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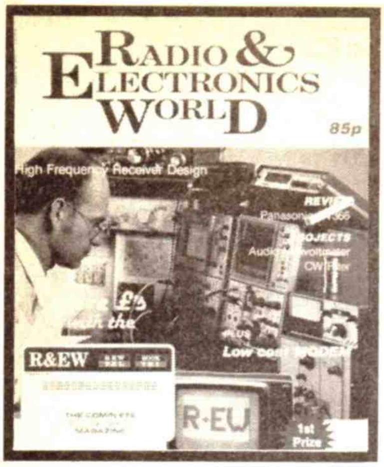

R&EW

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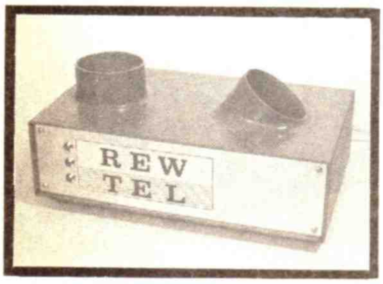

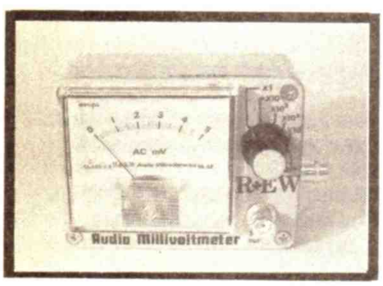

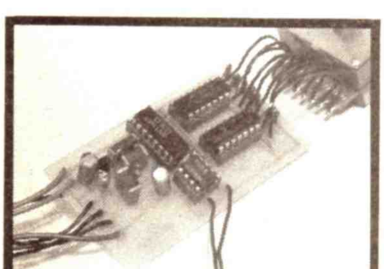

SEE PAGE 23 FOR DETAILS OF HOW TO MAKE THE MOST OF YOUR FREE COVER GIFT THE REWCARD.

QRV? FER ICOM

IC-R70, The very latest from Icom! £469.

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Other R-70 features include: input switchability through a pre-amplifier, direct or via an attenuator, selectable tuning steps of 1KHz, 100Hz or 10Hz, adjustable IF bandwidth in 3 steps (455KHz). Noise limiter, switchable AGC, tunable notch filter, squelch on all modes, RIT, tone control. Tuning LED for FM (discriminator centre indicator). Recorder output, dimmer control.

The R-70 also has separate antenna sockets for LW-MW with automatic switching, and a large, front mounted loudspeaker with 5.8W output. The frequency stability for the 1st. hour is ± 50Hz, sensitivity- SSB/CW/RTTY better than 0.32 μv for 12dB (S+N)÷N, Am-0.5μv, FM better than 0.32 for 12dB Sinad. DC is optional on the R-70. It has a built-in mains supply.

The IC-R70 measures 286mm x 110mm x 276mm and weighs 7.4Kg., making it a very attractive package indeed. Are you ready for this truly excellent receiver? You must hear it, we know you will be impressed!

IC-25E The Tiny Tiger £239.inc.

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Amazingly small, yet very sensitive. Two VFO's, five memories, priority channel, full duplex and reverse, LED S-meter, 25KHz or 5KHz step tuning. Same multi-scanning functions as the 290 from mic or front panel. All in all the best 2M and 70 cm. FM mobiles ICOM have ever made.

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Introducing the NEW IC-740. £699.

This latest transceiver contains all the most asked-for features, in the most advanced solidstate HF base station on the amateur market...performing to the delight of the most discerning operator.

Study the front panel controls of the ICOM IC-740. You will see that it has all of the functions to give maximum versatility to tailor the receiver and transmitter performance to each individual operator's requirements.

Features of the IC-740 receiver include a very effective variable width and continuously adjustable noise blanker, continuously adjustable speed AGC, adjustable IF shift and variable passband tuning built in. In addition, an adjustable notch filter for maximum receiver performance, along with switchable receiver preamp, and a selection of SSB and CW filters. Squelch on SSB Receive and all mode capability, including optional FM mode. Split frequency operation with two built-in VFO's for the serious DX'er.

The IC-740 allows maximum transmit flexibility with front panel adjustment of VOX gain and VOX delay along with ICOM's unique synthesized three speed tuning system and rock solid stability with electronic frequency lock. Maximum versatility with 2 VFO's built in as standard, plus 9 memories of frequency selection, one per band, including the new WARC bands.

With 10 independent receiver and 6 transmitter front panel adjustments, the IC-740 operator has full control of his station's operating requirements.

See and operate the versatile and full featured IC-740 at your authorized ICOM dealer.

Options include:
- FM Module
- Marker Module
- Electronic Keyer
- 2 - 9MHz IF Filters for CW
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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 on for dear life.

REWCARD's introduction, the monster book feature, a 300 baud modem, an RS232 interface for the ZX81, 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 someone 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.

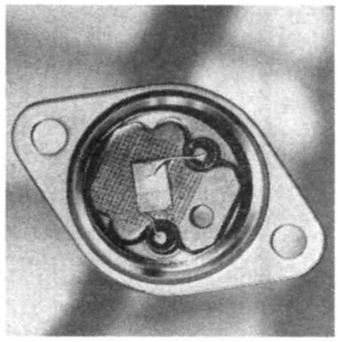
Those who found out about the specification after it was too late may justifiably be seething; but as usual, the Japanese industry has been able to get the gear in for approval in time. After the claims from the Home Office that anything like the pirate 47/1.6MHz allocations would be approved "over our 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 considerations, and they were on the doorstep, waiting for their approval certificate.

We would suggest that the DoI 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.

NEW 24HR REWTEL PHONE LINE (0277) 232628

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.

The MPC Regulator utilizes CMOS circuitry for the small-signal stages and standard EpiBase technology for the output transistors.

Principal features of the MPC100 include:

- Internal Thermal Protection
- Internal Short Circuit Protection
- Low Differential Voltage
- Overcurrent Limiting

Since the control network uses CMOS devices, some different approaches were used to derive circuit functions as opposed to bipolar designs. The current source reference uses a feedback circuit to establish stable operating conditions. The thermal limit is referenced to a base-emitter diode with a negative temperature coefficient and is compared to a silicon resistor with a positive temperature coefficient to produce the thermal control signal. The current sense network for limiting maximum output current was developed to be relatively independent of base voltage variations. This network does not require a resistor in series with the output to sense current and thus does not add to the input-output differential voltage as is done in many of the traditional approaches. Careful consideration of circuit layout compensates for transient thermal resistance and balancing of critical control elements along isothermal lines results in increased thermal stability. The regulator is internally compensated and designed to feed large capacitive loads.

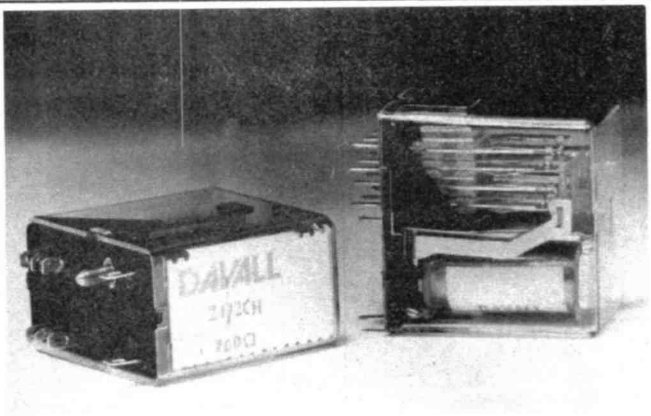
Handy Cases

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.,
HP20 1ET.



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

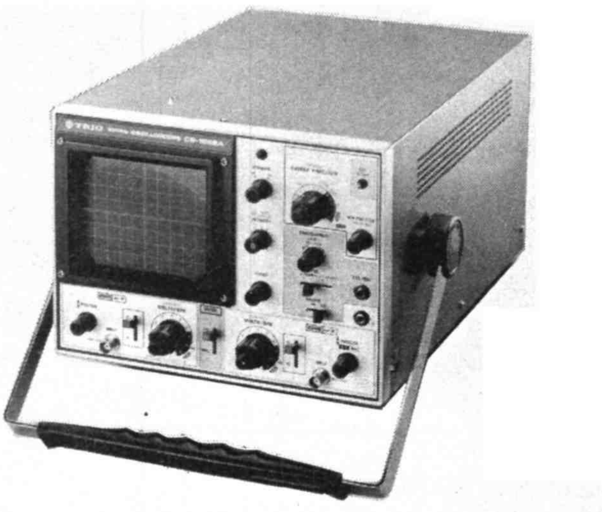
Rapid Terminals now supply a new DEC VT100-family terminal, direct from stock. Known as the VT102, it is a VT100 type terminal with built-in Advanced Video, printer port and full and half duplex communications and modem controls.

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.

NEW PRODUCTS



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 × 190 × 375mm and weighs 8kg.

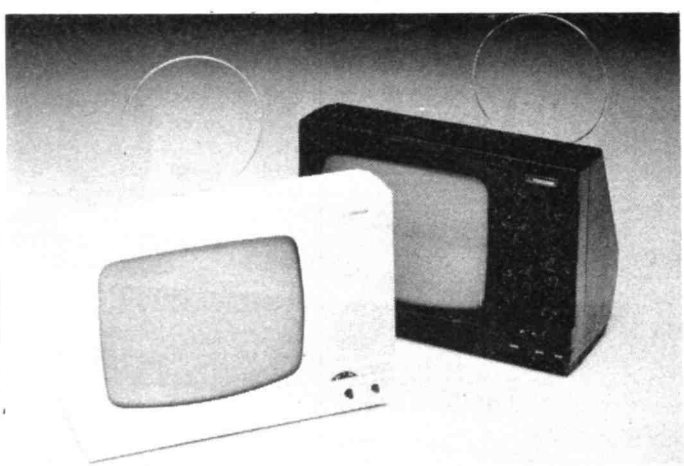
Verospeed,
Stansted Road,
Boyatt Wood,
EASTLEIGH,
Hants.
SO5 4ZY.

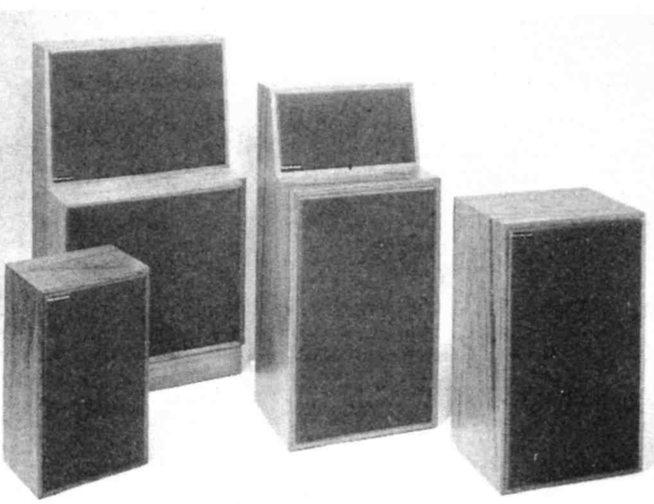
Black And White Sets

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 launch early next year is likely to keep this market buoyant.

Features include: mains isolated chassis, improved 12 volts 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

Novastatic £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

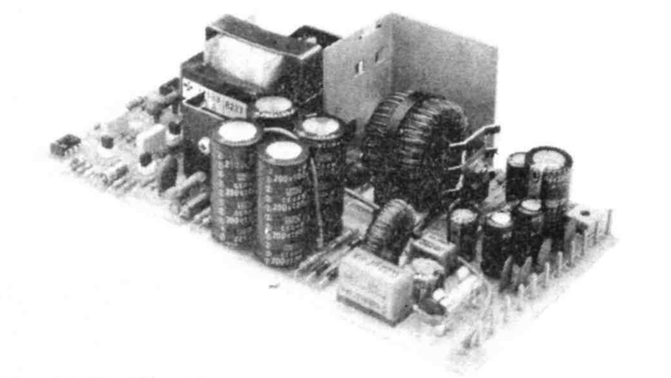
Electrostatic constant charge Shackman SES Drivers

Polarising voltage 1000 volts

Moving coil base driver 8" moulded fibre cone

Price £285 per pair

Shackman,
82 East Barnet Road,
NEW BARNET.
Herts,
EN4 8RQ.



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 standard features which include short-circuit protection, soft starting, overvoltage protection on the main output and primary power shutdown.

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.

ACOUSTIC MODEM

Jonathan C Burchell

A low cost originate-only modem with full RS232 interfacing.

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. Figure 1 shows how the four available channels of V21 (the CCITT name for the system we use) are assigned in the 300 baud system. The frequencies are quite close together and the shift from 1 to 0 is only 200 Hz. However by the use of sophisticated demodulators and filtering, the data is easily recovered.

There are two main methods of coupling the modem signal to the line and these will be dealt with in turn.

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.

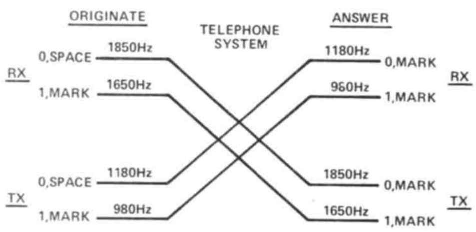


Figure 1: Assignment of the four channels of 'V21' in the 300 baud system.

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 truely cost conscious system.

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

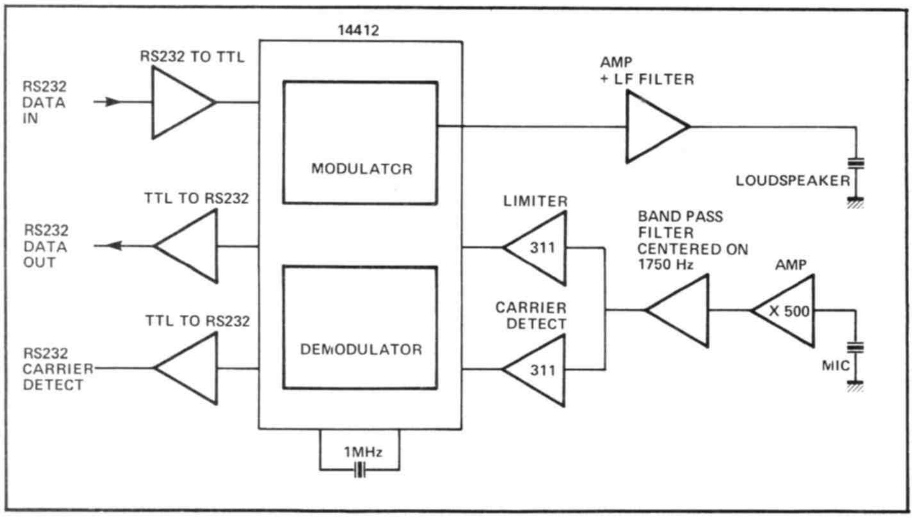
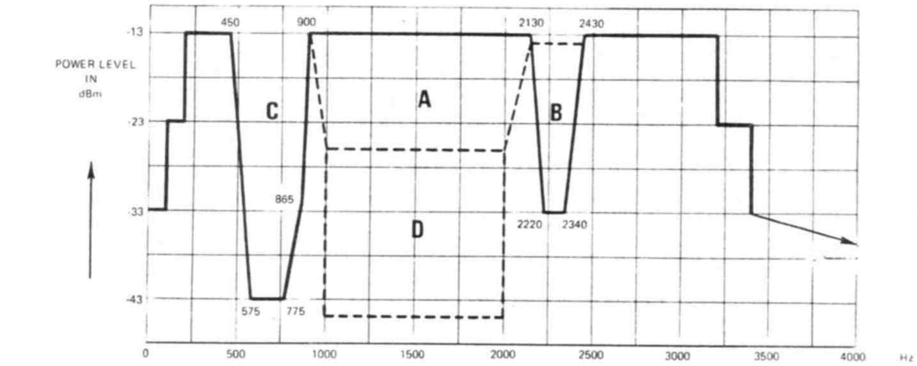


Figure 2: Block diagram of the MODEM



NOTES 1 SIGNALS (UP TO -14 dBm) ARE ONLY PERMITTED IN AREA B IF ACCOMPANIED BY COINCIDENT SIGNALS IN AREA A OR IF ACCOMPANIED BY COINCIDENT SIGNALS IN AREA D AT A POWER LEVEL NOT LOWER THAN 12 dB BELOW THE POWER LEVEL OF SIGNALS IN AREA B. THE TOTAL POWER LEVEL OF THE COMBINED SIGNALS MUST NOT EXCEED -13dBm

2 SIGNALS ARE NOT PERMITTED TO OCCUR IN AREA C BECAUSE FALSE OPERATION OF TRUNK SIGNALLING EQUIPMENT MAY RESULT

3 THE FREQUENCY RANGE 400-450 Hz SHOULD BE AVOIDED IF POSSIBLE BECAUSE A SMALL PERCENTAGE OF SWITCHED TELEPHONE NETWORK CONNEXIONS HAVE SIGNALLING EQUIPMENTS (500/20 RINGERS) THAT MAY BE FALSELY OPERATED BY SIGNALS 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 mutivibs.

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).

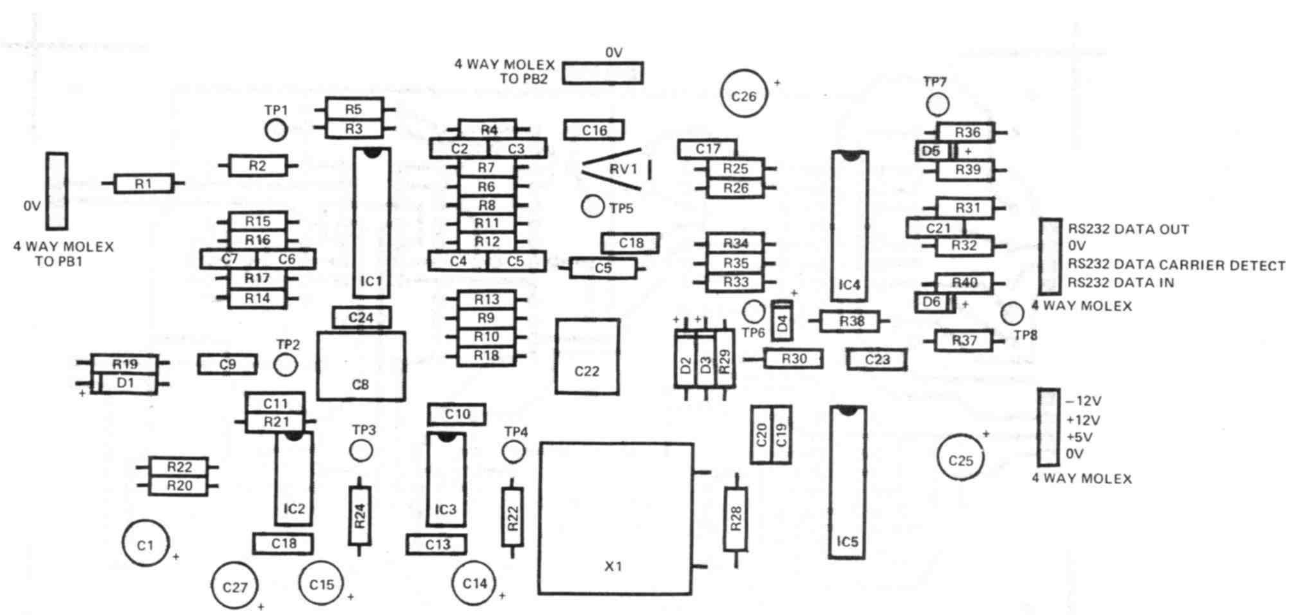


Figure 4: Component Placing

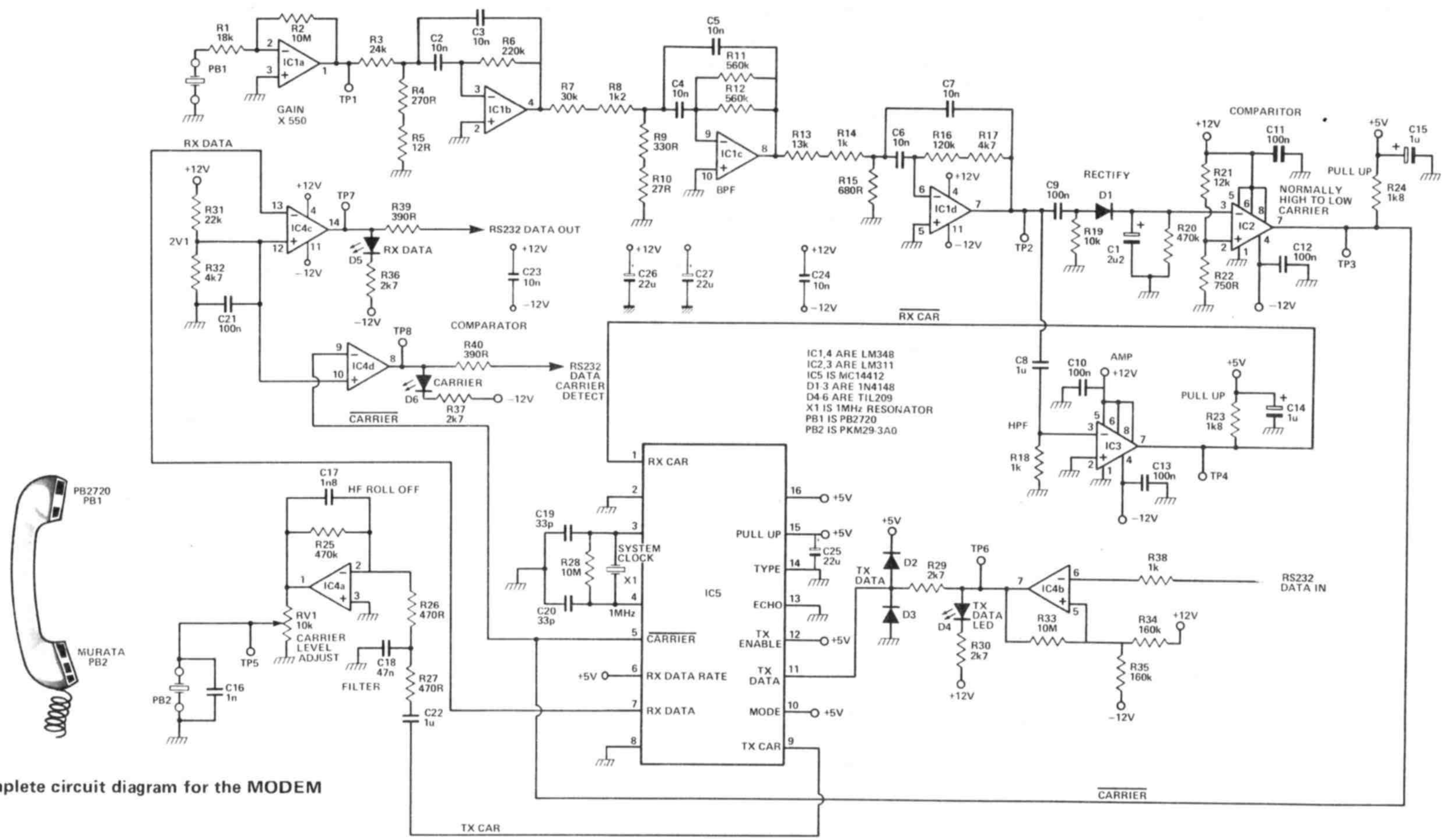


Figure 5: The complete circuit diagram for the MODEM

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 demodulated data is fed from pin 7 to IC4c, which converts the TTL level output of IC4 to the ±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.

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 R27,26 and C12 and then amplified by IC4a to 12 volts peak-to-peak. C17 provides further HF roll-off and increases the purity of the output waveform. The output level is adjusted by RV1 and finally applied to PB2. The modem requires ±12 volts at about 150 mA and 5 Volts at about 20 mA. This may be obtained from the host computer.

PARTS LIST

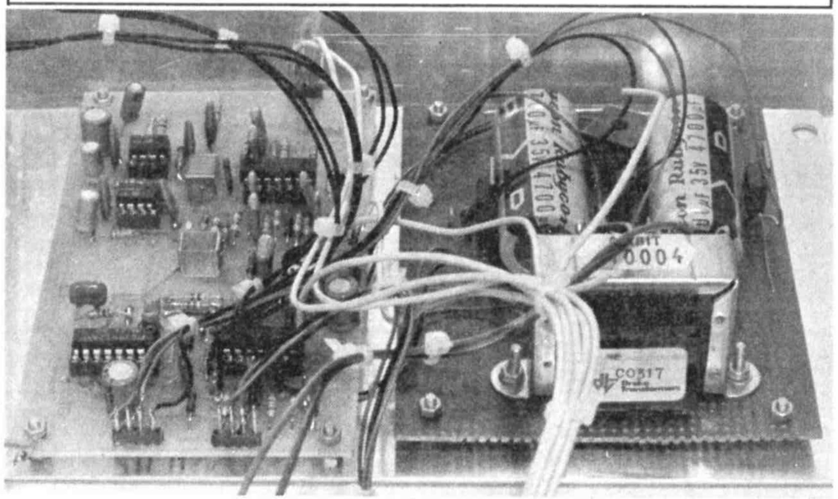
Resistors

R1	18k
R2,28,33	10M
R3	24k
R4	270R
R5	12R
R6	220k
R7	30k
R8	1k2
R9	330R
R10	27R
R11,12	560k
R13	13k
R14,18,38	1k0
R15	680R
R16	120k
R17,32	4k7
R19	10k
R20,25	470k
R21	12k
R22	750R
R23,24	1k8
R26,27	470R
R29,30,36,37	2k7
R31	22k
R34,35	160k
R39,40	390R
RV1	10k

Capacitors

C1	2u2 Electrolytic
C2,3,4,5,6,7	10n Mylar
C8,22	1u0 Polycarbonate
C9,10,11, 12,13,21	100n Ceramic
C14,15	1u0 Electrolytic
C16	1n Ceramic
C17	1n8 Ceramic
C18	47n Ceramic
C19,20	33p Ceramic
C23,24	10n Disc Ceramics
C25,26,27	22u Electrolytic
Semiconductors	
D1,2,3	1N4148
D4,5,6	5mm Red LED with chrome bezel
IC1	LM324
IC2	LM311
IC3	LM311
IC4	LM324
IC5	MC14412
Miscellaneous	
X1	1MHz Resonator
PB1	PB2720
PB2	Murata PKM 29-3AO

4off 4 way .1" terminal pins
2off 8 pin DIL socket
2 off 14 pin DIL socket
1 off 16 pin DIL socket
1 off PCB - 41-20201



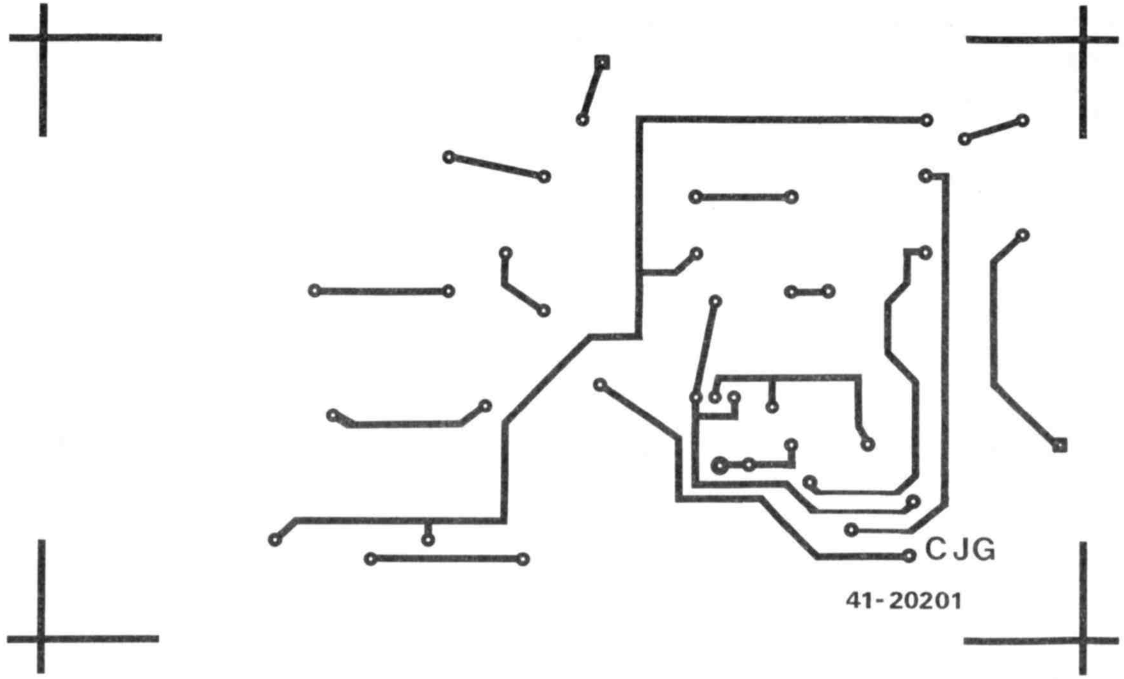
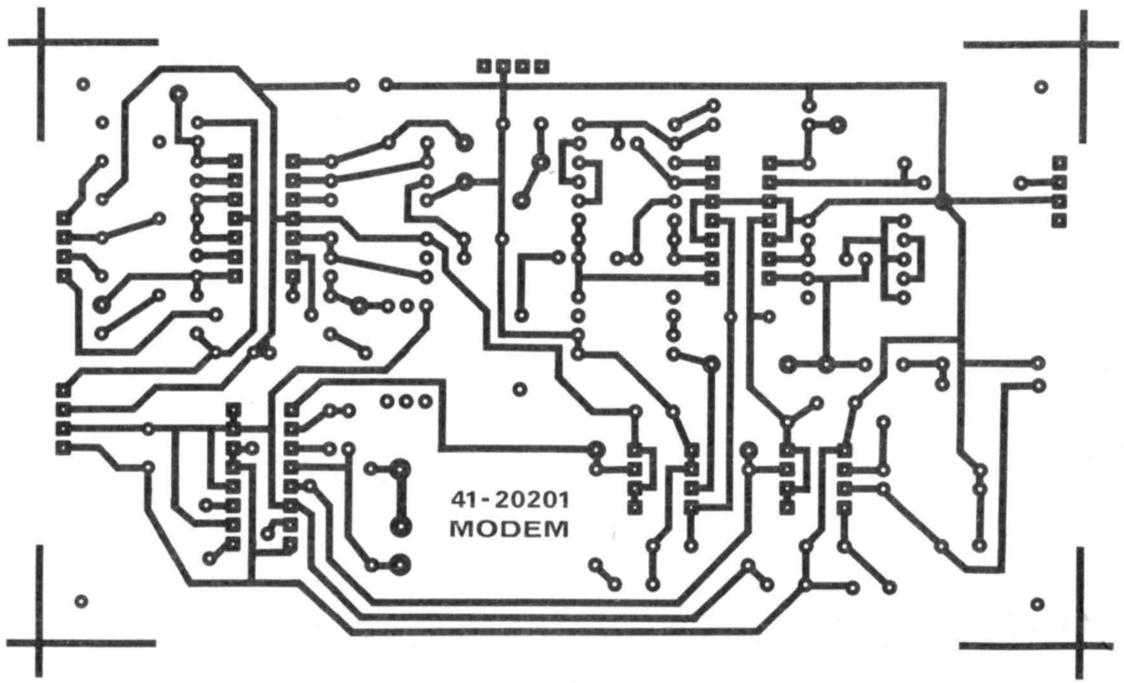


Figure 6 & 7: Both sides of the double sided PCB.



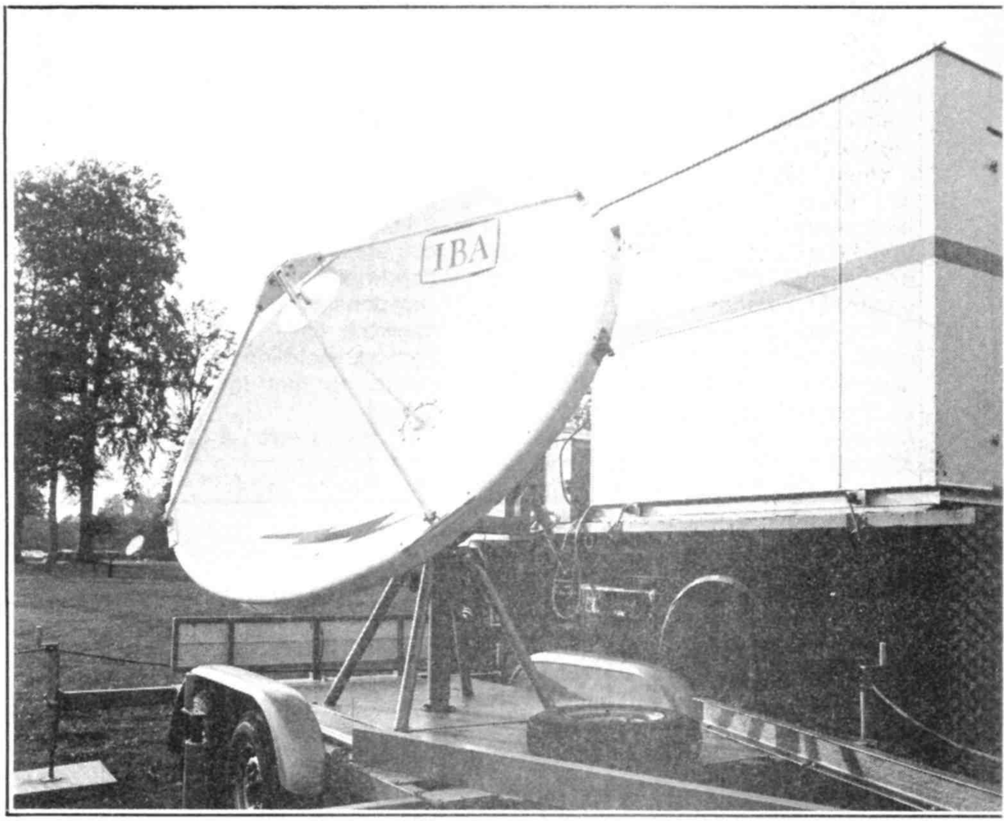
VIDEO NEWS

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 know as 'cross colour'. This effect is particularly noticeable with check patterns on clothing.

Another result of this overlapping is that the colour sub-carrier signal can become visible in the luminance signal, giving a crawling dot effect known as 'cross luminance.'

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.

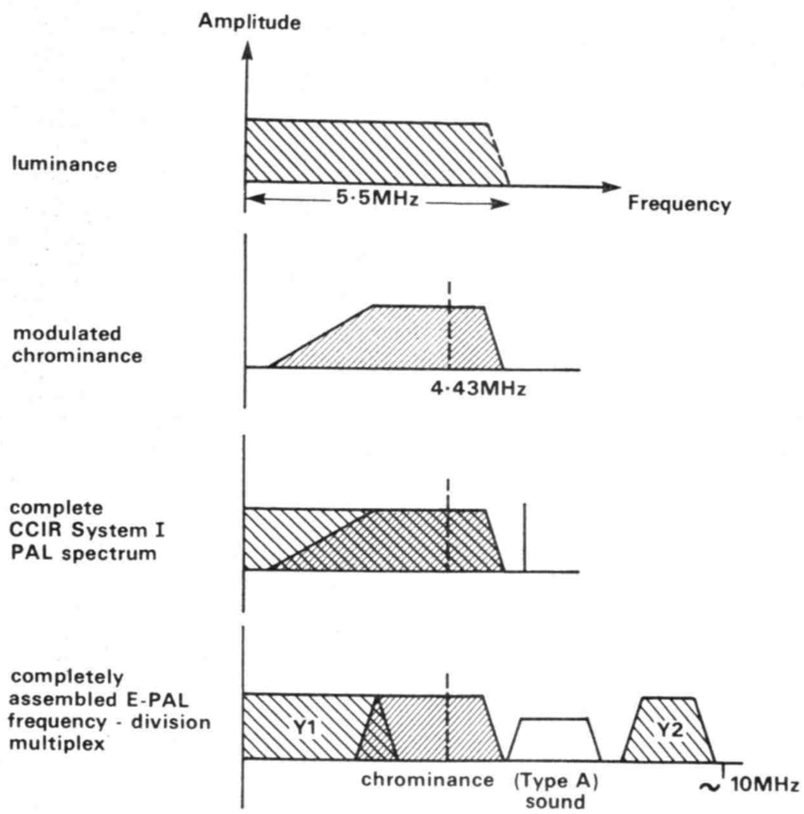


Fig.2. PAL Spectra showing the Superimposition of Chrominance & Luminance Baseband Signals.

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

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 base's.

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

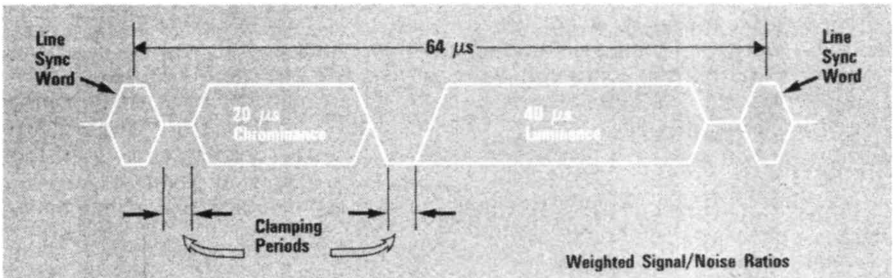
The demonstrations of the PAL and MAC systems side by side showed that MAC was clearly superior to PAL and better, albeit by a small margin, than E-PAL.

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.



Weighted Signal/Noise Ratios

	Luminance (4.5MHz Bandwidth)	Colour Difference (1.3MHz Bandwidth)
PAL (with pre-emphasis)	∽44dB	∽35dB
MAC	∽44dB	∽40dB

Figure 2: The IBA's MAC system uses time compression techniques to transmit chrominance and luminance information on the same line.

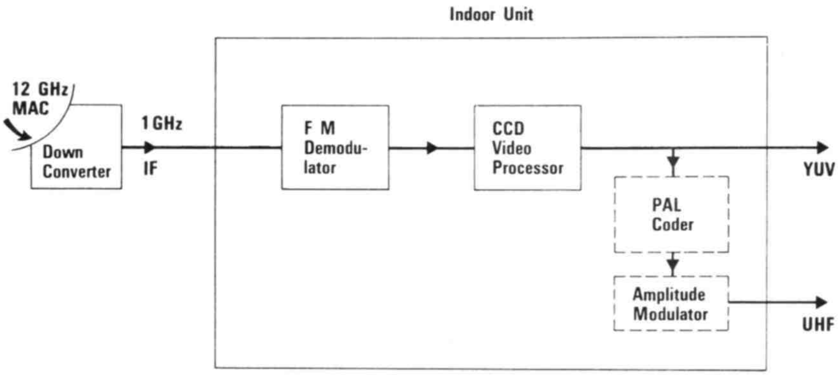


Figure 3: A MAC satellite converter uses a CCD video processor for time decompression of the satellite's signal.

