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RADIO & ELECTRONICS WORLD MAY 1983

ISSN 0262—2572

RADIO & ELECTRONICS WORLD

THE COMPLETE ELECTRONICS MAGAZINE

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FEATURES

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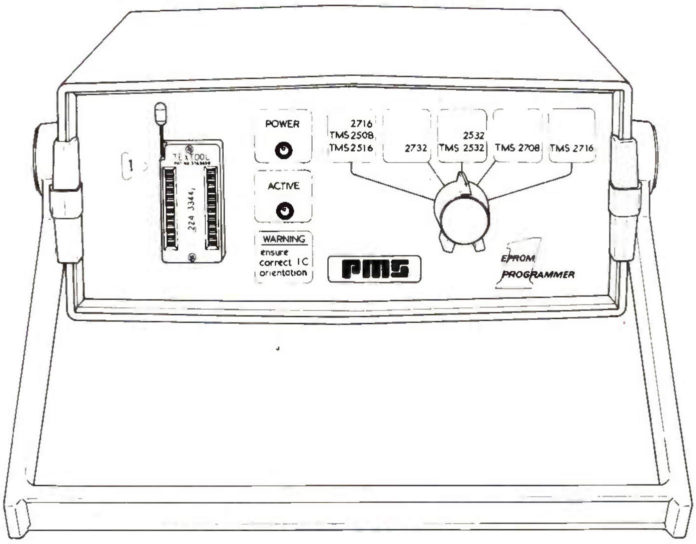
Single Chip Modem

D71699

PROM 1



Intelligent EPROM Programmer

The new PROM 1 from P.M.S. offers the user an intelligent, easy to use EPROM Programmer, capable of programming a wide range of common EPROM types. The unit has its own CPU with a 4K memory buffer and communicates to the user's Computer/Terminal over a standard R.S.232 link. Full on-screen editing facilitates easy modification of machine code programs.

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2. Buffer to Disk. Allows contents of buffer to be stored on disk.
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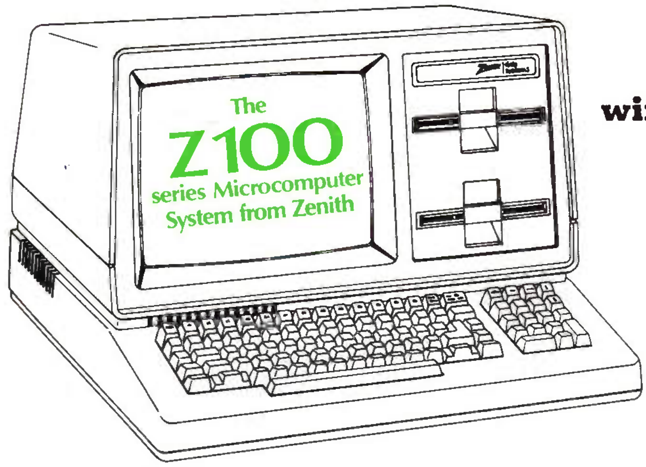
4. Buffer to EPROM. Programmes EPROM with current contents of the Buffer.
5. Display Buffer. Displays contents of the Buffer on screen and allows full screen editing of the buffer contents.
6. Check EPROM Status. Checks the status of the EPROM plugged into programmer socket i.e. EPROM type and whether it is blank, equal to or not equal to the buffer.

The PROM 1 can be used with just a terminal but functions 1 and 2 will not apply.
The unit is supplied with full operating instructions, including CP/M routines for system configuration.

R.R.P. **£349.00**

ZENITH data systems



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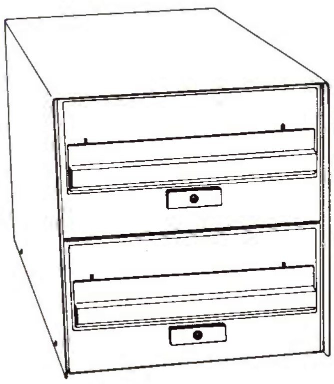

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RADIO & ELECTRONICS WORLD

MAY 1983

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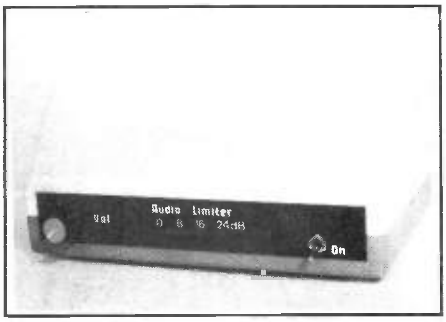

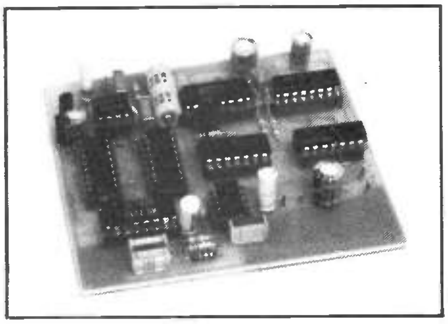

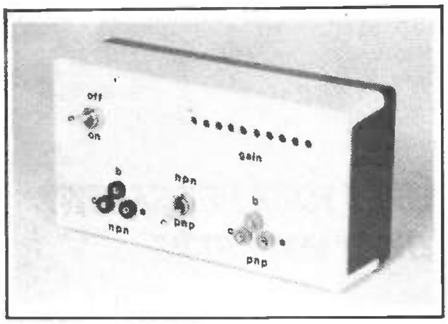

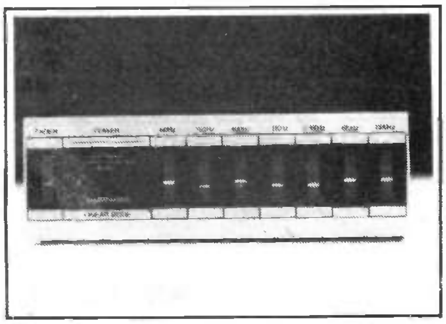

Projects

Features

Reviews

News

The third part of the Zilog 8000 course has been held over until next month.

Cover location — courtesy of imagination design.

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Project Universe

Project Universe, the research programme set up to investigate aspects of connecting computer systems in different parts of the country by high-speed digital links, was officially inaugurated in London recently.

The project is funded by British Telecom, the Department of Industry, GEC-Marconi Research, the Science and Engineering Research Council and Logica.

Mr William Shelton, a Parliamentary Under-Secretary of State from the Department of Education and Science, inaugurated Project Universe on the first day of the Info '83 Exhibition at the Barbican Centre.

British Telecom is providing the communications for a working demonstration of the project at the official inauguration of the experiment and for the duration of the Info '83 Exhibition.

A transportable Satstream small-dish earth terminal, three metres in diameter, has been sited close to the Barbican. The earth terminal will receive from a satellite, transmissions sent by the other participants, and will in turn transmit signals to the various locations involved.

At its peak level of performance Universe is expected to interconnect about 150 computer terminals. These terminals are linked locally to local area networks which use the Cambridge Ring technology, while a satellite provides the connection between the Cambridge Rings.

British Telecom is paying for the cost of using OTS for three hours a day and for providing the three metre small dish earth terminals being used by the universities. These terminals are installed on roof-top locations at University College London, Cambridge University and Loughborough University.

British Telecom is also taking part in the Universe experiment through its Research Laboratories (BTRL) at Martlesham near Ipswich, Suffolk. BTRL has two local area networks (LANs) installed and connected to a satellite ground station.

Sinclair Sells A Million

Sinclair Research has become the first company worldwide to sell a million *home* computers, just three years after it launched the world's first under £100, the Sinclair ZX80.

One computer every four seconds is now produced for Sinclair by the Timex-Dundee plant, its principal UK manufacturing site, and it has delivered in total some 130,000 ZX80's, over 750,000 ZX81s and 200,000 ZX Spectrums.

★ ★ ★ Nota Bene ★ ★ ★

Shortly after the *April* issue of **R&EW** appeared in the shops, we received this fascinating letter from a reader (whom we shall call Mr. X for the time being) in Ipswich:

Dear Sir,

I am writing regarding one article in your April 1983 magazine – namely the Polarfoil (otherwise an interesting issue). I am literally amazed that something like the Polarfoil got published, for several reasons:

1) ***Safety****: The circuit diagram suggests putting a relay(!) in the fuel pipe. Only intrinsically safe components can be used in an explosive atmosphere. This means that the energy stored in components is insufficient to ignite the petrol vapour. If any components are placed there they must be correctly fused.*

2) ***Design****: The design is truly apalling* (so is your spelling — Ed)*, using more than twice as many components as necessary for the job. Don't forget that a car alarm must be reliable and reliability is inversely proportional to the number of components. (Are all the components suitable for car temperatures? -10° C to +35° C). To simplify the circuit, IC2, IC3 and IC4 can all be omitted if the authors used a single transistor as an oscillator (Wein or phase-shift) running directly from* +12V — even the IC4 could be run from +12V rather than ±5V. Next, what is the opto-isolator for: Q1 should be able to drive a relay directly. Also why not use a simple commonly available device for Q1? (Likewise for D2 and IC4).

3) ***Article****: is badly written and is poor at explaining a) how the circuit works and b) what it does.*

I won't harp on any more, since I'm sure I've made my point. The basic idea of using a Hall Effect device is good, but at least give the article to someone who can design decent circuits and can write a decent article.

Yours Sincerely,

Mr. X.

The confusion arising over this article can be put down to 'The Typesetting Gremlins', which manifested themselves in the April edition. The manuscript from Stig and Boris clearly proclaimed that the circuit should have been titled ***APRIL FOOL!!***

If Steve Whitt, Of Foxhall Road, wishes to remain anonymous, perhaps he would consider some form of ex-gratia remuneration. Any donations — to be received no later that 1st April 1983 — to B. Bartok and S. Svenson.

Bigger Beeb

GSL (Geophysical Systems Limited) of Andover, Hants, have just revealed a remarkable breakthrough in the expansion of computer capacity, which will be of interest to all current owners of BBC-Acorn micros.

The newly developed GSL Winchester interface is applicable to BBC-Acorn Model B micro and can upgrade its memory capability from 32 Kbyte to as much as 340 Mbyte (4 x 85 Mbyte racked). The whole system can also be supplied as a complete package incorporating the BBC-Acorn Model B micro, controller interface module, system Disk/Tape controller, Quantum Winchester disk drive and Archive tape streamer.

It is anticipated that initially there will be a wide application for the new development in such areas as educational establishments, scientific and industrial data handling and general business use. A provisional filing system is currently available as a basic program providing an elementary capability for file handling and catalogging. This is being expanded by translation into machine code on EPROM for direct access of filing commands via the paged ROM facility on the BBC Micro.

INSPECting The List

Inspec has just announced that a new Thesaurus is available for 1983. It has many new features and contains over 9,000 terms. The new 1983 edition of the INSPEC Thesaurus provides a complete list of all subject index headings used by INSPEC throughout its subject fields of physics, electrical and electronics engineering, computers, and control engineering. The Thesaurus lists broader, narrower and related terms against each heading and provides a large number of 'lead-ins' or cross-references so that finding the most appropriate index heading is simple, quick and effective. An important feature introduced in this latest edition is that the date on which the term was added to the Thesaurus is shown, together with the appropriate terms in use before that date. Several hundred new 'lead-in' terms have been added to simplify use and the Thesaurus now contains over 9,000 entries. The 1983 Thesaurus is an invaluable aid in using any of the INSPEC abstracts journals, online files or tape services.

Keeping Tabs

Trials costing about £26 million are to start next year, which will enable more than a quarter of a million of British Telecom's customers to have details of telephone calls with their bills. If the trials are satisfactory they could herald the start of similar arrangements for all 18 million British Telecom customers.

The trials will itemise trunk and international calls. Statements sent with bills will give details of the number called, the date and time the call started, its duration and the charge. BT have said, the itemising of calls will be extremely accurate, will enable customers to keep a close eye on their bills, and will give us a much better picture of the use of the telephone in different parts of the country and by different kinds of customer. We will be able to develop and change to match much more closely our customers' varying needs.

Contracts for the trials are being placed with three companies, after competitive tender, for computerised systems and equipment to replace the present metering system on some local telephone exchanges. The successful tenderers are GEC, Plessey and IBM. They will share four telephone areas between them. Exchanges in the four areas will each offer up to 70,000 lines, and each exchange will be fully equipped. The trials will start in the summer of 1984.

GEC will handle trials in some exchanges in London's south telephone area and in Shrewsbury. Plessey will have some exchanges in Edinburgh. IBM will be trialling in some exchanges in Leicester.

Customers in the trial areas will be advised by local managers before the trials begin, and may decline to have itemised bills if they wish. In special circumstances they may also be able to have local calls itemised, but this will be an additional service. The call-logging equipment will modify existing analogue local exchanges of various types to enable them to match what the digital exchange of the future, System X, can offer on itemising bills.

JVC's THORNy Relationships

Thorn EMI plc and Victor Company of Japan, (JVC) have been closely linked for several years in the establishment of the VHS video system as the market leader in the UK. This close co-operation has resulted in the two organisations becoming joint partners in the European manufacturing venture — J2T — which now assembles VHS video cassette recorders at plants in Newhaven, Sussex and Berlin, West Germany.

The success of this existing relationship has led both companies to announce that negotiations are now at an advanced stage for Thorn EMI Ferguson to manufacture a range of large screen colour televisions for JVC. Based on the TX chassis, the series will consist of five models ranging from a 20" remote control receive to a 26" stereo model.

Evaluating DVMs

An evaluation kit for the Ferranti Electronics ZN451 Digital Voltmeter is now available. It fully evaluates the capabilities of its 3¼ digit monolithic DVM without the need to resort to the expense of designing and constructing a system from scratch.

The ZN451 has the facility whereby external circuits may be included in the auto zero loop: output signals are provided to control external auto zero switches so that op amps or other signal conditioning circuits can be included in the loop to boost input impedances and/or improve sensitivity to as low as 1.999 mV full scale. Apart from its other advanced features the ZN451 can thus measure low voltages without any "zero error".

Electronic Teaching

House of Instruments announce the availability of the YD-1OS, a Basic Semi-Conductor Trainer System and the YD-75DS, a Basic Logic Circuit Trainer System from Trio, whose general test and measurement instruments can be used in a multitude of possible experiments.

Both flexible and expandable systems are based on the easy push-fit, electronic circuit building block method, with circuit symbols clearly visible on the surface of each block. Housed in an integral rigid hinged carry-case, which can be used as a table or wall display, there are built-in facilities for supplying and monitoring power to the experiment.

Want A Service Manual?

Not many services are provided entirely free of charge in these days, but the National Wireless Museum in the Isle of Wight is offering to help any reader in dire need of technical information regarding a very old set.

The museum has recently been given a very large collection of service-sheets, wiring-diagrams and workshop manuals, dealing with tape-recorders and amplifiers, as well as radios and television-receivers, and dating right back to well before the war years.

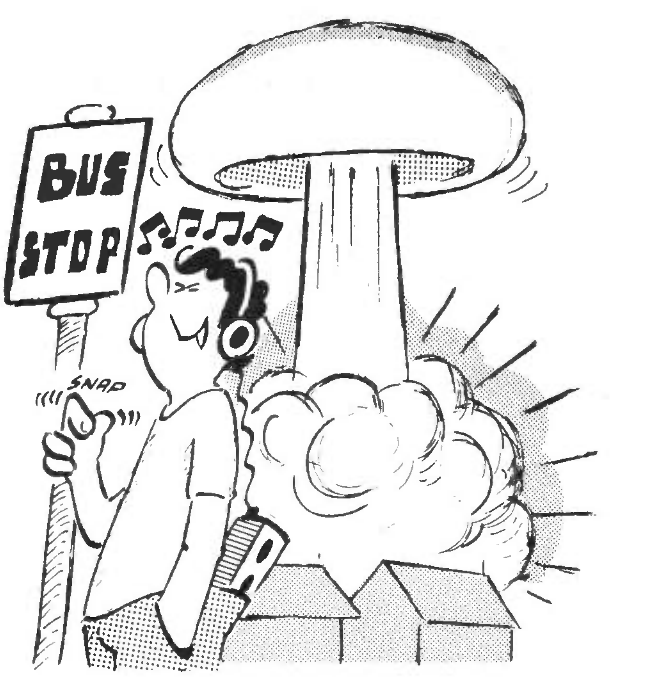
In the first instance, please contact the hon. curator, — Douglas Byrne, G3KPO — by ringing Ryde 62513.

Goonhilly Microwaves

Siemens Limited has supplied British Telecom with state-of-the-art microwave equipment for use at the Goonhilly Downs global satellite communications centre in Cornwall. The equipment, comprising two high-power amplifiers, automatic carrier level control and a signal routing and switching system, was designed, developed and made to BT requirements at Siemens, Cheshire.

The two high-power amplifiers include a number of unusual features to ensure operational efficiency and maximum reliability. For example, each has its own microprocessor supervisory system, fibre-optic-controlled power supply and comprehensive travelling-wave tube protection.

The carrier level control equipment comprises four automatic carrier level control systems with facilities for remote effective isotropically radiated power settings. Two of the ALC systems will be used with the new Siemens high-power amplifiers and the remaining two will replace obsolete equipment used on the existing Marconi amplifiers currently in service on Aerial number 2.



