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CONTENTS

FEBRUARY 1983

Volume 2 No. 5

Projects
Acoustic Modem
- Price breakthrough 10
Audio Millivoltmeter
- Checkout your audio 18
AF Signal Generator
- Quality test gear 36
Audio CW Filter
- Banish whistles 45
Keyer Speed Readout
- Complements our keyer 58
Zx81 RS 232 Interface
- One up on Clive 74

Features
Comment
- Season's greetings 5
Feedback
- R&EW comes clean 20
Data Brief: AD7110
- Binary audio attenuator 21
Audio Brief
- In depth analysis 26
SAWS Explained
- Practical applications 28
Amateur Radio World
- UOSAT news 34
Letters
- The right of reply 43
HF Receiver Design
- From TRF to date 48
Exhibition Brief
- Breadboard vs Hobbies Fair 54
REWSOFT
- A new service 56
Data File
- CMOS logic explained 67
Video Update
- Second generation machine 85
Notes From The Past
- History lesson 89
Last Word
- Misleading claims 96

Reviews
Panasonic RXC60L
- High power portable 40
Panasonic NV366
- Quality video on a budget 63
3030 'scope
Low cost, high performance 82

News
New Products
- Market update 6
Video News
- DBS latest 15
Computing News
- Sinclair stories 80
DXTV
- TV tales 90
Short Wave News
- Radio reports 92

Information
Next Month's R&EW
- A computing special 24
Advertiser's Index
- Placing people 96

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290E-144-146 MHz/490E-430-440 MHz. 10 W RF output on SSB, CW and FM. Standard and non-standard repeater shifts. 5 memories and priority channel. Memory scan and band scan, controlled at front panel or microphone. Two VFO's. LED S-meter. 25KHz and 1KHz on FM – 1KHz and 100KHz tuning steps on SSB. Instant listen for repeaters.

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Comment

Despite our coy submission to convention regarding our cover date, and actual publication date, we have not previously been over respectful of such practises, so we won't start now. This issue is due to appear circa. January 1st — so we'll indulge in the usual seasonal greetings, nostalgia and general speculation that abounds at this time of year.

Happy new year!
We should all feel pleasantly relieved that if any section of society is due for a HNY, then this is it, according to all the pundits and general observers.

It's been fun, hasn't it?
Well, we've had some fun together in the past year. The CB debacle, explosive growth in video, explosive growth in computing, the advent of REWTEL, the release of Lech Walesa . . .

Whatever next?
What a start to a year of electronics, computing, video and communications this issue is! We have been saving up for a blast into and through 1983 that should have all of you lot clinging for dear life.

REWCARD's introduction, the monster book feature, a 300 baud modem, an RS232 interface for the Z81, news of a major series on audio and another on radio are just some of the highlights from this issue. It's all happening.

Cordless phonies?
The 'legal' version of the cordless telephone specification slid out fairly quietly during the summer. So quietly, in fact, that you might be forgiven for imagining that it all happened in rather an undercover fashion.

The acute embarrassment and public fiasco of CB must have taught manufacturers a few lessons, and the amazing about-face on the use of 47MHz/1.6MHz must have turned a few faces that were already slightly red, a shade of deep maroon that must be shining like beacons from the portals of Waterloo Bridge House.

We forgive the HO and BT for apparently working on this spec surreptitiously with a few of its 'friends'. After all, CB would not have been quite such a cock-up if they had adopted a similarly enlightened policy in early 1981. It would be better if the HO and BT had come clean about the whole business a bit sooner, and perhaps adopted a more open policy on the question of enlightened self interest where the interests of British Industry are concerned.

Those who found out about the specification after it was too late may justifiably be seething; but as usual, the Japanese industry has been able to get the gear in for approval in time. After the claims from the Home Office that anything like the pirate 47/1.6MHz allocations would be approved "over our dead bodies" according to an unguarded comment from one of the residents of Waterloo Bridge House, UK manufacturers who were not offered enlightenment soon enough are feeling just a shade put out by these latest revelations, and willing to bring about the prophecy in person, if necessary.

The Japanese simply changed the crystals and a few peripheral interests of year. Besides our respectful mention of their interest in the 47/1.6MHz experiments, we have not previously been over respectful of such practises, so we won't start now. This issue is due to appear circa. January 1st — so we'll indulge in the usual seasonal greetings, nostalgia and general speculation that abounds at this time of year.

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The Japanese simply changed the crystals and a few peripheral considerations, and they were on the doorstep, waiting for their approval certificate.

We would suggest that the Dol look to the French when it comes to seeking ideas on thinly veiled protectionist measures. At least the French industrialists seem to get an even handed crack of the whip.
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NEW PRODUCTS

Motorola's Chip Fryer
The new MPC100 voltage regulator from Motorola is capable of delivering up to 10 amps, at 5 volts, and is expected to find widespread usage in MPU related applications such as memory boards, personal computers, word processors and computer peripherals. It is the first of a line of SMART power products (power integrated circuits) currently being designed for both digital and linear applications, and represents a significant breakthrough in IC technology.
The MPC100 Regulator can withstand an input voltage up to 25 volts. The typical output resistance is in the order of 2 milliohms which results in good load regulation.
The low saturation voltages of the output transistors allows the regulator to operate with differential voltages as low as 1V5 (typical), at full load. This results in improved efficiency and makes the MPC100 regulators ideal, in conjunction with a switching regulator, for remote applications.

Handy Cases
The new Boston hand-held instrument case range from West Hyde is moulded from black ABS.
The styling is ideal for all applications involving hand-held digital readouts such as thermometers and tachometers.
The cases feature a separate battery compartment and an optional thumb-button which could be used to operate on-off or range-change switches for example. A choice of display aperture sizes allows for a variety of digital displays to be fitted. West Hyde Developments Ltd., Unit 9, Park Street Industrial Estate, AYLESBURY, Bucks.

RADIO & ELECTRONICS WORLD
Hand Built By Humans

Bucking the current trends Davall Relays located in Crosskeys, Newport maintain highly specialised products by concentrating on precise specifications with hand built techniques of manufacture. This allows their Cradle Relays to be unique because it permits a combination of special contacts, different resistance values and physical configurations to accommodate most engineering requirements. The relays are designed to function effectively and efficiently with the minimum operating voltage with 2 pole, 4 pole or 6 pole changeover.

New Family From RT

Rapid Terminals now supply a new DEC VT100-family terminal, direct from stock. Known as the VT102, it is a VT100 type terminal with built-in Advanced Video, printer port and full and half duplex communications and modem controls.

The VT102 is a technically advanced VDU that provides the versatility required by modern mini, micro and mainframe computer installations. The Advanced Video in the VT102 provides the user with four alternate character attributes, that can be selected in any combination on a character-by-character basis (these include bold, underline, reverse and blink). In addition, up to 24 lines of 132 characters can be displayed, with provision for alternate character sets, mapped in ROM and inserted into the terminal.

The printer port on the VT102 is extremely useful, allowing an LA34 or LA120 to be connected directly to the terminal for local printing without host processor intervention.

Rapid Terminals, Rapid House, Denmark Street, HIGH WYCOMBE, Bucks, HP11 2ER.

Velleman kits can also be purchased from the following: Baxol Tele Exports Ltd., Ballinaclosh, Post Rathdrum, Co. Wicklow, Rep. of Ireland.
S&R Brewster Ltd., 86-88 Union Street, Plymouth, Devon.
Bradley Marshall Ltd., 325 Edgeware Road, London N1.
Marshalls Electronics, 86 West Regent Street, Glasgow.

Send for free illustrated catalogue to: Velleman U.K. Ltd., P.O. Box 30, St. Leonards on Sea, East Sussex. TN37 7NL

or telephone: 0424 753246

Name
Address

FEBRUARY 1983
Reliable Dual Beam Oscilloscope

A new dual-trace 10MHz oscilloscope, the Trio CS-1562A, is now available from Verospeed. Featuring solid-state circuitry and a 130mm cathode-ray tube, the instrument is designed for very high operational stability and reliability - ideal for applications in audio and video servicing as well as research and education. The deflection sensitivity on the vertical axis is 10mV per division, and the sweep rate can be varied from 1us to 500ms per division.

An automatic free-run feature enhances voltage measurements and input-signal detection, and a highly sensitive Lissajous pattern measuring capability allows phase differences to be determined accurately.

The oscilloscope measures 260 x 190 x 375mm and weighs 8kg.

Verospeed, Stansted Road, Boyatt Wood, EASTLEIGH, Hants. SO5 4ZV.

Black And White Sets

Two new British made Ferguson 12" monochrome portable televisions, model 38020 (black cabinet) and 38030 (white cabinet) should soon be appearing in the shops. The introduction of video recorders, TV games, home computers and the launch of Channel 4 have stimulated the demand for second or even third sets. Breakfast TVs launched early next year is likely to keep this market buoyant.

Features include: mains isolated power supply, improved 12 volt performance (typically 1 Amp consumption), electronic tuning, built-in foldaway loop aerial and personal listening earphone socket.
Shackman On The Shelf

Shackman have announced an electrostatic loudspeaker (of bookshelf size) that gives the accuracy of an electrostatic driver coupled with the bass extension and power handling properties of a conventional moving coil system.

Shackman speakers will be of particular interest to those interested in the accurate reproduction of classical musical instruments and the human voice. With the introduction of the Ministatic at £285 per pair the unique Shackman range which successfully marries electrostatic drivers with moving coil woofers is increased to four. Ministatic £285

Gould To The Fore

The latest unit in the Gould Simflex range of open-frame switch-mode power supplies, is a four-output unit supplied on a single PCB.

The new SXQ57/422 produces 57W from four outputs of +5V — 6A, — 5V — 0.5A, +12V — 1A and -12V — 1A. It is designed to meet all Output isolation is 2.5kV RMS, and radio-frequency filtering is included to meet the standards laid down by BS800. Output variation is less than 0.1%, for a ±10% line change, and ripple and noise are within 1%. Gould Power Supplies UK, Raynham Road, BISHOP'S STORTFORD, Herts.

Novostatic £295
Studio AS7 £550
Reference Wide Range £1050
Recommended amplifier power rating per channel is 20 — 100 watts
Frequency range 50 Hz — 20 kHz
Crossover 600 Hz
Electrostatic constant charge 1000 volts
Crossover 600 Hz
Frequency range 50 Hz
Recommended amplifier power rating per channel is 20 — 100 watts
Input/output isolation is 2.5kV RMS, and radio-frequency filtering is included to meet the standards laid down by BS800. Output variation is less than 0.1%, for a ±10% line change, and ripple and noise are within 1%. Gould Power Supplies UK, Raynham Road, BISHOP'S STORTFORD, Herts.

REFERENCES
- Gould Power Supplies
- Shackman Speakers
A MODEM (MODulator/DEModulator) is a device which converts computer data into tones for transmitting over the telephone network, along the standard voice channels. Many different modulation techniques exist as well as different standards related to the country or data rate. The most common modulation technique (and that used by the R&EW Modem) is Frequency Shift Keying. Here a 'High' or binary 1 from the computer is converted into a different frequency tone from a 'low' or binary 0.

Low speed modems are able to work full duplex (eg, everything typed at the terminal will be echoed back to it), possible because at the low data rates used, sufficient bandwidth exists to fit the forward and return paths into the 3kHz or so of available bandwidth. The two modems in a link are called ORIGINATE and ANSWER depending on which one originates the call and which one is answering it. The names also refer to which pair of channels is used by each end to transmit data on.

Direct Connect.
In this mode the modem signal is directly coupled into the telephone line via a suitable matching, isolating transformer. This method offers better coupling than the acoustic method, but has the distinct disadvantage of requiring direct connections to the telephone line which is not only illegal, but requires specialised switching from modem to telephone if ordinary speech facilities are required.

Acoustic Coupling.
This method avoids direct connection to the phone line by acoustically coupling to the telephone handset via a miniature loudspeaker and microphone assembly. This method is obviously better suited to the domestic environment. It offers similar performance to the direct connect modem, except in conditions of poor signal level or high ambient noise.

Typical Modem.
Figure 2 shows the block diagram of the modem. The main section is an MC14412 IC from Motorola, which provides all the logic and modulation/demodulation for both European/USA modems (configured for either originate or answer modes by selection of the input pins). Whilst it would be possible to design the circuit to allow the MC14412 to operate in any of these modes, the overhead in bandpass filters and switching makes this rather an unattractive option in a truly cost conscious system.

The filtering on the input is necessary to remove unwanted extraneous signals and to give the limiter and signal
Project

POWER LEVEL IN dBm

NOTES
1 SIGNALS UP TO 14 dBm ARE ONLY PERMITTED IN AREA B IF ACCOMPANIED BY COINCIDENT SIGNALS IN AREA A OR ACCOMPANIED BY COINCIDENT SIGNALS IN AREA D AT A POWER LEVEL NOT LOWER THAN 5 dB BELOW THE POWER LEVEL OF SIGNALS IN AREA B. THE TOTAL POWER LEVEL OF THE COMBINED SIGNALS MUST NOT EXCEED 13 dBm.
2 SIGNALS ARE NOT PERMITTED TO OCCUR IN AREA C BECAUSE FALSE OPERATION OF TRUNK SIGNALING EQUIPMENT MAY RESULT.
3 THE FREQUENCY RANGE 400-450 kHz SHOULD BE AVOIDED IF POSSIBLE BECAUSE A SMALL PERCENTAGE OF SWITCHED TELEPHONE NETWORKS HAVE SIGNALING EVENTS IN THIS BAND.

Figure 3: British Telecom's requirement regarding transmitted spectra

detection circuits the best possible chance of working. The bandpass filter has to be carefully designed to have as small and constant a group delay over the passband as possible. Otherwise smearing of the pulse edges will occur causing a very high rate of data errors. Fig. 3 details the requirements imposed by the BT on the transmitted spectra — the available bandwidth is very small. Hence the difficulty in building modems out of phase locked loops and multivib.

Construction & Testing
The MODEM is constructed on a double sided PCB (Fig 6, 7) and the components placed according to the overlay diagram Fig. 4. The construction holds no particular horrors apart from taking care not to overheat the ceramic resonator. The built circuit should be powered up without the ICs plugged in and the supply voltages verified. Then insert the ICs and turn the power back on. A tone should be heard from the Piezo transducer.

Taking the RS232 'data-in' input to the positive and negative rails should cause the tone to change in frequency and the LED to light. Making a sound into the transducer — acting as a microphone — should cause the carrier light to turn-on and by whistling, you should be able to make the 'received data' LED flash. You cannot ascertain correct operation of the modem by placing the transmitter next to the receiver and expecting anything typed on a terminal keyboard to appear on the screen.

Finally connect the modem to your data terminal and type a few characters. A burbling transmit tone should be heard as these are converted to tone sequences.

The Acoustic Coupler.
The prototype housing was constructed from two pieces of drain-pipe 'araldited' and 'isoponed' into the lid of a metal box. An alternative is to construct the couplers from high density poly-foam. The important points are that the transmit coupler should be as acoustically tight as possible, so as not to leak transmit audio and deafen the receiver. However the transmit housing must be provided with a small air leak so that the telephone transmitter, which is made from carbon granules, is not subjected to acoustic/pressure shock when it's inserted into the coupler.

The receive coupler should hold the transducer as close to the sound opening of the handset as possible (remember that acoustic chambers can be tuned, which can change the effectiveness of the assembly many-times over).

Figure 4: Component Placing
Circuit Description

The Receive Path

A piezo transducer, PB1 is used as a microphone within an acoustic chamber to couple to the telephone ear-piece. The output from the transducer is further amplified by IC1a, which has an AC gain of around 550. IC1b-d form an active bandpass filter (6 pole), centered on 1750 Hz. The values in this filter are extremely critical, and must be strictly adhered to. The filter is designed to roll off sharply on the low side so as to exclude the fundamental of the transmit frequencies. The voltage gain of this filter stage is around 4 per section. The amplified, bandpass — limited signal is now AC coupled via C9 to IC2 and IC3; a pair of LM311 comparators (IC2 forms a carrier detect circuit).

The signal is half-wave rectified (by D6), and allowed to charge C26. Once sufficient time has passed to allow C26 to reach a voltage greater than the threshold set by R21,R22 (about 0.7 volts) then the output of IC2 will go low, indicating that a carrier is present. IC3 forms a signal limiter, producing a symmetrical square wave from the signal, which is applied to the carrier input of IC5. This is a particularly crucial part of the design as the MC14412 employs digital demodulation, based on the period of the input waveform, and any inaccuracies in the limiter characteristics will produce a poor demodulation bandwidth.

IC5 is the heart of the modem, and demodulates the incoming carrier to either a logic 1 or 0. IC5 requires a 1 MHz clock, which is here provided by a 1MHz ceramic resonator (these devices are only 10 times worse than a quartz crystal in terms of stability and about a tenth of the price!) The transmit frequencies are converted to TTL levels by the clamping action of D2 and D3. The network of R33,34,R35 and finally applied to PB2. The modem requires ±12 volts levels at about 150 mA and 5 Volts at about 20 mA. This may be obtained from the host computer.

The Transmit Path

Transmit RS232 is inverted by IC4b and converted to TTL levels by the clamping action of D2 and D3. The network of R33,34,R35 provides a degree of hysteresis around the level converter to help provide noise immunity when used with very long lines. The TX carrier is a synthesised sine wave of 200 mV peak-to-peak, which is passively low pass filtered by IC4a to +12 volt levels of RS232. R31,32 provide a 2.1 volt reference to IC4c and d, thus any 5 volt signal is converted to —12 volts, whilst a 0 volt signal will be converted to +12 volts. The LED provides visual indication of incoming data and IC4d provides an RS232 level signal indicating whether or not an in-band carrier is present.
PARTS LIST

Resistors

C1
C2,3,4,5,6,7
C8,22
C9,10,11,12
C14,15
C16
C17
C18
C19,20
C23,24
C25,26,27
C29,30,36,37
C31
C34,35
C39,40
RV1

Capacitors

C1
C2,3,4,5,6,7
C8,22
C9,10,11,12
C14,15
C16
C17
C18
C19,20
C23,24
C25,26,27
C29,30,36,37
C31
C34,35
C39,40
RV1

Semiconductors

D1,2,3
D4,5,6

Miscellaneous

X1

Figure 6 & 7: Both sides of the double sided PCB.
Electronics and Computing looks at a computer as the beginning of something interesting rather than an end in itself.

We thought that using a micro to drive something other than a TV screen could open up fascinating possibilities.

A few simple circuits, used as building blocks, can stretch your computer, your imagination and your fun, a long way.

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A different look to video news this month as Peter Luke examines the likely shape of Satellite Broadcasting in the light of the recently published Part Report.

LAST JULY the Home Secretary set up a parliamentary advisory panel whose terms of reference were "to consider what technical transmission standards should be adopted for United Kingdom services of direct broadcasting by satellite; and to submit advice by early November 1982."

Sir Antony Part was appointed Chairman, the other members of the panel being Professor Day, an expert in economics, and Professor Griffiths of Loughborough University's Department of Electronics.

The panel's brief was wideranging, taking in both the economic merits of various DBS standards, and the technical aspects of any system — in particular ensuring that any recommendations met the technical parameters set out in the World Satellite Broadcasting Administration Radio Conference's (WARC) report of 1977 — and to examine the prospects for European agreement on DBS transmission standards.

In The Blue Corner

Both the BBC and the IBA have been working on their own DBS systems for a number of years and each organisation had formulated proposals for a DBS standard. The major task of the Part panel was to choose one or other of these rival systems.

The reasons behind the need for adopting a new system for satellite transmissions in preference to the PAL-I standard at present in use for terrestrial broadcasts was discussed in last month's Video News. Briefly, the present PAL system suffers from a number of picture impairments such as cross-colour and cross-luminance. The PAL system was formulated over 20 years ago and a prime requirement at that time was that any format must be completely compatible with monochrome receivers. Thus a PAL signal comprises the Y(luminance) signal occupying the full transmission channel, with the U and V colour signals superimposed on a subcarrier at the top end of the band.

The system produces acceptable results for the majority of the time but the process of overlapping and interleaving the brightness and colour information gives rise to problems when transmitting pictures containing considerable fine detail. The trouble stems from the fact that the receiver cannot distinguish between HF luminance signals and the colour information transmitted in the same part of the band. The fine luminance detail is treated as colour information and this results in spurious colour patterns known as 'cross colour'. This effect is particularly noticeable with check patterns on clothing.

In addition, as the 6MHz sound carrier is near to the shared vision channel, problems of sound on vision and vision on sound can manifest themselves. It is accepted by both the BBC and the IBA that the DBS standard should overcome these problems by separating the colour and luminance signals. The two organisations have, however, come up with very different solutions to the problem.

Prolonged Active Life

The BBC's proposals were again covered in last month's Video News and involve filtering out the HF part of the luminance signal (above about 3.5 MHz) before the addition of the chroma signal. The HF luminance signal (representing fine detail) is then shifted up in frequency — by an amount equal to the
colour sub-carrier frequency — to occupy the band between 8MHz and 10MHz.

At the receiver, the HF Y signal is shifted back to its original frequency and added to the LF Y information after the chroma signal has been filtered out. The associated luminance and colour components are thus transmitted separately and in different parts of the overall frequency band.

The portion of the band between the upper frequencies in the chroma signal and the lower frequencies of the (shifted) HF Y signal, provides ample room for one or more sound/data channels.

The BBC arguments in favour of extended PAL encompass the following points. Firstly that extended PAL is compatible with conventional receivers. A small amount of additional circuitry will allow the full 5.5 MHz vision bandwidth to be enjoyed while an unmodified set will display a picture with only slightly less resolution than that provided by standard PAL.

Problems associated with the noise content of frequency modulated DBS signals are taken care of by the fact that, as noise level increases with frequency, it is only the HF Y signal that would be affected by any noise. Noise in this part of the band is said to be subjectively much less disturbing than at low video frequencies and the subjective visibility of noise between Extended PAL and conventional PAL is slight.

**Big MAC**

The IBA proposal is that DBS broadcasting be carried out using a time multiplexed coding system known as MAC.

MAC is a time division multiplex system with the luminance and chrominance signals being transmitted at different times. In order that both luminance and chrominance signals can be transmitted in the same line it is necessary to compress the two signals in time. This means a proportionally wider bandwidth is required for each component — for example compression of the Y signal to two-thirds of a line would increase the bandwidth from 5.6 MHz to 8.4 MHz. To avoid the need for too much compression, and hence too great a bandwidth requirement, the two colour components (U and V) are sent on alternate lines. The resultant loss of vertical resolution in the colour signal is similar to that in the standard PAL system.

At the receiver, a CCD line store for time decompression of the component signals is required to provide a standard video signal.

The IBA see the MAC system as the only proposal which could become a single European standard. The system is said to offer higher definition than standard PAL with complete freedom from cross-colour and cross-luminance effects, particularly if used with a separate RGB monitor.

MAC is said to match the WARC FM satellite channels and to provide a 3dB to 4dB improvement in the noise levels associated with standard PAL. MAC is also claimed to be a good foundation for future extended definition broadcasting and also to provide a bridge between the new digital studio standards of the future.

In addition MAC is well suited to a scrambling system for subscription and PAY-TV in that the CCD elements used for time decompression could also be used for unscrambling.

**Part's Decision**

The Part panel arranged for both the BBC and IBA to demonstrate their two systems at the BBC's research department at Kingswood Warren in Surrey. The panel had hoped to use 'neutral territory' for the demonstration but the practical problems of humping equipment around the country made it more sensible to choose one or other of the broadcasters' home bases.

The very gentlemanly method of drawing lots decided the venue and the BBC won.

The demonstrations of the PAL and MAC systems side by side showed that MAC was clearly superior to PAL and better, albeit by a small margin, than E-PAL.

The panel members felt that MAC is more compatible with modern technology whereas E-PAL with its filters would tend to make volume manufacture more difficult. MAC, with its lack of sub-carriers, was also thought to be more suitable for cable TV. MAC is inherently better suited to encryption than PAL or E-PAL, another point in its favour.

As well as MAC's advantages from a technical point of view, the various manufacturers consulted during the compilation of the report were also in favour of the MAC standard as opposed to E-PAL.

By now you may have guessed that the Part report recommends that "The IBA's MAC system should be adopted for DBS in the UK."

The Part panel also urge, that the Government act on their proposals at the earliest practicable date. As DBS services are due to begin in 1986 the sooner the Government acts the better for all concerned.

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**Figure 1: Spectra of the BBC's proposed E-PAL system.**

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**Figure 2. PAL Spectra showing the Superimposition of Chrominance & Luminance Baseband Signals.**
Figure 2: The IBA’s MAC system uses time compression techniques to transmit chrominance and luminance information on the same line.

Figure 3: A MAC satellite converter uses a CCD video processor for time decompression of the satellite’s signal.

Reactions

It is perhaps not surprising that the IBA in a statement, published to coincide with the release of the Part Report, warmly welcomed the panel’s recommendations.

Equally predictable was the BBC’s less than enthusiastic reaction to the report. The following are extracts from the BBC’s statement.

“The BBC notes the recommendations of the Advisory Panel on Technical Transmission Standards. The BBC would, like most broadcasters, welcome a European standard for satellite transmission. But France has already declared it will use the SECAM system, and Germany and Spain the PAL system: in other words, they see virtue in using the same vision standards as those they use for their terrestrial transmissions. German and French receivers will, by bi-lateral agreement, have the capacity to operate on PAL and SECAM – they will be able to receive each other’s programmes on the same television set. There is virtually no possibility of MAC being accepted as the European standard.”

“In the BBC’s original application for Direct Broadcasting by Satellite we put forward, as one of our main objectives, the help to be given to the British receiver industry to get into Europe. If the UK was on a different standard from the rest of Europe this would be unachievable to any commercially significant degree.”

“Taking into account the recommendations of the Hunt Committee on cable, and the recommendations of the Part Panel, the possibility is that the financial viability of DBS services is dangerously diminished. Those financial aspects must be looked at very carefully by the BBC before a final decision is taken on whether or not to embark on a DBS service in 1986.”

As it is the BBC hope to start a DBS service in the autumn of 1986. Their reaction to the report is one that matters, we just hope that as the decision went against them they do not drag their feet over the implementation of a DBS service. Of course the Government still have the final say — the decision of the Home Secretary is eagerly awaited.

LAST MINUTE NEWS

Just as we were going to press on this issue we heard that the Home Secretary has decided to accept the Part Report’s recommendation.

YOUR REACTIONS  Circle No.
Good  70
Average  71
Poor  72
A high impedance AC millivoltmeter covering the range 5mV-50V. Design by Adrian Barnes.

Design
Initially, circuits to read true RMS were considered, but in order to perform the various mathematical functions required, a large number of op-amps (configured in precision mode) would be necessary. Another alternative is to use dedicated IC's, but this proves prohibitively expensive.

So by assuming that we will always be measuring sine-waves, a compromise may be struck using precision rectification techniques. This basically means employing an op-amp configured to provide full-wave rectification of small AC voltages — avoiding the problem of voltage drops across ‘pn’ junctions. Thus the circuit can measure signals of a few millivolts.

Construction
The unit is built on a single sided PCB (Fig. 4), which is intended to be bolted straight onto the back of the meter.

Circuit Description
In the circuit (Fig. 1), IC1a and b are configured as inverting amplifiers. The amount of gain is ultimately set by RV1 but a working value is around 30 — to ensure a wide bandwidth; in fact the response is fairly flat over the complete audio spectrum, tailing off around 95kHz.

AC coupling between the amplifier and precision rectifier is provided by C2. A potential divider is then used to give a x 100 (after calibration) 'scope output from the rectifier's output. The reason for using a rectifier based around op-amps, is that in a normal bridge circuit the diodes do not conduct until forward biased by 0.7V or so. This is little use for signals one-hundredth of that level, so the diodes are inserted in the op-amp's feedback loop. The feedback resistors must be close tolerance types to give uniform gain (so that positive and negative going pulses experience the same amplification).

A split rail supply is obtained via dividing resistors, R5 and R6 — C3 provides smoothing and decoupling. The junction of these two resistors acts as a floating earth to prevent clipping of the negative going cycle of a wave. For the best performance, remove R5 and R6 and use two batteries in series for the supply. The centre rail (0V) is then taken from the junction of the batteries.

The input voltage at pin 3 should be 0.5mV, so a precision divider is employed to give ranges of 50mV, 500mV, 5V and 50V. The accuracy of these ranges will then depend upon the accuracy of the divider resistors. The total resistance in this chain is 10M, therefore the input impedance is more than adequate for low signal levels.

Figure 1: Schematic diagram of the Audio Millivoltmeter.
Solder the meter tags directly to the board to ensure a good contact. The scale used on our prototype was modified as shown in the photograph. Pull off the plastic face cover and undo the two small crosshead screws to remove it. Some of the components are mounted on the rear of SW1, as shown in Fig. 2. These should be fitted close to the side of the switch to avoid fouling the PCB.

Calibration

Setting up is best performed before the PCB is bolted to the meter. Turn the unit to the 500mV range and apply a 1kHz sinusoidal waveform of 300mV RMS to the input. Adjust RV1 until the meter reads accordingly. IC1a and b provide overall gain in excess of 400, so the scope output can be calibrated as required. Monitor the output at the socket and trim RV2 to obtain the correct amplification factor. Calibration of the millivoltmeter is then complete.

- R&EW

<table>
<thead>
<tr>
<th>YOUR REACTIONS</th>
<th>Circle No.</th>
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</thead>
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<tr>
<td>Good</td>
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<td>Average</td>
<td>50</td>
</tr>
<tr>
<td>Poor</td>
<td>51</td>
</tr>
</tbody>
</table>

The scale used on our prototype.
Points arising over past constructional projects.

TX10 Direct Video
(December 1982)

1. C6 is "parts listed" as 100n where it should be as per drawing at 100u.
2. Audio output should be taken from the free end of R37 not as shown on the overlay from the wiper of R35.
3. C8 does not appear on the overlay. It fits adjacent to C7, at the end of the PCB between the pad marked d and the collector of Q5. Being an electrolytic its +ve plate goes to the d pad.
4. The circuitry comprising the PSU, printed as Fig. 3 does not include the components R701 and C701 to which the readers attention is drawn.
5. Fig. 4 should show eight wires from the module to the TX10's signal card. The article shows 5,6 the remainder are A and pin 10 of plug 4.
6. Finally, SW2 is a red herring. It is not provided on the MKII module. The time constant is hard wired in the AV position as the article describes in the final paragraph.

Thorn TX9 Video Mod
(November 1982)

Due to a slight hiccup in our typesetting machine the following alterations need to be made to the Circuit Description block of this article.

These changes apply only to the Circuit Description.

TR1 or 1 — should read — Q1
TR2 or 2 — should read — Q3
TR4 or 4 — should read — Q5
Q5 — should read — Q6
TR6 or 6 — should read — Q2
TR7 — should read — Q7
D2 — should read — D3
D3 — should read — D2
R16 — should read — R15
R17 — should read — R16
R22 — should read — R21
R25 — should read — R24
R28 — should read — R26
R32 — should read — R14
C2 — should read — C1
C3 — should read — C4

Animation Graphics Board
(January 1983)

Our apologies to the author, Mr. S.J. Holmes, whose name was incorrectly spelt at the beginning of the article.

Readers interested in building the board may like to note that a kit of parts is available from the author (containing PCB, decoder PROM, software and constructional details) for £28 inclusive of postage. Write to:
S.J. Holmes,
'Tanelorn'
Bank End,
Micklethwaite,
BINGLEY,
West Yorks.

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- Life 1,000,000 cycles
- Resolution Max. 250 pulses/rotation (Type LA240) Max. 50 pulses/rotation (Type LA226)
- Output level TTL level
- Output signal A and B (2 signals)
- Phase Configurations 90 ± 45°
- Rotational angle 360° (endless)

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INCREDISBLE!
Digitising your volume control

The encoder is a passive device, one of the ALPS range, giving a gray coded binary output. A logic '0' is given by a short circuit condition and a '1' by an open circuit (from the relevant bit to OV). Gray code is used here because only one bit changes at a time - mechanically no harder, but electrically it removes all those 'T's that occur when normal binary has all its digits changing between consecutive decimal equivalents.

