Morse code equipment is due to be phased out of marine use after 1990, the DTI is adamant that it should be retained in the amateur radio service. In their *Radio Amateur Licensing Information Sheet* it states, 'Morse will continue to be needed in the Amateur Service for the foreseeable future. But its use in maritime distress, safety work and commercial traffic is likely to decline towards the end of the century. Many amateurs wish to keep using Morse, believing it the best method of making contact in bad operating conditions. Most countries' radio societies also believe Morse is useful in the self-training of amateurs and in operating an amateur radio station. Knowledge of Morse can be important to an amateur using a secondary band if a primary user makes contact by Morse to complain of interference'.

Tomorrow's technologists

Mr John Butcher MP, an under secretary at the DTI, made some pertinent remarks when he opened last year's RSGB National Convention at the Birmingham NEC. He said, 'Communication is a high-growth industry and the UK urgently needs skilled radio engineers. Some of the top radio engineers in industry were launched into their careers as a direct result of an interest in amateur radio – today's enthusiasts are tomorrow's technologists.'

Another interesting official comment came from Nigel Heriz Smith, who is presently head of the DTI's Amateur Radio Section. He said at a public meeting of radio amateurs held in Gumersal, Leeds, last October, that after the present review of the amateur licence, the next priority was the introduction of some form of novice licence. Something along these lines might be forthcoming in the very near future.

Heavily into fax

One of the lesser known interests in amateur radio is that of the transmission of pictures by radio – facsimile, fax for short. Your scribe was quite heavily into fax some years ago and was active in a group of radio amateurs experimenting with amateur radio applications.

At that time, the biggest difficulty was to find suitable equipment. We did have some success with Deskfax machines. For amateurs these were small enough to be practical and cheap enough to be affordable.

It received messages on chemically treated paper marked by a fine metal stylus. When an electric current was passed through the stylus, which rested on the paper, it left behind a mark. This paper was wrapped around a metal drum, which rotated in synchrony with a similar drum at the transmitter. To transmit, a bright light was shone onto the picture to be transmitted. The reflected light from the picture modulated the radio signal. Many difficulties had to be overcome, possibly the worst of which was the smell when current passed through the chemical on the receiving drum. One way and another, the system was not popular and the experiments were discontinued. However, several quite successful pictures were transmitted and received over a two-metre link. Since then a few have resumed these experiments and, as improved equipment has become available on the surplus market, better and better pictures have been obtained. Now there are one or two successful fax nets which run regularly; a small fax group in Germany is particularly enthusiastic.

Not all weather maps

Computers have helped amateur fax to take a great leap forward, particularly in the field of weather map reception. In fact, it is true to say that most current fax interest is in the reception of weather maps and charts. Radio stations all over the world have been professionally transmitting weather faxs for many years to anyone who can afford the receiving equipment, and they are now widely used by seafarers, aviation operators, weather forecasters and so on. Not all the maps are just weather maps, some deal with sea conditions such as temperature, surface drift and wave height; in polar regions, ice conditions are regularly transmitted.

Up until recently, receiving equipment has been comparatively expensive, but ICS Electronics Ltd of Arundel, West Sussex, has marketed something for those of modest means. It will work off low-voltage accumulators in yachts and other small craft; operates from any HF receiver with SSB facilities; contains a fax demodulator, mains power unit,

Epson-compatible printer, paper, ribbon and – joy of joys – all connecting cables. You just connect up the units and plug in the receiver loudspeaker, or recorder output, tune to a suitable transmission and away it goes. I have recently installed an ICS FAX-1 System in my radio shack and I'm absolutely delighted with it.

Fascinating comparisons

A particularly interesting transmission around 1630hrs GMT on 3289.5kHz from Bracknell, the Weather Centre for the British Isles, is a weather chart covering the North Atlantic, Greenland, Iceland and the Baltic and coastal regions of Western Europe down to Spain. It is fascinating to compare the latest map with the previous day's, watch the movement of fronts and see the weather that results. Even the wettest weather, usually on public holidays it seems, has become quite interesting!

Many other fax transmissions can be received from home and abroad, and a most fascinating time can be had tuning around to see just what you can copy. ICS Electronics Ltd advertise regularly in this journal and will send enquirers full details of its weather fascimile receive terminal unit.

Phase 3C launched

By the time you read this, if all goes according to plan, which is unusual where satellites are concerned, the Phase 3C amateur radio satellite should be launched.

The amateur satellite scene has been a bit slow recently. Oscar 10 is out of the picture as far as communications are concerned, so it will indeed be good to have another similar satellite in orbit.

At the time of writing, reports from Kourou indicate that all is well for the launch on or around June 2nd. The spacecraft was 'closed out' – the official term for everything being ready for go except the fuelling up.

Most powerful

Phase 3C will be the most powerful amateur satellite to date, particularly in its JL mode which gives a 24cm uplink and a 2m uplink, and a 70cm downlink. The mode L uplink on Oscar 10 never reached its designed output owing to the failure bias regulator in the mode L power amplifier. Consequently, the power requirements needed to access the satellite in mode L were much greater than planned so that few satellite enthusiasts succeeded in communicating via this mode. Phase 3C mode L uplink power requirements may be 5dB better than those for Oscar 10, which should make it much more popular with mode L users.

VIPs invited

The Skitrek Transpolar Expedition was successfully completed in spite of some very difficult terrain. The team celebrated their success on May 1st with a get-together in the vicinity of the North Pole. A party of VIPs and journalists were invited to fly from Moscow to meet them at the pole. Michael, who compiles the UoSAT Bulletins at the University of Surrey UoSAT Control Centre, was one of those who made the journey. We await his return as we are interested to hear about his experiences.

The South African AMSAT Group has been very active flying VHF beacons/transponders from meteorological type data balloons These offer good practice to satellite enthusiasts wishing to check out their equipment and gain experience in VHF techniques. On March 26th last, they launched their 25th balloon, this time carrying a voice store and forward repeater, and a recovery beacon which provides direction-finding facilities. These balloons may reach heights up to 70000ft. NEW

DX-TV RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

Band I should be buzzing with long-distance TV signals from all over Europe unless, of course, something goes horribly wrong with the ionosphere.

During March, long-distance TV reception conditons in Band I proved disappointing for most enthusaists and descriptions ranged from 'a disaster' to the unprintable. When reception did occur it was either via meteor shower propagation or short-duration sporadic-E. Nevertheless, most European countries were identified during the month, mainly from test cards, despite their limited screening these days. In other parts of the world, Band I reception conditions were completely different. Exciting events in India could be a taste of what is shortly in store for the UK and Europe.

Tropospheric DX reception was noted in Wales on March 9th with signals present in Band III and UHF from the Low Countries. A minor tropospheric lift occurred on the 18th with France, Belgium and the Netherlands at UHF. The event wasn't exactly staggering although it did help to relieve the general monotony.

Band I reception

Here in Derby, the Spanish GTE test card fluttered up via meteor shower propagation at 1005 GMT on March 6th. Later in the day a small sporadic-E opening occurred to the south, consisting of Spanish programmes. At 2315 GMT on the 20th a very weak PM5544 test card materialised for a short period and, judging by the lateness of the test transmission, it could have been Iceland. Repeated sightings of a PM5544 (via meteor shower progagation) occurred between 1900 and 1945 GMT on the 28th. Again, the time of the test transmission strongly suggests Iceland. On the 27th and 28th very weak vision buzzes and carriers were resolved from a southerly direction on channel E2. Unfortunately, attempts to resolve any form of picture failed despite the use of reduced bandwidth IFs. The signals faded very gradually. Chris Howles of Lichfield also reported similar activity. To round off the month, Iain Menzies of Aberdeen reported auroral activity throughout the evening of March 26th with the *usual* Norwegian and Russian TV signals in Band I.

DX-TV log for March

This month the reception log is by Simon Hamer of New Radnor in Powys:

01/03/88: SVT-1 (Sweden) on channel E2 radiating the 'KANAL 1 SVERIGE' PM5534 test pattern.

03/03/88: RUV (Iceland) on channel E4 identified from the PM5544 test pattern with 'RUV ISLAND' identification; TSS (Russia) on channel R1 displaying the UEIT test pattern.

04/03/88: CST (Czechoslovakia) on channel R1 showing the 'RS-KH' EZO test card; NRK (Norway) on channel E2 with the 'NORGE GULEN' PM5534.

05/03/88: DR (Denmark) on channel E3 radiating the 'DR DANMARK' PM5534.

07/03/88: CST on channel R1 using the EZO test card; TVP (Poland) channel R1 identified from the dark-background PM5544.

PHOTO FILE ● PHOTO FILE ● PHOTO

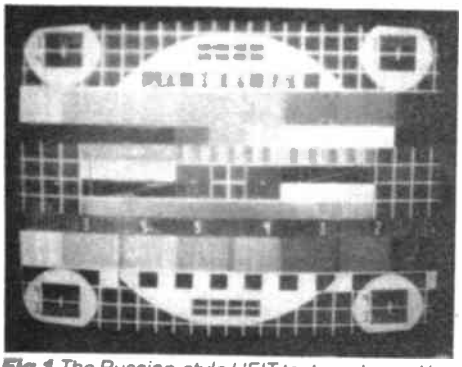


Fig 1 *The Russian-style UEIT test card, used by ICRT in Cuba*

Fig 2 *News programme from Cuban TV, called 'Tele Diario'*

Fig 3 *News programme in English from Syria's second TV network*

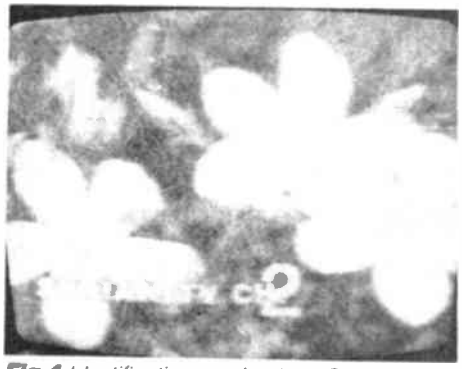


Fig 4 *Identification caption from Syria with the inscription 'Syrian TV Ch 2'*

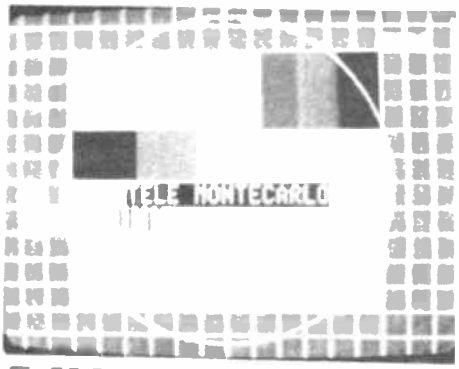


Fig 5 *FuBK test card which is occasionally used by 'Tele Monte-Carlo'*

Fig 6 *Station opening caption from the Dutch 'Nederland 2' service*

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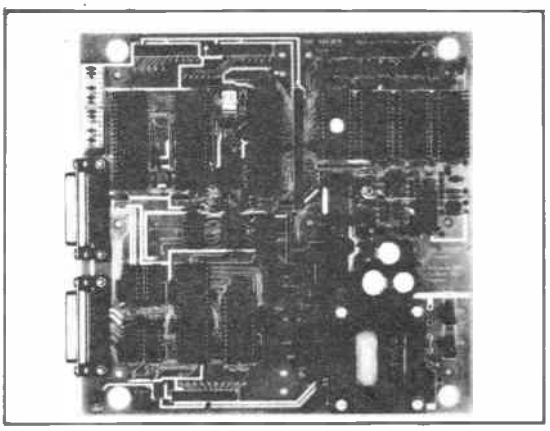

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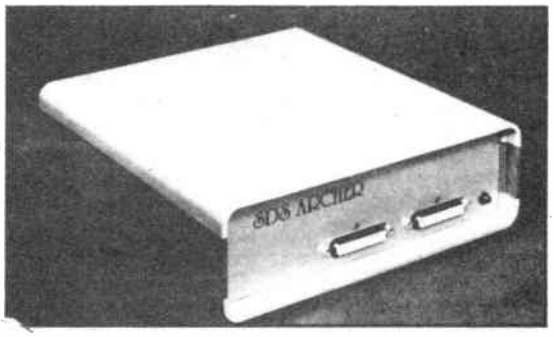

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Polystyrene capacitors 63V working E12 series long axial wires
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741 Op Amp – 20p. 555 Timer 22p
cmos 4001 – 20p. 4011 – 22p. 4017 ..... 40p
ALUMINIUM ELECTROLYTICS (Mfds/Volts)
1/50, 2.2/50, 4.7/50, 10/25, 10/50 ..... 5p
22/16, 22/25, 22/50, 47/16, 47/25, 47/50 ..... 6p
100/16, 100/25 7p; 100/50 12p; 100/100 ..... 14p
220/16 8p; 220/25, 220/50 10p; 470/16, 470/25 ..... 11p
1000/25 25p; 1000/35, 2200/25 35p; 4700/25 ..... 70p
Submin, tantalum bead electrolytics (Mfds/Volts)
0.1/35, 0.22/35, 0.47/35, 1.0/35, 3.3/16, 4.7/16 ..... 14p
2.2/35, 4.7/25, 4.7/35, 6.8/16 15p; 10/16, 22/6 ..... 20p
33/10, 47/6, 22/16 30p; 47/10 35p; 47/16 60p; 47/35 ..... 80p
DIODES (piv/amps)
75/25mA 1N4148 2p. 800/1A 1N4006 6p. 400/3A 1N5404 14p. 115/15mA OA91 ..... 6p
100/1A 1N4002 4p. 1000/1A 1N4007 7p. 60/1.5A S1M1 5p. 100/1A bridge 25p
400/1A 1N4004 5p. 1250/1A BY127 10p. 30/45mA OA91 6p. 30/15A OA47 ..... 8p
Zener diodes E24 series 3V3 to 33V 400 mW – 8p. 1 watt 12p
Battery snaps for PP3 – 6p for PP9 ..... 12p
L.E.D's 3mm. & 5m.m. Red, Green, Yellow-10p. Grommets 3mm – 2p, 5mm 2p
Red. flashing L.E.D.'s require 5V supply only 50p
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09/03/88: STV-1 received on channels E2 and E3 – the PM5534 with 'KANAL 1 SVERIGE' identification was being shown. Tropospheric DX included: NED-1 (Netherlands) on channels E4 and E39 from Lopik and Wieringermer; NED-3 on channels E30, E34, E35 and E42; BRT-1 (Belgium, Dutch-language network) on channel E10 from Wavre; RTBF-1 (Belgium, French-language network) on channels E3 and E8; RTL+ (Luxembourg) on channel E7.
20/03/88: SVT-1 received on channel E2 displaying the PM5534 test pattern.
21/03/88: CST seen on channel R1 showing the 'RS-KH' EZO test card.