SNIPPETS

Ministry's 'Scope Order

The Ministry of Defence has ordered a total of 500 Gould OS300 oscilloscopes, selected as the RAF's standard 15MHz general-purpose instrument. The order, combined with other MoD orders received on behalf of the Army, brings the total value of OS300 instruments with the Armed Forces to more than £200,000.

Satellite Terminals

Ferranti Offshore Systems Limited has supplied, under a contract placed by the Natural Environment Research Council, two compact satellite communications terminals to the British Antarctic Survey.

One terminal is destined for Signy on the South Orkney Islands and the other for Halley, a station situated on the ice shelf of the Weddell Sea in Antarctica. Each will provide its station with the facility of voice communication, along with fast and dependable telex and facsimile transmissions. In addition, the Halley terminal will permit the transmission of data, thereby providing a direct link between the Halley station computer and the British Antarctic Survey computer in Cambridge.

Anti-Smuggling System

British Aerospace, Bracknell Division, has announced a new anti-smuggling container-cargo examination system. The system enables customs authorities to examine containers for contraband, without unloading or unpacking the cargo and without causing damage to it.

The examination is by means of X-rays and spectographic gas analysis in a purpose built facility. On arrival at the examination building, containers are placed on an automatic conveyor system which carriers them forward. Before entering the building an air sample is taken for spectrographic analysis. This is used to detect alcohol, drugs and explosives. When the air sample has been taken, the container is passed in front of a double linear accelerator and exposed to a short burst of X-rays. The picture generated by the X-rays is stored on a computer and viewed on closed circuit television. Outlines of items such as guns and bottles, are readily visible to the operator. There are also a range of picture enhancement techniques, to assist with difficult subjects.

Direct Dialling From Ships

For the first time, you can direct dial telephone and telex calls from ships. The opening of British Telecom International's first satellite coast earth station, signals a revolution in maritime communications. It provides direct dialling to Britain and 97 per cent of overseas destination.

Using a new dish aerial at BTI's Goonhilly Downs earth station, and an Inmarsat satellite 22,300 miles above the Atlantic, ships equipped with satellite terminals can now provide passengers and crew with the same telephone and telex facilities available in a London city office.

Traffic Signalling

A major contract to supply and install traffic signal control equipment, for a £3.3m traffic management project in Leeds — the Sheepscar scheme — has been awarded to Plessey Controls Limited by West Yorkshire Metropolitan County Council.

The project — the first of several major signalised highway schemes in Leeds — is radically different from previous West Yorkshire signal schemes, in that the geometry of the area, has been designed specifically with synchronised signal junctions in mind.

The physical size of the scheme can be gauged by the fact that, although cheaper than any grade-separated solution, two years have been allowed for its contruction.

Virgin Search

In a period when many companies are closing their doors, Richard Branson, Chairman of the Virgin Group of Companies, is delighted to announce the setting up of another new subsidiary, Virgin Games Limited, it will concentrate on providing entertainment software/video games for the rapidly growing UK & International home computer market.

Virgin Games is looking for programs with a difference, to run on any of the following home computers — Atari, BBC, Commodore 64 and VIC 20, Dragon, ORIC 1, Sinclair ZX Spectrum and Texas Instruments 99/4A.

AUDIO LIMITER

David Strange takes time off from Audio Brief and presents the design of a professional recording limiter. Development by Adrian Barnes.

Overmodulation distortion and disproportionately loud sections within a recording seriously spoil the overall listening experience. Overmodulation is particularly likely to occur during live recording and at other times when there is no chance of previewing the incoming signal. Fortunately, recording from gramophone records or radio presents no such problems because both these mediums have tightly controlled limits of modulation — once the tape recorder input gain has been set correctly, the recording may be left to proceed without any further adjustment.

Not all material, however, is that predictable. Often we require continued level control during the recording. Some cheaper tape machines, destined for those who would not be too worried about such things anyway, get over the problem by incorporating an automatic gain control (AGC). However, the AGC has many disadvantages (unless the recorder is going to be used as a pure dictation machine), because *effectively* soft sounds are amplified to the same level as loud ones. Momentary overloads occur with explosive sounds and then, because the AGC has been pushed back, any succeeding soft sounds become lost and the whole dynamic nature of the original sound is destroyed.

An AGC can be successful, but only when applied to recording some predictable dynamic range material — such as gramophone records — where a long recovery time constant is required.

Becoming a little more creative with recording, for instance recording a local event, drama group, choir or band, means having to contend with many sound sources at different levels. Hopefully there will be opportunities for retakes and rehearsal, which not only benefits the people being recorded, but also the sound engineer, who can be ready for any crescendo or fall in level — before the crescendo the fader will be gradually easing back to the rehearsed position. Afterwards the fader will be artistically returned to its original working level (or perhaps eased forward a little for the expected quieter passage coming next!).

Not all situations offer the possibility of precision rehearsal before recording, so it would be a good idea to insert a limiter into the recording chain to prevent overloads. Ideally the limiter should be totally linear and not alter the dynamic nature of the recorded sound until an overload is likely (when, of course, any further increase in input will result in no increase of output). The **R&EW** limiter fulfills this requirement admirably. It can also be inserted into an individual mixer channel to obtain other effects. For instance, it may be used at the onset of limiting to add more punch to a narrator's voice, or in a group to smooth out the bass guitar.

Supply Voltage:	15V stabilised (18V with IC5 regulator)
Supply Current:	12mA quiescent - see text
Limiting Threshold:	-10dB
Output Level:	0dBV (0.775V RMS)
Limiting Range:	25dB
Attack Time:	10ms
Recovery Time:	100ms
Meter Range:	24dB in 4dB steps
Distortion 4dB below threshold:	0.2%
Distortion 4dB above threshold:	2%
S/N Ratio:	76dB

Table 1: Audio Limiter specifications.

Circuit Description

The audio limiter is based on the dual channel NE 570/571 chip. Both halves can function separately, so we'll just consider the left hand channel. Before the input level is reached, where limiting will take place, the NE571 may be regarded as a standard operational amplifier. In other words, the gain is set by the resistance into the inverting input (pin 5) and feedback from the output (pin 7). The gain is therefore R15/R8 or 20dB.

The NE571 has a trick or two that sets it apart from standard operational amplifiers. Connected internally, between pin 5 and pin 3, is the equivalent of a voltage controlled resistor. The resistor is referred to as a delta gain cell, and control voltage to the cell is applied to pin 1. In order to make the gain of the NE571 a function of the control voltage, it is only necessary to connect the delta gain cell (in the feedback path) in parallel with R15. This is done via capacitor C5 in order to avoid DC offset problems — the NE571 is designed to operate from a single rail, and pin 7 is internally contrived to be at half rail potential.

IC2a and b form a window comparator with the AC output of the NE571 and two DC fixed potentials. If the AC voltage exceeds one of the fixed potentials in any cycle, the base of Q1 is taken more negative, turning on Q1. C7 is therefore charged through R20 to a potential which will reduce the gain of IC1a and maintain an equilibrium — no increase in AC output. If the window potentials of the comparator are not exceeded, then the potential on C7, and therefore the potential at the control of the delta gain cell, does not change.

The instantaneous voltage on C7 is an error voltage, in other words a measure of the amount of gain reduction required to maintain a constant output. This voltage is measured by comparators IC3b to IC4d, in the form of a bargraph display which shows 'decibels of limiting'. Resistors R25 to RV2 set the comparator steps to 4dB.

So far we have only considered the left half of the limiter, but both sides share certain elements. It is necessary for the left and right hand stereo channels to be tied together in this way so that no image shifting occurs when limiting takes place. Left and right channels therefore share a common error voltage from C7, to which either may contribute.

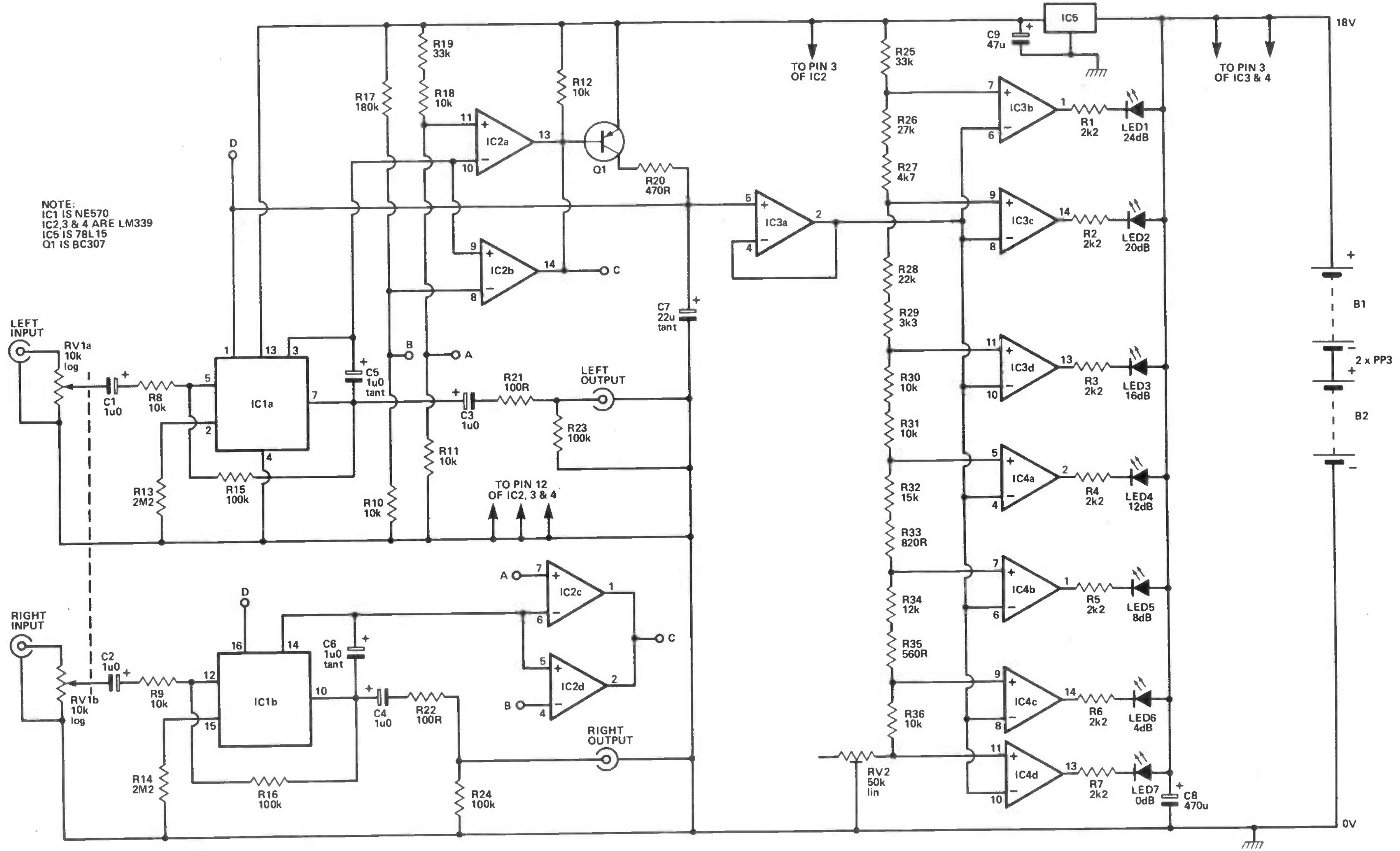


Figure 1. Full circuit of the Audio Limiter

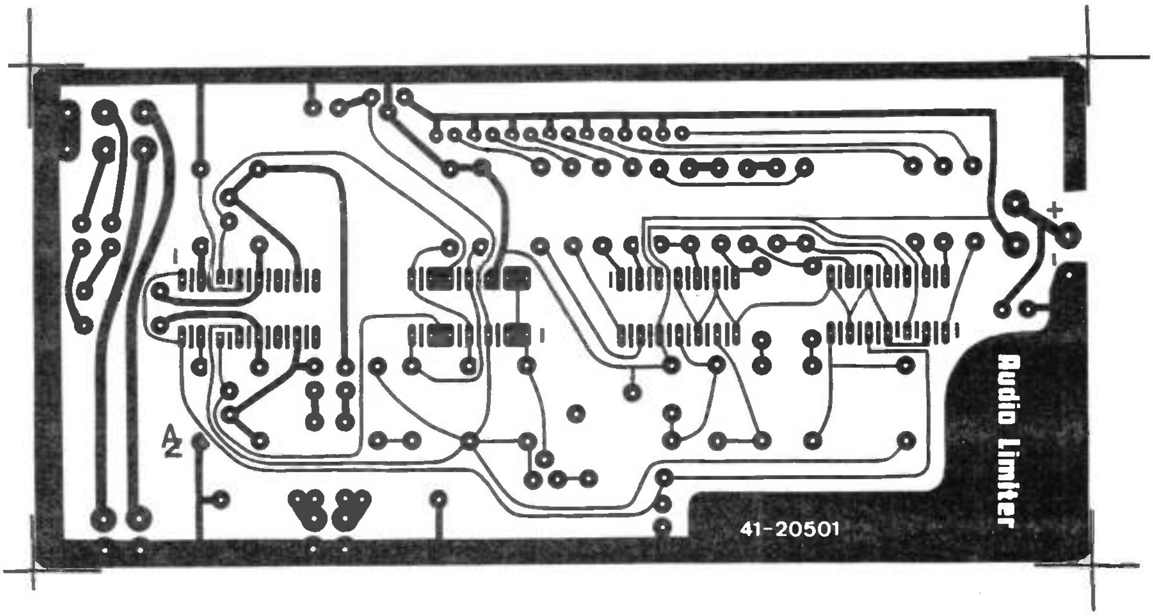


Figure 2. Foil pattern for the limiter board.

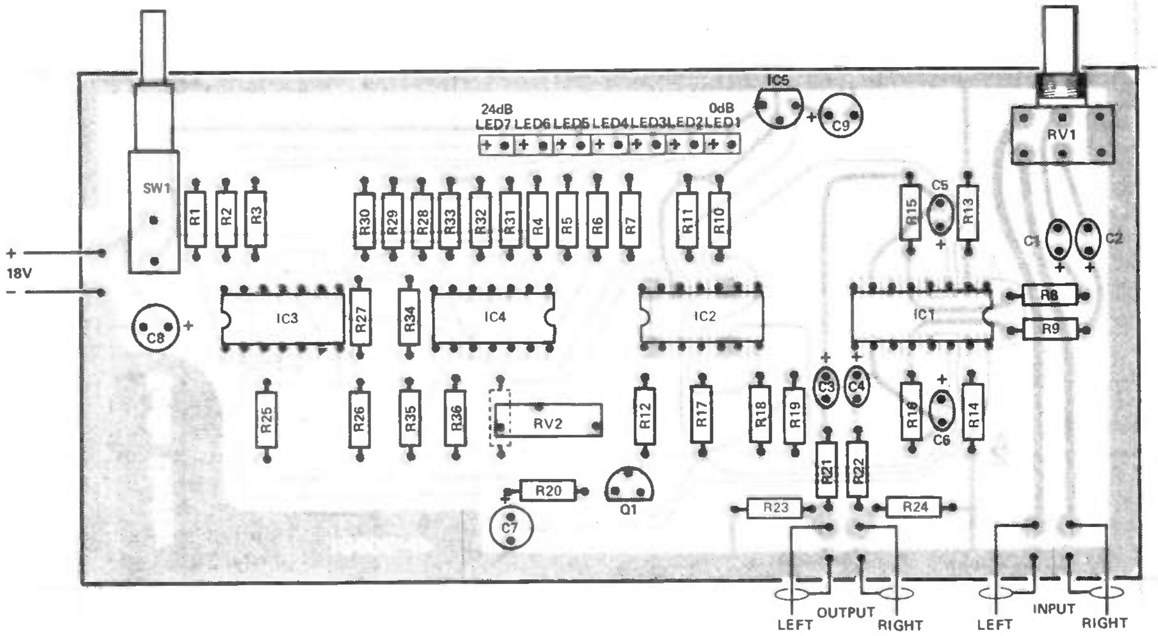
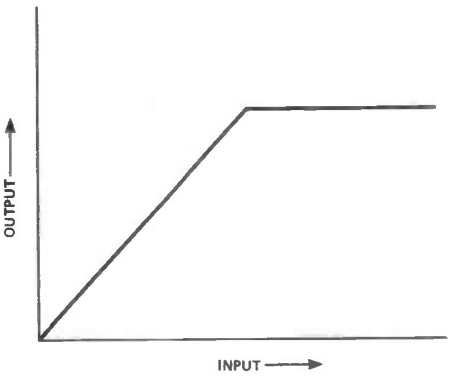


Figure 3. Component placing on the single PCB.