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.

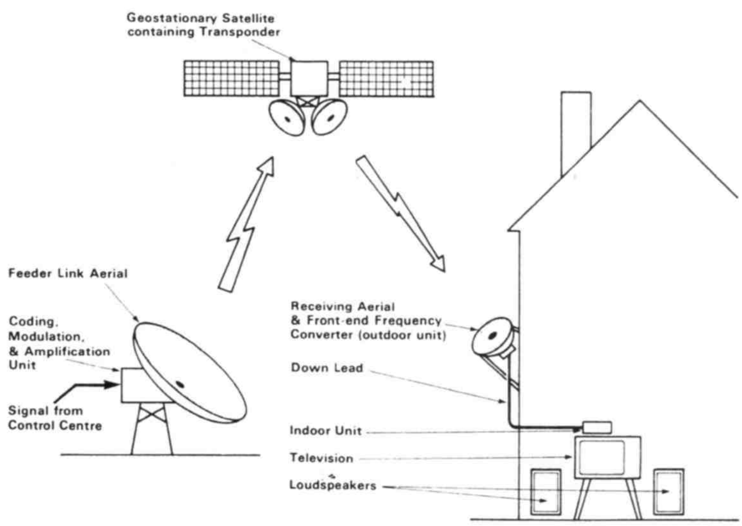


Figure 4: A typical satellite system. In the view of the manufacturers it will be the design of the microwave front end that will be the limiting factor in terms of time if a 1986 target for DBS broadcasting is to be met.

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.

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*70*
Average	*71*
Poor	*72*

AUDIO MILLIVOLTMETER

A high impedance AC millivoltmeter covering the range 5mV-50V. Design by Adrian Barnes.

WHEN WORKING with audio, it is often necessary to measure the amplitude of an AC signal somewhere in a circuit. This can involve tracing the signal along its path and taking accurate measurements in order to investigate the fault. However, commercially available units are usually quite expensive and over-elaborate.

The circuit described here gives a straightforward but accurate method of measuring AC voltages, but as a low price.

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 × 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.

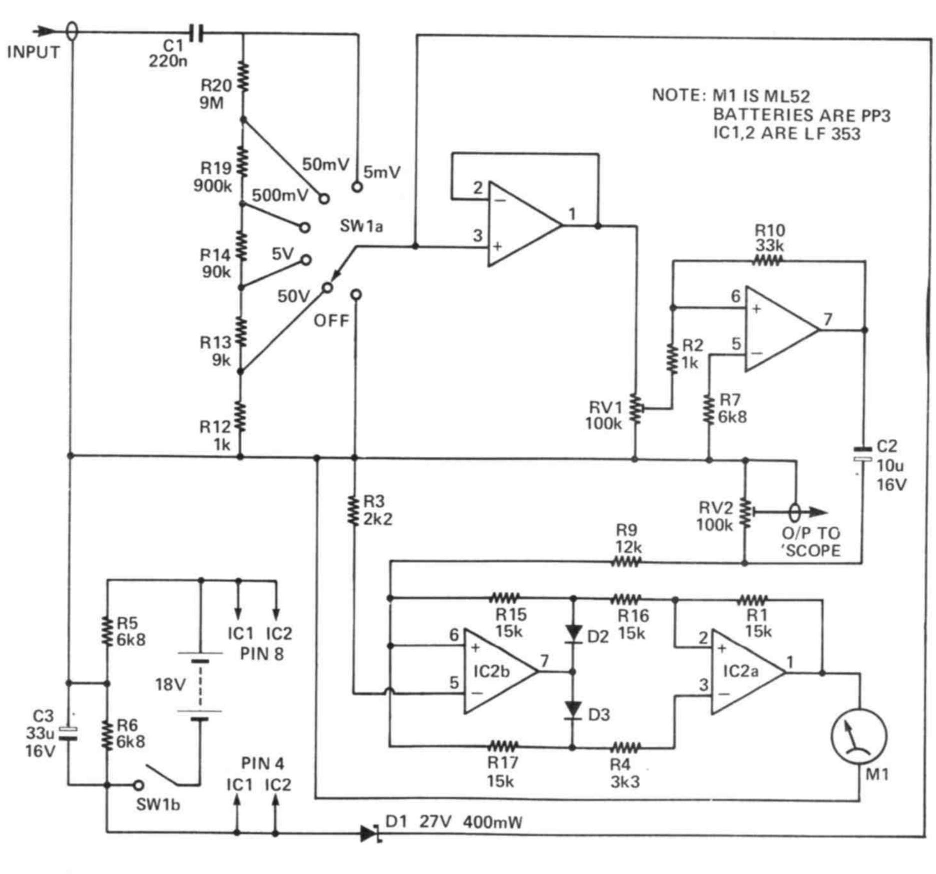


Figure 1: Schematic diagram of the Audio Millivoltmeter.

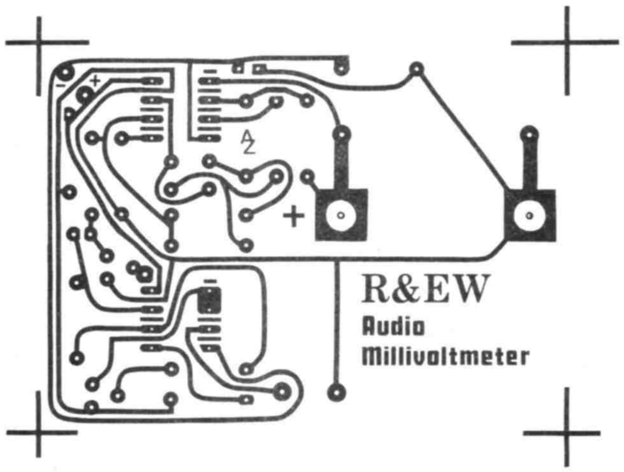


Figure 3: Foil pattern for the Millivoltmeter.

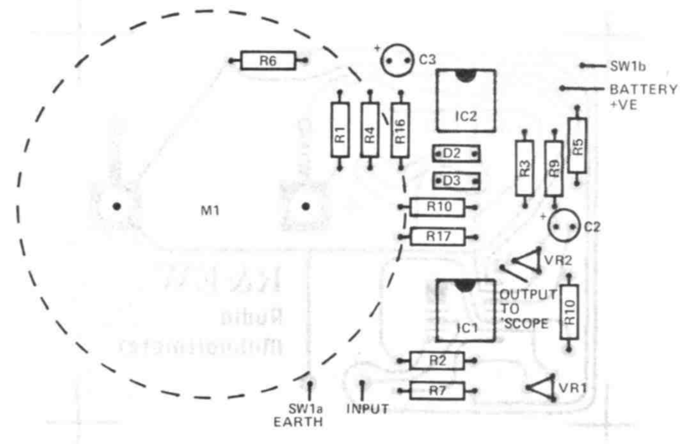


Figure 4: The PCB component layout.

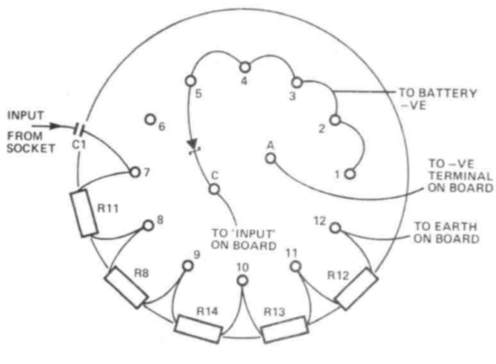


Figure 2: Wiring the underside of SW1.

PARTS LIST

Resistors	
R1,15,16,17	15k 1%
R2	1k
R3	2k2
R4	3k3
R5-7	6k8
R8	900k 0.5%
R9	12k
R10	33k
R11	9M 0.5%
R12	1k 0.5%
R13	9k 0.5%
R14	90k 0.5%
Potentiometers	
RV1,2	100k 6mm cermet preset

Capacitors	
C1	220n polyester
C2	10u 16V radial
C3	33u 16V radial
Semiconductors	
IC1,2	LF353
ZD1	BZY88C27V
D1,2	1N4148
Miscellaneous	
SW1	2p 6w rotary switch
M1	ML52 meter (see text)

8 pin DIL socket (2 off), PCB pins, PP3 clips, case, BNC chassis socket (2 off), knob, PCB.

Solder the meter tags directly to the board,to ensure a good contact.

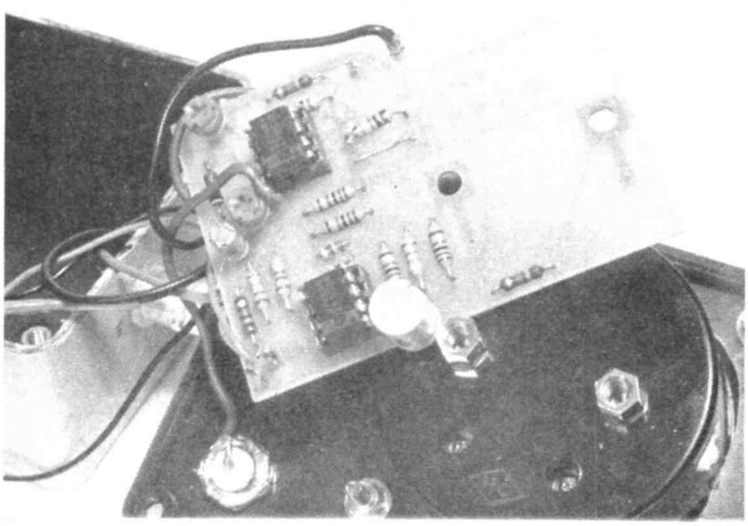
The scale used on our prototype was modified as shown in the photograph. Pull off the plastic face cover and undo the two small crosshead screws to remove it. Some of the components are mounted on the rear of SW1, as shown in *Fig. 2*. These should be fitted close to the side of the switch to avoid fouling the PCB.

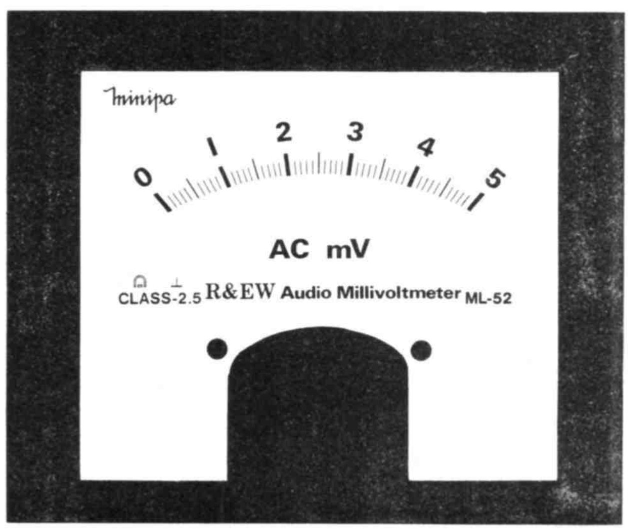
Calibration

Setting up is best performed before the PCB is bolted to the meter. Turn the unit to the 500mV range and apply a 1kHz sinewave 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

YOUR REACTIONS	*Circle No.*
Good	*49*
Average	*50*
Poor	*51*





The scale used on our prototype.

FEEDBACK

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.

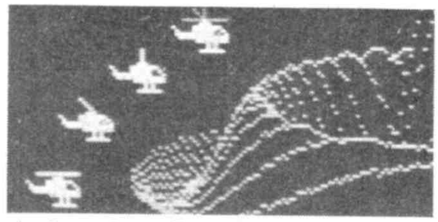
6. Finally, SW2 is a red herring. It is not provided on the MKII module. The time constant is hard wired in the AV position as the article describes in the final paragraph.

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.

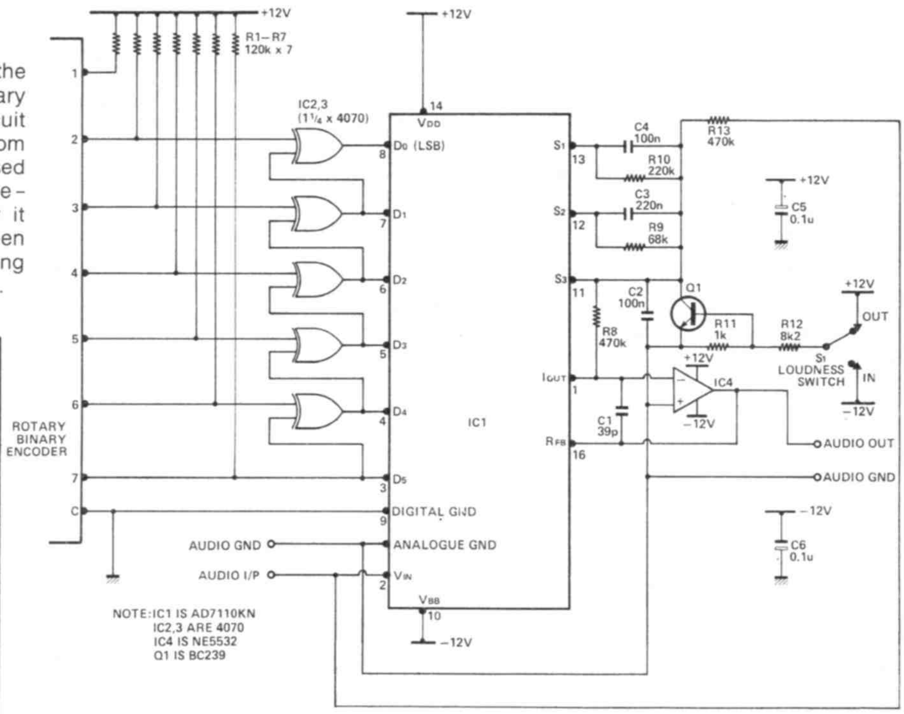
R&EW Data Brief AD7110KN

Digitising your volume control

The encoder is a passive device; one of the ALPS range, giving a gray coded binary output. A logic 'O' 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 "?"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	1k0
R12	8k2
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 attenuater. 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

PARAMETER	TEST CONDITIONS	AD7110KN WITH 'IDEAL' OP–AMP	AD7110KN WITH 'REAL' OP–AMP	UNITS
Attenuation Range	V_{IN} = 10V rms @ 1kHz	0 to –88.5	0 to –88.5	dB
Resolution	Frequency Range 20Hz to 20 kHz	1.5 max	1.5 max	dB
Attenuation Accuracy(Absolute) 0dB to –48dB –48dB to –88.5dB	(Note 3)	±0.7 max Monotonic	±0.7 max Monotonic	dB
Total Harmonic Distortion (THD)	per DIN 45403, BLATT 2 (with input level of 1V rms)	–98 max	–85 typ	dB
Intermodulation Distortion (IMD)	per DIN 45403, BLATT 4	–92 max	–79 typ	dB
V_{IN}	for <1% (max) THD (Note 1)	30 max	10 max	V peak
Feedthrough Error	1 KHz (Note 5)	–85	–85	dB
Output Noise Voltage Density	20Hz to 20kHz (Note 2)	30 max	70 typ	$nV/\sqrt{Hz}$
Bandwidth	0dB Attenuation	D.C. to 150 min	D. C. to 250 typ	kHz

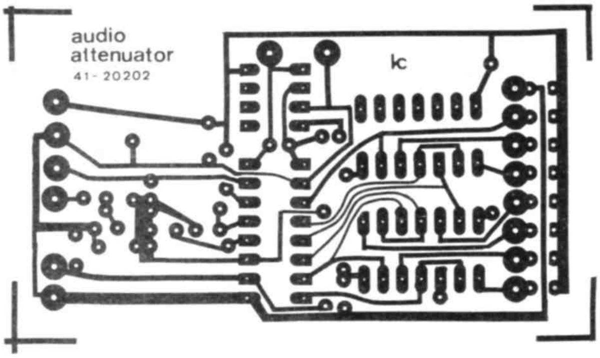
V_{DD} = +5 to +12V, V_{BB} = 0 to –12V, pins 11-13 open, T_A = 0 to +50°C unless otherwise noted

facility is removed by switching SW1 to V_{DD}. Given an audio input of -10V, and using the transfer function: $V_{OUT} = (-V_{IN}) \times 10^{-(1.5N/20)}$

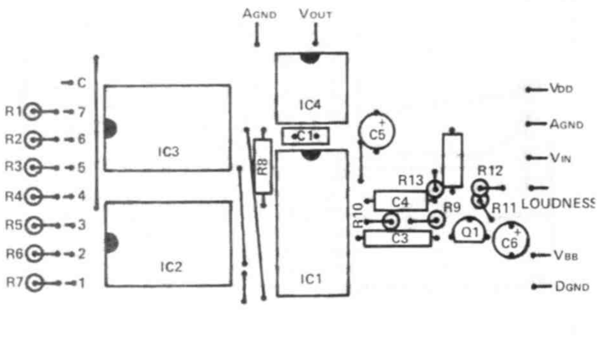
The table shows V_{OUT} for different values of N. This transfer function is dependent on the op-amp used for the output-current (I_{OUT}) to voltage conversion. However, it should be accurate for most low noise, low distortion op-amps.

The capacitor, C1, acts as feedback capacitance, to give stability to high speed amplfiers that might otherwise oscillate or ring.

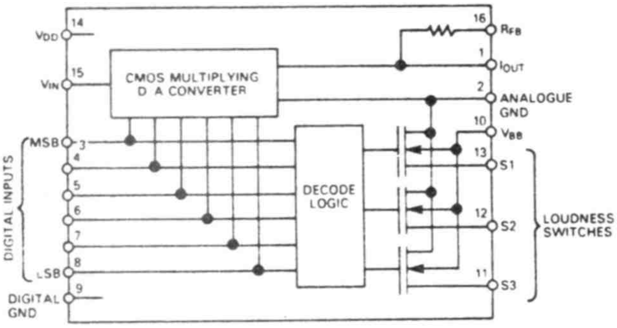
When laying out this circuit, it's worth remembering that to gain the best results, the input and output circuitry must be kept separate, with good power supply decoupling. Short inter-connections also help reduce pick-up problems.



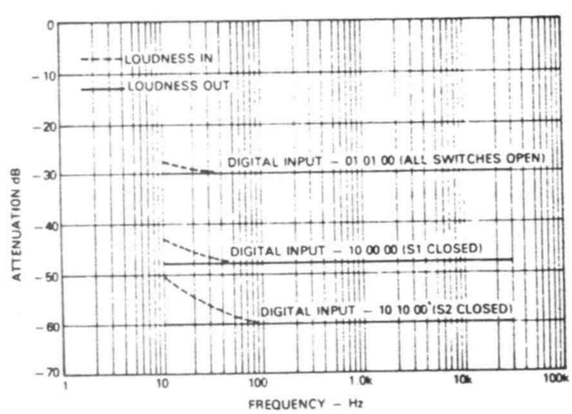
PCB foil pattern



PCB Overlay



Block diagram



Attenuation vs. Frequency Graph

N	Digital Input D5 D0	Attenuation dB	Switches[1] S1	S2	S3	[2] VOUT
0	00 00 00	0.0				10.000
1	00 00 01	1.5				8.414
2	00 00 10	3.0				7.079
3	00 00 11	4.5				5.597
4	00 01 00	6.0				5.012
5	00 01 01	7.5				4.217
6	00 01 10	9.0				3.548
7	00 01 11	10.5				2.985
8	00 10 00	12.0				2.512
9	00 10 01	13.5				2.113
10	00 10 10	15.0				1.778
11	00 10 11	16.5				1.496
12	00 11 00	18.0				1.259
13	00 11 01	19.5				1.059
14	00 11 10	21.0				0.891
15	00 11 11	22.5				0.750
16	01 00 00	24.0				0.631
17	01 00 01	25.5				0.531
18	01 00 10	27.0				0.447
19	01 00 11	28.5				0.376
20	01 01 00	30.0				0.316
21	01 01 01	31.5				0.266
22	01 01 10	33.0				0.224
23	01 01 11	34.5				0.188
24	01 10 00	36.0				0.158
25	01 10 01	37.5				0.133
26	01 10 10	39.0				0.112
27	01 10 11	40.5				0.0944
28	01 11 00	42.0				0.0794
29	01 11 01	43.5				0.0668
30	01 11 10	45.0				0.0562
31	01 11 11	46.5				0.0473
32	10 00 00	48.0				0.0398
33	10 00 01	49.5				0.0335
34	10 00 10	51.0				0.0282
35	10 00 11	52.5				0.0237
36	10 01 00	54.0				0.0200
37	10 01 01	55.5				0.0168
38	10 01 10	57.0				0.0141
39	10 01 11	58.5				0.0119
40	10 10 00	60.0				0.0100
41	10 10 01	61.5				0.00841
42	10 10 10	63.0				0.00708
43	10 10 11	64.5				0.00596
44	10 11 00	66.0				0.00501
45	10 11 01	67.5				0.00422
46	10 11 10	69.0				0.00355
47	10 11 11	70.5				0.00299
48	11 00 00	72.0				0.00251
49	11 00 01	73.5				0.00211
50	11 00 10	75.0				0.00178
51	11 00 11	76.5				0.00150
52	11 01 00	78.0				0.00126
53	11 01 01	79.5				0.00106
54	11 01 10	81.0				0.000891
55	11 01 11	82.5				0.000750
56	11 10 00	84.0				0.000631
57	11 10 01	85.5				0.000531
58	11 10 10	87.0				0.000447
59	11 10 11	88.5				0.000376
60	11 11 XX[3]	∞				

NOTES
[1] Switch closed in shaded area
[2] $V_{IN} = -10V$ dc
[3] X = 1 or 0 Output is fully muted for N>60

Performance Table

Switch ON Resistance	600Ω MAX at 1mA Iswitch
Switch OFF Leakage Current	1uA MAX at +12V Vswitch

Loudness Switches

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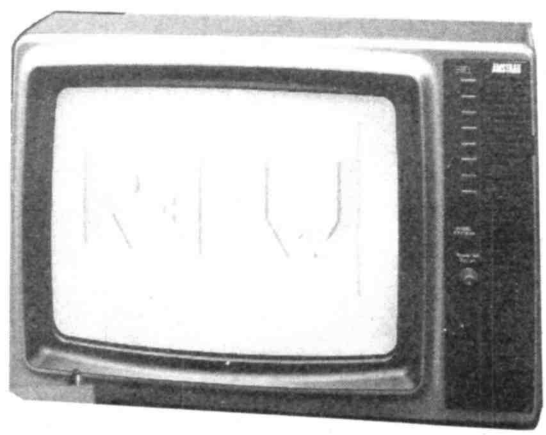

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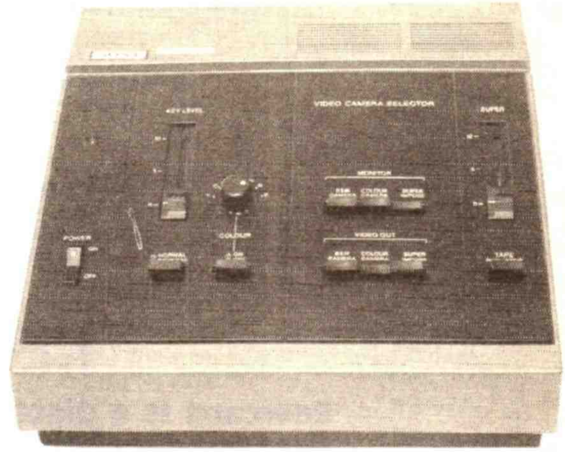
What to look for in the March issue of R&EW

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.

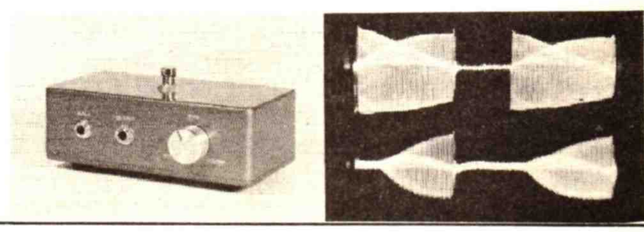


2M TRANSVERTER

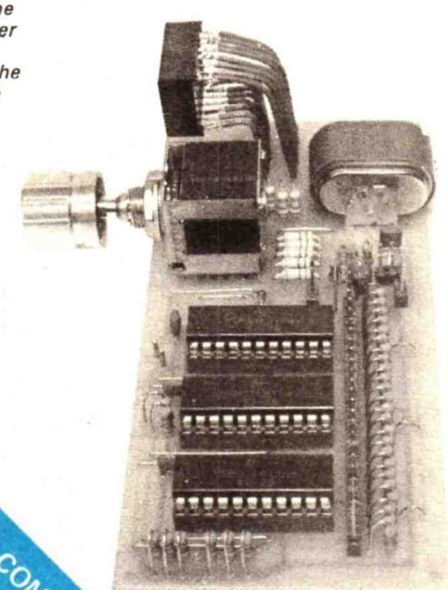
Next month we describe the design and construction of a 28MHz to 144MHz transverter based on the 6m design published in December's R&EW.

Guitar Sound Shaper

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



Articles described here are scheduled for the March issue, however circumstances may dictate changes in the final content of the magazine.



FREE COMPUTING SUPPLEMENT

A 16-page computing special that amongst other things presents an eight-channel DVM for use with our Z8 system and the start of Zilog's course with everything you could want to know about the Z8000 clearly explained.

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 0.42 A total on standby. Complete with back-up battery.

The complete electronics magazine

AUDIO BRIEF

The ideal mixer for home AV enthusiasts — David Strange elucidates . . .

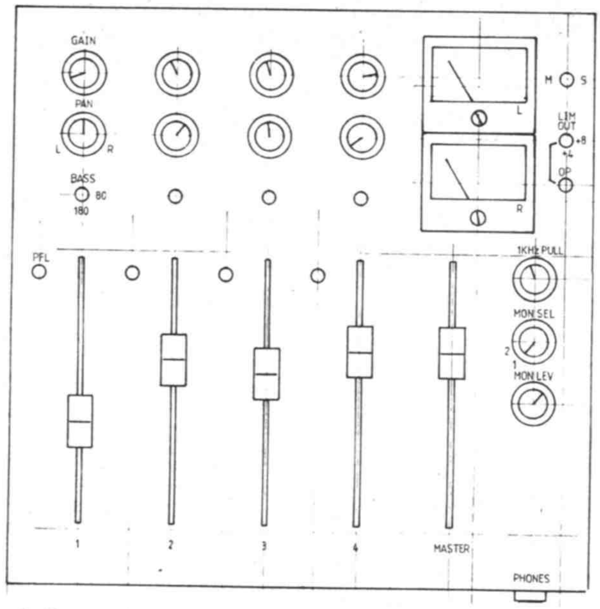


Figure 2. Proposed layout for the AV mixer.

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.

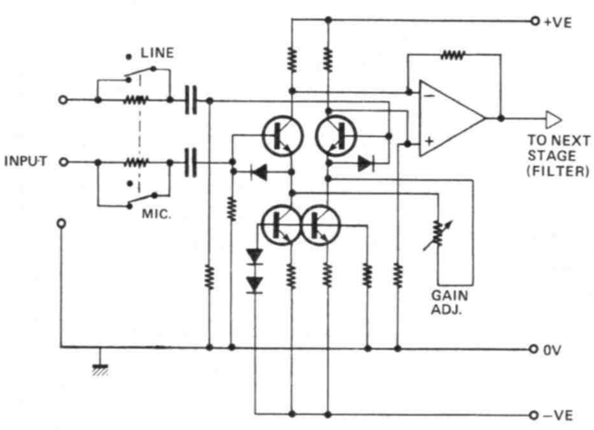


Figure 1. Mic/line pre-amplifier with balanced inputs.

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.

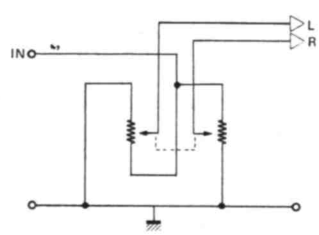


Figure 3. A typical set-up for left and right panning.

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 accidently 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.

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.

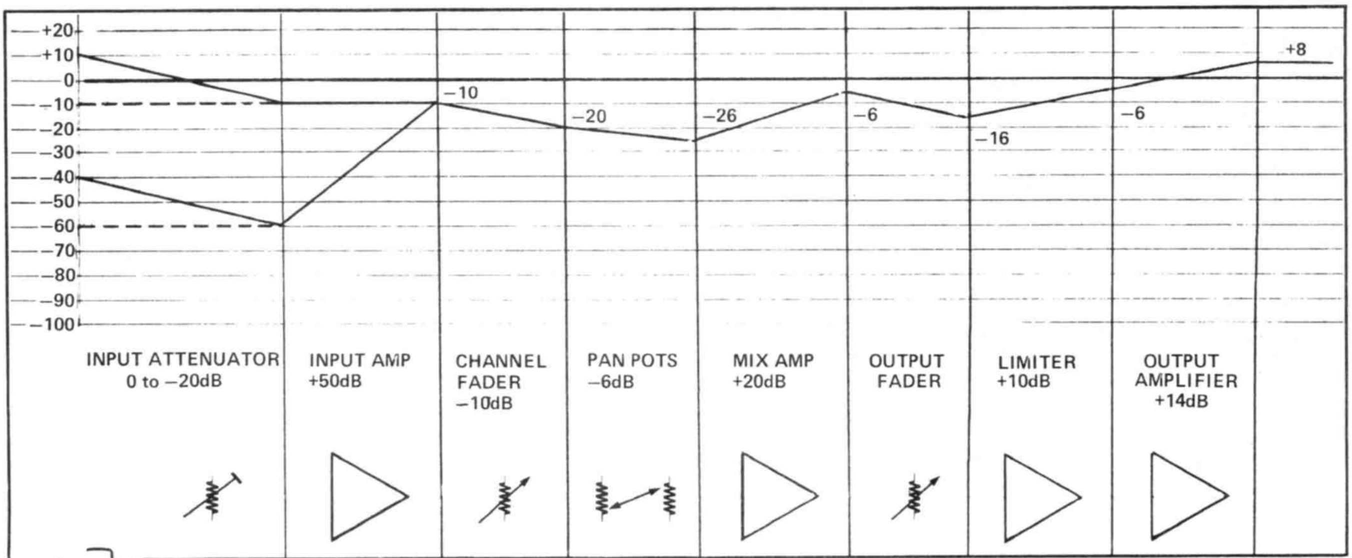


Figure 4. Signal levels at each stage in the mixer.

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*).

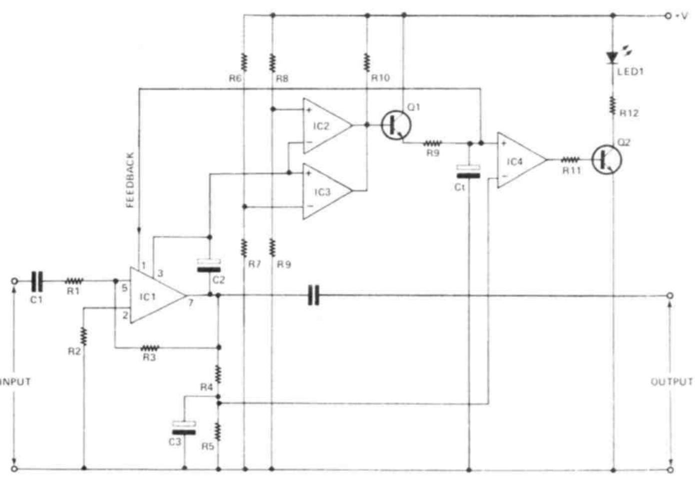


Figure 5. Schematic diagram of the limiter.

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

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.

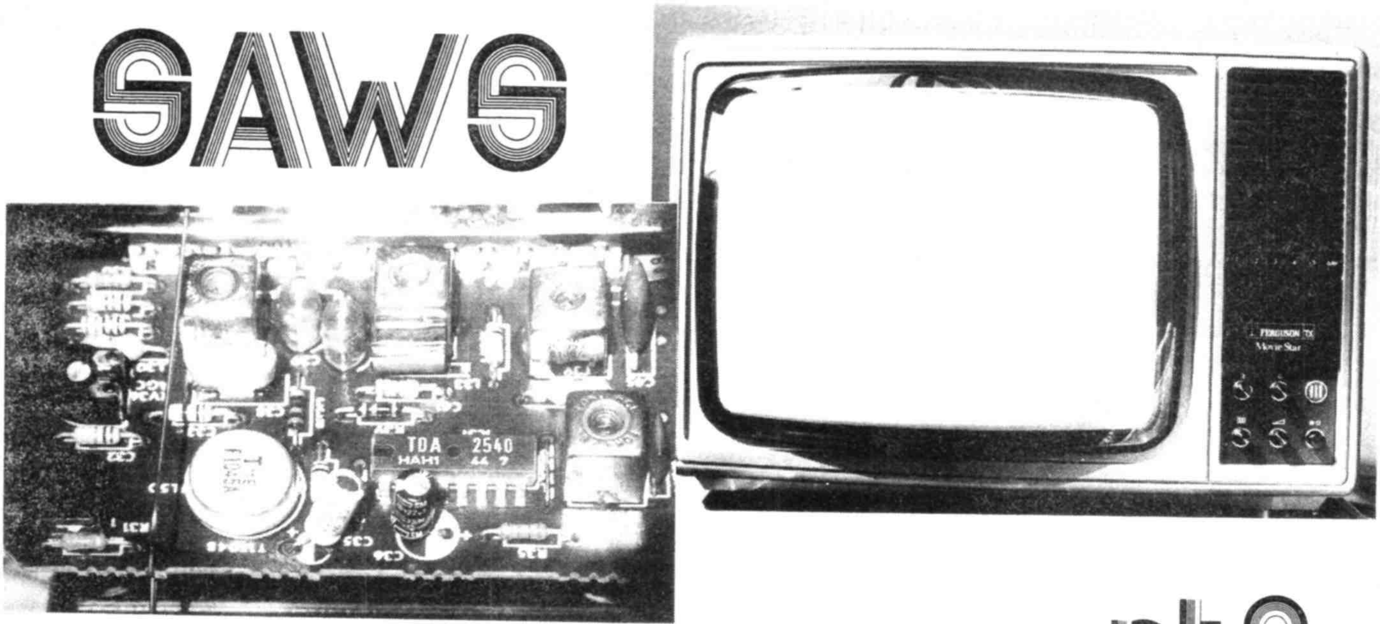
Fig. 4 shows the signal levels through the elements of the mixer. Starting at the front end, signals between -60dB and +10dB can be accommodated with better than 27dB of headroom. Mid-way things get tighter with about 23dB headroom and it is only at the output (after the limiter, incidentally) that 9.8dB 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.

■ R&EW

YOUR REACTIONS

	Good	*Average*	*Poor*
Circle No.	*79*	*80*	*81*

SAWS



pt 2

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 break-through 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. 15* 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.

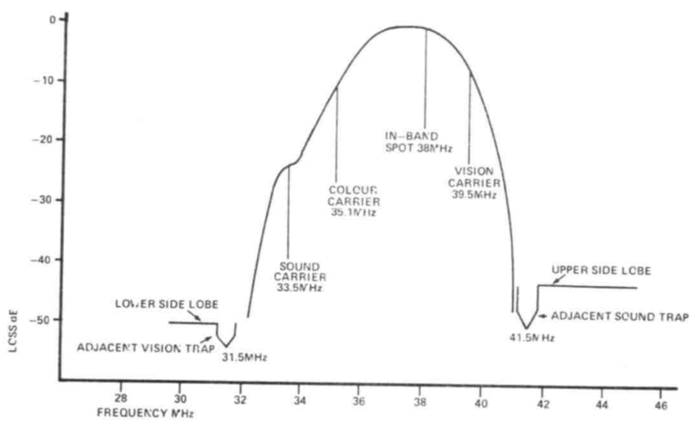


Figure 16: Filter characteristics required for UK television.

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

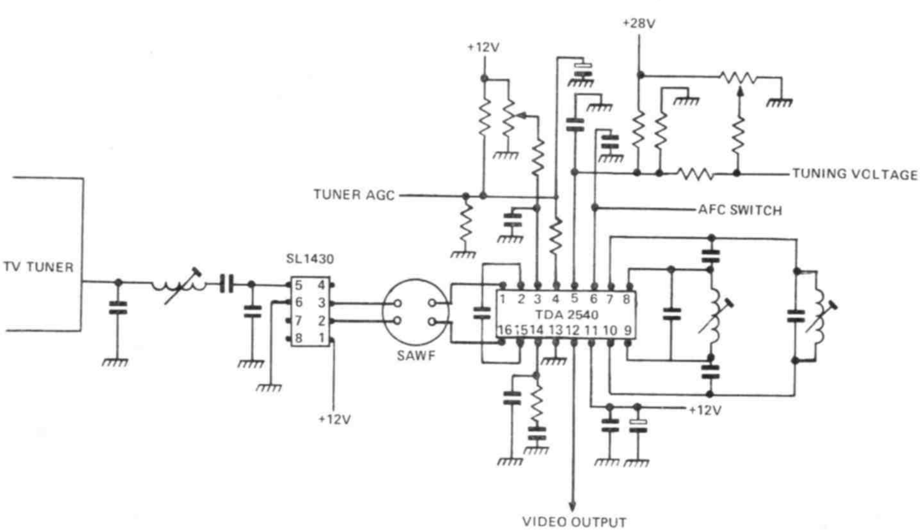


Figure 15: Typical TV video IF application circuit using a SAW filter.

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 contaning 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-

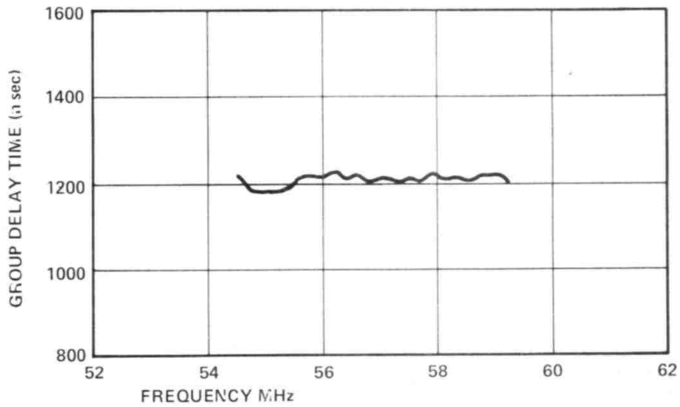


Figure 17: Group delay time characteristic of a Murata SAF 38.9MB filter.

chirps and the other stretches pluses 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 streatch 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

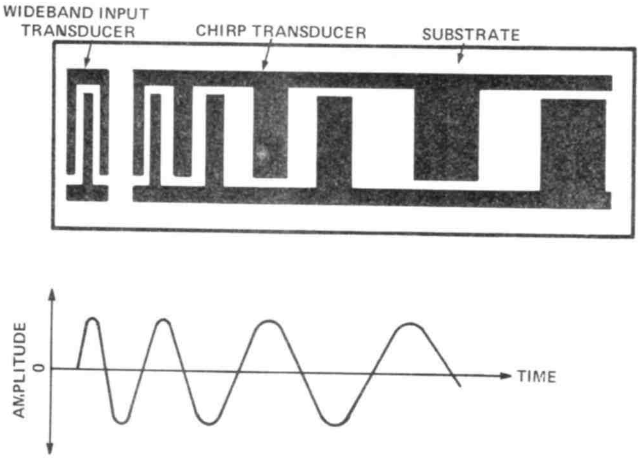


Figure 18: Down-chirp dispersive delay line and its output waveform.