Exotic DXing

Major Rana Roy of India has again reported what seems to be a form of transequatorial propagation which occurred regularly throughout the first half of March. Similar reception conditions were experienced last October. Fortunately the lower Band I channels are free from transmission in India which means DX signals are easy to detect. Channel E4 is not so favourable for DX reception because it is used extensively by a network of high-power transmitters throughout the country.

Signals from the Bangkok channel E3 transmitter in Thailand could be identified most days despite the very smeary nature of the pictures. Reception occurred late in the afternoon or during the evening. After the 13th, reception ceased and nothing was resolved between then and the time of compiling his report on March 22nd.

Between March 1st and 13th, Rana noted the following signals:
01/03/88: Bangkok TV noted on channel E3 at 2025 local time. The sound was clear but the pictures had multiple images, smearing and a characteristic flutter effect. Signals faded at 2130.
05/03/88: Bangkok TV on channel E3 between 2130 and 2145, local time.
06/03/88: Bangkok TV on channel E3 between 1900 and 2130, local time. There was also heavy interference with Delhi TV on channel E4.
07/03/88: Bangkok on E3 at 1910. Signals were exceptionally strong and there was heavy patterning on E4.
09/03/88: At 1930 local time, strong signals were received from a Chinese station on channel R1. No sound could be detected. Figures could be made out at 1940. At 1955 there was a wrestling match and at 2005, boxing. Signals faded at 2015.
11/03/88: Bangkok TV on E3 between 1930 and 2020, possibly from Malaysia. The sound was English but very distorted; so were the pictures. Between 2145 and 2215, Bangkok TV was noted on channel E3. Heavy interferences were present over Delhi TV on channel E4.
13/03/88: Strong signals from Bangkok TV on channel E3 were received from 1930 with heavy intereference on channel E4. Commercials were heard at 2030, local time.

Mystery in India

Reception of UHF signals is a big event in India because they receive very few transmissions in Bands IV and V, though a high-power channel E41 transmitter operates. Unfortunately it is located well over 100 miles away in Dubai.

Rana suspects that a pirate TV station may be operating in his locality on channel E21 showing UK material. Initial reception coincided with a tropospheric lift during early January when a BBC-1 programme announcement caption appeared. More BBC-1 programmes have been received since then with good signal levels at times. On February 20th at 2100 local time Rana noted cartoons followed by the comedy series *Terry and June*. At 2230 signals began to fade and had completely disappeared by 2245. A caption from Yorkshire TV was also seen. Radiation from an illicit VCR signal transmitter, a videosender, could be responsible for the pirate transmissions.

Lichfield Leeds to Derby

Towards the end of March, Chris Howles (Lichfield), Kevin Jackson and Mark Dent (both from Leeds) came to Derby to discuss trends in DX activity. According to them periods of enhanced tropospheric reception seemed more frequent during the early seventies than they are today. Extreme long-distance sporadic-E reception from the Middle East seems to have occurred more often over the past few years than during the early seventies when it was considered a once in a lifetime event.

Filter for Band II

Chris Howles has recently indulged in a spot of DX spring-cleaning. He's been busy overhauling cables and equipment in preparation for the 1988 sporadic-E season. Chris is unfortunate in having the Sutton Coldfield transmitter virtually on his doorstep but interference from FM radio transmitters can create havoc even as far as 25 miles away. All traces of interference on Band II have been removed since he fitted an FM bandstop filter to prevent the FM radio band breaking through on channels IC and R4 (82.25MHz and 85.25MHz respectively).

An inexpensive but effective filter can be made using four turns of coaxial cable inner (sold copper) in series with a 0.30pF miniature preset trimming capacitor. The coil is air-spaced and approximately 6mm in diameter. Connect the series combination between the aerial output and ground, then adjust the preset trimmer for minimum interference on channel R4. Connect the filter ahead of any amplifier; this prevents overload.

Maybe interference is the reason why Band II is often ignored. This is a pity because it provides the only chance of receiving Bulgarian and Albanian TV via sporadic-E propagation. R5, the highest of the four channels found between 77 and 100MHz, is certainly prone to severe interference from the Western European FM radio band. The other three channels lie below the FM band and are reasonably clear, especially when filtered.

R5 and two of the clearer channels, R3 and R4, are used in Russia and Eastern Bloc countries. The fourth is channel IC which is allocated to Italy and Albania.

Simple aerial

An aerial consisting of a dipole cut to 82MHz (each rod 33in long) can be used for reception. If the boom of the Band I aerial is extended, the dipole can be mounted 30in in front of the last Band I director. This will, in effect, provide a two-element Band II array in which the last Band I director acts as a reflector for the Band II dipole. Many enthusiats are tempted to use their existing Band I array but results are usually poor and unpredictable because it is being used to receive frequencies which are too high for the design.

Band II channels are only active during periods of intense sporadic-E activity when the maximum usable frequency (muf) rises sufficiently. If Continental FM radio stations are heard during a sporadic-E opening, the muf will be high enough to receive Band II TV, providing the opening affects the appropriate countries. TV pictures in Band II are usually stable with a characteristic slow-fading effect. In fact, the results look very similar to those experienced with tropospheric DX reception.

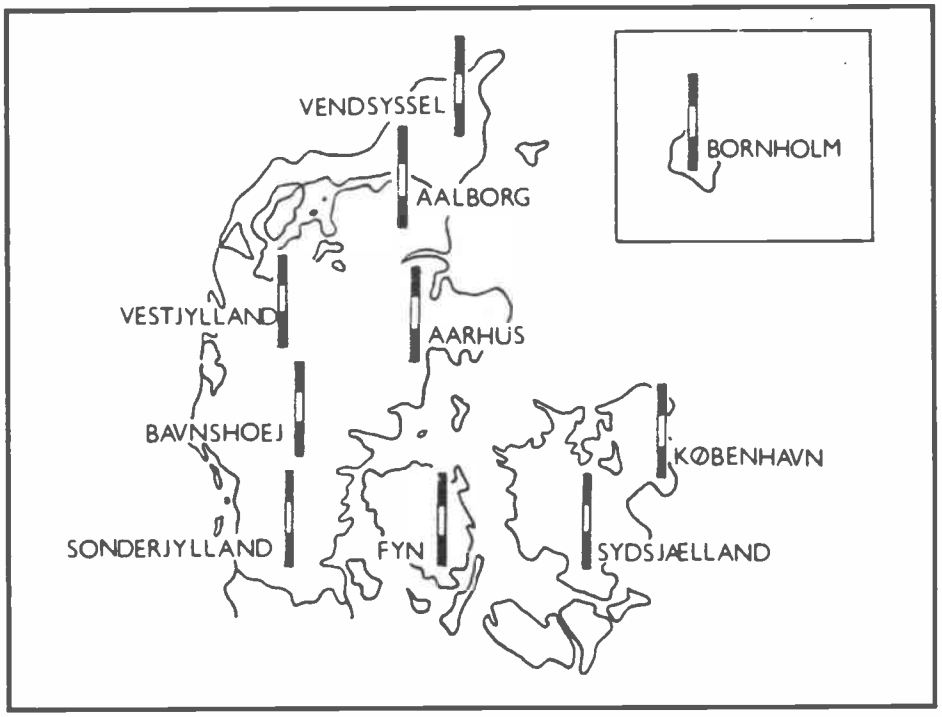
DX-TV map

An A4-size transmitter map for Bands I and II comes with a station list for the whole of the European area. It costs £2.00, including postage, from HS Publications, 7 Epping Close, Derby DE3 4HR. HS Publications can also supply aerial hardware and the D-100 DX-TV converter for Band II coverage.

Cuban test card

Jukka Kotovirta of Espoo in Finland was touring the sunspots of the Caribbean recently and has sent a photograph of the Cuban test card so we will know what to expect during the coming sporadic-E season. The national TV service, ICRT, uses the genuine UEIT (Russian) test card with the identification 'ICRT' at the top together with the time and date. Another picture was taken from breakfast news aired over Tele Rebelde (Rebel TV). Both stations operate in Band I and Jukka reckons they could be received in Europe.

Jukka says that the 1987 sporadic-E season was the most active he has ever witnessed. For example, he saw Saudi Arabia (Aramco TV) on channel E3 at least five times and, during a couple of



Danish 1st Network TV transmitter locations

high muf openings, Aramco Radio came through on 88.5MHz. When such reception occurred, there were vertical bars present on channel E4 – probably Bahrain which is only a few miles away. Unfortunately there was never any other test pattern shown which might have provided definite proof.

Jukka missed the two openings from across the Atlantic on June 19th and July 21st, but thinks reception would have been possible in Finland. An Espoo VHF ham noted Canadian amateurs at 50MHz on June 19th. Another amateur living at Pori in western Finland even worked a few 50MHz stations located in the USA (50/28MHz crossband) on June 17th during the late evening.

Service information

Syria: We have received details of the new second TV network operating in Syria. This network was noted operating on channel E21. The newscaster mentioned that broadcasts could also be picked up on VHF Band I channel E2 from a hilltop transmitter near Homs. Programmes consist mainly of imported films and documentaries. Programmes commence at 1700 UTC and close-down is at 2100 UTC (2300 local time). Captions are in English, not Arabic.

A new medium-power UHF transmitter has recently entered service on channel E26. It broadcasts SRT programmes (presumably the first network) in PAL colour as opposed to SECAM which is used by its other transmitters. We assume the transmissions are intended for neighbouring countries.

Turkey: Reports indicate that the Turkish TV service, TRT, is radiating the FuBK test card via the second network, minus the circle. The pattern can be shown with or without the digital clock.

Monaco: Although the Philips PM5544 test pattern is normally used for test transmissions, Tele-Monte-Carlo (TMC) is occasionally radiating the FuBK pattern with 'TELE MONTECARLO' identification before programmes begin.

India: Two low-power UHF transmitters entered service in Rajasthan during March, one of them at Pali. I do not know the location of the other, and I have no channel details.

Pakistan: Pakistan TV recently started breakfast television: a 45-minute programme contains news, morning exercises, cartoons and everything else you'd expect. Although the main test card is the PM5534, a black cross-hatched test pattern is sometimes shown.

Netherlands: The NED-3 network is now fully operational. The 'PTT NED-3' PM5544 is screened for most of the day but a 'NEDERLAND 3' version is shown for a few minutes before programmes commence. The opening caption is similar to the one used for NED-1 and NED-2 transmissions, namely a horizontal and vertical grey-scale/colour-bar pattern with the large network number in white to the right. Even the clock looks similar, except for the 'NEDERLAND 3' identification. Of greater importance is Loeki the Lion, the furry character shown between the adverts. He has joined the third network, much to the delight of some DX-TV enthusiasts.

Belgium: The identification in the lower rectangle of the RTBF-2 PM5544 has recently changed from 'TELE 2' to 'TELE 21'. The transmitter and channel number are now incorporated in the upper block.

Australia: There have been several rumours that TVQ-0 (a commercial TV station operating in Brisbane) will abandon channel 0 later this year. During the last sunspot maximum, which occurred in the late seventies and early eighties, signals on Australian channel 0 (46.25MHz vision and 51.75MHz sound) were received on numerous occasions in the UK. Closure will reduce the chances of such reception occurring again in the future. The only remaining channel 0 transmitter will be the ABC relay at Wagga Wagga (ABMN 0). The hopeful news is that TVQ-0 may simply swap frequencies with a channel 10 outlet at Toowoomba, a short distance inland from Brisbane.