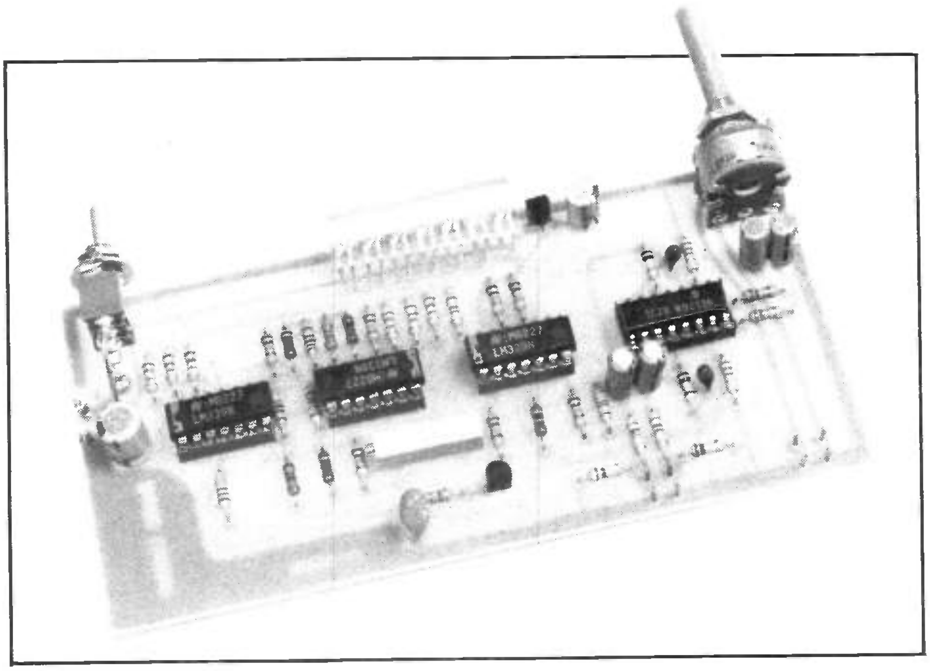


Transfer Characteristics

Plotting the input against the output (*Fig. 4*), we see that a 1:1 relationship is maintained until the onset of limiting. At this point, despite the input level continuing to increase, no more increase in output level occurs. No perceivable increase in distortion should occur during limiting, and this should be maintained over a reasonable overload range (about 20dB). The limiting action should be capable of being induced by both the positive and negative components of the audio signal, since asymmetry may occur by at least 6dB.

It is usual to have some visual indication of the amount of limiting being applied to a signal, in order to quantify the aural sensation and to ensure proper line-up with other receiving and sending equipment. The amount of limiting is then related to the error voltage stored on the time constant capacitor.

Figure 4. Plot of input against output in a typical recording environment.



Construction

Nothing too problematic here. Plan the construction so that pins go in first, along with any links, and then follow up with the IC holders. The IC holders give good points of reference when looking back at the printed layout. After completion check and double check before turning on.

Setting Up

The circuit relies on certain potentials being fixed, and so we recommend the use of the regulator IC5, even on batteries. The normal current drain is fairly low, around 14mA, and so it *is* feasible for limited use on two PP3's — bear in mind that as soon as half the LED's are on, the consumption rises to 44mA. When the unit is first connected to a power source one, or several, LEDs may stay on. RV2 should then be adjusted until D1 just extinguishes. If however, no LEDs stay on, RV2 should be adjusted until D1 comes on, and then back again until it just extinguishes (RV2 needs no further adjustment).

A source of tone should be connected to both inputs of the limiter and then RV1 adjusted, along with the tone level if necessary, so that D1 is fully on. At this stage the tape recorder inputs should be connected to the limiter's outputs and the gain of the recorder adjusted until the VU meters read +3VU. The tone source is taking the place of what would be normally connected to the tape recorder inputs. You may now remove it and plug in any other input sources. RV1 should be used as the gain control and the tape machine gain control left as originally set.

■ R&EW

PARTS LIST

Resistors

(All 5% carbon unless stated otherwise)

R1,2,3,4,5,6,7	2k2
R8,9,12	10k
R10,11,18,30,31,36	10k 1% metal film
R13,14	2M2
R15,16,23,24	100k
R17	180k 1% metal film
R19,25	33k 1% metal film
R20	470R
R21,22	100R
R26	27k 1% metal film
R27	4k7 1% metal film
R28	22k 1% metal film
R29	3k3 1% metal film
R32	15k 1% metal film
R33	820R 1% metal film
R34	12k 1% metal film
R35	560R 1% metal film

Potentiometers

RV1	10k log dual gang
RV2	50k 20 turn preset

Capacitors

C1,2,3,4	1u 16V radial
C5,6	1u tant
C7	22u tant
C8	470u 25V radial
C9	47u 25V radial

Semiconductors

Q1	BC307
IC1	NE570
IC2,3,4	LM339
IC5	78L15
D1-7	5mm LED

Miscellaneous

SW1	SPCO min toggle

PP3 connectors (3 off), 6PC half pins, 14 pin IC socket (3 off), 16 pin IC socket, knob, case, PCB etc.

EVENTS: MOBILE RALLIES May 1983

April 9th	Amateur Radio Demo	Spitfire Youth Centre Biggin Hill.	GB4BHC
April 10th	Swansea ARS Rally	Patti Pavilion, Swansea	GW4HSH (0792) 404422
April 13th	Lincoln SW Club (Contest Preparation)	City Engineers Club, Lincoln	G8ZHP, G6COL
April 18–20th	Circuit Technology '83	The Kensington Exhibition Centre	(0799) 22612
April 19–21st	All-Electronics/ ECIF Show	Barbican Exhibition Centre	Samantha Clarke (0799) 22612
May 1st	Maidstone YMCA ARS Mobile Rally	Loose Rd, Maidstone.	G31SD Sittingbourne-77431
May 8th	Lincoln Hamfest '83	Lincolnshire Show Grd.	G5FZ, G6COL

RF FILTER DESIGN

An explanation of the basic elements of RF bandpass filter design.

C. G. Gill

The basic element of bandpass filters is a parallel tuned circuit, which amongst other properties has an amplitude response plotted against frequency as indicated in ***Fig. 1***. The shape of the response is a function of two main factors *viz*. The characteristics and associated losses of the actual components used and the load applied to the circuit in order to extract output from it.

The quality or performance of such a filter element can be expressed by a quality factor Q, which defines the response and is mathematically equated to the resonant frequency F_o divided by the 3dB or half power bandwidth ΔF.

$$1. - Q = \frac{f_o}{\Delta f}$$

e.g. for a 3dB bandwidth of 1MHz at a centre frequency of 145MHz, Q=145. If the 3dB bandwidth was 0.5MHz then Q=290. NB, the higher the Q, the narrower the response.

The Q of a filter element is usually expressed in two forms. One is the unloaded Q, Q_U, and is equal to the maximum achievable Q of the element. The other is the loaded Q, Q_L, which is the Q of the element with a load applied, and can be expressed as the in circuit or working Q. Q_L is always less than the unloaded Q as the load resistance appearing across the circuit effectively damps the resonance resulting in a wider less selective response. An important concept now emerges from the theory.

Normalised Q Curve:

$$a = Q_L \frac{f - f_o}{f_o}$$

$$\text{Rel: Attn: } = -10 \text{ Log } 1 + 4a^2$$

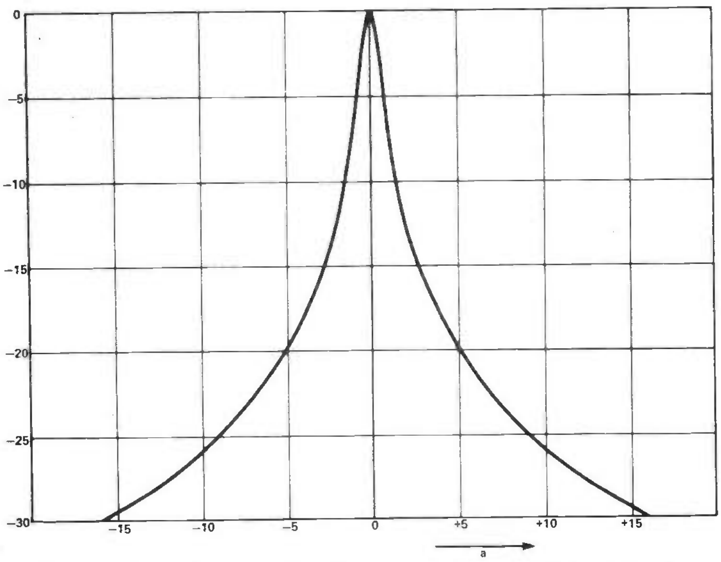


Figure 1: Amplitude vs frequency of a typical parallel tuned circuit.

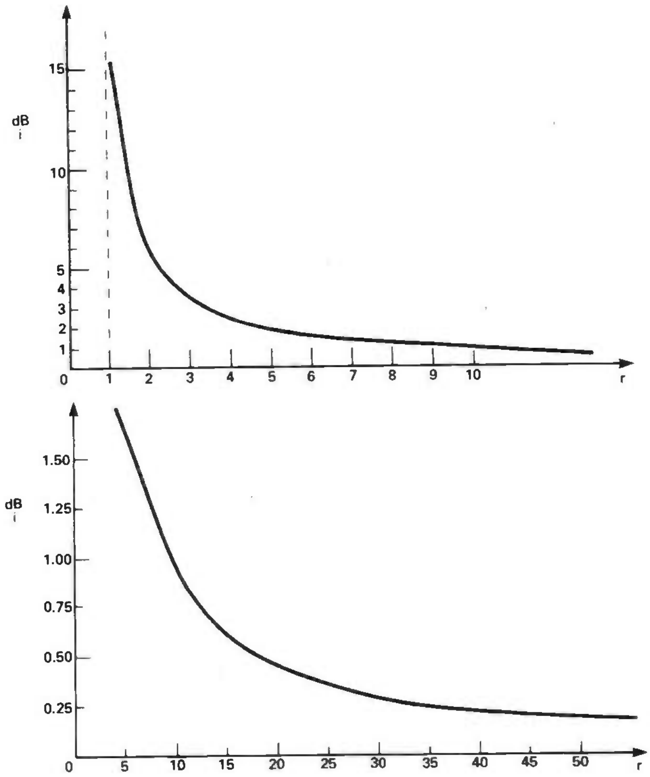


Figure 2: Insertion loss of a filter plotted against r the ratio of the unloaded to loaded Q of the filter.

NB, the insertion loss I in dB through a filter element is determined by the ratio r of the unloaded to the loaded Q.

$$\text{for } r = \frac{Q_U}{Q_L}$$

$$2. - I = -20 \log \frac{r - 1}{r} \text{ in dB}$$

This shows that for a fixed unloaded Q the lower the loaded Q the lower the insertion loss. The insertion loss for different values of r is shown in ***Fig. 2*** with an expanded scale for a low loss situation.

Practical Design Considerations

The definition of a filter requirement stating the insertion loss for a given response is all we need to know to commence our design. If we consider our previous example of Δf=1MHz and Q=145 we can see from ***Fig. 2*** that for an insertion loss of 1dB the ratio r=9. If the loaded Q is to be 145 then the unloaded Q must equal 1305 which is very high if we consider that a typical circuit, say 4 turns of 1mm dia copper wire on a 4mm former will yield a Q of less than 200 at 145MHz.

The outcome of these considerations is that to achieve a given loaded Q we must strive to achieve the highest unloaded Q possible in order to reduce the insertion loss.

The unloaded Q of a resonant circuit is determined by the quality of the components from which it is made and the constructional techniques employed. To achieve the best unloaded Q that we can, we should generally follow three basic rules.

1. The coil should have few turns to reduce the series resistance element and should be wound with copper wire of as large a diameter as is practical. If the filter is built for UHF or even high VHF then the skin conductivity becomes important, and silver plated wire is preferable to tinned, as the conductivity of lead is poor compared to copper or silver. Any core material should have as high a Q as possible at the frequency in use.

2. The capacitor should be of good quality, ideally air spaced, although the use of modern ceramic or PTFE type usually means that the capacitor will not limit the Q until the frequency is greater than 500MHz.

3. The construction should keep any connections between coil and capacitor to as low a resistance as possible ie, as short as possible. ***Fig. 3*** shows two typical constructions and their approximate unloaded Qs.

If we use the examples shown in ***Fig. 3*** and set a figure of 1dB as the insertion loss, then from the required ratio r=9 from ***Fig. 2*** the loaded Q's of these examples are approx 13 and 22. These will have associated 3dB bandwidths of 11 and 7MHz if f_0=145MHz, which is not very good if we have a filter required to protect a 2 metre receiver from adjacent signals.

The response of our filter along with the insertion loss are the two most important criteria for our design. We have discussed the insertion loss, so now, how can we consider the response. For this purpose we use what is known as a universal selectivity curve which is in fact ***Fig. 1***. This curve enables the attenuation for a given offset from the centre frequency to be easily evaluated graphically. The graph is plotted as relative attenuation A_L in dB against a, where a is a derived factor from

$$3. - a = Q_L \frac{f - f_o}{f_o}$$

$$\text{and} \quad 4. - A_L = -10 \log 1 + 4a^2$$

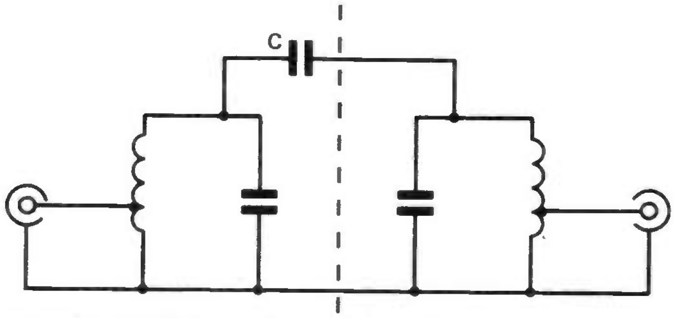
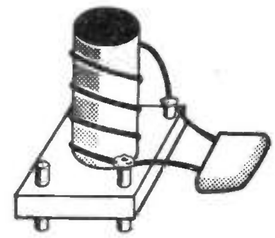


Figure 4: Coupled circuits result in better attenuation while maintaining a reasonable working bandwidth.

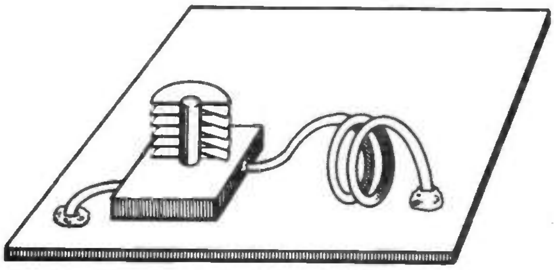
To use the curve let us assume we have our element at 145MHz and Q_L=20. If we require to know the attenuation at TV Band III say 220 MHz then for F = 220 MHz, Fo = 145MHz and Q_L = 20 from 3. a = 10.34, referring to ***Fig. 1*** this will yield a relative attenuation of 27dB which when added to the insertion loss will give the total attenuation from input to output.

The curve can naturally be used in reverse, that is given a required attenuation at a given offset, we can evaluate the required loaded Q. For this derived Q_L we can then refer to ***Fig. 2*** and cross referencing from our required insertion loss, r and hence Qu can be determined.

Figure 3: Typical construction of filters together with their typical unloaded Qs.



(a) Q≏120



(b) Q≏200

If the required attenuation cannot be achieved using one filter element then more can be used, say one before an amplifier and one after. This will produce the required attenuation but will also reduce the 3dB bandwidth which may be an undesired result.

The normal method of achieving better attenuation whilst maintaining a reasonable working bandwidth is to use two or more elements coupled together to form our filter. The most useful and easily realised construction is to use two parallel tuned circuits coupled together, a typical circuit of which is shown in ***Fig. 4***. The two elements can be constructed as shown in ***Fig. 3*** and should be identical. The value of C will determine the level of coupling. The larger the value the more the coupling, a typical value will be 0 — 5p. Assuming a constant load across each element, then varying the coupling will produce differing responses as shown in ***Fig. 5***.

For best overall performance the critical coupling is the one

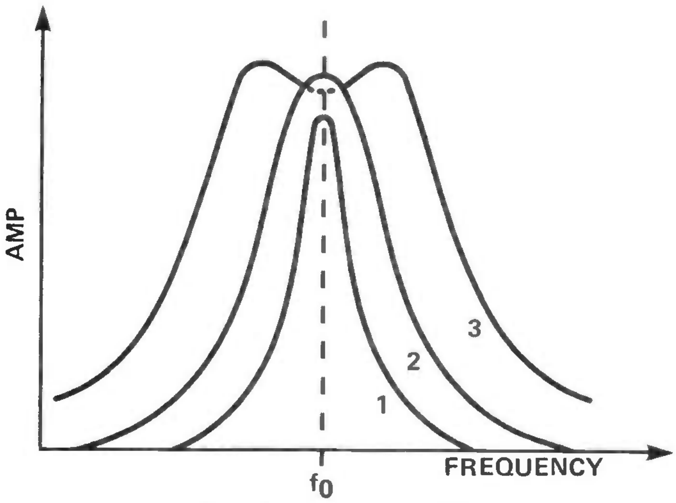


Figure 5: The result of varying the coupling between two filters. ▶

which is normally used as it represents the lowest insertion loss for a response with an identifiable peak at the centre frequency. The presence of this peak allows simple alignment by tuning for minimum loss without the need for complex methods or test equipment.