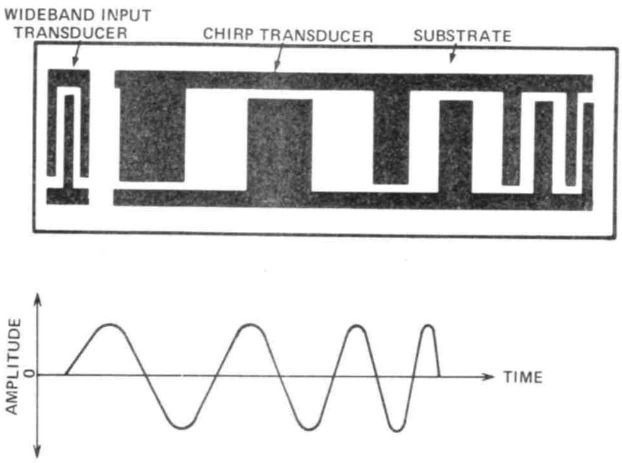


Figure 19: Up-chirp dispersive delay line and its impulse response waveform.

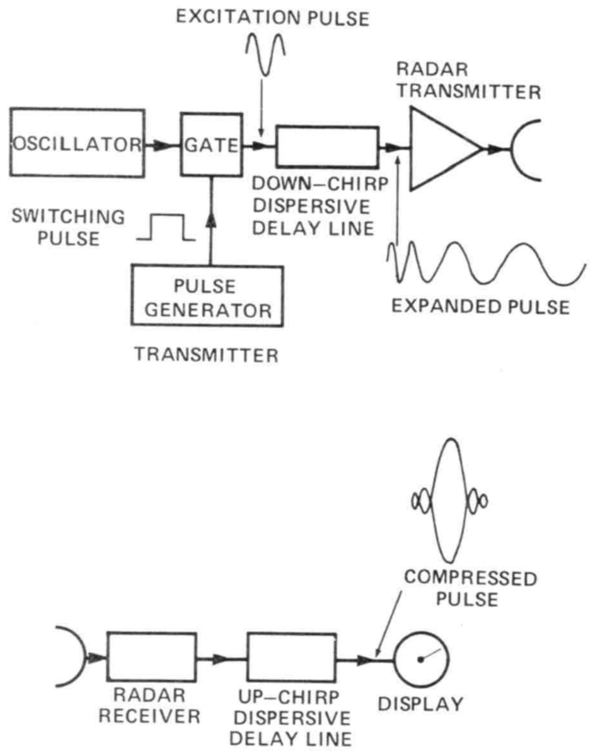


Figure 20: Block diagram of a simple pulse compression radar.

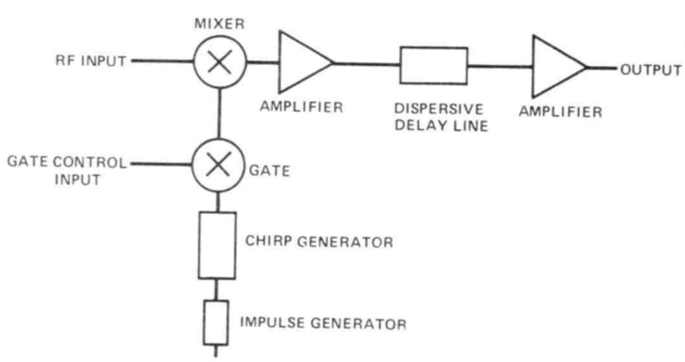


Figure 21: Block diagram of a compressive receiver.

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.

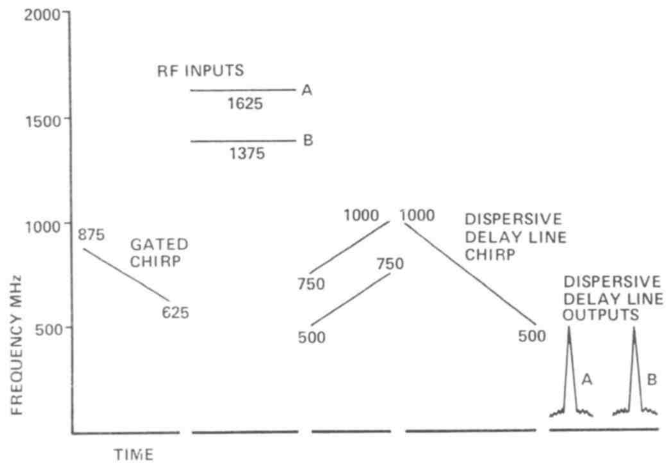


Figure 22: Frequency time diagram with an offset time axis, of a compressive reciever.

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 impluse 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.

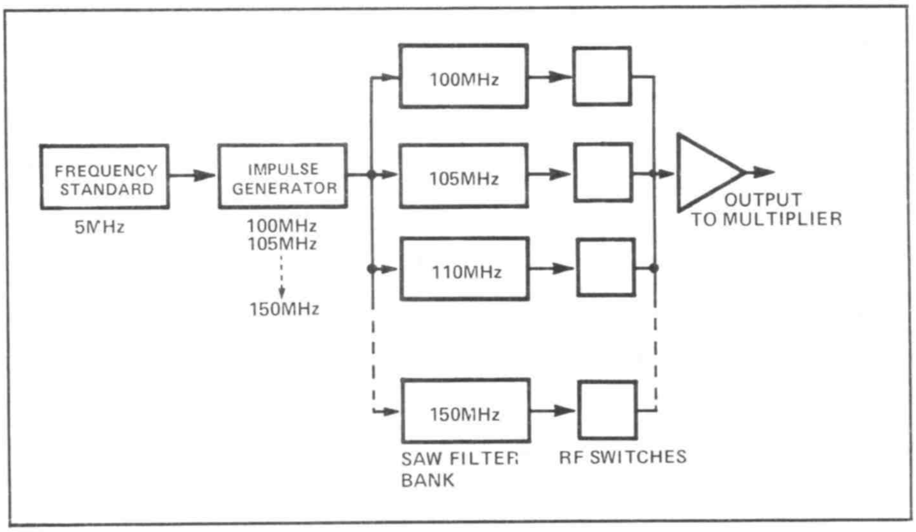
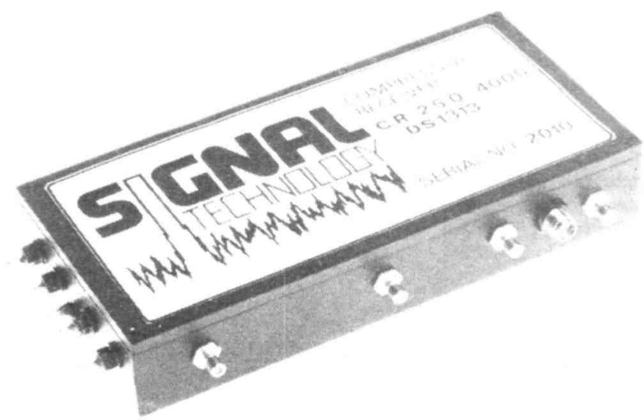


Figure 23: A SAW fast hopping frequency synthesiser.



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.

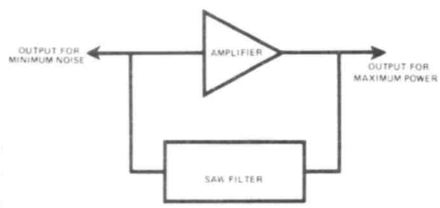


Figure 24: Block diagram of a SAW oscillator.

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. ▶

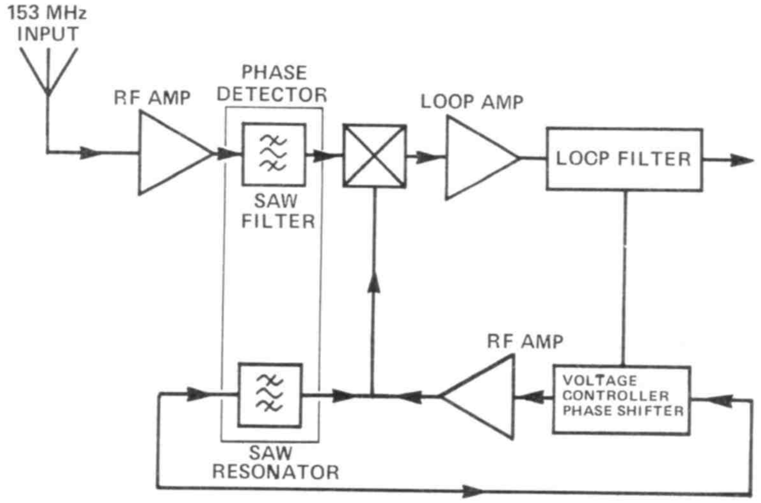


Figure 25: Experimental SAWF based direct conversion receiver.

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'.

■ R&EW

YOUR REACTIONS	*Good*	*Average*	*Poor*
Circle No.	*91*	*92*	*93*

AMATEUR RADIO WORLD

Compiled by Arthur C. Gee, G2UK

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.

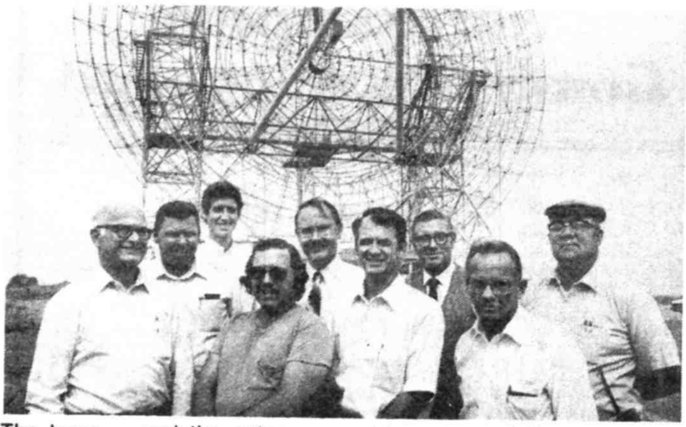
New Broadcast Bands

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.

Occupancy 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. This would seem to be pretty rare. However, on the afternoon of Sunday 3rd October, great excitment was produced by the appearance of ELOBY, who was putting a terrific 18MHz signal into Europe and working strings of European stations. He gave his location as "240 miles west of California"! This caused me to look up a note I had seen in "Radio Communications" for August 1981, in which it stated that the only Liberian stations known to be active — legally — were ELOAI and ELOAV. The others were thoughs to be illegal operators and a request had been received from the Liberian Bureau of Maritime Affairs for all who worked ELO stations to make a note of the name of the ship and send the information to LRAA, P.O. Box 1477, Monrovia, Liberia. It was noted that ELOBY appeared not to be giving the name of his ship!



The team — and the antenna — which successfully rescued UOSAT. (Acknowledged to:- AMSAT Satellite Report)

Pastures New

For a long time now, the RSGB has been finding its HQ in Doughty Street, WC1N 2AE, too small for its rapidly expanding activities. Membership of the RSGB has increased by over 50% in the last five years and their turnover has also increased dramatically. Those who have had to attend committee meetings there, know only too well the difficulties of the limited space available at No 35. At last, after a good deal of searching and much negotiation, a new HQ has been found. In November last, the Society moved into new quarters in Potters Bar, Hertfordshire. Their new address is:- Alma House, Cranborne Road, Potters Bar, Hertfordshire, EN6 3JN. Here they will have three to four times the floor space, ample scope for future expansion, good free car parking and sufficient storage area to keep much larger stocks of books, etc., than they had at Doughty Street. We wish them a happy and successful future in their new HQ.

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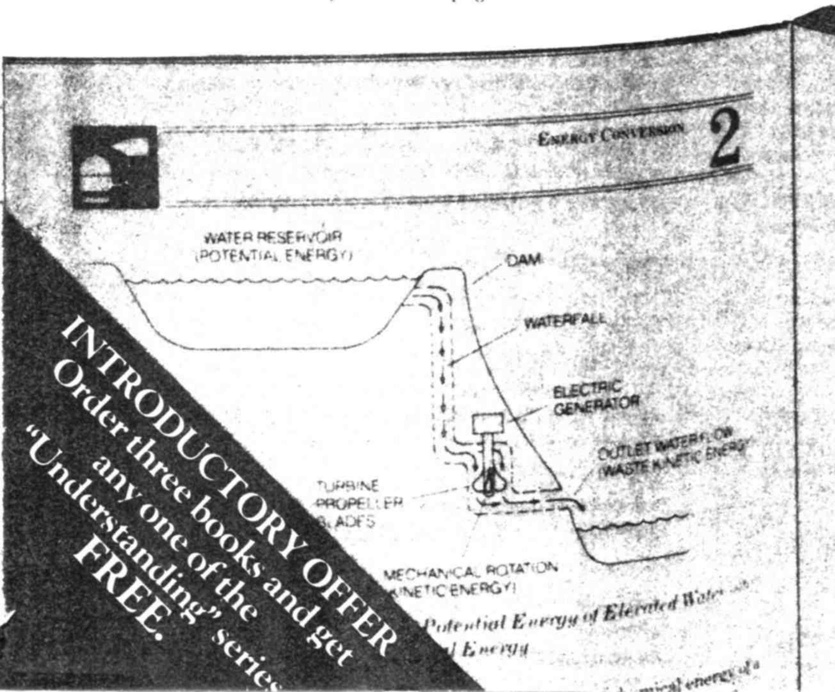

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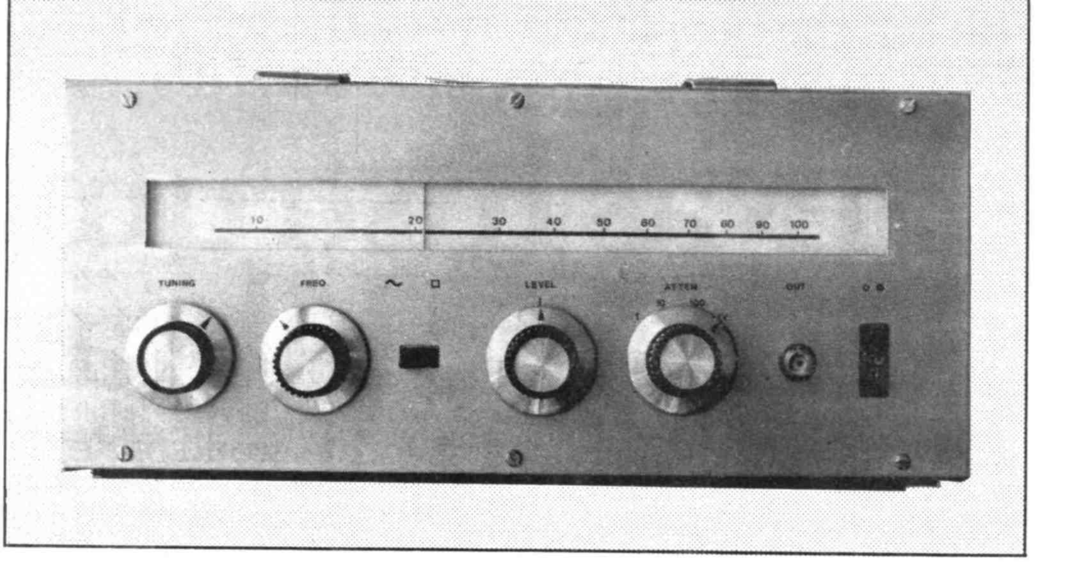


SIGNAL GENERATOR

L. Boullart.

The design of a precision sine-wave oscillator covering the range 10Hz-100kHz.

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 HA 12017, 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_S = 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 to an output voltage of 1.5 V RMS.

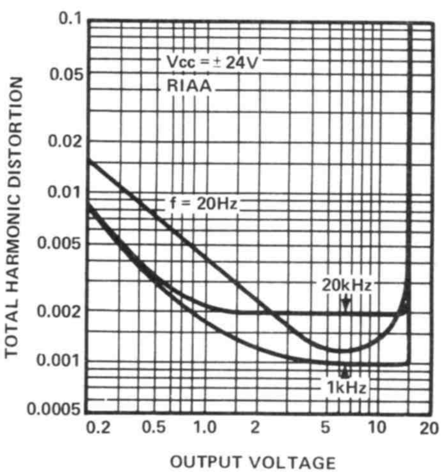


Figure 1: The THD characteristics of the HA12017 low noise amp.

Circuit Description

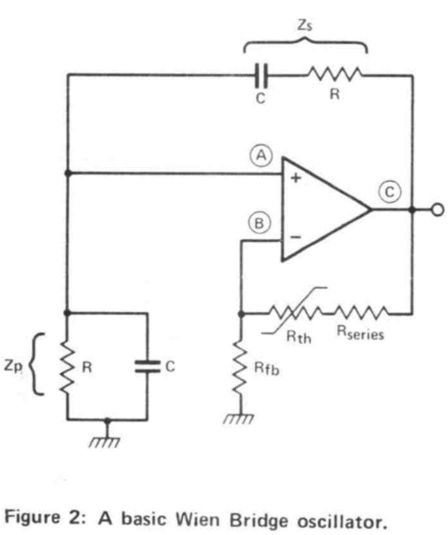


Figure 2: A basic Wien Bridge oscillator.

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, $C = 10^6 (2\pi f_0 R)^{-1}$ and Z_s = 1R4 with a phase angle of -45°. Similarly, Z_p will be 0R7 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.

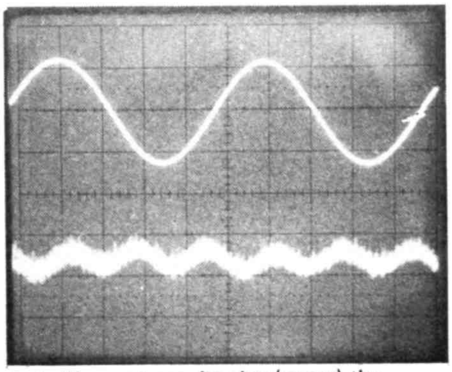
In order to avoid excessive distortion, the output voltage has to be stabilised at a reasonable value. This is achieved by a thermistor in the negative feedback loop, together with R_{series} and R_{fb}, which maintain an amplification factor slightly over 3. *Figure 5* shows the characteristics of the well known RA 53 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 four 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 capacitance meter 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 47 k, were chosen. This combination yields a final value of 15 k 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 1n 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 Ra, Rb and Rc are required. These will have to be made up by series or parallel combinations.



A dual 'scope trace showing (upper) the output sine wavw and residual distortion (lower).

The voltage across the lower limb of the voltage divider (R_{fb} in *Fig. 2*) will be 0.5 V. In practice, R_{fb} 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!

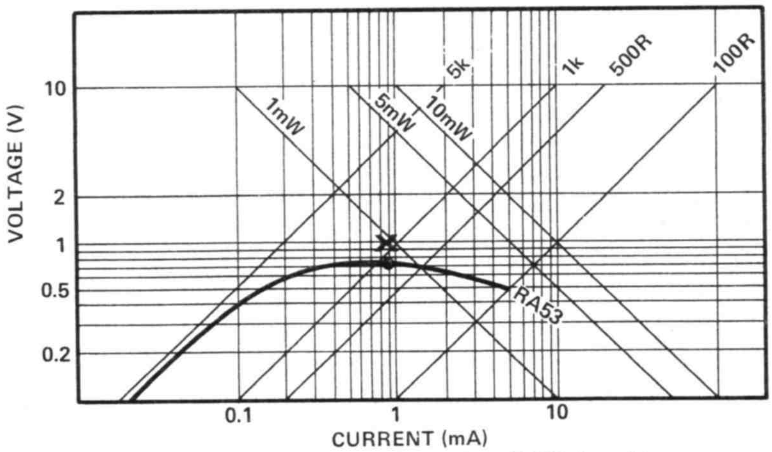


Figure 4: Working characteristics of the RA53 thermistor.

1. Distortion (including noise)	1kHz	0.0018%
	10kHz	0.0012%
	60 Hz	0.016 %
2. Frequency linearity	20Hz – 50kHz	± 0.10dB
	10Hz – 100kHz	± 0.25dB
4. Frequency ranges	1) 9.6 – 106Hz	
	2) 96 – 1060Hz	
	3) 0.96 – 10.6kHz	
	4) 9.6 – 106kHz	
5. Output voltage	1) 1V	
	2) 100mV	
	3) 10mV	
	4) 1mV	

Table of specifications for the Signal Generator.

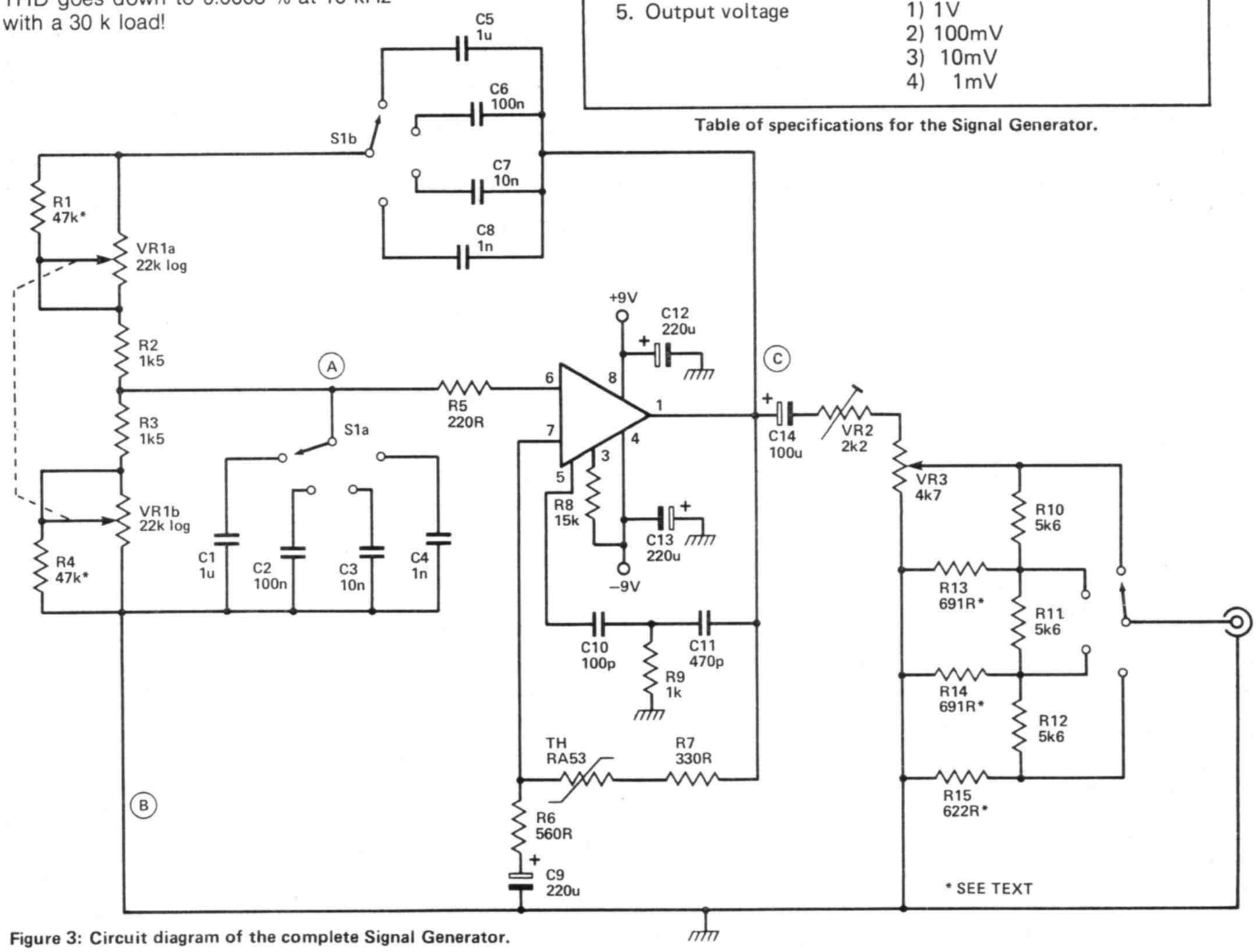


Figure 3: Circuit diagram of the complete Signal Generator.

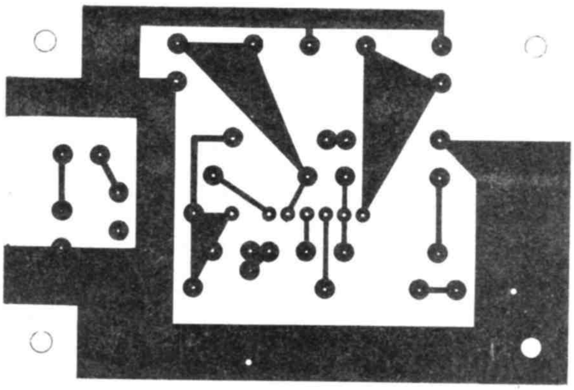


Figure 5a: PCB Foil Pattern.

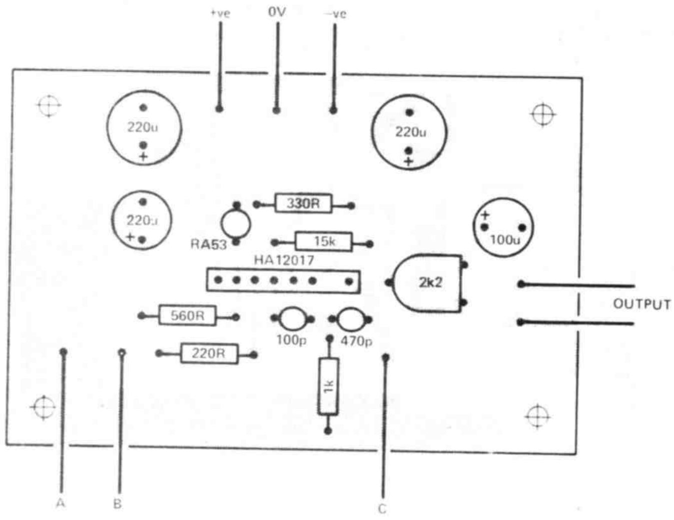


Figure 5b: Component Overlay.

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 1¼ 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.

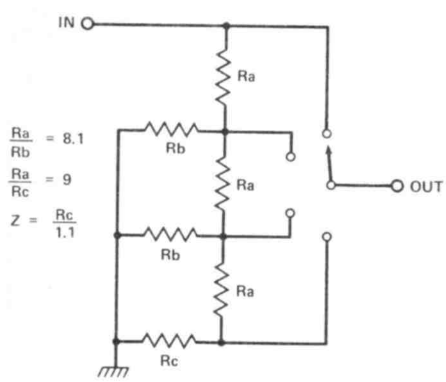


Figure 6: A constant impedance attenuator.

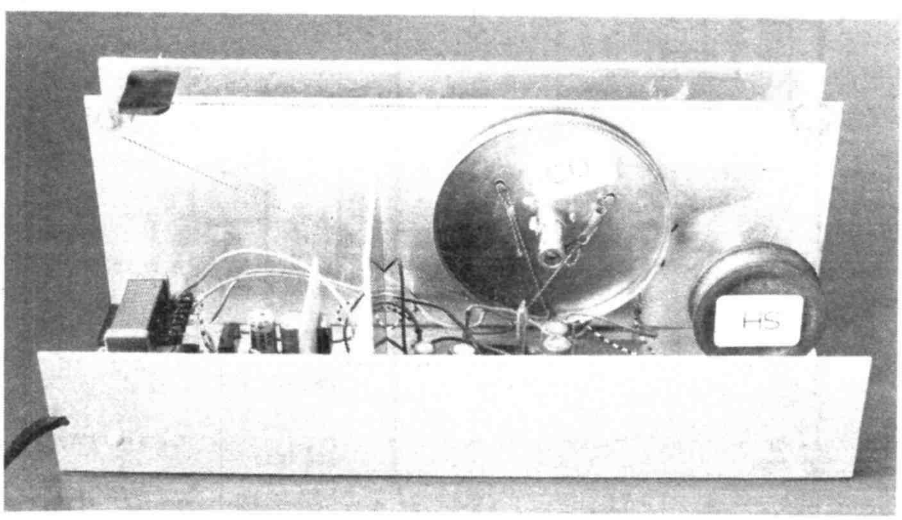
Calibration

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	1k5
R5	220R
R6	560R
R7	330R
R8	15k
R9	1k
R10,11,12	5k6
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	
IC1	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.

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*16*
Average	*17*
Poor	*18*

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 thumbwheel — 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 carrying 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 overpowering, 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 claims, 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

RADIO FREQUENCY RANGE:	FM: 87.5–108 MHz LW: 150–285 kHz MW: 520–1610 kHz SW: 5.9–18 MHz
POWER REQUIREMENT:	AC: 110–115/115–127/200–220/230–250 V, 50/60 Hz Power consumption: 35 W Battery: 12 V (eight UM-1, "D" size batteries) Car battery: with optional car adaptor RP-952
POWER OUTPUT:	15 W . . . RMS (max.) 20 W . . . MPO
SPEAKERS:	Woofer: 10 cm PM dynamic speaker Tweeter: 3 cm speaker
FREQUENCY RANGE:	40–12,000 Hz (with normal tape) 40–14,000 Hz (with CrO_2 tape) 40–16,000 Hz (with Metal tape)
RECORDING SYSTEM:	AC bias, AC erase
TAPE SPEED:	4.8 cm/s.
PROGRAMME TIME:	1 hour with C-60 cassette tape
FAST FORWARD and REWIND TIME:	Approx. 90 seconds with C-60 cassette tape
TRACK SYSTEM:	4-track 2-channel stereo recording and playback
JACKS: INPUT:	MIC: sensitivity 0.26 mV/applicable microphone impedance 200Ω–600Ω (recommended microphone RP-8135) MIX MIC: sensitivity 0.8 mV PHONO: sensitivity 2.5 mV/47 kΩ
OUTPUT:	EXT SP: 3–8Ω HEADPHONES: 8Ω
REC/PB CONNECTION:	5 pin REC/PLAY DIN type IN: 3 mV/10 kΩ OUT: 420 mV/4.7 kΩ
OTHERS:	DC IN: 13.2 V AC IN EXT ANTENNA and EARTH PHONO EARTH
DIMENSIONS:	53.0 cm (W) × 17.2 cm (H) × 17.6 cm (D) $20\frac{7}{8}$" (W) × $6\frac{25}{32}$" (H) × $6\frac{15}{16}$" (D) Main unit: 29.8 cm (W) × 17.2 cm (H) × 17.6 cm (D) $11\frac{23}{32}$" (W) × $6\frac{25}{32}$" (H) × $6\frac{15}{16}$" (D) Speaker box: 11.8 cm (W) × 17.2 cm (H) × 15.7 cm (D) $4\frac{5}{8}$" (W) × $6\frac{25}{32}$" (H) × $6\frac{3}{16}$" (D)
WEIGHT:	6.0 kg (13 lbs 3.6 oz) without batteries

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

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

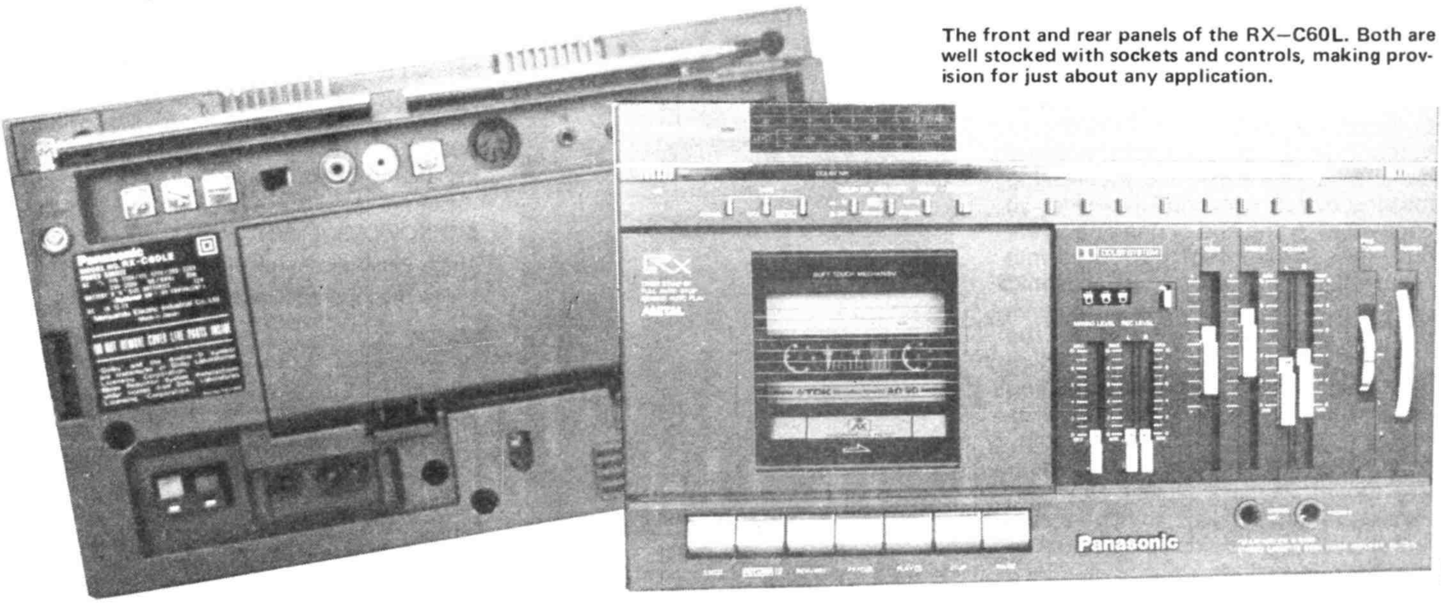
The speakers on the Panasonic RX are designed to match the styling *and* power capacity of the rest of the system. Each cabinet contains two drive units, enclosed in an infinite baffle arrangement (or, at least, they would have been if more attention had been paid to absorbing resonances). The drive 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.

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

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

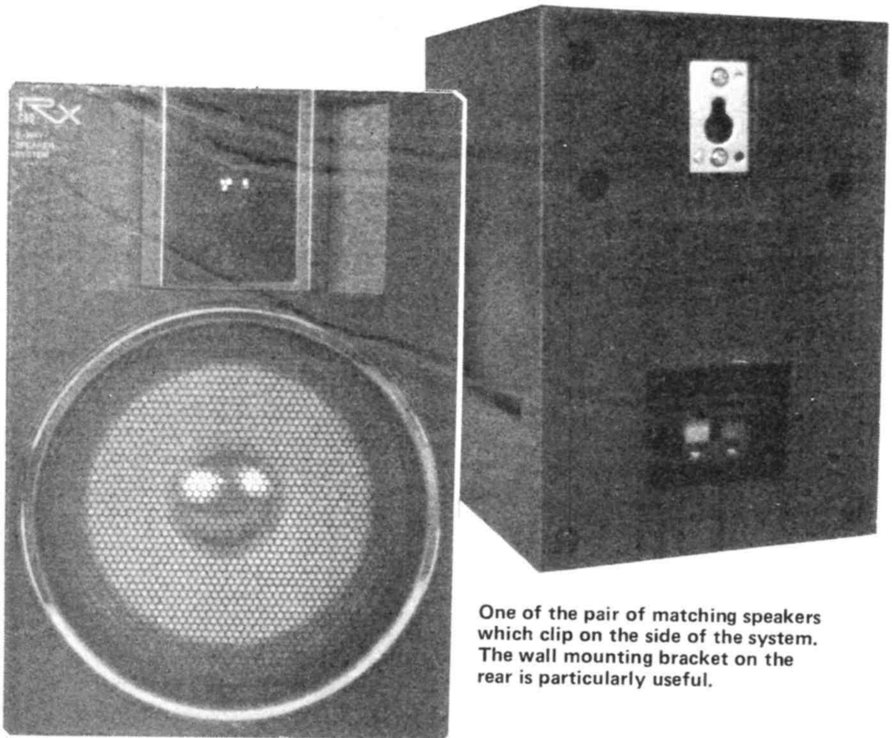
Banding Together

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-



The front and rear panels of the RX—C60L. Both are well stocked with sockets and controls, making provision for just about any application.

PANASONIC RX-C60L Review



One of the pair of matching speakers which clip on the side of the system. The wall mounting bracket on the rear is particularly useful.

ation within the tuner's limits of sensitivity (12uV for 50mW output).

Band selection is performed by pressing one of the four pushbuttons directly above the main level and tone sliders. A green LED indicates stereo reception and a similar red type shows when a station is tuned-in properly. In practise, the most viable method for ensuring a decent signal (least hiss and noise) involves a degree of 'trial and error', with the interaction between aerial direction and frequency lock. Unfortunately, the action of tuning to a particular station is not made any easier by the tuning scale, which is over-crowded and requires a concerted effort to read. A little extra thought here would have proved worthwhile (or did I just fail to spot the magnifying glass supplied with every system?)

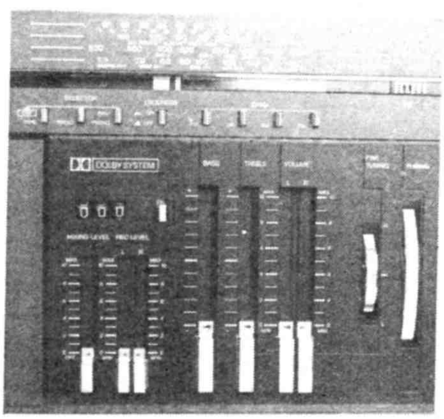
Smooth As Silk

One word aptly describes the cassette transport controls on the RX-C60L — 'smooth'. Many cheaper machines either hurl the cassette at you upon depressing the eject button, or clamp it in position so tightly that by the end of one side all the tape has been neatly spooled into an inverted pyramid. Not so Panasonics RX-C60L. This little beauty requires the merest touch to operate the transport and eject mechanisms, which combined with the three buttons setting equalisation (for 'metal' tapes as well as 'chrome' and 'ferric') and one for Dolby noise reduction, produce a comprehensive record/playback facility. However, Panasonic have taken things a step further with the addition of manual or automatic recording.

In manual mode, the levels are adjusted via two small sliders next to the cassette compartment. Metering is administered by an LED bargraph display, showing VU steps from -20 to +6dB. This makes it a simple matter to set the recording levels for optimum signal-to-noise performance, whilst avoiding saturation problems.