**PARTS LIST**

**Resistors**
- R1, 2, 3, 4, 5, 6, 7: 120k
- R8, 13: 470k
- R9: 68k
- R10: 220k
- R11: 1k
- R12: 8k

**Capacitors**
- C1: 39p ceramic
- C2, 4: 100n polyester
- C3: 220n polyester
- C5, 6: 0.1u 50V electrolytic

**Semiconductors**
- Q1: BC239
- IC1: AD7110KN
- IC2.3: 4070
- IC4: NE5532N

**Miscellaneous**
- Rotary Binary Encoder
- PCB
- S.P.S.T. Switch.

**Circuit diagram**

The only difficulty this presents, is that the attenuator needs a normal binary input. Gray code conversion to binary is via an EX-OR gate - one for each bit - as shown in the circuit (the MSB always goes through unchanged). The binary input can, of course, be used to drive a display for all those who like to read their settings.

The dedicated IC is an AD7110 KN, which takes the binary code to the D/A converter and an accurate digitally controlled attenuator. It also selects different loudness compensation filters, which boost the low frequencies. The final FET gate in the device mutes the output of N=60-63 (see table for other filter switching points). The loudness

**Electrical Characteristics**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>AD7110KN WITH 'IDEAL' OP-AMP</th>
<th>AD7110KN WITH 'REAL' OP-AMP</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attenuation Range</td>
<td>Vin = 10V rms @ 1kHz</td>
<td>0 to – 88.5</td>
<td>0 to – 88.5</td>
<td>dB</td>
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<tr>
<td>Resolution</td>
<td>Frequency Range 20Hz to 20 kHz</td>
<td>1.5 max</td>
<td>1.5 max</td>
<td>dB</td>
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<tr>
<td>Attenuation Accuracy(Absolute)</td>
<td>0dB to – 48dB</td>
<td>±0.7 max Monotonic</td>
<td>±0.7 max Monotonic</td>
<td>dB</td>
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<tr>
<td></td>
<td>– 48dB to – 88 5dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Harmonic Distortion(THD)</td>
<td>per DIN 45403, BLATT 2 (with input level of 1V rms)</td>
<td>– 98 max</td>
<td>– 85 typ</td>
<td>dB</td>
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<tr>
<td>Intermodulation Distortion(IMD)</td>
<td>per DIN 45403, BLATT 4</td>
<td>– 92 max</td>
<td>– 79 typ</td>
<td>dB</td>
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<tr>
<td>V_in</td>
<td>for &lt;1% (max) THD (Note 1)</td>
<td>30 max</td>
<td>10 max</td>
<td>V peak</td>
</tr>
<tr>
<td>Feedthrough Error</td>
<td>1 KHz (Note 5)</td>
<td>– 85</td>
<td>– 85</td>
<td>dB</td>
</tr>
<tr>
<td>Output Noise Voltage Density</td>
<td>20Hz to 20kHz (Note 2)</td>
<td>30 max</td>
<td>70 typ</td>
<td>nV / √Hz</td>
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<tr>
<td>Bandwidth</td>
<td>0dB Attenuation</td>
<td>D.C. to 150 min</td>
<td>D.C. to 250 typ</td>
<td>kHz</td>
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</tbody>
</table>

VDD = +5 to +12V, VBB = 0 to –12V, pins 11-13 open, TA = 0 to +50°C unless otherwise noted
Given an audio input of -10V, and using the transfer function: \( V_{\text{out}} = (V_{\text{in}}) \times 10^{11.5N/20} \)

The table shows \( V_{\text{out}} \) for different values of \( N \). This transfer function is dependent on the op-amp used for the output-current (\( I_{\text{out}} \)) to voltage conversion. However, it should be accurate for most low noise, low distortion op-amps.

The capacitor, \( C_1 \), acts as feedback capacitance, to give stability to high speed amplifiers that might otherwise oscillate or ring.

When laying out this circuit, it's worth remembering that to gain the best results, the input and output circuitry must be kept separate, with good power supply decoupling. Short inter-connections also help reduce pick-up problems.

<table>
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<tr>
<th>( N )</th>
<th>Digital Input</th>
<th>Attenuation (dB)</th>
<th>( S_1 )</th>
<th>( S_2 )</th>
<th>( S_3 )</th>
<th>( V_{\text{out}} )</th>
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Performance Table

| Switch ON Resistance | 600Ω MAX at 1mA Switch |
| Switch OFF Leakage Current | 1μA MAX at +12V VSWitch |

Loudness Switches

Notes:
1. Switch closed in shaded area
2. \( V_{\text{in}} = -10V \) dc
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SONY'S CAMERA SELECTOR UNIT

Peter Luke examines Sony's answer to the problem of titling home videos. Their camera selector allows captions, produced by a B&W camera, to be superimposed on a colour picture. The captions may be coloured and the keying level adjusted to suit various scenes.
A must for anyone with an interest in creative video.

2M TRANSVERTER

Next month we describe the design and construction of a 28MHz to 144MHz transverter based on the 6m design published in December's R&EW.

Guitar Sound Shaper

This unit takes the 'edge' off a guitar's fast attack envelope giving it a 'smoother' sound.

Airband Receiver Memory Unit

Our Airband Receiver, published in September has proved very popular. Next month sees a useful add-on for the receiver in the form of a memory unit.

Using 256 × 4 bit memories, the unit allows up to 160 discrete frequencies to be selected using a 40-way switch/LED readout combination.
Instant interface between thumbwheel and synthesiser.
Uses special low power memories which draw approx 0.42A total on standby. Complete with back-up battery.
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The ideal mixer for home AV enthusiasts —
David Strange elucidates...

UNTIL AROUND the 1960's, mixers (as such) didn't exist —
when it was necessary to mix two signals together, two input
amplifiers were connected to two attenuators or faders and
then plugged into an output amplifier. The input amplifiers were
of variable gain so that signals from microphone levels (-70dB),
to line levels (+8dB), could be accommodated without
overloading. Everything was kept balanced — inputs and
outputs — and faders were generally the stud variety,
configured as constant impedance devices to prevent
interaction problems.

As amplifiers got more compact and refined, it became more
sensible to hard wire elements together and enclose them in a
single box and the modern audio mixer was born.

Since a mixer provides such a convenient and accurate way
of controlling audio, its use is worthwhile even if only one or two
microphones are involved. However, because most mic amplifiers in tape machines leave a lot to be desired so far as
performance is concerned, it is better to use line level inputs to
the machine, and the mixer as a mic pre-amp.

Design
One of the problems in designing a mixer is knowing where to
stop. We often have to ask the question: "What is the mixer to be
used for?"

Working on the assumption that most people who want a "32
into 12" will buy one, we decided to concentrate on the problem
of creative audio. This concerns how to mix some voices,
effects or music onto a tape machine for something like an
audio visual sequence or radio production. The quality should
therefore be up to professional broadcast standards with a
versatile system. So, why not build a four channel stereo mic
mixer, that would be self-contained (battery powered), but
capable of expansion. After all, the mixing and monitoring
buses are already there and by adding a multiway socket on the
side, you gain a space saving input/output facility. That way, a
similar sized box accommodating only channel faders and
stereo line amplifiers could expand the mixer considerably.

Figure 1. Mic/line pre-amplifier with balanced inputs.

Figure 2. Proposed layout for the AV mixer.

Alternatively, the box could contain additional microphone
inputs and some talk-back, fold-back and monitoring
amplifiers. Anyway, both would be as at home in the field, as
back in the studio making a cost-effective and versatile
package.

The facilities of the mixer are best described by looking over
the control surface layout in Fig. 2. Starting at the top, 'gain'
controls on each channel, set the gain of the input amplifiers to
prevent overloading. Without these controls, the sliders would
only operate at one of the track extremes. In order to
accommodate high level inputs, a 20dB pad may be introduced
by pushing the gain controls down to operate a back switch.
With this arrangement, less gain results if the switch
is accidentally knocked down.

Next are the pan controls, which allow the inputs to be fed
proportionally left or right. The controls have a centre detent for
accurate central location of a signal. Since any microphone
worth using will have a flat frequency response, it was felt
unnecessary to include full equalisation, so only bottom-cut
filtering has been provided to remove rumble from the signal (a
three position switch has been used). In the up position no roll-
off takes place, in the mid-position there's a roll-off of
12dB/octave from 80Hz, and in the lower position a roll-off of
12dB/octave starts at 160Hz. Each channel has pre-fade listen,
which is especially useful when working in live situations. The
PFL works into a mixing bus similar to the main buses. It is
monitored by meters as well as phones — all other signals being
disconnected whilst PFL is in operation. Once the gain is
adjusted using PFL, the fader of that channel can be pushed to
the 0dB position to obtain the same level.

Moving over to the meters, it was decided not to compromise
and specify PPM's. Originally, a mono/stereo switch was going
to be included, however, it was left out and a mono feed made
available. We included a high quality limiter, which may be
switched out altogether or made to operate at just over +8dB in
order to catch any accidental overloads. In addition to the "out"
and "+8" positions, a "+4" position is available so that the limiter
acts 4dB earlier for compression of speech.

Figure 3. A typical set-up for left and right panning.
Features and Facilities

A TONE SOURCE is vital in a mixer. It is made to operate by pulling on the control, with the level of the tone variable. This is so that both VU meters and PPM’s can be accommodated during line-up purposes on a tape machine. The tone level leaving the mixer is indicated on the meters and can be referenced. The monitor-select switch allows both the normal facilities of the stand alone mixer to be monitored by meters and phones, as well as external sources.

output tries to exceed more than ±1 volt, a comparator (IC2 or IC3) threshold is exceeded. Q1 turns on and charges Ct through Ra, when the voltage on Ct is fed back to the gain cell; reducing the gain. Within the IC a precision reference voltage is generated. This is picked off from pin 7, reduced by R4 and R5, and the DC voltage compared (by IC4) with the voltage on Ct. Normally, the voltage on Ct is constant until Q1 conducts — limiting action is taking place — at which time Q2 is turned on by IC4 and LED1 is lit.

THE INPUT AMPLIFIER (Fig. 1) was adapted from an NS device. It was chosen for its non-transformer balanced input and exceptional performance characteristics. The common mode rejection — the rejection of in-phase signals (eg, hum) forced onto both inputs — is high, at over 60dB. The signal-to-noise ratio is also exceptional; better than 110dB. The gain is easily adjustable, from 0dB to 60dB, and the stability from oscillation is excellent — though some precautions to prevent RF pick-up are required on the input.

PANNING the signal left or right is carried out by dual log/anti-log potentiometers and the arrangement provides a smooth, ‘hole free’ movement of the stereo image (Fig. 3).

The limiter time constants are set by Ra, Ct and a 10K resistor, inside the NE 571. Some improvement could result by using voltage followers to isolate the time constant elements, making them less interdependant. However, compromises are permissible and in general the limiter works well both for speech and music — the limiter will cope with signals up to +15dB before distortion takes place.

Signal Levels

So far, one important area of the system has not been touched upon, and it is most critical to the operation — signal levels. To start with, we must define the headroom available and this is going to be dependent on the supply voltage. The voltage chosen for convenience is ±9V (18V total) but being pessimistic it must be assumed that we can only approach the rails to within 1 volt before the op-amps start limiting. This means that anywhere in the chain the signal must not exceed 17V peak-to-peak. This means working the mixer to a maximum of +8dB output, we have 17.8dB +8dB = 9.8dB of headroom.

We now work backwards and forwards, since the output level is defined and we know what to expect from microphone and line levels. As a rule, active devices are going to contribute most noise to the system and so any such elements are not just used simply as buffers, but are made to do some work and provide gain.

Fig. 4 shows the signal levels through the elements of the mixer. Starting at the front end, signals between -60dB and +10dB can be accommodated with better than 27dB of headroom. Mid-way things get tighter with about 23dB headroom and it is only at the output (after the limiter, incidentally) that 9.8dB of headroom is left. And if you were wondering about the apparent 10dB loss at each fader, it’s due to the fact that it is normal to run with faders not hard up, but with some 10dB of drive left.

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Limiter

Decent limiters, or more correctly limiters that do not have objectional effects such as momentary overload are hard to achieve. Also since stereo is involved, the limiter has to be stereo ganged otherwise (during gain reduction) some shifting of the stereo image would occur.

The NE 571 is stereo capable and can easily be configured into an excellent fast acting limiter (less than 1ms). When the output tries to exceed more than ±1 volt, a comparator (IC2 or IC3) threshold is exceeded. Q1 turns on and charges Ct through Ra, when the voltage on Ct is fed back to the gain cell; reducing the gain. Within the IC a precision reference voltage is generated. This is picked off from pin 7, reduced by R4 and R5, and the DC voltage compared (by IC4) with the voltage on Ct. Normally, the voltage on Ct is constant until Q1 conducts — limiting action is taking place — at which time Q2 is turned on by IC4 and LED1 is lit.

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Figure 4. Signal levels at each stage in the mixer.

Figure 5. Schematic diagram of the limiter.
Ian Campbell looks at some of the applications for SAW devices.

Probably one of the most prolific users of SAW devices is the TV industry. The photograph shows a popular British model with its video IF board. The flat round thing marked F1045A is the SAW filter. The SL1430 is an ultra linear fixed gain preamplifier with a differential output that has been optimised for driving low capacitance SAW filters directly with no coupling components. The differential mode of drive to the SAW filter has the advantage that it reduces the effect of layout borne direct breakthrough to a minimum and thus makes PCB design easier. The TDA2540 is a video IF amplifier with synchronous detector, AGC and AFC system. The SL1430 is used because of the necessity to overcome the inherent loss posed by the SAW filter. Fig. 16 shows a typical application circuit incorporating the TDA 2540, SL 1430 and a SAW filter.

It is obvious from the filter characteristics required for British TV, see Fig. 16, why SAW filters have become increasingly popular. The reason is that the necessary characteristics can be programmed into the IDTs of the SAW device which renders setting up obsolete. The trade off of the resulting high loss through the filter has been readily made up by the development of specialised and cheap ICs like the SL1430 et al. The circuit board for the video IF has also been considerably reduced in size, from the old circuits using LC filter techniques, which means smaller lighter and cheaper TVs.

Another important attribute of SAW filters is that they can be made with a very linear phase response. For the TV market, where signals are frequency modulated, this means a great deal. It is important that the velocity of the signal wave through the filter is constant with changing frequency. This ensures that any phase change in the filter is linear. If there is a non-linear phase change then different modulating frequencies will pass through the filter at marginally different times. The result of this is distortion of the input signal. It is important that distortion does not occur, particularly with the advent of teletext where corruption of the data would occur.

It is also interesting to note that if there is a pre-distortion set into a signal at the transmitter, the SAW filter can be manufactured with a phase response that compensates for that distortion. For those with a yen for knowing such things, it is hard to measure the phase linearity of a SAW filter because the gradient of the phase with regard to the frequency is large. It is much easier to use another measurement called the
Features Of SAW Devices

No adjustment required. The required amplitude and phase characteristics can be obtained during the manufacture of devices eliminating adjustments to coils etc.

Small size. A SAW filter which is equivalent to 4-7 LC tuned circuits in performance, is contained in a TO-8 case.

High stability. Compared with LC tuned circuits the SAW filter has fewer components and so is intrinsically more stable. This implies that the performance of the section of electronic equipment containing the SAW device eg Video IF boards of TVs, does not degrade after manufacture.

Optimum phase design. The SAW filter, with its flexibility of finger length and spacing, allows an independent design of amplitude and phase characteristics. This is not available in LC filter design.

Low cost. No adjustments and fewer components means reduced labour, material and instrumentation costs.

Versatility. Accessibility to the surface of SAW devices allows positive interactions to be made there by transducers etc, which in turn means the realisation of a wide variety of practical devices.

Fabrication. For most types of device, fabrication follows procedures already adopted in other fields, particularly integrated circuit technology.

Reproducibility. The SAW device is fabricated on a substrate which is a single crystal material and so has highly reproducible properties. The patterns in the surface transducers are produced from masks and so have a high degree of reproducible accuracy.

Passivity. Most SAW devices are passive ie consume no power and thus generate no noise (except thermal noise).

Radiation hardness. They have a high degree of immunity to radiation from nuclear weapons.

Temperature coefficients. These are usually low which means little drift of device characteristics with temperature eg only -90Hz/ MHz/ C.

High reliability. The use of an hermetically sealed package and super cleanliness in manufacture, ensures little degradation of the device with time. This gives rise to high reliability and long life.

Delay Time. This is a measure of the length of time taken by different frequencies (see Fig 17), which are in the passband of the filter, to pass through it. Obviously the flatter the line the more linear will be the phase response of the filter.

Radar

In pulsed radar systems it is important that as much energy as possible is put out by the transmitter to get as big a range as possible. It is also a good idea to have a pulse with a specific high spectral content which the receiver is designed to recognise.

This is where SAW techniques come in. They allow the radar to increase its output energy without exceeding the peak power limit of the transmitter valves, by expanding the pulse length (but still keeping it at a constant amplitude) and at the same time imposing a linear frequency sweep for the duration of the pulse. This means the pulse starts at a high frequency and finishes at a lower one (this is called a chirp).

The radar still has to be capable of the same resolution as it was with short duration pulses and SAWs again are capable of reducing the pulse length when it comes back to the receiver.

How It's All Done

This is all accomplished by the use of a modified delay line called a dispersive delay line (DDL). There are two groups of DDL, one stretches pulses and at the same time generates up-chirps and the other stretches pulses and produces down-chirps.

Fig. 18 shows the type of DDL, used in the radar transmitter, which produces down-chirps. The first thing that happens is that a narrow rf pulse, typically at the centre frequency of the delay line, is applied to the wideband input transducer and a surface wave pulse is launched towards the chirp transducer. This is where the clever bit comes in because as the pulse arrives, the first fingers it meets are close together and so respond by giving out high frequencies. As the pulse propagates across the transducer, successively wider fingers are stimulated and so the signal produced becomes lower in frequency. The output is therefore a pulse that not only shifts from high to low frequency but has been stretched due to the time it takes the pulse to pass along the length of the chirp transducer. In addition it will be of constant amplitude throughout its duration because of the weighting in the transducer fingers. In the receiver the pulse which returns after being reflected off a target is converted into an acoustic wave by the input transducer of an up-chirp device. This time high frequencies travel the length (Fig. 19) of the chirp transducer before they encounter fingers that are close together. The low frequencies meet the wide apart fingers first. There is no significant output from the chirp transducer until all the waveform has propagated into it. In this set-up the high frequencies will experience the most delay and the low
Figure 18: Down-chirp dispersive delay line and its output waveform.

Figure 19: Up-chirp dispersive delay line and its impulse response waveform.

frequency ones the least. Since the high frequencies arrive at the receiver first and have the most delay and the low ones arrive last and have the least delay, the overall effect on the pulse length is thus to compress it.

Fig. 20 shows the basic principle behind this simple radar. The compression SAW device in the receiver will of course have to have modified finger geometry in its chirp transducer. The reason for this is that the transducer shown in Fig. 19 will produce a \((\sin x)/x\) waveform and the sidelobes would be interpreted as spurious echoes by the radar.

The big advantage in using SAW devices in radar is the vast amount of space, normally occupied by LC filters, which can be saved using them.

**The Microscan Or Compressive Receiver**

In modern warfare, where electronic dominance is all important, the means for surveying the electromagnetic spectrum quickly and with a high probability of intercept is paramount. The ability to do this (called ESM or electronic surveillance measures) allows the frequency of the enemy's transmissions to be ascertained very promptly and the necessary measures (ECM or electronic counter measures) to be undertaken with speed.

The technique for doing all this is relatively simple. The instrument used is a microscan or compressive receiver the block diagram of which may be seen in Fig. 21.

The receiver transforms the frequency spectrum of interest into the time dimension. This is done by mixing the unknown frequencies with a chirped local oscillator signal produced by impulsing a dispersive delay line and then passing the mixed products through a delay line of exactly the same type as that used to make the chirp. The advantage of this system is that the scan speed is not limited by the required resolution. This constraint is overcome by the imposition of a code on the input signal with the chirped local oscillator and then the recognition of this code by the delay line pulse compressor which follows the mixer. The code is just a linear down-chirp that matches the dispersive delay line exactly.

The mixer products will have an up-chirp and the dispersive delay line following the mixer has a down-chirp response. This
As a way of explanation Fig. 22 shows what happens to two RF signals of 1625 MHz and 1375 MHz which simultaneously enter a compressive receiver. The down-chirp local oscillator signal, gated to sweep from 875 MHz to 625 MHz, enters the mixer as do the two RF signals. The result is a mixer output of two up-chirps, one 500 to 750 MHz and the other 750 to 1000 MHz, which both enter the dispersive delay line at the same time. They both arrive at the 750 MHz point on the down-chirp response at the same time. The whole of the 750 - 1000 MHz pulse will then be in the dispersive transducer and will produce an output. The 500-750 MHz pulse must travel on until the complete pulse has passed to the 500 MHz point before an output takes place. The time it takes to do this separates the two RF signals. Their frequency may thus be ascertained by virtue of their delay from the time the gate is switched on to allow the local oscillator chirp to enter the mixer.

Frequency Synthesis
There is a need nowadays for some types of military communications equipment to be able to hop exceedingly quickly from frequency to frequency in order to avoid detection and the bringing to bear of ECM from an enemy.

One of the simplest ways of doing this using SAWs is shown in Fig. 23. It will be seen that the synthesiser consists of a number of building blocks ie a frequency standard; an impulse generator; a bank of SAW filters each designed to let through the required harmonic; a set of RF switches and an output amplifier. The impulse generator produces a comb of pure harmonics of the frequency standard at constant amplitude, and presents these harmonics to a bank of SAW filters. The required SAW filter output is selected by turning on the appropriate RF switch. The switches may conveniently be under digital control. The digital code will be altered very quickly and will thus cause the transmitter to hop rapidly from one frequency to another and shift the transmitted signal and its message over as wide a spectrum as possible. This is known as spread spectrum communication. As far as the enemy is concerned the frequency hopping will occur in an unpredictable way. The friendly receiver, on the other hand, will be synchronised to the incoming signal since the digital codes used by the transmitter will be known.

Oscillators
Very small size, high stability and simplicity are the keywords in SAW oscillators. An oscillator can be readily made using a resonator filter in a circuit much the same as that using a conventional quartz crystal. The transversal filter can be used in the feedback loop of an amplifier, as in Fig. 24, where it acts as a delay line. When a signal is delayed, its phase shifts and where the phase shift in the oscillator loop is an integer multiple of 2n, oscillation occurs. The IDTs of the SAWF allow only the wanted frequency through and suppress the nasties. The amplifier gain must of course exceed the loss due to the SAWF.

The SAW oscillator may be frequency modulated by the incorporation of a varactor in its feedback loop. Of the two types of SAWF the transversal filter is probably the most useful in this application because it can be linearly modulated to a greater degree. The resonator filter is only suitable for very narrow band FM.

The good thing about both types of filter is that of the fundamental frequency at which they will oscillate. Frequencies of between 10 and 1500 MHz are feasible. This means that from VHF up, bulky multiplier stages may be omitted.
A Simple Direct Conversion Paging Receiver

Fig. 25 shows a novel approach which 'Philips' engineers have made to provide a paging receiver for the British Telecom National Paging System.

The unit is based on a resonator filter which has two identical filters on one small chip. Both filters are designed to operate at the same frequency of 153 MHz. After RF amplification the incoming signal is passed through one of the filters and on to a phase detector. The other filter forms part of the oscillator producing the LO signal which is also fed to the phase detector. When the incoming signal is frequency modulated, the SAW oscillator is made to track the instantaneous frequency of that incoming signal. This is made to happen because of the difference in phase which then results between the received and local oscillator signals. This phase difference causes the phase detector to produce an output which, after amplification and filtering, is presented to the voltage controlled phase shifter (VCPS). The VCPS then brings about a change in frequency of the SAW oscillator, forcing its frequency to approach that of the input signal. The filtered voltage is also the audio output which would then be used to drive an IC decoder for the personal paging 'bleep'.
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WELL, QUITE a lot has happened since December's Amateur Radio World was published. UOSAT has been brought back under control, the new bands for amateur radio have been released and finally, the Radio Society of Great Britain has moved into new HQ.

UOSAT OK

After many trials and tribulations, the 150 foot dish antenna at Stanford University, California, was successfully refurbished. This entailed repairing broken azimuth drive motors, overcoming hydraulic drive problems and sorting out tracking computers. At 2235 UTC on Monday, 20th September, success greeted the rescue team's herculean efforts when a powerful enough 70cm command signal got through to UOSAT, counteracting the jamming signals from its beacons. UOSAT was back under command again! May we add our congratulations to the team who accomplished this most happy result, to the many they have already deservedly received. It is good too, that subsequent checkouts of UOSAT, have revealed that there has been no damage to the electronics aboard and all systems are functioning perfectly.

The University of Surrey team, under Dr. Martin Sweeting, are now proceeding with a programme directed at reducing the satellite's spin rate to one revolution per minute. The gradient boom can then be deployed and the HF becon experiments can proceed. This will provide telemetry signals from beacons on 7050, 14002, 21002 and 29510 kHz. Watch these frequencies, as they may be operational by the time this appears in print.

New Broadcast Bands

1982 saw the granting of new frequency bands for amateur radio use in the 10, 18 and 24 MHz regions. The 10 MHz (30 metre) allocation became available on the 1st January 1982 and covers 10100 to 10150 kHz. The IARU Region 1 band plan allocates 10100 to 10140 kHz to CW, and 10140 to 10150 kHz to CW and RTTY. The band is allocated to the amateur service on a secondary basis. Your scribe was one of those who came up on the band just after midnight on the last day of 1980 and enjoyed a number of contacts on the band from the word "go"!

Activity on the band has continued at a reasonable level throughout the year but quite a lot of trouble occurs from QRM amongst those amateurs using the band. This is a result of the fact that as yet there is little sign of the commercial stations leaving the band which means that amateurs have to find clear spots in which to operate. These are severely limited. However, being a CW band only, the standard of operating and conduct is high, which makes it a very pleasant band to work inspite of the QRM problems.

The 18 (17 metre) and the 24 (12 metre) MHz bands became available on 1st October 1982. It was agreed at the World Administrative Radio Conference in Geneva in 1979 that these bands, "will remain allocated to the fixed and land mobile service until amateur primary status is achieved, not later than 1st July 1989".

However, the Home Office agreed to authorise use of these bands from 1st October last. Fairly severe restrictions were, however, imposed, the chief of which were the use of CW only and the carrier power supplied to the antenna being limited to 10 watts. The frequencies allocated were 18.068 to 18.168 MHz and 24.890 to 24.990 MHz.

Occupy of these bands by radio amateurs has been slow, activity being very light indeed. Infact, it was several days before any activity was heard at all. Again, due to the presence of much high powered commercial activity, little space is available for amateur use. Both these bands seem to be characterised by severe QSB and, not unnaturally in view of the power restriction, weak signals. Most of such activity as there is centers around 18070 to 18075 kHz and 24890 to 24895 kHz. Most signals are "European", though some dx has been reported.

Fairly severe restrictions were, however, imposed, the chief of which were the use of CW only and the carrier power supplied to the antenna being limited to 10 watts. The frequencies allocated were 18.068 to 18.168 MHz and 24.890 to 24.990 MHz.
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The **R&EW** signal generator is based on a traditional Wien-bridge circuit, with frequency-dependent positive feedback and thermistor stabilised negative feedback... although every textbook will give an explanation of the mathematics involved, we've decided on a more down-to-earth approach.

The first description of an oscillator based on this set-up was published way back in 1969. Quite a few circuits have appeared since then, aimed at ever lower distortion figures. All of these designs made use of discrete components because integrated circuits were not quite up to the same standards of distortion and input noise.

With the appearance of the Hitachi HA12017, all that has changed. This IC features extremely low THD (0.001% at 1 kHz, $V_{out} = 10$ V RMS, $A_v = 35.9$ dB) and low input noise (0.185 uV at BW = 20 Hz — 20 kHz, $R_b = 43$ ohms). However, since this IC was originally intended for use as an RIAA pre-amplifier, some changes are necessary:

1. Omit all resistors and capacitors for RIAA equalisation.
2. According to Fig. 1, a minimum value for THD will be reached at an output of approximately 6 V RMS. This suggests a supply of ± 9 V (for an output of 1.5 V RMS).
3. The voltage drop across the thermistor will be around 0.72 V, so a small resistor is added to the negative feedback loop, in order to obtain an output voltage of 1.5 V RMS.

### Circuit Description

![Figure 2: A basic Wien Bridge oscillator.](image)

Looking at Fig. 2 & 3, the positive input at A and the output at C are in phase, so the negative input at B and the output at C are opposed by 180°. At a frequency, $f_0 = 10^6 \left(2\pi R_0 C\right)^{-1}$ and $Z_s = jR_0$ with a phase angle of -45°. Similarly, $Z_p$ will be $QR_7$ with a phase angle of +45° and the phase angle at A will be 0°. A state of oscillation will therefore only occur as long as the overall amplification is > 3. The exact frequency will be determined by $f_0$.

In order to avoid excessive distortion, the output voltage has to be stabilised at a reasonable value. This is achieved by a thermistor in the negative feedback loop, together with $R_{thermos}$ and $R_b$, which maintain an amplification factor slightly over 3. **Figure 5** shows the characteristics of the well-known RA53 thermistor, and a suitable working point is to be found at X, where $V = 0.72$ volt, $I = 0.9$ milliamps and $R = 800$ ohms.

By choosing different values for C and making R continuously variable, a frequency range from 10 Hz to 100 kHz can be covered. Scale accuracy and frequency stability will be largely determined by the properties of these components. The range capacitors have to be high accuracy types (1% or better) — the exact values can be made up of series or parallel combinations, using a capacimeter or bridge.

For the double potentiometer, a reversed logarithmic pot is used. In order to compensate for the rather irregular curve of these types, a resistor of 22k, shunted by 47k, were chosen. This combination yields a final value of 15k as required. The total resistance varies from 1k5 to 16k5 — a range of 9.6 Hz to 106 Hz and multiples.

To maintain 1% accuracy on the highest range, a capacitor of 50 — 150n should be inserted in series with the In shunt capacitor, to compensate for stray input capacitance.

The output attenuator is the final section. A constant impedance "unbalanced L type" was chosen for simplicity. The resistor values for this are shown in the diagram (Fig. 6). To obtain the standard 600 ohms impedance, odd values for $R_a, R_b$ and $R_c$ are required. These will have to be made up by series or parallel combinations.
A dual 'scope trace showing (upper) the output sine wave and residual distortion (lower).

The voltage across the lower limb of the voltage divider (R_6 in Fig. 2) will be 0.5 V. In practice, R_6 will be 560 ohms and R_s, 330 ohms.

Distortion curves in Fig. 12 suggest that the sharp increase in THD at lower frequencies is largely due to the thermistor. At the higher end of the frequency scale a similar, though somewhat less severe increase, is caused by the reduction of open loop gain by the HA 12017. Nevertheless, THD goes down to 0.0008 % at 10 kHz with a 30 k load!

Table of specifications for the Signal Generator.

<table>
<thead>
<tr>
<th>Specification</th>
<th>1 kHz</th>
<th>10 kHz</th>
<th>60 Hz</th>
<th>1 kHz</th>
<th>10 kHz</th>
<th>60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distortion</td>
<td></td>
<td>0.0018%</td>
<td>0.0012%</td>
<td></td>
<td>0.016%</td>
<td></td>
</tr>
<tr>
<td>Frequency linearity</td>
<td>20Hz - 50kHz ± 0.10dB</td>
<td>10Hz - 100kHz ± 0.25dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency ranges</td>
<td>1) 9.6 - 106Hz</td>
<td>2) 96 - 1060Hz</td>
<td>3) 0.96 - 10.6kHz</td>
<td>4) 9.6 - 106kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage</td>
<td>1) 1V</td>
<td>2) 100mV</td>
<td>3) 10mV</td>
<td>4) 1mV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3: Circuit diagram of the complete Signal Generator.