The example shown in ***Fig. 4*** uses inductive tapping to match the input and output. This is the most commonly used method and allows simple calculations for matching purposes. If we consider the output side of the filter with a 50R load then we can evaluate the load which actually appears across the tuned circuit itself. This load resistance is equal to the square of the turns ratio of the tap position to the total number of turns used because the impedance increases with the inductance, and the inductance, in turn, increases as the square of the turns. For example if the coil has 4 turns and the tap is at 0.5 turns then the turns ratio is 8:1 and the impedance ratio is therefore 64:1. This means that for a 50R load the resistance across the element will be 3200R. From this we can see that to adjust the response of our filter element ie, the loaded Q, we can adjust the tapping position of our source and load to reflect a different load impedance across the element.

Having altered our loaded Q we must then readjust the coupling to obtain our critically coupled response. Tap up the coil and increase the coupling to reduce the loss at the expense of selectivity. Tap down the coil and reduce the coupling to achieve better selectivity at the cost of increased loss. It is important that the load resistances across our elements are equal and we must adjust the tapping positions relative to one another if the input and output impedances are unequal. For example, if the output is a 50R load and the tap is at 0.5 turns then if the drive source has an impedance of 200R it must be tapped at 4:1 impedance ratio which is 2:1 turns ie, 2×0.5, 1 turn. It is important to note that the filter has now become a matching device as well as a source of selectivity.

The coupled pair filter is a common component of many RF designs and our considerations have shown that to achieve the best performance the unloaded Q of the tuned element must be as high as possible. The most effective method of achieving this aim is to use the so called Helical Resonator as the parallel tuned element. This is in fact a slow wave transmission line in a cavity and we can now consider a simplified method of designing coupled pair filters constructed using these resonators.

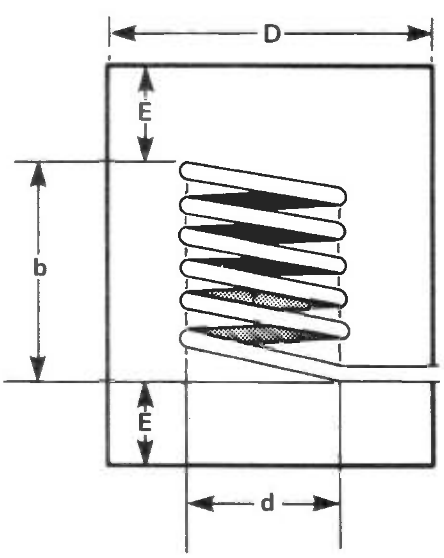


Figure 6: The basic design of a circular cavity filter.

For the purpose of outlining the design process we will use an example of a filter for a 2 metre transverter with a 1dB insertion loss to make it suitable for TX or RX. If we now consider our critically coupled pair the theory shows that the loaded Q of each resonator is $\sqrt{2}$ times the loaded Q of the filter itself. Therefore if we determine the loaded Q of the filter required we can proceed. For operation on 2 metres we require an operating bandwidth of 2MHz for say a 1dB degradation at the band edges. To make our filter as narrow as possible we will therefore have a 1dB bandwidth of 2MHz with f_0 = 145MHz.

To calculate the 3dB bandwidth merely multiply the 1dB bandwidth by 4/3 for a critically coupled pair. This gives a 3dB bandwidth of 2.66MHz and a corresponding loaded Q, Q_{LF} of our filter of 145 ÷ 2.66 = 54.39. The loaded Q of each resonator $Q_{LR} = \sqrt{2} \times Q_{LF}$ = 76.90.

We can now check what attenuation we will get at say the image frequency. Using an IF of 29MHz this frequency is 145 — (29× 2) = 87MHz. Referring to ***Fig. 1*** we can first calculate a = 76.9 x ((87–145)/145) = 30.76. This is off our scale so we can at least see that the attenuation will be in excess of 30dB/resonator or 60dB for the filter, a very acceptable performance.

Pursuing our design we now consider the insertion loss of 1dB which is 0.5dB/resonator. Referring to ***Fig. 2*** a loss of 0.5dB gives a Q ratio r = 18. The unloaded Q, Q_{UR} of each resonator is $Q_{LR} \times 18$ = 1384. We can now design the resonator itself. The basic design will be a circular cavity of the type shown in ***Fig. 6***, although it can be square and this will be discussed later. ***Figures 6*** and ***7*** show the design parameters where d_o is the wire diameter and dimensions d,b and τ, which is the winding pitch, are measured from the mean of the wire diameter as shown in ***Fig. 7***. From the theory we can achieve a good performance if we accept a set of basic rules.

1. $1.0 < b/d < 4.0$ (1.5 is optimum for minimum volume)
2. $0.45 < d/D < 0.6$ (0.55 is a good figure)
3. iF b/d from i = 1.5 then $0.4 < d_o/\tau < 0.6$ say 0.5 for a diameter spaced winding
4. $\tau < d/2$
5. E ⩾, D/4 in order to reduce the end effects.

The procedure for design is:-

1. Find D in inches from $Q_{UR} = 50D\sqrt{fo}$ where fo is centre frequency.
(In our example $Q_{UR} = 1384 = 50D\sqrt{145}$ = 2.3")
2. Find the number of turns from N = 1920/(fo × D)
(In our example N = 5.75)
3. Find the winding pitch τ from τ = 1.2D/N
(In our example τ = 0.48")
4. Find d the winding diameter from d/D = 0.55
(In our example d = 1.26")
5. For b/d = 1.5 for min volume find b from b = D/1.2
(In our example b = 1.91")

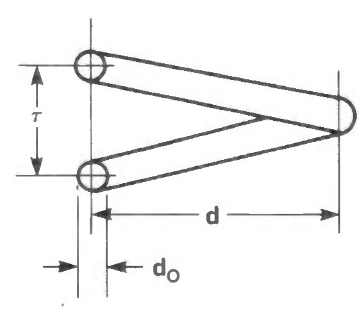


Figure 7: Winding measurements are taken from the mean of the wire diameter.

We now have all the basic parameters of our resonator design ie, Diameter = 2.3", number of turns = 5.75, wire diameter = $\tau/2$ = 0.24".

This is quite a large resonator and gives a good indication of the size required to achieve as narrow a filter as possible. NB, the performance of a helical resonator is proportional to its physical size, double the size, double the Q. In a real filter design we would not design for minimum bandwidth as allowance must be made for tuning adjustment and possible temperature drift. To allow for these factors firstly always design for slightly more than the highest frequency required as tuning will reduce the frequency to that required. Secondly always allow at least a 50% increase in 3dB bandwidth to allow for temp. variations as a general rule. To simplify the design process even further we can use the general solution which represents a good compromise as shown in ***Fig. 8***. We compute D as before and use ***Fig. 8*** to determine the dimensions, then compute N and τ as before to give also do = $\tau/2$ to complete the resonator design.

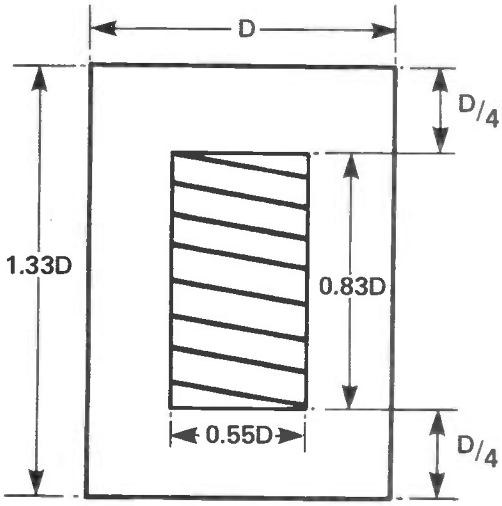


Figure 8: An illustration of a simplified design procedure.

To make our 2 metre filter more practical let us design for f_0 = 150 MHz and a 1dB bandwidth of 3MHz this will give an unloaded Q, Q_{UR} = 954 with

D = 1.59"
N = 8.05 turns
τ = 0.24"
do = 0.12"
d = 0.88"

The next step in our design process is to determine the coupling. The coupling is formed by a slot in the wall separating the two resonators as shown in ***Fig. 9*** with the depth of the slot determining the level of coupling. The deeper the slot the greater the coupling. To evaluate h for our filter, considering critical coupling, KQ_{LF} = 1 where K = coupling and Q_{LF} is the loaded Q of the filter. Or $KQ_{LR} = \sqrt{2}$ when Q_{LR} is the loaded Q of the resonator. In our example Q_{LR} = 954 and $K = \sqrt{2}/954 = 0.0015$. Assuming the dimensions shown in ***Fig. 9*** then using the formula

$$K = 0.071(h/d)^{1.91}$$

We can evaluate h = 0.9 " using d = 0.88"

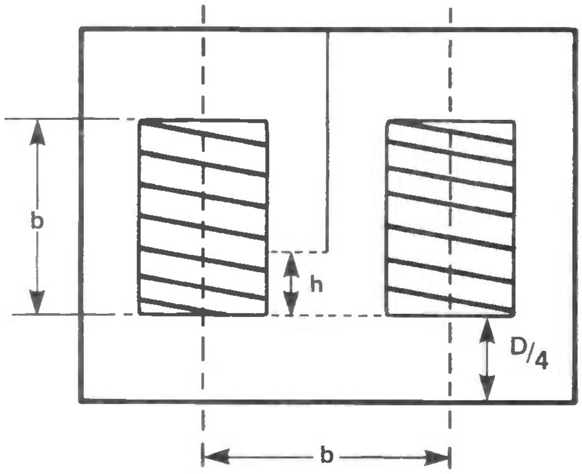


Figure 9: Coupling of filters is achieved by cutting a slot in the wall separating two resonators.

To determine the actual depth of the slot we must add D/4 to h to calculate the total depth. The depth in our example is 1.3" and the width is assumed to be equal or greater than d to allow the whole width of the coil to be projected across the gap.

To complete our design we must now evaluate the tap position and we will assume 50R input and output resistance for this filter design. To calculate the tap position we must first evaluate the characteristic impedance of our slow wave transmission Zo from transmission line theory

$$Z_o = \frac{98{,}000}{f_o\,D} \text{ for circular cavities}$$

(in our example $Z_o = \frac{98{,}000}{150 \times 1.59} = \underline{410.9\Omega}$

Secondly we must compute the doubly loaded Q Qd for our resonators. This is the working Q of the resonator loaded by the input or output resistance as well as the load imposed from the resonator coupled to another. For 2 resonators $Q_d = \sqrt{2}/2 \times Q_{LF}$ (in our example Q_{LF} = 37.5 so $Q_d = 0.707 \times 37.5 = \underline{26.5}$)

We can now compute a factor $Z_L = \frac{\pi}{4}\left(\frac{1}{Q_d} - \frac{1}{Q_{UR}}\right)$

(in our example Z_L = $\underline{0.0288}$)

This enables us to find the electrical angular position of the tap from

$$\sin\Theta = \sqrt{\frac{Z_L . R_{tap}}{2\,Z_o}}$$

Where R_{tap} = the impedance required ie, 50Ω in this case

(in our example Sin Θ = 0.0418 and therefore Θ = 2°24′ = $\underline{2.4°}$)

Our tap is placed at NΘ/90 turns from the earth end of our coil. (In our example = 0.214 turns ≏ ¼ turn).

We now have a complete paper design of our coupled filter and part 2 of this article will discuss the techniques used to turn paper designs into reality.

Reference

Anatol I. Zverev, handbook of filter synthesis pub. John Wiley & Sons inc.

■ R&EW

READERS LETTERS

Facts and opinions; Yours and Ours

Dear Sirs,
THE TELECOMMUNICATION APPARATUS (ADVERTISEMENTS) ORDER 1982 (STATUTORY INSTRUMENT 1982 NO 490) (THE "ADVERTISEMENTS ORDER")

THE TELECOMMUNICATION APPARATUS (MARKING AND LABELLING) ORDER 1982 (STATUTORY INSTRUMENT 1982 NO 491) (THE "MARKING ORDER")

A copy of the February 1983 edition of 'Radio and Electronics World' has recently come into our possession and I am writing to draw your attention to the fact that a wide range of telecommunication apparatus, which is capable of direct or indirect connection to British Telecom's (BT's) networks, now has to comply with the requirements of the above Orders.

The list of apparatus covered by the Orders includes modems and any unapproved apparatus capable of direct connection to a telecommunication system run by BT. Acoustically coupled devices fall within the definition of "directly connected" in the British Telecommunications Act 1981 and, like other apparatus such as modems they may not be connected to BT's network unless the apparatus concerned has been approved for this purpose. While arrangements have been worked out for the type-approval of apparatus produced in volume, one-off items such as DIY apparatus are subject to individual approval, the testing fees for which would probably amount to at least £1,000. This sort of expense would normally outweigh any advantages of home construction. I should be grateful, therefore, if you would carefully consider whether there is anything to be gained from publishing further articles which encourage your readers to construct apparatus for connection to BT's network and should you decide to continue doing so, I think it would help your readers to point out that British Telecom may require unapproved apparatus to be disconnected from its network and if a user declined to do so, could disconnect his service at the public exchange.

I would also ask you to bear in mind that the publication of an advertisement which infringes the Advertisements Order is an offence for which penalties are laid down in the above Act. Under the Order, advertisements for the supply, in the course of any trade or business, of certain descriptions of telecommunications apparatus that are capable of being connected (either directly or indirectly) to any telecommunication system run by British Telecommunications, must contain an appropriate symbol and a statement as to whether or not the particular apparatus to which the advertisements relate is approved apparatus. The advertisement for portable acoustic couplers on page 57 of your publication does not contain this symbol or statement, and infringes the Advertisements Order unless the acoustic coupler is approved for connection to BT's network. It is important that consumers should have this information because, as I have already pointed out it is unlawful for any person to connect unapproved apparatus, either directly or indirectly, to any telecommunication system run by BT. I hope that you will bear these points in mind in order to ensure that your readers do not find themselves in difficulties because they are in breach of the Act.

Unsuitable subscriber's apparatus can have a serious adverse effect on the quality of service offered by the public telephone network, and may even endanger BT's staff if it is possible for mains or other high voltages to be connected to telephone lines (eg under fault conditions). This safety risk is particularly great in the case of home built mains powered apparatus with an electrical connection to the network (not a likely problem in the case of an acoustically coupled device). But excessive signal levels may cause crosstalk in the network impairing other subscriber's service, while if a feedback path with sufficient gain were unintentionally established sustained oscillation could occur causing interference to other subscribers. Excessive or out of band carrier signals may interfere with network signalling.

These are just examples of the kind of problems that can occur if there were no control over subscriber's apparatus. There are other more subtle effect on service quality, eg if apparatus can worsen network congestion. Although the effect of a single item may be insignificant (except where safety is concerned), the effects are cumulative and could become serious if there is not appropriate technical control over subscriber's apparatus. This is why the Government has made careful arrangements for the independent approval of apparatus for connection to BT's networks.

The Marking and Advertisement Orders are designed to help users so that they do not unwittingly contribute to a deterioration in their service nor risk action by BT to remove unapproved apparatus. I have explained the background in the hope that 'Radio and Electronics World' will cooperate with the Department of Industry in ensuring that the advantages of competition in telecommunications are not offset by an avoidable deterioration in everybody's service.

Copies of the Orders I have mentioned can be obtained from HMSO, price £1.25 each.

J.P. Compton
London.

Dear Sir,
Some two weeks ago I sent you a letter asking for information regarding the power supply components ie, transistor, resistors, capacitor etc, for the Air Band receiver in your September issue of **R&EW** magazine which I have been buying since the first issue. I have also noticed in your letter column that I am not the only person to complain of missing component values in your well designed projects I have sent two letters on this matter the second had a stamped addressed reply and I still have had no reply. Hoping to hear in the near future.
Mr. E. Richardson.

Waiting Game

Thank you for your letter Mr. Richardson. If you've read any of our recent letters' pages you'll know why your first letter to us went unanswered – it had no SAE. Despite repeated statements to the effect that we **cannot** *answer queries that are not accompanied by an SAE some 50% of requests for assistance arrive sans payment for the return journey. As to the delay in replying to your second letter, our first priority is to get the magazine to our printers on time and answering enquiries must come lower down on our list of priorities. We try to answer all letters as soon as possible but you must bear with us if we don't respond 'by return'.*

As to your other point about missing component values in our 'well designed projects' we've slapped the wrists of those responsible and, injuries permitting, they've promised to do better in future.

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Computing News

Gary Evans returns to the subject of literature this month and has some dates for your diary.

The plethora of low cost computers that have, or are about to, hit the market have spawned slickly produced publications that aim to explain the intricacies of the machines in greater detail than the generally poor quality user manuals provided by the manufacturers. The standard of these supplementary instruction manuals is usually high, particularly if they're from a reputable publishing house.

A fair number of this sort of book have crossed my desk recently and having read, or at least scanned, most of them, one thing in particular caught my attention. This is the fact that the various titles are not as machine specific as one might expect from the titles. "Getting to know your X" or "The X revealed" are titles that suggest a large degree machine specific material. Not so. At least two titles from the same publisher contain whole chapters that could be swapped between the two books with only minimal changes to the text.