The automatic recording mode dispenses with the need to monitor signal levels altogether, but is best confined to those occasions when you haven't the time to set things up carefully enough to warrant manual recording.

Two other features are worthy of mention; the 'REC MUTE' button and mixing facility. Record mute is an extremely useful extra, which allows the conscientious user to edit cassette recordings, by muting source signals at the push of a button. This makes the task of removing radio commercials and over-zealous DJ's repartee quite straightforward (as long as you can get to the button before the music fades!).



The main amplifier and tuner controls.

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.

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*67*
Average	*68*
Poor	*69*

READERS LETTERS

Facts and opinions; Yours and Ours

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.

The Good

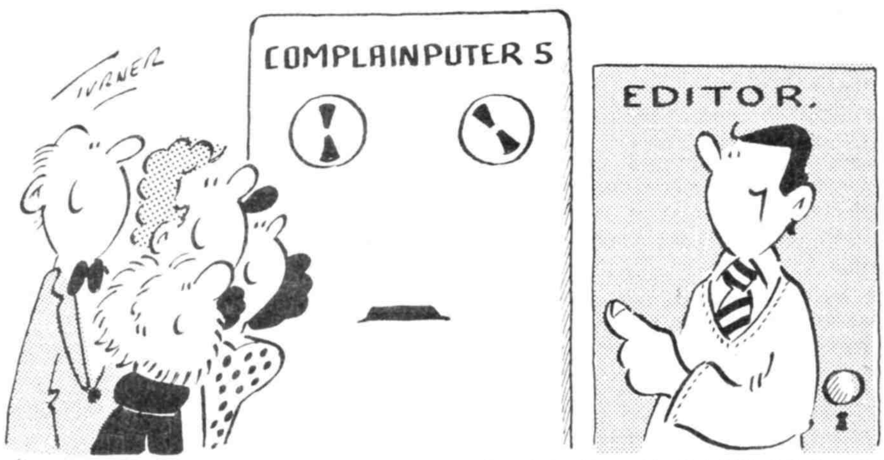
Dear Sir,
I have recently discovered 'Radio & Electronics World' and find it an absorbing and interesting magazine. I have successfully built and installed the recent CB Noise Squelch and considering that the previous item I constructed had valves, you can see that it has been some time since I undertook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

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 short comings.

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.



".. IT'S AN INVESTMENT AGAINST COMPLAINTS, IT DOES NOTHING, BUT WE CAN BLAME IT FOR EVERYTHING!"

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 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:
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Incidentally - all orders should be prepaid.

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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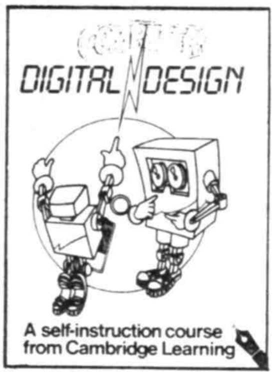

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178 for further details

CW FILTER

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 narrrow-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.

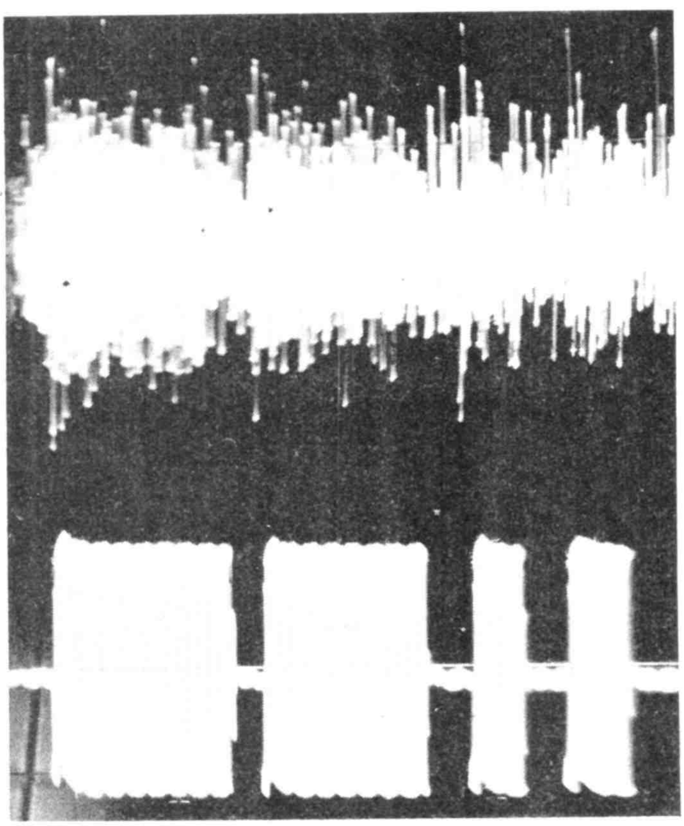
The CW filter uses a similar system (as can be seen from the block diagram of *Fig. 3*). At the input, are two audio bandpass filters operating on slightly different frequencies. The output of the second filter is fed to a mixer, via a gain control, and then to the headphones. When searching for signals, 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 × 100 × 50mm will comfortably accomodate 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.

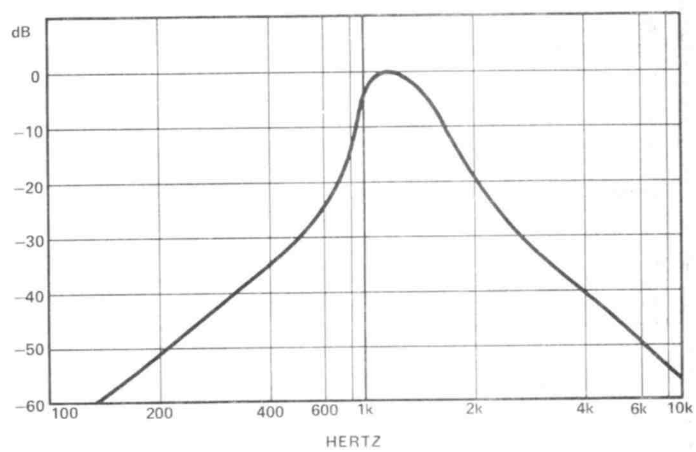


Figure 1: Bandpass filter response.

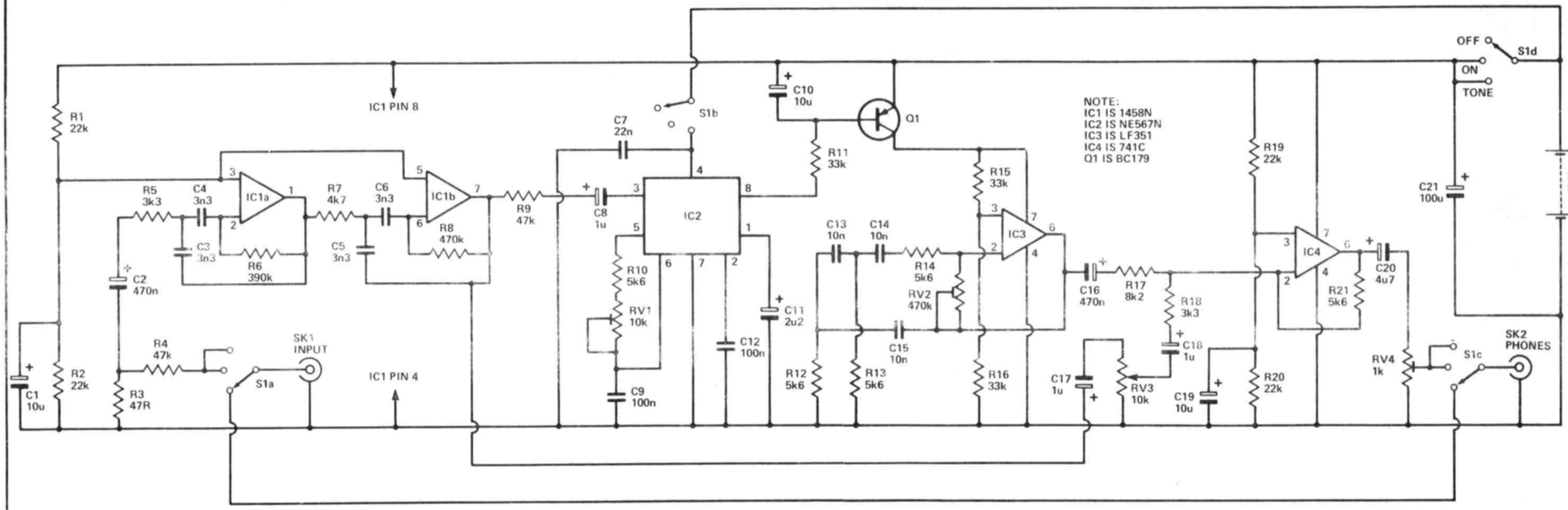


Figure 2: Schematic diagram of the Audio CW filter.

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 too 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 freqency, 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 circuit 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.

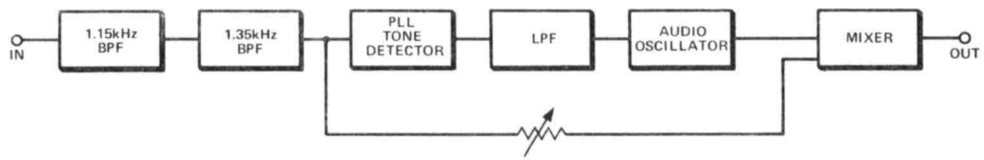
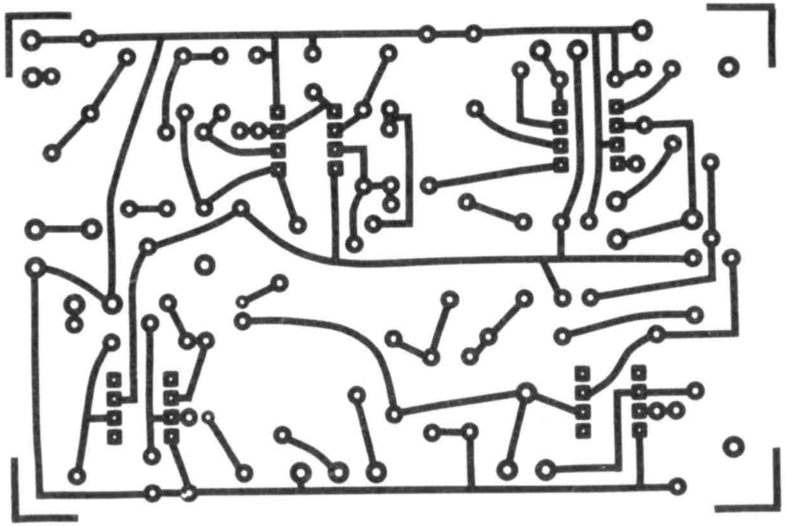


Figure 3: Circuit blocks used in the CW filter.



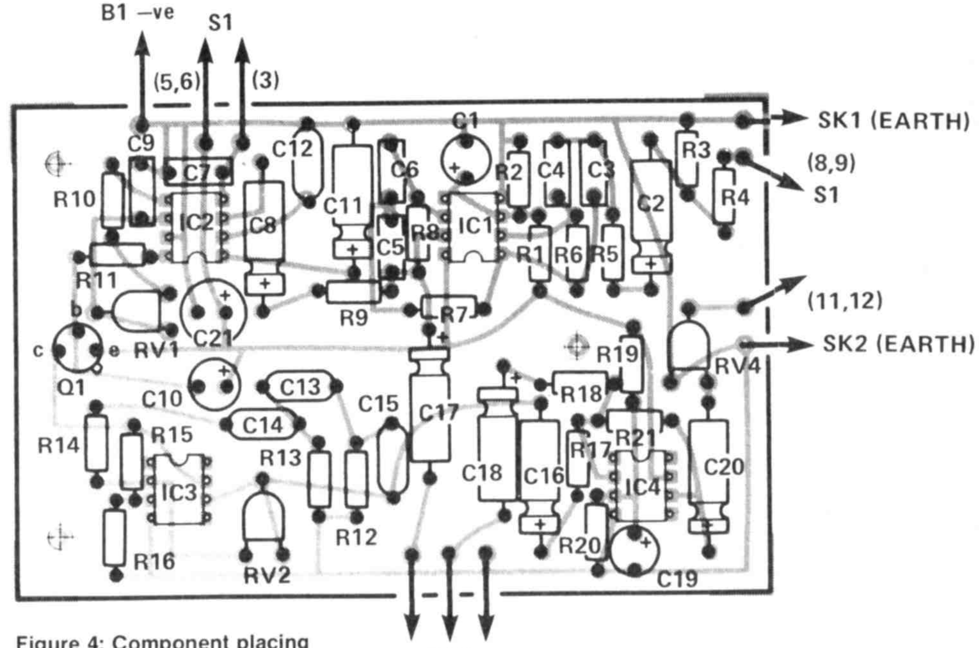


Figure 4: Component placing and foil pattern.

PARTS LIST

Resistors

R1,2,19,20	22k
R3	47R
R4,9	47k
R5,18	3k3
R6	390k
R7	4k7
R8	470k
R10,12,13,14,21	5k6
R11,15,16	33k
R17	8k2

Potentiometers

RV1	10k horiz preset
RV2	470k horiz preset
RV3	10k log
RV4	1k horiz preset

Capacitors

C1,19	10u 25V radial
C2,16	470n 63V axial
C3,4,5,6	3n3 carbonate (5%)
C7	22n carbonate
C8,17,18	1u 63V axial
C9	100n carbonate (5%)
C10	10u 16V tantalum
C11	2u2 63V axial
C12	100n polyester
C20	4u7 63V axial
C21	100u 16V radial

Semiconductors

Q1	BC179 or BC309
IC1	LM1458N
IC2	NE567N
IC3	LF351
IC4	741C

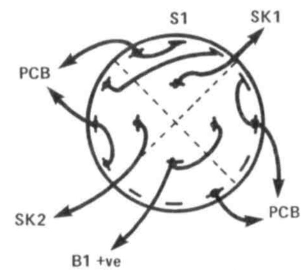
Miscellaneous

SW1	3 way 4 pole rotary

Jack sockets, 6 × HP7 cells in plastic holder, Case, PCB, Control knobs, Battery connector (PP3 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

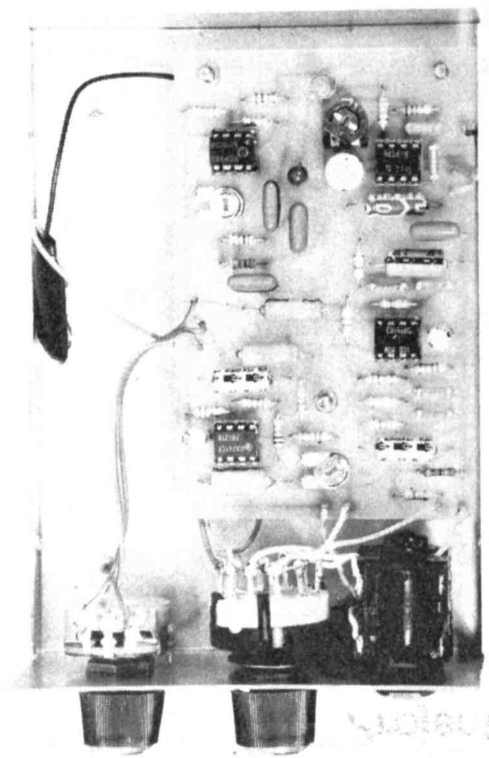


the beat frequency will produce an audio output within the filter's passband. Using this method, one response is brought into the centre of the IF passband, while the other falls outside the passband and is attenuated. Most modern receivers have switched USB and LSB modes (with one of these being used for CW reception) rather than a tunable BFO. With such sets, the BFO is automatically set at the correct frequency.

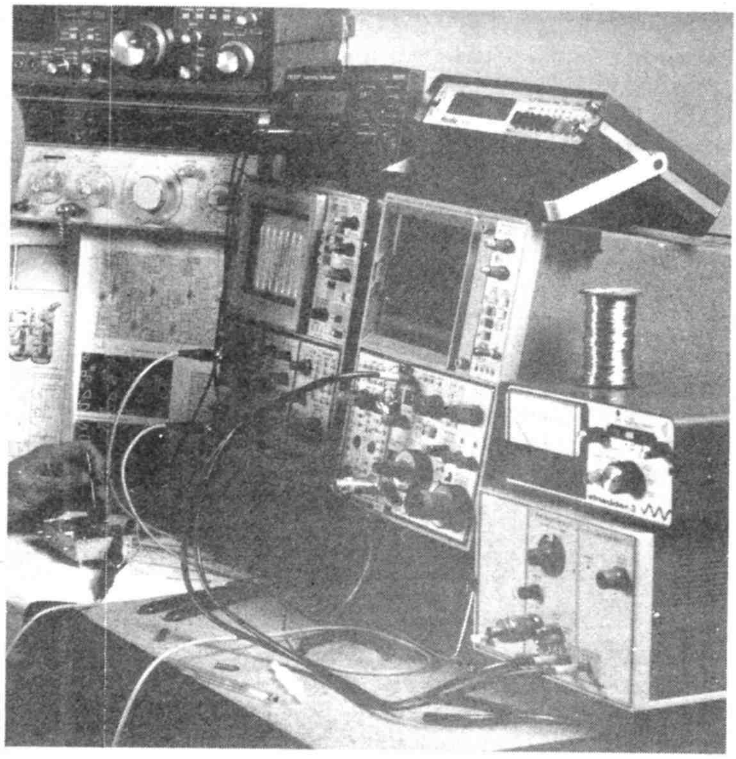
■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*58*
Average	*59*
Poor	*60*

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.

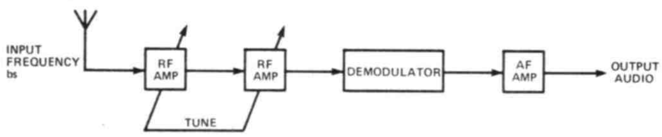


Figure 1: Block diagram of a TRF receiver

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.

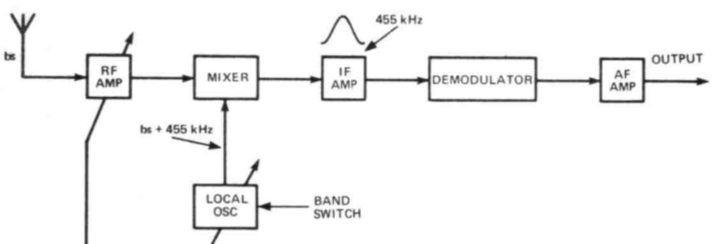


Figure 2: Block diagram of a single superhet

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.

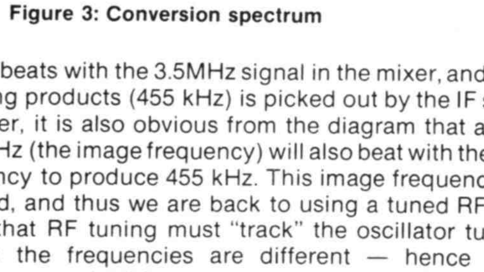


Figure 3: Conversion spectrum

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:

$F_{IMAGE} = F_{SIG.} + 2\ I.F.$

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 neccessary 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

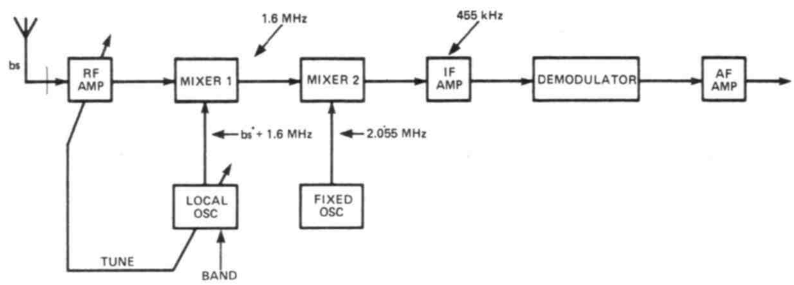


Figure 4: Arrangement of a double superhet receiver

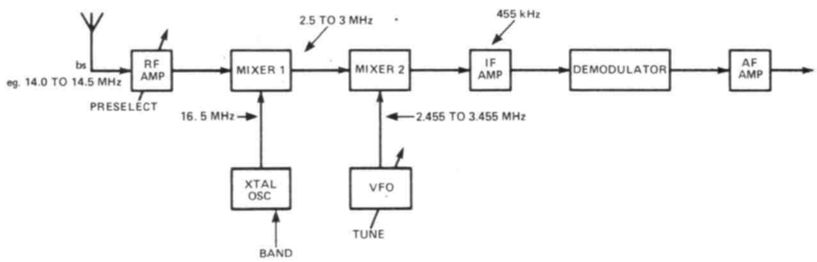


Figure 5: "Convertor' type double superhet

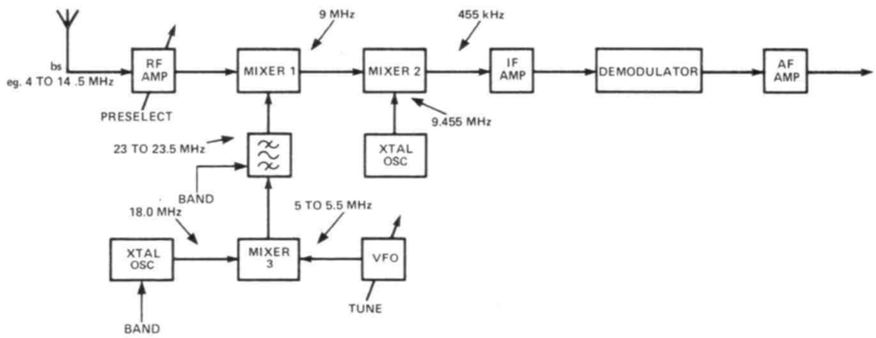


Figure 6: Pre-mixer receiver

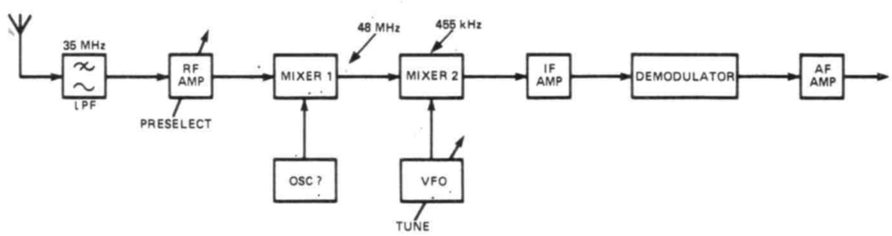


Figure 7: Embryonic up-conversion superhet

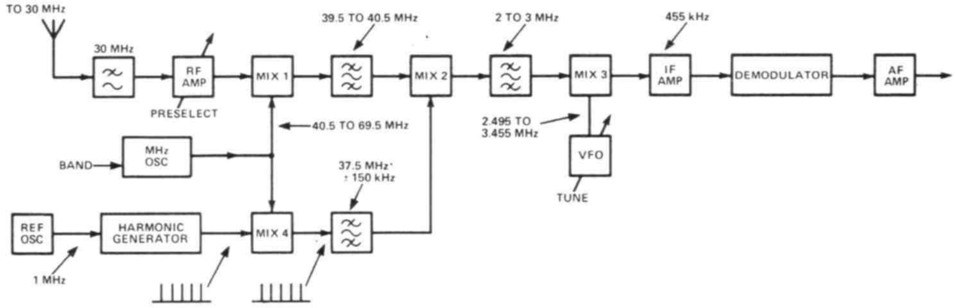


Figure 8: Wadley-loop receiver (RA 17)

▶

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.

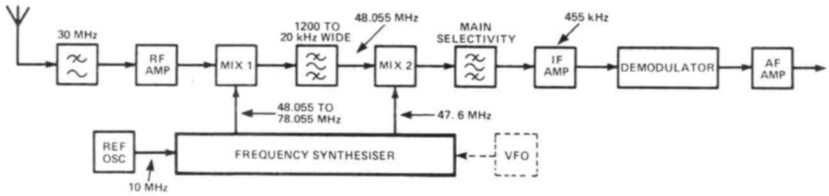


Figure 9: Up-conversion receiver — preferred configuration

This leads us to the idea of some device which can synthetically produce a number of frequencies (hence the name frequency synthesisor), 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 synthesisor 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 sythesis); 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).

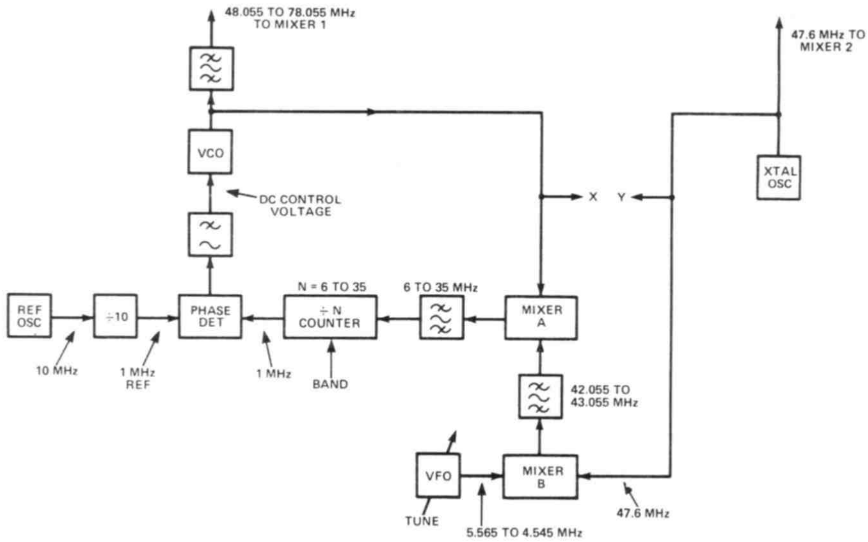


Figure 10: Phase-lock partial synthesiser

A form of partial synthesis was first used on the Racal RA17 receiver using an error correcting loop technique called "Wadley-loop tripple 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 with a comb of frequencies of 1MHz spacing derived from an accurate 1 MHz reference source, and the relevant product at 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 synthesisor, or a partial synthesisor with a VFO feeding into the synthesisor 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 synthesisors. But now one method reigns supreme — the phase lock loop. As an example of a partial synthesisor 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 programmable 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 programs the ÷ N counters, and thus sets the receiver frequency. Provided the steps are small enough (10Hz), a good approximation to true continuous tuning is achieved.

The arrangement shown below is a hypothetical extension of the R1000 circuit to incorporate full synthesis, and is fairly typical of what is done in some British receivers. In this case the idea of a secondary error correcting loop is extended to provide partial correction of the reference frequency drift. Correction at zero frequency is almost perfect while at 30MHz drift is only 0.3Hz°/C for a 1 in 10^8/° C reference oscillator. A total of four phase locked loops are used, three to generate the main (stepped) 48.055 to 78.05499MHz output, with a fourth around the 47.6MHz variable crystal oscillator (VXO).

The 1 MHz wide bandswitching is done as before in the top loop, with two more loops providing coverage in 10 Hz steps. The ÷ 10 stage in the output of the bottom loop enables a reference frequency of 100 Hz rather than 10 Hz to be used at the phase detector thus avoiding problems with loop gain / jitter etc.

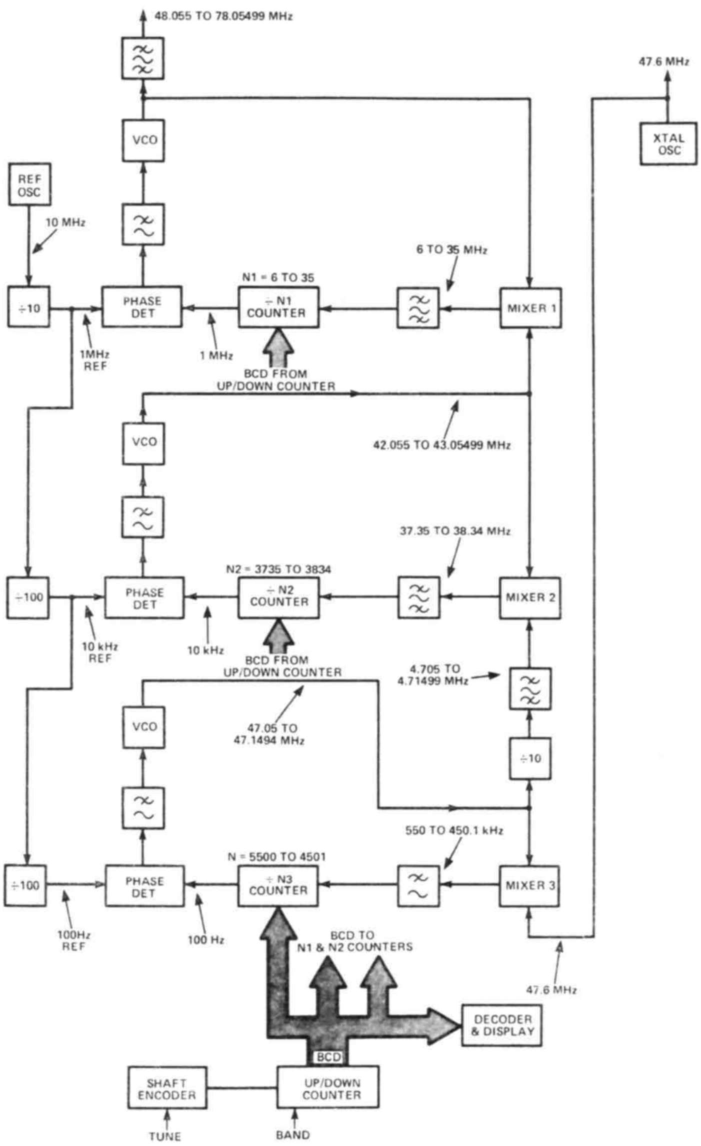


Figure 11: Full synthesiser

The Niceties Of Life

Various "nice" features can be incorporated into fully synthesised receivers, such as auto-bandswitching with continuous tuning right through the spectrum (no need to wind the VFO back for each band); direct frequency setting via numerical keypad; fast and slow tune rates; memory unit in which frequencies can be stored in channels for instant recall; 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 100 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 synthesisor 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 bascially 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 synthesisor — 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 synthesisor 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.

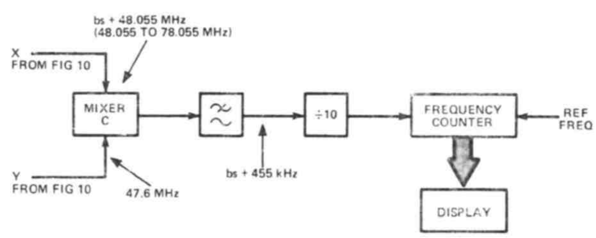


Figure 12: Frequency counter for Figure 10 synthesiser

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*).

High Frequency Receiver Design

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 synthesisor. 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.

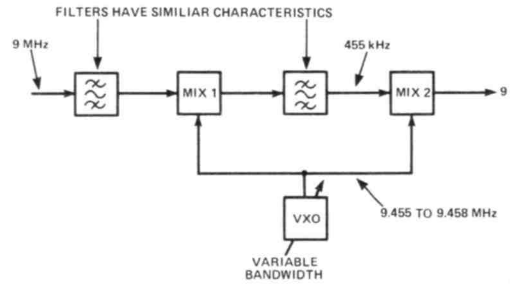


Figure 14: Variable bandwidth IF

Traditionaly 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.

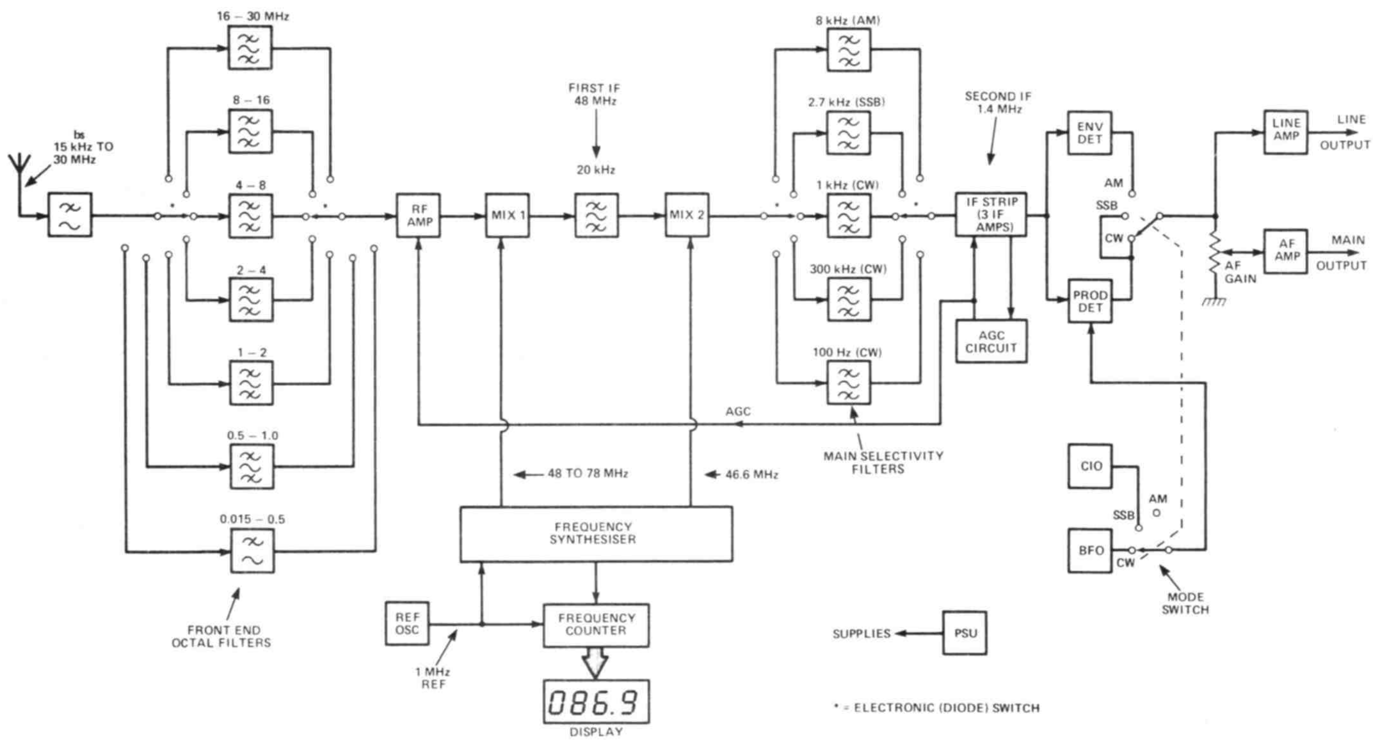


Figure 13: Typical modern HF receiver

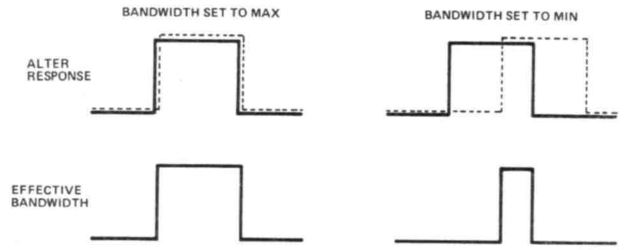


Figure 15: Variable bandwidth response

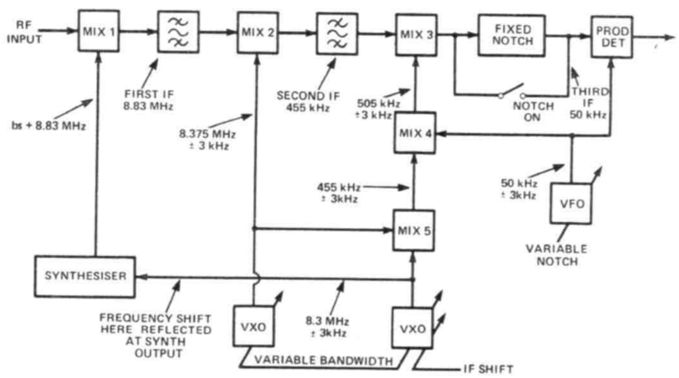


Figure 16: Variable bandwidth, IF shift and tuneable notch

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 (CIO) is used, or the necessary frequencies generated by the synthesisor. 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 limiting IF amplifier, disciminator, 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 anywhere 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.

■ R&EW

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1. Winn, R.F.E. (Racal Communications Ltd.) Synthesised Communications Receiver. Wireless World Oct. 74, pp 413-417.
2. Winn, R.F.E. Effects of Receiver Design in Communications Systems, IERE Proceedings of the Conference on Radio Receivers and associated Systems, 4-6 July 72, pp 193-204.

YOUR REACTIONS

	Good	*Average*	*Poor*
Circle No.	*76*	*77*	*78*

EXHIBITION BRIEF

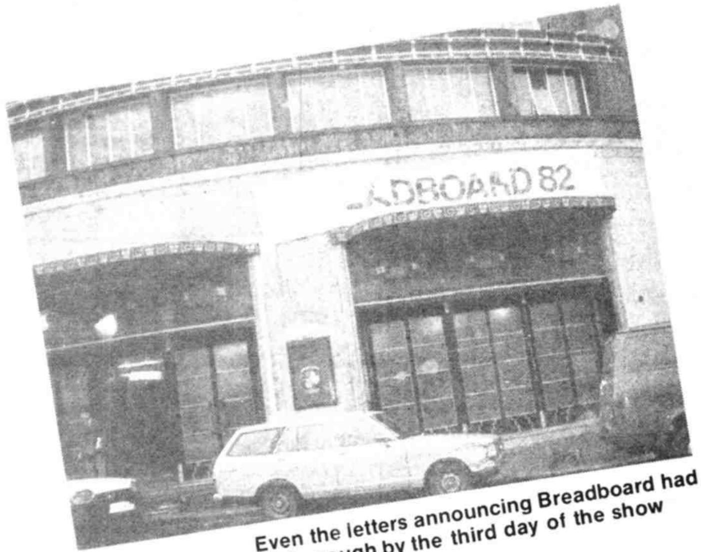
Gary Evans with a 'from the sidelines' view of Breadboard and the Electronics Hobbies Fair.

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 litle 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.