Figure 4: Working characteristics of the RA53 thermistor.
Construction
In order to achieve adequate screening, the prototype was mounted on the front panel of a U-shaped metal chassis. A second metal panel can then be fixed at approximately 1 1/4 inch behind the front panel, on which the double potentiometer is mounted (back to the front, to ensure the correct direction for the frequency scale – lower frequencies to the left). A cable drum is mounted on the pot shaft and a cable fed through 2 pulleys and around the driving shaft to allow a pointer to move along the scale.

There seems little point in adding a mains power supply, with all its inherent problems (hum, noise, pumping at the mains frequency and its harmonics), so a pair of 9V batteries serve the purpose quite adequately – especially since current drain does not exceed 4 mA.

Calibration
Those without access to a frequency meter, can make use of Lissajous figures on an oscilloscope. With reasonable care frequencies from 50 to 1000 Hz can be spotted, which will allow calibration on the range 100 to 1000 Hz. The other ranges should then be correct automatically.

PARTS LIST
Resistors (1%)
- R1,4 (see text)
- R2,3 1k
- R5 220R
- R6 560R
- R7 330R
- R8 15k
- R9 1k
- R10,11,12 (see text)
- R13,14 (see text)
- R15 (see text)

Potentiometers
- RV1 22k dual log
- RV2 2k2 preset
- RV3 4k7 linear

Capacitors
- C1.5 1u mylar
- C2.6 100n polysty (1%)
- C3.7 10n polysty (1%)
- C4.8 1n polysty (1%)
- C9 220u, 6 V tant
- C10 100 polysty
- C11 470 polysty
- C12,13 220u, 16 V
- C14 100u, 6 V tant

Semiconductors
- ICI HA 12017 (Hitachi)

Miscellaneous
- SW1.2 2 pole, 4 way rotary
- TH1 RA 53 thermistor
- BNC connector, PCB, knobs, pulley, wheels as required.

Internal shot of the prototype.
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  - 4kHz HC6/U
  - 3kHz HC6/U
- 3 to 30kHz HC13/U
  - Total tolerance ±100ppm (if) to ±10°C
  - 3kHz HC6/U
  - 3kHz HC6/U
- 6 to 79kHz HC13/U
  - Total tolerance ±100ppm (if) to ±10°C
  - 6 to 79kHz HC13/U
- 80 to 99kHz HC13/U
  - Total tolerance ±100ppm (if) to ±10°C
  - 80 to 99kHz HC13/U
- 100 to 159kHz HC13/U
  - Total tolerance ±100ppm (if) to ±10°C
  - 100 to 159kHz HC13/U
- 160 to 500kHz HC13/U
  - Total tolerance ±100ppm (if) to ±10°C
  - 160 to 500kHz HC13/U
- 500 to 999kHz HC13/U
  - Total tolerance ±100ppm (if) to ±10°C
  - 500 to 999kHz HC13/U

B High frequencies fundamentals/overtones
- Adj. to ±20ppm. Temp. to ±30ppm -10°C to +60°C
  - 800 to 999kHz fund HC6/U
  - 1kHz to 4.999kHz fund HC6/U
- 5 to 2.999MHz fund HC6/U
  - 2.5 to 3.999MHz fund HC6/U
  - 3 to 4.999MHz fund HC6/U
- 4 to 5.999MHz fund HC81 & 25/U
- 5 to 6.999MHz fund HC81 & 25/U
- 6 to 21MHz fund ALL Holders
  - 21 to 25MHz fund
  - 25 to 30MHz fund
  - 30 to 35MHz fund
  - 35 to 40MHz fund
  - 40 to 45MHz fund
  - 45 to 50MHz fund
  - 50 to 55MHz fund
  - 55 to 60MHz fund
  - 60 to 65MHz fund
  - 65 to 70MHz fund
  - 70 to 75MHz fund
  - 75 to 80MHz fund
  - 80 to 85MHz fund
  - 85 to 90MHz fund
  - 90 to 95MHz fund
  - 95 to 100MHz fund

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Chris Parsons examines a top-of-the-range portable audio system from National Panasonic.

PANASONIC RX-C60L

LOOKING AT the majestic array of controls on the RX-C60L fascia, you might be tempted to dismiss this portable system as just another example of gimmickry from the 'land of the rising share-in-the-marketplace'. However, in this particular case the conclusion is unfounded, since Panasonic have produced an elegant and uncompromising system equally suited for reproduction at home, in the office or jiving along Brixton high street.

The C60L is a stereo tuner amplifier and cassette deck with matching speakers. Either or both of the speakers are detachable from locking clips on the sides of the central unit. The tuner section covers four wavebands, including stereo FM, and can be SW fine-tuned by adjusting a secondary thumb-wheel - the first wheel is for overall tuning. Signals from the tuner are fed to the amplifier - 7½ watts RMS per channel — and, if desired, onto tape using the cassette recording facilities. The complete system is portable, with provision for battery power (from eight 1.5V torch batteries) and a lift-up handle. It also has an internal mains adaptor and inputs for a variety of external sources.

These features, plus some unexpected refinements, left this reviewer in no doubt about the quality and versatility of the system. The power output was more than adequate for the purpose and the general styling and 'feel' were liked; though this is what we've come to expect from Panansonic. All in all, an excellent system for the person who travels a lot, but likes to maintain a certain standard of listening fidelity.

Facing The Music

The layout of the front and rear panels, though slightly over, lowering, follows a logical pattern. Tape transport, cassette loading and equalisation controls are on the left, whilst the main level and tone controls, plus radio tuning, are situated on the right. At the centre of the system lurk three small sliders and an easy-to-read tape counter. Two of the sliders set the input level to the tape section and the third, rather unusually to adjust the 'MIXING LEVEL'. This turns out to be the gain control for an extra microphone input, providing a useful (albeit crude) mixing facility with any of the other sources.

The back panel of the RX-C60L is just as crammed with features, but of a more practical nature. Again the design concept seems to attempt the impossible — a host of sockets, switches and hardware presented in a logical fashion with clear labels. At the top is provision for AM and FM external aerials, DIN and phono signal inputs and separate JACKS.

Table 1: The complete specification listing for the RX-C60L.
Review

microphone sockets. Above these is an extendible FM rod-aerial, which turned out to be perfectly satisfactory for stereo reception of ILR stations.

A large part of the back section is occupied by the battery compartment which, when loaded with "D" type cells, adds to the overall weight significantly (though, unlike some other similar systems, you don’t have to start weight-training to be able to carry the RX-C60L around). Below the batteries you’ll find the usual AC mains input, speaker terminals and voltage selector (for AC), plus a DC input socket — especially useful for taking power from a car battery (via the customary ‘optional’ car adaptor).

Woofers and Tweeters

The speakers on the Panasonic RX are designed to match the styling and power capacity of the rest of the system. Each cabinet contains two drive units, enclosed in an infinite baffle arrangement (or, at least, they would have been if more attention had been paid to absorbing resonances). The drive units chosen — a 1” ceramic tweeter and 4” woofer — complimented the amplifier with admirable range and clarity; even with both amplifiers operating at full power, the music was free from severe distortion and clipping (just try turning the volume right up on a portable cassette recorder and you’ll realise the significance of this). In fact, due to the speakers’ high efficiencies, the sound levels at full volume are more than adequate for a small room; good news for head-bangers everywhere! Listeners of a more discerning disposition will probably find the sound produced is a little top heavy and lacks bass depth, but for the size and construction these speakers perform well. Indeed, the inclusion of fixing brackets allowing you to mount them on the bedroom wall, is just one more endearing quality.

Banding Together

A good example of the thorough way in which this portable has been designed, is the four band stereo tuner. The tuner covers the usual wavelengths with usable FM sensitivity of 2uV (the addition of an external multi-element antenna improves reception markedly). Automatic frequency control (AFC) circuitry provides 'lock' onto FM stations; though, it's a pity this is not a switchable function since low power transmitters are difficult to tune if another stronger signal is nearby on the tuning dial. The approach for SW is far superior, with coarse and fine tuning thumbwheels giving a precision oper-

Table 2: The many different combinations of recording mixing that can be achieved via the mic/line mix facility.

<table>
<thead>
<tr>
<th>ORDER</th>
<th>CONTROLS</th>
<th>Radio Broadcasts &amp; Microphone</th>
<th>Equipment connected to the DIN Connector Jack or Phono Input Jack &amp; Microphone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Function Selector</td>
<td>RADIO</td>
<td>DIN / PHONO</td>
</tr>
<tr>
<td>2</td>
<td>Input Selector</td>
<td>—</td>
<td>Stereo amplifier &quot;DIN&quot; / Record player &quot;PHONO&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Band Selector</td>
<td>FM, LW, MW or SW</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Tuning Control</td>
<td>Tune in your favourite station</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>Tape Selector</td>
<td>Set for the tape used</td>
<td>Set for the tape used</td>
</tr>
<tr>
<td>6</td>
<td>Dolby Noise Reduction Switch</td>
<td>IN</td>
<td>IN</td>
</tr>
<tr>
<td>7</td>
<td>Recording Mode Selector</td>
<td>MANUAL</td>
<td>MANUAL</td>
</tr>
<tr>
<td>8</td>
<td>Mode Selector</td>
<td>Set for the source to be mixed</td>
<td>Set for the source to be mixed</td>
</tr>
<tr>
<td>9</td>
<td>Tape Function Button</td>
<td>1PAUSE -&gt; 2RECORD</td>
<td>1PAUSE -&gt; 2RECORD</td>
</tr>
<tr>
<td>10</td>
<td>Recording Level Control</td>
<td>Adjusts the recording level</td>
<td>Adjust the recording level</td>
</tr>
<tr>
<td>11</td>
<td>Mixing Level Control</td>
<td>Adjust the mixing mic volume</td>
<td>Adjust the mixing mic volume</td>
</tr>
<tr>
<td>12</td>
<td>Tape Function Button</td>
<td>PAUSE</td>
<td>PAUSE</td>
</tr>
</tbody>
</table>

The front and rear panels of the RX—C60L. Both are well stocked with sockets and controls, making provision for just about any application.
The addition of a mixing control and extra microphone input (as mentioned earlier), widens the scope of the recording function considerably. Table 2 summarises the various options available, but probably the most exciting for budding musicians (who own a small portable tape recorder) is mic/line mixing. By plugging a second cassette player into the line input, you can mix together backing and lead tracks; recorded on the RX-C60L's tape system and monitored via the headphone socket.

Panasonic Panache

The integrated amplifier for the system takes inputs from the radio and cassette sections as well as external phono and DIN. Main controls are volume (L + R), bass and treble, with extra equalisation from a loudness button. Two further switches provide mono/stereo and function select, enabling the user to monitor input sources in quick succession.

The volume (‘Level’) and tone controls are well engineered mechanically and electronically. The amount of boost/cut about 0dB is impressive on both bass and treble, though at full volume and boost, the speakers take a bit of a battering. The left and right level controls operate smoothly, taking the output volume from zero to full power steadily — no sudden bursts of sound here — however, this reviewer would have been happier with a balance control rather than the two separate volume sliders. These comments aside, the amplifier teams up well with the rest of the system.

Overall the Panasonic RX-C60L is an excellent piece of design. Apart from a few omissions and areas where improvements could be made, the system really does fulfill its purpose as a portable all-in-one audio centre. Sound quality is quite remarkable for the size and each section is well matched to the others. If you’re looking for a compact audio with stereo cassette, tuner amplifier and bookshelf speakers, it’s worth adding Panasonic to your list.

ACKNOWLEDGEMENT: Our thanks to Angie Patterson for providing us with a review model at such short notice.

Your Reactions

Circle No. 67

Good

Average

Poor

68

69
Dear Sirs,

Your comments on rallies in the October issue raise once again the perennial question of why UK prices for imported equipment are so high, yet the dealers are so poor! The reason is really quite simple - the two tier distribution that grew up in the black box explosion of the seventies is just too expensive for the size of the market. In short, too many people are trying to take a margin on too little business.

This approach, and the pricing polices that go with it, are forcing amateurs to pay for an expensive local service that is really quite unnecessary. After all, amateur radio is a hobby. The majority of us do not need instant local servicing, and, for a major manufacturer or importer a moderate number of exhibitions is far more cost effective than a multitude of permanent dealer facilities for displaying his wares.

It is also more effective for the customer, because he can see a far greater range. Once upon a time they even used to take the lids off the boxes! Fifteen years ago, most equipment came direct from the factory/importer. Coupled with efficient, centralised servicing, this arrangement was quite adequate, and far more appropriate to a rather small and specialised market. In those days, most amateurs did their own ‘firstline’ repairs - in my view they still should; if the equipment is too complex to understand, maybe they should be using something else.

Pricing should be fixed for direct sale by the importer. If dealers can still justify their existence in this environment, then good luck to them, but we should not be compelled to pay for an expensive service that we do not need.

A.J. Shepherd,
Surrey.

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The Good

Dear Sir,
I have recently discovered ‘Radio & Electronics World’ and find it an absorbing and interesting magazine. I have successfully built and installed the recent CB Noise Squelch and considering that the previous item I constructed had valves, you can see that it has been some time since I undertook such a task.
P.J. Whyer,
Bucks.

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The Bad

Dear Sirs,
I am writing with a few comments on R&EW magazine which I hope you will view as constructive criticism. When I first bought R&EW at the start of 1982 I was pleasantly surprised to find a campaigning journal with interesting state of the art projects and articles. However, since then a significant number of articles have been rather poorly produced (typical faults are misidentified components between text, parts list & diagrams, absent information, typographic errors and so on). There are many articles which I would have found particularly interesting were it not for these shortcomings.

I hope that you don’t feel I’ve been unfair in my criticism, but if R&EW is meant to be useful/authoritative some improvements are necessary.
Steve Whitt,
Ipswich.

Fair comment – our efforts at present are directed at improving the accuracy of the projects we publish and a distinct improvement will soon be evident.

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Dear Sirs,

I believe in the November issue of ‘Radio and Electronics World’ an article review on the ‘Sony ICF 2001’ was published.

May I without too much trouble have a photocopy of this article review on the ‘Sony ICF 2001’ as soon as possible. Any costs incurred will be remitted by return of post.

With many thanks.
J.G. Barnes.
Cheshire.

The November issue did indeed contain a review of the Sony ICF 2001 and there are still plenty of back numbers of this issue available from our back numbers department. The charge for back copies of R&EW is only £1 inclusive of postage – the cost of providing a photocopy in terms of staff time etc. would probably be greater than this. In these circumstances it is therefore not surprising that it is not our policy to provide photocopies of individual articles.

The address of our back numbers department is:
45 Yeading Avenue,
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Middx. HA2 9RL.
Incidentally – all orders should be prepaid.

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Dear Sirs,

What a wonderful spirit among your readers. I advertised in your journal for a rare continental socket. A reader in Switzerland sent me one at his expense free of charge.

What a kind gesture.
T.A. Carrick,
Cornwall.

R&EW - the number the world’s sold on.
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Ambit's new autumn/winter catalogue is OUT NOW!
A compact unit for filtering out background noise and interference.
Design by A.P. Roberts.

EVEN INEXPERIENCED radio operators can copy a particular CW transmission from a group of signals and noise. However, deep concentration is required which can become fatiguing after a time. It would obviously be an advantage to have a receiver that gives only the required signal at the output by using an audio filter.

Filters of this type are by no means a new idea. Early designs consisted of a narrow-band audio filter feeding a level detector circuit, which keyed an audio oscillator when the input signal was above a preset level. By listening to the output of the audio oscillator, noise-free reception was produced.

The CW filter uses a similar system (as can be seen from the block diagram of Fig. 3). At the input, are two audio bandpass filters operating on slightly different frequencies. The output of the second filter is fed to a mixer, via a gain control, and then to the headphones. When searching for signals, the gain is adjusted to give optimum volume. Selectivity, given by the input filter, should substantially reduce noise and adjacent channel interference, especially if the receiver does not have an IF or AF filter for CW reception.

It would be possible to use one bandpass filter at the input, but a high Q filter tends to produce an excessively narrow passband — good at reducing unwanted signals, but difficult to use — and a lower Q filter cannot provide a high enough attenuation slope. Using two filters, on slightly different frequencies, widens the passband and gives a rapid roll-off. Fig. 1 shows the frequency response of the input filters, providing a passband about 500Hz wide with 30dB per octave attenuation, sloping away after the resonant frequency.

Setting Up
Details of the printed circuit board and wiring are provided in Fig. 4. A metal instrument case, measuring 150 x 100 x 50mm will comfortably accommodating all the components using the layout shown in the photographs.

Initially, adjust RV2 fully clockwise to produce strong oscillation. If a good quality AF signal generator is available (p.36 in this issue), use it for setting the PLL centre frequency to about 1.2kHz. RV1 is set by connecting the unit to a receiver (set for CW or SSB reception) and tuning to a MW station so that a heterodyne is produced. While monitoring the output using headphones, adjust the tuning to produce a heterodyne within the filter's central passband. The response of the filter is sufficiently 'sharp' for this to be achieved with reasonable accuracy. RV1 is then adjusted to lock the PLL onto the input signal and switch on the audio oscillator.

Two 'scope traces showing (top) barely discernable 7MHz band and (bottom) the filtered single signal output.
Figure 2: Schematic diagram of the Audio CW filter.

**Circuit Description**

*Figure 2* shows the complete circuit diagram of the Audio CW filter.

The bandpass filters are standard op-amp configurations, using two sections of IC1. The total gain through these filters is about 40dB, so an attenuator (consisting of R3 and R4) is used to reduce the output to the original level. This is essential, as the input signal level is likely to be a few volts peak-to-peak, which could cause severe loading on the circuit. The attenuator also ensures that the first filter section is fed from a low source impedance.

IC2 is a LF phase locked loop, primarily intended for use in tone detector circuits. Input levels as low as 20mV are sufficient to operate it, which is a little too sensitive for this application. So, R9 is present to give a small (about 10dB) reduction in sensitivity. R10, RV1 and C9 are the timing components for the current controlled oscillator (RV1 tunes the centre frequency).

A switching circuit, inside IC2, operates at 'lock' to control Q1 via the lowpass filter formed by R1 and C10. C11 is a filter capacitor for the switching circuit of IC2. It must have a high enough value to prevent output switching at the beat frequency, but it must not be so high that the unit will not operate fast enough to accurately reproduce CW signals.

A simple phase shift audio oscillator, based on IC3, is used to generate the audio tone and RV2 is adjusted to give a strong output of reasonable purity. A 741 op-amp was originally tried here, but was found to produce spurious oscillations as the supply fell to a low level. An LF351 was therefore chosen for the final stage and Q1 merely switches the positive supply on and off.

The mixer is a conventional summing op-amp circuit, with RV2 as the gain control for the signal from the bandpass filter. The output of the unit may be excessive for some headphones, particularly low impedance types, so RV4 is included to attenuate the output. SW1 enables the unit to be used as a straightforward audio filter, without the phase locked loop and tone generator.

Figure 3: Circuit blocks used in the CW filter.
PARTS LIST

Resistors
R1,2,19,20
R3
R4,9
R5,18
R6
R7
R8
R10,12,13,14,21
R11,15,16
R17

22k
47R
47k
3k3
2k
100k
5k6
33k
220k
10k horiz preset
47k horiz preset
1k log
10k horiz preset

Capacitors
C1,19
C2,16
C3,4,5,6
22n carbonate
1u 63V axial
10n 63V axial
2n 63V axial
100n 63V axial
3n3 carbonate (5%)

Potentiometers
RV1
RV2
RV3
RV4

10k horiz preset
47k horiz preset
1k log
1k horiz preset

Semiconductors
Q1
IC1
IC2
IC3
IC4

BC179 or BC309
LM1458N
NE567N
LF351
741C

Miscellaneous
SW1
Jack sockets
6 x HP7 cells in plastic holder
Case, PCB, Control knobs
Battery connector (P3 type)
Veropins
Four 8 pin DIL sockets

Operation
The unit can make a vast improvement in signal-to-noise ratio, especially when used in conjunction with a receiver that does not have a built-in CW filter. The narrow locking range of the PLL prevents the problem of two signals activating the unit. However, if the unit will not lock onto an incoming signal properly, the best course of action is to switch off the PLL and tone generator and copy the signal passing through the bandpass filter. When using the unit with a receiver that has wide bandwidths for AM or SSB reception, the BFO should be tuned to one edge of the receiver's passband. Signals 1.2kHz either side of the beat frequency will produce an audio output within the filter's passband. Using this method, one response is brought into the centre of the IF passband, while the other falls outside the passband and is attenuated. Most modern receivers have switched USB and LSB modes (with one of these being used for CW reception) rather than a tunable BFO. With such sets, the BFO is automatically set at the correct frequency.

R&EW

YOUR REACTIONS  Circle No.

Good  
Average  
Poor  

SK1 (EARTH)
(8,9)

SK1 (EARTH)

Figure 4: Component placing and foil pattern.

Internal shot of the prototype filter.
High Frequency Receiver Design

John Dyer traces the development of the modern synthesised HF communications receiver.

The simplest form of receiver is the “straight” or TRF receiver which consists of a tuned RF amplifier, a demodulator, and an audio amplifier.

Figure 1: Block diagram of a TRF receiver

The arrangement is of limited use as a communications receiver as it is virtually impossible to make the tuned RF stages sufficiently selective across a wide range of input frequencies despite the use of positive feedback technique to increase Q. Thus was born the superhet principle in which the incoming frequency is converted to a fixed intermediate frequency (IF). At this fixed IF, the required selectivity could easily be obtained with two stages of amplification, provided the frequency chosen for the IF was low enough, 455 to 470 kHz or even 100 kHz being commonly used.

Figure 2: Block diagram of a single superhet

The frequency conversion is achieved by the use of an oscillator and mixer and this introduces an extra problem, that of oscillator drift. On AM the oscillator has to drift a long way to move the signal out of the IF passband, but this is not the case for CW where filters of 300 Hz or even 100 Hz may be used. With the advent of SSB even less drift can be tolerated, as an SSB signal has to be on tune to within about 80 Hz to be intelligible.

To enable the receiver to cover a wide range of frequencies, the oscillator itself has to cover a large range, and also has to be bandswitched, and this makes the required level of stability difficult, if not impossible, to achieve.

(SSB was pioneered by amateur radio enthusiasts in the late 60’s but due to stability problems it was another decade before SSB became universal in the professional radio world, after the development of frequency synthesis).

On The Beat

From the “spectrum analyser” drawing below it can be seen that for an IF of 455 kHz and a signal on 3.5 MHz the local oscillator has to be set to 3.5 MHz plus or minus 455kHz. In practice the plus side is normally used, thus the oscillator will be set to 3.955 MHz.

Figure 3: Conversion spectrum

This beats with the 3.5MHz signal in the mixer, and one of the resulting products (455 kHz) is picked out by the IF selectivity. However, it is also obvious from the diagram that a signal on 4.41 MHz (the image frequency) will also beat with the oscillator frequency to produce 455 kHz. This image frequency must be rejected, and thus we are back to using a tuned RF amplifier. (Note that RF tuning must “track” the oscillator tuning even though the frequencies are different — hence the name “tracking superhet” for this type of receiver).

As the main selectivity of the receiver is provided by the IF amplifier, the RF tuning need not be as sharp as that required by the TRF set, but only needs to be tight enough to reject the image frequency, which is always removed from the wanted frequency by an amount equal to twice the IF (this can be seen from the above spectrum diagram, and from the expression below:

\[ F_{\text{IMAGE}} = F_{\text{SIG}} + 2 \times I.F. \]

Thus the higher the IF, the further away will be the image and the easier it will be to reject. We now have a conflicting
requirement for a high IF for image frequency and a low IF for selectivity. This led to the development of the double conversion receiver, with a high first IF and a low second IF. One arrangement is to make the first oscillator variable and the second fixed, as shown below, but this configuration inherits all the problems regarding drift outlined above for the single superhet. (See Fig. 4).

The alternative configuration uses a fixed first oscillator (usually crystal controlled) with variable frequency oscillator (VFO) as second. This is equivalent to a single superhet with fixed frequency converter up — front. (See Fig. 5).

The first oscillator can have switchable crystals to cover different bands, and the VFO can be made more stable, as it can have a limited range, with no bandswitching problems. It means that a separate control has to be used for RF tuning, usually known as the "pre-selector" control, and it also means that the first IF is wideband, which could compromise certain aspects of receiver performance — more of which later. Nevertheless, this arrangement has been the basis of many successful limited coverage receivers eg amateur band only, or marine band only receivers.

Variations On A Theme

A variation of the above theme is a technique called pre-mixing, in which the output of a crystal oscillator is pre-mixed with a VFO output before being applied to the signal mixer. (See Fig. 6).

The technique can be used on a double superhet receiver, as shown above in Fig. 6, or can be used to produce a single superhet design with stability similar to the double superhet of Fig. 5. Note that in both cases the wideband IF of Fig. 5 is not required. The bandpass filter is necessary to remove unwanted products of the pre-mixing (mixer 3) process.

However suppose we want unbroken coverage of the complete HF spectrum! This used to be achieved by complex switching of a multi-conversion receiver. On some bands it would be single superhet, some double, and some even triple; with tuning scales for each band of different resolution, and even with reversal of scale direction on some bands!

Nowadays the solution is up-conversion to a first IF higher than the highest frequency being received. Thus for a HF receiver a VHF first IF is used (usually in the range 40 to 90 MHz). This enables unbroken coverage and has the advantage of putting the image frequency not only very far away (for a 10 MHz signal an IF of 48 MHz means an...
image is at 106 MHz), but also easily rejected by means of a 35 MHz low-pass filter. (See Fig. 7).

This still leaves us with a wideband first IF, and also the problem of how to generate the first local oscillator signal. Banks of crystal oscillators were originally used, which is expensive and involves a lot of switching. Also for an IF of 48 MHz and a signal at 29 MHz, the local oscillator will be running at 77 MHz and will be none-too-stable.

This leads us to the idea of some device which can synthetically produce a number of frequencies (hence the name frequency synthesiser), which have the same stability as that of a single crystal controlled reference oscillator. The latter can be made very stable by suitable choice of crystal and professional receivers use ovened crystal oscillators of 1 in 10^8 °C stability, giving 0.1Hz drift at 10MHz! Even an un-ovened crystal can give 1 in 10^6 °C which is 10Hz at 10MHz.

It must be understood that the synthesiser generates a discrete set of frequencies and doesn't tune continuously like a variable oscillator. Thus a HF receiver can either use a small number of big steps — eg. 30 steps of 1MHz used like a bandswitch, with VFO to tune across each 1 MHz band (called partial synthesis); or it can use a large number of small steps (10Hz or 100Hz) and by dispensing with the VFO can achieve very high stability (full synthesis).

A form of partial synthesis was first used on the Racal RA17 receiver using an error correcting loop technique called "Wadley-loop triple mix".

Bandswitching is achieved by roughly setting the MHz oscillator. Any error or subsequent drift will be reflected as a shift at the first IF. However the oscillator output is also mixed continuously like a variable oscillator. Thus the frequency shift near 37.5 MHz is used as an injection frequency for the second mixer. Thus the frequency shift in the first IF is exactly cancelled out in the second mixer. Tuning of the 1 MHz band is by VFO into mixer 3.

The RA17 represented a great step forward in its time (the early 50's) with its five foot wide tuning scale (a moving 35mm film-strip) on each 1 MHz wide band, with near constant tuning on each band, and rock-like stability. However, the first two IF's were both wideband (1MHz wide) and this had an effect on cross modulation and intermodulation performance, especially in later versions of the receiver which used bipolar transistors in place of valves — see Ref. 1 and Ref. 2 for full details.

Cross modulation and intermodulation occur due to non-linearities in any of the receiver stages (especially mixers) up to the first really selective stage. Thus for maximum performance we want a first conversion stage to a narrow band first IF, ie. to introduce at the first (VHF) IF, a fairly sharp filter (called a roofing filter).

Thus we need either a full frequency synthesiser, or a partial synthesiser with a VFO feeding into the synthesiser and not the second mixer. The synthesis process must be completely separate from the signal path, not intertwined as in the Wadley loop. The preferred configuration for a synthesised receiver with up-conversion is thus as shown below in Fig. 9.

**Frequency Synthesisers**

Initially all sorts of techniques were used for frequency synthesis including the previously mentioned pre-mixer techniques, which can be thought of as being simple partial synthesizers. But now one method reigns supreme — the phase lock loop. As an example of a partial synthesiser for a general coverage receiver consider the block diagrams above and below for the Trio R1000 receiver.

A phase lock loop works as follows. A voltage controlled oscillator (VCO) is forced by its DC control voltage input to run such that the frequency fed back to a phase detector is the same as the accurate reference frequency also fed to the phase detector.

Thus if a programmable frequency divider is incorporated into the loop, a discrete set of frequencies can be generated by altering the division ratio of the divider. Similarly, if a mixer is also included in the loop, a continuously variable frequency, such as that from a VFO, can also be fed in.

In the case of the R1000 the thirty 1MHz bands are provided by switching the division ratio of the N adjustable counter, and tuning across each band is by feeding the output of a VFO into the loop mixer (mixer A).

The second mixer injection frequency of 47.6MHz is generated by a crystal oscillator, and a further refinement is to also feed this signal into the loop via mixer B. Thus as well as the main (phase locked) loop, we also have a secondary error correcting loop involving both mixers and the first IF (in a similar way as the Wadley loop), which corrects for any drift in the second mixer frequency.

(points marked X and Y are discussed later — see Fig. 12) In a fully synthesised receiver the VFO is replaced by another phase locked loop (or loops) in which synthesis down to steps
of 100Hz, 10Hz, or even 1Hz, can be achieved. The first full-synth. receivers used a row of switches to set the desired frequency and while this may be suitable for point-to-point type receivers, it is of limited use for a general purpose “search” type receiver.

Thus the “digital VFO” concept was developed in which the operator can tune the receiver just as if he were tuning a VFO, but in fact the tuning knob is connected to an optical shaft-encoder, which generates pulses to drive a counter up or down. It’s the output of this counter (usually in BCD form) which converts the tuning input into a digital frequency and while this may be suitable for point-to-point type receivers used a row of switches to set the desired frequency and channel scan; computer control by external data bus; etc.

In some receivers “almost-but-not-quite” full synthesis is employed in which a variable crystal oscillator (VXO) is mixed into the loop to interpolate the final 10 Hz (usually called the “clarifier” or “Δf” control). Receiver Independent Tuning (RIT) can also be implemented in a similar way, but using a range of (say) ±8 kHz.

It should be noted that a lot of the synthesizer circuitry is digital rather than analogue. This applied to the +N programmable divider (which can be quite complex), the reference dividers, and even the phase detectors. Also, in the case of full synthesis, the shaft encoder and counter and all the “optional extra’s” mentioned above. This digital circuitry is implemented using integrated circuits (chips).

A further well known example of the application of digital electronics to “steam” radio, is the use of frequency counter (FC) and display to replace (or supplement) the conventional tuning scale. The FC actually measures the frequency being received by looking at the mixer injection frequencies and, applying a suitable IF sidestep it counts the pulses over an accurate gate period and displays the result. Accuracy can be very good, and basically depends on the accuracy of the reference frequency used to generate the gate period. This reference source can be the same as that for the synthesizer — thus a single high accuracy (low drift) reference source can do both jobs.

Nowadays, all the complex digital FC circuitry can be obtained in a single chip which can drive a display direct (LED, fluorescent or liquid crystal) and which can be programmed for a number of standard IF’s. The R1000 uses such a chip, and the various frequencies in the receiver have been carefully chosen so that by mixing the two main synthesizer output frequencies together (in mixer C) an output is obtained which is equal to the received frequency plus the standard IF of 455 kHz. This, after a +10 prescale, is suitable for feeding the FC chip, as shown in Fig. 12 below.