Iceland: RUV now broadcasts seven days a week. Not so long ago there were no programmes on Thursdays, and during the late sixties and well into the seventies, RUV used to close down for several weeks during the summer, showing only the test card. A second (Pay-TV) channel entered service in October 1986 and it now has 20,000 subscribers. Both services carry commercials and there are an estimated 70,000 TV sets in use throughout Iceland.

Denmark: During April 1988, the new UHF transmitters at Copenhagen entered service. DR programmes are radiated on channel E31, TV-2 on E53. The DR Band I transmitter on channel E4 is expected to continue operating for a few more years. From January 1988, the 22kW DR transmitter at Vendsyssel has moved to channel E57 (formerly E51). Also, the low-power E30 relay at Vejle will close when the TV-2 transmitter at Hedensted enters service.

Location	Channel	ERP
Fyn	E3	10kW
København	E4	50kW
Aalborg	E5	50kW
Bornholm	E5	10kW
Bavvnshoej	E5	5kW
Sydsjaelland	E6	60kW
Sønderjylland	E7	60kW
Aarhus	E8	60kW
Vestjylland	E10	60kW
København	E31	600kW
Vendsyssel	E57	22kW

This month's information was kindly supplied by Gösta van der Linden (Rotterdam, Netherlands), the Benelux DX Club (Netherlands), Michael Summers Larsen (Odense, Denmark), Duncan Fraser (Upper Hutt, New Zealand), Major Rana Roy (Meerut, India), Charles Hage (Graz, Austria) and David Bocca Corsico Piccolino (Vigevano, Italy).

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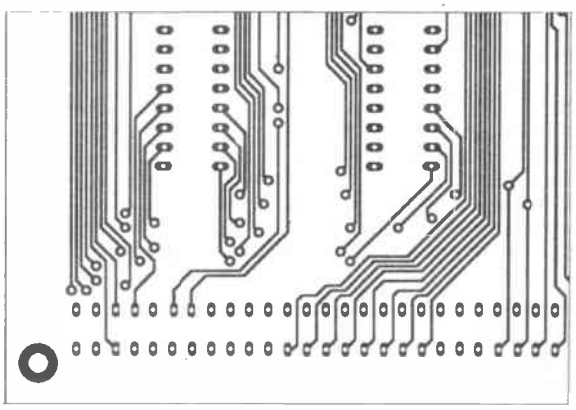

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ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

This month's news round-up is a real mixed bag with something for everyone.

New repeaters

No, not in Britain but in the Netherlands. It's certainly possible to contact Holland on 24cm (I've proved it), so you may work through these, or at least see them during the next tropo opening. PI6EHV has an input on 434.25MHz AM and its output on 1285MHz FM. Sited in Maarheze, its locator is JO21SK and is PA0SON's own personal project. It is just 40m above sea level. This corrects earlier information. A new repeater in the Hilversum district,PI6ATV, is located at CM67J, which is the same as JO22PE. Its input is on 2359MHz, output is on 1285MHz, both FM of course. Hans Holsink PE1CKK looks after this one and would doubtless be happy to send you a QSL if you manage to see his machine. Thanks to Paul PA0SON for this info.

900MHz TV

'900MHz ATV is the next way to go,' says Tom O'Hara W60RG of PC Electronics. Unfortunately for us, the opportunity is open only to hams in North America, but there's no harm in daydreaming. As a prelude to our American ATV report here is a survey of commercial goodies available to American ATVers. If nothing else, it will be instructive to look at ATV from a different viewpoint.

Why 900MHz? Cost is one answer. Thanks to cellular radio, price and availability of semiconductors, antennas and other parts for this band are excellent. Compare the costs of 33cm and 70cm modules and you will see that 900MHz components cost only 10 to 20% more on average. 1200MHz parts are comparatively expensive and hard to obtain. An equivalent 1W 23cm final is three times the price of a 33cm one. We use standard broadcast AM, so it only takes a downconverter ahead of any TV set tuned to channels 2, 3 or 4 rather than an additional receiver costing over $200 for FM. AM is still best for weak signal DX ATV.

Ease of assembly is another reason. Anyone who has put together a 70cm system should be able to assemble a 33cm system the same way. PC Electronics now has all the modules for a basic 1W system, and three other companies are developing linear amplifiers.

Performance

All things being equal, a 33cm system has 6dB more path loss than a 70cm system, but almost 3dB less than a 23cm one. Co-ax loss is of course less than on 23cm, and in most areas there is little interference from other services and radar. To give 70cm picture quality, the 6dB is easily made up in the higher gain of smaller antennas and/or by mounting the downconverter at the antenna. Compare the cost of a 16.3dBd Tonna yagi to a 14dBd gain 70cm one: you can almost put up dual 33cm yagis for the price of a single 70cm one. Snow-free line-of-sight DX with 1W and single Tonna yagis at each end is 10 miles; with a 7dB omni and an 18W amplifier in the repeater, it's 20 miles. These figures assume 4dB feeder loss: you would get greater DX of course with lower-loss co-ax and an antenna-mounted down-converter.

Best of all, full duplex ATV is now possible. You can talk and see each other by transmitting on one band (70cm), receiving on the other (33cm). Using one of the 70cm transmitters, there are no harmonics of the 108MHz crystals that fall into the 33cm band, so you probably won't need any special filtering to transmit at the same time as receiving the other band. You can usually avoid front-end overload with a vertical antenna separation of just 8ft. Be a repeater yourself.

Crossband repeater

The loss of 420-430MHz near the Canadian border has left some amateurs with problems: interference from FM repeaters, radar and the fact that an in-band repeater doesn't allow simplex without interference. Crossband repeat to 900MHz is an answer. You not only free one of the 70cm frequencies for simplex, you can also see your own video coming back to you and make adjustments without someone else's opinion.

In case you are wondering how much all the equipment costs, here is a quick rundown. The 1W (peak sync) vision transmitter costs $139: audio subcarrier costs an extra $29. A GaAs FET receive converter (to VHF channels, 2, 3 or 4) is $69 bare or $109 cased, and the Tonna 23-element yagi costs $59. All prices include delivery within the USA and with nearly two dollars to the pound look by no means dear.

Frequencies used for simplex ATV are 910.25 and 911.25MHz, while repeater output is on 923.25MHz. In Britain, of course, these frequencies fall within the cellular radio allocation, but in America this is not the case. Because the UHF band is not used so much for broadcast TV (VHF covers the larger distances better), cellular radio is accommodated on the 800MHz band rather than on 900MHz. This leaves room for a healthy amateur band from 902-928MHz.

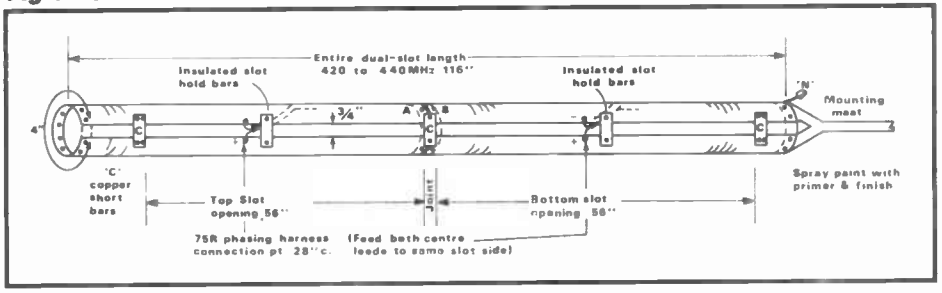
A true horizontal omni for 70cm

This is the antenna they said couldn't be built, according to Mike Stone WB0QCD, who has kindly given permission for us to share this remarkable design. It was first published in the January 1988 issue of *Spec-Comm*, which Mike edits and publishes. The antenna is a modified Alford Slot and gives 5 to 6dB omnidirectional gain, horizontally polarised. This version is by Merle Reynolds W9DNT of Moline, Illinois and costs about £15 to build. He has built eight of them, and they are used on the Davenport, Iowa, ATV repeater with great success. They handle the 100W power and 421/439MHz separation with ease, and have out-performed stacked dipoles, big wheels, bow-ties and stacked beams.

Common tinned stovepipe was chosen as the main constructional material; undoubtedly copper or brass would be better, but more expensive and difficult to find. Tinned steel is cheap, easy to work and withstands the weather well. Plastic PVC pipe support pieces are attached at the top, middle (joint) and bottom areas to give extra strength. Both insulated material and copper conductive support and shorting bars are used across the slot opening to hold it in place at exactly 3/4in. You can also use 3in or 3.5in pipe stock, if you change the slot opening to 1/2in. Any circumference from 3/8 to 1/2 wavelength will work and remain truely omnidirectional. Any less, and gain and null lobes start to appear.

The calculation of the 75 to 50 ohm phasing harness uses the standard formula shown in the diagram. Special care must be taken to solder and seal all co-axial connection points. The finished

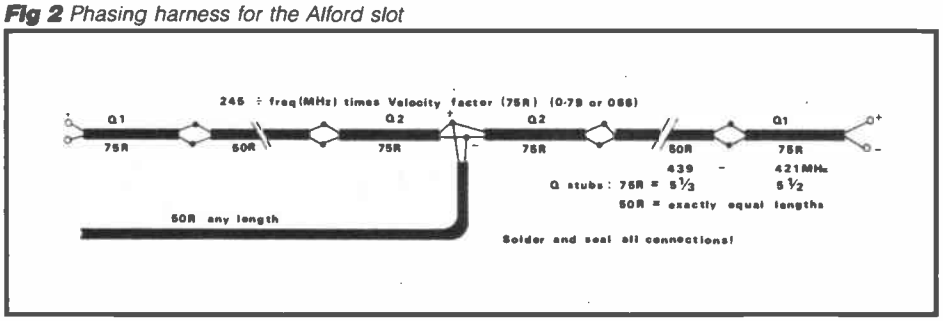
Fig 1 *W9DNT Alford Slot UHF*



array is admittedly lengthy, and on the Davenport installation a PVC pipe extender arm protrudes from the top of the antenna. Non-conductive guy ropes hold the structue in place as it is top-heavy. Side-mounting from a tower would introduce nulls and it is recommended that this antenna is mounted topmost.

If you decide to build this, please drop me a line and I'll pass on the news to Merle. I welcome all activity reports that were sent in.

Fig 2 *Phasing harness for the Alford slot*



NETWORK 934

Andy Emmerson G9BUP

Optimising your antenna

Given the number of 934MHz restrictions, it makes sense to get the most out of your system. Transceiver power levels are set by regulations, power amplifiers are not allowed, so what is there to alter? The antenna and its feeder to the rig. Take the trouble to optimise them; and by optimise, I mean getting things *exactly* right. Sometimes the position of the antenna and the way it's connected are more important than its size, cost and number of elements.

The greater the numbers of elements on an antenna, the greater the gain. Most textbooks tell you that antenna gain is everything; it gives you extra clout on transmit and boosts received signals as well. Fabulous, something for nothing? Well, almost. Too much gain can actually be a hindrance, not a help. Too much gain could be the reason why some users of the band are not getting the best results.

Hoses help you visualise

Before analysing what happens with too much gain, let's define gain. Gain is a measure of signal improvement. In the same way, signal loss represents throwing away some of your transmitted or received signal. Gain is measured logarithmically. A gain of 13dB means that your transmitted signal will appear to be improved by a factor of 20. Your received signals will also be improved by a factor of 20.

Advertisements frequently quote gain figures, but it isn't always clear that this applies only in one particular direction: the gain is focussed into a beam. A yagi antenna has its gain focussed in one direction, similar to a horizontal garden hose where all the water hits the plant you are spraying. Omnidirectional antennas, such as collinears, are a little different. You might think that magic is involved, after all you are getting all-round radiation as well as gain, but there is a trade-off.

The lighthouse effect

Think of a stationary lawn sprinkler. Water usually comes out in all directions and quite a lot goes straight up in the air. If, however, you were to block off some of the holes in the middle, the water would tend to come out only at the side and with more pressure. Collinears don't waste signal going straight up into the sky but try to squirt it all at the horizon. This creates one problem.

Think back to the lawn sprinkler. If you force all the water out sideways at high pressure, the grass right beneath the sprinkler doesn't get wet. The same can happen if you are directing your signal too far out at the horizon. It is known as the lighthouse effect. People standing right beneath a lighthouse do not get the benefit of the light because it is coming out sideways, straight over their heads.

Multi-elements v biconicals

What problems might we encounter by having too much gain? Let's take three cases: a mobile installation, a homebase collinear and a homebase yagi beam.

When choosing a mobile antenna, most users go for the one with the highest gain. These are the most expensive (and impressive-looking) and it does seem logical to go for the best aerial on the market. If most of your mobile operation is in fact static mobile from hilltops, one of these multi-element jobs is indeed a wise choice. But for proper mobile use it is not: you are likely to drive through dips and other obstructed areas where you do not want all your gain concentrated on a narrow part of the horizon. You'll need to trade-off some of that gain and go for an antenna with a wider angle of radiation and lower gain. Nevada Communications of Portsmouth sells two such antennas. Other models on the market follow the same philosophy. In Japan and Switzerland the so-called biconical antenna is popular despite its strange shape – a bit like two discones. Biconical antennas also have a broad radiation and reception angle. When in doubt look at what the professionals do: cellular radio fitters never use high-gain antennas because they know that some reception in all kinds of terrain is more important than high gain in ideal locations.