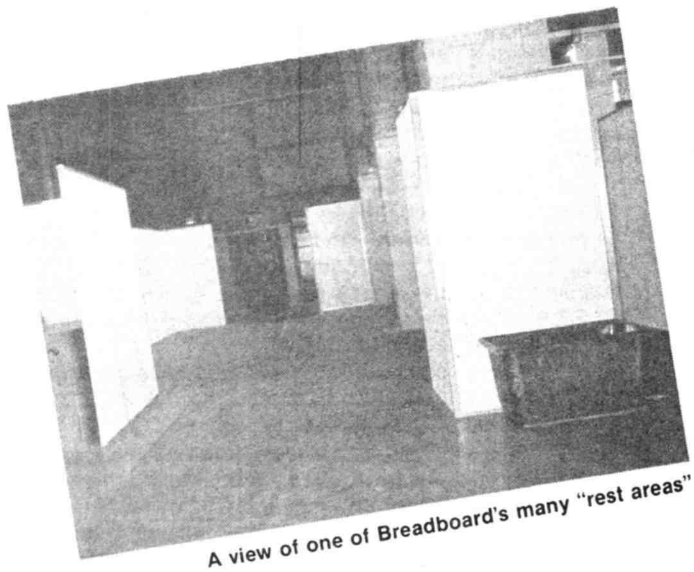
As the two exhibitions were staged by rival publishing houses that are between the two of them responsible for the majority of electronics hobbyist magazines, it is not surprising that each exhibition had only four or five magazines represented. Of the 'independent' publications in the business Elektor 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.



Even the letters announcing Breadboard had had enough by the third day of the show

Our friends at Ambit put in an appearance



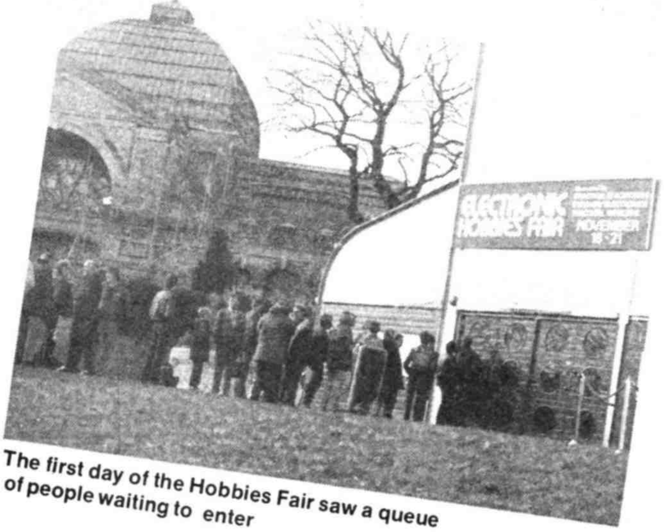
A view of one of Breadboard's many "rest areas"

Bread-Bored

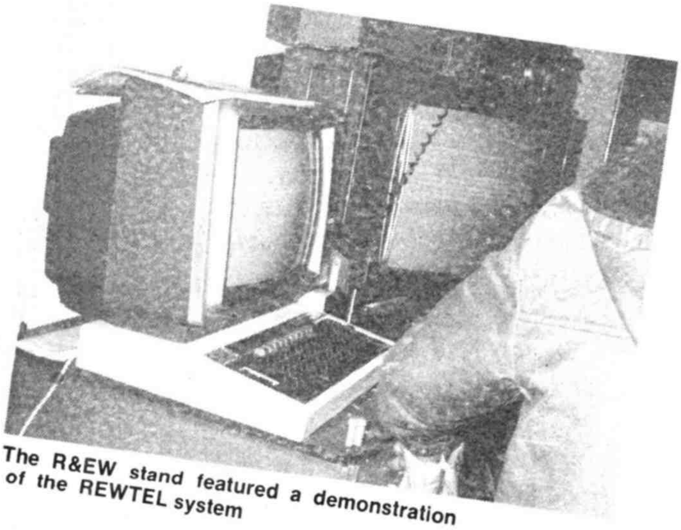
As Breadboard was the first of the two events to be staged we'll take a closer look at this before shifting the attention to the Hobbies Fair.

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, familar 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 5000'.

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 years 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 Electronis 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

	Good	Average	Poor
Circle No.	*22*	*23*	*24*

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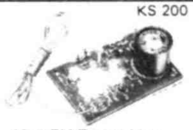

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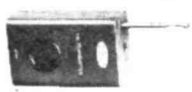

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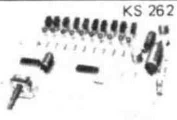

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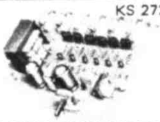

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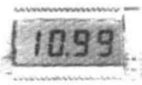

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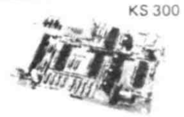

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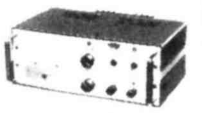

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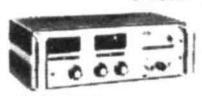

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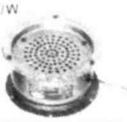

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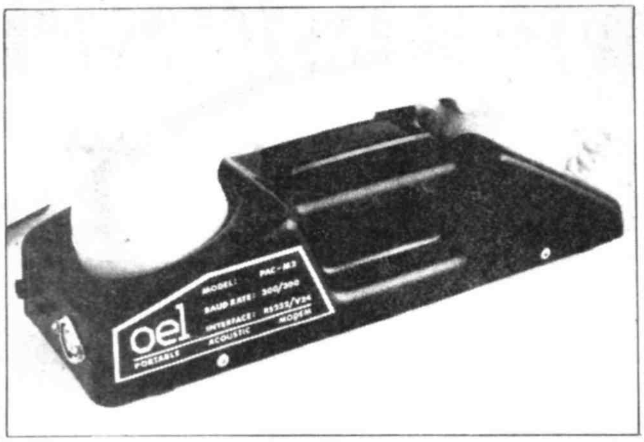

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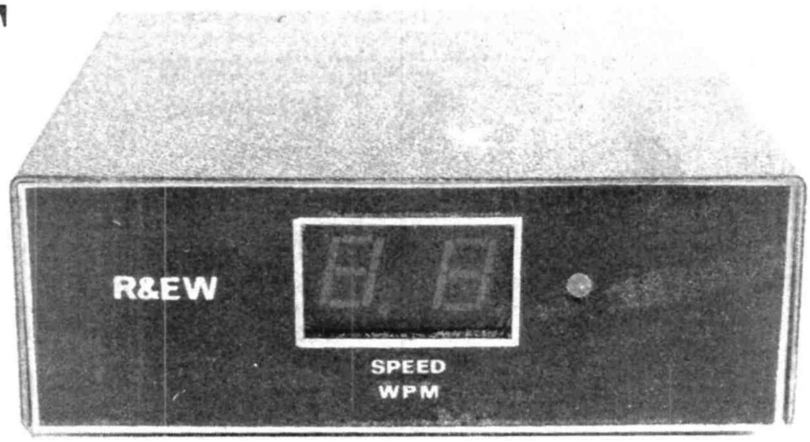
MORSE SPEED READOUT



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 minue (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.

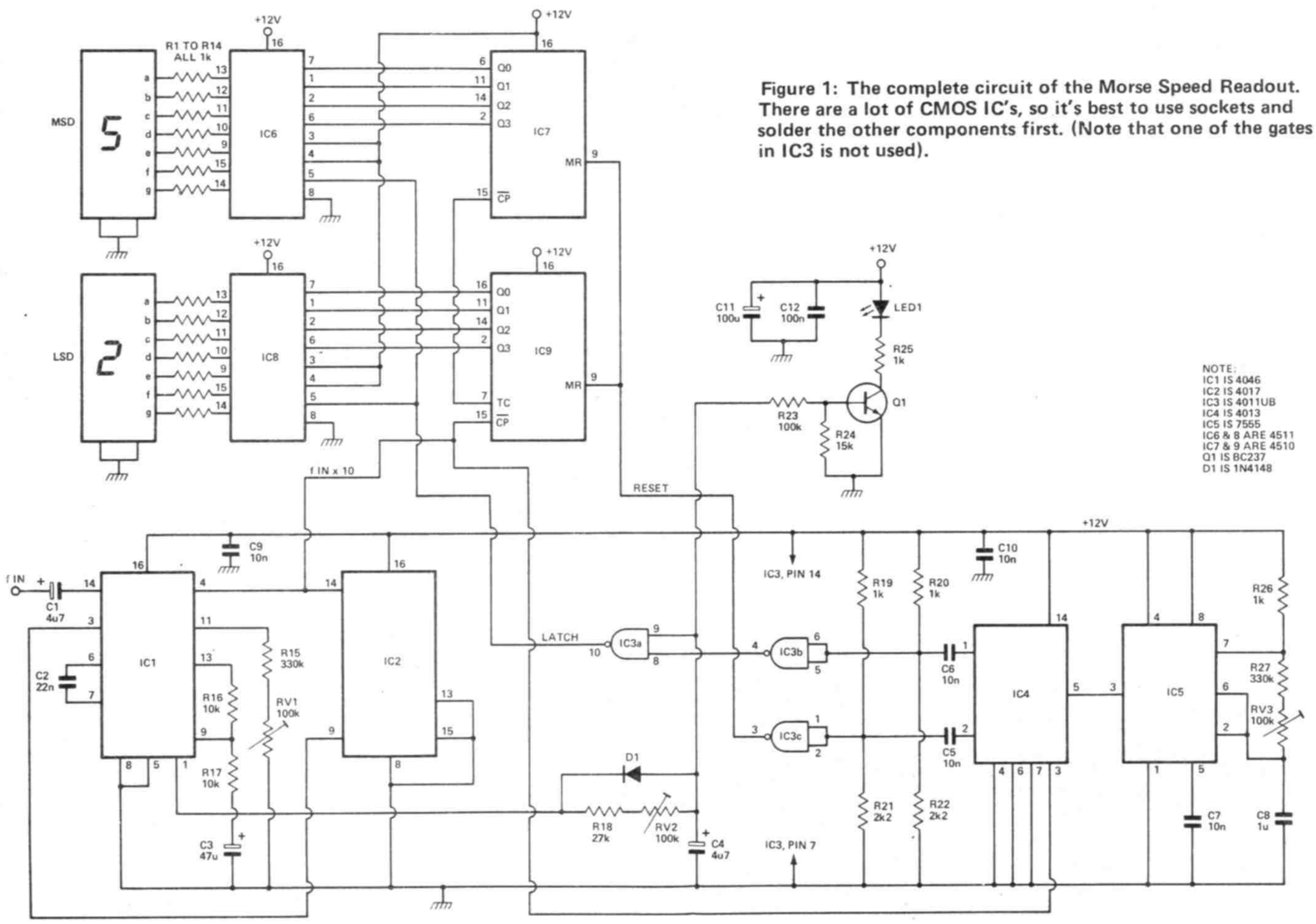
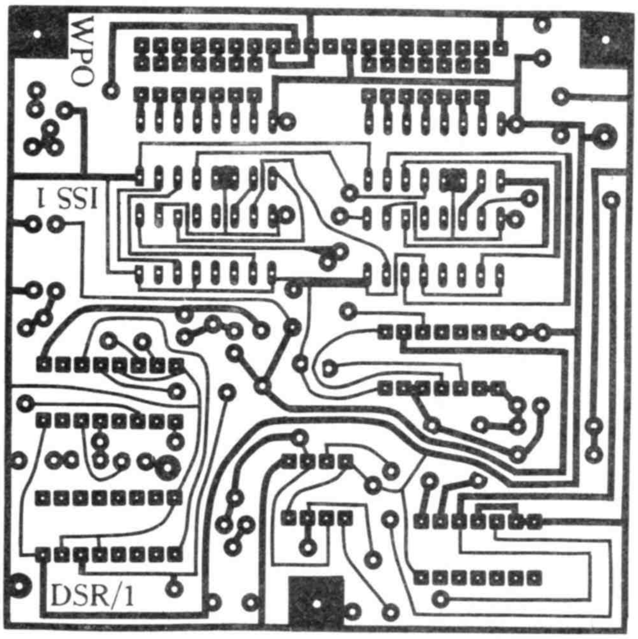


Figure 1: The complete circuit of the Morse Speed Readout. There are a lot of CMOS IC's, so it's best to use sockets and solder the other components first. (Note that one of the gates in IC3 is not used).



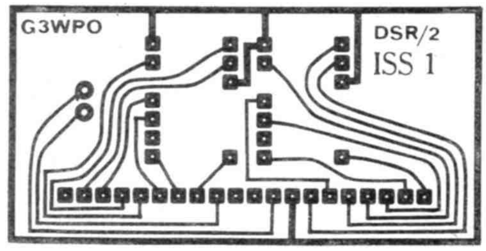


Figure 3a: PCB foil pattern for the Speed Readout display board.

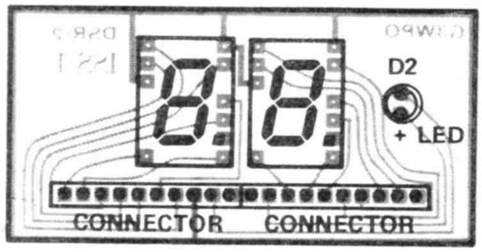
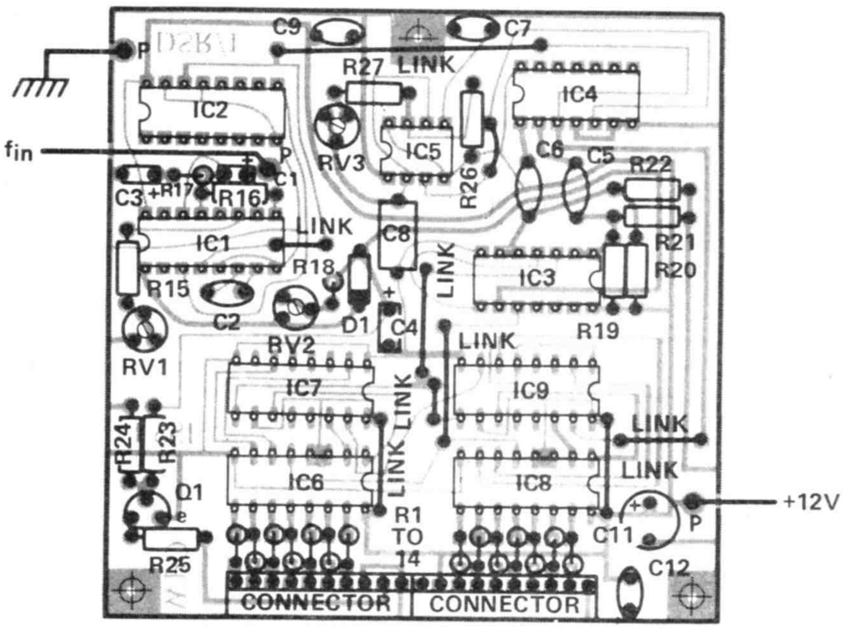


Figure 3b: Layout of the board.



● P = CONNECTION PIN

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.

Figure 2a: PCB foil pattern for the main board (top left).
Figure 2b: Component placing on the main PCB (opposite).

Circuit Description

Looking at *Fig. 1*, 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.

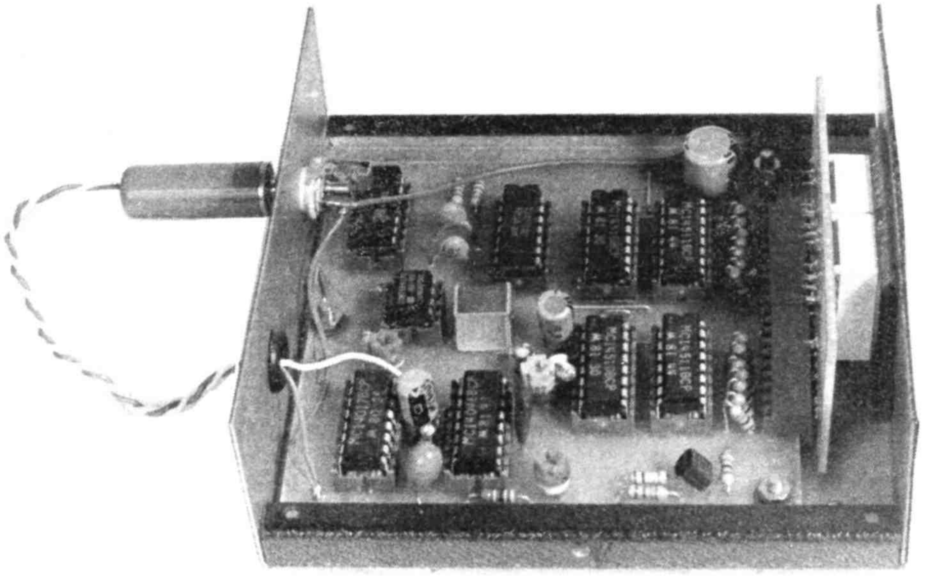
The 4046 input circuit is capacitively coupled (C1) to the keyer clock and locks onto inputs ranging from a few hundred millivolts to the supply voltage. If your keyer clock runs continuously, the display will update continuously; otherwise a series of dots or dashes need to be sent until the VCO is 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. ▶

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	100u 16V electrolytic
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 accomodate 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).

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*19*
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PIN RF Switch	PS1 433	9.10	7.75
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FM Package 2 (Synthesised)	70PAC2	163.00	128.00
TV Products			
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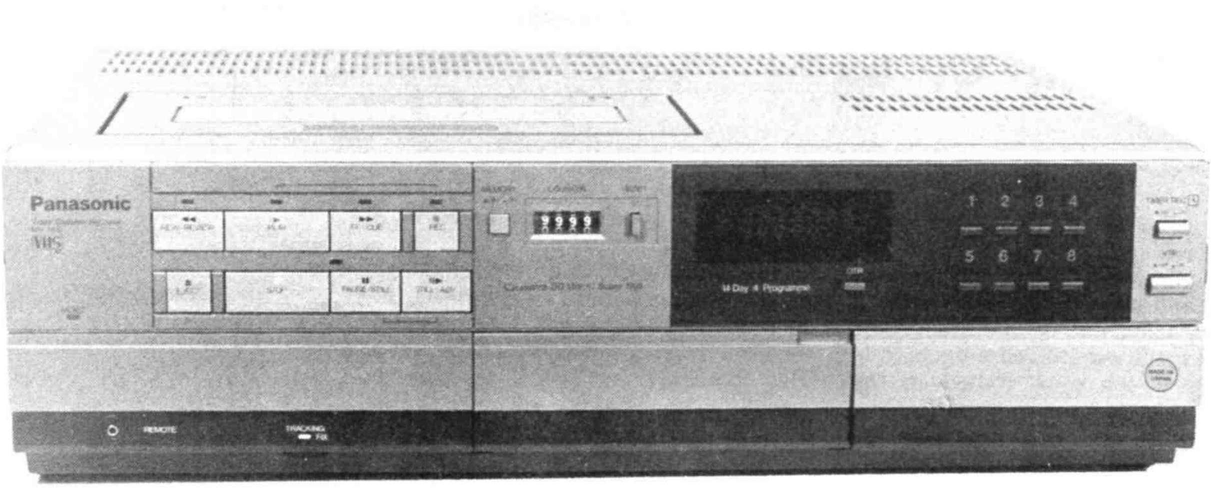
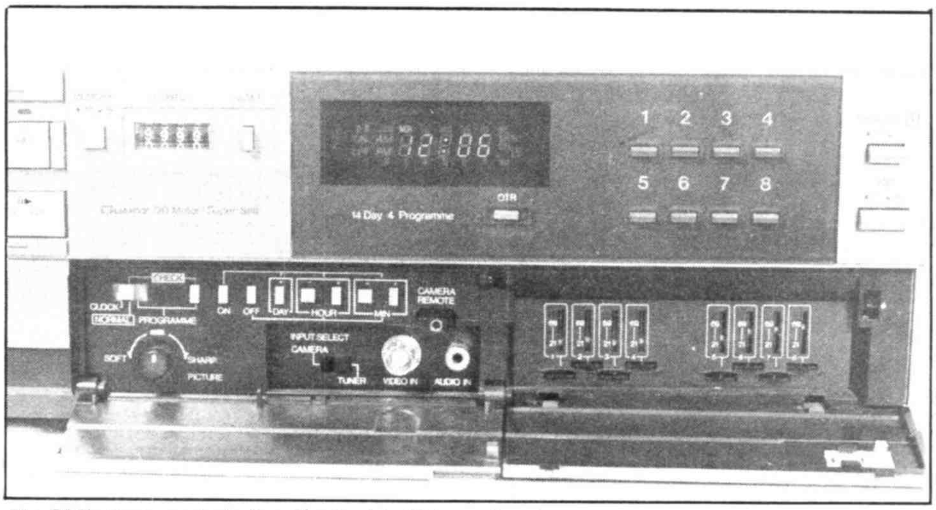


PANASONIC NV 366

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.



The 366's timer controls, input/output facilities and tuning presets are hidden behind two front panel flaps.

The 366 is an attractive machine to look at and one of the things that is evident at first glance is that the tape motion controls are sensibly sized rather than the small indifferent buttons that were a major criticism of the 7800.

Not unsurprisingly, many of the 366's controls are reminiscent of its bigger brother, but in a slightly stripped down form.

The recorder provides eight preset stations, tuned in by a series of thumbwheel presets concealed behind a hinged panel directly below the channel selectors. The clock display is, as with 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 already referred to, the power/standby/timer controls and the control for Panasonic's OTR (One Touch Recording) system — we'll take a closer look at the operation of this a little later.

The Ins And Outs

The only visible input/output socket is the 3.5mm jack that the (wired) remote control unit plugs into but a second hinged flap conceals audio and video inputs as well as the timer setting controls.

Audio and video outputs are located on the rear panel — this suits the audio 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.

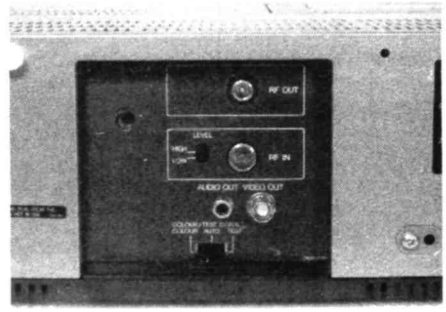
Entering the stop and start times follows the same procedure as that described for the 7800 last month. The system is easy to use and timer settings can be confirmed at the press of a button.

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.



The rear panel houses the RF in and out sockets as well as line level audio and video outputs.

Final points

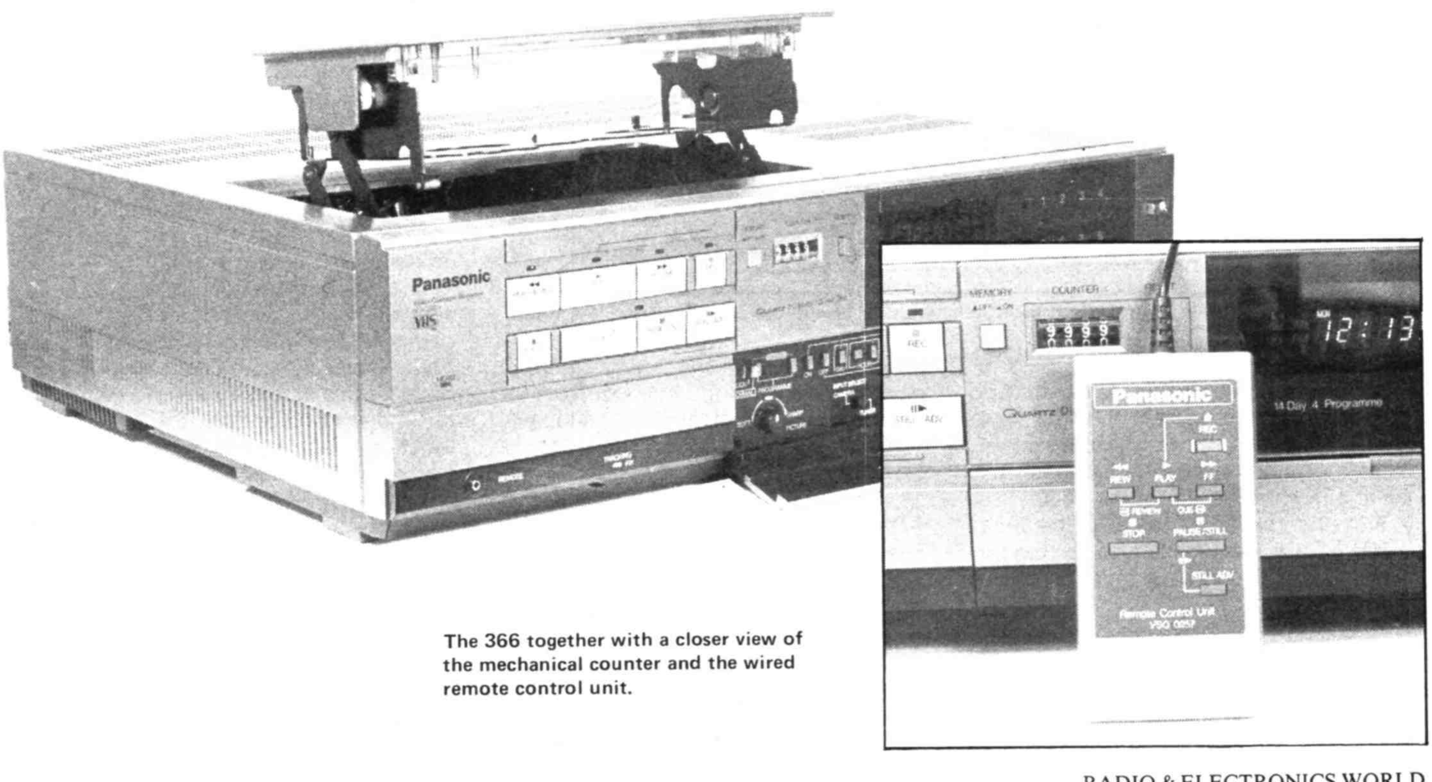
The quality of the playback from the 366 was good — there are very few machines on the market that fall down in this respect, the choice between various models being on the facilities that they offer. In terms of facilities, the Panasonic 366 does rather well for a budget machine.

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.

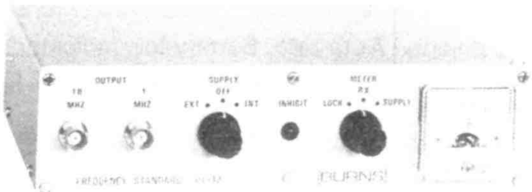
All in all the 366 is a good machine at a low price.

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*10*
Average	*11*
Poor	*12*

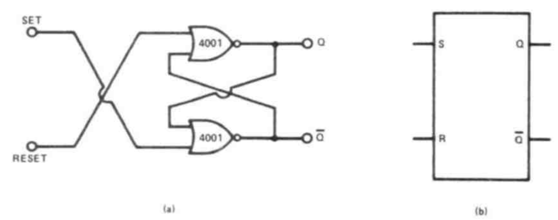


The 366 together with a closer view of the mechanical counter and the wired remote control unit.



Data File No. 15

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.



(a)

(b)

S	R	Q	$\overline{Q}$
0	0	STAYS THE SAME	
0	1	0	1
1	0	1	0
1	1	DISALLOWED	

(c)

Figure 1: Circuit (a), symbol (b) and truth-table (c) of a NOR-type SET-RESET (S-R) flip-flop.

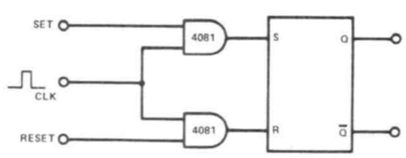
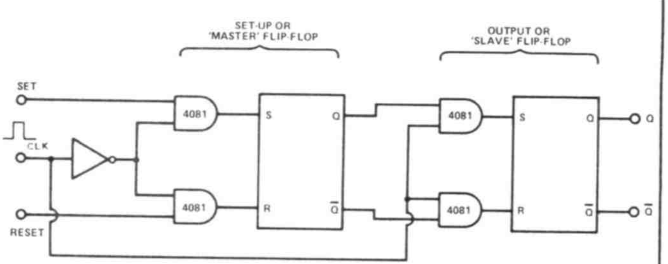


Figure 2: Clocked S-R flip-flop.



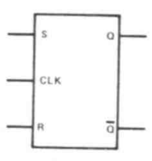


Figure 3: Clocked master-slave flip-flop circuit and symbol.

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 $\overline{Q}$ 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 $\overline{Q}$ 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 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- ▶

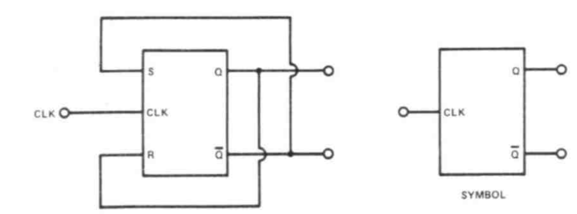
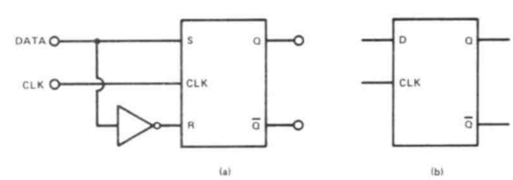


Figure 4: A 'Toggle' or type-T flip-flop is a Fig. 3 type configured as shown.



D	CLK	Q	$\bar{Q}$
0	_|¯	0	1
1	_|¯	1	0

(c)

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

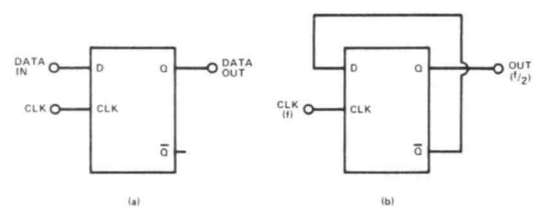
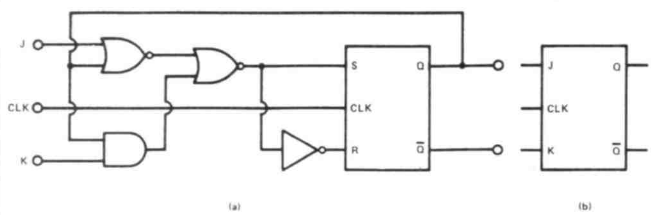


Figure 6: A D-type flip-flop can be used as a data latch (a) or as a divide-by-two (binary counter/divider) circuit.



J	K	CLOCKING ACTION
0	0	DOES NOTHING (INHIBITS)
0	1	SETS Q OUTPUT LOW
1	0	SETS Q OUTPUT HIGH
1	1	CHANGES OUTPUT STATE

(c)

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

flop are disabled, so this data is not passed to the output terminals. When the CLK input terminal goes to the high state, the inputs to the 'master' flip-flop are disabled via the inverter, which thus outputs only the 'remembered' input data, and simultaneously the input to the 'slave' flip-flop is enabled, and the 'remembered' data is latched and passed to the output terminals.

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 $\bar{Q}$ (and RESET and Q) 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 $\bar{Q}$ terminals are coupled together.

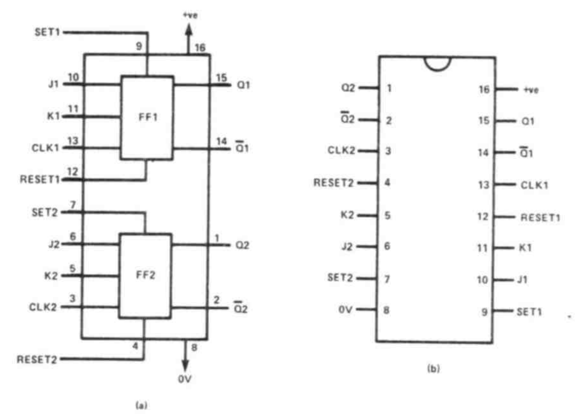
Figure 7 shows the basic circuit, symbol and 'action table' of an even more important and versatile clocked flip-flop, which is universally known as the JK-type. This flip-flop can be 'programmed' to act as either a data latch, a counter/divider, or as a do-nothing element by suitably connecting the J and K terminals, as indicated in the table. In essence, the JK flip-flop acts like a T-type when both J and K terminals are high, or as a D-type when the J and K terminals are at different logic levels. When both J and K terminals are low, the flip-flop states remain unchanged on the arrival of a clock pulse.

4013 and 4027 Dual Flip-Flops

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-O, 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



CLOCKED INPUTS

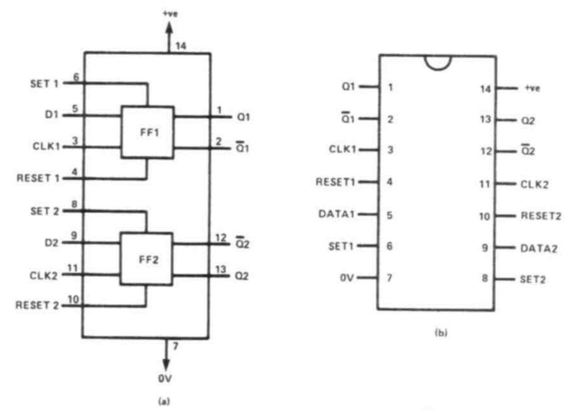
K	J	CLK	Q	$\overline{Q}$
0	0	↑	NO CHANGE	
0	1	↑	1	0
1	0	↑	0	1
1	1	↑	CHANGES	

DIRECT INPUTS

R	S	Q	$\overline{Q}$
0	0	CLOCKED OPERATION	
0	1	1	0
1	0	0	1
1	1	DISALLOWED	

(c)

Figure 8: Functional diagram (a), outline (b) and truth-tables (c) of the 4013 dual D-type flip-flop.



CLOCKED INPUTS

D	CLK	Q	$\overline{Q}$
0	↑	0	1
1	↑	1	0
$\overline{Q}$	↑	CHANGES	

DIRECT INPUTS

R	S	Q	$\overline{Q}$
0	0	CLOCKED OPERATION	
0	1	1	0
1	0	0	1
1	1	DISALLOWED	

(c)

Figure 9: Functional diagram (a), outline (b) and truth-tables (c) of the 4027 dual JK flip-flop.

and fall times of less than 5 uS. 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-O, to accept clocked operation. In the case of the 4013, the $\overline{Q}$ 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 $\overline{Q}$ 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 ($\div 2^4$), five stages give 32 ($\div 2^5$), six give 64 ($\div 2^6$), 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').

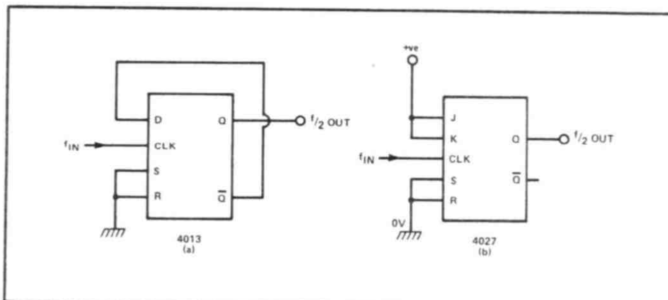


Figure 10: Divide-by-two counters made from (a) type-D and (b) JK flip-flop stages.

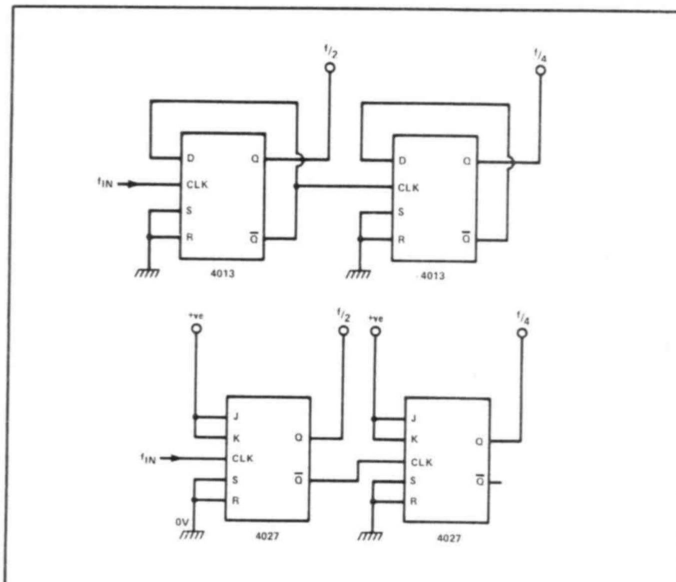


Figure 11: D and JK versions of divide-by-four ripple counters.

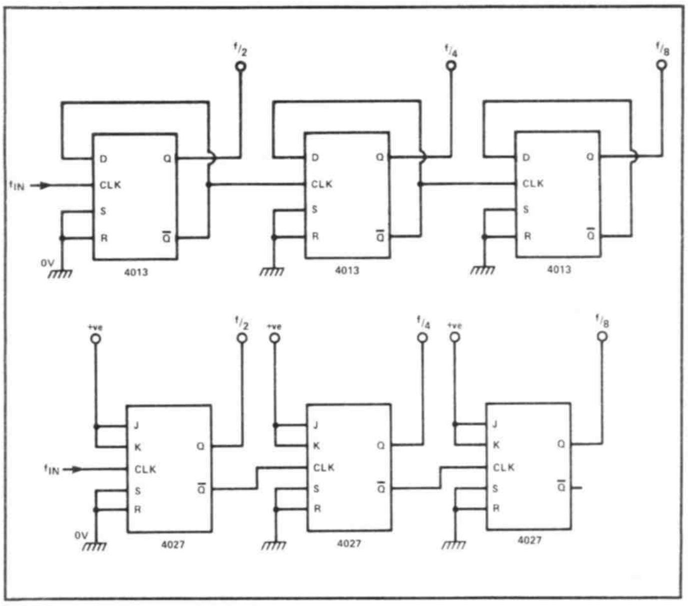


Figure 12: D and JK versions of divide-by-eight ripple counters.

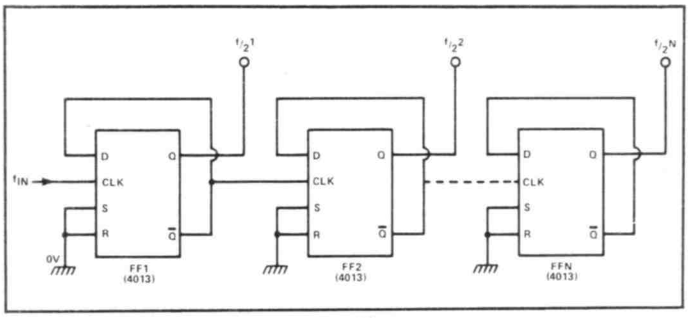


Figure 13: D version of divide-by-2^N ripple counter.

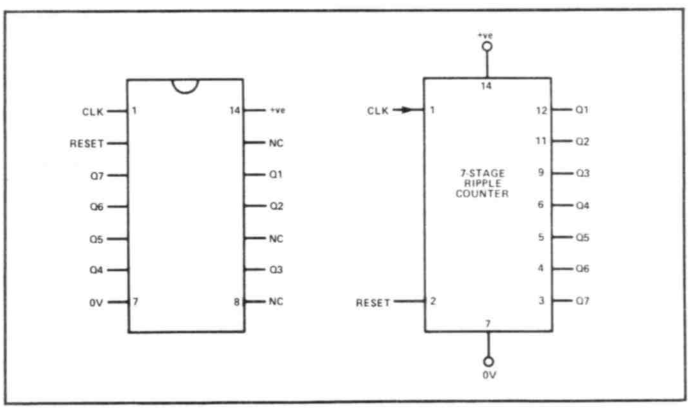


Figure 14: Outline and functional diagram of the 4024 7-stage ripple counter.