Note that some fully synthesised receivers don’t use a true frequency counter but simply decode and display the BCD data used to program the +N loop counters. However this relies on all loops being in lock, and doesn’t show the effects of clarifier or RIT controls. (See Fig. 11).
The Modern HF Receiver

Figure 13 depicts a possible configuration for a general coverage HF communications receiver with a first IF of 48 MHz and a second IF of 1.4 MHz. As can be seen, the use of frequency synthesis, and up-conversion techniques aren't the only changes that have taken place with HF receiver design.

Early synthesised receivers retain the tuned RF stage, with separate preselector bandswitch and preselector tune control (eg, the Racal RA17 range). These are somewhat inconvenient in use and in the interest of simplicity of operation, considered to be of great importance in the professional field, the tuned RF amplifier has been replaced by a wideband RF stage preceded by a number of bandpass filters. These are usually octal filters; ie, they cover a frequency range such that the highest frequency is twice the lowest, and are normally automatically switched (using electronics (diode) switches), by decoding the BCD bandswitch data from the synthesizer. For a typical array see Fig. 13 (uses a low pass filter below 500 kHz).

Linearity in RF amplifiers and mixers is, as already mentioned of great importance. (ie, mixers must be linear for two signals arriving down the signal input, but they must of course be non-linear in the case of one signal on each input, or they wouldn't be mixers!) FET's are now universally used as RF amplifiers as they are more linear than bipolar transistors, and have good noise performance. (The dual gate MOSFET has the additional advantage of a good AGC characteristic). Linearity can be further improved by using high voltage supply rails and in some cases power transistors and FET's have been used with claims that 140dB of dynamic range have been achieved. Mixers are usually balanced or double-balanced (for good cross-modulation performance) using FET's or diode ring modulators, and use high injection levels to improve "single-port" linearity. The use of a front-end attenuator to improve cross-modulation and intermodulation performance has been common-place for some time, but has the disadvantage of reducing sensitivity. With a carefully designed receiver this attenuator can be dispensed with.

Traditional IF amplifiers have had "distributed selectivity", ie, each amplifier stage contributes to the overall selectivity. Again, a change has taken place and now the IF amplifier is either wideband, or fairly broadly tuned, and preceded by a block filter, which alone determines the selectivity of the receiver. In practice various filters are provided and can either be selected manually or are automatically switched by the mode switch (often using electronic switching). Good quality filters can be made with the nearly ideal response of a flat top with very steep sides (good shape factor), with a stopband at better than -60dB; and a typical array of 5 filters for a professional communications receiver is shown in Fig. 13. The filters may be crystal, mechanical, or (cheaper) ceramic, and the use of such filters means that the old constraint of needing a low second IF no longer applies. Indeed, it's much easier to make crystal filters at IF's of 1.4, 1.6, 9 or even 10.7 MHz, although many ceramic filters are still at 455kHz.

Variable IF's

A technique often used on imported (Japanese) Amateur transceivers is "variable IF bandwidth" using pairs of filters and extra conversion stages. A possible scheme is shown in Fig. 14 to illustrate the principle.
1.1312t;ARY 1983
53
injection at the IF minus 1.5kHz for USB, and plus 1.5 KHz for
generated by the synthesisor. The 010 normally provides
oscillator (C10)
be re-inserted so either a crystal controlled carrier insertion
made an appearance on HF. On SSB the missing carrier has to
form of FM discriminator is sometimes now fitted as NBFM has
fitted to give a choice of decay times.
20ms) to follow fast fading. Often "Fast/Slow" switches are
a slow decay (2s), or even better, fast attack a "hang" of 2s
change for 100dB change in input. On SSB and CW where there
complex using amplification to achieve figures of 3dB output
(Trio R820) which uses independent variable IF bandwidth, IF
conversion and filter stages of a triple conversion superhet
Thus an interfering signal can be pushed out of the passband.
2.4kHz, and for CW with 600Hz filters bandwidth can be varied
2.4kHz SSB filters bandwidth can be varied from about 600Hz to
With the variable crystal oscillator (VXO) set to 9.455MHz the
is no carrier the AGC must have fast attack (10ms typically) and
is put into designing front panels that are logical and easy to
use (known as Ergonomics). This is enabled by the current trend of
considerable interest is currently being expressed in other
types of demodulator, such as synchronous and coherent
detectors, which give improved performance. FM is now
gaining a foothold in the HF bands, and needs a separate
limited IF Amplifier, discriminator, and squelch circuit. Again a
single chip is available to do the job.
The audio amplifier is fairly conventional and is usually
implemented with a 1.5 or 2W AF chip. A separate line amplifier
is often provided with its output unaffected by the AF gain
control. In some amateur equipment sharp audio filters are
used in lieu of a good CW filter in the IF.
Finally consider the man-made interface. Considerable effort
is put into designing front panels that are logical and easy to use
(known as Ergonomics). This is enabled by the current trend of
making virtually all controls semi-remote. Thus front panel
switches switch DC voltages, which are used to operate the
"actual" switch, which is an electronic device on the circuit
board itself (usually diodes, transistors, CMOS analogue
switch etc.) Similarly a BFO knob, instead of being connected
by a shaft to a variable capacitor in the BFO, now operates a
variable resistor, and a DC control voltage is fed to a varicap
diode in the BFO. This gives the freedom to place controls
everywhere on the front panel, and also considerably eases the
problem of internal layout design. With the replacement of the
tuning scale by the FC, there are now virtually no mechanical
moving parts in the receiver.
Full remote control is also possible, with a receiver at a
remote aerial site (free from QRM), with an operator and his
dummy front panel twenty miles away down a microwave link!
Thus we've come a long way from the traditional 10 valve
"tracking" superhet. We now have a synthesised, wideband
superhet with block filtering and full of chips!
A probable future development is the use of microprocessor
control — an "intelligent" HF receiver! Such a receiver will have
about 10000 active devices in it, (if you add up all the devices in
every chip), and thus receiver complexity will have increased by
roughly 1000 times, in the space of 40 years.
References
1. Winn, R.F.E. (Racial Communications Ltd.) Synthesised
2. Winn, R.F.E. Effects of Receiver Design in Communications
Systems, IERE Proceedings of the Conference on Radios
Receivers and associated Systems, 4-6 July 72, pp 193-204.

Figure 15: Variable bandwidth response

Figure 16: Variable bandwidth, IF shift and tuneable notch
With the variable crystal oscillator (VXO) set to 9.455MHz the
response curves of the two filters coincide. If the VXO
frequency is varied slightly, the response curves no longer
coincide and the effective bandwidth is reduced (see Fig. 15).
The second mixer returns the IF to 9MHz and compensates for
a signal shift caused by the first mixer. If high quality (8 pole)
crystal filters are fitted good results can be obtained. With two
2.4kHz SSB filters bandwidth can be varied from about 600Hz to
2.4kHz, and for CW with 600Hz filters bandwidth can be varied
down to 150Hz or so.
Another technique used is known as IF shift. Here the
received signals can be (apparently) shifted within the IF
passband without a change in CW pitch or SSB intelligibility.
Thus an interfering signal can be pushed out of the passband.
Figure 16 shows a much simplified block diagram of the
conversion and filter stages of a triple conversion superhet
(Trio R820) which uses independent variable IF bandwidth, IF
shift, and a variable IF notch filter.
Automatic gain control (AGC) systems have become fairly
complex using amplification to achieve figures of 3dB output
change for 100dB change in input. On SSB and CW where there
is no carrier the AGC must have fast attack (10ms typically) and
a slow decay (2s), or even better, fast attack a "hang" of 2s
where the output doesn't change, followed by fairly fast decay
(200ms). For AM a fast attack and fast decay is required (eg.
20ms) to follow fast fading. Often "Fast/Slow" switches are
fitted to give a choice of decay times.
The demodulator stage invariably consists of an envelope
detector for AM, and a product detector for SSB and CW. Some
form of FM discriminator is sometimes now fitted as NBFM has
made an appearance on HF. On SSB the missing carrier has to
be re-inserted so either a crystal controlled carrier insertion
oscillator (C10) is used, or the necessary frequencies
generated by the synthesizer. The C10 normally provides
injection at the IF minus 1.5kHz for USB, and plus 1.5 KHz for
LSB. The alternative is to use two separate asymmetrical SSB
filters, one USB, one LSB, and then to inject at exactly the IF.
For CW a variable "beat frequency oscillator" (BFO) is used.

Enter LSI

Discrete circuitry (FETs and transistors) is still often used for
the IF amplifier, but complete "IF system" chips are already
available, with a complete IF strip, AM and SSB demodulator,
comprehensive AGC system including hang AGC, and audio
pre-amplifier. These large scale integration (LSI) devices will
undoubtedly be increasingly used, but one possible snag that
needs careful watching is the introduction of wideband noise
after the main selectivity filters.
Another example of a single chip is the noise blanker, which
can be effective on impulse type noise. It consists of an IF
amplifier with its own AGC system, a noise pulse shaper or
detector, and a "noise gate" in the main IF path (usually prior to
the main selectivity).

Considerable interest is currently being expressed in other
types of demodulator, such as synchronous and coherent
detectors, which give improved performance. FM is now
gaining a foothold in the HF bands, and needs a separate
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Your reactions

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Gary Evans with a ‘from the sidelines’ view of Breadboard and the Electronics Hobbies Fair.

The minor epidemic of exhibitions for the electronic hobbyist that broke out in mid-November last resulted in a few people catching a cold. Of the two events, Breadboard and the Electronics Hobbies Fair, there was little doubt in the minds of those who visited both, that the Hobbies Fair was the better attended and more professionally organised of the two. Having said that though, the dilution of effort on behalf of the trade and the understandable reluctance on behalf of the paying public to attend both events meant that neither show really lived up to expectations.

The jovial introductions to the two exhibition guides boldly proclaimed that anything and everything of interest to the hobbyist had been gathered together under one roof — the sad fact being that this was not the case. Of the larger mail order firms, some, including Watford put their efforts into Breadboard, while others, Maplin being the most notable, decided that the Hobbies Fair was for them. Few firms attended both shows although those that did decide on an each way bet included familiar names such as Clef Products, Vero and our friends at Ambit.

As the two exhibitions were staged by rival publishing houses that are between the two of them responsible for the majority of electronics hobbyist magazines, it is not surprising that each exhibition had only four or five magazines represented. Of the ‘independent’ publications in the business Elektor chose to attend Breadboard (the booking having been made after last year’s Breadboard) while we at R&EW chose the Hobbies Fair.

As to the number of people passing through the respective turnstiles, the Hobbies Fair, although a day shorter than Breadboard, attracted getting on for twice the number of people. This is all the more surprising in view of the fact that the admission charge for the Hobbies Fair was about double the price eventually charged on the door at Breadboard.

Bread-Bored

As Breadboard was the first of the two events to be staged we’ll take a closer look at this before shifting the attention to the Hobbies Fair.

The venue chosen for the show was the Royal Horticultural Society’s New Hall just off Victoria Street in the centre of London. Although a central location has many attractions in terms of the ease with which people can get to the place, the Central Hall is rather a drab and uninspiring edifice. The general atmosphere of the building was closer to a bring-and-buy sale rather than, what purported to be, the country’s premier hi-tech electronics exhibition.

The stand guide showed that, with some 36 exhibitors, it was obvious many people had stayed away and a large area coyly designated as a rest area, showed that the organisers had misjudged the number of people wanting stand-space at the show. The rather large computer display area, which turned out...
The first day of the Hobbies Fair saw a queue of people waiting to enter.

The R&EW stand featured a demonstration of the REWTel system.

The R&EW stand during a quiet moment.

To be one of the most popular areas, also had the distinct ring of a last minute space filler.

The stands that were there, included many household names from the component supply industry, Vero, Watford and Ambit have already been referred to but others in the shape of Bradley Marshall, Display Electronics, Roadrunner and SGS had also set up shop for the duration.

None of the exhibitors were very happy with the volume of business during the show and even allowing for the generally low attendance levels and the very slow start to the show — not helped by pouring rain on the first two days — it would appear that the general economic situation had not left people with much money in their pockets.

As far as magazines at Breadboard go, familiar names such as ETI, Hobby Electronics and Computing Today were represented and generally managed a good showing in fact almost 25% of the stands at Breadboard were concerned with publishing of one kind or another.

The catering facilities at Breadboard proved adequate, but only because of the few people in the hall at any one time. If the event had been any better attended, the one small drink/food 'area would not have been up to the task of 'feeding the 500'.

One welcome feature of Breadboard was a series of lectures running in parallel with the main event and covering topics ranging from Electro-Music through Holography to Cable TV.

To sum up, this year's Breadboard was a rather drab and low-key affair that was poorly attended by both trade and public.

**Electronics In Camping**

In contrast to Breadboard's central location, the venue for the Electronics Hobbies Fair was North London's Alexandra Pavilion. Although little more than a white plastic sheet stretched over a steel frame, the new exhibition area created a light, airy and pleasant atmosphere. Getting to and from the show was made relatively easy as the organisers had arranged for combined British Rail and entrance tickets and a regular London Transport shuttle service between the BR station and Wood Green underground.

Almost twice as many exhibitors compared to Breadboard had booked into the show, with many, including Maplin booking more than one stand. Maplin in fact took three stands, and their new catalogue, published on the first day of the show, sold extremely well.

Component suppliers and kit suppliers were much in evidence along with the likes of the RSGB, the Army Apprentices College and even the BBC. Pride of place in terms of stands must however go to the three sponsoring magazines, PE, PW and EE. Their circular display featuring all three titles concealed a hospitality suite that was rather well stocked with various beverages.

On the subject of catering, the Alexandra Pavilion provided a number of bars, buffets and shops meaning none of the queues evident at other events made an appearance.

**End Of The Day**

The challenge that the Electronics Hobbies Fair made to Breadboard's supremacy in this type of exhibition resulted in, if not exactly a winner and a loser, a bedraggled Breadboard and a slightly smug Hobbies Fair.

Hobbies Fair has booked the same venue for 83 (November 10-13) so it looks as if this show is firmly on the map. As yet there is no news of next year's Breadboard but it is unlikely that the powers behind this show will let it fold. Breadboard will have to do something special if it is to regain its premier position in the exhibition stakes.

The major lesson to be learnt from this year's shows is that neither trade nor public can cope with two events separated by only a few days. If this is to change, Breadboard will have to change its dates. Let's pray that they do so.

**YOUR REACTIONS**

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Ref.: R&EW/2/83
MORSE SPEED READOUT

Tony Bailey G3WPO follows up last month's CMOS Keyer with a digital 'keying speed' display unit.

BEFORE LOOKING at the circuit, it's worth defining what constitutes morse speed in words per minute (WPM). For instance, plain language and 5 letter groups, given a constant dot speed, are not running at the same speed in WPM! Using the standard of 3 dots per dash, 1 dot space between dots/dashes, 3 dot spaces between characters and 7 dot spaces between words, the word 'PARIS' (generally accepted as a speed setting standard) contains 50 dot elements; 600 of these constitutes 12 WPM with an average dot length of 0.1 seconds.

As the period of 0.1 seconds is equivalent to 12 WPM, counting the number of dot elements sent in 1.2 seconds will give the speed in WPM. This can be achieved by measuring the clock frequency of the keyer (assuming the keyer has a clock period equivalent to a dot length) on a digital frequency meter. However, the measurement period will have to be 2.4 seconds, as one cycle of the clock will be 2 dot-units in length.

This standard is used for our circuit, though the calibration can be set for any other standard you desire.

Figure 1: The complete circuit of the Morse Speed Readout. There are a lot of CMOS IC's, so it's best to use sockets and solder the other components first. (Note that one of the gates in IC3 is not used).
Circuit Description

Looking at Fig. 3, a 555 timer, IC5, (astable mode) generates the clock period for the counter, with RV3 setting the speed. IC4, a dual flip-flop, provides the reset and latch pulses for the counter, with the output pulses integrated by resistor/capacitor networks on pins 1 & 2.

A phase-locked-loop, takes the pulses from the keyer clock. The VCO frequency is divided by 10 (via IC2) and compared with the input frequency in the phase detector. The phase detector output is then filtered and applied to the VCO so that it locks to a multiple of the input frequency. The 2.4 second clock can now be reduced to .24 seconds, accurately set by RV3.

IC3b & c invert the pulses from the 4013 to obtain the waveforms required by the 4510/4511 counter circuits. The R&EW Keyer's clock, in common with many other keyers, does not run continuously, but only while keying. To get round this, a delay is introduced before the counter updates the display. The output on pin 1 of the 4046 goes high when the VCO is locked to the input signal. This is connected to a delay network (C4, D1, R18, RV2), which controls an extra gate, IC3a. Until the VCO is locked, and C4 approaches full charge, the voltage at pin 9 of IC3a will be insufficient to allow the output to change states.

When the VCO is locked, pin 1 of IC1 stays high and after a short delay, latch pulses pass through IC3a. The delay is set by RV2 to around 0.5 seconds to ensure that a full clock cycle has occurred before any latch pulse is enabled. An indication of the VCO being locked is given by LED1. This intermittently flashes until lock is achieved, when it glows continuously and the display shows the correct speed.

The circuit requires a +12V supply at 40-200mA, depending on the segment configurations at any given moment. Thus the keyer and display are best powered by a regulated supply rather than a battery.

The 4046 input circuit is capacitively coupled (C1) to the keyer clock and locks onto inputs ranging from a few hundred millivolts to the supply voltage. If your keyer clock runs continuously, the display will update continuously; otherwise a series of dots or dashes need to be sent until the VCO is locked and the speed is indicated. The VCO will lock over a speed range of 6-60 WPM without any problem, although lock takes longer at the extremes of that range.

Construction & Testing

The counter is accommodated on 2 single sided PCB's (Figs. 2 & 3), one for the display and the other for the remaining circuitry. All IC's are held in sockets, but the displays are soldered directly to their PCB.

After checking the wiring, connect up the power and clock from the keyer. The LED's should give an arbitrary display, as no reset or latch pulses are generated until the clock input has been running.

Set RV1, 2 & 3 to mid-travel. Then, with the keyer running continuously at about 55 - 60 WPM, adjust RV1 so that the +ve end of C3 reads close to 9V. Now, sending bursts from the keyer, adjust RV2 so that the display updates about 0.5 seconds after the LED glows continuously.
### PARTS LIST

#### Resistors
- R1-14,19,20,25,26: 1k
- R15: 330k oxide
- R16,17: 10k
- R18: 27k
- R21,22: 2k2
- R23: 100k
- R24: 15k
- R27: 100k oxide

#### Potentiometers
- RV1,3: 100k ALPS cermet preset
- RV2: 100k ALPS preset

#### Capacitors
- C1,4: 4u7 tant
- C2: 22n Mylar
- C3: 22u 15V tant
- C5,6,7,9,11: 10n disc
- C8: 1u polycarb
- C10: 100n tant
- C12: 100n tant

#### Semiconductors
- D1: 1N4148
- LED1: Green 3mm
- Q1: BC237
- IC1: 4046
- IC2: 4017
- IC3: 4011
- IC4: 4013
- IC5: 7555
- IC6,8: 4511
- IC7,9: 4510

#### Miscellaneous
- 7 segment LED displays (common cathode, 2 off), 0.1" dia pins (3 off), 10 way PCB mount parallel-to-face connectors (2 off), 10 way PCB plug connectors — straight (2 off), 16 pin DIL sockets (6 off), 14 pin DIL sockets (2 off), 8 pin DIL socket, case, PCB.

Internal view of the Speed Readout. A small piece of polarising glass is placed in front of the display board to protect the LED segments and hold the PCB in place.

The only remaining adjustment is to set the counter period with RV3. There are several ways of doing this. Either, send the word PARIS at 12-15 WPM, counting how many times it is sent in 1 minute, or use a scope and set the clock period to exactly 0.24 seconds.

If your keyer has a clock that doesn’t have a period equal to the dot length, it is still possible to use the unit but the counter period will have to be altered to accommodate it (ie, if it is 4 periods to a dot then the counter period will be only 0.06 seconds) and the VCO frequency altered (set by R15, RV1/C3).

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Peter Luke investigates Panasonic's budget recorder and likes what he finds.

THE PANASONIC NV7800 reviewed last month represents the company's top of the range recorder for which, not unexpectedly, you'll have to pay a fairly top of the range price. Those of you that can do without such bells and whistles as Dolby C noise reduction and stereo audio may find the company's NV-366 recorder a better buy.

Other Panasonic products, of the 24 hour format, and provides a large, easy to read display. The tape counter is, unfortunately, a mechanical affair and is rather small and difficult to read. It's nice to see that a memory rewind facility is included on the 366 even though it is a budget machine. Other front panel controls include the motion controls output but the video output would perhaps be better placed at the front of the machine where it would be easier to locate. RF input and output connections are also on the rear panel along with a test signal switch. The NV 366 also features a sensitivity switch for the RF stage — the instructions suggest that this is normally set to HIGH, the LOW setting only being used if any cross modulation effects are noted on the screen.

We did not have an opportunity to measure the RF sensitivity but did note that in the high position the Panasonic could pull in stations that a Sony portable set connected to the same aerial system could not.

Setting Up
Getting the Panasonic going is relatively straightforward — the built in test generator aids tuning the TV set to the frequency of the 366's modulator while the use of manual tuning means that it's not necessary to master the vagaries of an electronic tuning system.

The tape transport controls have already been mentioned with their generous size making them easy to use. Their large size however means that there seems to have been no room left for individual controls for the review functions. The review, which incidentally is at five times normal speed, thus shares the rewind controls. Pressing the appropriate wind control while the machine is in play will activate the search function. This arrangement is not as elegant as providing separate controls.

Grouped together with the transport controls is the eject button. The eject function of the 366 is solenoid controlled rather than the mechanical system adopted on most VHS machines. This is
a more stylish approach but does mean that power must be applied to the machine for it to operate. This reviewer was caught out a few times, realising after the mains had been disconnected that a cassette was still in the machine. In addition if the tape fouled in the recorder, the electronic system might be fooled and one might wish for the simplicity of a mechanical eject function.

Why A Wire
The 366 features the valuable record interlock facility, preventing channel change when the machine is in record. Pausing the machine while in record will release this interlock, allowing the station to be changed.

The major pointer to the budget nature of the recorder is the fact that its remote control unit is of the wired rather than IR kind.

The unit provides control of all transport functions duplicating all front panel controls. When connected, the remote will "lock out" all front panel controls with the exception of stop and eject. This was probably by accident rather than design as there would appear to be no reason for defeating the front panel controls in this way and during the period of the review, was found to be irritating on more than one occasion.

For a low cost machine, the 366's timer is a fairly up market 14 day 4 event type.

Entering the stop and start times follows the same procedure as that described for the 7800 last month. The system is easy to use and timer settings can be confirmed at the press of a button.

The OTR facility is a Panasonic idea that enables timed recordings of between 30 minutes and 2 hours to be entered by means of a single control. To use the OTR facility the recorder is switched on and the channel to be recorded is selected. Pressing the OTR button once will display 0:00 instead of the clock display. Pressing the button again will display 0:30 and start the recording. Further operation of the OTR control will select 1:00, 1:30 or 2:00 recording times. During the recording the display will count down to give an indication of the amount of recording time left.

This OTR facility was most welcome, meaning that if one had started watching a programme but for whatever reason was dragged away, the recorder could very quickly be programmed to record the rest of the material.

Polyglot Pages
The instruction manual, although of a multilingual nature, was clear and provided a logical explanation of the 366's operation. This is due to the fact that Panasonic have not fallen into the trap that many other multilingual offerings fall into. Panasonic have completely separate sections devoted to the different languages rather than all versions of the text explaining a particular feature being lumped together on the same page.

Final points
The quality of the playback from the 366 was good — there are very few machines on the market that fall down in this respect, the choice between various models being on the facilities that they offer. In terms of facilities, the Panasonic 366 does rather well for a budget machine.

Still frame, frame advance, fast search, memory rewind, OTR multi-event timer — the list goes on. About the only down market thing about the machine is its wired remote control.

All in all the 366 is a good machine at a low price.
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Clocked flip-flops form the basis of virtually all digital counter/dividers, shift registers and data latches. Ray Marston explains how CMOS versions of these devices work.

CMOS digital IC's can be classified into two basic types, one of these being 'logic' IC's that are based on simple gate networks, and the other type being those that are primarily based on clocked flip-flop (bistable or memory) elements. This latter category of devices includes simple counter/dividers, shift registers and data latches, etc., and complex devices such as presettable up/down counters and dividers. In all cases, however, the devices are based on the clocked flip-flop element, which is a fairly simple device.

In the next few pages we explain how the clocked flip-flop works, and then go on to introduce some simple CMOS flip-flop IC's and show practical ways of using them. As an immediate follow-up we will, in the next two issues of 'Data File', introduce a range of advanced counter/divider IC's and associated devices, together with a stack of applications information.

Basic Principles

The simplest type of CMOS flip-flop is the cross-coupled bistable, and Fig. 1 shows the circuit, symbol and truth table of a NOR-gate version of this device, which has two input terminals (normally tied low via pull-down resistors) and a pair of anti-phase output terminals. The basic action of the circuit is such that if the SET terminal is briefly taken high (to logic-1) the Q output immediately switches high (and the Q output switches low), and the cross-coupling then causes the outputs to latch into this state even when both inputs are pulled low again. The only way that the output states can then be changed is to apply a logic-1 to the RESET terminal, in which case the Q output immediately switches low (and the Q output switches high), and the cross-coupling then causes the outputs to latch into this new state even when both inputs are pulled low again.

Thus, the basic SET-RESET (S-R) flip-flop acts as a simple memory element, which 'remembers' which of the two inputs last went high. Note that if both inputs go high simultaneously, the output state cannot be predicted, so this state must not be allowed to occur.

The versatility of the basic Fig. 1 circuit can be greatly enhanced by wiring an AND gate in series with each input terminal, using the connections shown in Fig. 2, so that 'high' input signals can only reach the S-R flip-flop when the clock (CLK) signal is also high. Thus, when the clock signal is low, both inputs of the S-R flip-flop are held low, irrespective of the states of the SET and RESET inputs, and the flip-flop acts as a permanent memory, but when the clock signal is high the circuit acts as a standard S-R flip-flop. Consequently, information is not automatically latched into the flip-flop, but must be 'clocked' in via the CLK terminal: this circuit is thus known as a clocked S-R flip-flop.

Figure 3 shows how two of these clocked S-R flip-flops can be cascaded and clocked in anti-phase (via an inverter in the clock line) to make the most important of all flip-flop elements, the so-called 'clocked master-slave flip-flop'. The basic action of this circuit is as follows:

Master-Slave Flip-Flop

When the CLK input terminal of Fig. 3 is in the low state, the inputs to the 'master' flip-flop are enabled via the inverter, so the SET-RESET data is accepted, but the inputs to the 'slave' flip-
A 'Toggle' or type-T flip-flop is a Fig. 3 type configured as shown.

Figure 4: A 'Toggle' or type-T flip-flop is a Fig. 3 type configured as shown.

Figure 6: A D-type flip-flop can be used as a data latch (a) or as a divide-by-two (binary counter/divider) circuit.

Figure 5: Basic circuit (a), symbol (b) and truth-table of a simple D-type flip-flop.

Thus, the clocked master-slave flip-flop accepts input data or information only when the clock signal is low, and passes that data to the output on the arrival of the leading edge of a positive-going clock signal (edge-clocking). The clocked master-slave flip-flop is such an important device that it is given its own circuit symbol, as shown.

The clocked master-slave flip-flop can be made to give a toggle or divide-by-two action by cross-coupling the input and output terminals as shown in Fig. 4, so that SET and Q (and RESET and Q̅) logic levels are always opposite. Consequently, when the clock signal is low, the 'master' flip-flop receives the instruction 'change state', and when the clock goes high the 'slave' flip-flop executes the instruction, so that the output states change on the arrival of the leading edge of each new clock pulse. It takes two clock pulses to change the output from one state to another and then back again, so the output switching frequency is half that of the clock frequency. This circuit, which is known as a 'Toggle' or type-T flip-flop, thus acts as a binary counter/divider.

`D' and `JK' Flip-Flops

The type-T flip-flop is a specialised element which acts purely as a counter/divider. A far more versatile device is the 'Data' or type-D flip-flop, which is made by connecting the clocked master-slave flip-flop in the configuration shown in Fig. 5, in which an inverter is wired between the S and R terminals of the flip-flop, so that these terminals are always in anti-phase and the input data is applied via a single DATA pin. Figures 5b and 5c show the symbol and truth table of the type-D flip-flop, which can be used as a data latch by using the connections shown in Fig. 6a, or as a binary counter/divider by using the connections shown in Fig. 6b, in which the D and Q̅ terminals are coupled together.

Figure 7: Basic circuit (a), symbol (b) and action table of the JK flip-flop.

The clocked master-slave flip-flop accepts input data or information only when the clock signal is low, and passes that data to the output on the arrival of the leading edge of a positive-going clock signal (edge-clocking). The clocked master-slave flip-flop is such an important device that it is given its own circuit symbol, as shown.

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The two best known CMOS clocked flip-flop IC's are the 4013 D-type and the 4027 JK-type. Both of these IC's are duals, each containing two independent flip-flops sharing common power supply connections. Figure 8 shows the functional diagram, pin connections and truth tables of the 4013, and Fig. 9 shows similar details of the 4027.

Note that both of these flip-flop IC's have SET and RESET input terminals that are additional to the connections shown in the basic circuits of Figs. 5 and 7. These terminals are known as DIRECT inputs and enable the clock action of the flip-flop to be over-ridden, so that the devices act as simple unclocked SET-RESET flip-flops. For normal clocked operation (counter/divider or data latch, etc), the direct R and S terminals must be tied to logic-0, as indicated.

The 4013 and 4027 are fast-acting IC's, and it is very important when using them to note that their clock signals must be absolutely 'clean' (noise-free and bounceless) and have rise
and fall times of less than 5 µS. The 4013 is particularly fussy about the shape of its input clock signals, the 4027 being rather less fussy about such matters. Both IC’s clock on the positive transition of the clock signal.

Ripple Counters

The most popular application of the clocked flip-flop is as a binary counter, and Fig. 10 shows how to connect the 4013 D-type and the 4027 JK-type flip-flops to make divide-by-two counters. In both cases, the S and R terminals are tied to logic-0, to accept clocked operation. In the case of the 4013, the Q output is tied directly to the DATA input terminal, while in the case of the 4027 the J and K terminals are both tied high (to logic-1), to give counter/divider action. When clocked by a fixed-frequency waveform, both circuits give a symmetrical square-wave output at half of the clock frequency.

Numbers of the Fig. 10 stages can be cascaded to give multiple binary division by simply clocking each new stage from the Q output of the preceding stage. Thus, Fig. 11 shows how two ‘D’ or ‘JK’ stages can be cascaded to give an overall division ratio of four \(2^2\), and Fig. 12 shows how three stages can be cascaded to give a division ratio of eight \(2^3\). Figure 13 shows how ‘D’ stages can be cascaded to make a divide-by-2N counter, where ‘N’ is the number of counter stages. Thus, four stages give a ratio of 16 \(+2^4\), five stages give 32 \(+2^5\), six give 64 \(+2^6\), and so on.

The Figures 11 to 13 circuits are known as ‘ripple’ counters, because each stage is clocked by the preceding stage (rather than directly by the input clock signal), and the clock signal thus seems to ‘ripple’ through the counter. Inevitably, the propagation delays of the individual dividers all add together to give a summed delay at the end of the chain, and counter stages (other than the first) do not ‘clock’ in precise synchrony with the original clock signal; such counters are thus ‘asynchronous’ in action. If the outputs of the counter stages are decoded via gate networks, the propagation delays of the asynchronous counter can result in output ‘glitches’ (see ‘DECODING’).
Figure 12: D and JK versions of divide-by-eight ripple counters.