Collinear compromises

Homebase collinears have some similiarities with mobile antennas. It is tempting to go for the highest gain to get omnidirectional coverage. Most of the collinears available in the UK have a gain of about 7dBi, achieved with three ⅝-wave elements: a wise compromise between directivity and gain. Another option is the seven half-wave element collinear available through Selectronic, the gain of 7.14dBi is almost the same, but it has a wider vertical angle and covers a smaller ground area. This antenna comes into its own if you live in a bit of a dip, when the broader vertical angle is vital. See how it's always a compromise.

Off-beam yagis

The trade-off with yagis or beam antennas is also obvious: the greater the gain the narrower the beamwidth. In other words, signals will come in stronger when you are pointing straight at the station but you will hear less off the side of the beam. A lower gain means you will pick up more stations, you will find it easier to beam on to stations and you will reduce the risk of not hearing some stations at all. Too much gain can cause other problems which are usually interpreted as something quite different.

The cellular spectre

Operators who are more enlightened accept that some of their so-called intereference problems are actually shortcomings in the rig. Some transceivers are unable to reject strong off-frequency signals and cause spurious reception on certain channels. This is often put down to cellular radio. Cellular is an easy target: I have investigated several cases and in none of them was cellular the true cause. The telephone calls, which were supposed to have been overheard, were not phone calls by normal broadcast radio chitchat.

Any strong radio/TV signal can get into an inadequately designed transceiver. Excessive antenna gain is sometimes the cause; another culprit is unsuitable preamplifiers. Changing to a yagi with a

low gain cures the problem miraculously and may have the other benefits described earlier.

On the other hand, there is no denying that some interference problems are due to the proximity of the dreaded 'Voodoophone' transmitters on closely adjacent frequencies. In these cases there is no magic solution. The so-called interference filters do work very well, because they don't just reduce the strength of unwanted interference, they reduce the strength of wanted (934MHz) signals as well. I haven't heard so many complaints of cellular interference lately, but I suspect this is because the people worst-affected have sold up and found some other band or hobby. This is a shame.

Position is crucial

The position of an antenna and the way it is connected to the transceiver are very important if all the signal is to be transferred from one end of the feeder to the other. Antennas should be in the clear, out of the way of clutter and obstructions. Homebase antennas should be as high as possible above the roof-line; any obstruction will stop the signals from getting in and out. A pole similar to a television aerial standard is fine, fixed either to the chimney or on a wall bracket. The 934MHz antenna should be fixed higher than any other antennas.

On mobile installations it is crucial to get things right because the antenna doesn't have the height advantage of a homebase set-up. The 'hedgehog car' (*Figure 1*) shows some of the possible positions for a 934MHz antenna. Position 1 is the best, using a magnetic mount. The roof of the car makes a good ground-plane and the central position means that gain will be equal in all directions. A gutter-mount (position 2) is not ideal because the antenna gets only half a ground-plane. Fittings 3, 4, 5 and 8 suffer from the same problem. Poles such as 6 and 7 are not so bad, but the radials on the antenna do not make such a good ground-plane. Also it may not be possible to mount the pole properly vertical.

Figure 2 shows how important it is to mount an antenna vertically. A vertical antenna produces a nice radiation pattern, with plenty of power leaving the antenna parallel to the ground. Tilt it 45°, as though it had drooped, and nearly all the radiation goes straight up into the sky. What a waste! If you make a few contacts with an aerial in that state, think how many more you might make if the antenna were properly installed.

The feeder is also important: you want a cable which offers the least resistance to radio signals. Sharp bends in the cables, deformation where it has been trapped in a door, or poorly made soldered joints in the connectors will inevitably lose signal.

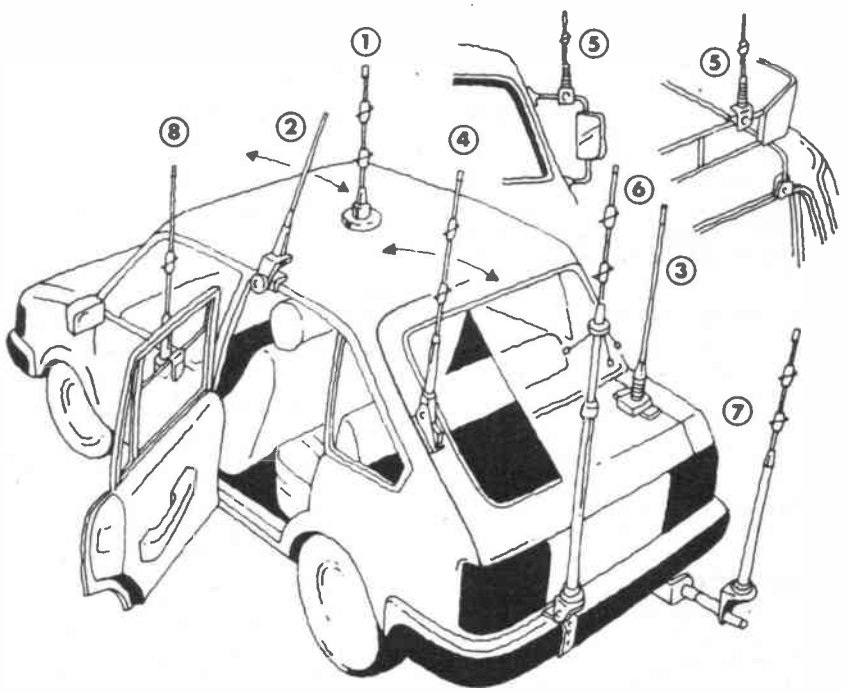


Fig 1

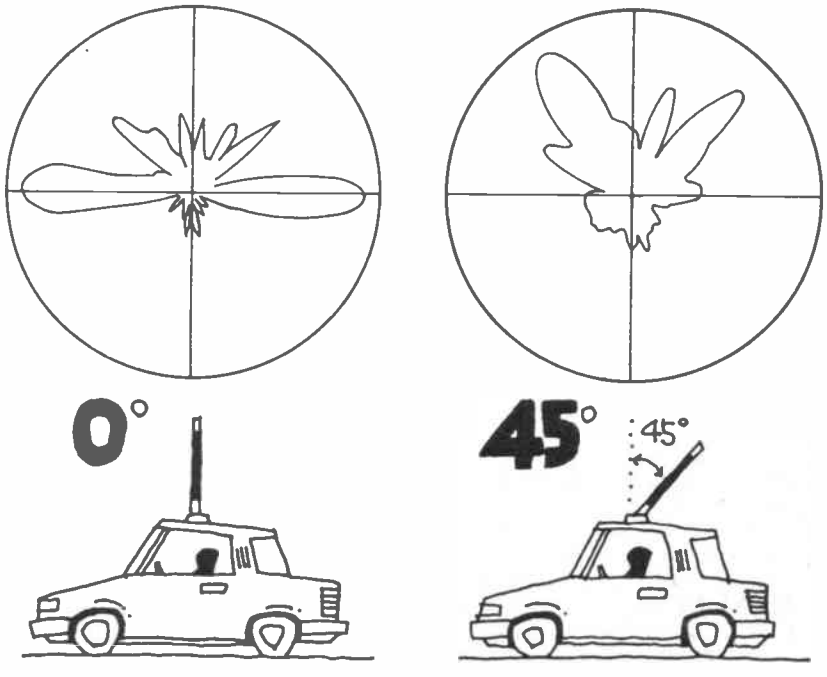


Fig 2

Don't be bamboozled

I hope this has shed some light on the mysteries of optimising your system. If not, write in and say so. I am always pleased to deal with any queries, or at least to try. Before you buy another antenna, work out exactly what you want it to do. Don't be bamboozled into buying the biggest and best in the shop: a good dealer will always be happy to advise you; and remember, small is sometimes beautiful.

MEDIUM WAVE DXING

by Steve Whitt

Summer is usually a slack time for MW DXing, and this year with the spectre of rapidly increasing solar activity, I wouldn't blame you if you abandoned your radio for the sunshine. Hence, this month I have a rather unusual mix of topics for the MW listener.

More great circles

In the January issue of this column I briefly explained how to calculate the great circle distance between your listening location and anywhere in the world. The formula I used was chosen because of its simplicity (it's easy to handle the calculation on a pocket calculator) but it made the assumption that the earth was spherical in shape, when in fact the globe is slightly flattened at the poles. The polar circumference is 39,936km whereas that of the equator is 40,074km.

The original formula assumes the average circumference of the earth to be 40,000km and this can lead to an error of about ½%. This is OK for many purposes but for the purist something better is required. Although it's immediately obvious that a correction is needed for the elliptic shape of the earth this is only directly responsible for a small part of the error. A rather larger error arises because there is an over simplification of the way in which the latitude calculation is made.

Since space is limited and the necessary calculation quite complex, I have written a short computer program in BASIC that will repeatedly calculate great circle distances accurate to about 0.2%, representing an error of about 40km on a contact between London and New Zealand. With additional corrections the best accuracy one can get is around 0.1% since calculations are complicated by the fact that the earth isn't smooth (you might conceivably be 1,000m up a mountain) and isn't an exact ellipse.

The program was written and tested on an Amstrad PCW8256 but since it contains no clever tricks it should work on most computers with BASIC. If you would like a copy please send an SAE and two 13p stamps to Steve Whitt c/o the R&EW offices.

Double trouble

Some purists will argue that what follows isn't MW DXing at all but nevertheless it can still give an interesting insight into MW listening. As you may have guessed from the heading I intend to take a brief look at second harmonics radiated from broadcast transmitters.

A radio station's MW transmitter is a bit like a hi-fi amplifier at home – only substantially more powerful. Both amplifiers suffer from harmonic distortion in which unwanted signals are created at an exact multiple of the input frequency. In a good hi-fi the distortion might be stated as 0.5%, a figure which is rarely matched in a powerful transmitter. Just consider ½% of a megawatt; that still leaves 5,000W of unwanted signals which would cause serious interference if they were actually radiated.

Normally equipment manufacturers and station engineers do their best to filter or suppress these harmonics but sometimes poor maintenance or lack of spares causes the signal to reach the aerial. This is when things become interesting to the MW DXer. Generally harmonics are of quite low power but they can often be heard over a great distance for two reasons. Firstly, they appear on frequencies which are not congested with other broadcast stations (1600-3200kHz) and secondly, these higher frequencies can be subject to propagation conditions quite unlike those affecting the normal MW channels. In this way it is sometimes possible to hear a MW station that would otherwise be totally inaudible.

Remember when looking for such signals that they may come and go on an irregular basis, eg after the transmitter has been serviced. In the recent past the following have been reported:

1872 (2×936) Unidentified Thai station heard in India and beyond.

2322 (2×1161) Bulgaria noted here.

2340 (2×1170) Radio Orwell, Ipswich; weak harmonic sometimes audible a few miles from transmitter.

2340 Breffni Community Radio, Kilnaleck, Eire; powerful signal heard all over Europe.

2916 (2×1458) Radio Tirana, Albania; sometimes noted in England.

These are just some ideas to try out; you may well hear something different. If so, do drop me a line and let me know what you heard and when.

Newsdesk

Algeria: 1355 National Radio of the Saharan Arab Democratic Republic reported on air 2000-2400 with Arabic until 2315 followed by Spanish. The 1355 channel has been joined by 576, a channel used by the Algerian Arabic service and the Polisario Front's Voice of the Free Sahara service.

Eire: 657kHz – Breffni Regional Radio is here (formerly 1170).

738kHz – Energy 103 closed down on 11th March after nearly two years on air. A few hours later the frequency was taken over by Q102 in parallel with 819kHz. This involved the movement of studio link transmitters from the Energy studio to that of Q102. The 738kHz transmitter is on low power and may soon be relocated.

837kHz – KITS FM Co, Monaghan is new here with low power.

954kHz – Hits 954 Limerick closed down on 8th April, but a blank carrier still left on 954kHz.

1008kHz – KISS-FM have started normal programmes but have had some technical problems. Address: Unit 2, The Mall, Old Cross Square, Monaghan Town, Monaghan. Heard with massive AM (and FM) signals in England.

1008kHz – North Dublin CR is still active here despite KISS-FM.

1071kHz – Longford CR is closing down; equipment is up for sale.

1125kHz – Radio Luimni, Limerick, rumoured to be about to close down.

1170kHz – NWCR Buncrana is here now (formerly 1008; driven away by KISS-FM).

1242kHz – WABC Co Donegal should be back here from late April.

1278kHz – Millenium 88 is licensed till 30th October 1988 and has plans to increase its FM power to 1kW. This is not a pirate station but an arm of RTE set up to celebrate the 1,000th anniversary of the City of Dublin.