Long Ripple Counters

4013 and 4027 counters can be cascaded to give any desired number of ripple stages. Where more than four stages are needed, however, it is usually economic to use a special-purpose MSI ripple-carry binary counter/divider IC. *Figures 14* to *17* show the outlines and functional diagrams of four popular IC's of this type.

The 4024 (*Fig. 14*) is a 7-stage ripply unit with all seven outputs externally accessible; it gives a maximum division ratio of 128. The 4040 (*Fig. 15*) is a 12-stage unit with all outputs accessible; it gives a maximum division ratio of 4096. The 4024 (*Fig. 16*) is a 14-stage unit with all outputs except 2 and 3 externally accessible; it gives a maximum division ratio of 16 384.

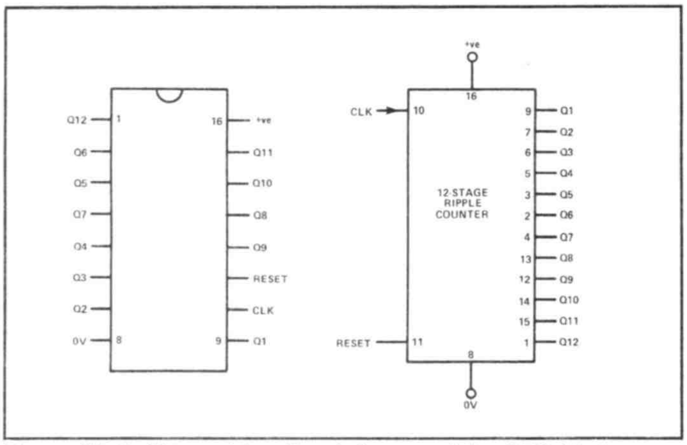


Figure 15: Outline and functional diagram of the 4040 12-stage ripple counter.

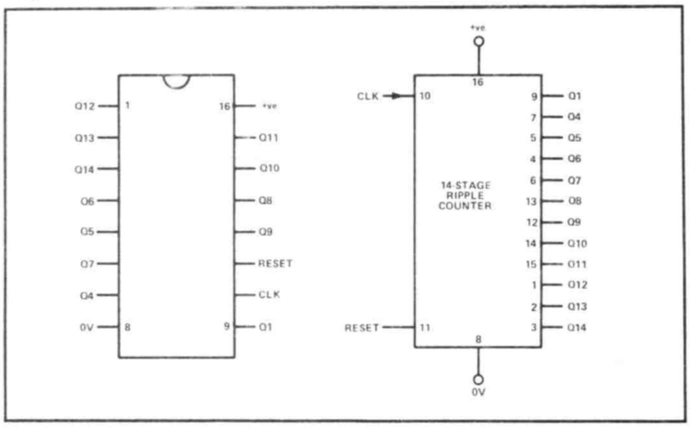


Figure 16: Outline and functional diagram of the 4020 14-stage ripple counter.

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 'O' – reference of each clock cycle, the $\bar{Q}2$ and $\bar{Q}1$ 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, $\bar{Q}2$ and $\bar{Q}1$ 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 'O' 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.

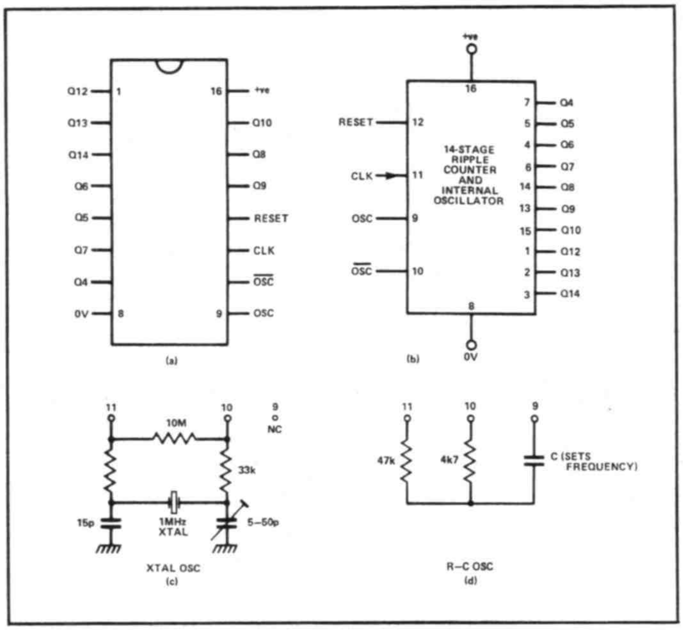
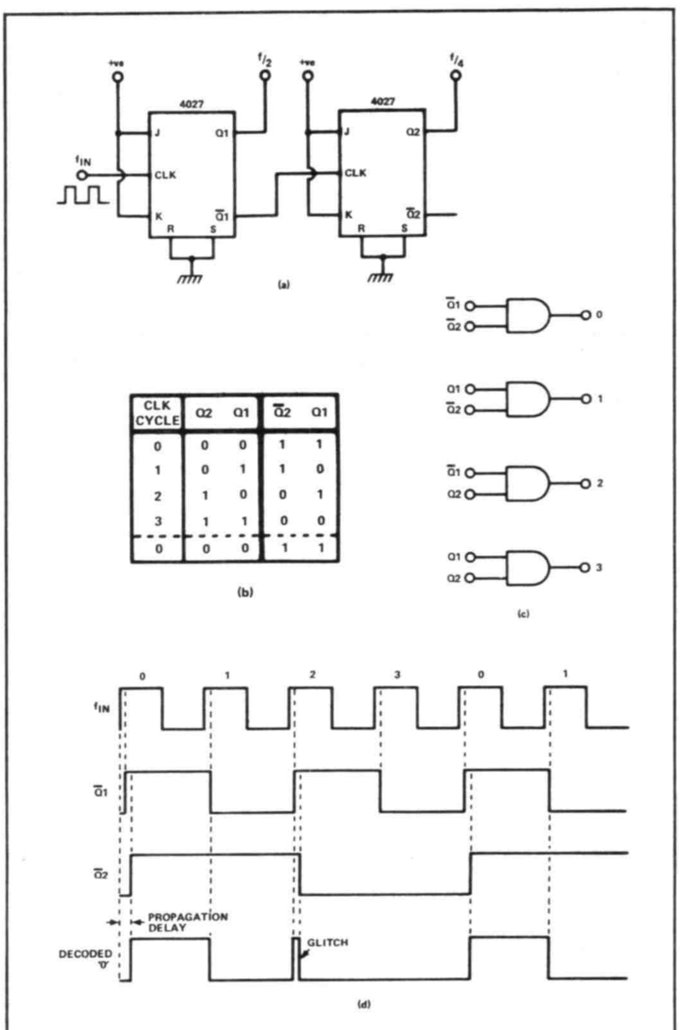
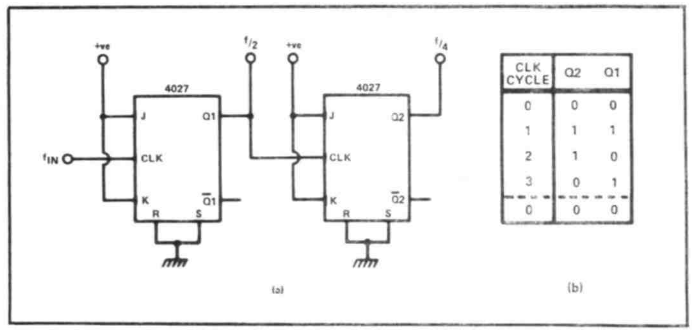


Figure 17: Outline (a), functional diagram (b) and alternative oscillator connections (c and d) of the 4060 14-stage ripple counter.



CLK CYCLE	Q2	Q1	$\overline{Q2}$	$\overline{Q1}$
0	0	0	1	1
1	0	1	1	0
2	1	0	0	1
3	1	1	0	0
0	0	0	1	1

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).



CLK CYCLE	Q2	Q1
0	0	0
1	1	1
2	1	0
3	0	1
0	0	0

Figure 19: Circuit (a) and truth-table (b) of a 2-stage (divide-by-four) ripple 'down' counter.

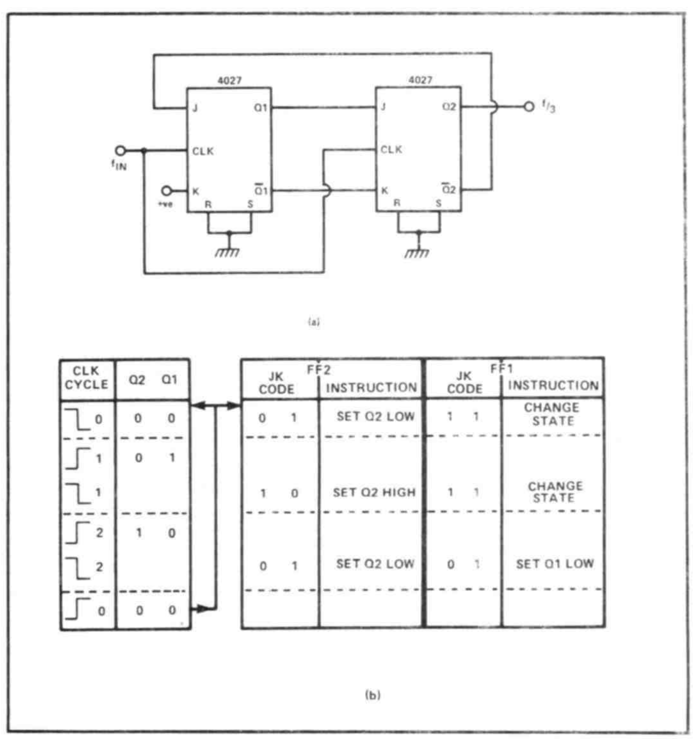
Up and Down Counters

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 $\overline{Q}$ 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, by simply cloc:.ing 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.

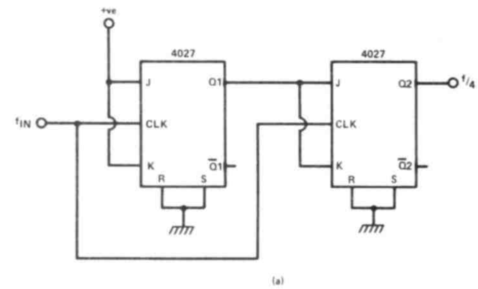
Walking-Ring (Johnson) Counters

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,



CLK CYCLE	Q2	Q1	FF2 JK CODE	FF2 INSTRUCTION	FF1 JK CODE	FF1 INSTRUCTION
0	0	0	0 1	SET Q2 LOW	1 1	CHANGE STATE
1	0	1				
1			1 0	SET Q2 HIGH	1 1	CHANGE STATE
2	1	0				
2			0 1	SET Q2 LOW	0 1	SET Q1 LOW
0	0	0				

Figure 20: Circuit (a) and truth-tables of a synchronous divide-by-three counter.



(a)

CLK CYCLE	Q1	Q2
0	0	0
1	0	1
2	1	0
3	1	1

(b)

Figure 21: Circuit (a) and truth-table of synchronous divide-by- four counter.

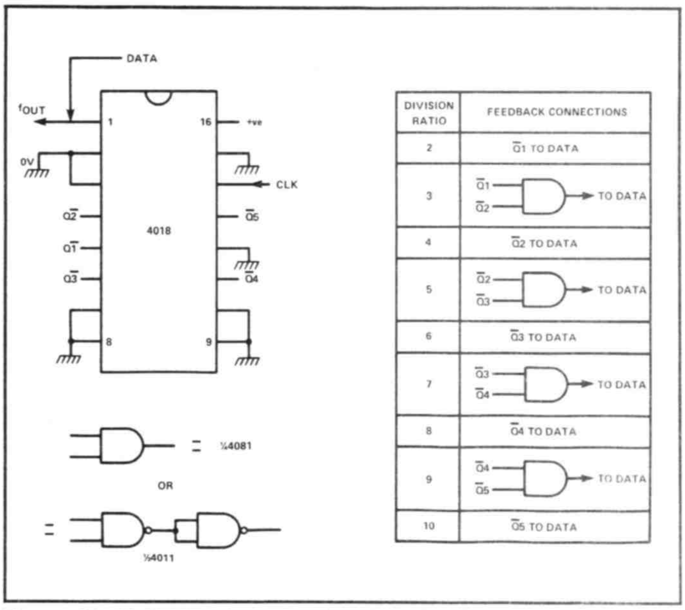
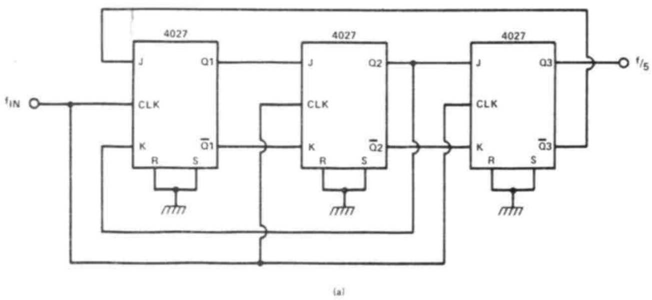


Figure 24: Methods of connecting the 4018 for divide-by-2 to divide-by-10 operation.



(a)

CLK CYCLE	Q3	Q2	Q1
0	0	0	0
1	0	0	1
2	0	1	1
3	1	1	0
4	1	0	0

(b)

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

which enables them to act as either SET or RESET latches, as binary dividers, or as 'do nothing' devices. In walking-ring counters, all flip-flops are clocked in parallel, and thus operate in synchrony with the input clock signal, and are known as 'synchronous' counters. They give glitch-free decoded outputs.

Figure 20 shows the circuit and truth tables of a synchronous divide-by-three counter. Note that the truth table shows the action state of each flip-flop at each stage of the counting cycle, and remember that when the clock is low the action instruction is loaded (via the JK terminals) into the flip-flop, and the instruction is then carried out as the clock signal transitions high. Thus, at the start of the cycle (CLK low), when Q2 and Q1 are both low, the instruction 'change state' (11) is loaded into FF1, and the instruction 'set Q2 low' (01) is loaded into FF1. On the arrival of the first clock pulse, this instruction is carried out, and Q1 goes high and Q2 stays low.

When the clock goes low again, new program information is fed to the flip-flops. FF1 is instructed 'change state' (11), and FF2 is instructed 'set Q2 high' (10), and these instructions are implemented on the positive transition of the second clock pulse, causing Q2 to go high and Q1 to go low. When the clock goes low again, new program information is again fed to the flip-flops from the outputs of their partners. F̄F1 is instructed 'set Q1 low' (01) and FF2 is instructed 'set Q̄2 low' (01), and these instructions are implemented on the positive transition of

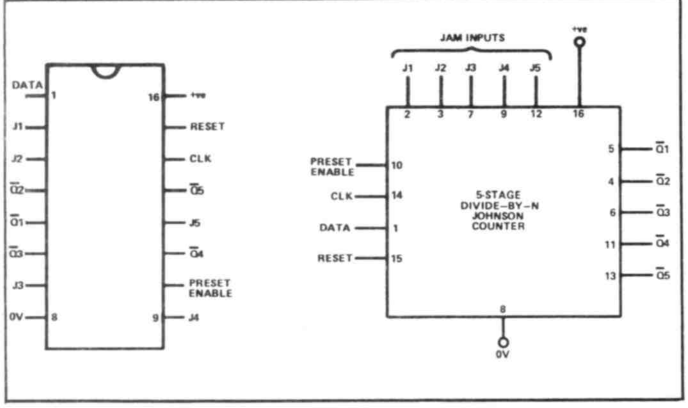


Figure 23: Outline and functional diagram of the 4018 presettable divide-by-N counter.

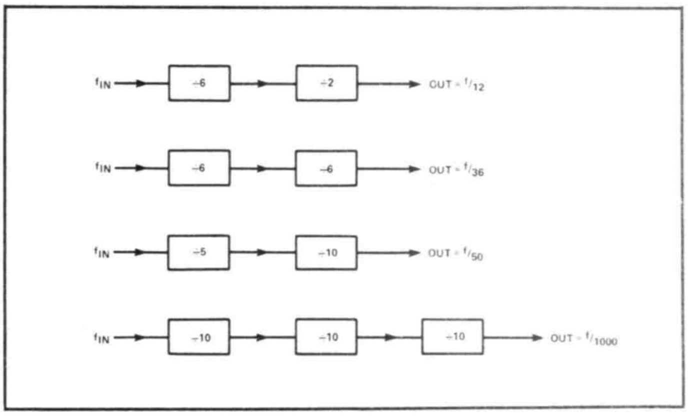


Figure 25: Typical examples of division by numbers greater than ten.

the next clock pulse, causing $\bar{Q}1$ and $\bar{Q}2$ to go back to their original "O' 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 than 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.

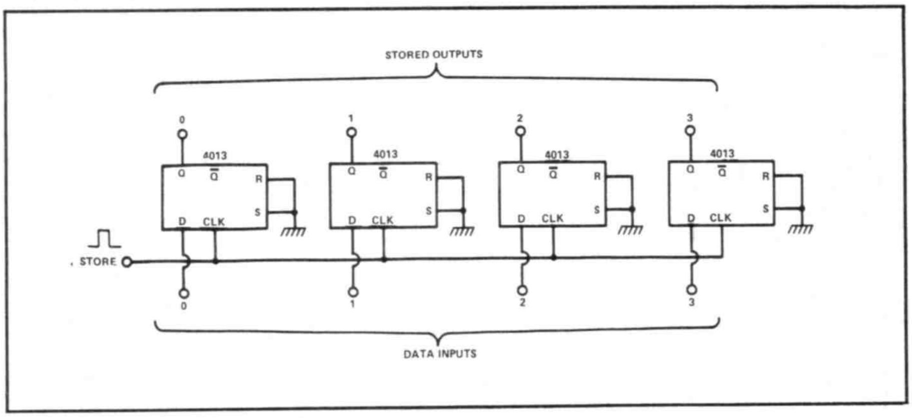


Figure 26: 4-bit Data latch.

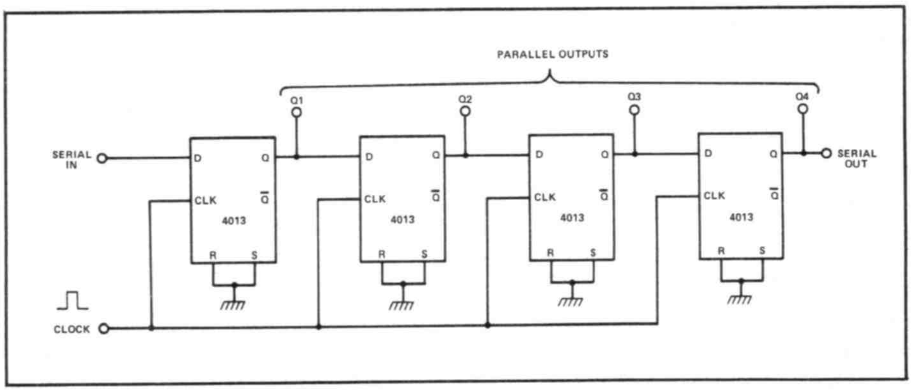


Figure 27: 4-bit Serial-In-/Serial-Out (SISO) shift register.

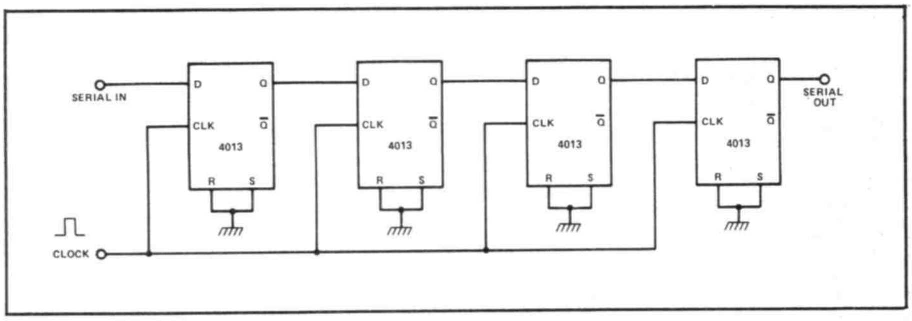


Figure 28: 4-bit Serial-In/Parallel-Out (SIPO) shift register.

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.

■ R&EW

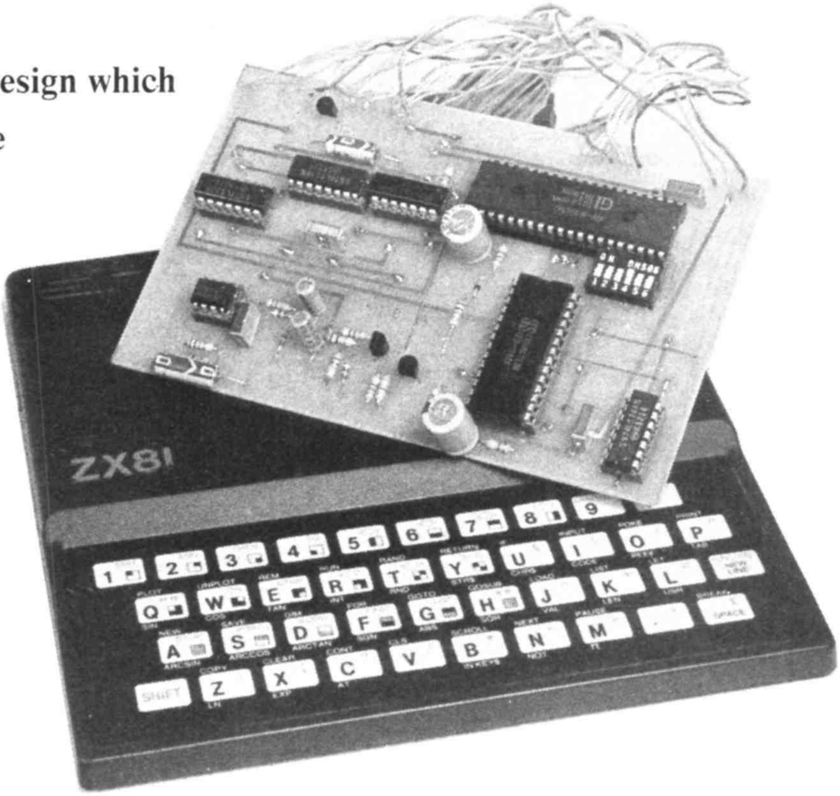
YOUR REACTIONS

	Good	Average	Poor
Circle No.	88	89	90

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 the board is freed by removing a further two screws. The memory already fitted will be one of two kinds; a 4118, 1k × 8 bits designated IC4, or two 2114's, 1k × 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.

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.

Software Coding

The machine code listing is shown in *table 2* (in hexidecimal), 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).

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 Z80A 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.

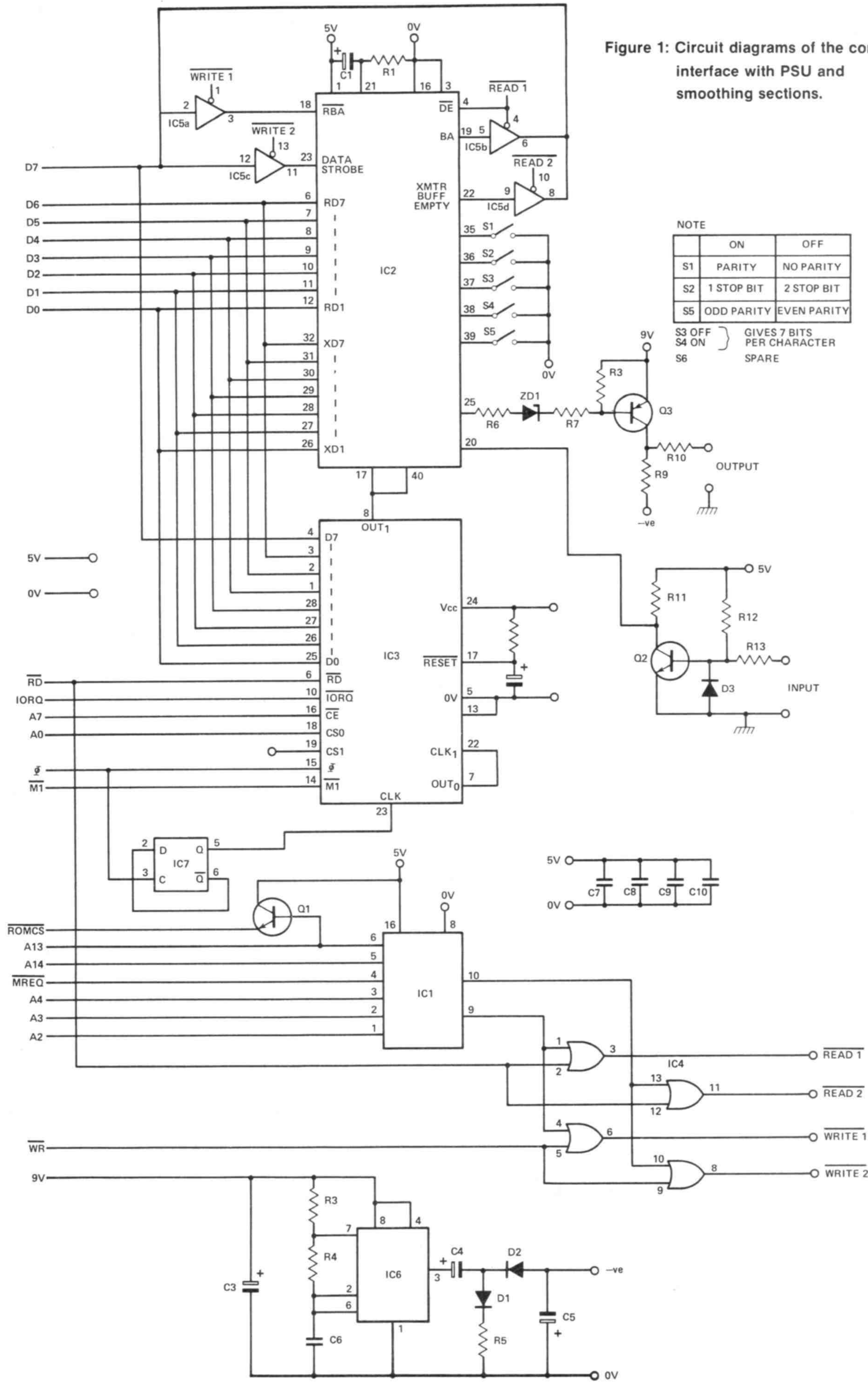


Figure 1: Circuit diagrams of the complete interface with PSU and smoothing sections.

NOTE

	ON	OFF
S1	PARITY	NO PARITY
S2	1 STOP BIT	2 STOP BIT
S5	ODD PARITY	EVEN PARITY

S3 OFF, S4 ON } GIVES 7 BITS PER CHARACTER

S6 SPARE

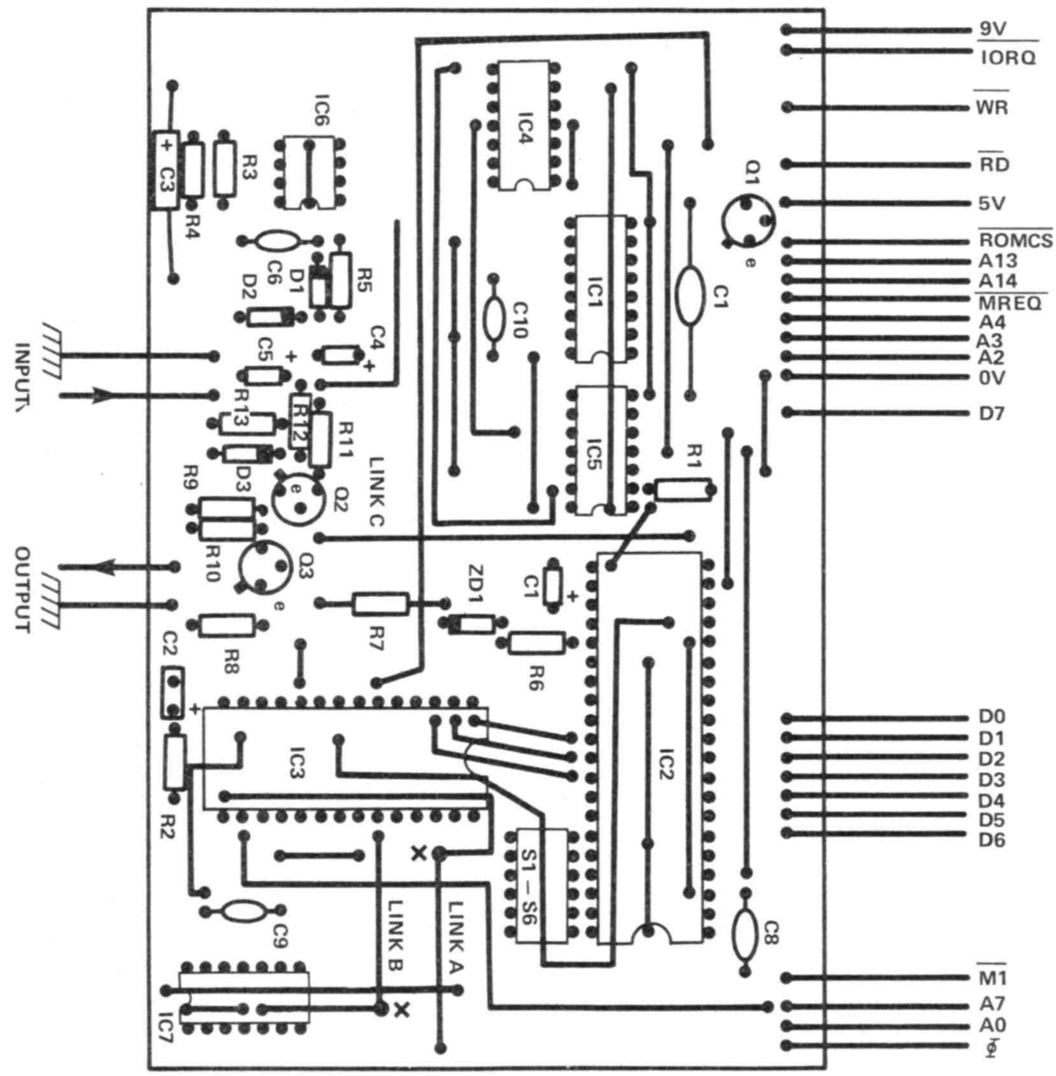
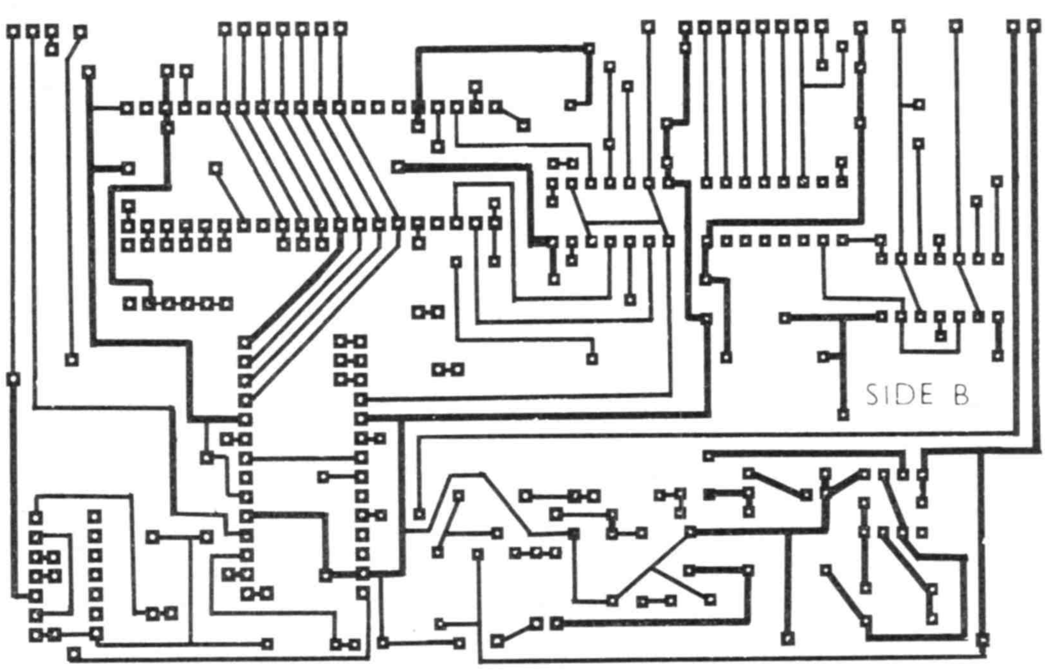


Figure 2: Component placing for the single PCB.

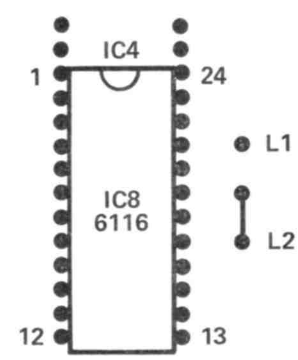
Underside		Component side
*ROMCS	–	RFSH
* A 4	–	M1 *
A 5	–	RESET
A 6	–	BUSPQ
* A 7	–	WAIT
A 8	–	BUSAK
A 9	–	WR *
A10	–	RD *
ROA11	–	10RQ *
A12	–	MREQ *
* A13	–	HALT
* A14	–	NMI
A15	–	INT
* A 3	–	D4 *
* A 2	–	D3 *
A 1	–	D5 *
* A 0	–	D6 *
* 0	–	D2 *
0V	–	D1 *
* 0V	–	D0 *
		KEY WAY
* 9V	–	RAMCS
* 5V	–	D7 *

Table 1: Link descriptions for the ZX81 connector.



PCB foil pattern for the interface board.

FITTING THE SOCKET



LINK L1 REMOVED IF FITTED
NEW LINK L2 FITTED

Figure 3: Placing the 24 pin socket and associated link wiring.

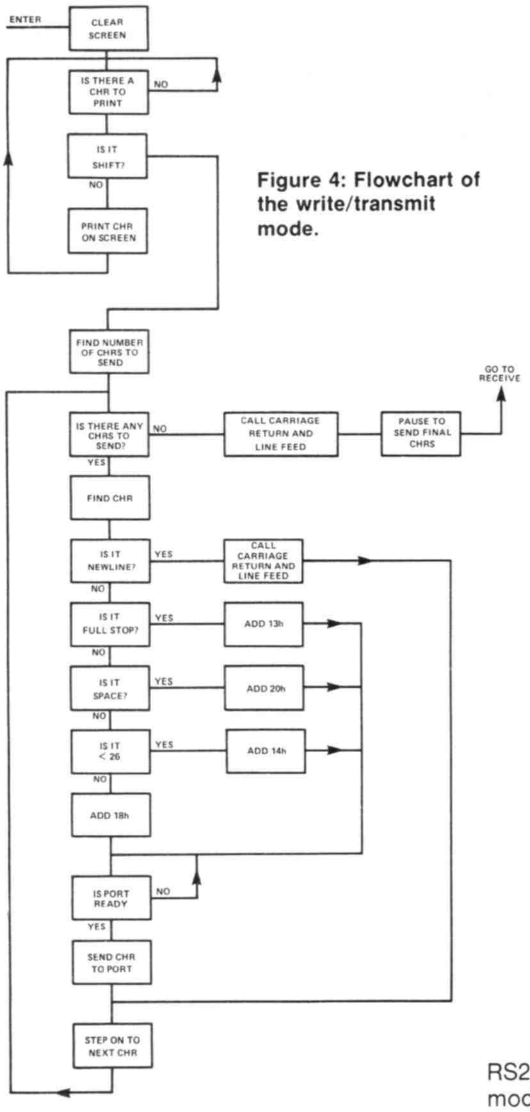


Figure 4: Flowchart of the write/transmit mode.

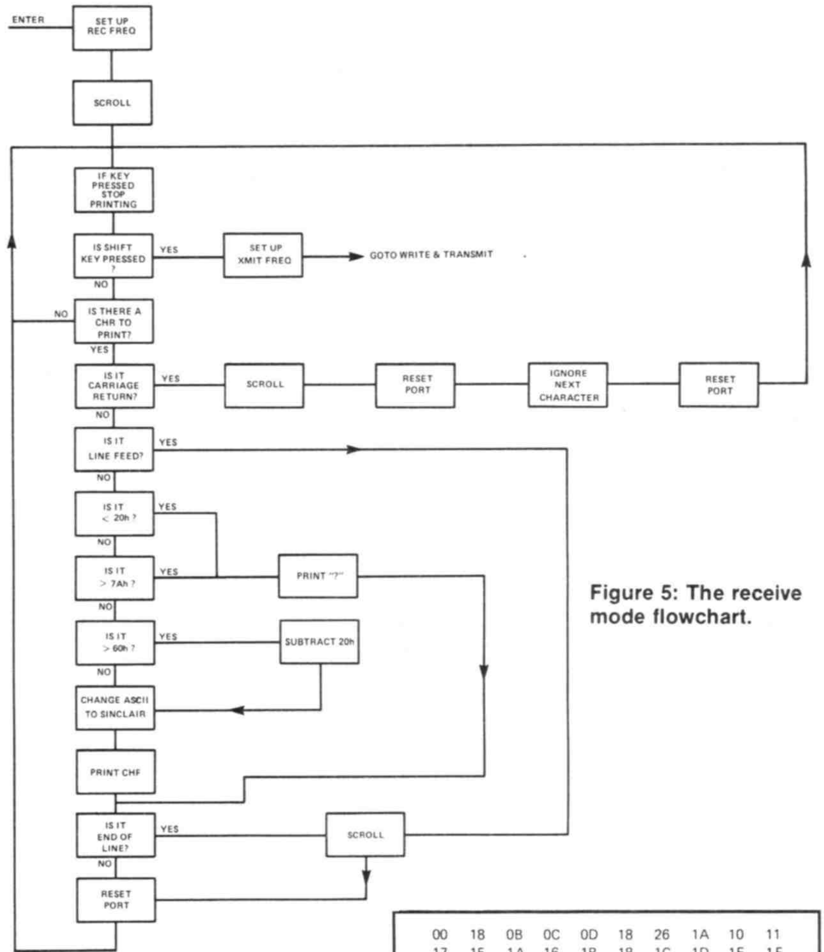


Figure 5: The receive mode flowchart.