Figure 13: D version of divide-by-2^N ripple counter.

Figure 14: Outline and functional diagram of the 4024 7-stage ripple counter.

Figure 15: Outline and functional diagram of the 4040 12-stage ripple counter.

Figure 16: Outline and functional diagram of the 4020 14-stage ripple counter.

Figure 17 gives details of the 4060. This is another 14-stage unit, but does not have outputs 1, 2, 3 and 11 externally accessible. A special feature of this IC is that it incorporates a built-in clock oscillator circuit. The diagram shows the connections for using the internal circuit as either a crystal or an R-C oscillator.

The 4020, 4024, 4040 and 4060 ripple-counter IC's are all provided with Schmitt trigger action on their input terminals and trigger on the negative transition of each input pulse. All counters can be set to zero by applying a high level to the RESET line.

Decoding
The outputs of a 2-stage divide-by-four ripple counter (Fig. 18a) have four possible 'coded' states, as shown in Fig. 18b. Thus at the start or '0' - reference of each clock cycle, the Q2 and Q1 outputs are in the logic-O state. On the arrival of the first clock pulse in the cycle, Q1 switches high. On the 2nd pulse, Q2 goes high and Q1 goes low. On the 3rd pulse, Q2 and Q1 both go high. Finally, on the 4th pulse Q2 and Q1 both go low again, and the cycle is back in its 'O'-reference state.

Each of the four possible coded states of the ripple counter can be decoded, to give four unique outputs, by ANDing the high outputs that are unique to each state, as shown in Fig. 18c. Since the ripple counter is an asynchronous device, however, the propagation delay between the two flip-flops may cause 'glitches' to appear in the decoded outputs, as illustrated by the '0' decoded waveforms of Fig. 18d.

The principles outlined in Fig. 18 can be extended to any multi-stage ripple counter in which the coded outputs are accessible for decoding. Note, however, that the greater the number of stages, the greater become the total propagation delays and, consequently, the greater the magnitude of decoded glitches.
Figure 17: Outline (a), functional diagram (b) and alternative oscillator connections (c and d) of the 4060 14-stage ripple counter.

Figure 18: Circuit (a) and coded output states (b) of a 2-stage ripple counter. Each of the four possible coded states can be decoded via a 2-input AND gate, but in a ripple counter the decoded outputs may not be glitch-free (d).

Up and Down Counters

A 'standard' ripple counter is one in which positive-edge clocked flip-flops are used, and in which each stage (except the first) is clocked from the Q output of the preceding stage. As shown from the coded output states of Fig. 18b, the binary outputs of a 'standard' counter increase with each succeeding pulse of the clock cycle, and such counters are inherently known as 'up' or 'add' counters.

It is, however, possible to make 'down' or 'subtract' counters, in which the binary coded output decreases with each new clock pulse, simply by clocking each flip-flop stage (except the first) from the Q output of the preceding stage. Figure 19 shows the circuit and truth table of a 2-stage (divide-by-four) ripple 'down' or 'subtract' counter.

Walking-Ring (Johnson) Counters

Ripple counters are very useful where un-decoded binary division is needed, but (because of 'glitch' problems) are not very suitable for use in decoded counting applications. Fortunately, an alternative dividing technique, which is suitable for use in decoded counting applications, is available. It is known as the walking ring or 'Johnson' technique. Such circuits rely on the 'programmable' nature of JK flip-flops,
Figure 21: Circuit (a) and truth-table of synchronous divide-by-4 counter.

Figure 22: Circuit (a) and truth-table of synchronous divide-by-5 counter.

Figure 23: Outline and functional diagram of the 4018 presettable divide-by-N counter.

Figure 24: Methods of connecting the 4018 for divide-by-2 to divide-by-10 operation.

Figure 25: Typical examples of division by numbers greater than ten.
the next clock pulse, causing \( Q_1 \) and \( Q_2 \) to go back to their original '0' states. The counting sequence then repeats add-infinitum.

Thus, in the walking-ring or Johnson counter, all flip-flops are clocked in parallel, but are cross-coupled so that the response of one stage (to a clock pulse) depends on the states of the other stages. Walking-ring counters can be configured to give any desired count ratio, and Fig. 21 and 22 show the circuits and truth tables of divide-by-four and divide-by-five counters respectively.

4018 Divide-by-N Counter

When synchronous count numbers greater than four are needed, it is usually economic to use an MSI CMOS IC such as the 4018 (rather than several 4027's) to perform the function. Figure 23 shows the functional diagram and outline of the 4018, which is a 'presettable' divide-by-N counter that can be made to divide by any whole number between 2 and 10 by merely cross-coupling its DATA and output terminals in various ways. The IC incorporates a 5-stage Johnson counter, has a built-in Schmitt trigger in its clock line, and clocks on the positive transition of the input signal. The counter is said to be 'presettable' because the outputs can be set to a desired state at any time by feeding the inverted version of the desired binary code to the J1 to J5 'JAM' inputs and then loading the data by taking PRESET ENABLE (pin 10) high.

Figure 24 shows methods of connecting the 4018 to give any whole-number division ratio between 2 and 10. On even division ratios, no additional components are needed, but on odd ratios a 2-input AND gate is needed in the feedback network. This gate can be a single 4081 AND gate, or can be made from two 4011 NAND gates.

Greater-Than-Ten Division

Even division ratios greater than ten can usually be obtained by simply cascading suitably scaled counter stages, as shown in Fig. 25. Thus, a divide-by-2 and a divide-by-6 stage give a ratio of 12, a divide-by-6 and divide-by-6 give a ratio of 36, and so on. Non-standard and uneven division ratios can be obtained by using standard synchronous counters such as the 4018 and decoding the outputs to generate suitable counter-reset pulses on completion of the desired count. We'll look at more advanced types of counter, together with special decoder IC's, in the next two issues of 'Data File'.

Latches And Registers

To round off this edition of 'The File', let's move away from counters and take a brief look at three other applications of the clocked master-slave flip-flop. Figure 26 shows how to make a 4-bit data latch from four D-type flip-flop stages (for an 8-bit latch, use eight flip-flops). The data latch is useful for storing binary numbers or data. Input data is ignored until a positive STORE pulse is applied, at which point the latch stores and outputs that data, and maintains it until told to do otherwise via a new STORE command.

Figure 27 shows how to make a 4-bit Serial-In/Serial-Out (SISO) shift register. If a bit of binary data is applied to the input, it is passed to the output of the first flip-flop on the application of the first clock pulse, to the output of the second on the second pulse, to the output of the third on the third pulse, and to the fourth (final) output on the fourth pulse. The circuit can hold four bits of data at any given moment. The SISO register is useful for simply delaying binary signals, or for storing bits of binary data and unloading them (in serial form) when required.

Finally, Fig. 28 shows how the above circuit can be converted to a Serial-In/Parallel-Out (SIPO) shift register by simply taking the parallel outputs from the Q outputs of all flip-flops. This register is useful for converting serial data into parallel form.
RS232 INTERFACE
FOR THE ZX81

J. C. Barker describes a single board design which allows the ZX81 to transmit and receive ASCII coded RS232 data.

THIS INTERFACE is built on a single printed circuit board, which plugs into the expansion port on the back of the ZX81. When used in conjunction with a telephone modem, transmission and reception of ASCII data over the public telephone network is possible.

The facilities offered by the conversion include:-
1. Receiving RS232 ASCII coded characters (from 32 to 122)
2. Transmitting ASCII characters 0-9, A-Z, space, period, carriage return and line feed.
3. Switch selectable word length, parity and stop bits.
4. Programmable, independent transmit and receive baud rates.
5. Automatic SCROLLing of the screen in receive mode.
6. "Freeze Screen" facility
7. Initial setting of the baud rate at 300 for both receive and transmit.

Construction

It is recommended that IC2 and IC3 are left in their package until fitting to the board. Then all the usual handling precautions (ie earthed bodily contact) must be taken.

All components fit on the double sided printed circuit board, side A, as shown on the component overlay (Fig. 2). Each copper track on side A must be connected to side B via soldered through-links; except the two marked with an X. The links should not stand too far above the board, since difficulty may be encountered when fitting the IC sockets. Next, the three insulated wires are fitted with links A and B (on side A at X). The board must then be wire-linked to the ZX81 connector (appropriate points are shown below in table 1). The rest of the components can then be fitted, taking note of correct orientation.

Access to the ZX81 is gained by removing the five screws on the underside of the case (three are obscured by stick-on rubber feet). Then all the board is freed by removing a further two screws. The memory already fitted will be one of two kinds; a 4118, 1k x 8 bits designated IC4, or two 2114's, 1k x 4 bits, IC4a and IC4b.

If a 4118 is fitted, IC4 is removed and the link between pin 19 and L1 taken out (see diagram in Fig. 3), fitting a new link between pin 19 and L2. The 6116 RAM chip can now be placed in IC4's socket.

Software Coding

The machine code listing is shown in table 2 (in hexadecimal), along with a BASIC program to load it into a 'line 1' REM statement. To load the program, the REM statement must be filled with 380 character 9's. This is a lengthy task, best achieved by making a direct command FAST and then loading:

1 REM 9999999999 . . (380 in all).

If 2114's are fitted - sockets IC4a and IC4b — the IC's must be removed, leaving the sockets intact. The 24 pin socket is placed (Fig. 3) in IC4's position. The spacing bars on the socket must first be removed, so as not to foul the socket. No link is fitted at pin 19, and it is only necessary to fit a link between pin 19 and L2. Insert the 6116 RAM chip into the IC4 socket and the mod is complete.

Circuit Description

The project can be split into three parts: the hardware, software, and fitting the 2k RAM chip into the ZX81. The software, which consists of 375 bytes of machine code, is listed along with a loading program and description of 'how to load', towards the end of the article. The hardware is best understood by referring to the circuit diagram of Fig. 1. There are three distinct parts; the baud rate generator, the decoding circuit and the asynchronous receiver/transmitter.

The baud rate generator consists of IC3, a 280A CTC, which has four counter/timers (two of which are used here in the counter mode). Under program control the counters are made to divide the CLK frequency by any integer numbers between 1 and 256. By feeding the output of one counter to the input of the second, the division ratio comes out as a product of the two ratios. The initial CLK frequency is derived from IC7, a D type flip-flop configured as a divide-by-two circuit. The Sinclair clock, which is 3.25 MHz, is thus halved and fed to the CLK of counter 0 and its output is fed to the CLK of counter 1. The output of counter 1 is used as the UART clock, which runs at sixteen times the baud rate.

The decode circuit is built around IC1 and IC4. The memory between 8192 and 16383 is not used by the ZX81 — it is an image of the Sinclair ROM. The UART is accessed as a memory location in this memory block. So, it is the job of IC1, IC4 and Q1 to deselect the internal ROM and enable the UART.

The UART itself does most of the work. The fact that ASCII consists of 7 bits enables the 8th data bit to the ZX81, D7, to be used as a flag, which tests the condition of the UART and resets certain flags. In the receive mode, the ZX81 keeps reading from the UART (READ 1) and when pin 19 goes to level 1, the ZX81 decodes the lower 7 bits from ASCII to Sinclair characters and prints them to the screen. At the same time it resets RDA pin 18 with a WRITE 1 command. In the transmit mode, the ZX81 continually scans pin 22 (READ 2), and every time this goes high, the ZX81 loads the next character to be transmitted into the UART.

The circuit around Q2 converts the RS232 level voltages, at the input, to TTL levels. Around Q3, the conversion is from TTL output to RS232 level — the negative voltage being derived from IC6 and associated components.
Figure 1: Circuit diagrams of the complete interface with PSU and smoothing sections.

NOTE

<table>
<thead>
<tr>
<th>S1</th>
<th>S2</th>
<th>S5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARITY</td>
<td>1 STOP BIT</td>
<td>ODD PARITY</td>
</tr>
</tbody>
</table>

GIVES 7 BITS PER CHARACTER
RS232 INTERFACE

Figure 2: Component placing for the single PCB.

Table 1: Link descriptions for the ZX81 connector.

Table 3: Placing the 24 pin socket and associated link wiring.
When line 1 is complete, return to SLOW mode. The BASIC program is then listed (lines 10 to 70) and RUN pressed. Loading the machine code is in response to an input prompt — one line at a time or 10 bytes — and must be copied exactly as listed. When all the bytes are loaded, type STOP and press NEWLINE, which returns to BASIC. When the program is listed, line 1 looks totally different, lines 10 to 70 are deleted and you will see:

10 GOTO USR 16845
Lines 1 and 10 now constitute the program and must be SAVED on cassette for future use. It is easiest to do this by typing the direct command:

SAVE " "
Once the program is SAVED it can always be LOADED by LOAD " "

Getting It Together

Once the hardware has been built, the RAM chip inserted and the software written and SAVED, the project can be assembled. Firstly, plug the board into the back of the ZX81 and connect the RS232 I/O and earths to the appropriate modem sockets. The five DIL switches should now be set up according to the data transmission format (ie even parity, two stop bits and the number of bits, need setting to 7 for ASCII).

Power is connected to the ZX81, which should show the usual K in the bottom left hand corner, and the two line program previously SAVED should be LOADED. Hit the RUN key and the ZX81 goes into the receive terminal mode, printing the incoming RS232 data onto the screen — the screen can be 'frozen' by pressing anything except SHIFT.

To go into transmit mode, the SHIFT key is pressed. Any message typed is displayed directly to the screen. To send that message, SHIFT is pressed and whatever was on the screen is serially transmitted (in ASCII). After this, the terminal returns to receive mode (if a blank screen is transmitted, carriage return and line feed are automatically sent before returning to receive mode). When receiving data, every carriage return must be followed by a line feed, or the terminal will go into an infinite loop waiting for the next character.

It is possible, once the program is

Table 2: Software listing and load table.

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<th>0C</th>
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<td>INPUT AB</td>
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<td>IF AB = &quot; &quot; THEN GOTO 20</td>
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</tr>
<tr>
<td>40</td>
<td>POKE X, 16 * CODE AB + CODE AS (2) - 476</td>
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<td>LET X = X + 1</td>
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<tr>
<td>60</td>
<td>LET AS = AS (3 TO )</td>
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<td>70</td>
<td>GOTO 30</td>
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</table>

N.B. DO NOT TYPE THE SPACES BETWEEN PAIRS OF DIGITS E.G. "16180B0CC..."
The baud rates are programmable and totally independent. To change the receive baud rate, two integer numbers (A and B), between 1 and 255 must be POKEed to location 16852(A) and 16856(B), with the program loaded and still in BASIC mode. For example, a baud rate of 110 is implemented with the values A=13 and B=71 from the formula:
\[
AB = 1.625 \times 10^3/(16 \times \text{BAUD RATE})
\]
\[
= 923
\]
\[
= 13 \times 71
\]
Therefore to change the receive baud rate to 110, type the two direct commands:
POKE 16852, 13
POKE 16856, 71
The transmit baud rate is changed in exactly the same way, except the two integer numbers are POKEd to 16869 and 16874.
Table 3 shows some common speeds and the equivalent A and B values.

<table>
<thead>
<tr>
<th>BAUD RATE</th>
<th>HART CLOCK</th>
<th>1625000</th>
<th>HART CLOCK</th>
<th>A AND B VALUES</th>
</tr>
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<tbody>
<tr>
<td>75</td>
<td>1200</td>
<td>1354</td>
<td>113</td>
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<td>1760</td>
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<td>150</td>
<td>2400</td>
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<td>300</td>
<td>4800</td>
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<td>38340</td>
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Table 3: Common transmission speeds and their corresponding ‘A’ and ‘B’ values.

**PARTS LIST**

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<th>Resistance</th>
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<td>R3,7</td>
<td>1kΩ</td>
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<tr>
<td>R4</td>
<td>10kΩ</td>
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<tr>
<td>R5</td>
<td>47R</td>
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<tr>
<td>R6,8,9,11</td>
<td>4kΩ</td>
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<tr>
<td>R10</td>
<td>330R</td>
</tr>
<tr>
<td>R12</td>
<td>100kΩ</td>
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<tr>
<td>R13</td>
<td>15kΩ</td>
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<table>
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<th>Capacitors</th>
<th>Value</th>
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<td>100u 25V</td>
</tr>
<tr>
<td>C4,5</td>
<td>15u 16V</td>
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<tr>
<td>C6,8,9,10</td>
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**Semiconductors**

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<tr>
<td>IC7</td>
<td>74LS74</td>
</tr>
</tbody>
</table>

**Miscellaneous**

- ZX81 connector, PCB, 6 way DIL switch, DIL sockets: 40 pin, 28 pin, 16 pin, 4 pin (3 off), 8 pin.
- Note: A 6116 RAM and 24 pin DIL socket are required for expansion of the ZX81.

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191 for further details
William Poel takes a look at some Japanese companies that, although not household names, are multi-billion yen industries.

It's really quite amazing just how little is known about many of the world's leading electronics companies by electronics engineers in this country. It's a sad reflection on the state of the electronics manufacturing market that so many engineers in the business are quite prepared to confess that they have "never heard of" most of the world's largest potentiometer manufacturers/ ceramics manufacturers/ coil manufacturers etc., and seem happy to accept that the world ends at Epworth Street.

Maybe it isn't the role of the engineer to know about product sources ("you should speak to the buyer about that"), but some engineers are willing to take their academic detachment from the source of the components to a distinctly injurious level, when it means that they are blissfully unaware of the product that more than half the world market is using.

The language barrier has inevitably meant that much of the Japanese industry has kept itself to itself, waiting until its "act" is well and truly together before pouncing on an unsuspecting market.

The overnight infiltration of world memory markets is the most notable such event, and now it is unthinkable that engineers haven't heard of Hitachi, NEC, Fujitsu and Toshiba. Even as recently as four years ago, it's quite likely that more than half the designers in the country only ever thought of Hitachi as makers of TV sets and audio equipment. And there's plenty more where they came from.

**One-Four for the knee cap?**

One particularly interesting case concerns Kyocera. Kyo-who? will doubtless be the cry — for if your world ends at Calais, then you can be forgiven for not recognising the name of one of the world's largest industrial ceramic organisations, responsible for the lion's share of the world market in ceramic substrate materials.

A look inside many CB transceivers will reveal the familiar blue plastic covers of their ceramic ladder filters, and many of you will recall the press coverage afforded to a ceramic internal combustion engine that was announced a while ago. I bet you don't recall the name of the firm who had developed it — even if it was actually given, rather than reported as simply "A Japanese Company".

If you're wondering about the sub-heading, then you might be surprised to learn that the world famous CB makers, Cybernet, are owned by Kyocera — and amongst the many innovative aspects of Kyocera product development is a range of orthopaedic replacement parts in ceramic — plus some very gruesomely illustrated examples of individual false teeth that are screwed into the jaw one at a time. It beats the water torture out of sight.

**Hold on tight**

R&EW will be running an occasional feature series introducing many of these "household" names to you lucky lot, so at least when the rep from the world's largest this-or-that manufacturer turns up on your doorstep, you stand a good chance of impressing him by being the first person he's seen all week that has actually heard of the company and the product he is hawking.

In the course of this series, we will be unveiling many secrets of the mystic Orient — such as who makes those ultra natty XY drum plotter mechanisms that adorn your PC1500 micros, and where you can buy them (if you're an OEM) for under £20. Or who makes the keyboard for the BBC micro, that costs less than 15p per key, yet performs just as well as many of the better known names costing twice as much. And would you believe that TOKO are the world's leading manufacturers of NC robot and machine tool controller systems, with a positional accuracy of 24 bits?

And the name of the people who make those exquisite low cost rotary encoders that abound on most Japanese synthesised transceivers. They cost under £2.

The penalties of being isolated from this information are potentially disastrous for an already uncompetitive UK industry. The fact that our market is scarcely large enough to warrant the companies concerned to translate the data sheet means that if you want to take advantage of the technology, then you are going to have try a little harder than simply reaching for the ubiquitous and omnipotent broadline distributor catalogues to get through. Such sources are rarely trend setters, merely reflecting the majority view. So if you want your design to stand out and be different in the UK market, then you won't do it entirely from established sources.

When introduced to delights of the technology, most UK manufacturers wonder aloud why on earth they haven't seen it before. The answer is that they have, all over the products that pour out from Japan and so concisely provide the customer with what he wants.

**Fair do's**

Just in case you all think we are wildly besotted with Japanese products, we aren't. Maybe there's plenty of justification for feeling that they really have got it sewn up by now, but what we want to try and do is simply broaden the awareness of our readers and try and illustrate the company profiles of some companies they might have overlooked. After all, Kyocera only has one sales rep in the UK at present, and he can't see more than a handful of customers in this context.

We do not intend to make "recommendations" as such. The products and prices can do that for themselves, and we would be delighted to hear from any UK source that feels it gets a raw deal from our exasperated approach to the UK component industry and its complete and disastrous inability to keep up. At the end of the day, we want to see UK designers using the best product from the world market to design and make the best product it02for01 the world market. Not simply the one that comes most readily to hand, or is represented by the firm with the biggest luncheon budgets. No one, least of all the Japanese, are going to buy that policy.

---

**YOUR REACTIONS**

Circle No.

- Good: 61
- Average: 62
- Poor: 63

---

Some of Kyocera more esoteric offerings — in fact a range of products for orthopedics.
Gary Evans with a couple of items about the Spectrum and news of a new colour monitor.

ADVERTS FOR Sinclair’s Spectrum computer carry the phrase ‘allow 28 days for delivery’. Unfortunately these claims would appear to be more fiction than fact. A strike at the Timex factory that assembles the machines can not have helped but it’s a sad fact that even before the problems caused by the strike Sinclair were not living up to the 28 day delivery claim.

Some sections of the computer trade have had trouble meeting their delivery targets for many years now, with Sinclair’s record during the early stages of the ZX80 and ZX81 not being particularly brilliant.

In those days however, the companies usually got away with things. They’d upset a few thousand customers but usually managed to get the goods to anybody that threatened to get nasty.

One of the worst aspects of the trading practices adopted by the companies was that they banked your money as soon as they got hold of it. This, together with extended delivery times, meant that the companies were getting huge, interest free loans. A nice business if you can get away with it.

Today though, with the heightened level of consumer awareness, a clamp down by the major credit card companies on such operations and increased awareness of such practices on behalf of the Advertising Standards Authority has meant that we should see the end of this sort of trading.

Whether or not Sinclair will end up in court as a result of their record in supplying the Spectrum is uncertain but any company planning to market a computer without the resources necessary to meet a reasonable level of demand, can expect to be in hot water.

On A Brighter Note

Phipps Associates have produced a 160 page ‘pocket book’ aimed at Sinclair Spectrum users.

The book can be divided into two sections, the first featuring programs written in basic, the second being machine code section. The majority of the Basic programs are games, including an interesting looking game called ‘The Great Fire Of London.’ Also included in the basic section are some ‘non-game’ programs including a useful looking budget account package.

The machine code section of this books features advice on using the Spectrum’s ROM together with an assembler and disassembler and a machine code monitor.

At £6.50 the spectrum pocket book looks to be a good buy.

More information about this, and other titles from the Phipps range is available from them at
99 East Street,
Epsom,
Surrey.
KT17 1EA.

Colour Video Monitor

After the interest shown in our series of articles describing conversions to allow domestic TV sets to be used as monitors, a new product from Isle Communications may well be of interest to those of you who prefer not to tamper with your new colour TV set.

The list of standard features includes:
20-inch pre-aligned cathode-ray tube, PAL composite video or RGB input, two-channel input switchable, looped-through input connectors, switchable colour kill, switchable underscan, sound channel with built-in loudspeaker, sound and vision VCR input connector.

Further details from:-
Isle Communications at,
24 Hurlbutt Road,
Heathcote Industrial Estate,
Leamington Spa,
Warwickshire,
CV34 6TD.
TONE SQUELCH UNIT MODEL PTS-1

Designed to wire-in to the microphone and loudspeaker lines of existing FM or AM transceivers, Model PTS-1 provides a second independent squelch system.

The squelch operates only when the incoming signal carries a pre-arranged tone of precisely the correct frequency. Thus two transceivers, each fitted with Model PTS-1, will respond only to each other's transmission protecting the user from undesired interruptions.

The system is ideal for Raynet groups, club nets, or groups of friends who wish to monitor for each other's communications.

Sixty-four tones in the range from 1747 to 2330 Hz are selectable by a DIL switch. A built-in notch filter removes the tone from received signals.

Model PTS-1 is built to high standards using 9 ICs on a glass fibre PCB. A full data sheet is now available.

Unit price: £39.99 + VAT (£45.99 inclusive) (Note - a unit is required for each radio in the group).

MODEL PTS-1

COMPACT RECEIVING ANTENNAS

MODEL AD270/370

Datong Active Antennas solve the age-old problem of finding space for a 'good' receiving aerial. Model AD370 mounted on a roof top or Model AD270 in a loft will give similar sensitivity to much larger conventional aerials yet are only 2½ and 3 metres long respectively.

Moreover they do not suffer from interference picked up by the feeder cable, such pick-up can be a problem with conventional dipoles because it is hard to maintain good balance over a band of frequencies.

Although active antennas were introduced to the amateur market by Datong only a few years ago they have long been used by military and commercial receiving stations. The performance specifications achieved by the Datong AD270/370 are very close to those of "professional" active antennas selling for ten times the price - a point which is not lost on many professional customers.

The advanced design ensures two things: you don't miss signals through inadequate sensitivity and that the antenna does not invent signals which are not there.

Datong Active Antennas represent an advanced solution to a common problem and so far as we know have no serious competition in terms of performance at the price. (Reviewed in Rad. Com., June 1982.)

MODEL AD270/370

BROADBAND PREAMPLIFIER

MODEL RFA

Model RFA is designed to improve slightly "deaf" receivers within the range 5 to 200 MHz. It includes r.f. activated in-out switching so that it can be used to improve the sensitivity of low power transceivers (less than 20 watts PEP) simply by connecting it in series with the aerial.

Most receivers have nearly adequate gain to compensate for the feeder cable, such gain can be a problem with conventional dipoles because it is hard to maintain good sensitivity over a band of frequencies.

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HIGH PERFORMANCE 2 METRE CONVERTER

MODEL DC144/28

Again strong signal performance is the key to the design of Model DC144/28. Where conventional converters use a dual gate mosfet as a mixer, the Datong uses a balanced pair of Schottky diodes fed with nearly 10 mW of local oscillator at 116 MHz. Where other converters use open wound coils, the Datong coils are in screening cans on a plated through board.

The result: an unusual freedom from spurious signals and overload effects together with a spurious-free dynamic range of 112 dB.

As the Rad. Com. reviewer wrote "With a 3 db noise figure and 90 db dynamic range the Datong DC144/28 is one of the best 144 MHz converters currently available", Rad. Com., April 1982.

Model DC144/28 is available either as a tested PCB module, as illustrated, or fully cased in a diecast aluminium box.

Pricing

All prices include delivery in U.K. Basic prices in £ are shown with VAT inclusive prices in brackets.

<table>
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<tr>
<th>Product</th>
<th>Description</th>
<th>Price (inc. VAT)</th>
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<td>FL3</td>
<td>112.50 (129.37) AD370</td>
<td>60.00 (64.40) Codecall</td>
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<tr>
<td>FL2/A</td>
<td>34.00 (39.67) AD370-MPU</td>
<td>45.00 (51.75) (Linked) (28.00 (32.20) Codecall</td>
</tr>
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<td>FI</td>
<td>69.00 (79.35) AD370-MPU</td>
<td>60.00 (69.00) Codecall</td>
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<td>FL2</td>
<td>76.00 (89.70) MPU</td>
<td>60.00 (69.00) Codecall</td>
</tr>
<tr>
<td>PC1</td>
<td>119.50 (137.42) DC144/28</td>
<td>34.50 (39.67) Basic DF System</td>
</tr>
<tr>
<td>ASP</td>
<td>72.00 (82.80) DC144/28</td>
<td>28.00 (32.20) DF System</td>
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<td>VLF</td>
<td>26.00 (29.90) Module</td>
<td>28.00 (32.20) DF System</td>
</tr>
<tr>
<td>D70</td>
<td>49.00 (56.35) Keyboard Morpe</td>
<td>Complete Mobile DF</td>
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<tr>
<td>D75</td>
<td>49.00 (56.35) Sender</td>
<td>119.50 (137.42) System</td>
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<tr>
<td>RFM</td>
<td>26.00 (29.90)</td>
<td>214.00 (246.10)</td>
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<td>AD270</td>
<td>41.00 (47.15)</td>
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See previous advertisement or price list for further details.

Data sheets on any products available free on request - write to Dept R.E.W.

DATONG ELECTRONICS LIMITED

Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE, England. Tel: (0532) 552461

192 for further details
Crotech 3030

A single beam 15MHz 'scope that, in Michael Graham's opinion, offers adequate performance at a budget price.

If you have £3k plus at your disposal there are plenty of 'scope manufacturers that would be more than happy to sell you their latest dual beam, digital storage model with IEE interface. If, on the other hand, your means are slightly more modest and you do not fancy wading through reams of instructions in order to learn how to drive a complex piece of gear, the Crotech 3030 may be more suited to your requirements.

Down to Basics

The 3030 offers, what must be considered, a basic specification, with little in the way of frills although the component test facility, to which we'll return later, does brighten up the technical spec. The facilities that the 3030 does offer however are adequate for many applications and its healthy 15 MHz bandwidth means it's good for use far beyond the audio range of frequencies.

The 3½” CRT provides an adequate display area, in contrast to some of the mini 'scopes that are about today. The maximum sensitivity of the 3030 is 5mV/div with a 12 step, 1,2,5 sequence attenuator taking this up to 20V/div. The 'scopes input impedance is a fairly standard 1M in parallel with 35p with a switch selectable DC or AC input coupling. Basic accuracy is quoted as ±3%.

Sweeping Statements

Sweep speeds from 0.5m Sec/div to 0.2 Sec/div are available in 18 calibrated steps. A variable, uncalibrated control, allows the fastest sweep speed to be increased to 0.2u Sec/div.

The triggering facilities of the 'scope are again, fairly basic but adequate. In the auto position, the 3030 will trigger on signals above 50Hz with an additional control allowing triggering on either the positive or negative edge of waveform. An external trigger facility is also available via a front panel BNC socket.

Other front panel controls take care of such things as horizontal and vertical trace shifts as well as intensity and focus adjustments. A 200mV, 1 kHz square wave signal, for calibration purposes is also brought out to the front panel.
Testing, Testing

The component tester referred to above, utilises the X-Y ability of the instrument in conjunction with an AC voltage derived from its mains transformer's secondary, to provide a means of performing elementary dynamic tests to both active and passive components. The diagrams shown in Fig. 1 show some of the displays associated with some common components. While not performing any sophisticated tests, this facility does allow go/no go tests to be performed and is a useful facility.

Explanation Time

The instruction book supplied with the instrument recognises that a 'scope in the 3030's class is likely to be the first 'scope that many people buy. It sets out, in a straightforward manner, all the features of the instrument together with their relevance when using the 3030. The instruction manual is also supplemented by an additional book — Getting The Best From Your 'Scope. This is a well written and comprehensive guide, not only to the various uses to which a 'scope can be put, but also a description of the various circuit blocks that go to make up the instrument.

Value for Money?

At around the £170 mark the 3030 will be within many people's grasp and, although a basic model, limited to only a single trace, what it does do, it does very well. A shortage of 'scopes in the R&EW labs this month meant that the 3030 was pressed into service on one of our engineer's work benches where, according to reports, it was well received. For those wishing to buy a low cost 'scope the 3030 offers a viable alternative to taking a chance in the second hand equipment market, where it's all too easy to buy an uncalibrated, temperamental collection of valves that makes a good room heater but not much else — the voice of experience.

S.E.M.

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Now feature either POWER AMP alone or PRE-AMP alone or both POWER AND PRE-AMP or STRAIGHT THRU when OFF. Plus a pre-amp GAIN control from 0 to 20dB. N.F. around 1dB with a neutralised strip line DUAL GATE MOSFET.