Now of couse it can be said that as many of the computers share many features — they all use a TV as the VDU, use cassette tapes as the mass storage medium and use similar dialects of BASIC — this duplication of explanations might be expected. It strikes me however, that it might be better to produce a general title for those who are unfamiliar with setting up TV sets for use with a computer, using cassette recorders etc, and to reserve the 'dedicated' titles for a meatier explanation of the hardware and software peculiarities of the various machines. This would mean that for the £6.00 asked for these sort of titles, the reader would at least get more facts/pound.

Diary Dates

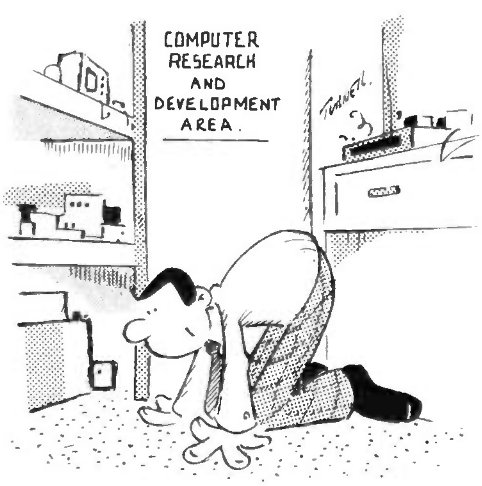
Civilisation as we know it does not exist North of Watford. This sort of attitude was amongst those of us living in London and the South East in the past but I'm glad to say the Watford intellectual barrier is starting to crumble. A couple of years ago, no self respecting Londoner would have considered treking up to Birmingham to attend exhibitions. The advent of the NEC has certainly changed that attitude and events staged at the centre attract significant numbers of people from the home counties.

Of the premier computing events of 1983, the annual Earl's Court Computer Fair is, naturally enough, sticking to its London base while a new venture 'Brainwave' is opting for the NEC Brainwave is still a fair way off (4th to 6th November) but I'll mention it now for those of you whose diary's look rather blank after the month of April.

The main theme of Brainwave will be computing in all its forms, with particular emphasis on the lower cost end of the market. The organisers hope, however, that the show will not be solely a computing fair. It's expected that video equipment, Hi-Fi, electro music, and other areas of the consumer electronics industry will also be represented. There's even talk of a Father Christmas (in November!) and a grand firework display (more appropriate for the time of year).

The concept of the show organisers hope to promote is that of a 'day out for the family'.

It is hoped that the show will attract large numbers of exhibitors and visitors alike and, although competition in the exhibition stakes is quite fierce, Brainwave looks as if it will be well worth a visit.



"JUST MY LUCK, BUILD THE WORLDS SMALLEST HOME COMPUTER, THEN GO AND DROP THE #?S!S¢ THING!"

Take The High Road

Continuing both the 'dates for your diary' and 'North of Watford' themes, there is news of a series of computer shows to be staged around Britain during the year. Organised by the people that brought you the London Home Computer Show in January, the, what might be termed computer road show, gets under way in Manchester at the end of April.

The show, like Brainwave, concentrates on the low cost end of the market (from £50 to £400 or to put it another way from ZX81 to BBC). Competitions, advice centres and demonstration areas plus other assorted attractions make the shows sound as if they might be fun, particularly as with the multitude of venues, they're bound to be virtually on your doorstep at some time during the year.

The Manchester show is being staged at the Midland Hotel from Friday April 22nd to Sunday April 24th from 10am to 6pm on the first two days and until 4pm on the Sunday.

The stalls will also be set up in the following conurbations thoughout the year: Glasgow in May, Birmingham in June, Nottingham in September, Newcastle in October and Bristol in December (I'll put up with Santa at this one).

Sinclair Speculation

Clive and Co., chose last year's Earl's Court show to launch the Spectrum and at that time demonstrated the micro drive disc storage system to go with the machine. It was, he said, still at the prototype stage but was scheduled for launch in a few months time. Almost a year on and we're still waiting.

Will he choose this year's show to launch the disc system or won't he? Will he have launched it between the time that I'm writing this and the time that you read **R&EW**? Is the answer 42?

I've started an office sweepstake on the launch date and another on the date when the first customer gets his hands on said object.

■ **R&EW**

R&EW Data Brief

LM346N

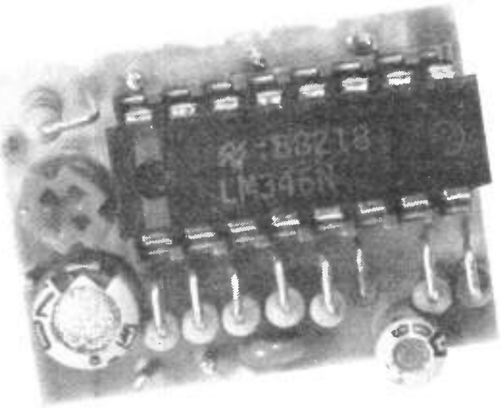
A sound operated switch based on a programmable op-amp.

The LM346N is a programmable, quad operational amplifier which, apart from possessing two extra programming pins, is pin compatible with the LM124 and LM148 (see ***Fig. 1***).

The four op-amps contained in the package are independent as far as inputs and outputs, but three share a common programming pin; the fourth having its own pin. Programming is via two external resistors which control the gain bandwidth product, slew rate and input noise, bias and offset currents. This allows the op-amp's performance to be tailored by trading one characteristic for another.

The LM346 has a maximum supply voltage of ±18V, with differential input voltage limits of ±30V (reduced to supply rails when using ±15V or lower).

The IC has internal compensation to provide an open loop gain of 120dB (output noise = 28nV/ Hz). The slew rate is typically 0.4V/us (see ***Figs. 2*** and ***3***).



Voltage Follower Transient Response

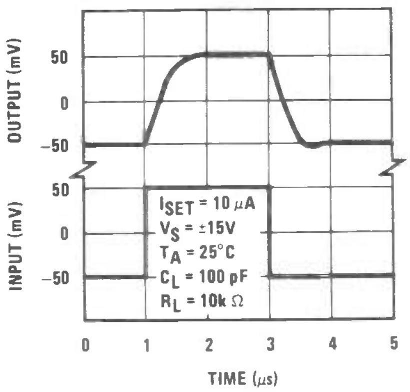


Figure 2: Transient response, showing input and output waveforms.

Voltage Follower Pulse Response

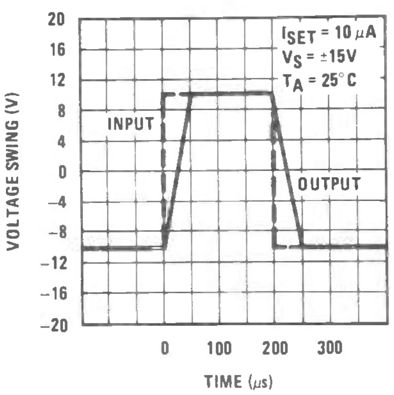


Figure 3: Pulse response against voltage swing.

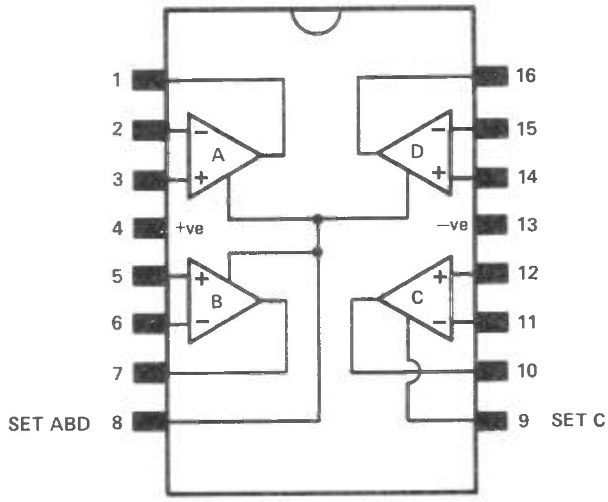
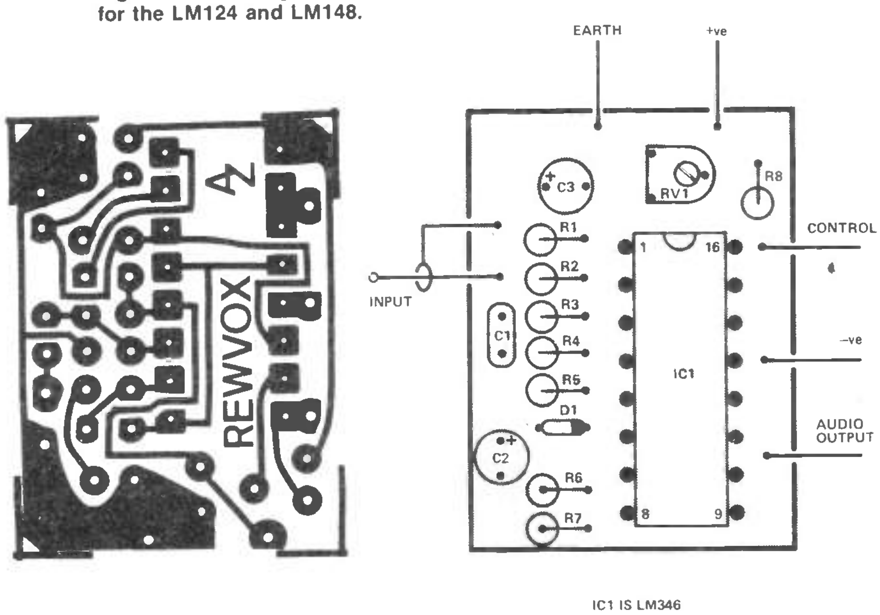


Figure 1: Pin configuration of the LM346N. The layout is identical for the LM124 and LM148.



Component overlay and foil pattern for the voice operated switch.

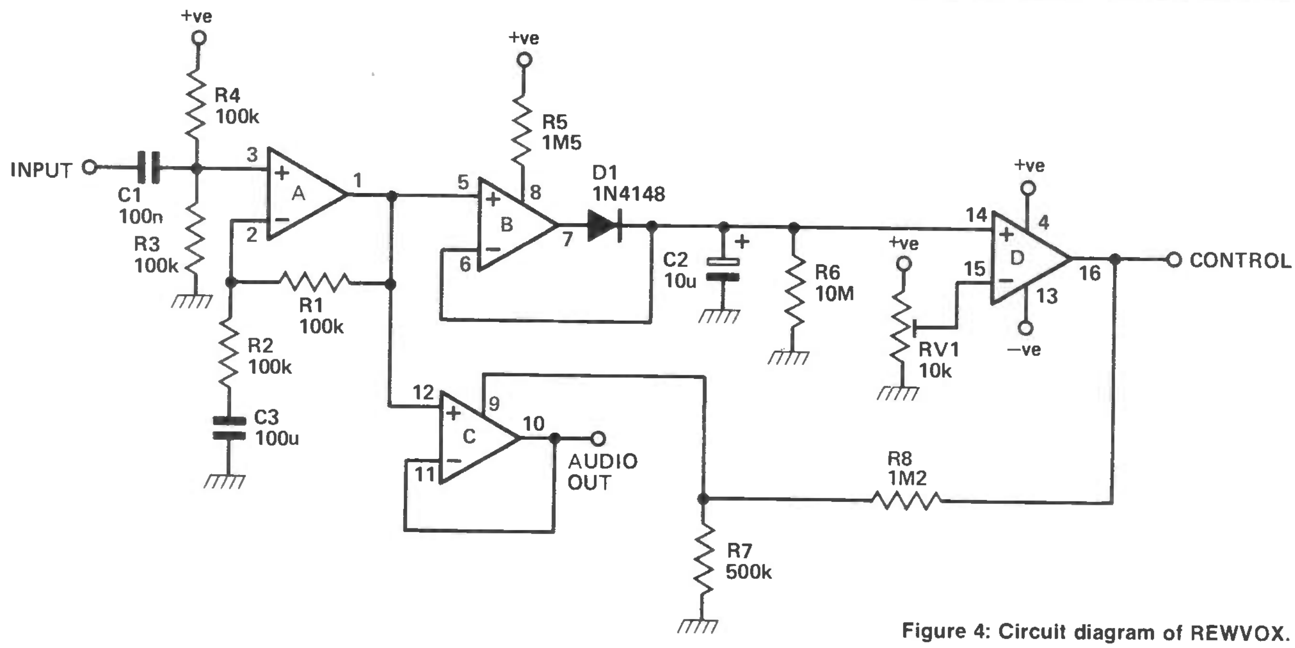


Figure 4: Circuit diagram of REWVOX.

REWVOX

One useful application for the LM346 is as a voice operated switch. The circuit operation is quite straightforward. Signals from a microphone are AC coupled, through C1, and amplified by op-amp 'A'. R3 and R4 take the non-inverting input slightly positive when there is no input (see ***Fig. 4***). If this level should be too high, triggering will be difficult due to the low level output from microphones. In this case R3 should be reduced.

Op-amp B is a unity gain buffer, with half-wave rectification provided by D1 so that C2 is charged as a result of positive-going peaks from the microphone. R6 discharges the capacitor, where the C2R6 time constant determines the 'turn off' delay.

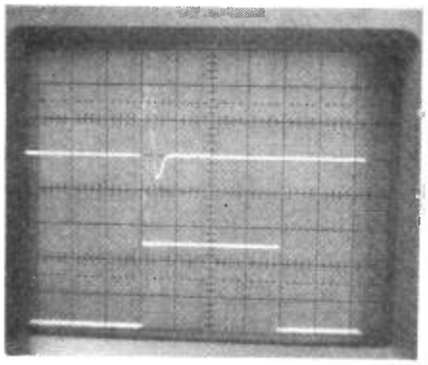


Figure 5: Control pulse obtained from REWVOX can be used to operate external devices.

The third op-amp has its inverting input set by RV1, the output going from negative supply to the positive rail when the level at the non-inverting input is higher than that at the inverting input. The output control voltage is taken from this point, and can be used to control tape recorders etc, as required (see ***Fig. 5***).

A portion of this control voltage is used to control the characteristics of the unity gain audio output buffer, according to the following parameters:

Absolute Maximum Ratings (Note 1)

		LM146	LM246	LM346
Supply Voltage		±22V	±18V	±18V
Differential Input Voltage (Note 1)		±30V	±30V	±30V
CM Input Voltage (Note 1)		±15V	±15V	±15V
Power Dissipation (Note 2)		900 mW	500 mW	500 mW
Output Short-Circuit Duration (Note 3)		Indefinite	Indefinite	Indefinite
Operating Temperature Range		−55°C to +125°C	−25°C to +85°C	0°C to +70°C
Maximum Junction Temperature		150°C	110°C	100°C
Storage Temperature Range		−65°C to +150°C	−65°C to +150°C	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)		300°C	300°C	300°C
Thermal Resistance (θ_{jA}), (Note 2)				
Cavity DIP (D) (J)	P_d	900 mW	900 mW	900 mW
	θ_{jA}	90°C/W	90°C/W	90°C/W
Molded DIP (N)	P_d			500 mW
	θ_{jA}			140°C/W

DC Electrical Characteristics (V_S = ±15V, I_{SET} = 10 µA, Note 4)

PARAMETER	CONDITIONS	LM146			LM246/LM346			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	V_{CM} = 0V, $R_S \leq 50\ \Omega$, T_A = 25°C		0.5	5		0.5	6	mV
Input Offset Current	V_{CM} = 0V, T_A = 25°C		2	20		2	100	nA
Input Bias Current	V_{CM} = 0V, T_A = 25°C		50	100		50	250	nA
Supply Current (4 Op Amps)	T_A = 25°C		1.4	2.0		1.4	2.5	mA
Large Signal Voltage Gain	R_L = 10 kΩ, ΔV_{OUT} = ±10V, T_A = 25°C	100	1000		50	1000		V/mV
Input CM Range	T_A = 25°C	±13.5	±14		±13.5	±14		V
CM Rejection Ratio	$R_S \leq 10$ kΩ, T_A = 25°C	80	100		70	100		dB
Power Supply Rejection Ratio	$R_S \leq 10$ kΩ, T_A = 25°C	80	100		74	100		dB
Output Voltage Swing	$R_L \geq 10$ kΩ, T_A = 25°C	±12	±14		±12	±14		V
Short-Circuit Current	T_A = 25°C	5	20	30	5	20	30	mA
Gain Bandwidth Product	T_A = 25°C	0.8	1.2		0.5	1.2		MHz
Phase Margin	T_A = 25°C		60			60		Deg
Slew Rate	T_A = 25°C		0.4			0.4		V/µs
Input Noise Voltage	f = 1 kHz, T_A = 25°C		28			28		nV/√Hz
Channel Separation	R_L = 10 kΩ, ΔV_{OUT} = 0V to ±12V, T_A = 25°C		120			120		dB
Input Resistance	T_A = 25°C		1.0			1.0		MΩ
Input Capacitance	T_A = 25°C		2.0			2.0		pF

Control Parameters

Total supply current = 1.4mA (I_{SET}/10uA)

Gain bandwidth product = 1MHz (I_{SET} .10uA)

Slew rate = 0.4V/us (I_{SET}/10uA)

Input bias current 50nA (I_{SET}/10uA)

I_{SET} = current into pin 8,9 (R_{SET} is R8,5)

= ($V^+ - V^- -$ 0.6V)/R_{SET}

Table 1. Programming parameters.