1386kHz – Kandy Radio, Ballinasloe, has closed down owing to lack of funds.

1404kHz – Galway District Radio, Loughrea, has closed down; no money left!

1413kHz – Kildare CR may be operating only on Sundays (was full-time).

1566kHz – Coast 103 (Co Galway) is now full-time with improved signal.

The Irish situation changes from week to week, so there's certainly enough to keep the DXer busy throughout the summer.

Sweden: Radio Sweden International is celebrating its 50th anniversary in 1988. On 1179kHz it has English programmes at 1700, 2100 and 2300 during the summer.

United Kingdom: *BBC* Somerset Sound broadcasts 2½ hours per day as an opt out from BBC Radio Bristol. It is on MW only using studios at Taunton 0730-1000hrs. Address: 14-15 Paul St, Taunton TA1 3PF.

IBA Yorkshire Radio Network, an amalgamation of Radio Hallam, Pennine

Radio and Viking Radio, is celebrating its first anniversary. It produces a network programme that is carried by all three stations throughout the night; this is cheaper than each station producing separate material.

Capital Radio, London, will be completely changing its programming as the first stage in the process of splitting its MW and FM services. Two separate 24hr AM and FM services are expected by the autumn. The MW service will be renamed Classic Capital 1548 and will be an 'all gold' format.

County Sound, Guildford, is also splitting AM and FM services; from 1st June County Sound Gold will be on 1476kHz, initially from 0600-1800 (local time) daily.

Pirate: Storeton Community Radio (Liverpool) has closed down permanently after several years of activity. It used to be fairly regular on 1026kHz but raids and the difficulty of finding suitable sites has made continued operation impractical.

USA: WHAS, Louisville Kentucky, now has a regular phone-in show hosted by a DXer and aimed at the avid radio listener. Ted Fleischaker (a member of International Radio Club of America) now hosts a unique three-hour call-in show every Friday night at 2200-0100hrs Eastern Local Time. During the programme WHAS hopes to hear from listeners calling in about reception and as an incentive they may give out a prize to the farthest caller each month. They have a free 1-800 telephone number but it's not much use to DXers outside the USA.

WHAS can be heard on 840kHz when DX conditions to the USA are favourable; if you do hear them on a Friday why not give Ted a call or drop them a line with a reception report.

The Federal Communications Commission is exploring the possibility of creating up to nine national AM radio channels within the next two years, and is considering licensing a single body to operate each channel nationally. At the end of February the FCC voted to open a fourth public enquiry into a possible expansion of the AM band from 1605 to 1705kHz, which has a target date of 1st July 1990.

Long Wave update

Since the April feature on Long Waves, the last station due to shift frequency on 1st February has finally moved to its new assigned channel.

Radio Monte Carlo made the move from 218 to 216kHz in mid-March. Meanwhile a heterodyne is still present on 200kHz and in addition to that there seems to be a weak unidentified station on 225 behind Poland.

DX file

Spring time DX this year has been depressingly poor so in order to hear something interesting I boarded a Jumbo 747 bound for Miami. Before you cast doubts upon my sanity I should say that I was in Florida on business (and extended holiday) so I made sure that I was equipped with my Sony ICF2001D portable.

Whilst I was in Key West I took the opportunity to visit several stations. One station I called in to was WKWF (this was a rare DX catch that I heard in Scotland on DXpedition in November last year) but to my surprise there was no station in existence.

It transpired that WKWF is just a box of electronics relaying a programme fed via satellite from Chicago. Of course the automated system inserts pre-recorded local identification so that the listener is left none the wiser! In actual fact WKWF is little brother to the largest FM station in Key West which, I guess, wanted to earn some easy money from its AM frequency. Quite why they were so successful was hard to fathom as they seemed incredibly disorganised.

In a small shack, just a few blocks down the road, I found WKIZ which was a complete contrast to WKWF. This family run and operated station really tried to be part of the community and I was warmly welcomed. What was supposed to be a brief visit turned into a tour of the studios and transmitters with an introduction to everyone on hand. Eventually, I exited into the Florida sunshine weighed down with T-shirts, posters and other goodies which the station gave me as parting gifts. REW

SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin All times in UTC, **bold** figures indicate the frequency in kHz

Continuing the update of Latin American stations currently active on the 90m Tropical Band (**3200** to **3400**), readers are reminded that in most instances only the station closing times are specified. Although LA transmitters do operate during our daylight hours, their signals will not be heard here in the UK. Our night-time periods, when the signal path is mostly in darkness, present the maximum opportunity for logging such transmissions.

Listen for these

Radio Maya de Barillas, Huehuetenango, Guatemala on or around **3324.8** signs off at 0330. The power is 1kW and the language used is Spanish.

Radio Liberal, Belem, Brazil is listed as working in Portuguese around the clock on **3325** but in fact slightly varies in frequency either side of that specified. With a power of 5kW it is frequently heard and reported by DXers worldwide.

Varying in frequency from **3324.6** to **3325** is Ondas Quevedenas in Quevedo, Ecuador. Using Spanish and Quechua, it closes around 0530, has a power of 1.5W but unfortunately is on the air irregularly.

Radio Difusora Universitaria, Guarulhos, Brazil closes at 0300 on **3325**. The power is 2.5kW and the language Portuguese.

The Peruvian Ondas Huallaga in Huanuco switches off its 0.5kW transmitter some time around 0500 after programming in Spanish and Quecua on **3329.6**. This one is only rarely heard in our part of the globe.

The 1kW Brazilian station Radio Alvorada, Londrina signs off at 0200 on Sunday and at 0300 weekdays on **3335**, the language being Portuguese.

Radio Altura, Cerro de Pasco, Peru on **3339.6** at 1kW signs off around 0500 on Saturday and Sunday, Monday to Friday at 0630. The identification is 'Transmite Radio Altura en onda corta tropical OBZ4B 3340kHz, banda de 90 metros, desde Cerro de Pasco, Peruana'.

In Viloco, Bolivia, Radio Viloco at 1kW operates in Spanish on **3340.1** closing at 0200. It is rarely heard far from signal source.

The Bolivian station Radio 27 de Diciembre in Villamontes is on **3349.3** until sign off at 0200. At 1kW it radiates Spanish programmes to the local community, being only rarely heard here in Europe.

In Sucua, Ecuador the 10kW Radio Federacion on **3360** carries programmes in Spanish and Quechua until close around 0400, identifying as 'Emisora Cultural, Radio Federacion, en 3360kHz, la banda de 90 metros y 4960kHz en la banda internacionale de 60 metros'.

La Voz de Nahuala, Nahuala in Guatemala is on **3360.3** closing around 0300. At 1kW, it programmes in Spanish.

Radio Cultura, Araraquara, Brazil at 1kW transmits a 24-hour schedule in Portuguese on **3365**. It is probably planning to increase power.

The frequency **3370** presents a problem for DXers: there are no fewer than three transmitters radiating Spanish language programmes, the first of which is located in Coban, Guatemala. The 1kW Radio Tezulutlan signs off at 0230, often being reported by DXers. Radio Florida, Samaipata, Bolivia et 1kW closes around 0030 and the 5kW Radio Lircay, Lircay in Peru signs off at 0430 but in addition to Spanish uses Quechua, the official language of the Inca Empire.

The Bolivian 1kW station Radio Nuevo Mundo in Sucre is in Spanish until 0300 on Saturday and Sunday and until 0130 on weekdays on **3372.3**. The identification is 'Desde la ciudad de los cuatro nombres, un nobre para los cuatro puntos cardinales de Bolivia, Nuevo Mundo de Sucre, onda corta 3375kHz'.

The frequency **3375** is used by two Brazilian transmitters thereby presenting a confusion hazard to DXers. Mostly reported is Radio Educadora, Guajara Mirim which, at 5kW, closes at 0200. Unfortunately it signs off at the same time as the 5kW Radio Ecuatorial in Macapa, both stations programming in Portuguese.

Radio Cumbre, Tazna, Bolivia at 1kW operates in Spanish on **3380.3**, closing around 0400. Its signals are occasionally heard here in Europe.

The rarely heard Radio Chortis Jocotan in Chiquimla, Guatemala on **3380.1** has a power of 1kW, uses the Spanish language and closes at 0300.

One of the most frequently reported Latin American stations on the 90m band is Radio Iris in Esmeraldas. It can be located on **3381** although its frequency is apt to vary slightly on occasions. The power is 5kW. Using both the Spanish and Quechua languages, it identifies as 'La Voz de los Campesinos', literally 'the voice from the country folk', ie rural folk. It closes at 0400 (Sunday at 0100).

Radio Camargo in the Bolivian town of that name programmes entirely in Spanish on **3390** at 1kW, signing off around 0200. It rarely appears in DX reports.

Radio Zaracay, Santo Domingo de los Colorados occupies **3394.8** where it radiates programmes in Spanish and Quechua with a power of 10kW, closing around 0600. The station derives its name from Zaracay, an old and much repected chief of the local colourfully clothed Colorado Indian tribe, the males of which apply to their hair red dye made from seeds of the achiote plant.

Lastly, on **3400** is the 1kW Radio Difusora de Agosto, Xapori, Brazil, programming in Portuguese until sign-off at 0200.

ON THE AIR

Have you got your receiver working? Have you got your *Radio and Electronics World* open at Short Wave News? You have. Are you sitting comfortably? You are. Well then, see how many of these stations you can log.

AFRICA

Equatorial Guinea

Radio Nacionale, Bata on **5004** at 2156 when signing off with an orchestral rendition of the National Anthem. Radio Nacional has also been heard on **6249.4** at 2146 when transmitting a programme of highlife music and songs in Spanish. Highlife is that term used by DXers when reporting the distinctive fast and rhythmic music of the locality.

Chad

Nd'jamena on **4905** at 0506, songs in vernacular with highlife music backing. The Home Service in French and vernaculars is scheduled from 0455 to 0730 (Sunday until 0700) and from 1600 to 2200 (Saturday to 2300), the power being 100kW.

Liberia

VOA (Voice of America) Monrovia on **17870** at 1854, an interesting talk about the latest developments in science during an English programme for Central Africa, timed from 1600 to 2100 on this channel.

Kenya

Nairobi on **4885** at 2105, a talk, some songs, OM with the station identification, epilogue, the identification again then a choral version of the National Anthem, all in Swahili, then carrier off. The National Service in Swahili is scheduled from 1830 to 2110.

The Voice of Kenya, Nairobi on **4935** at 1845, a discussion about child welfare in Kenya, the station identification and a programme preview, all in English.

Mauritania

Nouakchott on **4845** at 2026, some announcements, some stringed instrumental music followed by a newscast with many local and world place names, all in Arabic. The

Home Service in vernaculars, French and Arabic is timed from 0600 to 0830 and from 1800 to 2400 Saturday to Thursday inclusive (Friday from 1700 to 2400) with a power of 100kW.

Morocco

VOA Tangier on **9760** at 1705, a news bulletin followed by comments on current world events during the English presentation to Europe, timed from 1700 to 2200.

Rabat on **17815** at 1750 when featuring a talk about Islam, OM with the Rabat identification then a newscast in the English programme for Europe, scheduled from 1730 to 1830.

Zimbabwe

Harare on **3306** at 1823, OMs with a discussion in vernacular in a Radio 2 programme. Harare is on the air in Shona, Ndebele and English from 0325 (Saturday and Sunday from 0400) to 0615 and from 1545 to 2020 (Saturday until 2050). From Sunday to Thursday inclusive, Harare relays Radio 3 programmes which include English newscasts from Radio 1 0400, 0500, 0600, 1600, 1745 and at 2000. The power is 20kW.

CENTRAL AMERICA

Antigua

BBC Relay on **9640** at 0603, a news bulletin in the English transmission to Central America, timed from 0600 to 0815.

Costa Rica

Radio Impacto, San Jose on **5030** at 0556, OM with the full station identification in Spanish followed by an orchestral rendition of the National Anthem, some announcements, the identification again and off at 0559.

Netherlands Antilles

Radio Nederlands Relay, Bonaire on **9715** at 0543, a newscast in the English programme for West North America, scheduled from 0530 to 0625.

NORTH AMERICA

Canada

CBC Montreal on **9625** at 1212, OM with the news followed by the station identification, time-check, local weather forecast then a talk about Chinese politicians. All in an English transmission to Canada, the USA, Pacific and the Caribbean areas. This English/French programme is timed from 1200 to 0610 daily.

USA

WYFR Florida on **9815** at 0643, OM with a religious talk in English, YL with the station identification and a request for listeners reports. Also heard in parallel on **7355.**

SOUTH AMERICA

Argentine

Radio Rivadavia on **9115** at 2140, OM with a talk in Spanish. Transmissions in the USB mode are made on this out of band frequency from 1400 to 2400, the power being 0.5kW.

Bolivia

Radio Nueva America, La Paz on **4795** at 0357, OM with announcements in Spanish, the station identification and off without the Himno Nacionale (National Anthem) at 0359. This 1kW transmitter is on the air from 1000 to 1310 varying to 1810 and from a sign-on varying from 2000 to 2200 to a sign-off at 0400 variable. The Sunday schedule is from 1000 to 2245.