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SENTINEL AUTO 2 METRE or 4 METRE PRE-AMPLIFIER

Around 1dB N.F. and 20dB gain, (gain control adjusts down to unity). 400W P.E.P. through power rating. Use on any mode. 12V 25mA. Sizes: 6" x 24" front panel. 3" deep. £28.00 Ex stock.

Here are some of the displays resulting when using the component tester facility with Zener (left) and signal (right) diodes.

Figure 1: The displays resulting when using the component tester facility with Zener (left) and signal (right) diodes.
The new Gould OS300 Dual Trace 20MHz Scope

A tough, professional instrument you can trust – at a price you can afford! ★ Max. sensitivity 2mV/cm. ★ Stepped and continuously variable attenuator and timebase controls. ★ D.C. coupled triggering and "active" T.V. sync separator. ★ 'Add' and 'Invert' for differential measurements. ★ X-Y facility. Built to do more – safely, reliably and for longer.

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GOULD INSTRUMENTS DIVISION

184, London Road, Leicester LE2 1ND. Tel: (0533) 549407

Permissible costs only. Open Saturday in accordance with European Broadcast System.
Where VHS goes Beta is sure to follow, and with most manufacturers in the VHS camp producing a stereo machine as their top of the range machine, it was only a matter of time before Sony followed suit.

The new C9 replaces the popular C7 recorder and looks destined to become the most popular up-market Beta machine. Sony have obviously learnt a thing or two from the design and development of their portable F1 recorder, for the C9 sheds the bulky image of most mains Beta machines, and is, according to Sony, Britain's slimmest video recorder.

The C9 is a front loading machine and, despite its modest dimensions, manages to provide access to virtually all controls from its front panel.

As one might expect on a fully featured recorder, all manner of trick video facilities are provided.

The timer is of a nine-event two-week spec and, a nice touch this, has a battery back up to protect timer settings in the event of short interruptions in the power supply.

A couple of features have been borrowed from the aforementioned F1, namely a real time tape counter and a "go to zero" facility.

On the audio front, as well as providing stereo sound, the C9 features BNR — that’s Beta Noise Reduction that offers a S/N ratio of 43dB.

At about £700, the C9 costs more than the average machine but it looks a superb machine. A full review of the recorder is planned in the near future.

Stereo TVs Too

To complement the launch of the C9, Sony have launched a range of stereo colour TV sets.

The XR series will initially consist of two models, both 20” sets the difference being the provision of teletext on one model.

The built-in amplifiers provide a 5 watt output and a “space-sound” feature enables mono broadcasts to be processed to give a pseudo stereo effect.

Colour, Stereo, 3D — what next?

---

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ZX81/RS232 INTERFACE
Allows ZX81 to transmit and receive ACS11 code RS232 data. Kit includes, resistors, capacitors, transistors, diodes, ICs, PCB, sockets, connector & ribbon cable.

Stock No.    Price
41-00207    £32.40

CW FILTER
1.2kHz audio CW filter, complete kit of parts excluding case, including: All resistors, pots, capacitors, transistors, ICs, PCB, switch, knobs, sockets, battery holder and connector.

Stock No.    Price
41-00205    £9.82

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Acoustically coupled Modem with RS232 interfacing. A full kit is available in 2 sections;
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Hardware Kit — Set of pre-formed metal work to house Modem board and telephone hand-set. (Delivery excepted end January).

Stock No.    Price
41-00201    £22.93 Electronics Kit
41-00208    £13.80 Hardware Kit

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High quality fibre glass printed circuit boards for R&EW projects and data briefs.

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<thead>
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<th>DESCRIPTION</th>
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<td>FEBRUARY</td>
<td>Modem</td>
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<td>Audio Attenuator (Undrilled)</td>
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<td></td>
<td>ZX81/RS232 Interface</td>
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on channel 35 — (£27.90 inc VAT, p + p £1). Full transmit/receive
switching is included together with an internal wave form test
generator. The unit is housed in a highly durable black die cast case
and all cuiting is constructed on high quality glass-fibre printed
printed circuit board. The two stage linear amplifier is housed in a separate
internal compartment, thus ensuring excellent electrical and
termal stability.
Centre tap returns to the subject of club magazines and tells the tale of a “junk hunt” around London of the 1960’s.

Since my recent notes and suggestions regarding Club Magazines and News Sheets, I have been reading copies of those received with much interest. A number, too, have come to light, apart from those of which specimen copies have been received. The biggest, both, in the number pages and circulation, is “Monitor,” the organ of the very lively ISWL, but there are also many creditable efforts by local clubs with memberships around the fifty mark. Even these are not only self-supporting, but make a small profit to contribute to the general funds of the group. Sixpence per copy is the usual price.

Generally speaking, the reproduction is good all the way round, but occasional lapses in spelling appear – i.e. artical, voluntier etc. The most general weakness is absence of bold headings and the rareness of illustrations. Where are the amateur cartoonists? Pages of typescript look dull unless the matter is attractively displayed, and mere typewritten capitals alone need thoughtful planning to enlighten a page. Special announcements, etc., are better boxed (set out in a lined border). One magazine failed to do this in an obituary notice, where an extra bold black border should be used. More attention could well be given to the reporting of current club events and local affairs.

Despite these minor points, the general production standard is extremely good, but without exception the amateur editors make urgent appeals for more material from their fellow members, who universally seem reluctant to put pen to paper. I am sure that with mutual co-operation this aspect could be materially improved, so I am putting forward a tentative plan in the hope that it will ease the lots of the harassed editors.

A Central Bureau

Briefly, the idea resolves itself around a central pool of News Sheets, with each editor submitting a small batch of copies of his magazine for distribution to other amateur editors. In return he will receive his quota of copies of other clubs’ efforts, and from these he will be entitled to reproduce any article, or digest of it, which he feels may be of interest to his club members. Permission to reproduce would not have to be specifically sought, as membership of the Bureau would be taken as tacit consent although, naturally, acknowledgment to the source and to the writer would be made.

Incidentally, I discovered that an Amateur Magazine Association once did exist, and it struck me that such an organisation could well serve as the central pool for such a scheme. However, a letter to the last known officer of that association has failed to produce a reply, so it seems there is no other alternative, if the plan finds general favour, than to get the scheme started independently. Perhaps a volunteer organiser will come forward until such time as an elected manager can be appointed.

The pool would be run on the lines of a QSL Bureau, a number of stamped self-addressed wrappers being sent in lieu of the usual envelopes.

It seems probable that a scheme on these lines would provide the stimulus to make many club magazines brighter and even more readable, and may encourage contributors who at present feel that the effort of making a contribution is scarcely worth while when the result is seen by so limited a number of readers.

With sufficient support it may be possible to get someone to donate an annual award for the best magazine standard maintained throughout a given period, points being allocated for reproduction, layout and material interest. The size of the club and the best use of the contents/paper-size ratio would be taken into consideration. An award to the writer of the article, irrespective of its length, which is reproduced in the greatest number of different magazines might also be arranged. Amateur writers and others who have no local club magazine might be induced to send contributions to the central bureau, where they would be available for the use of all affiliated amateur editors.

Amateur editors and others who are interested are invited to send their views and suggestions as soon as possible, even if it is merely a postcard promising support.

Junk Hunt

I recently had a radio-minded friend from Scotland staying with me for a few days, and he was, of course, intent on spending the Saturday on touring the Surplus Shops to look over the diminishing number of bargains. Most provincial readers know the London radio shops pretty well, and make a point of visiting them whenever they come to town – and from further afield than the provinces, for that matter. I remember one continental amateur who had to go to the north of England on behalf of his firm, to see a demonstration of some new mining equipment. On his way back he had a few hours to spare, which he decided to spend in London. It was his first visit, and he was met at King’s Cross by an English friend who mentally planned a lightening tour of the usual sights, Parliament, The Abbey, St. Paul’s, etc., leaving the visitor to choose which to include and which to cut out. Upon his arrival, he duly asked the continental amateur which of the many places of interest he most wished to see, and he was amazed to receive the reply, “The Junk shops”.

It took the friend (who knew nothing of radio) some minutes to guess what he meant and, even when at last it dawned on him, he hadn’t the faintest idea where to look for them. Fortunately, a taxi-driver knew better and took them to Lisle Street, where our English friend waited patiently while the visitor browsed over battered ex-WD gear. No doubt he is still marveling at the strange ways of foreigners!

Lisle Street was the first point of call for my Scottish visitor and I. We poked around for a long time but bought nothing. Lisle Street must be losing its grip, for when we moved on to the Edgware Road area we both indulged in an orgy of junk buying. I only wanted a few bits and pieces, myself, and to equalise the load I found myself carrying nearly half of his. He bought an enormous half-stripped chassis for a few shillings, just for the sake of the meter, and as he was already fully loaded I had no choice but to offer to help carry it. If I had taken a screwdriver and pliers I might have whipped off a few of the components and shed them on the wayside. In fact, at the time I fervently wished I had. Ex-WD chasses are invariably awkward shapes, and this particular one would have left Euclid simply dizzy.

It was nearing dusk when we got back, hot and dirty, and looking like a couple of itinerant tinkers carrying our stock-in-trade. We were both too ashamed to be seen in our select suburban district in such a state, loaded up as we were like beachcombers after a shipwreck. We hung around taking in a little refreshment to sneak in after it was dark. Even then, a horrible clanking of ironmongery heralded our return, which in the quiet of the evening seemed worse than ever.
There was a noticeable decline in Sporadic-E activity during October compared with the previous month. Although signals were around on most days they tended to be of short duration and mainly from the south; countries such as Spain, Portugal, Italy and Yugoslavia. The middle of the month witnessed the return of extremely long-distance television reception via the F2-layer with excellent signal strengths from transmitters located in Africa and the Middle East. Unlike the past four seasons, F2 reception from the east, that is China and the USSR, proved a disappointment due, perhaps, to the MUF not reaching the channel R1 vision frequency at 49.75MHz. Probably we should not grumble too much since this is the fifth consecutive year in the present sun-spot peak where Band I television signal have been received.

On October 17th from 0830 onwards, a build-up of Russian forward-scatter networks was noted below 46MHz. At 0905, channel R1 video appeared with typical hearing effects associated with F2 reception but the signal faded completely around 0930BST. Channel E2 became active shortly after 1200BST with F2 reception from Zimbabwe. Fortunately the test card was being transmitted at the time to enable positive identification. Similar activity was noted around lunchtime on the 18th.

On the 24th, weak channel R1 video appeared briefly before a Sporadic-E opening occurred which confused the issue!

At the end of the month the high-pressure system centred just to the east of the UK produced a widespread tropospheric opening on all television bands which permitted reception from many stations in Central Europe. Tropospheric ducting must have occurred since excellent pictures were obtained from East Germany, Czechoslovakia and Austria at UHF whereas signals from the Low Countries were poorly received. A new transmitter noted in central England for the first time was the East German (DDR:F1) network radiated from Donnersberg operating on channel E12(224.25MHz vision).

Meteor Shower Reception

Having been impressed with Sporadic-E activity during the summer, most newcomers to the hobby become disillusioned during the bleak winter months when there seems to be a lack of signals when they switch on, unless there happens to be an opening due to enhanced trop, SpE or F2 conditions. If the receiver is left running on any of the DX channels in Band I, random signals of very short duration often appear. In this case: 'short duration' means a signal lasting between a fraction of a second and several seconds. This form of propagation is usually referred to as Meteor Shower (MS) reception. Meteors entering the atmosphere burn up producing ionised trails which reflect television signals back to the Earth. The number of meteors entering the upper atmosphere and their density will govern the results seen on the screen. The budding astronomers amongst us will know that several times during the year there are periods of enhanced meteor shower activity (see Table 1). These dates will vary only by a couple of days at the most from year to year. During these "peak" periods, the DX-TV enthusiast who is tuned to a channel in Band I may witness possibly 100 or more "pings" per hour whereas during the quieter periods only a dozen or so will be seen. Reception of Continental television signals is therefore possible on a daily basis throughout the year although for most of the time only a few seconds per day may be possible. This is hardly suitable for the impatient DX-er!

As with Sporadic-E signals, MS tends to affect Band I frequencies and also Band III, but to a lesser degree. During an intense MS period such as the Geminids, Quadrantids or perseids it is worth leaving a receiver running on a vacant Band III channel. This may allow certain transmitters to be received that would otherwise be impossible by SpE or tropospheric propagation, for example, TVR-Romania on channel R6 and YLE-Finland on E5 (175.25MHz vision). Reception distances via MS are similar to those encountered with Sporadic-E.

Since the signals may be weak and of short duration it is essential that the gain of the receiver is as high as possible. It is also very important that the signal will lock-in instantly thus stable timebases are necessary; there may not be sufficient time to adjust the line-hold! Ideally the transmission will be a test card and hopefully not the ubiquitous Philips PM5544! It is up to the individual whether directional arrays are used or not. Signals may arrive from any direction so it may be advisable to use an aerial with omni-directional characteristics such as crossed dipoles, suitably phased, and mounted horizontally.

Calling All DX-ers

Is anyone interested in helping to produce a monthly DX-TV bulletin? Cyril Willis (Little Downham, Cambs) has plans for one which will include logs, news, photographs, features, interviews, free ads for sale and wanted equipment, etc. For further information he may be contacted on 0353-87755.

Details have also arrived regarding a newsletter called "DX-TV RX GROUP". It has been in existence for some time but was due to cease publication. Fortunately a rescue plan was put into operation by Dave Lauder who is now the Editor. There are currently 44 members and the newsletter is published quarterly. The cost is only six 15p stamps for the next three issues. The

The French Antenne 2 closedown clock caption received on October 30th, 1982.

The East German News programme caption received on October 30th via enhanced trop conditions on channel E12.

Closedown clock caption received from RTB:F1, Belgium.
On October 24th, Hugh noted channel R1 video via F2 just above the noise but while using a scanner further down the band he located the vision carrier of the Australian channel 0 at 46.25MHz. Unfortunately, only line syncs could be resolved on the receiver.

Simon Hamer (no relation incidentally) has written from his home in Presteigne, Powys. On the 29th, reception came in "literally thick and fast" with pictures from France and Belgium for the entire evening. The 30th was even better with the Dutch 2nd network (NOS-2) showing a cowboy film at 1800. A Norwegian programme was noted later in the evening and he suspects it as being "NOS Journaal". The programme was seen on various UHF channels. While tuning into West German television he noted a sports programme about football with the trainer of "Armada Bielefeld" being interviewed in the studio. On channel E8 from an unidentified source, Simon saw a comedian who looked like Jasper Carrot telling jokes. Is that what he does?

Norwich enthusiast Clive Athowe has sent us another bundle of log reports which makes for envious reading. The Gwelo E2 transmitter of the Zimbabwe Broadcasting Corporation was received on no fewer than seven days during October via F2/SpE propagation. The multi-burst test pattern of the Ghana Broadcasting Corporation was noted on the 9th and 10th on channel E2. The transmitter is situated at Kissing and has an ERP of 100kW. RCTV-Dubai was present on the 17th and 18th using the Philips PM5544 at lunch time. Closer to home, the Buccaneer channel R2 transmitter of Televiziunea Romana was seen radiating the EBU Bar on the 7th and their distinctive monochrome test card on the 15th at 1847 BST which was followed by a subtitled programme from the news programme "TELEJURNAL" at 1900. A subtitled programme from the Portuguese channel R31 and Spanish channel R2 was visible on UHF. The Brazilian channel R1 video via F2 just above the noise but while using a scanner further down the band he located the vision carrier of the Australian channel 0 at 46.25MHz. Unfortunately, only line syncs could be resolved on the receiver.

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The dates given in Table 1 are for any year but 1983 is a very special year as the planetary system falls into line. This phenomenon occurs only every 180 years. From January 2nd, the "peak" dates may be two days earlier than shown. Just for the record (as the event should have taken place by the time this is read), between January 1st and 2nd, the Earth should have slowed down thus allowing more cosmic dust to enter the atmosphere. Our thanks to Peter Sturgess for supplying this information.

---

**YOUR REACTIONS**

**Circle No.**

- Good: 64
- Average: 65
- Poor: 66
SHORT WAVE NEWS FOR DX LISTENERS

Frank A. Baldwin

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

IN THE LAST issue I dealt with some of the Indonesian stations that could be logged on the 60 metre band during this present 'season' provided the right conditions were apparent. In this instalment some other eastern stations are brought to the attention of readers — the difficult to receive stations will be listed in a later issue.

Let us start with a couple of Chinese transmitters, the first being Xizang PBS (People's Broadcasting Station) in Tibet (Xizang + Lhasa) on 4750, often reported by Dxers. The best chance of hearing this one is at, or near, the opening time of 2230, the frequency being on or just prior to the closing time of 1545. The station identification in Chinese is 'Hsi-Tang Jen Min Kwang Po Tien Tai'. Then there is Yunnan PBS, Kunming operating on 4760. This is Yunnan 1 which also includes some relays of Radio Peking. The opening time is 2150 in Chinese but it lists an English language lesson from 2200 to 2230. The identification is 'Yunnan JMKPTT' (as above). It closes at 1600.

Or you could try Radio Thailand, Bangkok on 4830, at which frequency it opens at 2245 and closes the final transmission at 1630. I have found the best time for this one to be around 1530 or so.

Then there are a couple of Malaysians that are worth a try. Tune to 4835 where, if you are lucky, you may log Radio Malaysia, Kuching in Sarawak, from where it operates from 2200 through to 1600, listen just prior to the opening and closing times. Radio Malaysia, Kuala Lumpur may be found on 4845 opening on Saturdays at 2200, the rest of the week at 2130. It closes at 1530 except for Sunday when it signs off at 1700. This station serves the Malaysian Indian/Sri Lankan community. The type of music broadcast could fool you into thinking you were tuned to All India Radio — except that there is no Indian station on this channel or Sri Lankan for that matter.

On 4870 SLBC Colombo in Sri Lanka is on the air from midnight and closes at 1730, this being the Home Service 2 in Sinhala. The other Sri Lankan often reported is SLBC Colombo on 4902 which carries the Home Service 1 programmes but it operates irregularly and the best chance of hearing this one is on full moon days when the monks keep up an endless religious chant. Listen for this during the late afternoons and early evenings, the schedule on these occasions being from 1000 through to 2400.

To complete this opening gambit, some Indian local transmitters are featured, the first being AIR (All India Radio) Calcutta on 4820, it closes at 1740 and it does have a newscast in English at 1530 — not often reported but well worth a try. Tune to 4920 where you may find AIR Madras, it also has an English newscast at 1530 and again at 1730, the closing time is 1740.

In the next issue I will be bringing some more of these eastern stations to your attention. Good hunting — I wish you good luck with your Dxing.

Club news —

The Lothians Radio Society now meet at the Drummond High School, Edinburgh on the second and fourth Thursdays of each month at 7.30 p.m. clock time (not GMT). The syllabus for the 1983 season shows that all interests are covered, including RAE classes tutored by GM4BYF, GM4EZJ, GM8BJF, GM4DTH and GM6JAG. The classes are held every Wednesday and further details of these and other events are available direct from the Hon. Sec., E. Evans, Lothians Radio Society, 4 Burdiehouse Street, Edinburgh. EH17 8EY.

Amateur Bands

In the period under review some short visits were made to the various Amateur bands and although no great success is claimed, as the results will show. I did at least enjoy the changes from broadcast band operations.

Listening in the CW mode, as usual, the first band visited was —

Top Band (1800-2000kHz)

Activity on this band by the CW fraternity seems to be pretty sparse of late, in fact if more amateurs do not occupy this frequency allocation more often then I can envisage an eventual loss which also applies to SSB working.

Searching the band on a couple of evenings around the 2000 GMT mark produced signals from Czechoslovakia in the shape of OK26WM, OK3CZM, OL1BEl and OL4BDOQ. From the Netherlands PAOUU put in an appearance whilst Lithuania was dealt with by UB5SS, UB5ZRE and only other signal of note was that of YU3JDH in Yugoslavia. It would appear that the most active on the band are those based in Czechoslovakia.

40 metres (7000-7100kHz)

Diving into the thick of the signals and QRM at the low end of this band can be quite rewarding at times although from the results obtained I did rather poorly on this occasion.

From out of the pile-ups the following appeared. CXSA0 from Uruguay whilst from St. Pierre and Miquelon Islands there were signals from FP8AA. On the occasion I listened, the sole representative of Brazil was PY1AE. From Cyprus — the British assigned portion — ZC4YC was busily working a G station with the South African ZS68IM just a few kHz away pounding in with a massive signal. That was the lot apart from some Ukrainians working away amongst themselves — UB5FFJ, UB5JMO and UB5RS.

20 metres (1400-14350kHz)

One very early morning session on this band did bring forth a moderate success in the form of the following — HK4COK in Colombia vainly calling CO and getting just silence for his trouble, probably because his signal was just audible, LU1SE in Argentina working the States with VK3BW and ZL3QG in Australia and New Zealand respectively, having a go at the Gs. The one weirdly logged was 5TK1D — where on earth is he located?!

15 metres (2100-21450kHz)

Two forays on this section of the dial, one late night and one early morning, ended with this list of notables; the remainder are not worth mentioning!

Uruguay in the form of CX1DZK, Ecuador represented by HC2VK, Japan brought to mind by JA2NYY, Argentina remembered by signals from LU6UP, my broadcast band stamping ground by OA4AXK and Brazil recalled to mind by the dots and dashes from PY2FK and PY2NMB.

Canada, in particular British Columbia, was entered into the log with the reception of signals from VE7NH, Bermuda via VP9AM, Venezuela by means of YV1AD with the South African ZS6ME and the Guyana based 8R1J bringing up the rear.

Finally, to end the saga of these operations, I did manage to log VK5MV one evening on 10 metres on the only occasion I visited the band — and I haven’t been there since!
Recordings (cassette tapes of interest to listeners); Technical Books (of interest both to the transmitter and listener); Miscellaneous Titles (featuring many subjects such as Time Signal Stations, Short Wave Frequency Directory etc.) and last but not least Section 6 which lists Periodicals and Further Notes.

I was interested to note that of those magazines listed, only two were recommended – one being a German monthly and the other – guess who – why R&EW of course!

Around The Dial

In which are listed some of the frequencies you can visit, the times to be there and the type of programmes you are likely to hear.

**Sweden**

Stockholm on 21645 at 1904, OM with a talk in Swedish in the Domestic Service 1st Programme relay to ships, embassies and Swedes living in Latin America and West Africa, times from 1930 to 2030 for this target area. Switch the Rx to USB for this one – SSB is the mode.

**Greece**

Athens on 11645 at 1920, YL with news of local events and personalities in the English programme for Europe, transmitted from 1920 to 1930. OM (Old Man = male announcer) with station identification at the commencement of the German programme at 1930. These short ten minute broadcasts in various languages are composed of news items only.

**Albania**

Tirana on 9500 at 1931, YL with news of events and personalities in the Foreign Service, timed from 1915 to 2000.

**Madagascar**

Radio Nederlands Relay on 15220 at 1918, OM with announcements, frequencies and station identification at the end of the English programme for Africa, scheduled from 1930 to 1920 on this channel.

All these programmes in the English language should provide the SWL, and particularly the curious, with some definite information about this one.

**Egypt**

Cairo on 15475 at 0624, OM and YL with songs in Arabic together with some local-style music in the Palestine Service scheduled from 0500 to 0700 on this frequency, OM with announcements, time-check followed by a newcast in Arabic at 0630.

**Italy**

Rome on 11800 at 1939, yet another newcast of local and world events, this time during the English presentation to the U.K., times from 1935 to 1955.

**Belgium**

Brussels on 7335 at 1944, OM with station identification followed by a sports report, all during an English transmission to Europe and Africa and timed from 1915 to 2000.

**India**

AIR Delhi on 3905 at 1930, YL with announcements in Arabic followed by some Arabic-type music during the Arabic transmission times from 1800 to 1945 in the Foreign Service.

AIR Delhi on 9912 at 1940, songs and music in the Arabic World, scheduled from 1745 to 1945.

**Afghanistan**

Kabul on 4450 at 1809, local music and songs in the Home Service 1 which is on this frequency from 0125 to 0330 and from 1140 to 1930.

**Singapore**

SBS (Singapore Broadcasting Corporation) Singapore on 5052 at 1553, OM with announcements in English followed by a piano recital. This station operates in English from 2230 through to 1630 (1700 on Sunday and it can also be heard in parallel on 5010. The power is 20kW.

**China**

Qinghai PBS, Zining on 3950 at 2143, YL with a talk in Chinese soon after the sign-on. The schedule is from 2140 to 0100, from 0355 to 0630 and from 0950 to 1515.

**Pakistan**

PBC Rawalpindi on a measured 5008 (listed 5010), OM with songs in a Home Service programme. The schedule here is from 0045 (December to March from 0130) to 0400 (Friday to 0500) and from 1500 to 1800. The frequency can vary from 5006 to 5012, so be warned.

**Peru**

Radio Tingo Maria, Tingo maria on 4760 at 0412, OM with a song in Spanish, sign-off was at 0503 after OM with announcements and identification at 0416. Sign-off was at 0503 after OM with announcements and identification, announcements and an orchestral version of the National Anthem. The schedule is from 1100 to 0500 and the power is 2kW.

**Bolivia**

Radio Andina, Huancayo on 4996 at 0421, YL with songs in Spanish, probably just prior to this station being taken over temporarily by some armed insurgents who promptly broadcast their point of view together with some slogans before vanishing into the countryside.

**Radio Catolica, Santa Cruz**

on a measured 6727 at 0355, YL with a song in Spanish and then some light orchestral music. OM with announcements and identification at 0409 prior to an orchestral rendition of the National Anthem and off. My thanks are due to Gordon Darling of Reading for drawing my attention to this one.

**Indonesia**

RRI (Radio Republik Indonesia) Banda Aceh on 4955 at 1544, OM in Indonesian, heard with some difficulty under QRM and using LSB to clear.

RRI Yogyakarta on 5046 at 1546, YL and OM alternate in Indonesian, clearly audible under some CW QRM (Morse interference).

RRI Lambar on a measured 4927 at 1552, OM with religious chants, guitar melody at 1556 and off at 1600. The guitar melody was not Love Ambon and from other observations on Indonesian stations it would appear that this particular melody has been replaced by a new composition.

**Sri Lanka**

SLBC Colombo on 4870 at 1550, OM with a song in Sinhalese, complete with local orchestral music.

**Now Hear This**

Belize on 3285 at 0456, OM with announcements in English prior to the orchestral National Anthem and sign-off at 0504.

**YOUR REACTIONS**

Circle No.

Good 46

Average 47

Poor 48

FEBRUARY 1983
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BBC MICRO RTTY. Complete transmit-receive program for BBC micro with 32k plus user port. Cassette £7.50, or s.a.e. details and software list. Cheques payable to R. Sterry. Terminal units also available. 1 Wavelli Garth, Sandal, Wakefield, W. Yorks, WF2 6JP.

£12 OSCILLOSCOPE. Yes, approx. £12 of readily available standard components, plus my circuit and plans makes an easy built unit which plugs into aerial socket of any TV and converts it to large screen oscilloscope. Circuit & plans £3. J. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

ZX81 & SPECTRUM CASSETTE. Venture is a new and exciting graphical adventure type game. (Actual 7 games in 1). This is a genuine 16k game. £4. Please say if for ZX81 or Spectrum. G. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

WANTED: Instruction manuals for D53A and DM53A Telequipment oscilloscopes, please ring Witham (0376) 511321.

AERIAL ELECTRONICS. Please send s.a.e. for lists of new and used components, plus free with each reply — five IN4148, "Briandene", Fackley Road, Teversal, Sutton-in-Ashfield, Notts., NG17 3HL.

SUPERBOARD UK101 REWTEL TERMINAL. Program cassette and full details of hardware mods. £3.90. M. Hilton, 32A Cavan Drive, St. Albans, Herts., AL3 6HR.

RADIO JUMBLE/AUDIO JUMBLE (Euston). Once-only secondhand Bazaar. Everything audio/radio, vintage/modern, 20th February (SUN), 12.30 p.m. / 5.30 p.m. Gandhi Hall, 41 Fitzroy Square, London W.1. (adjacent Tottenham Court Road). Parking good. Sell off your unwanted equipment — immediate stall bookings half-price. Admission 95 pence (only 50p with this advertisement). Stall space details s.a.e. to 67 Liverpool Road, London N1 ORW. Phone 01-837-7811.

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AIRCRAFT COMMUNICATIONS HANDBOOK (Europe) including UK Spot MF, HF, VHF, UHF. Frequencies, military and civil airports, air traffic control centres, weather reports, broadcast times, beacons, long range stations, callsigns, maps, etc, 384 pages £7.50, post & packing £1. PLH Electronics, 97 Broadway, Chingford, London, E4 8EP.

SONY ICF2001 £95. SB505D 10M SSB Transceiver, has import licence, 28.5 - 35 Marmion Avenue, Chingford, London, E4 8EP.


AIRWAY/V-H.F. TRANSMITTER Made by Transound/Filotex. Professional grade cables from Europe's premier cable manufacturers. 28.95 MHz, £80. GM4DJH, Phone: 041-286-7440.

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SONY ICF2001 £95. SB505D 10M SSB Transceiver, has import licence, 28.5 — 28.95 MHz, £80. GM4DJH, Phone: 041-889-9010.

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The Publishers cannot be held liable in any way for printing errors or omission, nor can they accept responsibility for the bona fides of Advertisers. Where advertisements offer any equipment of a transmitting nature, readers are reminded that a licence is normally required. Replies to Box Numbers should be addressed to: Box No….., Radio & Electronics World, 45 Yeading Avenue, Rayners Lane, Harrow, Middlesex HA2 9RL.

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Gary Evans with...

The Hi-Fi Trade's advertising during the early seventies, whilst staying within the law of the Advertising Standards Authority's legal, truthful, decent and honest guidelines, can hardly have been said to be in keeping with the spirit of these laudable phrases.

Output powers quoted in an advert's copy were usually those that could only be obtained if one channel were driven into an ideal load, always assuming that the wind was in the right direction. With luck they would be sustained for the odd microsecond or two.

Quoted distortion figures were similarly those obtained under the most favourable of conditions and hardly reflected the performance of an amplifier under 'real' conditions.

The DIN standard, although not a particularly tough spec, was introduced in an effort to codify the situation with regard to the description of 'Hi-Fi' equipment. This helped to some degree but the major force behind the more sensible claims, was the fact that consumers in general were becoming more educated.

Thanks to the efforts of the Hi-Fi press, the buying public treated any output power figures followed by the words 'Peak Music Power' with the scorn they deserved. The meaning of true RMS power was understood and this was the figure that people began to look for. Amplifiers that were 100W one day were 20W the next.

For the past few years, the unbridled specmanship that was rife, has died down to a fairly ordered marketing environment, in which everybody plays the game.

Old habits die hard however, and at least one radio advert for a Hi-Fi unit in the past month has contained the dreaded words PEAK MUSIC POWER. It only takes one company to revert to such claims before the others, with an eye on their market share, will be forced to follow suit.

There is a way to prevent such a retrograde step however, and that's for you the public to ignore any such gradiose claims, and go straight for the RMS output power — of course the 'you' above does not refer to R&EW readers, if you're reading a technical magazine such as this you'll be able to find your way around a spec sheet. What about your friends, relatives and neighbours though. Spread the word and don't let them be fobbed off with some grand sounding piece of equipment that will never live up to the claims made for it.

There Is A Limit

R&EW receives a very varied selection of mail each morning but one particular letter to come our way recently must rank as one of the all time greats. We can do no better than to quote from the tome which refers to some problems a gentleman from the Metalum Roofing Company of Ikeja is having with a Swedish Colour TV set (if you're wondering what a Swedish TV is doing in Ikeja there is probably a very good explanation — unfortunately we don't know it).“After many months of inability of various Electronic Companies and Enterprises here to repair my set, the last attempt revealed that my TV is not having sufficient 'Showers' to receive image. When switched on, it would tend to produce image and voice, and then cut off instantly and showing nothing than 'Showers' on the screen."