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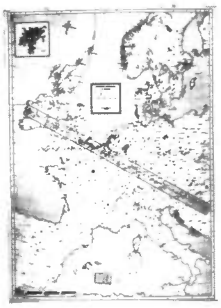

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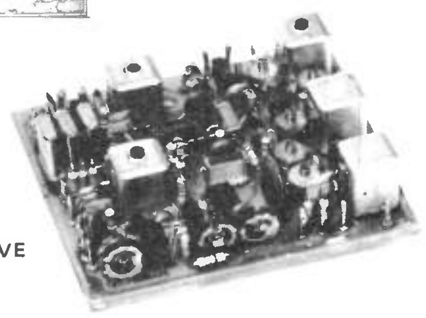

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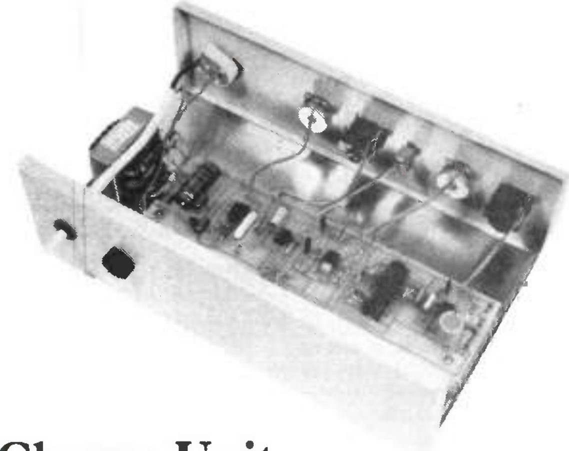
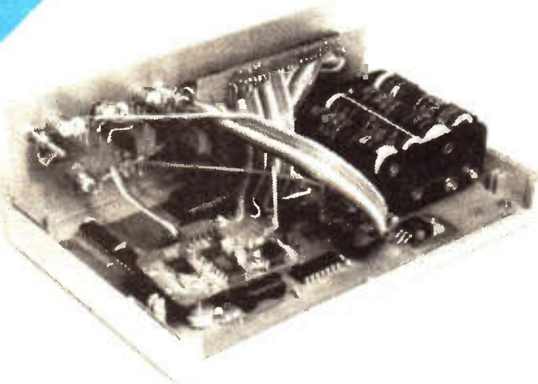


Chorus Unit

We hunted around for a design which didn't use op-amp filters or the now commonplace TDA1022 with its associated noise problems. Eventually we stumbled across a device with the right performance to produce a deep 'chorus' effect without noisy breakthrough. If you're into serious music, the R&EW Chorus Unit is well worth a listen.



WIDEBAND LCD-DFM

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Articles mentioned here are scheduled for the June issue but circumstances may dictate alterations to the final content of the magazine.

Also:

CIRCUIT MODELLER – computer assisted circuit design
DATA FILE – OTA's explained
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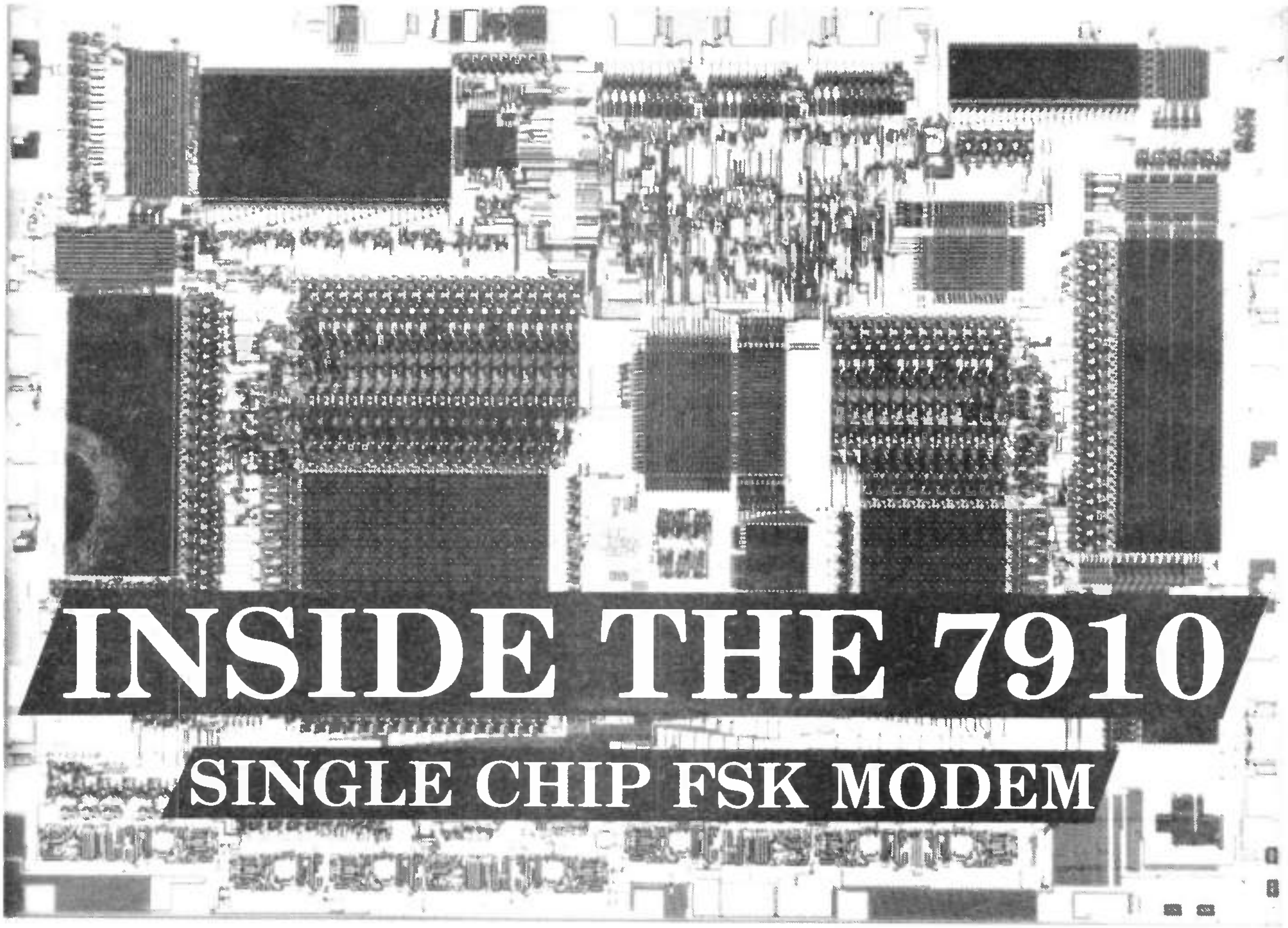

INSIDE THE 7910

SINGLE CHIP FSK MODEM

David Brain MSc* describes a new device which provides low speed modem applications using digital processing techniques.

Modem design has traditionally been associated with black boxes and 'the black arts'. The 7910 is the first device to exorcise this demonic possession and produce a circuit that the average digital designer can use as a standard building block.

The problems associated with designing and building a modem are as follows:-

- Much of the knowledge required is very specialised and detailed, and is not usually possessed by digitial designers- standards vary in different countries.
- Optimisation of filter characteristics can be awkward especially for a designer who's not used to the analogue world.
- A relatively large amount of board space is required for the various passive components. This can be expensive in space conscious applications.

The 7910 approach is to use digital processing (see later) to produce accurate on-chip filters which do not require external components or "tweaking" to achieve repeatable performance. Also, since the characteristics of digital filters are defined by numbers in a ROM, they are very easy to adopt for different standards and, in fact, the 7910 supports both US (Bell 103 and Bell 202) and the CCITT (V21/V23), which is used in the rest of the world. The chip can support speeds up to 1200 baud and has a 75 baud back channel which is useful for Prestel-like applications. Standard RS232/V24 interface control functions are also included.

*Advanced Micro Devices

Digital Signal Processing

Digital signal processing is the technique which makes the 7910 modem possible. Conventional modems use external filters (either active or passive) to perform the necessary bandpass filtering. These rely on precision resistors and capacitors which are relatively bulky and drift with temperature and voltage. Digital processing, however, relies on arithmetic operations. Digital numbers, rather than actual signal voltages, make it inherently accurate and repeatable.

Figure 1 shows a block diagram of a digital filter. The filter works by successively delaying the input signal, multiplying the delayed signal sample Y(n) by co-efficients C(n) and finally summing all the delayed samples. If the feedback path shown in the dotted line is not included in the filter, it is known as a Finite Impulse Response or FIR Filter, since a pulse input will give an output which is limited in time by the length of the delay element. If the feedback path *is* included, the response will be theoretically infinite and hence it is known as an IIR or Infinite Impulse Response filter. It can be shown mathematically that the effect of these operations in time is equivalent to filtering in the frequency domain. Therefore, high, low and bandpass filters can all be implemented with these structures. IIR filters usually need less hardware for a given performance, but require care in design since the feedback path can make them unstable.

The filters can be implemented either with a special hardware or (if speed is not important) can be programmed on a general purpose computer. ▶

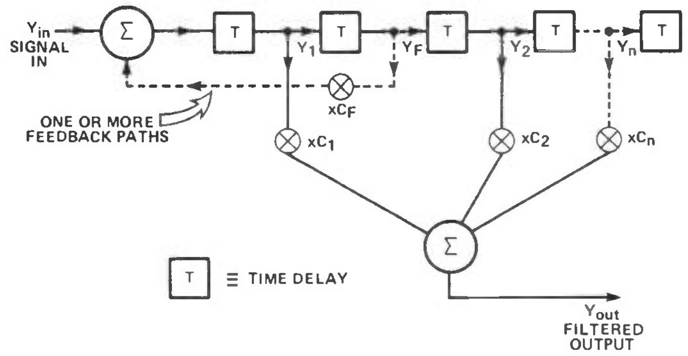

Figure 1. Block diagram of a filter, with feedback path shown by the broken line.

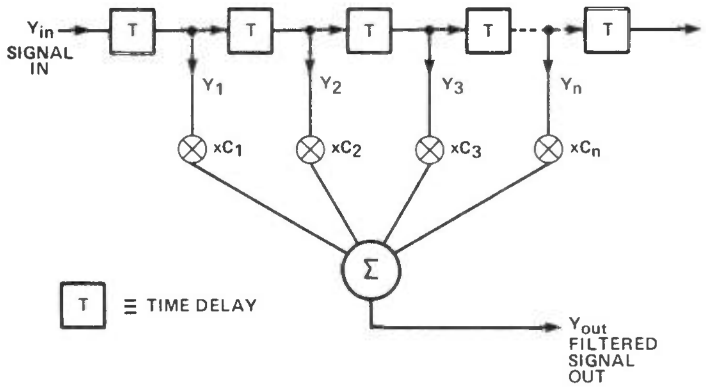

Figure 2. A similar filter without external feedback path.

The 7910 uses a specially designed ALU controlled by a microprogrammed on-chip ROM to implement all its filters. Filter coefficients for each operation are also stored in ROM and the MC lines are used to select which set is required.

Table 1. Operational characteristics as defined by the states of ▶ MC lines.

Architectural Design

A block diagram of the internal architecture of the chip is shown in ***Fig. 3***. The function of the transmitter section is to produce a sine wave output of one of two frequencies (mark or space corresponding to a one or a zero applied to the input). Unfortunately, a rapidly-changing frequency-shifted sinewave produces appreciable signal energy outside of these nominal frequency allocations, so extensive filtering is needed if severe interference to other phone users is to be avoided. Conventional modem chips use a voltage controlled oscillator to produce the signals and these usually require the designer to implement off-chip active filters (to clean up the spectrum) with all their attendant problems of accuracy and repeatability.

The 7910, however, as can be seen from the diagram, approaches the problem in a radical new way. The sine signal is stored as a series of values in a ROM which form a "piecewise" approximation to the final analogue signal. However *before* putting the samples through a digitial-to-analogue converter, they are passed through a digital bandpass filter on chip. Therefore, when the signal is produced at the output of the DAC, it is already clean. All the user is required to do is provide a crude analogue post filter to remove the high frequency

MC4	MC3	MC2	MC1	MC0	
0	0	0	0	0	Bell 103 Originate 300bps full duplex
0	0	0	0	1	Bell 103 Answer 300bps full duplex
0	0	0	1	0	Bell 202 1200bps half duplex
0	0	0	1	1	Bell 202 with equalizer 1200bps half duplex
0	0	1	0	0	CCITT V 21 Orig 300bps full duplex
0	0	1	0	1	CCITT V.21 Ans 300bps full duplex
0	0	1	1	0	CCITT V.23 Mode 1200bps half duplex
0	0	1	1	1	CCITT V.23 Mode 2 with equalizer 1200bps half duplex
0	1	0	0	0	CCITT V.23 Mode 1 600bps half duplex
0	1	0	0	1	Reserved
0	1	0	1	0	Reserved
0	1	0	1	1	Reserved
0	1	1	0	0	Reserved
0	1	1	0	1	Reserved
0	1	1	1	0	Reserved
0	1	1	1	1	Reserved
1	0	0	0	0	Bell 103 Orig loopback
1	0	0	0	1	Bell 103 Ans loopback
1	0	0	1	0	Bell 202 Main loopback
1	0	0	1	1	Bell 202 with equalizer loopback
1	0	1	0	0	CCITT V 21 Orig loopback
1	0	1	0	1	CCITT V.21 Ans loopback
1	0	1	1	0	CCITT V 23 Mode 2 main loopback
1	0	1	1	1	CCITT V.23 Mode 2 with equalizer loopback
1	1	0	0	0	CCITT V 23 Mode 1 main loopback
1	1	0	0	1	CCITT V.23 Back loopback
1	1	0	1	0	Reserved
1	1	0	1	1	Reserved
1	1	1	0	0	Reserved
1	1	1	0	1	Reserved
1	1	1	1	0	Reserved
1	1	1	1	1	Reserved

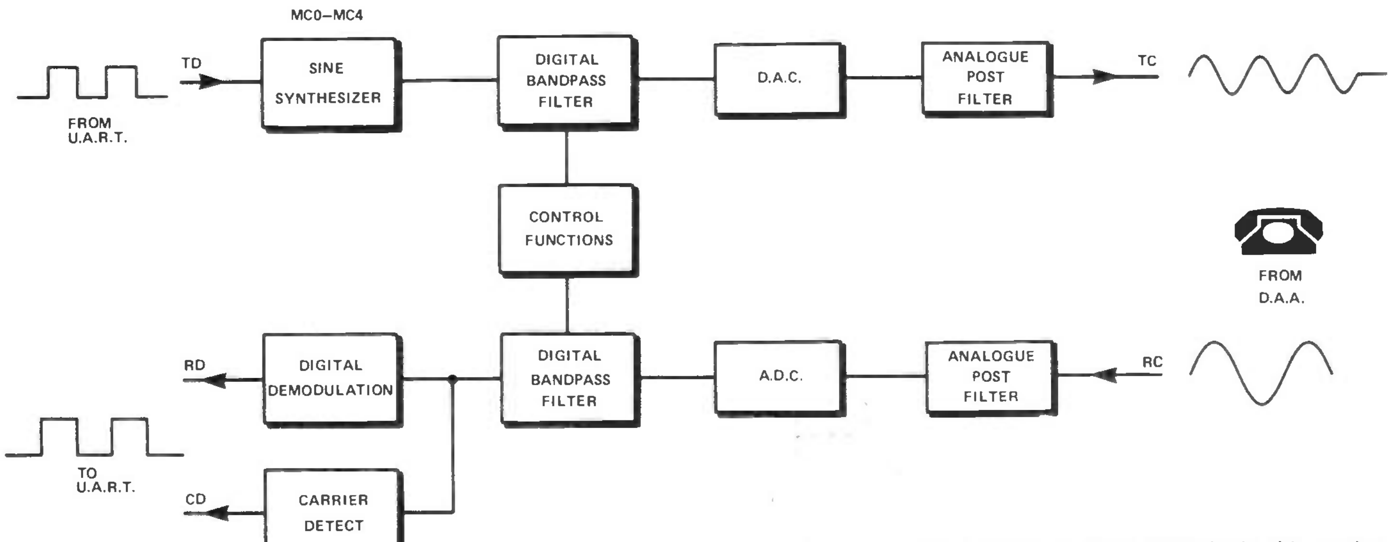

Figure 3. Internal structure of the 7910 single chip modem.