Brazil

Radio Nacional, Brasilia on **9760** at 0548, OM with the station identification, some local-style music, the identification repeated at the end of a Portuguese programme for Africa (announced) then suddenly off at 0549.

Chile

Santiago on **15140** at 2142, OM with a sports commentary in Spanish in a programme for South American consumption. The schedule is from 1000 to 0400 with a power of 100kW.

Ecuador

Radio Iris, Esmeraldas on **3381** at 0252, announcements in Spanish followed by a pasillo (slow sad folk song). This station operates from 1000 to 1300 and from 2100 to 0400 with a power of 5kW.

Venezuela

Radio Tachira, San Cristobal on **4830** at 0353, OM with the station identification in Spanish, choral version of the National Anthem followed by the state anthem and off. The schedule is from 0900 (Sunday from 1000) through to 0400 (Sunday until 0300) at 10kW.

ASIA

China

CPBS (Chinese People's Broadcasting Station) Beijing on **4190** at 2118, with songs and music. This transmitter is scheduled to relay the Radio Beijing Minority Language Service in Korean and Mongolian from 1100 to 1155 and in Mongolian from 2000 to 2125 with a power of 50kW.

United Arab Emirates

Abu Dhabi on **21700** at 0555 featuring a talk about Zionism, followed by the station identification and the National Anthem at the end of the English programme directed to East Asia from 0415 to 0600.

SOUTH-EAST ASIA

Indonesia

The 50kW RRI Jakarta on **9680** at 1343, announcements, songs and music in the Indonesian programme timed from 1000 to 1705.

North Korea

Radio Pyongyang on **9325** at 1340, presenting a talk followed by the station identification in the English transmission for Europe, scheduled from 1300 to 1400. Also heard in parallel on **9345** with better reception.

Philippines

VOA Poro on **9660** at 1438, a talk in the Mandarin (Standard Chinese) programme directed to south-east Asia and scheduled from 1100 to 1500.

EUROPE

Poland

Warsaw on **15120** at 0633, OM with a talk about the Polish economy during the English programme for Europe, from 0630 to 0700.

Romania

Bucharest on **15250** at 0645, the station identification and announcements followed by a newscast of local events. This English programme is directed to Australia and is timed from 0645 to 0710 daily.

Switzerland

Berne on **9560** at 0855, YL with a talk about opera productions in Switzerland. This English transmission is for Eastern Australia, and it is usually timed from 0830 to 0900.

PACIFIC

Australia

Shepparton on **9655** at 0858, announcements, the station identification, six pips time-check then a news bulletin during the English programme for Europe and the south Pacific, scheduled from 0700 to 1030 daily.

CLANDESTINE

Radio Caiman (Alligator) on **9940** at 2227, OM with a talk in Spanish having several mentions of Cuba then the station identification followed by a series of chimes, all in a CID (Cuba Independiente Democratica) programme for Central America, timed from 1200 to 0700. The transmitter for this station is located in Guatemala.

Receiver shopping list

Since the last issue of this interesting and useful publication in November 1986, several new communication receivers have appeared on the market, and the next issue, May 1988, contains an update. Details of older receivers have been deleted.

The receivers surveyed are mainly designed for international listening. Models are either currently on the world market or have been recently discontinued.

Some of the receivers included are the Grundig Satelit 400, Kenwood R-5000 (revised evaluation), Kenwood RZ-1, Panasonic RFB-40L, Sangean ATS-803A and MS-101, Silver XF-2400, Sony receivers WA-6000, WA-8800, ICF-7601, ICF-7600DA, ICF-7600DS, ICF-2003, ICF-7700, SW1-S and CRF-350 and the Tandy DX-440.

This informative booklet may be obtained free of charge from Receiver List (attn Jonathan Marks), Radio Netherlands, English Section, PO Box 222, 1200 JG Hilversum, The Netherlands.

Jonathan Marks is of Media Network fame.

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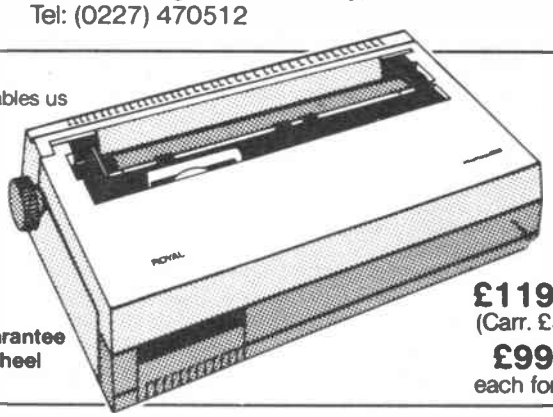

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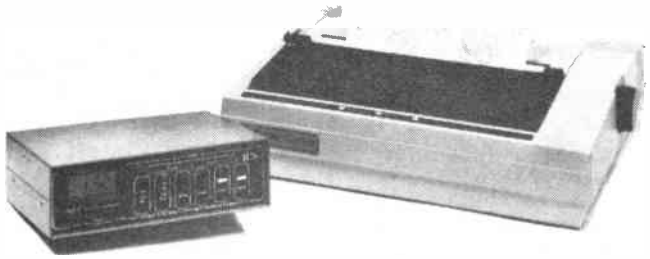

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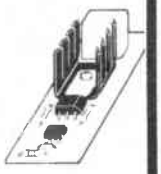

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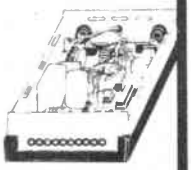

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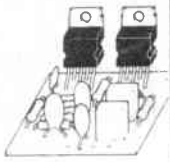

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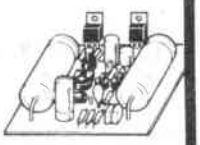

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■ Ekco eliminator, circa 1928, HT GB and LT metered, £25. Sargrove receiver 1947, £75. 18in Goodmans speaker, 35lb, £45. Collaro tape transcriptor, good cond, £12. Acos GP12 PU, unused, £6. Bell Howell 12in LS, cased, £12. 1155 receiver, £25. Grampian VHF/FM valved tuner, 19in MTG, £25. Service sheets, service manuals etc, too numerous to list, send SAE for details. John Willmot, 5 Southcourt Avenue, Bexhill. Tel: (0424) 221636

■ Soft free-standing tower with ladder incorporated, 4 sections, 4ft sq base, £350, or exchange for quality Yaesu, Kenwood ATU or AOR2002 scanner, WHY? Terry Devlin, 4 Legion Terrace, Longford, Eire. Tel: (043) 41455 (Eire)

■ Trio R600 HF receiver, as new, boxed, £200 ono. David G6KTG. Tel: Staines (0784) 58346

■ Stalker ST9 CB rig, all mode super clean, £145 ono. Tel: (0733) 243417

■ R2000 HF/VHF receiver, 100kHz-30MHz all modes, plus 118MHz-174MHz all modes, fitted with narrow CW filter, £500 ono. Also Trio TS500 HF transceiver with external VFO, £150 ono. Bill Hall G0BPI. Tel: (0532) 466108 work, (0532) 686900 home (Leeds)

■ Quality VHF transmitter, tunable from 70 to 200MHz approx, needs metal case and 30 volts supply, £20. Write for details to Lucian, 56 Thurlestone Road, London SE27 0PD

■ Ranger 3500, tuning steps 100kHz, 1kHz, 10kHz. 100kHz, 1MHz. LSB/USB/CW/FM/AM, 26-30MHz, transceiver scan memory, split frequency, £350 (2 months old). Superstar 2000 5x40, 25.965 to 28.005, £135 ovno. Tel: (0283) 221870

■ Grundig Satellit 1400SL, £50. Akai GX4000D reel to reel tape deck, £75. Hitachi D220 stereo cassette tape deck, £35. *WRTH* for years 1984, 1985, 1986, 1987, £5 each. Tel: (0258) 53933

■ Marconi FM/AM signal generator, TF995/A/I/M, special model with ± incremental control, recent overhaul and recal, excellent condition, c/w manual and spec sheet. Also Marconi FM deviation meter, TF934/3, c/w all leads, plugs and instruction manual, as new. Also Solartron precision electronic millivolt meter, ac, 10Hz to 100kHz, 1.5mV to 150V FSD in 18 ranges, lowest reading 0.02mV. Also socket for CRO connection. Tel: (0202) 692952 evenings, for details

■ Clearing workshop: valves, old and new types: Class D wavemeter; precision resistors; meters and gauges eg vacuum 0-30in Hg, £2 each (new, unused); reflective adhesive 'Scotchlite' 6in wide; motor accessories, spanners, filters, V-belts, tie-rods, brake shoes, lenses, light units – all new, most for 1950s models. Projector lamps, studio lights, 35mm filmstrips (mostly geographic), dictaphone, various telephones converted to suit new system, from £5 each. Send unused stamps for photocopied list, stating interests. Williams, 25 Glenmore Road, Oxton, Birkenhead, Cheshire L43 2HQ

■ Sony ICF7600D Rx 150k-30MHz, brand new, still in wrapper and boxed, £140. Heath HW9 de luxe QRP CW txcvr, 80-10m, inc new bands, full QSK, beautifully built, perfect working order (except needs alignment on 10m Tx), includes Yaesu FL110 100W linear amp, giving instant QRO, cost £380 selling both for £280 inc leads and handbooks. Excellent QRP/QRO station, buyers pay carriage. Steve GM4GTU QTHR. Tel: (0224) 743039 or (0903) 776570

■ Hitachi V212 oscilloscope, never used, including signal generator probes and manual, £250 for quick sale. Delivery possible. Chris. Tel: (0792) 781961 evenings

■ Hameg oscilloscope 205-3, 12 months old, dual-trace 20MHz with built-in component tester (shows pictorial view of component breakdown characteristics), comes with 2 probes, cost £350 new, sell for £250. Tel: Poole (0202) 686423

■ Vintage items: rare 1930s No 17 military wireless transceiver, in mint condition with original packing and manual, £145. Marconi TF801A RF/AF sig gen, £60. Marconi TF4288/1 (WD4168) and Furzehill V200A valve voltmeters, £25 each. Early radar receivers R1124C/D and R1466, £30 each. Old, unused NU4 (ESU208) and NT39 (ACT36) Tx valves in original packing, £20 each. Big PT25 RF/AF screen grid bottles, £10 each. Unused MU12/14 rectifiers, £4 each. All equipment in vgc. Tel: Bookham (0372) 52569

■ Large selection back issues magazines: *AR; R&EW, HRT, ETI, PW, PE* etc, plus list amateur radio books. Send large SAE for full lists. Also due to recent upgrade, selling Amstrad CPC464 micro accessories, too numerous to list, please write for details. Some amateur radio home brew equipment, test gear etc, also going cheap. Mr Small, 8 Cherry Tree Road, Chinnor, Oxon OX9 4QY. Tel: (0844) 51694 evenings

■ Vintage 1941 American naval radio, Model CRV46156, 300kHz to 23MHz, needs set of valves. Offers, WHY? Tel: (0662) 42929, work

■ Two Digiplan CD20 stepper motor drive modules with instruction manual, as new, will separate, £80 each. Mr Poole. Tel (0772) 314980

■ CBM64, 1541, CN2, plus approx £600 of software, both disc and tapes, includes languages (Forth, Logo, Pascal, Comal), spreadsheet, WP and games, also approx 70 blank discs, plus number of books, £325, no offers, buyer collects. Tatung Einstein TM01, £100. Ron. Tel: (061) 437 0916

■ Quad II amplifier double, each has 3 valves, little used. Also multiplex decoder and control unit. Anthony Wilson. Tel: (0559) 370081 evenings

■ Yaesu FRG7000 general coverage receiver, excellent condition, boxed, £175 ono, or pt/ex for R/C VHS video recorder. Turner +3B desk mic, £15. Two PCB assembly jigs, £35 each. Tel: Leeds (0532) 663814 or 443558

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■ Ferguson video VHS 3V24 portable. 3V25 tuner, 3V26 PSU/CHG, remote control. (New video heads fitted in April), £220 the lot or swap for FT290R/FT790R/FT707/FT101E or similar, or WHY? Also discone scanner ant, £15 buyer collects. Would swap above for Sattelite receiver, 950-1750MHz, or pt/ex against set of Astec modules for same, or DC to light 24cm FM receiver. Tel: (0782) 46570

■ Yaesu FRG7 receiver, 0.5MHz-29.9MHz, vgc, £140 ono Daiwa Search 9 12V receiver, 146-152MHz UFC and crystals, some provided, with car mounting bracket. £15. Hitachi cassette recorder, built-in mic, ac/batt computer compatible, £15. Phil. Tel: (0582) 662030 evenings

■ AR88ARX, immaculate, Hallicrafters S27 Rx, 27.8 to 143MHz. KW Vanguard Tx with Top Band, SEM transmatch, Thandar frequency counter, advance signal generator, all with manuals and in good condx. Exchange for 2m mobile or WHY? G4VNG. Tel: (0733) 231639