If any of you shower has any idea as to what the problem might be we'll forward any suggestions onto Metalum Roofing. The situation is really quite serious as the last paragraph of the letter reveals."At my age now, I can't afford the cost of a new set, and my family is going to bed unusually because of nothing to keep them a little awake."

Post Script

Those of you who read the story of Coster’s Car in last month’s Last Word might like to know the latest in the saga. The owner of the other car has been traced (hooray) but it looks as if our Paul’s car is a write-off (boo). Stay tuned for further developments.
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AMATEUR ANTENNA TESTS AND MEASUREMENTS
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ANDROID DESIGN
By M B Weinstein
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This book provides a comprehensive look at the tools, materials, and techniques necessary for designing an android. It examines what an android is, what you can expect it to do, and how this will translate into the design requirements. Also included is a look at both usual and unusual hardware and software, and mechanisms and mechanisms. The book offers intriguingly sophisticated designs and the opportunity to see them realized.

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I wish to enter the lucrative field of building and installing electronic equipment. This field is likely to find wide application. This exploits modern feedback techniques, and new light is shed on the concept of loop gain leading to a distinctly useful Nyquist criterion. By the author of this book should combine sophisticated circuitry.

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CHARGE-COUPLED DEVICES AND SYSTEMS
By M J Howes & D V Morgan
Stock No: 02-96655 Price £22.20
This book ranks high alongside others published on this subject in recent years and is recommended for anyone seeking an introduction to charge-coupled devices. It deals with the physics, technology and applications of charge-coupled devices. It is the third in a series of books which develops the concept of integrating the device physics and the circuit problems. Charge-coupled devices are novel in that they have as their basic parameter electric charge rather than currents and voltages.

CMOS COOKBOOK
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Tells all you need to know about CMOS and Tellus how to design and profitably use this inexpensive and genuinely fun-to-work with digital logic family.

COMPLETE GUIDE TO CAR AUDIO
By M Clifford
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This book is a complete guide to car audio. You will learn about the various components available and how to plan a system that fulfills your desires. You will learn how to read and interpret specs, compare various units, and gain an understanding of the language of autosound. Information on installation, noise suppression, and theft protection are also included in this comprehensive book.

DESIGNING AND CREATING PRINTED CIRCUITS
By W Sikonowiz
Stock No: 02-40964 Price £7.90
An in-depth guide to the design, layout, manufacture, and assembly of printed circuits. The author clearly explains the most current advances in methods and design criteria including computer-aided techniques, multilayer fabrication, and different chemical processes for developing and etching printed circuit boards.

DESIGN OF OP-AMP CIRCUITS, with experiments
By H M Berlin
Stock No: 02-21531 Price £8.70
A complete introduction to almost every operational amplifier. It teaches the reader all there is to know about op-amp circuits with a series of 37 methodical experiments covering linear circuits, differential amplifiers, integrators, comparators, oscillators, non-linear circuits, and active filters.

DESIGN OF PHASE-LOCKED LOOP CIRCUITS, with experiments
By H M Berlin
Stock No: 02-21545 Price £8.70
The design of the basic PLL circuits is described, detector, phase comparator, and voltage-controlled oscillator circuits are detailed. Contains many practical circuits using the 560-series devices and the CMOS 4046 chip. With over 15 experiments.

DESIGN OF VMOS CIRCUITS, with experiments
By R T Stone et al
Stock No: 02-21686 Price £9.45
The vertical metal oxide semiconductor or VMOS, is a new and exciting device that may be a giant step towards the ideal active circuit element. This book written to what you need to know. It features 11 chapters on the VMOS and its characteristics. Chapter 11 presents a series of experiments that demonstrate a number of the concepts discussed in earlier chapters.
DIGITAL COMMUNICATIONS BY SATELLITE
By V K Bhargava et al
1981; 566pp; 165 x 240mm; Hardcover; Wiley; ISBN 0-471-08316-X
Stock No: 02-083161 Price £39.25
This book brings together theories, trade-offs, and implications for system design for digital communications by satellites, with emphasis on modulation, multiple access, and coding techniques. The book includes tables and worked examples with emphasis on practical design parameters; also over 130 problems. Presents much new material, including over-all digital satellite system design equations; carrier and clock recovery on practical design parameters; an introduction to integrated coding and modulation techniques; a complete survey of TDMA of burst modems; an introduction to design equations; carrier and clock recovery on practical design parameters; an introduction to TDMA satellite systems with emphasis on synchronization problems; an introduction to satellite systems with emphasis on techniques; a complete survey of TDMA of burst modems; an introduction to design equations; carrier and clock recovery on practical design parameters; an introduction to packet satellite networks; ARO for satellite channel; detailed treatment of Viterbi and sequential decoding; and a unified treatment of threshold decoding for both block and convolutional codes.

DIGITAL ELECTRONIC TECHNOLOGY
By D C Green
1982; 171pp; 185 x 245mm; Paperback; Pitman; ISBN 0 273-01722-5.
Stock No: 02-17225 Price £7.45
This is a first-year higher technician text for electronics and telecommunication students. The various logic families are discussed and their relative merits considered but the description of the digital circuits, such as counter, is illustrated by reference to the two most popular families, i.e. TTL and CMOS, only.

EFFECTIVELY USING THE OSCILLOSCOPE
By R G Middleton
1981; 169pp; 135 x 215mm; Paperback; Sams; ISBN 0 672-21794-5
Stock No: 02-21794 Price £7.95
This book emphasises practice not theory. Information is presented without frills, showing you how to do various jobs with your equipment as efficiently as possible. This book has a two fold purpose to help you understand how to make waveform tests with an oscilloscope and to show you how to analyse the waveforms produced by defective circuits.

ELECTRONIC FAULT DIAGNOSIS
By G C Loveday
2nd Ed 1982; 110pp; 185 x 245mm; Paperback; Pitman; ISBN 0 273-01854-x
Stock No: 02-01854 Price £5.25
One of the most important skills that an electronics technician can have is the ability to diagnose the causes of faults in circuits and electronic equipment. This book is an introduction to the subject which aims to teach the student how to acquire such valuable skills.

After first considering the basics of fault diagnosis, the text mainly concentrates on component faults in particular types of circuit rather than on the technique required for localising faults in complete electronics systems.

The book is particularly intended for students studying for the City and Guilds 224 Electronics Servicing, and appropriate Technical Education Council units.

ELECTRONICS II
By D C Green
2nd Ed 1982; 150pp; 175 x 235mm; Paperback; Pitman; ISBN 0 273-01827-2
Stock No: 02-01827 Price £5.45
This book presents a comprehensive and concise descriptive treatment of the basic principles of electronic devices and circuits. It constitutes an entirely suitable text for any first course in electronics for technicians, and particularly for telecommunication electronics.

The coverage is based on the Electronics II unit of the UK Technician Education Council and completely covers the requirements of the unit.

ELECTRONICS III
By D C Green
2nd Ed 1982; 204pp; 175 x 235mm; Paperback; Pitman; ISBN 0 273-01831-0
Stock No: 02-01831 Price £6.00
This book provides a wholly satisfactory text for any second-stage course in electronics for technicians, particularly in the fields of line and radio engineering and telephone switching.

The coverage is based on the Electronics III unit for the UK Technician Education Council and completely covers the requirement of this unit.

The text explains the principles, performance and application of bipolar and field-effect transistors; describes the construction, range and performance of integrated circuits, then extends the treatment of amplifiers and oscillators, with special attention to the use of bipolar transistors, FETs and integrated circuits, and provides a clear treatment of the basics of multivibrators, noise, integrators and differentiators, and stabilized power supplies.

ELECTRONICS: CIRCUITS AND DEVICES
By Ralph J Smith
1980; 496pp; 150 x 225mm; Paperback; Wiley; ISBN 0-471-08761-3
Stock No: 02-08761 Price £10.45
I wouldn't normally have noticed, but the very crooked cutting of the first few pages drew my attention to the fact that the volume was printed in Singapore of all places. Notwithstanding all that, the actual print quality is good - if you can overlook the print through on the thin paper, and the frailty of the binding.

Elsewhere references to semesters and sophomores give away the fact that the book is intended for American University/College freshmen, whose approach to education is generally rather more obtuse than in the UK! If you can overlook the Carl? overtones the book eventually gets into the title matter.

The book is a superb reintroduction for the rusty, and a good course for the informally trained electronics devotee seeking a better theoretical basis. The Q/A session in each chapter provides just the right level of self-assessment.

Subjects range from your old friend the coulomb through logic gates to the real gem of the book - one of the finest 'quickies' I have yet found describing microprocessors (featuring the Z80). Maybe we have at last lived long enough with MPU that the educationalists can step back far enough to achieve a true perspective.

ELECTRONICS FOR THE BEGINNER
By J A Stanley
3rd Ed 1980; 160pp; 135 x 215mm; Paperback; Sams; ISBN 0 672-21737-6.
Stock No: 02-21737 Price £7.95
Teaches the fundamentals of electronics by showing you how to build a single-transistor radio, an IC amplifier, CB and aircraft tuners, and a shortwave receiver. No previous knowledge of electronics is necessary. Includes over 100 illustrations.

ELECTRONIC TELEPHONE PROJECTS
By A J Caristi
1979; 168pp; 135 x 215mm; Paperback; Sams; ISBN 0 672-21618-3.
Stock No: 02-21618 Price £8.45
This handbook of electronic telephone projects was written to provide information long needed on the subject which could be used by electronics hobbyists and others to increase the utility of their telephones. Up until 1979 much of this information was either unavailable to the general public, or appeared in bits and pieces in various electronics publications.

FERROMAGNETIC CORE DESIGN
By M F 'Doug' DeMaw
1981; 251pp 155 x 235mm; Paperback; Prentice; ISBN 0-13-314088-1
Stock No: 02-40881 Price £20.45
The work within the chapters of this book is dedicated expressly to engineers, technicians, and college students who are presently or soon to be involved professionally with electronics. The chapters include basic theory and practical circuit examples in which toroids, rods, slugs, and pot cores are used. Emphasis has been placed on the practical aspects of magnetic core materials from low frequencies through UHF. The RF engineer or technician will find this volume invaluable in his or her daily efforts.


**FOUNDATIONS FOR MICROSTRIP CIRCUIT DESIGN**
By T C Edwards
Stock No: 02-79447 Price £14.15

This book provides a sound fundamental approach to the understanding of the microstrip medium and the accurate design of microwave or digital circuits using this medium, including applications both in microwave systems and in the significantly fast-growing area of high-speed digital subsystems.

The main emphasis throughout the book is on techniques suitable for fast computer-aided design (CAD). Proven-accurate design expressions and procedures are given for microstrip and for a variety of circuits using it. Appropriate design summaries, with an engineering approach, are given at the end of each chapter and measurement techniques are treated quite extensively.

**HANDBOOK OF ELECTRONIC TABLES FORMULAS**
By Howard Sams Engineering Staff
Stock No: 02-21532 Price £8.95

A complete reference book that quickly puts at your fingertips the laws and formulas so important to all branches of electronics. Provides you with the hard-to-remember constants as well as standards that have been established by industry and government. Also covers symbols and codes, service and installation data, design data, and math tables and formulas. A dependable book that technicians, engineers, experimenters, and others in the field of electronics turn to daily.

**IC TIMER COOKBOOK**
By W G Jung
Stock No: 02-21416 Price £6.70

Gives you a look at the hundreds of ways IC timers are used in electronic instrumentation. This cookbook provides a collection of numerous recipes for using the IC timer, including a 555 monostable circuit with auxiliary output, a touch switch, a programmable monostable circuit, and hundreds of others.

**INTRODUCTION TO OPTICAL WAVEGUIDES**
By M J Adams (Degree level)
Stock No: 02-79692 Price £22.00

I once observed a certain book on microwaves was well supplied with references – one chapter had over 100 listed. Well, there’s over 600 listed in alphabetical order at the end of this work which may well represent one of the finest bibliographies in the field.

The book sets out to provide the link between outright academic and communications engineering with optics – topical stuff indeed.

The theory never quite manages to bridge that useful gap with a ‘real’ application description. Maybe it’s not quite the place of this book, but since it sets out to be a teaching reference, maybe they could have helped dispell the big sums phobia that can afflict those who have discovered that no amount of solid-state physics has actually prepared them for the smell of flux and sound of an exploding tantalum capacitor.

**LARGE SCALE INTEGRATION**
By M J Howes & D V Morgan
Stock No: 02-79895 Price £18.00

This book covers engineering and design aspects of modern LSI systems. It concentrates on two basic device structures, the BJTs and FETs. It details LSI circuits, their design and testing, and the basics of LSI technology, while considering memory and design technology as well as custom design of circuits.

**LINEAR INTEGRATED CIRCUITS**
By S D Prensky
Stock No: 02-40845 Price £16.45

Finally, a practical reference on linear-integrated circuits written in an easy-to-read style for the technician, engineer, and student. The operational amplifier and its application in various areas are covered in depth, including testing and breadboarding, power amplifiers consumer/communications circuits, regulators, digital interfacing, phase locked loops, A/D and D/A conversion, and more.

**MICROVAX DEVICES AND CIRCUITS**
By S Y Liao
Stock No: 02-58120 Price £28.50

Any professional engineer engaged in communications will be well aware of the rapid growth of microwave systems. The recent advances in low-cost microwave technology have accelerated this already rapid growth, so a really thorough book like this is a valuable reference work for anyone seeking to either learn from scratch, or refresh existing knowledge.

**MOD DEVICE AND CIRCUIT DESIGN**
By O J McCarthy
Stock No: 02-10026 Price £20.00

This book provides a very complete and easy to understand introduction to metal oxide semiconductors (MOS). While focusing mainly on device design it also offers some insights in to the design and layout of digital logic and memory systems.

**OP AMP HANDBOOK**
By F W Hughes
Stock No: 02-63729 Price £16.95

This book is written for the electronics technician and student engineer under the assumption that the readers have a grasp of the fundamentals of DC/AC theory and other simple electrical theory. Amongst the many circuits are various self-assessment mutichoice "quizzes" for the reader to gauge his/her progress.

**OPERATIONAL AMPLIFIER CHARACTERISTICS AND APPLICATIONS**
By R G Irvine
Stock No: 02-35345 Price £20.45

This book is primarily written for students and electronic engineers, dealing with practical and theoretical aspects of almost every unusual and common op amp. It is a well presented book with worked examples, plus a section of problems with answers.

**OPTICAL FIBRE COMMUNICATIONS: DEVICES AND CIRCUITS**
By M J Howes & D V Morgan
Stock No: 02-76111 Price £22.20

This is a good and useful book, well referenced, and full of information. By linking together solid state devices and communications theory it fills an important gap in the bookshelf.

International contributions discuss the important subject of optical fibre communications. The use of glass fibres as a medium for transmission lines in optical communication systems has reached the stage where systems are being constructed and evaluated. This book deals with developments in this area of interest to engineers.

A working knowledge of industrial elements, components and their associated circuits. The book is essentially a physicists' viewpoint (there are no circuit diagrams), although the mathematics aren't quite as daunting as you might imagine. If you want to establish exactly why and how your semiconductors fail (at a structural level) - and how to avoid problems - then this book has all the answers.

Contents: Semiconductor Physics; Physics and Properties of Semi-conductors - A Resume; Bipolar Devices; P-N Junction Diode; Bipolar Transistor; Thyristors; Unipolar Devices: Metal-Semiconductor Contacts; JFET and MESFET; MIS Diode and CCD; MOSFET; Special Microwave Devices; Tunnel Devices; Impatt and Related Transit-Time Diodes; Transferred-Electron Devices; Opto-electronic Devices; LED and Semiconductor Lasers; Photodetectors; Solar Cells; Appendices; Index.

POPULAR CIRCUITS: READY-REFERENCE

By John Markus

This book provides in a compact form a core of fact, key, calculations, derivations and main principles. Important concepts are described in an abbreviated form. A diagram follows to illustrate each concept, and its application is shown in a worked example. Then to test the student's grasp of what he has just read, he is given a problem to solve.

The idea is to a) save classroom time spent on laborious note-taking, thus giving the student the opportunity to spend more time on practical work and b) enable the student to take a syllabus unit in the shortest time possible.

PRACTICAL HANDBOOK OF VALVE RADIO REPAIR

By C E Miller

This book fills a gap in the sources of information available to those interested in all aspects of vintage radio. The book contains historical and technical information together with a comprehensive and detailed description of fault-finding and repair techniques covering a wide range of wireless sets from the 1920s to the 1950s.

PRACTICAL SOLID-STATE CIRCUIT DESIGN

By J E Oleksy.

An introductory course in practical solid-state circuit design for the experimenter, designer, or technician who is interested in constructing "tailor-made" circuits. Chapters contain short examples and quizzes to help you test your understanding.

RADIO HANDBOOK 22nd EDITION

By W I Orr

Today amateur radio stands upon a new frontier, looking forward to major technical advances in the coming decades: spread-spectrum modulation digital communications, and speech synthesis, to name a few. This book has helped bring amateur and commercial radio communication from where they were to where they are.

RELIABILITY AND DEGRADATION

By M J Howes & D V Morgan

This book includes a basic review of metallization systems (Chemistry and Metallurgy), physical techniques for the study of metal semiconductor systems and a detailed appraisal of degradation mechanisms in silicon and III-V systems.

SCRS AND RELATED THYRISTOR DEVICES

By C Laser

The purpose of this book is to provide electronic engineers, technicians and experimenters with a practical understanding of thyristor devices. The material - fundemental theory of operation, specifications, and applications - is organized primarily as self-study text to assist in the design or maintenance of electronic circuits that involve thyristors.

SON OF CHEAP VIDEO

By D Lancaster
1980, 224pp. 135 x 215mm; Paperback; Sam's. ISBN 0-672-21723-1.

Don Lancaster leads the unwary through the wires and wheezes of the low cost approach to producing a VDU. The author's well-known style helps to provide guidance and advice on the black art of video for the computer user and enthusiast.

Transform your computer graphics into a format suitable for a standard TV set.

TELEGRAPH AND DATA TRANSMISSION OVER SHORTWAVE RADIO LINKS

By L. Wiesner

This book is intended to familiarize a wide audience with telegraph and data communication over shortwave links. It fully discusses the technical facilities now available for the attainment of maximum reliability in message transmission, and clearly yet critically describes the physical phenomena encountered in shortwave propagation and the fundamental problems of telegraph communication over radio links. The characteristics of short waves, types of modulation, and transmission methods, as well as diversity and data protection methods, are dealt with in great detail.

TELEVISION SERVICING WITH BASIC ELECTRONICS

By J G Sloop

This book tells how to quickly isolate a television servicing problem to a section and then troubleshoot that section to repair the TV in a minimum number of steps. Uses the block diagram analysis approach to illustrate logical TV servicing. Covers the basic math's required for TV servicing. Discusses the importance of public relations in TV servicing. Covers test equipment - tells the best instrument to use for the particular type of troubleshooting being performed. Emphasizes safety - both of technician and customer. Diagnostic troubleshooting is enhanced with troubleshooting charts to guide you step-by-step through the troubleshooting procedure for given symptoms.
TRANSMISSION SYSTEMS TEC II
By D G Green
2nd Ed 1982; 148pp; 175 x 235mm;
Stock No: 02-01826 Price £5.45
This book first introduces the concepts of amplitude modulation and frequency modulation, and then considers the various types of signal, and the factors leading to the choice of a carrier frequency and bandwidth.

This is followed by descriptions of the most important equipments and functional units, in particular filters and transmission lines and circuits, and the book ends with the basic systems of frequency-division and time-division multiplex.

Many worked examples demonstrate the principles and application involved and every chapter concludes with test exercises.

TROUBLESHOOTING WITH THE OSCILLOSCOPE
By R G Middleton
4th Ed 1980; 256pp; 135 x 215mm;
Stock No: 02-17384 Price £8.70
One of the quickest and least costly ways of troubleshooting most electronic equipment is to use an oscilloscope - properly. In this book, now in its fourth edition, the author not only provides correct step-by-step procedures on the use of an oscilloscope but combines these with specific facts of television receiver troubleshooting.

TV ANTENNAS & SIGNAL DISTRIBUTION SYSTEMS
By M J Salvati
1979; 256pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21584-5.
Stock No: 02-21584 Price £8.70
An invaluable guide to selecting and installing TV antennas and signal distribution systems. Packed with easy-to-understand information on using these systems to produce high quality TV reception. Many of the antennas described have been personally tested by the author.

UNDERSTANDING CMOS INTEGRATED CIRCUITS
By R Melen & H Garland
1979; 144pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21588-6.
Stock No: 02-21588 Price £5.70
A building-block approach that helps you completely understand CMOS ICs. Tells you what CMOS ICs are, how they work, and how they can be used in electronic circuit design. Many practical circuits, complete with parts values are presented. These include a digital timer, capacitance meter, analog-to-digital converter, and electronic stopwatch.

VIDEOTEX
By R Woolfe
1980; 170pp; 180 x 250mm; Hardcover; Hayden (WI); ISBN 0-86501-493-8.
Stock No: 02-14938 Price £12.50
This book provides an overview for authors who wish to evaluate what videoex can do, and to understand the techniques involved, and to learn of the developments that are forecast.

The next decade will see a revolution in the provision of information which will affect all our lives - this book shows how it interacts with business requirements and how it can enter our homes too. There is a glossary of the technical terms used in connection with this service.

WIND/SOLAR ENERGY FOR RADIO COMMUNICATIONS AND LOW-POWER ELECTRICAL SYSTEMS
By E Noll
2nd Ed 1981; 264pp; 135 x 215mm;
Stock No: 02-21827 Price £10.20
Provides a practical look at the efficient use of sunlight in the operation of photovoltaic power supplies and the conversion of wind energy to electricity using wind-energy conversion systems (WECS). You benefit from the author's personal experience as Ed Noll explains how you can design and install your own working system. Covers low-power solar systems and mini-power through high-power wind generator installations.

555 TIMER APPLICATIONS SOURCEBOOK
By H Berlin
1976; 160pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21538-1.
Stock No: 02-21538 Price £5.75
A practical and informative guide to the world famous 555 timer IC. A host of applications (including many unusual circuits) for using this device in applications ranging from voltage regulation to signal generation.

99 PRACTICAL ELECTRONIC PROJECTS
By H Friedman
1979; 128pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21635-3.
Stock No: 02-21635 Price £5.05
16 groups of projects are presented to illuminate the path for the beginner. From audio amplifiers, test equipment and photography projects, to automotive projects. Most projects can be constructed for less than 5 pounds.

MOTOROLA DATA BOOKS
EUROPEAN MASTER SELECTION 1982
248pp. Paperback; Motorola.
Stock No: 02-14000 Price £4.05
Shortform listing of approx 4,000 Motorola consumer devices including: MOS ICs. Bipolar ICs. Telecommunications, Linear Discrete components and Hybrid circuits.

THE EUROPEAN CMOS SELECTION
860pp. Paperback; Motorola.
Stock No: 02-04000 Price £7.55
Complete technical data for a very large range of Motorola CMOS ICs, with extra information on handling precautions, reliability product previews, etc.

EUROPEAN HOME ELECTRONICS, INTEGRATED CIRCUITS
590pp. Paperback; Motorola.
Stock No: 02-16182 Price £6.05
Covers ICs most commonly found in Home Electronics today. Types include: Op amps. Voltage Regulators, TV ICs, Radio, CMOS and Micros.

EUROPEAN HOME ELECTRONICS, DISCRETE DEVICES
590pp. Paperback; Motorola.
Stock No: 02-28182 Price £6.05
Full data on a wide range of discrete components including small signal transistors, power transistors, FETs, Diodes, SCRs and Triacs.
COMPUTER BOOKS

ADVANCED BASIC: APPLICATIONS AND PROBLEMS
By J S Coan
1976; 192pp; 150 x 230mm: Paperback:
Hayden: ISBN 0-8104-5855-1
Stock No: 02-58551 Price £10.00

Now you can extend your expertise in the BASIC language with this book of advanced techniques and applications of the BASIC language. It allows you to gradually increase both your understanding of concepts and your ability to write programs. The development of each topic progresses throughout, thereby offering engineers a critical approach to circuit analysis.

Features include: a much improved presentation of two-port analysis through the use of wiring operators, and discussion on the growing use of computer programs for transfer function analysis both in the s-domain and symbolically. There is a careful and lucid treatment of sensitivity analysis, and an important chapter on tolerance analysis, including integrated circuit tolerances.

ATARI ASSEMBLER
By D & K Inman
1981; 270pp; 145 x 235mm: Paperback:
Stock No: 02-95931 Price £7.25

This crystal-clear guide is the first book to open up the vast creative possibilities of artistic programming to owners of the ATARI 400 and ATARI 1000 - the most visually advanced personal micros on the market. With this self-paced, self-teaching guide, you'll advance step-by-step through simple techniques for creating a fascinating array of sounds and images.

As a beginner with no computing experience, this guide lets you see and hear things on your ATARI right away. It enables you to learn to compose and play melodies, draw cartoons, create sound effects and games, and progress to more sophisticated artistic programming, and because the book uses BASIC and requires no programming knowledge, you learn elementary BASIC programming in the context of each newly introduced technique!

BASIC PROGRAMMING AND PROBLEM SOLVING WITH PASCAL
By G M Sirtle & S C Bruell
1981; 520pp: 160 x 230mm; Paperback:
Stock No: 02-91553 Price £8.40

A Guide to good programming habits and style using PASCAL. Teaches the user to manage all aspects of the programming process and to be comfortable with large programming projects.

ADVANCED COMPUTER DESIGN
By J K Iliffe
1982; 469pp: 180 x 240mm: Paperback:
Stock No: 02-011254 Price £19.45

In this clearly written book, Professor Iliffe provides a study of some of the major areas that are likely to be dominant in computer design in the near future. Based on the author's extensive experience in industrial research and development, this discussion includes the encoding and execution of problem-oriented or high level programming languages, the provision of high-speed operations on numeric and non-numeric data, and the reduction and containment of programming costs.

BASIC CONVERSIONS HANDBOOK FOR APPLE, TRS-80, AND PET USERS
By M J Borgerson
1982; 234pp; 170 x 255mm; Paperback:
Stock No: 02-32042 Price £7.25

This comprehensive book was written for you. It shows you how to convert your BASIC programs into the powerful programming language PASCAL, as well as variations for the TRS-80 (Model I, Level II), Applesoft BASIC, and PET program languages, the provision of high-speed operations on numeric and non-numeric data, and the reduction and containment of programming costs.

APPLIED CIRCUIT THEORY: MATRIX AND COMPUTER METHODS
By P R Adby
1980; 490pp: 155 x 230mm: Paperback:
Stock No: 02-69081 Price £9.00

This book develops, compares and illustrates all the more important methods of circuit analysis, developed for use directly by computer. It is the only text to intermediate between basic circuit theory and computer-aided design, and with a clarity which renders the text easily understandable by engineers and students alike. Steering a middle course between fundamentals and advanced theory, the book is subject to treated in sufficient depth to allow general application to active circuits throughout, thereby offering engineers a critical approach to circuit analysis.

Features include: a much improved presentation of two-port analysis through the use of wiring operators, and discussion on the growing use of computer programs for transfer function analysis both in the s-domain and symbolically. There is a careful and lucid treatment of sensitivity analysis, and an important chapter on tolerance analysis, including integrated circuit tolerances.

ATARI SOUND AND GRAPHICS
By H Moore et al
1982; 234pp; 170 x 255mm: Paperback:
Stock No: 02-95931 Price £7.25

This crystal-clear guide is the first book to open up the vast creative possibilities of artistic programming to owners of the ATARI 400 and ATARI 1000 - the most visually advanced personal micros on the market. With this self-paced, self-teaching guide, you'll advance step-by-step through simple techniques for creating a fascinating array of sounds and images.

As a beginner with no computing experience, this guide lets you see and hear things on your ATARI right away. It enables you to learn to compose and play melodies, draw cartoons, create sound effects and games, and progress to more sophisticated artistic programming, and because the book uses BASIC and requires no programming knowledge, you learn elementary BASIC programming in the context of each newly introduced technique!

BASIC PROGRAMMERS GUIDE TO PASCAL
By B Albrecht et al
1982; 334pp; 170 x 255mm: Paperback:
Stock No: 02-92932 Price £7.25

This book gently leads readers through the fundamentals of programming. In introducing increasingly sophisticated concepts, it is careful to reinforce the relevant preliminaries, and takes you from knowing almost nothing to knowing almost everything about BASIC.

BASIC PROGRAMS HANDBOOK FOR THE BBC MICROCOMPUTER
By N & P Cryer
1982; 200pp: 135 x 235mm: Paperback:
Stock No: 02-66407 Price £6.45

This comprehensive book has been written with particular reference to the BBC Microcomputer, the amazingly versatile
home computer which has been causing so much interest and enthusiasm in the computing world. As the book uses non-technical language and does not assume previous experience of computing or special mathematical training, it is particularly suitable for beginners.

**BUILD YOUR OWN Z80 COMPUTER**
By S Ciarcia
1981. 332pp. 215 x 275mm; Paperback.
Stock No: 02-09621 Price £15.00

There is a major need for a book such as this. The information is not readily available elsewhere. Or anywhere. There are dozens (hundreds?) of microprocessor books but nearly all deal with software and treat hardware as abstractions or block diagrams. Ciarcia's book is literally filled with very useful and practical 'hands-on' hardware advice, tips and techniques.

**BYTE BOOK OF COMPUTER MUSIC**
By C P Morgan
1979. 144pp. 210 x 275mm; Paperback.
Stock No: 02-30977 Price £10.25

By analogy to the library.

**BYTE BOOK OF PASCAL**
By B Liflick
1979. 334pp. 210 x 265mm; Hardcover.
Stock No: 02-78231 Price £22.45

This book contains a collection of the best articles from past issues of BYTE magazine, the leading technical journal in the microcomputer field. The language in discussion has until recently only enjoyed a large following in the academic community, and now has been practical to use with microcomputers.

**COMMUNICATION CONTROL IN COMPUTER NETWORKS**
By J Puzman & R Porizek
1980. 294pp. 155 x 235mm; Hardcover.
Stock No: 02-78947 Price £16.45

This book deals with communication functions and communication protocols and describes communication control in computer networks in terms of communications functions such as error control, flow control, routing, addressing, synchronisation and sequencing, link capacity sharing, etc. and relates these functions to communication protocols and network architecture. Various methods of several communication functions are dealt with. Communication protocols are treated as formal tools used for implementation of selected communication function methods. Design, modeling, verification and evaluation of protocols are also included.

**COMMUNICATIONS NETWORKS FOR COMPUTERS**
By D W Davies & D L A Barber
1973. 645pp. 155 x 235mm; Hardcover.
Stock No: 02-98749 Price £31.85

This book is concerned with the technology created by the convergence of computing and telecommunications and the emergence of systems which combine them in order to provide "teleprocessing" services. One particular theme is the communication needs that are being created by computer networks as these needs are very different from those human requirements which led to the design of present day telecommunication networks.

The contents of this book include: Computers and Communications; Data Communication and the Telephone; Computer Interaction; Private Data Networks; Data Transmission; Information Flow Control; Storage and Coding; Digital Multiplexing; Message Switching Systems; Data Switching Principles; Network Structure for Packet Switching; Protocols, Terminals and Network Monitoring; Network Geography, Reliability and Routing; The Software of Packet Switching Systems; Review of the Design Principles of Data Networks.

**COMPUTER DICTIONARY AND HANDBOOK**
By C J & R J Sippl
1980. 928pp. 155 x 255mm; Hardcover.
Stock No: 02-21632 Price £27.20

You and other computer users throughout the world can have at your fingertips the largest and most complete reference book available on all phases of computers and their applications.