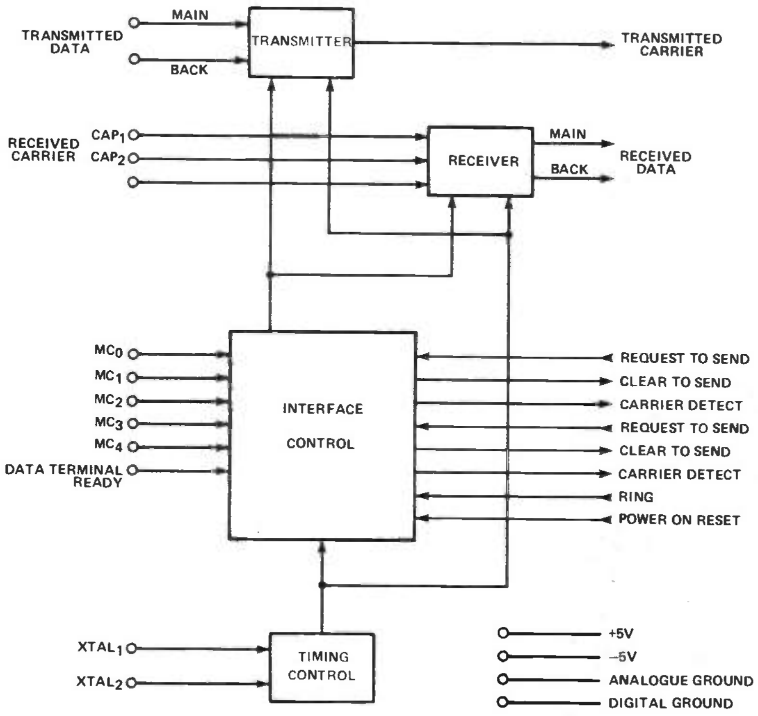

Figure 4. Control circuitry involved in modem design.

quantisation noise, produced as a byproduct of the digital-to-analogue conversion.

The receive section works in the opposite manner. A low pass anti-aliasing filter cleans up the incoming signal which is then oversampled and transformed into a digital signal. Extensive filtering and demodulation is then carried out on chip, and the required digital signal presented at the RD pin. Additionally, digital circuitry detects the presence of the carrier and indicates this via the CD pin. The MC_0-MC_4 lines are used to select the modem standard. Table 1 lists the standards and their corresponding codes. As can be seen, in addition to the standard operating modes, "loopback" modes are also included to facilitate testing of the circuit.

A Controlling Influence

Besides signal processing, the other aspect of modem design is the control circuitry. (***Fig. 4***) Reception and transmission of information must be controlled and synchronised by a set of interface signals defined by either CCITT (outside the US) or EIA. These signals allow the host terminal to indicate when it requires modem operation (data terminal ready) and when data transmission is required (request to send). The modem acknowledges the latter signal with the clear-to-send signal. The exact sequence of events to be carried out when one of these signals is activated is also defined.

The 7910 implements these functions on-chip and performs the correct sequences in line with these standards. This saves the user having to add extra control circuitry. Two sets of signals are provided: one for the main channel and one for the answerback channel (75 baud).

Another useful feature of the current modems is the auto answer facility, whereby a called modem can detect the ringing signal and place a tone on the line to tell the calling modem that it is ready to receive data. In most areas outside the US this is defined by CCITT standard V25.

The 7910 helps the user implement this function by means of the ring input. An active signal on this line will cause the V25 answer tone to be placed on the TC output for the appropriate time.

Figure 5 shows the chip used in a system. Interface can be either to a remote host via RS232 levels (as shown) or straight into a UART from a micro. External components consist of only a crystal for the on-chip oscillator, an RC network for the A-D converter and some line interface circuitry which, in the example shown, includes ring detect circuits. An acoustic coupler could be used as an alternative.

To summarise, the AM7910 chip provides the user with a complete system solution for low speed modem applications, utilising sophisticated digital processing techniques to combine optimal and consistent performance with ease of use.

■ **R&EW**

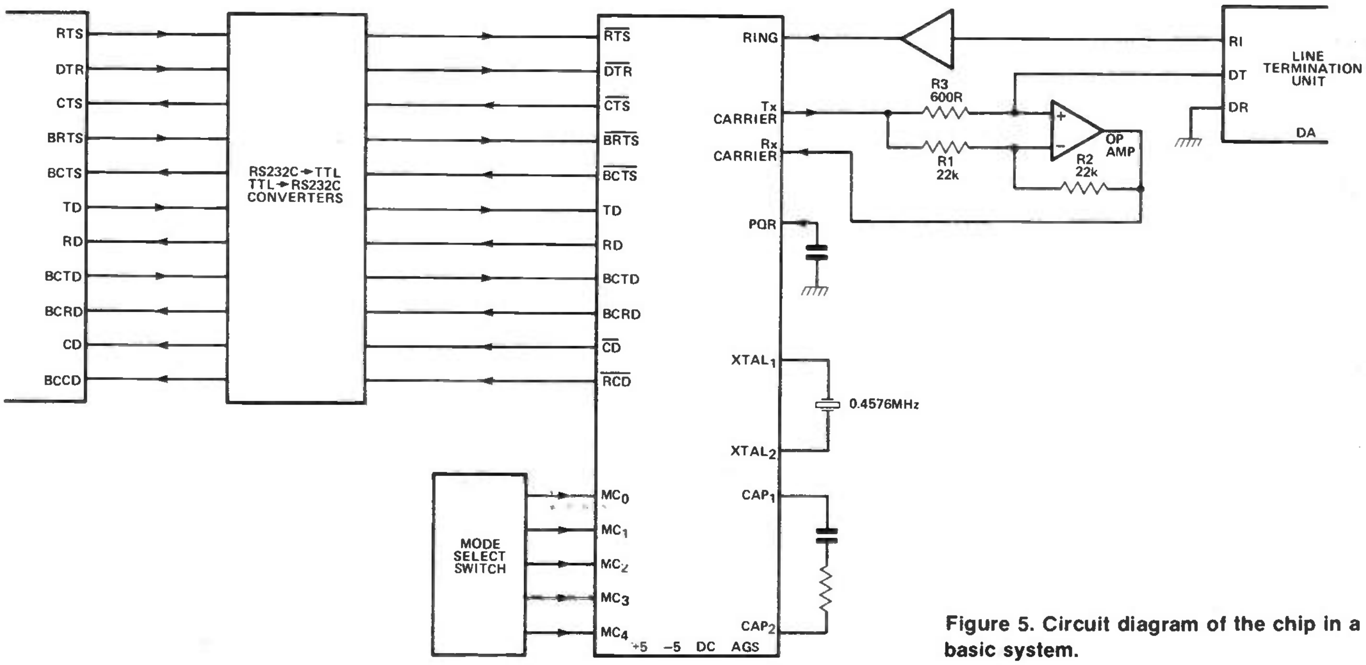

Figure 5. Circuit diagram of the chip in a basic system.

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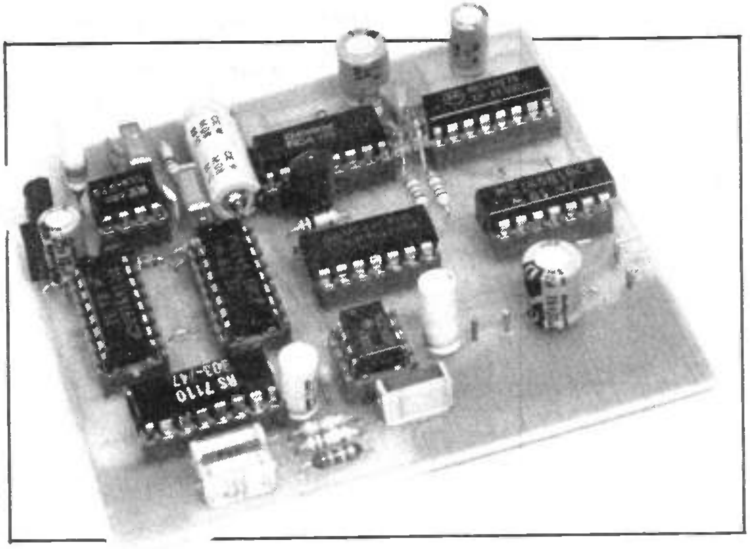


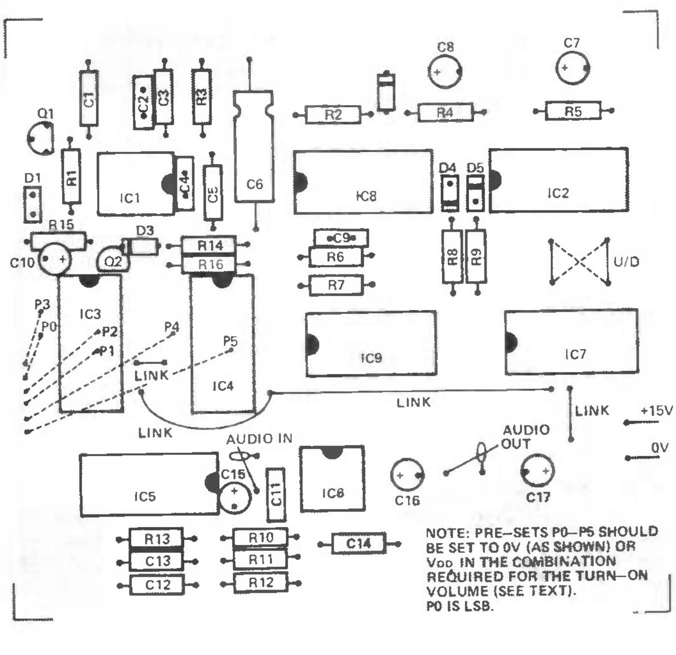
IR VOLUME CONTROL

A design that uses an existing transmitter to control an audio signal. Adrian Barnes and Peter Luke present the design.

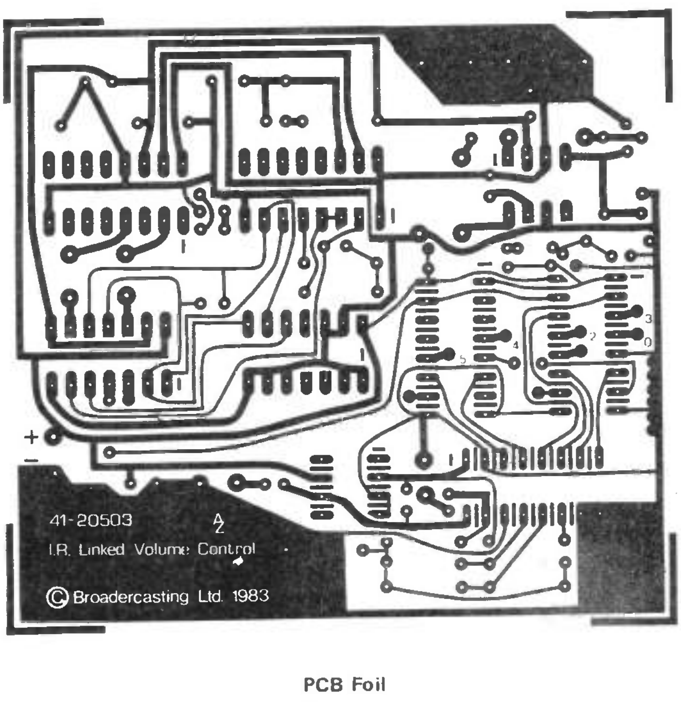
This project grew out of a specific requirement — namely to control the volume level of a TV that did not feature remote control. The set in question was used in conjuction with an IR controlled video recorder and it seemed a good idea to utilise the recorder's remote unit as the transmitter. As the exact format of the data transmitted by different remote control units varies, in order that the receiver can work with any such unit, it was necessary to pay attention to the exact way in which the receiver would be activated.

The method eventually adopted was to integrate the IR pulses at the receiver, thus the vageries of PPM codes would be ironed out, the receiver merely indicating whether or not an IR signal was present. It's necessary, however, to be able to control the direction in which the volume 'moves' (up or down). This requirement is provided by using a sort of morse code at the transmitter.

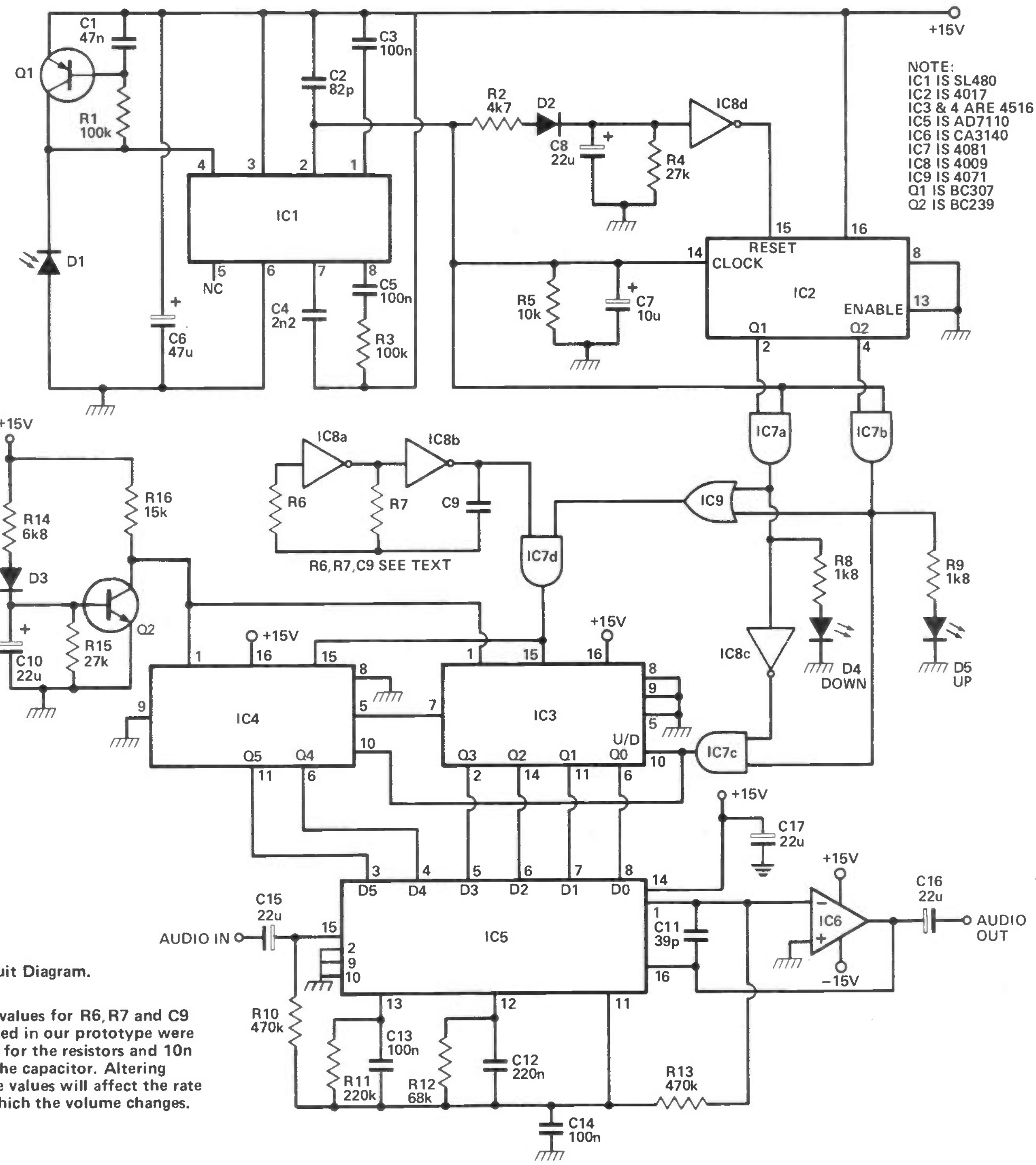
In use, with a video recorder in say the PLAY mode, a button that will not affect the recorder is chosen, in otherwords don't try and signal to the unit using the rewind control as this will send the recorder scuttling back to the start of the tape. Assuming the recorder is playing back a tape, the obvious control to choose is PLAY. In order to decrease the volume, this button should be pulsed with one short pulse and then a long pulse, the volume will continue to



Component Overlay



PCB Foil



Circuit Diagram.

The values for R6, R7 and C9 as used in our prototype were 1M0 for the resistors and 10n for the capacitor. Altering these values will affect the rate at which the volume changes.

Circuit Description

Q1 provides biasing for D1, the receiver diode which feeds IC1, the detector and amplifier IC. C2,3,4 and 5 decouple individually the three amplification stages.

C7 smooths output from IC1 so that short glitches in the transmission caused by the transmitter coding do not affect the unit. R5 discharges C7 in the absence of a signal.

C8 is charged via R2 and D2, and discharged by R4 so that this performs as a retriggerable monostable, turning on when the signal is present for more than 100ms, and off 500ms after the signal ends. This is inverted, so that 500mS after the last pulse ends, IC2 resets, ready for the start of the next command.

Thus, when transmitting, pulses must be at least 100mS long, and the spaces in between no longer than 500mS.

On reset, output Q0 to IC2, a decade counter goes high. On receipt of the first pulse, reset goes low, ready to advance if another pulse is received within 500mS. This next pulse allows the clock generator IC8a,b pulses to reach IC3 and IC4 via the AND/OR gates plus the inverter gates, binary up/down counters, counting down. This will cause the volume to increase whilst the signal is still received.

If however, the signal stops and a third pulse is received, IC2 advances another step and the counters IC3 and 4 count up, for the length of the pulse. When the signal stops, the counters IC3 and 4 remain set, and the 7110 (IC's) binary attenuator stays at that level.