■ Trans 240V, two 12V 30A sec, (17V dc). Chassis and panel. Four 60A diodes on heatsink. Two RS caps 63V 3.300UF filter socket RS 6A with plug and lead. Meter 2½in 0-25A. Buyer collects, £35. RS isolation trans 200W, £5. RS trans 207.251 0-12V 4A, 207-144 0-12V 3.5A, 207-150 0-15V 1.5A, 207-172 0-17.5V 1.5A, £3 each, plus postage. Earl, 1 Mayfield Drive, Daventry, Northants. Tel: Daventry 702265

■ Yaesu FT726R, fitted 2m/70cm board, with Yaesu SP102 matching speaker and MH-B8 mic, as new, orig boxes, £650 ono. Tel: (0926) 32486

■ Shack clearout: Systron Donner signal generator Model 1702, professional instrument, 0-1GHz in 100Hz steps, AM/FM/CW, fully variable output over 6 decades, built-in IEEE interface, c/w full service manual, £350 ono. Buyer collects. Large quantity 2732 and 2716 EPROMs, all used, tested and erased, £1 each. Multi-output switchmode PSU, 24V +15 -15 +5 enclosed type, £7. Kevin Godsave. Tel: (0279) 503568

■ Digital readout for Racal RA17, display to nearest 10Hz is by six large red LEDs with leading zero suppression, plugs into PL11, 8x2x5in instrument case, built-in power pack, £70. Carriage paid. Please write to A G Hacker, Easton House, Obridge Road, Taunton, Somerset TA2 7QA

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■ Sony ICF7600D, as new, £115 ono. Benkson TR31, 7 w/b pocket Rx, including FM stereo, 11-126 metres continuous, £25. May consider p/x Phillips Compass D1835 or similar medium grade multi-bandspread Rx. Would also welcome constructors' ideas on straight TRF Rx, say 13-2000 metres, using up-to-date transistor circuitry. Tel: 01-959 7715

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■ Eddystone EC10. Please write to I Tarleton, 499 Burton Road, Midway, Burton-on-Trent

■ Eddystone EC10, must be in good working order. Tel: (0283) 221870

■ KW2000B HF Tx/Rx, or later model with a/c PSU, £150 offered. VHF monitor Rx xtal controlled covering marine band, for about £20. G8RHU. Tel: (0273) 516801

■ Looking for oscilloscope in good condition, preferably solid state with dual trace, having a good bandwidth. Users manual preferred but not essential. Would consider direct swap or p/ex for a Technics SLXP7 portable CD player with mains adapter, hi-fi leads and accessories, immaculate condition. Tel: 01-570 8482 after 5pm if possible, ask for David

■ R1155 6V ex-WD Rx, pref unmodified. Also variometer ATU (19 set type). Your price and carriage paid. Peter. Tel: (0287) 34397 9.30-5.00, not Sunday

■ Eddystone receivers and literature: collector willing to pay substantial sums for models missing from his collection. Have a look at the model number on that old set under the bench and give me a ring Richard Baker. Tel: (021) 556 3324 (not weekends)

■ Manual/schematic for Cossor scope, type CDU/150/CT531, DWG No D/GA8049. Buy or loan. Tel: (0662) 42929 work

■ Belcom LS102 10m mobile rig, good price paid for good condx rig. Will travel to see rig, (yes, even to England). Barry Connell, 34 Cleddans Crescent, Hardgate, Clydebank G81 6NR. Tel: (0389) 72827

■ Pair Pye quality amps (type PF91), complete with 2×KT66, G232, 2×EKC35 and controls (RCV type PF91A), will not separate, 20 phonograph wax cylinders, *Dr Rosenthall's original recordings*, made May 1886 – unused, still in original containers. Most of a German language course (1 French lesson also available) made in New York. Valves such as PX4, KT66, AC044, 7193. Vortexian audio amp, uses 2×807 in push/pull metal case. HMV TV, 9in model 1905, made in 1948/49, complete and original untested. Japanese Unica Rx, 500kHz-30MHz ideal first SWL set, mains or 12VC supply. FET semiconductors. Military radio, type R210, covers 2MHz-16MHz in 7 bands, requires 175V HT + 6.3V heaters or 24V dc, last one now. Will exchange above for military-related radio bits, 1939-1960. Buying R106, R107, R109, R208, R209, R309, R1155, T1154, TR9, BC342, BC348 etc. WHY? Also PSUs (various). Contact Tony Howard: Tel: Milton Keynes (0908) 73114.

■ Valve tester, valve tester manuals, any new boxed valves. Please, if possible, send list of type numbers and quantities for offer by return post. Also interested in old or unusual components and equipment, old books, service sheets, advertising material etc. Tel: (021) 472 3688, or write to K Bailey, 40 Seymour Close, Selly Park, Birmingham B29 7JD

■ Service manual or circuit diagram and alignment details for Hammarlund HQ180 receiver. All expenses paid. Pete Whittle, 41 Stafford Avenue, Poulton le Fylde, Blackpool, Lancs FY6 8BJ.

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■ Valve transmitter, CW/SSB – no junk, (local location please). Would want to see before buying. Tel: Basildon (0268) 282373

■ R109 6V Rx, pref unmodified. Your price paid plus carriage. Also ex-army type aerial, variometer (19 set type) as above. Your price paid plus carriage. Peter. Tel: (0287) 34397 daytime

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■ Scanner listener requires someone from the Angus or Kincardineshire area to swap frequencies with. Please write to Tom, PO Box 4, Montrose, Angus

■ Certain trader service sheets, between numbers 1 and 573 on valve radios. Also old QSL cards, postcards etc relating to radios, radio stations and amateurs. Please contact Tom Valentine, 38 Grampian View, Montrose, Angus DD10 95X. Tel: (0674) 76503

■ Mullard BGY36, 35 or 32 module, price and source of supply. Critchley G6NUK, 16 Finch Mill Avenue, Shevington Vale, Wigan WN6 9DF

■ Scrapped CB multimode, Ham series Concord, Tri Star, Cobra etc, no mods please, and with original VCO block, any condition. Tel: Peter (0639) 820356

■ Icom ICR7000 25 to 2000 scanner. Yaesu FRG9600. Datong active antenna. HF and VHF converters, Rx4 RTTY/CW/SSTV/Amtor/receive programs or Morse/RTTY reader/decoder. Pocom or other makes. Reference books also required. Tel: (0283) 68439

■ Still seeking a KDK2025 2 metre FM mobile transceiver. A fair price offered for a good condition example. Particulars to J H Lepper, Turlington, Salisbury Road, Shootash, Romsey, Hants SO51 6GA. Tel: (0794) 512283 evenings/weekends

■ RAC AR88 LF manual or data, can you help please? John Reid, 1 Bolton Court, New Skelton, Saltburn, Cleveland TS12 2YE. Tel: (0287) 50948

■ Bug keys, any semi-automatic mechanical speed keys by Vibroplex, McElroy, Bunnell, Speed-X, Lionel, Eddystone etc. Any age, any condition, scrap or mint. American J-37 or J-38 lightweight hand keys. G3TSS. Tel: (043) 471 3125

■ Novus model 650 electronic calculator – the type with LED display, on sale in 1974. It has six digits and uses a PP3 battery and must be marked Novus 650. Wanted to replace one of sentimental value which was stolen from my place of work. Please write with price wanted to David Knight, 2 The Croft, Putnoe, Bedford.

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C P I

POPULAR BAKERS DOZEN PACKS (Still available)

All packs are £1 each, of you order 12 then you are entitled to another free. Please state which one you want. Note the figure on the extreme left is the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

BD2	5	13A spurs provide a fused outlet to a ring main where device such as a clock must not be switched off
BD7	4	in flex switches with neon on/off lights, saves leaving things switched on
BD8	2	6v. 1A mains transformers upright moutning with fixed clamps
BD11	1	6½" speaker cabinet ideal for extensions, takes your speaker. Ref BD137
BD13	12	30 watt reed switches, it's surprising what you can make with these – burglar alarms, secret switches, relay etc, etc
BD22	2	25 watt loud speaker two unit cross-overs
BD29	1	BOAC stereo unit is wonderful value
BD30	2	nicad constant current chargers adapt to change almost any nicad battery
BD32	2	humidity switches, as the air becomes damper the membrane switches and operates a microswitch
BD34	48	2 metre length of connecting wire all colour coded
BD42	5	13A rocker switch three lag so on/off or change over with centre off
BD45	1	24hr time swtich, ex Electricity Board, automatically adjust for lengthening and shortening day. Original cost £40 each
BD49	10	neon valves, with series resistors, these make good night lights
BD56	1	mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole
BD59	2	flat solenoids – you could make your multi-tester read AC amps with this
BD67	1	suck or blow operated pressure switch, or it can be operted by any low pressure variation such as water level in water tanks
BD91	2	mains operated motors with gearbox. Final speed 16rpm. 2 watt rated
BD103A	1	6 750 power supply, nicely cased with input and output leads
BD120	2	stripper boards each contains a 400v 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens or condensers etc
BD122.	10m	twin screened flex with white pvc cover
BD128	10	very fine drills for pcb boards etc. Normal cost about 80p each
BD132	2	plastic boxes approx 3" cube with square hole through top so idea for interrupted beam switch
BD134	10	motors for model aeroplanes, spin to start so needs no switch
BD139	6	microphones inserts – magnetic 400 ohm also act as speakers
BD148	4	reed relay kits you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets
BD149	6	safety cover for 13A sockets – prevent those inquisitive little fingers getting nasty shocks
BD180	6	neon indicators in panel mounting holders with lens
BD193	6	5 amp 3 pin flush mounting sockets make a low cost disco panel
BD196	1	in flex simmerstat – keeps your soldering Iron etc always at the ready
BD199	1	mains solenoid very poweful has 1" pull or could push if modified
BD210	8	Keyboard switches – made for computers but have many other applications
BD210	4	transistors type 2N3055 probably the most useful power transistor
BD211	1	electric clock mains operated put this in a box and you need never be late
BD221	5	12v alarms make a noise about as load as a car horn. Slightly soiled but OK
BD242	2	6" x 4" speakers 4 ohm made from Radiomobile so very good quality
BD246	2	tacho generators, generates one volt per 100 revs
BD252	1	panostat, controls output of boiling ring from simmer up to boil
BD259	50	leads with push on ¼" tags – a must for hook ups – mains corrections etc
BD263	2	oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot swltch if fitted into pattress
BD268	1	mini 1 watt amp for record player. Will also change speed of record player motor
BD175	1	Guitar mic – clip on type suits most amps
BD283	3	mild steel box approx 3" x 3" x 1" deep – standard electrical
BD293	50	mixed silicon diodes
BD296	3	car plugs with lead, fits into lighter socket
BD305	1	tubular dynamic mic with optional table rest

Most other packs still available and you can choose any as your free one

5A BATTERY CHARGER KIT – all parts including case only £5 add £1 postage

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 classfied list of these packs and our latest 'News Letter' will be enclosed with your goods, and you will automatically receive our next news letter.

THIS MONTH'S SNIP

ACORN COMPUTER DATA RECORDER (ref ALF03) this is a mono data recorder with switchable motor control intended for use with the Acorn Electron or BBC computers but also functions with almost any other computer and can be used for normal record and play back of music and speech

Six key controls give 'PAUSE', 'STOP' and 'EJECT', 'CUE/FAST FORWARD', 'REVUE/REWIND' and 'RECORD', fast forward and rewind (100 seconds by C60). Also tape counter with reset button. Input signal range 5mV to 500mV Input impedence 40k ohm. Can be battery operated but is supplied with a mains adaptor. Brand new in manufacturer's wrapping. **£8** Order Ref: 8P18 add £2 post.

AN ALLADIN'S CAVE. We have opened another shop in Hove, the address is number 12 Boundary Road which is between Hove and Portslade fairly close to the seafront. When you want to see before you buy and when you want to brouse around the special bargains available, this is where you should make for as the Portland Road shop in future will be just mail order. You can of course collect from Portland Road but you should bring in an order complete with reference numbers so that the stores can attend to it easily.

9" MONITOR

Ideal to work with computer or video camera uses Phillips black and white tube ref M24/306W. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and EHT circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. The VDU comes complete with circuit diagram and has been line tested and has our six months guarantee. Offered at a lot less than some firms are asking for the tube alone, only **£16 plus £5 post.**

CASE FOR 9" MONITOR We have arranged with a metal worker to make cases for the 9" Monitor. Delivery promised for the end of May and the price **£12 + £2 post.** The case will be made from coated sheet steel, overall size approx. 10" x 10" x 7" high which will give ample space for the Power Supply and external controls if you fit them.

PROBLEM SOLVED! We have obtained from the manufacturers of the 9" monitor, the TTL converter which makes it composite input suitable to work with any computer. We have had the printed circuit board made and have all the components and can supply this converter in kit form price **£6.** Our Ref: 6P4.

CHINNON 3½" FDD 80 track 500K. Beautifully made and probably the most compact device of its kind as it weighs only 600g and measures only 140mm wide, 162mm deep and has a height of only 32mm, other features are high precision head positioning – single push loading and eject – direct drive brushless motor – Shugart compatible interface – standard connections – interchangeable with most other 3½ and 5¼ drives. Brand new with copy of makers manual at **£28.50** post and VAT included.