More than 22,000 definitions, acronyms, and abbreviations bring the whole realm of computer technology to you.

**COMPUTER GRAPHICS PRIMER**
By M Waite
1979. 184pp. 135 x 215mm; Paperback.
Stock No: 02-21650 Price £11.70

This Sams best-selling Primer is used in computer courses nationwide as an introductory text for computer graphics, but
COMPUTER NETWORKS AND THEIR PROTOCOLS
By D W Davies et al
Stock No: 02-97501 Price £30.00
This book follows on from Communications Networks for Computers by Donald Davies and Derek Barber, (as shown above). The development of networks has put emphasis on formal protocols and standard interfaces which are fully described in the new book.
Contents: Computer Networks; Packet Switching, Routing, Flow Control and Congestion Avoidance; Packet Broadcast Systems; Communication Protocols and Interfaces, High Level Protocols; Terminals in the Network; Message Authentication; Network Optimisation.

COMPUTER PROGRAMS THAT WORK!
By J D Lee et al
Stock No: 02-04102 Price £5.45
This all-British book of computer-aided calculations, simulations and games is a complete list of CP/M-compatible software, covering to help you to immediately begin using and working with CP/M. Includes a complete list of CP/M-compatible software, too!

CP/M PRIMER
By S M Murtha & M Waite
Stock No: 02-21791 Price £11.70
If you are a first-time microcomputer user wanting to increase your technical knowledge or a veteran who wants to explore switching to the CP/M operating system, this book can help you find your answers. It’s the only complete one-stop source available on CP/M – the very popular operating system for 8080, 8085 and 286-based microcomputers. Complete terminology, hardware and software concepts, and start-up of CP/M systems are covered to help you to immediately begin using and working with CP/M. Includes a complete list of CP/M-compatible software, too!

CP/M USER GUIDE
By T Hogan
Stock No: 02-88829 Price £12.45
In this revised edition, the latest CP/M developments are discussed, including CP/M-86, the operating system for 8086 and 8088-based microcomputers such as the IBM Personal Computer. For computer users who want to know the basics of CP/M, this guide bridges the gap between technical manuals and your working knowledge of microcomputers. For beginners this book covers all the CP/M commands in detail; describes standard CP/M utility programs; discusses high-level languages and utility programs that run on CP/M; provides reference lists and tables and examines the systems approach to implementing CP/M.

CRASH COURSE IN MICROCOMPUTERS
By L E Frenzel Jrn
Stock No: 02-21634 Price £15.45
Because of its content and unique form of presentation, the reader is provided with a solid background in microcomputers quickly and effectively. No previous computer knowledge is necessary, as the self-teaching/self-testing format force-feeds only the most important information to you in easy bites. Excellent for busy microcomputer students of all ages, regardless of occupation.

DATABASE FOR THE SMALL COMPUTER USER
By T Elbra (NCC)
Stock No: 02-23283 Price £9.50
This book explores what database means, considering different database models, security, the data dictionary, and the database administrator. Database usage on a microcomputer — a likely small-user approach — is described, and the author considers particular shared-data machines and distributed database concepts.

DATABASE MANAGEMENT SYSTEMS PROTOCOLS
By A J Swan
Stock No: 02-22031 Price £15.50
Problems arise when the components of a distributed system need to be linked to form an integrated data processing system. Two classes of interface are identified: a communications interface for long-distance links, and a local interface for short links. This book focuses on the problem of integrated communications systems, a problem first considered in the earlier NCC publication, ‘Why Distributed Computing?’ International standardisation bodies are influencing this area, with specification of standards for data link level communication protocols and the proposal for public packet switched data network access.

DATABASE PROGRAMMING IN BASIC
By L Finkel & J B Brown
Stock No: 02-08333 Price £9.25
A step-by-step, self-instructional guide to programming and maintaining data files on microcomputers using BASIC. Shows how to use data files for a variety of home and business applications.

DATABASE STRUCTURES AND OPERATING SYSTEMS
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This book develops a theoretical foundation for both hardware and software engineers. A mathematical basis of information organisation is developed and used to model the hardware of a computer system and the architecture of the operating system. The power of the method is illustrated by a theoretical formalisation of the well-known Multics system.

DATABASE SYSTEMS PROTOCOLS
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DATABASES: CONCEPTS AND APPLICATIONS
By D R Doll
Stock No: 02-21634 Price £15.45
This book surveys the background to electronics that make a computer function but with how to use computers. It is primarily intended for the fast-growing number of school children who have access to personal microcomputers at home or at school.

Because of its content and unique form of presentation, the reader is provided with a solid background in microcomputers quickly and effectively. No previous computer knowledge is necessary, as the self-teaching/self-testing format force-feeds only the most important information to you in easy bites. Excellent for busy microcomputer students of all ages, regardless of occupation.

DATA STRUCTURES FOR MICROCOMPUTERS
By B S Frenzel Jrn
Stock No: 02-21634 Price £15.45
Because of its content and unique form of presentation, the reader is provided with a solid background in microcomputers quickly and effectively. No previous computer knowledge is necessary, as the self-teaching/self-testing format force-feeds only the most important information to you in easy bites. Excellent for busy microcomputer students of all ages, regardless of occupation.

DATA COMMUNICATIONS: FACILITIES, NETWORKS AND SYSTEMS DESIGN
By P D Doll
Stock No: 02-17689 Price £31.75
Turn to this book for specific guidance on all areas of data communications – from basic terminology to detailed design methods. The author brings together the most up-to-date concepts in the design, management, and application of minimum-cost, reliable networks.

DATA COMMUNICATIONS PROTOCOLS
By A J Swan
Stock No: 02-22031 Price £15.50
Problems arise when the components of a distributed system need to be linked to form an integrated data processing system. Two classes of interface are identified: a communications interface for long-distance links, and a local interface for short links. This book focuses on the problem of integrated communications systems, a problem first considered in the earlier NCC publication, ‘Why Distributed Computing?’ International standardisation bodies are influencing this area, with specification of standards for data link level communication protocols and the proposal for public packet switched data network access.

DATA FILE PROGRAMMING IN BASIC
By L Finkel & J B Brown
Stock No: 02-08333 Price £9.25
A step-by-step, self-instructional guide to programming and maintaining data files on microcomputers using BASIC. Shows how to use data files for a variety of home and business applications.

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This book develops a theoretical foundation for both hardware and software engineers. A mathematical basis of information organisation is developed and used to model the hardware of a computer system and the architecture of the operating system. The power of the method is illustrated by a theoretical formalisation of the well-known Multics system.
DESIGN AND CONSTRUCTION OF COMPILERS
By R Hunter
Stock No: 02-80542 Price £11.00
This book deals with the design and construction of compilers for high-level programming languages, particularly modern languages such as ALGOL 68, Pascal, and ADA. The emphasis is on the design aims of compiler projects and how they might be achieved. The practical details of compiler writing have been covered and are soundly based on the underlying theory. All the major aspects of compiler writing are discussed in an integral manner, including lexical analysis, syntax analysis, use of symbol tables, storage allocation, and code generation, without over emphasizing one aspect at the expense of others.

DICTIONARY OF COMPUTING
By F J Galland
Stock No: 02-04698 Price £9.00
This is a dictionary of computing and information processing for the student and advanced student of programming, systems analysis, operating or field engineering. It is designed for all those who have to deal with the terms and technology of modern computing, e.g. technical writer, instructors, managers, etc.

DIGITAL CIRCUITS AND MICROCOMPUTERS
By D E Johnson et al.
Stock No: 02-21407 Price £11.45
This book introduces the language, covering the mathematical, non-numeric and data-processing facilities. Where possible the text is machine-independent although supplements are included to show variations in a number of manufacturer's implementations. The book is suitable for use in schools and colleges and is also appropriate for self-study by anyone wishing to become familiar with the language.

DIGITAL COMPUTER FUNDAMENTALS
By T C Bartee
Stock No: 02-61723 Price £7.45
This dictionary will help you to convert programs from one computer to another. Not specific to a particular language (though illustrative examples are given in well-known languages such as FORTRAN), the book is intended for use (in conjunction) with a language-specific textbook or manual.

DICTIONARY OF BASIC
By W A Hart
Stock No: 02-04277 Price £6.00
This book details the step-by-step direction you will understand what it does and how you can make it work on your computer. Each entry is explained in plain English - not computerese.

HOW TO BUILD A COMPUTER-CONTROLLED ROBOT
By T Loofbourrow
Stock No: 02-56818 Price £9.35
This book details the step-by-step direction for building a computer-controlled robot, named "Mike" controlled by a KIM-1 microcontroller. Every step of the construction of "Mike" is explained, with

DIGITAL LOGIC DESIGN AND APPLICATIONS
By L B McCurdy et al.
Stock No: 02-23819 Price £11.45
This is a laboratory manual which has been developed to provide experiments in applied logic network and design. Altogether there are 22 experiments. Each one commences with an introductory paragraph which outlines the purpose of the experiment and this is followed by a brief introduction and a listing of the components used. The procedure of the experiment is then outlined.

GUIDE TO GOOD PROGRAMMING PRACTICE
By B Meek & P Heath
Stock No: 02-21524 Price £6.00
As a part of Brian Meek's series "Computers and Their Applications" this book is the first to bring together, in such compact and assimilable form, guidance on the many and varied aspects of the computer programmer's work. From the extensive experience in educational, industrial and commercial programming of ten specialists, it offers a broad range of practical advice on how to tackle the inevitable problems of writing programs, professionally or otherwise.

HARTS DICTIONARY OF BASIC
By B Meek & P Heath
Stock No: 02-21524 Price £6.00
This is a laboratory manual which has been developed to provide experiments in applied logic network and design. Altogether there are 22 experiments. Each one commences with an introductory paragraph which outlines the purpose of the experiment and this is followed by a brief introduction and a listing of the components used. The procedure of the experiment is then outlined.

GUIDELINES FOR COMPUTER MANAGERS
By National Computing Centre
Stock No: 02-56818 Price £9.35
This dictionary will help you to convert programs from one computer to another. Not specific to a particular language (though illustrative examples are given in well-known languages such as FORTRAN), the book is intended for use (in conjunction) with a language-specific textbook or manual.
the complete control programs clearly written out. Photographs, diagrams, and tables help to direct you in the construction. You may use the directions exactly as they are set forth in the book or as a basis for developing your own design.

**HOW TO BUY THE RIGHT SMALL BUSINESS COMPUTER SYSTEM**  
By C R Smolin  
1981. 156pp, 170 x 255mm; Paperback; Wiley; ISBN 0-471-08494-8  
Stock No: 02-84948 Price £7.50

This compact book contains all the vital information you need to take full advantage of the ongoing revolution in small business computer systems. Outlined in this book is how a computer operates; what you should expect from it; what you'll have to put in to get something of value out; how to shop for the equipment and programs you'll need; how complex programming provided by the manufacturer and microcomputers in general and the Motorola 6800 microprocessor family in particular. Covers 6800-based microcomputers and learning systems. Over 30 'real-world' experiments demonstrate applications as the concepts are being explained.

**HOW TO PROGRAM AND INTERFACE THE 6800**  
By A C Staugaard  
1981. 146pp, 135 x 215mm; Paperback; Butterworth; ISBN 0 408 01129 7  
Stock No: 02-11297 Price £5.50

This book consists of practical projects for the home constructor by which a micro system may be linked to the world around it, e.g. light sensor, sound effects generator. The theory and circuit of each interface is fully explained. Using this book, a wide variety of interfaces can be constructed to suit almost any microprocessor or microcomputer system.

**INTRODUCING MICROPROCESSORS AND MICROCOMPUTERS**  
By O Bishop  
1982. 146pp, 135 x 215mm; Paperback; Butterworth; ISBN 0 408 01129 7  
Stock No: 02-96010 Price £5.00

This book is intended specifically for such readers, not previous knowledge of electronics is assumed, but since microprocessors are invariably a part of other electrical circuits and exercise control by electrical means, some background knowledge of elementary circuits must be assumed.

**INTRODUCTION TO MICROCOMPUTERS FOR THE HAM SHACK**  
By H L Helms  
1979. 96pp, 135 x 215mm; Paperback; Sams; ISBN 0 672 21459 8  
Stock No: 02-14598 Price £8.70

Here is a guide to assembly language programming of the Intel 8080, Motorola MC6800, and MOS Technology MC6502 microprocessors. It is written especially for beginning programmers with hobbyist microcomputers based on one of these three chips. The topics covered range from data manipulation at the bit level up to data manipulation of tables and lists, and from simple adds and subtracts up to floating-point operations.

**HOW TO TROUBLESHOOT AND REPAIR MICROCOMPUTERS**  
By J D Lenk  
1980. 304pp, 135 x 235mm; Paperback; Prentice; ISBN 0 8359 2981 7  
Stock No: 02-29817 Price £12.45

This working guide will assist all hobbyists and technicians in trouble shooting and repairing microcomputers and peripheral system repair made simple for advanced computers. The book will help you program computers based on the 8080. It is intended to provide an understanding of the development of the subject, in an informal style while assuming no background in circuit theory, semiconductor physics, or abstract algebra.

**INTRODUCTION TO INTERACTIVE COMPUTER GRAPHICS**  
By J E Scott  
1982. 255pp, 150 x 230mm; Hardcover; Wiley; ISBN 0 471 86623 7  
Stock No: 02-88623 Price £11.00

Written in a clear, non-mathematical style, and assuming no prior knowledge of interactive computer graphics, this book spans the entire spectrum of the technology, including input and viewing, two-dimensional and three-dimensional graphics, monochrome and full-colour screens and plotters, storage and refreshed screens, line-draw and raster methods, and proposals for a graphics standard. This working guide will assist all professionals concerned with applying interactive computer graphics to drafting, manufacturing, design, mapping, business graphics, and scientific data presentation. It will benefit users in a wide range of industries, ranging from electronics, automotive, aerospace, and ship building to weapons, manufacturing, architecture, engineering, and construction.

**INTRODUCTION TO 8080/8085 ASSEMBLY LANGUAGE PROGRAMMING**  
By J N Fernandez & R Ashley  
1981. 318pp, 170 x 255mm; Paperback; Wiley; ISBN 0 471 86623 7  
Stock No: 02-88098 Price £8.00

This clear, precise book explains what Assembly Language is and teaches you how to code programs that include input/output, data movement, conditional, logical and arithmetic operations, register and stack manipulations, and much more. Knowledge of a computer language is helpful but not required. The book will help you program computers based on the 8080. It is intended to provide an understanding of the development of the subject, in an informal style while assuming no background in circuit theory, semiconductor physics, or abstract algebra.
The author chose the Motorola M6800, and gives his reasons for doing so, but remarks that many other popular 8-bit microprocessors would have been quite suitable.

MICROCOMPUTER INTERFACING WITH THE PPI CHIP
By P F Goldsbrough
Stock No: 02-21614 Price £7.95
This self-instructional text is designed to introduce the user to the Intel 8255 Programmable Peripheral Interface (PPI) through discussion and experiments. Much of the material is applicable to PPI's in general and tells what the 8255 is, where it fits in a microcomputer system, why it is used, and how it is used.

MICROPROCESSOR APPLICATIONS HANDBOOK
By D F Stout
Stock No: 02-17988 Price £19.45
In this important new reference, experts offer circuit design engineers, systems engineers, physicists, chemists, medical researchers, and all others operating and designing microprocessor systems, the applications they need to make their systems timely, cost-effective, and versatile.

MICROPROCESSORS AND LOGIC DESIGN
By R L Krutz
Stock No: 02-82317 Price £10.40
Written to provide a comprehensive understanding of microcomputer hardware, fabrication technology, software and interfacing which can be applied to future as well as present microcomputers. It assumes no prior knowledge of digital systems; presents background material including detailed handling of arithmetic operations in microcomputers, useful algorithms, flow-charting, and communications terms and protocols.

MICROPROCESSOR DATA BOOK
By S A Money
Stock No: 02-15319 Price £16.50
This book contains condensed data for most of the available types of microprocessor and microcomputer devices, and its aim is to assist the engineer who has to choose a suitable microprocessor, when designing a modern electronic system, by avoiding the necessity of collecting a mountain of data sheets and manuals.

MICROPROCESSOR SYSTEMS
By M Aumiaux
Stock No: 02-10129 Price £12.25
This is the first book on microprocessors to treat in detail the three fundamental topics; interfacing, programming in assembler, and the use of a development system. The book gives a complete and detailed study of the microcomputer environment within a microprocessor system.

MICROPROCESSOR SYSTEMS. INTERFACING AND APPLICATIONS
By R J Bibbero & D M Stern
Stock No: 02-53066 Price £17.15
Here are state-of-the-art techniques for using microprocessor circuits in systems involving distributed functions, processing, and the use of communication links between processors and peripherals. This practical manual thoroughly explains processor and peripheral instrumentation interfacing and the use of programming displays for effective user interaction.

MODERN MICROPROCESSOR SYSTEM DESIGN
By D R McGlynn
Stock No: 02-64920 Price £22.45
This detailed overview of the new 16-bit and bit-slice microprocessors present an up-to-date survey of their capabilities and current uses, together with recent developments in interfacing, system development, modern peripheral components and devices such as magnetic bubble memories and charge-coupled devices. Progress in the development and application of 16-bit and bit-slice microprocessors has largely defined the two principal directions microprocessor technology has followed in the last few years. The 16-bit processors such as the Intel 8086, the Zilog Z8000, and the Motorola 68000 are general purpose computers on chip which have more of the features and facilities of large-scale computers.

PASCAL IMPLEMENTATION: COMPILER AND ASSEMBLER/INTERPRETER
By S Pemberton & M C Daniels
Stock No: 02-73259 Price £23.00
PASCAL PROGRAMMING
By L Atkinson
Stock No: 02-77746 Price £7.95
This book provides a first course on Pascal Programming which can be used as an introductory text for those with no previous knowledge of programming or as a conversion text for those with experience of other high level programming language other than Pascal.

PET BASIC
By R J Battery et al
Stock No: 02-55249 Price £12.45
The material in each chapter of this book is written for people who are learning to use the PET. There are plenty of examples, do-it-yourself exercises, and fun-filled explorations.

PET/CBM AND THE IEEE 488 BUS (GPIB)
By E Fisher & C W Jensen
Stock No: 02-86780 Price £13.00
The purpose of this book is to describe the relationship between the PET/CBM and the IEEE 488 Bus in sufficient technical depth so the CBM user can find answers to timing and address problems that might occur while interfacing a variety of electronic instruments to the CBM via the J1 interfacing port.

PET INTERFACING
By J M Downey & S M Rogers
Stock No: 02-21795 Price £12.35
The user port, the memory expansion port, and I/O breadboard for the memory port and interfacing to the IEEE 488 port of the PET are explained.

PRACTICAL HARDWARE DETAILS OF 280, 2800, 8086 & 8080 MICROCOMPUTER SYSTEMS
By J W Coffron
Stock No: 02-69108 Price £18.85
The book details how each of the above families of microprocessors are orientated and how each system operates. It has many software and extensive hardware details for each microcomputer discussed.

PRACTICAL GUIDE TO COMPUTER COMMUNICATIONS AND NETWORKING
By R Deasington
Stock No: 02-75456 Price £16.50
This book is an essentially "practical" guide to the implementation of computer software to communicate (possibly over networks) with other computers or terminals. It bridges the gap between electronic engineering and computer science, and provides those who have a purely computing background with a good grounding in the physical mechanism of data transmission. Similarly, it will give electronics engineers a knowledge of computer software for communications.

COMMUNICATIONS AND NETWORKING
By R Deasington
Stock No: 02-69108 Price £18.85
This book provides a first course on Pascal Programming which can be used as an introductory text for those with no previous knowledge of programming or as a conversion text for those with experience of other high level programming language other than Pascal.
PRACTICAL PROGRAMS FOR THE BBC COMPUTER AND ACORN ATOM
By D Johnson-Davies
Stock No: 02-04145 Price £6.45
The programs in this book illustrate many of the features of the BBC Computer and its close relative, the Acorn Atom. They include games, language manipulation, mathematics, and sophisticated graphics.

PRACTICAL TROUBLESHOOTING TECHNIQUES FOR MICROPROCESSOR SYSTEMS
By J W Coffey
Stock No: 02-69427 Price £17.25
Written for the engineer or technician who uses microprocessor systems, this book is a collection of different troubleshooting techniques. The text is hardware orientated to meet the needs of practical troubleshooters and others who will deal with microprocessors in a real world context. The author describes troubleshooting techniques for 8-bit microprocessors and covers circuits utilizing the 8080, 8085, Z80 and 6800.

PROGRAMMER'S GUIDE TO THE 1802
By T Swan
Stock No: 02-51832 Price £7.05
This is an assembly language primer that has an assembler! Coverage includes everything from the binary number system and the fundamentals of machine language to the development of a working 1802 assembler. Simply written in non-technical language, the text is intended for the beginner but contains information that will be appreciated by experts.

PROGRAMMING AND INTERFACING THE 6502
By M L De Jong
Stock No: 02-21651 Price £12.45
Dr De Jong has compiled 14 interesting chapters of information and programs that will be useful to those interested in using 6502-based microcomputer systems. Experiments and examples are written so that a KIM, AIM or SYM system may be used to reinforce the material presented in each chapter.

PROGRAMMING EMBEDDED MICROPROCESSORS
By R J Foulger (NCC)
Stock No: 02-23364 Price £13.00
This book, building upon the work of Taylor and Morgan (High-level Languages for Microprocessor Projects (1980), gives guidance on the use of high-level languages to program embedded micros.

PROGRAMMING WITH BASIC
By B S Gottfried
Stock No: 02-38653 Price £6.45
This book offers instruction in computer programming using the standard features of BASIC. All the principal features of BASIC are discussed. In addition, the book stresses the development of programs that are logical, efficient and orderly, thus the reader is exposed to the specific rules of good programming practice as well as the specific rules of BASIC.

S100 AND OTHER MICROBUSINES
By E C Poe et al
Stock No: 02-21810 Price £7.95
This very useful book gives details on 24 common buses for all popular microcomputers as well as discussion on each bus. They range from the Apple II/Ill bus and ATARI BUS through IEEE 488 to the TOSA/LSI-11 bus. Also some information on how to interface from various buses to the S100 bus.

SOFTWARE MAINTENANCE GUIDEBOOK
By R L Glass et al
Stock No: 02-09644 Price £7.25
This book attempts to remove much of the mystery surrounding maintenance and forms a generalised guide for people involved in software maintenance.

SOFTWARE SECRETS: INPUT, OUTPUT AND DATA STORAGE TECHNIQUES
By G Beech
Stock No: 02-04153 Price £6.45
The Sharp MZ-80K is a very popular personal computer, offering excellent value for those interested in software maintenance. This book attempts to remove much of the mystery surrounding maintenance and forms a generalised guide for people involved in software maintenance.

STRUCTURED PROGRAMMING WITH COBOL
By R Atherton
1982. 266pp. 150 x 230mm; Paperback. Wily. ISBN 0-85312-423-X.
Stock No: 02-12423 Price £7.40
This book draws together, "under one roof", the simple style and ease of the programming language BASIC with the elegantly sophisticated structure and clear appearance of the more recent COMAL.

SYSTEMS ANALYSIS AND DESIGN FOR COMPUTER APPLICATIONS
By D Millington
Stock No: 02-12424 Price £9.40
This book gives a clear and detailed introductory text, sets out the foundations of systems development and follows through the tasks to be performed, and the tools and techniques needed. The author has divided his work into two competent and comprehensive parts; the first setting out to meet the individual or a sound introduction for both the experienced programmer wishing to move into systems analysis, and for the businessman new to computer application, as well as for the student of computer science and programming.

TRS-80 ASSEMBLY LANGUAGE
By H S Howe
Stock No: 02-93112 Price £9.45
This book shows how to program the TRS-80 at assembly language level, even for the newcomer to the subject. It gives many machine code Z-80 routines as well as details of sub-routines in the ROMS and DOS.
USING COMPUTERS: A MANAGER'S GUIDE
By M Peltu (NCC)
1982, 200pp, 150 x 210mm; Paperback;
NCC (I), ISBN 0-85012-241-4
Stock No: 02-22414 Price £9.00
This book is intended to help any person charged with the responsibility for putting computing power to effective use in any organisation, large or small. It assumes no previous computing knowledge, and explains why good management practices rather than technical expertise are the key to the success of a computing project.

USING MICROPROCESSORS AND MICROCOMPUTERS: THE 6800 FAMILY
By J D Greenfield & W C Wray
1981, 456pp, 190 x 235mm; Paperback;
Stock No: 02-88728 Price £10.10
Thoroughly explains how to use the 6800 microprocessor and its associated peripheral ICs. Covers the architecture of the 6800, the instruction set, elementary assembler and machine language programming, and explains the peripheral and interfacing ICs in detail. Also covers more recent microprocessors, such as the 6809 and system development tools, and gives several examples of applications, including the CRT driver.

USING THE UNIX SYSTEM
By R Gauthier
1981, 298pp, 160 x 235mm; Hardcover;
Stock No: 02-81649 Price £16.40
This comprehensive book presents the UNIX system which was designed for both business and personal use. It includes an introduction to the system, a discussion of the file system, asynchronous communication, system management, and system development. It also covers the architecture of the Z-80 and Z8000 microprocessors, and the use of UNIX with these microprocessors.

VISICALC HOME AND OFFICE COMPANION
By D M Castlewitz et al
1982, 180pp, 210 x 280mm; Paperback;
Stock No: 02-88500 Price £12.00
Experienced VisiCalc users should find this book a handy source of reference and inspiration. Many of the models can be easily expanded to meet individual needs. Additionally, the algorithms and VisiCalc modelling techniques offer an opportunity to design new and useful models.

WORDSTAR MADE EASY
By W A Ettlin
1981, 126pp, 185 x 235mm; Paperback;
Stock No: 02-86691 Price £8.45
This book applies a hands-on approach to learning WordStar, an extremely popular and yet practical word processing system. This self-teaching manual allows you to use WordStar starting with Lesson 1. Hours of frustration can be eliminated by following the 14 time-saving lessons and examples presented here. By teaching you how to use this compulsory program one step at a time, this book enables you to use WordStar comfortably without the inherent burdens of teaching yourself a new system. It come with a convenient pull-out Command Card that can be kept nearby as a quick reference to all of WordStar's most useful commands.

YOUR ATARI COMPUTER
By I Poole et al
1982, 458pp, 165 x 235mm; Paperback;
Stock No: 02-88659 Price £12.45
Here's an invaluable all-in-one guide for ATARI 400/800 computer users. The authors provide complete operating instructions and troubleshooting tips on hardware, peripherals, and compatible software. Plus there are two chapters devoted solely to the superb ATARI computer graphics capabilities.

280 ASSEMBLY LANGUAGE PROGRAMMING
By L A Leventhal
1979, 600pp, 160 x 235mm; Paperback;
Stock No: 02-88271 Price £12.45
This book provides comprehensive coverage of the 280 microprocessor assembly language programming. Programming examples illustrate software development concept and actual assembly language usage. Assemblers and assembler directives are also explained.

Z-80 MICROPROCESSOR DESIGN PROJECTS
By W Barden
1981, 208pp, 210 x 280mm; Paperback;
Stock No: 02-21682 Price £11.45
Even a beginner in electronics will enjoy constructing and operating the EZ-80 microcomputer, a project that requires surprisingly little time and money. The book is a solid introduction to the Z-80 microprocessor and the remarkable chip, EZ-80. Several EZ-80 applications programs are included.

Z-80 MICROPROCESSOR HANDBOOK
By W Barden
1978, 304pp, 135 x 215mm; Paperback;
Sams; ISBN 0-672-21500-4
Stock No: 02-21500 Price £9.45
This thorough handbook covers hardware, software and microcomputers built around the Z-80. Z80 MICROPROCESSOR PROGRAMMING AND INTERFACING BOOKS 1 & 2
By Nichols et al
Book 1: 1979, 304pp, 155 x 245mm; Paperback;
Sams; ISBN 0-672-21600-4
Stock No: 02-21600 Price £10.20
Book 2: 1979, 496pp, 155 x 245mm; Paperback;
Sams; ISBN 0-672-21610-8
Stock No: 02-21610 Price £12.45

28000 MICROPROCESSOR: A DESIGN HANDBOOK
By B K Fawcett
1982, 308pp, 175 x 235mm; Paperback;
Zieg (P); ISBN 0-13-893734-5
Stock No: 02-98842 Price £15.00
This is the one source for complete, objective, and accurate information on 4 and 8-bit microprocessors. This book describes virtually every 4 and 8-bit microprocessor on the market today, and allows you to evaluate any device or combination of devices. It is the only detailed description of 4 and 8-bit microprocessors from an independent source.

16-BIT MICROPROCESSOR HANDBOOK
By A Osborne & G Kane
1981, 600pp, 175 x 235mm; Paperback;
Stock No: 02-88438 Price £15.00
This is the one source for complete, objective, and accurate information on 16-bit microprocessors. This book describes virtually every 16-bit microprocessor on the market today, and allows you to evaluate and compare any device or combination of devices. It is the only detailed description of 16-bit microprocessors from an independent source.

16-BIT MICROPROCESSORS
By Titus et al
1981, 350pp, 155 x 235mm; Paperback;
Sams; ISBN 0-672-21805-4
Stock No: 02-21805 Price £11.45
The authors have attempted to reduce the vast complicated documentation available on the many microprocessors into something manageable and at the same time provide a format in which the reader can easily compare the processors.

6502 SOFTWARE DESIGN
By L Scanlon
1980, 272pp, 135 x 215mm; Paperback;
Sams; ISBN 0-672-21790-6
Stock No: 02-21790 Price £10.20
The 6502 integrated circuit is a very popular
microprocessor that is currently being used in general-purpose microcomputers, video games, and personal computers. This material is presented to increase the reader's understanding of the 6502 integrated circuit. Fundamentals are first explained then more complex topics are gradually introduced in the nine information-packed chapters.

68000: PRINCIPLES AND PROGRAMMING
By L J Scanlon
Stock No: 02 21853 Price £11.70
A comprehensive introduction to one of the most powerful new 16-bit microprocessors the Motorola 68000, this book assumes a basic understanding of computer architecture and familiarity with some types of assembly language.

8080A BUGBOOK
By P R Rony
Stock No: 02 21447 Price £10.20
The principles, concepts, and applications of an 8-bit microcomputer based on the 8080 microprocessor. The emphasis is on the microcomputer as a controller. Covers the four fundamental tasks of computer interfacing:

1) generation of device select pulses;
2) latching of output data;
3) acquisition of input data;
4) servicing of interrupt signals.

Intended to help develop the skills needed to use an 8080-based breadboard microcomputer system.

8080/80 Assembly Language
By A R Miller
Stock No: 02 81248 Price £9.00
For both intermediate and advanced programmers, this complete guide to programming the 8080 and Z80 microprocessors lets you get every response your computer is capable of generating, and enables you to systematize much more complex and sophisticated operations.

With this book you learn the details of assembly language programming - easily and quickly - as you develop a powerful system monitor in a step-by-step, top-down approach. Over 100 pages of programs are included to let you develop, write, and test your own routines.

RADIO AND ELECTRONIC BOOKS

02 21853 Active Filter Cookbook/Lancaster
11.70
02 09593 Active Filter Design/Chen
9.00
02 09662 Antenna Tests & Measure/Hooton
7.95
02 51921 Android Design/Weinstein
10.35
02 21590 Basic Elect/Electronics Troubleshooting/Tomal
7.95
02 20156 Beginners Handbook of Amateur Radio/Laster
10.20
02 07428 Beginners Handbook of IC Projects/Heiserman
10.85
02 21418 Broadband Feedback of Amplifiers/Maclean
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02 21465 Building & Installing Elect Int Alarms/Cunningham
8.70
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02 21704 Complete Guide Read Schematic Diagrams/Douglas-Y
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02 40964 Design & Creating Printed Circuits/Sikonowicz
7.90
02 21539 Design of Active Filters/Berlin
8.70
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