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

00	18	0B	0C	0D	18	26	1A	10	11
17	15	1A	16	1B	18	1C	1D	1E	1F
20	21	22	23	24	25	0E	19	13	14
12	0F	26	26	27	28	29	2A	2B	2C
2D	2E	2F	30	31	32	33	34	35	36
37	38	39	3A	3B	3C	3D	3E	3F	10
18	11	0F	13	16	CD	0E	0C	CD	BB
02	2C	20	FA	CB	44	28	5A	21	18
20	5E	CB	7B	28	EE	CB	BB	3E	0D
BB	20	10	D9	CD	0E	0C	D9	73	5E
CB	7B	28	FB	CB	BB	73	18	D7	3E
0A	BB	28	2D	3E	1F	93	38	05	3E
0F	D7	18	16	3E	7A	93	38	F6	3E
60	93	30	04	7B	D6	20	5F	21	62
40	16	00	19	7E	D7	3A	39	40	D6
01	28	06	21	18	20	73	18	A5	D9
CD	0E	0C	D9	18	F3	00	00	C3	DE
41	CD	BB	02	24	20	FA	CD	2A	0A
CD	BB	02	44	4D	54	14	28	F7	CB
44	28	15	CD	BD	07	7E	D7	CD	BB
02	24	20	FA	16	15	1B	7A	FE	00
20	FA	18	DE	CD	BB	02	24	20	FA
2A	10	40	ED	4B	0C	40	C6	00	ED
42	7D	D6	19	6F	03	7C	FE	00	20
0A	7D	FE	00	20	05	CD	B9	41	18
72	0A	FE	76	20	06	CD	B9	41	03
18	1A	FE	1B	20	04	C6	13	18	12
FE	00	20	04	C6	20	18	0A	FE	26
30	04	C6	14	18	02	C6	1B	FD	77
7B	11	14	20	1A	CB	7F	28	FB	FD
7E	7B	12	2B	03	18	B9	00	00	00
00	11	14	20	1A	CB	7F	28	FB	3E
0D	12	1A	CB	7F	28	FB	3E	0A	12
C9	3E	45	D3	02	D3	03	3E	03	D3
02	3E	71	D3	03	C3	C3	40	3E	45
D3	02	D3	03	3E	03	D3	02	3E	71
D3	03	C3	2D	41	16	05	1B	7A	FE
00	20	FA	18	D4					

```
10   LET X = 16514
20   INPUT A$
30   IF A$ = "  " THEN GOTO 20
40   POKE X, 16 * CODE A$ + CODE A$ (2) – 476
50   LET X = X + 1
60   LET A$ = A$ (3 TO )
70   GOTO 30
```

N.B. DO NOT TYPE THE SPACES BETWEEN PAIRS OF DIGITS E.G. "00180BOC......"

Table 2: Software listing and load table.

BAUD RATE	HART CLOCK	1625000 HART CLOCK	A AND B VALUES	
75	1200	1354	11	123
110	1760	923	13	71
150	2400	677	6	113
300	4800	339	3	113
1200	19200	85	85	1
1800	28800	56	56	1
2400	38340	42	42	1

Table 3: Common transmission speeds and their corresponding 'A' and 'B' values.

PARTS LIST

Resistors

R1,2	3k9
R3,7	1k
R4	10k
R5	47R
R6,8,9,11	4k7
R10	330R
R12	100k
R13	15k

Capacitors

C1,2	33u 6V3
C3	100u 25V
C4,5	15u 16V
C6,8,9,10	100n
C7	1u 63V

Semiconductors

D1,2,3	1N4148
ZD1	BC239
Q1,2	BC307
Q3	2N2907
IC1	74LS138
IC2	AY-3-1015
IC3	Z80A CTC
IC4	74LS32
IC5	74LS125
IC6	555
IC7	74LS74

Miscellaneous

ZX81 connector, PCB, 6 way DIL switch, DIL sockets: 40 pin,28 pin,16 pin,14 pin (3 off), 8 pin.

Note. A 6116 RAM and 24 pin DIL socket are required for expansion of the ZX81.

running, to get back into BASIC by going into transmit mode and typing 23 'NEWLINE' characters to the screen.

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 POKEd 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. ■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*52*
Average	*53*
Poor	*54*

NEWS BACKGROUND

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 acedemic detatchment 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.

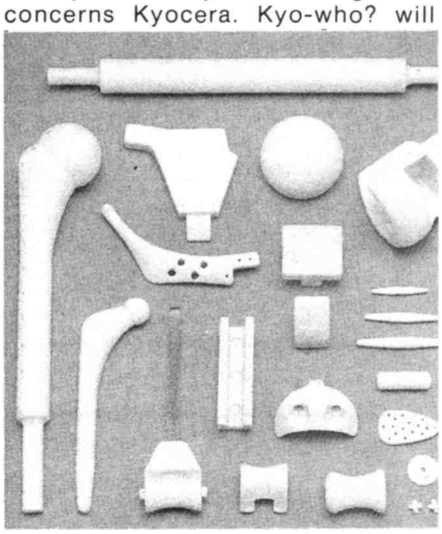
The language barrier has inevitably meant that much of the Japanese industry has kept itself to itself, waiting until its "act" is well and truly together before pouncing on an unsuspecting market.

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



Some of Kyo more esoteric offerings — in fact a range of products for orthopedics.

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 subheading, 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 Sharp 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 uncompetetive 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 i02fori01 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.

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*61*
Average	*62*
Poor	*63*

COMPUTING NEWS

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 particulary 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.

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.

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.

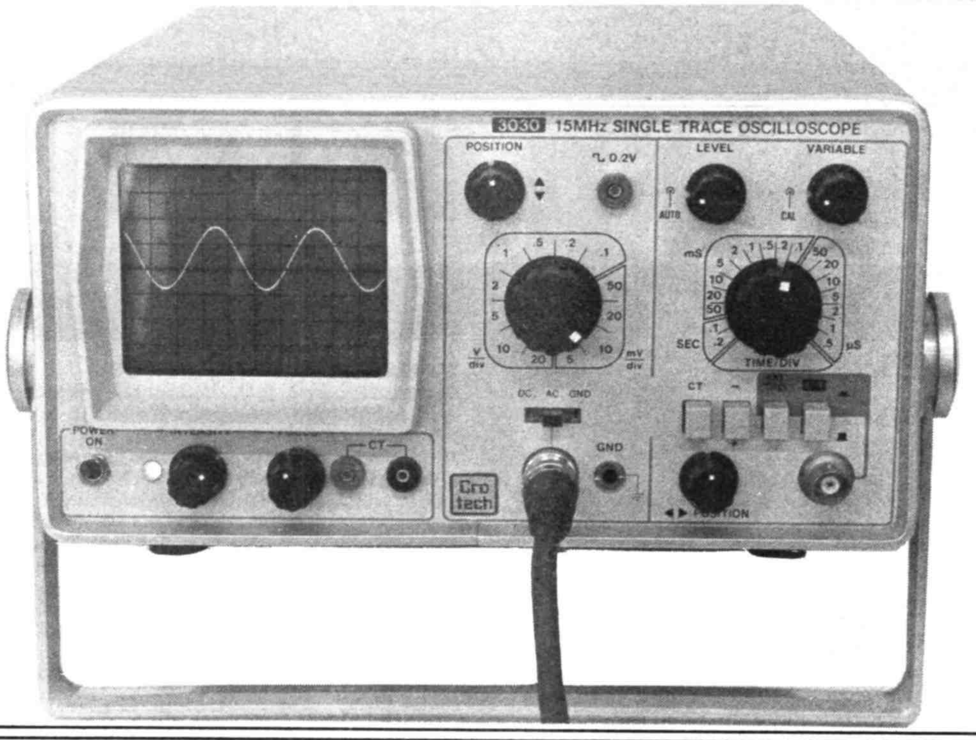
The machine code section of this books features advice on using the Spectrum's ROM together with an assembler and disassembler and a machine code monitor.

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.

Isle Communications' 20-inch RGB monitor

YOUR REACTIONS	Circle No.
Good	7
Average	8
Poor	9



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.

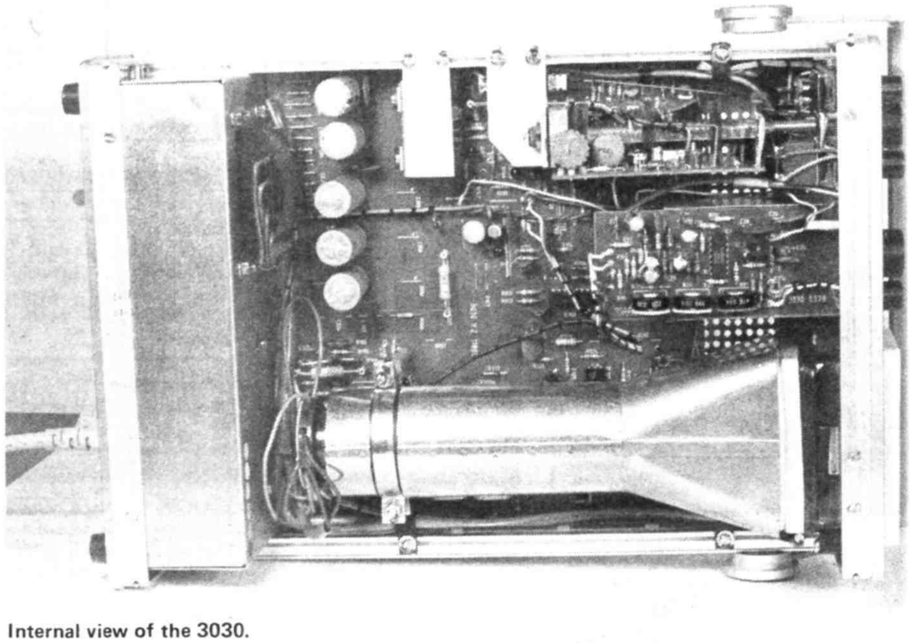
The 3½" CRT provides an adequate display area, in contrast to some of the mini 'scopes that are about today. The maximum sensitivity of the 3030 is 5mV/div with a 12 step, 1,2,5 sequence attenuator taking this up to 20V/div. The 'scopes input impedance is a fairly standard 1M in parallel with 35p with 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.



Internal view of the 3030.

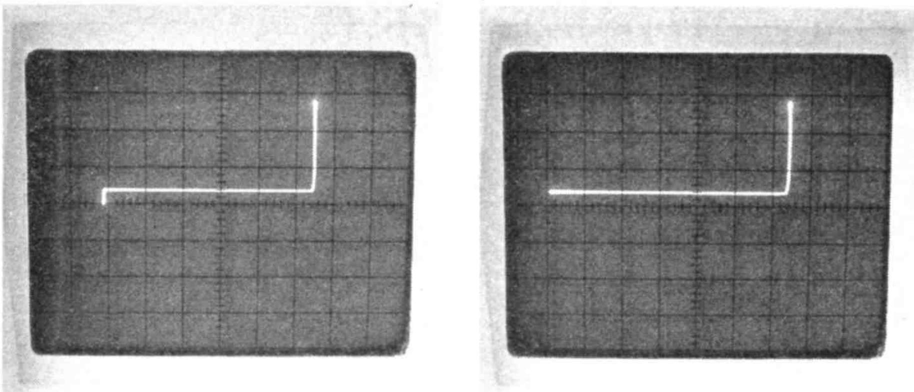


Figure 1: The displays resulting when using the component tester facility with Zener (left) and signal (right) diodes.

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/nogo 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.

■ R&EW

YOUR REACTIONS	*Circle No.*
Good	*55*
Average	*56*
Poor	*57*

VIDEO NEWS EXTRA

Peter Luke with a brief look at Sony's new C9 recorder.

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.

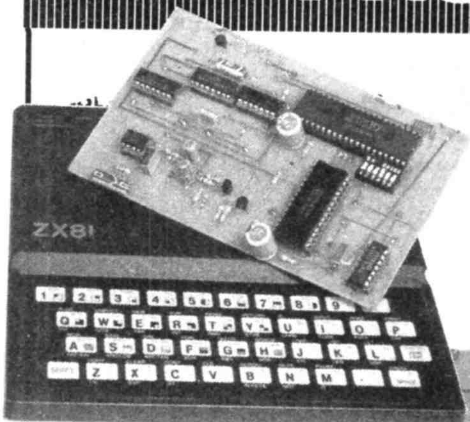
The built-in amplifiers provide a 5 watt output and a "space-sound' feature enables mono broadcasts to be processed to give a pseudo stereo effect.

Colour, Stereo, 3D — what next? ■ R&EW

YOUR REACTIONS

	Good	Average	Poor
Circle No.	94	95	96

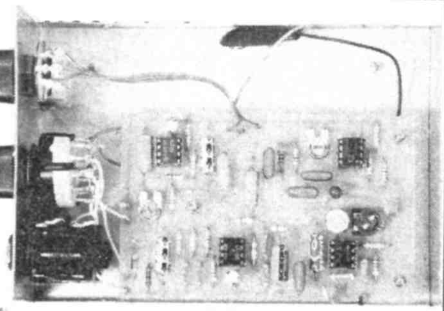
PROJECT PACKS

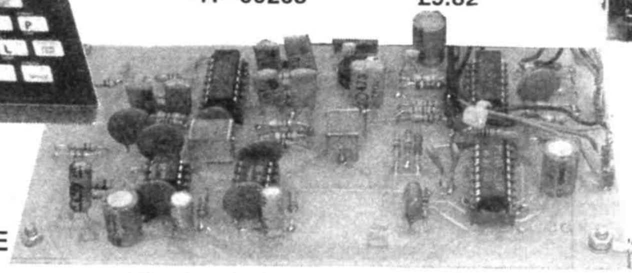


CW FILTER

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**





MODEM

Acoustically coupled Modem with RS232 interfacing. A full kit is available in 2 sections;
Electronics Kit – Including all resistors, capacitors, transistors, diodes, ICs, sockets and PCBs.
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**

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**

All prices include VAT @ 15% Please allow 21 days for delivery. Postage & Packing 60p per order.

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

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	CW Filter	41–20205	£2.76
	Audio Signal Generator	41–20206	£1.66
	ZX81/RS232 Interface	41–20207	£7.96
JANUARY	SSB Controller Board	41–20101	£2.48
	CMOS Morse Keyer	41–20102	£3.72
	Z8 MCS	41–20103	£9.98
	Tracking PSU (Undrilled)	41–20105	£1.89
DECEMBER	Wide Band Amp	44–14700	£2.79
	SSB CW Generator	44–10704	£1.86
	PPM – Mono	44–10240	£1.86
	PPM – Stereo Add–On	44–10241	£1.86
	TX10 Video Interface	44–00012	£3.10
NOVEMBER	2M Converter–MKII	44–14401	£4.14
	20Hz – 150MHz DFM	44–17702	£2.90
	TX9 Video Interface	44–00009	£3.95
	CTV1400 Video Interface	44–01400	£2.21
	TDA4420/1	44–94420	£1.10
OCTOBER	70cm PA	44–27000	£4.02
	SSB Mixer	44–10702	£2.89
	SSB Buffer	44–10703	£0.98
	2m GaAs FET PreAmp	44–47000	£4.14
	Train Controller	44–04930	£4.96
	U264 (Undrilled)	44–00264	£0.46
	MF10 (Undrilled)	44–00010	£0.69
	DNR	44–12345	£3.31

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NOTES FROM THE PAST

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 enliven 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 lightning 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 marvelling 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 surburban 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.

Reception Reports

Compiled by Keith Hamer and Garry Smith.

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 smearing 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 a 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 1 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.

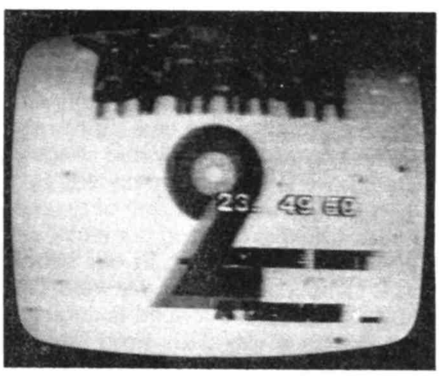
Since the signals may be weak and of short duration it is essential that the gain of the receiver is as high as possible. It is also very important that the signal will lock-in instantly thus stable timebases are necessary; there may not be sufficient time to adjust the line-hold!

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

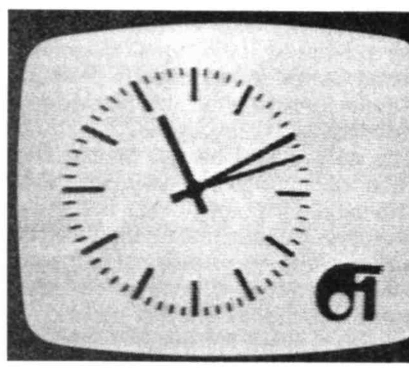
Is anyone interested in helping to produce a monthly DX-TV bulletin? Cyril Willis (Little Downham, Cambs) has plans for one which will include logs, news, photographs, features, interviews, free ads for sale and wanted equipment, etc. For further information he may be contacted on 0353-87755.

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 15½p 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:F 1,Belgium.

sample copy which we have is very impressive giving details of the technical aspects of the hobby such as intercarrier sound and the various ways of extracting DX-TV sound. There is also an experimental DX signal alarm circuit which is ideally suited for those of us requiring early-morning viewing! Further information may be obtained by sending an SAE to Dave at 18, Burnside Close, Barnet, Herts EN5 5LN.

We hope that there will be sufficient support to enable the above newsletters to thrive and to allow this rather specialised hobby to be promoted even further before the intruders (namely CB amateur radio, PMR, etc.) take over the DX-TV bands. Readers with only a limited interest in DX-TV who may be receiving neighbouring IBA regions are also invited to subscribe. Who knows, it may be Central and Anglia now, but Hungarian TV tomorrow.

Service Information

Luxembourg: RTL is to commence a 2nd network this year from a new transmitter located at Marnach in the northern part of the country. Its effective radiated power is not known at present.

Portugal: Since October of last year (ie, 1982), the first network of Radio Televisao Portuguesa (RTP) has radiated programmes from 0800 local time.

Monaco: Tele-Monte-Carlo (French-language network) is expected to start a teletext service in the near future.

Sweden: It is anticipated that a third television network will be introduced later this year.

The above information has been kindly supplied by our Rotterdam DX-TV correspondent, Gosta van der Linden.

Reception Reports

Hugh Cocks (Robertsbridge, East Sussex) has advised us that Radio-Tele-Luxembourg on channel E7 is now using transmission system B (5.5MHz intercarrier sound, negative-going vision modulation and 625 lines scanning) with PAL colour. Prior to the transmitting mast collapsing, RTL used system C (AM sound and positive-going vision modulation) with PAL colour on E7. We understand that the E21 outlet still transmits using SECAM on the French system L standard whilst the E27 outlet uses PAL colour on the G/H standard (a variant of system B). This is all very confusing but at least Luxembourg now has only two basic standards to contend with instead of three.

The French 819-line system is being phased out. The first network (TF1) Band III transmitter at Lille on channel F8a, which used to put a good signal into southern and central England, has now been switched off. All three French networks are now available at UHF. Bands I and III are to be re-engineered to provide a fourth network operating on the 625-line standard.

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 news 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 Corportion was received on no fewer than seven days during October via F2/SpE propagation. The multi-burst test pattern of the Ghana Broadcasting Corportion was noted on the 9th and 10th on channel E2. The transmitter is situated at Kissi 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 Bucuresti 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 the news programme "TELEJURNAL" at 1900. A subtitled programme from the same transmitter was seen on the 9th. Reception of TVR R2 is fairly rare throughout the main SpE season, let alone three times in October, since the signal is usually double-hop.

Spain and Portugal are two other countries which feature many times in Clive's log on channels E2, E3 and E4. During a Sporadic-E opening on the 1st, a Portuguese FM radio station was heard on 87.9MHz which is quite an achievement so late in the year. Clive has now purchased a multi-standard colour portable, the JVCCX610 GB, which many television DX-ers speak enthusiastically about. His first SECAM signals appeared during an SpE opening from the east on the 26th with Russian programmes on R1 and R2. At the end of the month during the excellent trops, SECAM colour was resolved on the RS-KH test card from CST-Czechoslovakia on channel R31. According to the EBU station list, the nearest R31 outlet is at Liberec which radiates CST-2 with 600kW ERP! Its location is close to the East German/Polish border. In the same letter he indicates that Ray Davies (Happisburgh, Norfolk) saw a programme on E4 from the south during an SpE opening on the 24th. Band I had been active with the usual Spanish signals but this particular programme had an Arabic sound channel suggesting that it was the recently opened Moroccan E4 outlet at Laayoune in the sourthern part of the country.

Cyril Willis (Little Downham) noted his first F2-layer signal this season on channel E3 on the 8th at 1530BST. The signal was very weak and smeary (a characteristic of F2 reception) and originated from the south-east. On October 10th, reception from the south included ZTV-Zimbabwe on E2 at 1505 with a re-appearance at 1800. Also on E2 at 1530 signals arrived from GBC-Ghana. The low-power Madrid transmitter (E4 with 2kW ERP) was seen using the colour test card on the 15th with other RTVE signals lasting for most of the day on channels E2 and E3.

Finally this month, Graham Angel (Sheffield) advises that he is the proud owner of a Sanyo 9300 VCR which enables him to record off-air Band I/III DX signals by means of its multi-band tuner. This has provided food for thought since the VCR can be used as an up-converter allowing DX signals to be viewed on a standard television receiver using the VCR channel.

METEOR SHOWER	PEAK PERIOD
* Quadrantids	Jan 3rd - Jan 4th
Lyrids	April 19th - April 22nd
* Aquarids	May 1st - May 9th
* Perseids	July 27th - August 17th
Orionids	October 15th - October 25th
Taurids	October 26th - November 16th
Leonids	November 15th - November 17th
* Geminids	December 9th - December 13th

* Denotes the largest showers of meteors.

Table 1: Annual Meteor Showers.

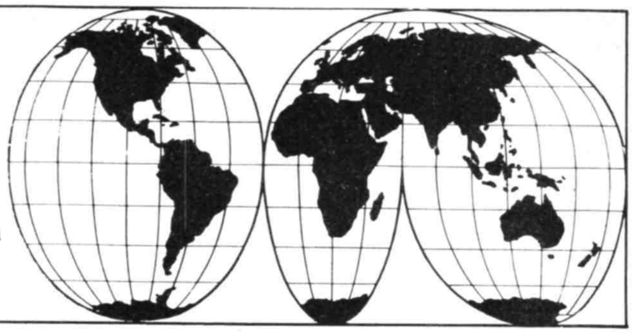
The dates given in *Table 1* are for any year but 1983 is a very special year as the planetary system falls into line. This phenomenon occurs only once every 180 years. From January 2nd, the "peak" dates may be two days earlier than shown. Just for the record (as the event should have taken place by 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.

■ R&EW

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 next possibility being at, 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 change 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 diect frm the Hon. Sec., E. Evans, Lothians Radio Society, 4 Burdiehouse Street, Edinburgh. EH17 8EY.

Media Network Publication

The Media Network programme broadcast by Radio Nederland Wereldomroep in Hilversum and chaired by Jonathan Marks is aimed primarily at the short wave listener and Dxer.

Media Network publishes a number of booklets/leaflets which are designed to interest the short wave enthusiast, such publications being listed in the *Listener Services Catalogue*. The publications listed in this catalogue are free, gratis and for nothing - including the Catalogue itself. Simply address your request to Jonathan Marks, Producer Media network, English Section, Radio Nederlands Wereldomroep, P.O. Box 222, 1200 JG Hilversum. Holland. Mention **R&EW**.

The 6th Edition of the *Media Network Booklist* is also now available free to applicants, this 20 page publication listing the sources of information that are now available to the SWL and Dxer alike.

The booklet is divided into 6 sections as follows - Listening Guides (broadcasts in English listed); Books and Pamphlets for the SWL (those currently available for the enthusiast); Tape

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, and that 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 OK2BWM, OK3CZM, OL1BEI and OL4BDQ. From the Netherlands PAOUU put in an appearance whilst Lithuania was represented by UP2BCG. The only other signal of note was that of YU3DH 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. CX5A0 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 ZS6BIM 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 CQ and getting just silence for his trouble, probably because his signal was just audible, LU1SE in Argentina working the States with VK3BW and ZL3GQ in Australia and New Zealand respectively, having a go at the G's. The one weirdy 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 JA2NVY, 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 1830 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

SORRY, NORMAN, MALAYA, CHINA AND PERU ARE CLEAR AS A BELL, BUT 'THE ARCHERS' ON RADIO FOURS UNOBTAINABLE...

broadcasts in various languages are composed of news items only.

Albania

Tirana on **9500** at 1931, YL with the local news during the English programme for Africa, scheduled on this channel from 1930 to 2000.

Romania

Bucharest on **9510** at 1935, YL with news and a review of internal affairs in the English transmission to Europe from 1930 to 2030.

Bulgaria

Sofia on **15110** at 1937, OM with world news and comment from their point of view in the English programme, timed from 1930 to 2000.

Italy

Rome on **11800** at 1939, yet another newscast 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.

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 1830 to 1920 on this channel.

All these programmes in the English language should provide the SWL, and particularly the beginner, with something positive to listen for, to log and to report if one requries the QSL cards.

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 newscast in Arabic at 0630.

Nigeria

Kaduna on **4770** at 0425, YL with songs in Hausa, local music in a Channel 2 programme, on this frequency from 0400 through to 2400. 50kW is the power.

Benin

Cotonou on **4870** at 0430, OM with a song complete with a soft chimes backing - sounded like a lullaby to me. Cotonou is on the air from 0400 (Saturday from 0550) to 0800 and from 1300 (Saturday from 1100) to 2400. Sunday from 0600 to 2300. The power is 30kW and this is the Home Service in French and Vernaculars.

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 transmission for 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.

Xinjiang PBS, Urumqi on **4735** at 0117, YL with songs in Uigher, OM with announcements in the Uigher Home Service which is on this channel from 2230 to 0200 and from 1045 to 1730. It also relays the Beijing (Peking) Foreign Service Russian programme from 1800 to 2100 - promptly jammed by an overlay of Moscow 2!

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 frm 1500 to 1800. The frequency can vary from **5006** to **5012**, so be warned.

PBC Islamabad on **5060** at 0150, Yl with songs in the Regional Service which has a rather complicated seasonal schedule on this channel. If you want to log it, listen at 0130 December to March when it opens or at the closing from November to February at 1800. The power is 100kW.

French Guyana

FR3 (France Region 3) Cayenne on **3385** at 0240, YL and OM with a duet in French, OM with announcements in the same language at 0245. This one operates with a power of 4kW from 0900 to 1200 and from 2100 to 0100 (Saturday until 0400 variable closing).

Bolivia

Radio Movima, Santa Ana de Yacuma on a measured **4473.1** at 0223, YL with a pop song in Spanish, OM with a ballad in Spanish, heard on peaks amid utility QRM. The power is just 0.25kW and the schedule is from 1100 to 0400.

Peru

Radio Tingo Maria, Tingo maria on **4760** at 0412, OM with a song in Spanish, station identification being at 0416. Sign-off was at 0503 after ON with a further identification, announcements and an orchestral version of the National Anthem. The schedule is from 1100 to 0500 and the power is 1kW.

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 until 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 Jambi 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.

RRI Palembang on a measured **4856** at 1600, just caught the guitar melody when signing off. Most Indonesians sign off at this time although there are those that can be heard up to 1730.

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

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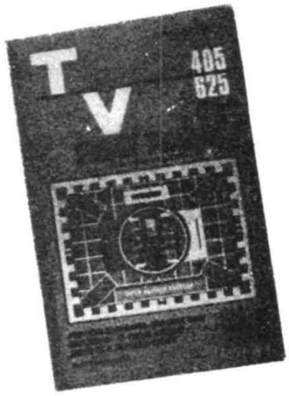

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Gary Evans with . . .

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 micro-second 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.

THE LAST WORD.

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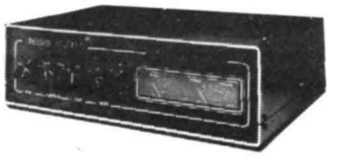

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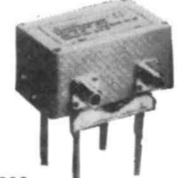

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A practical, user-orientated treatment of active filters. This book explains what active filters are, and how they work, and gives detailed information on design analysis and synthesis techniques. It explores some interesting applications for active filters in brainwave research, electronic music, quadrature art, and psychedelic lighting.

ACTIVE FILTER DESIGN
By Carson Chen
1982; 134pp; 150 × 225mm; Paperback; Hayden; ISBN 0-8104-0959-3.
Stock No: 02-09593 Price £9.00
Well, what can you say about this perennially favourite subject? Well, the bad news is that most active thinkers and enthusiasts will not be able to put this book down, without adding it to their collection of active filter reference works.

AMATEUR ANTENNA TESTS AND MEASUREMENTS
By H D Hooton
1977; 192pp; 135 × 215mm; Paperback; Sams; ISBN 0-672-21466-0.
Stock No: 02-21466 Price £7.95
This book provides the radio amateur with a practical understanding of the design measurement and adjustment of antenna systems. The majority of circuitry detailed is value based.

ANDROID DESIGN
By M B Weinstein
1981; 248pp; 145 × 225mm; Paperback; Hayden; ISBN 0-8104-5192-1.
Stock No: 02-51921 Price £10.35
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 mechanics and mechanisms. The book offers intriguingly sophisticated designs and the opportunity to see them realized.

BASIC ELECTRICITY/ELECTRONICS TROUBLESHOOTING COURSE
By D R Tomal
1979; 128pp; 215 × 280mm; Paperback; Sams; ISBN 0-672-21590-X.
Stock No: 02-21590 Price £7.95
A fundamental course in troubleshooting electrical and electronic devices. Discusses basic methods, test equipment, and hands-on practical applications.

BEGINNERS HANDBOOK OF AMATEUR RADIO
By C Laster
1979; 384pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21569-1.
Stock No: 02-02156 Price £10.20
Designed for either the classroom or individual study, this handbook takes the beginner in amateur radio through the licence preparation and study phase, and into the operation of a novice amateur radio station.

BEGINNERS HANDBOOK OF IC PROJECTS
By D L Heiserman
1981; 216pp; 175 x 235mm; Paperback; Prentice; ISBN 0-13-074286-4.
Stock No: 02-07428 Price £10.85
Caught up in the rush of new and wonderful developments in electronics, writers and publishers often lose sight of the unending parade of beginners who are struggling to master the fundamentals of building, troubleshooting, and testing electronic projects. This is a book especially written for those beginners who have the feeling that they are being left behind and overwhelmed with complex and sophisticated circuitry.

BROADBAND FEEDBACK AMPLIFIERS
By D J H Maclean
1982; 296pp; 155 x 230mm; Hardcover; Wiley; ISBN 0-471-10214-8.
Stock No: 02-02148 Price £15.25
It is particularly fitting that the opening text by the author of this book should combine theoretical rigour with practicality. Starting from the foundations laid by Black and Nyquist, new light is shed on the concepts of loop gain leading to a distinctly useful method for assessment of total feedback in a multiloop system. This exploits modern computer and measurement techniques to full advantage providing broadband representations of transistor amplifiers which are likely to find wide application.

BUILDING AND INSTALLING ELECTRONIC INTRUSION ALARMS
By J E Cunningham
New Ed 1977; 128pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21954-9.
Stock No: 02-21465 Price £8.70
Countermeasures to offset crime are suggested in this book written for the novice who wants to install a security system in his home and the technician who wishes to enter the lucrative field of security electronics. Countermeasures outlined include electromechanical intrusion alarms, sensors and switches, closed-circuit television, proximity alarms, power supplies, telephone attachments, and alarms for the protection of automobiles.

CB RADIO CONSTRUCTION PROJECTS
By L Buckwalter
1976; 126pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-20952-7.
Stock No: 02-20952 Price £3.45
These projects include add-on accessories, operating aids, test instruments to monitor the output of your equipment, the devices are simple and also inexpensive. No prior knowledge of electronics is required to complete these projects, and a minimum of tools is necessary.

CHARGE-COUPLED DEVICES AND SYSTEMS
By M J Howes & D V Morgan
1979; 312pp; 160 x 235mm; Hardcover; Wiley; ISBN 0-471-99665-3.
Stock No: 02-96653 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.
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
By D Lancaster
1977; 416pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21398-2.
Stock No: 02-21398 Price £10.20
Tells all you need to know to understand and profitably use this inexpensive and genuinely fun-to-work with digital logic family.

COLOR TV TRAINING MANUAL
By Howard Sams Editorial Staff
1977; 232pp; 215 x 280mm; Paperback; Sams; ISBN 0-672-21532-2.
Stock No: 02-21412 Price £11.70
One of the most comprehensive color TV training manuals on the market. First, you are familiarized, with the makeup of a color TV signal. Then, receiver circuitry, including all late improvements, is analysed step by step. The book finishes with complete troubleshooting techniques.

COMPLETE GUIDE TO CAR AUDIO
By M Clifford
1981; 232pp; 135 x 215mm; Paperback; Sams; ISBN 0-6722-21820-8.
Stock No: 02-18208 Price £7.95
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.

COMPLETE GUIDE TO READING SCHEMATIC DIAGRAMS
By J Douglas-Young
1980; 303pp; 155 x 215mm; Paperback; Prentice; ISBN 0-13-160416-3.
Stock No: 02-04244 Price £11.70
This popular book is now in its second edition. With the rapid and far reaching developments in solid-state and integrated circuits the opportunity has been taken to include many important new circuits to add to the standard ones which are so essential.

DESIGNING AND CREATING PRINTED CIRCUITS
By W Sikonowiz
1981; 164pp; 150 x 230mm; Paperback; Hayden (W); ISBN 0-8104-0964-X.
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-assisted techniques, multilayer fabrication, and different chemical processes for developing and etching printed circuit boards.
Topics are introduced and discussed in a step-by-step approach, beginning with general design principles and materials, and continuing through image transfer, electroplating, etching, machining operations, and finally assembly and testing.

DESIGN OF ACTIVE FILTERS
By H M Berlin
1977; 240pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21539-X.
Stock No: 02-21539 Price £8.70
An introduction to the implementation and design of active filter circuits that use the popular 741 op-amp chip. The emphasis is on the use of active filters and their design, without complex mathematics. Twenty-six detailed experiments and many practical examples.

DESIGN OF OP-AMP CIRCUITS, with experiments
By H M Berlin
1977; 244pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21531-3.
Stock No: 02-21537 Price £8.70
A complete introduction to almost every op-amp application. 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
1978; 256pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21545-3.
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
1980; 176pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21686-8.
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 whet your appetite, 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: 02-08316 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 of burst modems; an introduction to integrated coding and modulation techniques; a complete survey of TDMA satellite systems with emphasis on synchronization problems; an introduction to packet satellite networks; ARQ 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 telecommuniation 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; 168pp; 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 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; 206pp; 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; 495pp; 150 X 225mm; Paperback; Wiley; ISBN 0-471-08751-3.
Stock No: 02-87513 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 BEGINER
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 £6.45
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
1981; 264pp; 155 × 235mm; Hardcover; Wiley; ISBN 0-471-27969-2.
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 emphasis, are given at the end of most chapters and measurement techniques are treated quite extensively.

HANDBOOK OF ELECTRONIC TABLES FORMULAS
By Howard Sams Engineering Staff
5th Ed 1979; 288pp; 155 × 255mm; Hardcover; Sams; ISBN 0-672-21532-2.
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
1977; 288pp; 155 × 215mm; Paperback; Sams; ISBN 0-672-21416-4.
Stock No: 02-21416 Price £8.70
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 auxilliary output, a touch switch, a programmable monostable circuit, and hundreds of others.

INTRODUCTION TO OPTICAL WAVEGUIDES
by M J Adams (Degree level)
1981; 400pp; 175 × 255mm; Hardcover; Wiley; ISBN 0-471-27969-2.
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 readers 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
1981; 346pp; 155 × 235mm; Hardcover; Wiley; ISBN 0-471-27988-9.
Stock No: 02-79889 Price £18.00
This book covers engineering and design aspects of modern LSI systems. It concentrates on two basic device structures, the BJT's and FET's. It details LSI circuits, their design and testing, and the basis of LSI technology, while considering memory and design technology as well as custom design of circuits.

LINEAR INTEGRATED CIRCUITS
By S D Prensky
1981; 354pp; 160 × 235; Hardcover; Prentice; ISBN 0-8359-4084-5.
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, the engineer, and the 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.

MICROWAVE DEVICES AND CIRCUITS
By S Y Liao
1980; 530pp; 160 × 235mm; Hardcover; Prentice; ISBN 0-13-581207-0.
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.

MOS DEVICE AND CIRCUIT DESIGN
By O J McCarthy
1982; 260pp; 155 × 230mm; Hardcover; Wiley; ISBN 0-471-10026-9.
Stock No: 02-10026 Price £20.00
This book provides a very complete and easy to understand introduction to metallic 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
1981; 288pp; 180 × 240; Hardcover; Prentice; ISBN 0-13-637298-8.
Stock No: 02-63729 Price £16.95
This book is written for the electronics technician and the student engineer under the assumption that the readers have a grasp of the fundamentals of DC/AC theory and other simple electronic theory. Amongst the many circuits are various self-assessment multichoice "quizzes' for the reader to gauge his/her progress.

OPERATIONAL AMPLIFIER CHARACTERISTICS AND APPLICATIONS
By R G Irvine
1981; 462pp; 180 × 235mm; Hardcover; Prentice; ISBN 0-13-63775-1.
Stock No: 02-63775 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
1980; 316pp; 160 × 235mm; Hardcover; Wiley; ISBN 0-471-27611-1.
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.

Contents: Introduction to Optical Communications – Optical Source Devices – Photodetectors for Communication by Optical Fibres – Optical Waveguide Components – Optical Fibres and Cables – Optical Communication Systems.

OPTICAL FIBRE COMMUNICATION SYSTEMS
By C P Sandbank
1981; 348pp; 155 × 235mm; Hardcover; Wiley; ISBN 0-471-27667-7.
Stock No: 02-76677 Price £24.90
A book on optical fibre communications which discusses all the basic devices and technologies relevant to the realization of optical communication systems. It gives detailed system designs for a variety of analogue and digital systems and includes worked examples where appropriate.

OSCILLOSCOPES
By S Prentiss
1981; 161pp; 155 × 245mm; Paperback; Prentice; ISBN 0-8359-5353-X.
Stock No: 02-53548 Price £11.65
You the reader or student, will find this a very different book from the others on the market dealing with vital test equipment subjects. For only briefly are you told what an oscilloscope is, while you're shown in great detail what it does and why. The contents of this highly informative book originates from the author's direct experiences in the intensive use of such equipment, beginning with DC oscilloscopes in the early 1950's spectrum analyser, work on recent video and two way radio, beginning in 1976.

PHYSICS OF SEMICONDUCTOR DEVICES
By S M Sze
1982; 880pp; 160 x 235mm; Paperback; Wiley; ISBN 0-471-09837-X.
Stock No: 02-09837 Price £13.65
A recently updated edition of one of "solid-state physics' most durable reference works that takes the reader from basic crystallography through to microwave semiconductor techniques. The book is essentially a physicists' viewpoint (there are no circuit diagrams), although the mathematics aren't perhaps 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
1982; 216pp; 210 x 280mm; Paperback; McGraw-Hill; ISBN 0-07-040458-5.
Stock No: 02-04585 Price £10.25
Most inveterate dabblers share an interest in the way others design circuits, and sooner or later begin to build a collection of photocopied abstracts from books and periodicals.