CASE – adaptable for 3½" FDD, has room for power supply components price only **£4** includes circuit of PSU. Our Ref 4P8.

POWER SUPPLY FOR FDD – 5V and 12V voltage regulated outputs, complete kit of parts will fit into case 4P8 price **£8** or with case **£11.**

DOUBLE MICRO DRIVES as fitted to many ICL and some Sinclair computers complete double units with 2 drive motors tape heads, and 2 PCBS each with plug in ULA. Ref 2G007ES. Price only **£5.** Ref 5P113

SWITCH AC LOADS WITH YOUR COMPUTER this is easy and reliable if you use our solid state relay. This has no moving parts, has high input resistance and acts as a noise barrier and provides 4kW isolation between logic terminals. The turn on voltage is not critical anything between 3 & 30v internal resistance is about 1k ohm. AC loads up to 10A can be switched. Price is **£2** each. Ref: 2P183.

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

MINI MONO AMP on pcb size 4" x 2" (app) Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of **£1.15 each, or £13 for £12.00**

LIGHT BOX This when completed measures approximately 15" x 14". The light source is the Philips fluorescent 'W' tube. Above the light a sheet of fibreglass and through this should be sufficient light to enable you to follow the circuit on fibreglass PCBs. Price for the complete kit, that is the box, choke, starter, tube and switch, and fibreglass is **£5 plus £2 post.** Order Ref: 5P69

Ex-Electricity Board Guaranteed 12 months.

VENNER TIME SWITCH
Mains operated with 20 amp switch, one on and 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 **£3.20.**

POWERFUL IONISER Generates approx 10 times more IONS than the ETI and similar circuits Will refresh your home, office, shop work room etc. Makes you feel better and work harder – a complete mains operated kit, case included **£11.50 - £3 P&P.**

J & N BULL ELECTRICAL
Dept RE, 250 PORTLAND ROAD, HOVE BRIGHTON, SUSSEX BN3 5QT

MAIL ORDER TERMS: Cash, PO or cheque with order. Orders under £20 add £1.50 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. **Brighton (0273) 734648 or 203500**

NEW ITEMS

Some of the many described in our current list which you will receive with your parcel

8" GREEN SCREEN MONITOR complete, cased and ready to work. Composite input so just right to use with Acorn or other computers or camera. Requires only 15 volt DC. Has been used for a short period but we have tested and give six months guarantee. Price **£17.50** plus £3 post etc

MAINS TO 15V SWITCH MODE POWER SUPPLY with mulitple outlets intended to power up to 6 x 8" Green Screen Monitors. Slightly used but tested and guaranteed working, £20 each plus £2 post

FREE POWER! Can be yours if you use our solar cells – sturdily made modules with new system bubble magnifiers to concentrate the light and so eliminate the need for actual sunshine – they work just as well in bright light. Voltage ouput is .45 – you join in series to get desired voltage – and in parallel for more amps. Module A gives 100mA Price **£1** Our Ref: BD631. Module C gives 400mA Price **£2** Our Ref: 2P199. Module D gives 700mA Price **£3** Our Ref: 3P42

SOLAR POWERED NICAD CHARGER 4 Ni-Cad batteries AA (HP7) charged in eight hours or two in only 4 hours. It is a complete, boxed ready to use unit. Price **£6** Our Ref: 6P3

50v 20a TRANSFORMER 'C' Core construction so quite easy to adapt for other outputsd – tapped mains input. Only **£25** but very heavy so please add £5 if not collecting. Order Ref: 25P4

EQUIPMENT CASES Originally part of GPO equipment, these are rather large but maybe just the thing you are looking for. In good condition made of sheet steel sprayed grey:
Our Ref: 10P40 measures 19" x 12½" x 8" deep. Price **£10** + £3 carriage
Our Ref: 15010 measures 24" x 16" x 11½" – £8. Price **£15** + £8 carriage

15A PANEL METER These have been stripped from Government's surplus battery charger units made originally for army use. Unused, tested, but of course rather old, diamter 2" can be surface or flush mounted **£3** each. Our Ref: 3P40

13A PLUGS good made complete with fuse, parcel of 5 for **£2**. Order Ref: 2P186

13A ADAPTORS Takes 2 13A plugs packet of 3 for **£2**. Order Ref: 2P187

20v-0-20v Mains transformers 2½amp (100 watt) loading, tapped primary 200-245 upright mountings **£4**. Order Ref: 4P24 add £1 post

MOST USEFUL CASE constructed entirely from heavy gauge aluminium size approx 4½ wide 5¼high and 16" long. But its construction is such that it is a very simple job to reduce the length to your own requirements. The long top and both sides are flat and completely free from holes. One end has mains input socket – fuse swtich – the other end has output plug – in brand new condition. Price **£10** plus £3 postage. Ref 10035

12V DC FAN made by the famous PAPST company these are brushless so are ideal for cooling computers without causing any electrical interference, size approx 3½ x 3½ x 1½, all brand new. Price **£10** Our Ref: 10P33

AXIAL FANS very quiet running and purpose designed for cooling instruments etc made by the famous Germany PAPST Co – these are 4½" square approx 230v mains operated and metal bladed, so OK in sunbeds and other hotspots – price **£8** each. Our Ref: 8P8

BENCH ISOLATION TRANSFORMER 250 watt again availble 230v in and out with plenty of tappings to give exact bolts **£5** plus £2. Order Ref: 5P5

3 CORE FLEX BARGAIN No 1 Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm for **£2** Orfer Ref: 2P189

3 CORE FLEX BARGAIN No 2 Core size 1.25mm so suitable for long extension leads carrying up to 13 amps – or short leads up to 25A, 10m for **£2** Order Ref: 2P190

ASTEC PSU Switch mode type so very compact. Normal 230V input. Has 3 outputs +5V at 3.5 amps +12V at 1.5 amps and –5V at 0.3 amps. Should be ideal to drive floppy disc units. Regular price around £30, our price only **£10** although brand new and unused. Order Ref: 10P34

24 HOUR TIMESWITCH 16A C/O contacts, up to 8 on offer per day. Nicely cased for wall-mounting. Price **£8.00**. Ref: 8P6

CAPICTOR BARGAIN Axial ended 4700 uf at 25V, Superior Jap make, normally 50p each, you get 4 for **£1.00**. Ref: 613

AGAIN AVAILABLE – 12" mini fluorescent tubes – Price **£1** each. Ref: BD314

MINIATURE BCD THUMB WHEEL SWITCH – Matt black edge switch engraved white on black – gold plated, make before break contacts – size approx 25mm high, 8mm wide 20mm deep – made by the famous Cherry Company and designed for easy stacking – Price **£1** each. Ref: BD601

PEZO ELECTRIC FAN an unusual fan, more like the one used by Madame Butterfly, then the conventional type, it does not rotate. The air movement is caused by two vibrating arms. It is American made, mains operated, very economical and causes no interference. So it is ideal for computer and instrument coding. Price is only **£1** each. Ref: BD605

SPRING LOADED TEST PRODS – heavy duty, made by the famous Bulgium company. Very good quality. Price four for **£1**. Ref: BD597

TELEPHONE BELLS – these will work off our standard mains through a transformer, but to sound exactly like a telephone, they then must be fed with 25hz 50v. So with these bells we give a circuit for a suitable power supply. Price 2 bells for **£1**. Ref: BD600

APPLIANCE THERMOSTATS – spindle adjust type suitable for convector heaters or similar price 2 for **£1**. Ref: BD582

CASE WITH 13A PRONGS – to go into 13A socket, nice size and suitable for plenty of projects such as car battery tickle charger, speed controller, time switch, night light, noise suppressor, dimmers etc. Price – 2 for **£1**. Ref: BD565

ALPHA NUMERIC KEYBOARD – this keyboard has 73 keys arranged in two groups, the main area is a QWERTY array and on the right is a 15 key number pad, board size is approx 13" x 4" – brand new, but offered at only a fraction of its cost namely **£3** plus £1 post. Ref: 3P27

TELEPHONE EXTENSIONS – it is now legal for you to undertake the wiring of telephone extensions. For this we can supply 4 core telephone cable 100m coil **£8.50**. Extension BT sockets **£2.95**. Packet of 500 plastic headed staples **£2**. Dual adaptor for taking two appliances from one socket **£3.95**. Leads with BT plug for changing old phones, 3 for **£2.**

WIRE BARGAIN – 500 metres 0.7mm solid copper tinned and pvc covered. Only **£3** + £1 post. Ref: 3P31 – that's well under 1p per metre and this wire is idea for push on connections

INTERRUPTED BEAM KIT – this kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components – relay, photo transistor, resistors and caps etc. Circuit diagram but no case. Price **£2** Ref: 2P15

3-30V VARIABLE VOLTAGE POWER SUPPLY UNIT – with 1 amp DC output. Intended for use on the bench for experimenters, students, inventors, service engineers etc. This is probably the most important piece of equipment you can own. (After a multi-range test meter). It gives a variable output from 3-30 volts and has an automatic short circuit and overload protection, which operates at 1.1 amp approximately. Other features are very low ripple output, a typical ripple is 3m V pk-pk, 1mVrms. Mounted in a metal fronted plastic case, this has a voltmeter on the front panel in addition to the output control knob and the output terminals. Price for complete kit with full instructions is **£15**. Ref: 15P7

TRANSMITTER SURVEILLANCE (BUG) – tiny, easily hidden, but which will enable conversation to be picked up with FM radio. Can be housed in a matchbox, all electronic parts and circuit. Price **£2**. Ref 2P52

NEVADA

HIGH QUALITY BRITISH MADE PRODUCTS

TM1000 1KW All Band ATU

Our unique wide band roller coaster enables effortless matching of G5RV, LW, Vertical and Coax fed antennas with this unit.

Standard model **£148**
For balanced feed **£165**
Fitted with 2 Kw Balun
TM1000 Kit complete **£129**
(Add £5 carriage for all versions)

BUILD YOUR OWN HIGH POWER ATU WITH OUR RANGE OF ATU COMPONENTS

Roller Coaster 1KW 30uH	£24.00 +£1 p+p
250 pF Var. Capacitor 1KW (4mm air gap)	£19.95 +£1 p+p
250 + 250 pF Ganged Variable 1Kw (4mm air gap)	£28.00 +£2 p+p
TC48 Turns counter for RC26	£12.95 +£1 p+p
Case (Pre-drilled for above	£28.86 +£3 p+p

U.H.F. REMOTE ANTENNA SWITCH

(For masthead mounting)
Freq: **DC - 1.2 Ghz**
Power: **300W P.E.P.**
Insertion Loss: **0.19 dB at 900 Mhz**
Connectors: **Green Par 'N' Type**

£49.95

ALLOWS SELECTION OF 2 ANTENNAS FROM 1 COAX FEEDER

H.F. REMOTE ANTENNA SWITCH

(For masthead mounting)
Now you can switch between two HF Antennas on one coax feeder.
Freq: **DC - 185 Mhz**
RF Power: **1KW P.E.P.**
Insertion Loss: **0.15 dB at 144 Mhz**
Connectors: **SO239**

£39.95

50 Mhz LINEAR AMPLIFIER

WITH HARMONIC FILTER

SPECIFICATIONS
Supply: **13 V DC**
Input Power: **2·5 Watts**
Output Power: **15 Watts**
Freq: **50-52 Mhz**
Power Gain: **Approx 8dB**

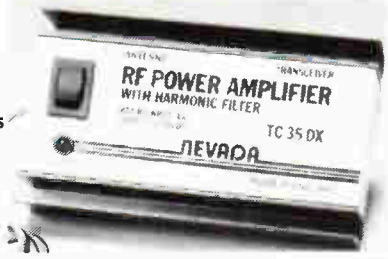
£29.95
+ £1 p+p

29Mhz FM R.F. POWER AMPLIFIER

WITH HARMONIC FILTER

SPECIFICATIONS
Supply: **13 V DC**
Input Power: **1-4 Watts**
Output Power: **25-30 Watts**
ONE YEAR GUARANTEE

£24.95
+ £1 p+p



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POCKET SCANNER
Switcheable between AM/FM
Complete with NiCad Charger
Frequency range -
26-30MHz 60-88MHz
115-178Mhz 210-260MHz
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Hand held scanner
with 16 channels
Memory scan covering -
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405-512 Mhz
Complete with carrying case
earphone and charger unit

£189.99

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Base station scanning Rx
with 16 channel memory scan
covering 66-88Mhz
118-174 Mhz 405 -512 MHz
NEW LOW PRICE

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Covers. 29-54MHz, 118-174MHz,
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Complete with
12 volt AC adaptor

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Pocket size scanner
with 20 memory scan
covering 66-88 Mhz,
118-174 MHz, 406-512 MHz
Complete with carrying case
earphone and charger unit

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Base or mobile scanner
100 Memory channels covers
29-54 MHz 118-174, 410-512 MHz
Requires 12V DC supply

£225

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