We were fascinated to find that John Markus' collection of electronic memorabilia, from the last 10 years or so, contains a large number of the very circuits that lurk filed away (in a couple of binders) marked simply "ideas'.

The book is well indexed and collated, and actually recognizes the fact that life exists in sinusoidal form as well as between logic levels. Markus doesn't go into the theory of the circuits – but that isn't the function of this work.

It's a lot easier than trying to keep track of a wad of photocopies.

PRACTICAL ELECTRONICS
By B Woollard
1978; 184pp; 150 x 225mm; Paperback; McGraw-Hill; ISBN 0-7-084232-9.
Stock No: 02-42329 Price £5.75
This book gives an introduction to the components used in industrial electronics with regard to their recognition, ratings, associated circuitry and typical applications and is developed to include some commonly encountered integrated circuits. The text has been written with a "hands on' development program in mind, since to gain a working knowledge of industrial elements, it is considered that practical experience is essential. In support of this, the description principles have been curtailed to the minimum, and many practical exercises have been included to illustrate the principles and techniques of the components and their associated circuits.

PRACTICAL HANDBOOK OF VALVE RADIO REPAIR
By C E Miller
1982; 230pp; 195 x 255mm; Hardcover; Butterworth; ISBN 0-408-00593-9.
Stock No: 02-05939 Price £14.00
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.
2nd Ed 1981; 216pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21787-2.
Stock No: 02-21787 Price £7.95
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
22nd Ed 1982; 1200pp; 155 x 255mm; Hardcover; Sams; ISBN 0-672-21874-7.
Stock No: 02-21874 Price £26.70
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
1982; 444pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-28028-3.
Stock No: 02-80283 Price £22.50
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 mechanism in silicon and III-V systems.

SCRS AND RELATED THYRISTOR DEVICES
By C Laster
1981, 136pp; 215 x 280mm; Paperback; Sams; ISBN 0-672-21806-2.
Stock No: 02-21806 Price £10.20
The purpose of this book is to provide electronic engineers, technicians and experimenters with a practical understanding of thyristor devices. The material – fundamentals, 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; Sams; ISBN 0-672-21723-1.
Stock No: 02-21723 Price £7.95
Don Lancaster leads the unwary through the wiles 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.

STUDY NOTES FOR TECHNICIANS: ELECTRICAL AND ELECTRONIC PRINCIPLES – VOL 1
By J B Pratley
1982; 72pp; 190 x 250mm; Paperback; McGraw-Hill; ISBN 0-07-084661-8.
Stock No: 02-46618 Price £3.75
This book provides in a compact form a core of key facts, 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.

TELEGRAPH AND DATA TRANSMISSION OVER SHORTWAVE RADIO LINKS
By L Wiesner *1981; 199pp; 145 x 210mm; Paperback; Heyden (W); ISBN 0-85501-291-9.*
Stock No: 02-12919 Price £16.50
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
1981; 224pp; 210 x 280mm; Paperback; Sams; ISBN 0-672-21859-3.
Stock No: 02-18593 Price £13.20
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 maths 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 C Green
2nd Ed 1982; 148pp; 175 x 235mm; Paperback; Pitman; ISBN 0-273-01826-4.
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; Paperback; Sams; ISBN 0-672-21738-4.
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.

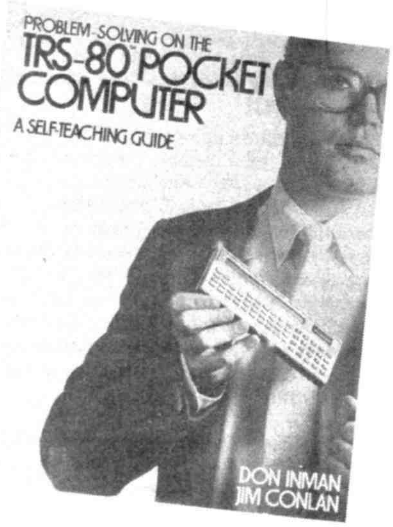
TV ANTENNAS & SIGNAL DISTRIBUTION SYSTEMS
By M J Salvati
1979; 256pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21584-5.
Stock No: 02-21584 Price £8.70
An invaluable guide to selecting and installing TV antennas and signal distribution systems. Packed with easy-to-understand information on using these 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 0-672-21598-5.
Stock No: 02-21598 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 (W); ISBN 0-85501-493-8.
Stock No: 02-14938 Price £12.50
This book provides an overview for readers who wish to evaluate what videotex can do, 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; Paperback; Sams; ISBN 0-672-21827-5.
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.

LOW POWER SCHOTTKY TTL
468pp; Paperback; Motorola.
Stock No: 02-29478 Price £6.15
Complete data sheets for Motorola consumer range of 74LS TTL.

LINEAR INTEGRATED CIRCUITS DATA
830pp; Paperback; Motorola.
Stock No: 02-08182 Price £7.20
Technical data on a large proportion of Motorola Linear ICs, including voltage regulators.

MOTOROLA MEMORY DATA MANUAL
280pp; Paperback; Motorola.
Stock No: 02-02168 Price £5.20
Complete specification and selection guide for a very broad range of MOS and bipolar memories.

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: 02-18182 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 graduall, increase both your understanding of concepts and your ability to write programs. The development of each topic progresses from simple to more sophisticated problems and is accompanied by many sample programs to clarify the discussions.

ADVANCED BASIC opens with a review chapter on the elementary points of BASIC. Then, the book covers extended features, strings and files, and the applications of the BASIC language in such areas as: coordinate geometry, area, sequencies and series, polynomials, graphing, simulations and games. Summaries and problem exercises end each section.

ADVANCED COMPUTER DESIGN
By J K Iliffe
1982; 469pp;180 x 240mm; Paperback; Prentice; ISBN 0-13-011254-2.
Stock No: 02-01125 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-orientated 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.

ADVANCED PROGRAMMING AND PROBLEM SOLVING WITH PASCAL
By G M Schneider & S C Bruell
1981; 520pp; 160 x 230mm; Paperback; Wiley; ISBN 0-471-09155-3.
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.

APPLIED CIRCUIT THEORY: MATRIX AND COMPUTER METHODS
By P R Adby
1980; 490pp; 155 x 230mm; Paperback; Wiley; ISBN 0-470-26908-1.
Stock No: 02-69081 Price £9.00
This book develops, compares and illustrates all the more important methods of ciruit 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 fundamental and advanced theory, the subject is treated in sufficient depth to allow general application to active circuits throughout, thereby offering engineers a critical approach to circuit analysis.

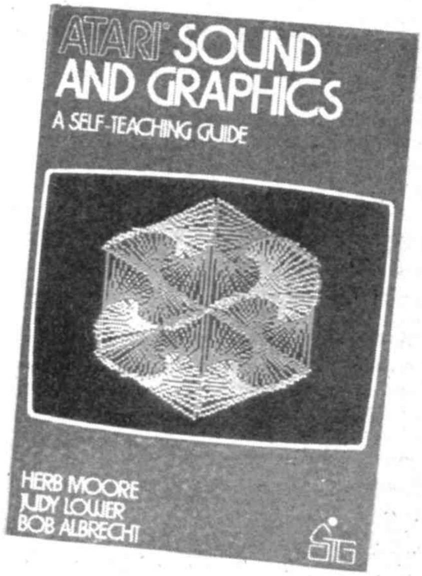
Features include; a much improved presentation of two-port analysis through the use of wiring operators, and discussion on the growing use of computer programs for transfer function analysis both in the s-domain and symbolically. There is a careful and lucid treatment of sensitivity analysis, and an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

ATARI ASSEMBLER
By D & K Inman
1981; 270pp; 145 x 235mm; Paperback; Prentice; ISBN 0-8359-0236-6.
Stock No: 02-02366 Price £10.85
For novices with some knowledge of BASIC programming, this introduction to using the ATARI also gives basic information on programming in assembly language.

ATARI SOUND AND GRAPHICS
By H Moore et al
1982; 234pp; 170 x 255mm; Paperback; Wiley; ISBN 0-471-09593-1.
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 800 – 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 CONVERSIONS HANDBOOK FOR APPLE, TRS-80, AND PET USERS
By D A Brain et al
1981; 80pp; 145 x 225mm; Paperback; Hayden (W); ISBN 0-8104-5534-X.
Stock No: 02-45534 Price £6.70
This book shows you how to convert a BASIC program for TRS-80, Apple II, or PET into the form of BASIC used by any other one of those machines. This is a complete guide to converting Apple II and PET programs into the TRS-80, TRS-80 and PET programs into Apple II, and TRS-80 and Apple II programs into PET. Equivalent commands are listed for TRS-80 BASIC (Model I, Level II), Applesoft BASIC, and PET BASIC, as well as variations for the TRS-80 Model III and Apple Integer BASIC. Also described are variations in graphics capabilities, PEEK, POKE, and CALL statements, cursor and control characters, memory locations, etc.



BASIC FOR HOME COMPUTERS
By B Albrecht et al
1978; 334pp; 170 x 255mm; Paperback; Wiley; ISBN 0-471-03204-2.
Stock No: 02-32042 Price £7.25
This books shows you how to read write, and understand MICROSOFT BASIC, the programming language used in the PET, APPLE, TRS-80, and other personal-size microcomputers. In just a few days you can learn to do nearly anything you want using BASIC programs – without any special background or access to a computer.

It 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 PROGRAMMERS GUIDE TO PASCAL
By M J Borgerson
1982; 118pp; 170 x 255mm; Paperback; Wiley; ISBN 0-471-09293-2.
Stock No: 02-92932 Price £7.25
If you're an experienced BASIC programmer who's ready to move up to Pascal, then this book was written for you. It shows you how to convert your BASIC programs into this powerful programming language PASCAL, and write new programs with more depth, flexibility and sophistication.

Two invaluable appendices provide: 1) a complete set of procedures and functions to help you build a library of input and output routines, 2) a Programmer's Cross Reference – a concise Pascal/BASIC dictionary that helps you compare BASIC functions and statements with their Pascal equivalents.

BASIC PROGRAMMING ON THE BBC MICROCOMPUTER
By N & P Cryer
1982; 200pp; 135 x 235mm; Paperback; Prentice; ISBN 0-13-066407-3.
Stock No: 02-06640 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 nor special mathematical training, it is particularly suitable for beginners.

BASIC PROGRAMMING PRIMER
By M Waite & M Pardee
1981; 236pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21586-1.
Stock No: 02-15861 Price £9.45
This book has been written to teach you the basics of BASIC. The BASIC language is designed for students and professionals alike. It has the power of the complex languages, but is inherently simple to learn and use.

BUILD YOUR OWN Z80 COMPUTER
By S Ciarcia
1981; 332pp; 215 x 275mm; Paperback; McGraw-Hill; ISBN 0-07-010962-1.
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; McGraw-Hill; ISBN 0-07-043097-7.
Stock No: 02-30977 Price £10.25
This book combines the best computer music articles from past issues of BYTE Magazine with exciting new material – all written for the computer experimenter interested in this fascinating field.

For the first time, material difficult to obtain has been collected into one convenient, easy to read book. An ardent do-it-yourselfer or armchair musicologist will find this book to be a useful addition to the library.

BYTE BOOK OF PASCAL
By B Liffick
1979; 334pp; 210 x 285mm; Hardcover; McGraw-Hill; ISBN 0-07-037823-1.
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.

For those uninitiated, the articles contained in this book can serve as a general introduction to Pascal, providing the background information necessary for a potential user, or for those requiring a more in depth study of the merits of the language and its possible implementation

CALCULATOR CLOUT: PROGRAMMING METHODS FOR YOUR PROGRAMMABLE
By M D Weir
1981; 235pp; 175 x 235mm; Paperback; Prentice; ISBN 0-13-110403-9.
Stock No: 02-11040 Price £9.70
This book presents methods and techniques for using hand-held programmable calculators that have the algebraic (AOS) entry method. Its "hands-on' approach allows you to follow the text and work through the examples with your calculator – as you read. Since it is impossible to design a "hands-on' book to be used with every one of the many programmable calculators available, this book is designed specifically to be used with the Texas Instruments TI-59 calculator. It is easily adaptable to the TI-58, SR-52 and SR-56.

CBM PROFESSIONAL COMPUTER GUIDE
By A Osborne et al
1982; 512pp; 160 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-75-6.
Stock No: 02-88756 Price £11.45
Beginners and experts alike will find a wide range of information in this step-by-step computer guide. You can learn to: load, save, and print programs; use many peripherals, including disk units, printer, modem, and voice synthesiser; program in CBM BASIC; Edit programs, drawings, and text; master the use of random numbers, graphics, the machine-language monitor, and the built-in clock; debug, maintain, and upgrade your system.

Organized for quick reference or in-depth study, this book is indispensable for users of the Commodore CBM Professional Computer.

CHEAP VIDEO COOKBOOK
By D Lancaster
1978; 256pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21524-1.
Stock No: 02-67221 Price £6.45
Here is a brand new, super low-cost way to get words, pictures, and opcode out of a computer and onto an ordinary TV set with minimum modifications to either. You will find complete do-it-yourself nuts and bolts construction details with thoroughly documented and debugged support software.

COMMUNICATION CONTROL IN COMPUTER NETWORKS
By J Puzman & R Porizek
1980; 294; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-27894-7.
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 phasing, 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, modelling, verification and evaluation of protocols are also included.

COMMUNICATION NETWORKS FOR COMPUTERS
By D W Davies & D L A Barber
1973; 594pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-19874-9.
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 Network; 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; Sams; ISBN 0-672-21632-9.
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; Sams; ISBN 0-672-21650-7.
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

is unlike any textbook you've ever used – almost every page has a colour drawing, a photograph, a picture or a schematic that helps you learn computer graphics programming easily and quickly. The only book on the market right now that shows you how to do computer animation! Programming concepts apply to all microcomputers.

COMPUTER NETWORKS AND THEIR PROTOCOLS
By D W Davies et al
1979; 504pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-99750-1
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
1980; 113pp; 145 x 210mm; Paperback; Sigma (W); ISBN 0-905104-10-2.
Stock No: 02-04102 Price £5.45
This all-British book of computer-aided calculations, simulations and games is a carefully designed practical guide aimed at the first-time computer user. It is suitable for schools, colleges and personal use. Anybody with access to a small computer that supports BASIC will be able to make immediate use of it.

There are 24 programs described and listed in the areas of biology, mathematics, chemistry and physics. Some are simulations of real-life situations.

COMPUTERS IN ENGINEERING AND MANUFACTURE
By G L Simons
1982; 358pp; 150 x 215mm; Hardcover; NCC (W); ISBN 0-85012-347-X.
Stock No: 02-12347 Price £15.50
This book surveys the background to CAD/CAM development, profiling the various elements in computerised production control, product design, draughting and plotting, process control, measurement and testing, and the uses in manufacturing of NC machine tools and robots. Attention is given to automated assembly operations, a crucial and traditionally labour-intensive part of manufacturing. Particular computer applications in various industry sectors are described.

COMPUTING IS EASY
By D Parker & M Hann
1982; 113pp; 155 x 230mm; Paperback; Butterworths; ISBN 0-408-01203-X
Stock No: 02-01203 Price £4.50
This book is not concerned with the 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.

Essentially, the beginner is introduced to the computer and encouraged to explore its capabilities, by means of carefully prepared programs and experiments using the BASIC programming language.

The text is easy to follow, well illustrated by apt and amusing cartoons and is suitable for all beginners.

CP/M PRIMER
By S M Murtha & M Waite
1980; 99pp; 215 x 280mm; Paperback; Sams; ISBN 0-672-21791-0.
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 Z80-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
2nd Ed 1982; 286pp; 160 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-82-9.
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 Jnr
1980; 264pp; 215 x 280mm; Paperback; Sams; ISBN 0-672-21634-5.
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)
1982; 176pp; 145 x 210mm; Paperback; NCC (W); ISBN 0-85012-328-3.
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.

DATA COMMUNICATIONS: FACILITIES, NETWORKS AND SYSTEMS DESIGN
By D R Doll
1978; 494pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-21768-9.
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
1978; 195pp; 150 x 210mm; Paperback; NCC (W); ISBN 0-85012-203-1.
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 R Brown
1981; 348pp; 170 x 255mm; Paperback; Wiley; ISBN 0-471-08333-X.
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.

DATA STRUCTURES AND OPERATING SYSTEMS
By T Rus
1979; 376pp; 170 x 250mm; Hardcover; Wiley; ISBN 0-471-99517-7.
Stock No: 02-95177 Price £20.60
This book develops a theoretical foundation for both hardware and software engineering. 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
1981; 272pp; 155 x 240mm; Hardcover; Wiley; ISBN 0-471-28054-2.
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.

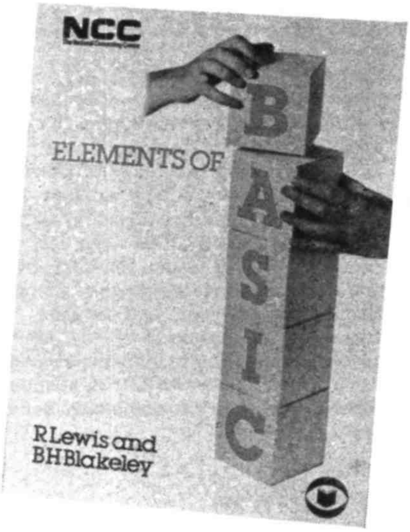
DICTIONARY OF COMPUTING
By F J Galland
1982; 330pp; 225 x 155mm; Paperback; Wiley; ISBN 0-471-10469-8.
Stock No: 02-04698 Price £9.00
This is a dictionary of computing and information processing for the student and advanced student of programming, systems analysis, operating or field engineering. It 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.
1979; 369pp; 160 x 240mm; Paperback; Prentice; ISBN 0-13-214072-1.
Stock No: 02-21407 Price £11.45
Basic introd. ctory material is illustrated in this book by two hundred line-drawings Combinational circuits are discussed in detail and sequential circuits are explained. Examples and numerous exercises are supplied.

DIGITAL COMPUTER FUNDAMENTALS
By T C Bartee
5th Ed 1981; 638pp; 145 x 210mm; Paperback; McGraw-Hill; ISBN 0-07-066172-3.
Stock No: 02-61723 Price £7.45
The purpose of this book is to present, as clearly as possible, the principles of modern digital computers. Many questions are included in a separate section of each chapter, and answers to selected odd-numbered questions are given at the end of the book.

DIGITAL CONTROL USING MICROPROCESSORS
By P Katz
1981; 300pp; 135 × 255mm; Hardcover; Prentice; ISBN 0-13-212191-3.
Stock No: 02-21219 Price £18.45
A systematic introduction to the principles and methods of digital control, this advanced book provides a thorough guide to designing systems based on microprocessors. It is suitable for both students who require a modern approach to digital control design and for experienced engineers who wish to change from analog compensators to microcontrollers.

DIGITAL LOGIC DESIGN AND APPLICATIONS
By L B McCurdy et al.
1981; 122pp; 210 x 280mm; Paperback; Prentice; ISBN 0-13-212381-9.
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.



ELEMENTS OF BASIC
By R Lewis & B H Blakeley (NCC)
1972; 202pp; 150 x 210mm; Paperback; NCC (W); ISBN 0-85012-118-3.
Stock No: 02-21183 Price £10.50
The BASIC language has been developed as a language particularly attractive in the teaching environment and for the newcomer to computing.

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.

GUIDELINES FOR COMPUTER MANAGERS
By National Computing Centre
1981; 266pp; 150 x 215mm; Hardcover; NCC (W); ISBN 0-85012-248-1.
Stock No: 02-22481 Price £18.00
Many topics need to be considered by computer managers for the successful implementation and operation of installations. The present Guidelines cover the important areas to which attention should be given. Checklists are included to encourage a systematic approach, and brief bibliographies are appended to each chapter.

Topics covered include: the control of data, selection (of terminals, data preparation methods, programming languages, etc), insurance, dp staff, system efficiency, documentation, contracts, auditing, programming, software, operations management, security, systems implementation, and microcomputers. It is expected that these Guidelines will be useful both to experienced dp managers and to managers newly charged with the task of implementing a computer system.

GUIDE TO GOOD PROGRAMMING PRACTICE
By B Meek & P Heath
1981; 181pp; 150 x 230mm; Paperback; Wiley; ISBN 0-85312-152-4.
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.

Whilst it thoroughly covers structural programming and program-writing techniques, it goes far beyond. It investigates and explains every aspect of the programmer's job, including analysis, design, testing, debugging, "tuning' for greater efficiency, coping with the limitations of computer systems, selection of a language and the use of language standards, program documentation, program maintenance and transferability, teamwork, and taking over another programmer's work. 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.

HARTS DICTIONARY OF BASIC
By W A Hart
1982; 162pp; 150 x 210mm; Paperback; Sigma (W); ISBN 0-905-10427-7.
Stock No: 02-04277 Price £6.45
This dictionary will help you to convert programs from one computer to another. The main part contains over eight hundred entries which summarise the actions of almost every statement, command or function you're ever likely to meet. So, whenever you find a new statement in a program 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
1978; 132pp; 155 x 230; Paperback; Hayden (W); ISBN 0-8104-5681-8.
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 microprocessor. Every step of the construction of '"Mike" is explained, with

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 should work and features to look for.

HOW TO PROGRAM AND INTERFACE THE 6800
By A C Staugaard
1980; 416pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21684-1.
Stock No: 02-21684 Price £12.45
An in-depth introduction to microprocessors and microcomputers in general and the Motorola 6800 microprocessor family in particular. Covers 6800-based microcomputers-learning systems. Over 30 "real-world' experiments demonstrate applications as the concepts are being explained.

HOW TO PROGRAM MICROCOMPUTERS
By W Barden Jnr.
1979; 256pp; 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 manipulations at the bit level up to data handling 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 £8.45
Microcomputer and peripheral system repair made simple for advanced computer hobbyists and technicians.

INSTALLING A SMALL BUSINESS COMPUTER
By P A Knight (NCC)
1981; 110pp; 150 x 210mm; Paperback; NCC (W); ISBN 0-85012-343-7.
Stock No: 02-23437 Price £6.00
The diminishing cost of computer hardware is making it increasingly attractive for businessmen and other potential users to consider investing in available commercial computer products. However, there are problems in installing mini-computers and other small business systems. If the task is not approached sensibly, the investment decisions will be wrongly taken and money may be wasted.

This book is intended to provide guidance to those managers charged with the responsibility for installing computer systems. Attention is given to the responsibilities of staff, the approach to manufacturers and software suppliers, costs, insurance, documentation, and other aspects.

INTERFACING TO MICROPROCESSORS AND MICROCOMPUTERS
By O Bishop
1982; 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
By I R Sinclair
1981; 120pp; 135 x 215mm; Paperback; Sinclair; ISBN 0-907266-01-0.
Stock No: 02-66010 Price £5.00
This book is intended specifically for such readers; no 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 0-672-21681-7.
Stock No: 02-21800 Price £4.95
The author introduces the reader to the dawning era of 'computercations' or the widespread introduction of computer technology into electronic communications. By reading this book the reader can take the first step towards the application of microcomputers to amateur radio.

INTRODUCTION TO MICROCOMPUTERS: THE BEGINNERS BOOK
By A Osborne & D Bunnell
3rd Ed 1982; 185 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-64-0.
Stock No: 02-88640 Price £6.45
This book provides the novice with an overview of microcomputers: how they function and what they can do for today's data management problems. The text clearly describes the components and functions of a micro system and introduces the reader to the basics of programming languages, the binary code, logic, timing and memory. New sections on software and communication have been added. This book provides the initial concepts needed for a thorough understanding of microcomputers.

INTRODUCTION TO INTERACTIVE COMPUTER GRAPHICS
By J E Scott
1982; 255pp; 150 x 230mm; Paperback; Wiley; ISBN 0-471-86623-7.
Stock No: 02-66237 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-drawing 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 0-471-08009-8.
Stock No: 02-80098 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 8080/8085 microprocessors.

LOGIC DESIGN OF COMPUTERS
By M P Chinitz
1981; 413pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21800-3.
Stock No: 02-18003 Price £13.25
The authors intention is to provide an understandable and orderly development of the subject, in an informal style while assuming no background in circuit theory, semiconductor physics, or abstract algebra.

MICROCOMPUTER DESIGN AND CONSTRUCTION
By A Clements
1982; 520pp; 180 x 240mm; Hardcover; Prentice; ISBN 0-13-580738-7.
Stock No: 02-07387 Price £19.75
The basic plan of the book is to deal in general terms with each component part of a microprocessor system and then a particular arrangement is chosen as part of the microprocessor system which is developed during the course of the book. The system chosen being the TS1.

Chapter 1 is of an introductory nature describing the evolution from early electronic computers using valves to the silicon chip of today.

The author had to chose a particular microprocessor for the TS1 so that the design system could be considered in detail.

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

1979; 224pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21614-0.

Stock No: 02-21614 Price £7.95

This self-instructional text is designed to introduce the reader 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

1982; 472pp; 160 x 240mm; Hardcover; McGraw-Hill; ISBN 0-07-061798-8.

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

1980; 466pp; 160 x 230mm; Paperback; Wiley; ISBN 0-471-08231-7.

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

1982; 264pp; 305 x 210mm; Hardcover; Granada; ISBN 0-246-11531-9.

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

1982; 218pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-10129-X.

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

1982; 196pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-471-05306-6.

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

1980; 294pp; 220 x 285mm; Hardcover; Wiley; ISBN 0-471-06492-0.

Stock No: 02-64920 Price £22.45

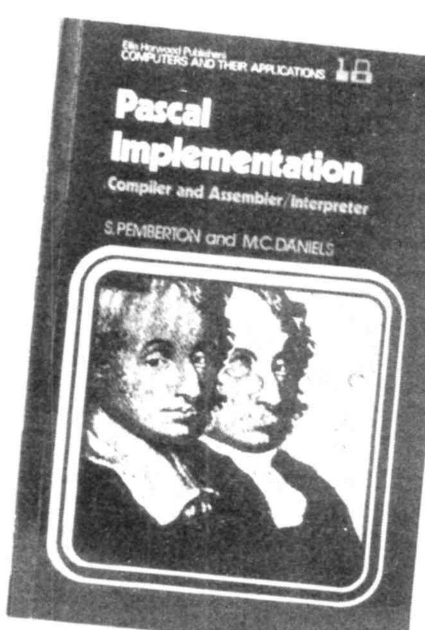
This detailed overview of the new 16-bit and bit-slice microprocessors present an up-to-date survey of their capabilities and current uses, together with recent developments in interfacing, system development, modern peripheral components and devices such as magnetic bubble memories and charge-coupled 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

1982; 82pp; 155 x 230mm; Paperback; Wiley; ISBN 0-470-27325-9.

Stock No: 02-73259 Price £23.00



PASCAL PROGRAMMING

By L Atkinson

1980; 438pp; 150 x 230mm; Paperback; Wiley; ISBN 0-471-27774-6.

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 some high level programming language other than Pascal.

PET BASIC

By R Zamora et al

1981; 308pp; 150 x 225mm; Paperback; Prentice; ISBN 0-8359-5524-9.

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

2nd Ed 1982; 320pp; 165 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-78-0.

Stock No: 02-88780 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 electronics instruments to the CBM via the J1 interfacing port.

PET INTERFACING

By J M Downey & S M Rogers

1981; 240pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21795-3.

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 48 port of the PET are explained.

PRACTICAL HARDWARE DETAILS OF Z80, 8080, 8085 & 6800 MICROCOMPUTER SYSTEMS

By J W Coffron

1981; 330pp; 180 x 240mm; Hardcover; Prentice; ISBN 0-13-691089-0.

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

1982; 132pp; 155 x 235mm; Hardcover; Wiley; ISBN 0-470-27545-6.

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.

PRACTICAL PROGRAMS FOR THE BBC COMPUTER AND ACORN ATOM
By D Johnson-Davies
1982; 120pp; 145 x 210mm; Paperback; Sigma (W); ISBN 0-905104-14-5.
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 Coffron
1981; 256pp; 180 x 240mm; Hardcover; Prentice; ISBN 0-13-694273-3.
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
1981; 156pp; 155 x 230mm; Paperback; Hayden (W); ISBN 0-8104-5183-2.
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 DeJong
1980; 416pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21651-5.
Stock No: 02-21651 Price £12.45
Dr De Jong has compiled 14 interesting chapters of information and programs that will be useful to anyone 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)
1982; 240pp; 150 x 210mm; Paperback; NCC (W); ISBN 0-85012-336-4.
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
2nd Ed 1982; 282pp; 210 x 275mm; Paperback; McGraw-Hill; ISBN 0-07-023855-3.
Stock No: 02-38553 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 principles of good programming practice as well as the specific rules of BASIC.

S100 AND OTHER MICROBUSES
By E C Poe et al
1981; 208pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21810-0.
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/III bus and ATARI BUS through IEEE 488 to the TI99/4 and LSI-11 buses. Also some information on how to interface from various buses to the S100 bus.

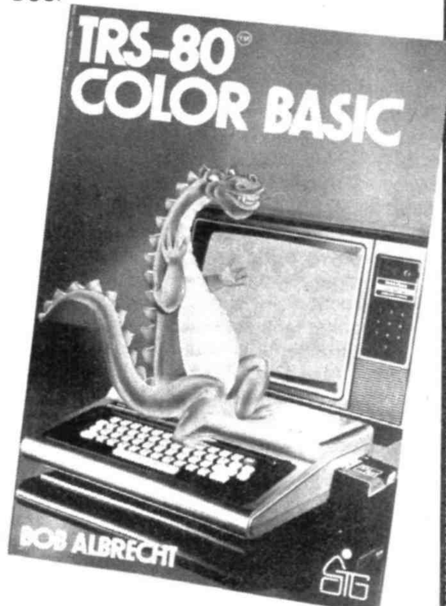
SOFTWARE MAINTENANCE GUIDEBOOK
By R L Glass et al
1981; 193pp; 155 x 265mm; Hardcover; Prentice; ISBN 0-13-821728-9.
Stock No: 02-17289 Price £18.90
This book attempts to remove much of the mystery surrounding maintenance and forms a generalised guide for people involved in software maintenance.

SOFTWARE SECRETS: INPUT, OUTPUT AND DATA STORAGE TECHNIQUES
By G Beech
1981; 142pp; 150 x 210mm; Paperback; Sigma (W); ISBN 0-905104-15-3.
Stock No: 02-04153 Price £6.45
The Sharp MZ-80K is a very popular personal computer, offering excellent value for money. This book enables users of this - and other machines - to: Produce computer games and other graphics software, and to understand how to store and process data on cassette or disk.

STRUCTURED PROGRAMMING WITH COBOL
By R Atherton
1982; 266pp; 150 x 230mm; Paperback; Wiley; 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
1981; 222pp; 150 x 230mm; Paperback; Wiley; ISBN 0-470-27224-4.
Stock No: 02-72244 Price £9.40
This book, a clear and instructive 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 need for 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
1981; 186pp; 175 x 235mm; Paperback; Prentice; ISBN 0-13-931121-1.
Stock No: 02-93112 Price £8.45
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.



TRS-80 COLOUR BASIC
By B Albrecht
1982; 378pp; 170 x 250mm; Paperback; Wiley; ISBN 0 471 09644 X.
Stock No: 02-09644 Price £7.25
The book is presented as a self-teaching guide with self-assessment Q&A sessions in each chapter, capable of taking a novice through the paces of very basic familiarisation ("What is a ROM"), and on to some reasonably advanced concepts in BASIC. It's a bit of a shame that the author doesn't credit the reader, who has got as far as subscripted variables and arrays, with a bit more intelligence than the style implies - but notwithstanding this gripe, the book is tailor-made for the growing band of Dragon fanciers.

TRS-80 INTERFACING BOOKS 1 & 2
By Titus et al.
Book 1; 1980; 256pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21633-7.
Stock No: 02-21633 Price £8.70
Book 2; 1980; 256pp; 135 × 215mm; Paperback; Sams; ISBN 0-672-21739-2.
Stock No: 02-21739 Price £9.45
If you have a fairly good understanding of the commands in Level II BASIC, Book 1 will appeal to you. The book introduces you to the signal available within the TRS-80 computer and illustrates how they can be used to control external devices. You will have an opportunity to construct and test a number of interesting interface circuits that will be used in the experiments. Book 2 introduces you to more advanced interfacing techniques that allow you to do realthings with your TRS-80 computer.

USING COMPUTERS: A MANAGER'S GUIDE
By M Peltu (NCC)
1982; 200pp; 150 x 210mm; Paperback; NCC (W); 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; Wiley; ISBN 0-471-09872-8.
Stock No: 02-98728 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; Prentice; ISBN 0-8359-8164-9.
Stock No: 02-81649 Price £16.40
This comprehensive book presents the UNIX system which was designed for both program development and software applications. Among the topics examined are a hierarchical file system, asynchronous processing, over 100 subsystems and utilities, and languages such as FORTRAN 77, FORTRAN VI, Pascal, BASIC and C.

VISICALC HOME AND OFFICE COMPANION
By D M Castlewitz et al
1982; 180pp; 210 x 280mm; Paperback; McGraw-Hill; ISBN 0-931988-50-0.
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 many new and useful models.

WORDSTAR MADE EASY
By W A Ettlin
1981; 126pp; 185 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-69-1.
Stock No: 02-88691 Price £6.45
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 to use this contemporary 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; McGraw-Hill; ISBN 0-931988-65-9.
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.

Z80 ASSEMBLY LANGUAGE PROGRAMMING
By L A Leventhal
1979; 600pp; 160 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-21-7
Stock No: 02-88217 Price £12.45
This book provides comprehensive coverage of the Z80 microprocessor assembly language. Programming examples illustrate software development concept and actual assembly language usage. Assemblers and assembler directives are also explained.

Z-80 MICROMPUTER DESIGN PROJECTS
By W Barden Jnr
1981; 208pp; 210 x 280mm; Paperback; Sams; ISBN 0-672-21682-5.
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 microcomputer and the remarkable chip, EZ-80. Several EZ-80 applications programs are included.

Z-80 MICROCOMPUTER 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 0-672-21609-4.
Stock No: 02-21609 Price £10.20
Book 2: 1979; 496pp; 155 x 245mm; Paperback; Sams; ISBN 0-672-21610-8.
Stock No: 02-21610 Price £12.45
Two volumes of laboratory-orientated text. Book 1 explores Z-80 software and machine language programming. Book 2 addresses interfacing digital circuits with the Z-80 CPU, PIO, and CTC chips. Both books stress learning through experimentation.

Z8000 MICROPROCESSOR: A DESIGN HANDBOOK
By B K Fawcett
1982; 308pp; 175 x 230mm; Paperback; Zilog (P); ISBN 0-13-983734-5.
Stock No: 02-37345 Price £13.25
This volume focuses on the architecture of the Z8001 and Z8002 microprocessors and logic design using the Z8000 family of components. The text includes a detailed discussion of the Z8000 architecture, emphasising the features that determine the hardware interface to the CPU. The book also explains the benefits of particular hardware features to help the reader to learn the reasons behind a particular design approach.

4 & 8-BIT MICROPROCESSOR HANDBOOK
By A Osborne & G Kane
1981; 1000pp; 175 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-42-X.
Stock No: 02-98842 Price £15.00
This is the one source for complete, objective, and accurate information on 4 and 8-bit microprocessrs. 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; McGraw-Hill; ISBN 0-931988-43-8.
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 0-672-21798-8.
Stock No: 02-21656 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
1981; 238pp; 155 x 235mm; Paperback; Sams; ISBN 0-672-21853-4.
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
1977; 416pp; 155 x 235mm; Paperback; Sams; ISBN 0-672-21447-4.
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 computer 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/Z80 ASSEMBLY LANGUAGE
By A R Miller
1981; 328pp; 170 x 255mm; Paperback; Wiley; ISBN 0 471-08124-8.
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 perform 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.

8085A COOKBOOK
By Titus et al
1980; 352pp; 155 x 235mm; Paperback; Sams; ISBN 0-672-21697-3.
Stock No: 02-21697 Price £10.95
From basic concepts to details on system control, memory interfacing and 8085A family compatible chips, this book shows the reader how to design a microcomputer using the 8085A microprocessor chip.

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02-18182	European Home Electronics - ICs/Motorola	6.05	☐
02-28182	European Home Electronics - Discrete Devices	6.05	☐

6809 ASSEMBLY LANGUAGE PROGRAMMING
By L A Leventhal
1981; 600pp; 160 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-35-7.
Stock No: 02-88357 Price £12.45
This is a comprehensive book. It covers 6809 assembly language programming in unmatched detail. The entire instruction set is presented and fully explained. The book contains many fully debugged, practical programming examples with solutions in both object code and source code. Discussion of assembler conventions, I/O devices, and interfacing methods is also included.

6809 MICROCOMPUTER PROGRAMMING AND INTERFACING, WITH EXPERIMENTS
By A C Staugaard
1981; 272pp; 135 x 215mm; Paperback; Sams; ISBN 0-672-21798-8.
Stock No: 02-21798 Price £11.70
Gives you a solid understanding of how to program and interface the high-performance 6809 microprocessor, Staugaard demonstrates the ease with which this 8-bit chip can be programmed and interfaced. The author completely explores internal structures, addressing modes, data movement instructions, registers, arithmetic logic, and test instructions for the 6809. Many sample software programs are included.

8086 BOOK
By R Rector & G Alexy
1980; 600pp; 160 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-29-2.
Stock No: 02-88292 Price £13.00
As the 8086 and other 16-bit microprocessors gain wider inclusion in small computers, these products will increase in power, speed and utility – creating a new generation of microcomputer products able to compete with minicomputers for many applications.
This book is a comprehensive and thoroughly readable reference that is more than a hardware book and more than an assembly language text. This is an invaluable reference book that covers all of the 8086's most important features.

8086/8088 PRIMER
By S P Morse
1980; 276pp; 150 x 230mm; Paperback; Hayden; ISBN 0-8104-6255-9.
Stock No: 02-62559 Price £9.25
Written by the man responsible for the design of the 8086 microprocessor, this revised edition has been updated to provide novices and professionals alike with a thorough introduction to Intel's 8086 and 8088 microprocessors.

68000 MICROPROCESSOR HANDBOOK
By G Kane
1981; 114pp; 175 x 235mm; Paperback; McGraw-Hill; ISBN 0-931988-41-1.
Stock No: 02-88411 Price £7.45
Whether you're currently using the 68000, planning to use it, or simply curious about how the 68000 works, this handbook has all the answers. A clear presentation of signal conventions, timing diagram conventions, functional logic, three different instruction set tables, exception processing, and family support devices provides more information about the 68000 than the manufacturer's data sheets.

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