Meanwhile IC2 resets ready for the next command.

Turn On

On turn on, the volume could be anywhere since IC4 and IC3 are not set. However, a preset facility on the 4516 allows the 7110 to be set for a particular level on turn-on, triggered by the monostable C10/Q2/R14. R15 discharges C10 when the unit is turned off. The level on turn on is set by the user by the links J1-6.

A full explanation of the operation of the binary audio attenuator was given in the February 1982 issue.

PARTS LIST

Resistors		Capacitors (cont.)	
(All ¼ watt 5%)		C7	10u 25V radial
R1,3,15	100k	C8,10,17	22u 25V radial
R2	4k7	C9	See text
R4,15	27k	C11	39p
R5	10k	C12	220n
R6,7	See text	C15,16	22μ 10V radial
R8,9	1k8	**Semiconductors**	
R10,13	470k	Q1	BC307
R11	220k	Q2	BC239
R12	68k	D1	BPW41
R14	6k8	D2,3	IN4148
R16	15k	D4,5	Triangular(acute)LED
Capacitors		IC1	SL480
		IC2	4017
		IC3,4	4516
C1	47n	IC5	AD7110
C2	82p	IC6	μA741
C3,5,13,14	100n	IC7	4081
C4	2n2	IC8	4009
C6	47u 25V axial	IC9	4071

decrease while this long pulse continues. To increase the volume, two short pulses followed by a long pulse will increase the sound, again for the duration of the last (long) pulse.

The unit uses the audio output of a video recorder, processing this and feeding the output to the aux socket of a hi-fi amplifier.

Construction

As with all projects operating at less than RF frequencies there is very little to worry about when building a circuit. Follow the overlay, paying particular attention to the orientation of any polarity conscious components and to the standard of soldering if you decide not to use the PCB we have designed, the only point to note is the wiring around the IR detector IC. As this device features high gain stages, it's rather prone to instability if care is not taken with the layout.

Testing

There's nothing to set up on this project and the only testing that might be usefully undertaken is to monitor the output of IC1, after smoothing, with a high impedance voltmeter. This should indicate that an IR signal has been received.

In Use

As well as using the project with a video recorder, it could quite usefully be used with your hi-fi system. In this case the unit would be placed between the tape in and out connections of the amplifier to provide armchair control of your hi-fi — a facility that's available on only a few systems.

■ R&EW

Z8 EXEC

An operating system for the Z8 microcomputer board.

Compiled by Richard Hinder.

Features

* Easy to use
* Very flexible
* Compact compared with conventional operating systems
* Brings benefits of 'structured programming' within reach of Z8 BASIC users.
* Enables programs to be used as procedures
* Command-line interpreter
* 15 commands
* 6 fast machine code routines accessible to the user.
* Interrupt-driven real time clock.
* Filing system for both EPROM and tape.

Z8 Exec helps you create, record, load and run programs by using a series of simple commands. No longer do you need to keep track of where programs are in memory, or where programs are filed on EPROMS. Z8 Exec looks after the housekeeping chores, leaving you free to concentrate on the essentials. It includes a clock and scheduler which allow you to run programs in a set order, or at preselected times of day.

Part 1	Part 2	Part 3
HELP LOAD DELETE TIME SET TIME SPEED RESTART	WRITE NEW QUARTZ EDIT READ EPROM READ TAPE	SET TASK SCHEDULER

Table 1. Command distribution on the three EPROMs.

Using Z8 Exec

Z8 Exec comprises three EPROMs. Plug Part 1 into the EPROM socket at addresses %B000 to %BFFF and put Part 2 into the zero insertion-force (ZIF) socket. Then switch on and type
∧8 = %B020 : RUN
The Executive asks you to state the time of day and the speed at which you are running your terminal and tape system. It then prompts you with *, awaiting the first command.

Try typing HELP first. You will be shown a list of commands available, including those derived from the chip in the ZIF socket. Type TIME to see what the time is now. Then press the 'return' key to see the time again. Now create your own command. Start with something simple, like a command HELLO which gives the response "Hi! Whats new?" To do this, follow these instructions:

1. After the * prompt, type LOAD (remember to press the return key after you have typed the name of the command).
   Z8 Exec asks you which file you want loaded.
2. Type WRITE.
3. Type NEW.
   Z8 Exec will tell you how much program space is left, and print 'Ready'.
   You are now out of Z8 Exec and into Z8 BASIC/DEBUG.
4. Type the BASIC/DEBUG instruction NEW, to set the Z8's internal registers ready for a new program.
5. Type in this program:
   10 "Hi! What's new?"
   20 Stop
6. Type ∧8 = %B020: RUN
   This puts you back into Z8 Exec. After the * prompt, type WRITE, which finds the end of your new program. Next you must confirm it, just in case you have included machine code quirks which look like a BASIC end-of-program marker. To confirm, just type in the address given by the WRITE command.
   WRITE asks you whether you want to write to tape or EPROM.
7. Plug a new EPROM into the ZIF.
   WRITE asks you the title of your new program.
8. Type in the title as HELLO.
   WRITE then writes your program onto the EPROM ('Finished' will appear on the terminal).

That was a very simple example of using Z8 Exec. However, it is capable of *much* more, and the glossary shown in ***Table 2*** will give you some idea of this versatility.

Loading other machine code programs can be speeded up by sandwiching the code in memory between two small BASIC programs, like so:

First Program:	10∧8 = ∧8 + 'X' = RUN
Machine code:	....
Second program:	10 GO@(∧8 — 'Y') 20 STOP

X and Y are two offsets which enable the programs and code to be run anywhere in memory. They appear in the BASIC programs as real offsets, such as %90. X is the difference between the values of ∧8 for the two BASIC programs. Y is the difference between the value of ∧8 for the second BASIC program and the start address of the machine code.

To file this sandwich as a Z8 Exec command you need to use WRITE, just as you did when creating HELLO.

To run the program all you have to do is call it by name.

How Does It All Work?

At the heart of Z8 Exec is a command line interpreter (***Fig. 1***). The Executive prompts you to type a command by printing * on the terminal. It takes all the characters typed between * and the 'return' character (you can backspace and correct if you want to) and compares them, symbol by symbol, with records of known commands. If it finds a match, it looks at the corresponding record to see where the appropriate program is to be found.

Z8 Exec keeps records of commands in three places:-

- In the Part 1 EPROM, with pointers to subroutines.
- In main memory (RAM) where it maintains a table of loaded files, with pointers to each file.
- In the EPROM loaded in the ZIF, where it examines a directory kept at the top end of the EPROM. If it finds a match here, Z8 Exec transfers the program to main memory before running it.

You can gain a further insight into the way Z8 Exec works by looking at memory maps and file formats (***Fig. 2*** to ***4***).

DELETE

Purpose

To delete from main memory a file which has been previously loaded from an EPROM.

Description

Z8 Exec responds to DELETE by asking which file is to be deleted. It then deletes the file and rearranges the remaining files so that the memory space previously used by the deleted file is added to the free space available for new programs.

Associated commands

HELP, LOAD, RESTART

Demonstration

```
 * DELETE
 File name ? * WRITE
 WRITE deleted
 * DELETE
 File name? * WRITE
 File not listed
 *
```

EDIT

Purpose

To examine or change a file loaded from EPROM or tape.

Description

EDIT transfers you to BASIC/DEBUG at the beginning of the last loaded file. Registers 4 and 5 are set to the end of this file, so you can amend, add and delete program lines at will. If your file was loaded from EPROM, its last 'stop' instruction will have been changed by Z8 Exec. If you want to WRITE an edited version of the file, remember to change the last program line to 'stop'.

Associated commands

LOAD, READEPROM, READTAPE, WRITE WRITE

Demonstration

```
 * EDIT
 Ready
 :
```

HELP

Purpose

To show what commands are available.

Description

Z8 Exec prints the titles of commands stored in three places:

1. Within the main Executive EPROM (part 1) — These are called 'inherent' commands.
2. In main memory (RAM). These will have generally been loaded from EPROM inserted in the ZIF.
3. In the EPROM plugged into the ZIF.

Associated commands:

LOAD, DELETE

Demonstration

```
* HELP
Inherent:
LOAD DELETE TIME
SET TIME SPEED RESTART
Loaded:
WRITE
In EPROM:
HELLO
```

Note: If there are no commands in RAM, the word 'Loaded' is omitted. If there are no commands in the ZIF, 'In EPROM' is omitted.

LOAD

Purpose

To transfer a file to main memory (RAM) from an EPROM plugged into the zero insertion force socket.

Description

Z8 Exec responds to the command LOAD by asking which file is to be loaded. You type in the file name. Z8 Exec checks through the EPROM. If the file is found it checks that it has not been loaded already and then checks that there is sufficent space for the file in main memory. If all the checks are satisfactory, it loads the file into main memory immediately after the last loaded file.

Associated commands

HELP, DELETE

Demonstration

```
 * LOAD
 File name ? * SET TASK
 SET TASK loaded
 *LOAD
 File name ? * SET TASK
 File already loaded
 *
 *LOAD
 File name ? * YET ANOTHER
 Not enough space
 *
 * LOAD
 File name ? * NON-EXISTENT
 File not on this EPROM
 *
```

NEW

Purpose

To change from Z8 Exec to BASIC/DEBUG so that a new program can be created.

Description

NEW finds the first spare address after any loaded files and calculates the amount of RAM left for your new program. It does not reset all registers, so if you intend to type in a new program, type NEW again as soon as you are in BASIC/DEBUG.

Associated commands

WRITE

Demonstration

```
 * NEW
 %1239 bytes free
 Ready
 :
```

Note: * is the Z8 Exec prompt, : is the BASIC/DEBUG prompt.

QUARTZ

Purpose

To adjust the rate of the internal clock.

Description

The internal clock used by Z8 Exec is derived from the quartz crystal which drives the Z8 chip. Z8 Exec assumes that the crystal frequency is 7.373MHz, but QUARTZ allows you to vary it. You can deliberately set it low, say to 800kHz, in order to speed up the internal clock to ten times faster than normal. This can be useful when checking our timed sequences of programs.

Associated commands

TIME, SET TIME

Demonstration

```
 * QUARTZ
 Specify crystal frequency (kHz) ? 7000
 *

 * QUARTZ
 Specify crystal frequency (kHz) ? 7500
 Specify A and B such that A*B = 9375, A < 65 and B < 257
 A,B ? 47,200
 *
```

Note: Parameters A and B have to be chosen when the crystal frequency is not 7MHz or 8MHz.

READEPROM

Purpose

To transfer a specified block of information from EPROM to main memory (RAM).

Description

Whereas LOAD transfers named files in their entirety from EPROM to main memory, READEPROM transfers data from any part of an EPROM. All you have to do is give READEPROM the start and end addresses of the block of EPROM you want transferred to RAM. READEPROM puts the information you want immediately after the last loaded file and then transfers you to BASIC/DEBUG. It leaves you at the start of the information, so you can easily use BASIC/DEBUG commands to examine the information.

Associated commands

LOAD, READTAPE, EDIT, WRITE

Demonstration

```
 * READEPROM
 Eprom start address ? %93
 Eprom end address ? %CB2
 Loaded from %1283 to %1E22
 Ready
 :
```

READTAPE

Purpose

To transfer a file from tape to main memory.

Description

READTAPE loads a file from tape to main memory immediately after the last loaded file. Whilst loading, it checks the file against a checksum. If the file is corrupted it asks you to try loading again. When a file has been loaded correctly, it gives you the file title as read from tape.

Associated keywords

WRITE, EDIT, LOAD, READEPROM

Demonstrations

```
 * READTAPE
 Prepare tape, press PLAY then hit RETURN
 * BUDGET loaded from %1385 to %1A0C
 Ready
```

Note: READTAPE leaves you in BASIC/DEBUG at the start of the tape file.

RESTART

Purpose

RESTART is provided so that you can start again from square one without having to press the RESET button on the microcomputer board or your terminal.

Description

RESTART puts you through both TIME and SPEED commands, then clears any loaded files. Speeds are initially set to 300 bps (terminal) and 150 bps (tape). RESTART is run automatically when you first enter Z8 Exec after switching power on.

Associated commands

TIME, SPEED, DELETE

Demonstration

```
 * RESTART
 hhmmss * 134255
 300 bps terminal, 150 bps tape
 Keep or change ? * K
 Ready
 :
```

Note: If you wish to RESTART but not to reset the clock, press 'return' after 'hhmmss *'. Z8 Exec will ask you the time again. Press 'return' again, until Z8 Exec moves into SPEED. You will find that the clock has continued undisturbed.

SCHEDULER

Purpose

To run tasks according to a timetable and sequence arranged by SET TASK.

Description

SCHEDULER is a special purpose Executive for running tasks. It leaves BASIC variables A to Z untouched so that parameters can be passed from one task (or program) to another. It therefore enables programs to be broken down into modules which can be tested and run as self-contained units.

Two kinds of scheduling are supported. The first schedule is a straightforward timetable. The second is a cyclic sequence which repeats until you force it to stop.

SCHEDULER alternates between the two schedules. It checks the timetable first against the internal clock and sees if any tasks have to run. If there are any it runs them. Then it runs one complete cyclic schedule before checking the timetable again.

Associated commands

SET TASK, TIME, SET TIME, QUARTZ

Demonstration

```
 * SCHEDULER
```

Notes: SCHEDULER has no responses of its own. If the time were now 0600, say, SCHEDULER would run TEMPO first, then HELLO, then TEMPO, then HELLO and so on. At 0730 it would run HELLO specifically. You would find two HELLO programs running consecutively, one timetabled and the other taken from the cyclic schedule. Later in the day, at 1615, you would find a sequence of two TEMPO programs in succession.

SET TASK

Purpose

With SET TASK you can arrange for files loaded from EPROM to be run at set times. You can also arrange for some of the files to be run repeatedly, in order.

Description

SET TASK examines a table of loaded files and gives you a list showing when each file is set to run and the order in which files are to run in cyclic manner. It then gives you the option of changing everything. Files set by SET TASK are run by SCHEDULER.

Associated commands

TIME, SET TIME, QUARTZ, SCHEDULER

Demonstration

```
 * SET TASK
 Task          #         Time
 WRITE         1         ----
 HELLO         2         ----
 TEMPO         3         ----
 Cyclic schedule: None.
 Keep or change? C
 Type run-time as hhmm (or N if task is not to be set)
 Task 1 run-time? * N
 Task 2 run-time? * 0730
 Task 3 run-time? * 1615
 Specify order of tasks for cyclic schedule as order number, or N if not required.
 Task      Order
 1          *N
 2          *2
 3          *1
 Task          #         Time
 WRITE         1         ----
 HELLO         2         0730
 TEMPO         3         1615
 Cyclic schedule: 3 2
 Keep or change? *K
 Ready
 *
```

SET TIME

Purpose

To set the internal clock.

Description

Z8 Exec asks what time it is. You type in the time in the form hhmmss, then press 'return' at the instant you want the clock to be set.

Associated commands:

TIME, QUARTZ

Demonstration

```
 * SET TIME
 hhmmss * 163425
 *
```

SPEED

Purpose

To examine speeds set for the terminal and tape filing system. The command allows you to change these speeds if you wish.

Description

A bank of switches at address %FFFD is read by BASIC/DEBUG as soon as power is applied to the Z8 chip. The switch positions determine the initial speed of the serial communications port. You may select speeds from 75 bits a second (bps) to 19200 bps.

Z8 Exec enables you to use the serial port for communication with either a terminal or a tape recorder (via a suitable modem). You usually want to use different speeds. When switching between tape and terminal, Z8 Exec looks at the speeds you have chosen. It ignores the bank of switches so that you can change speed without touching the microcomputer board.

Associated commands:

None

Demonstration

```
 * SPEED
 300 bps terminal, 150 bps tape
 Keep or change? * CHANGE
 New speed for terminal? 1200
 New speed for tape? 150
 1200 bps terminal and 150 bps tape
 Keep or change? * K
 Ready
 *
```

TIME

Purpose

To show the current time of day.

Description

TIME prints on your terminal the current time in the form hhmmss.

Associated commands:

SET TIME, QUARTZ

Demonstration

```
 * TIME
 140554
 *
```

WRITE

Purpose

To preserve a copy of a program or data on EPROM or tape.

Description

Z8 Exec has filing systems for both EPROM and tape. Before using WRITE you need to have created a new file, edited an old one, or just loaded a file from EPROM or tape. WRITE assumes that the start of the file you want written is at the beginning of this latest file. The file itself can be program or data or a combination of both.

WRITE looks through the file for a byte set to %FF and assumes the next byte is the end-of-file. It tells you this hex address and asks you to confirm that it is indeed the end-of-file. It will be so if your file is entirely BASIC program. If it contains machine code which has a byte set to %FF it will give you an erroneous end-of-file address and you will need to give WRITE the true end address. You will almost certainly know this already if you have been using machine code.

WRITE then asks you to select EPROM or tape. Finally it asks you to name the file. You can type as long a title as you like, using any keyboard symbols, but WRITE will use only the first 22. If you have selected tape, WRITE asks you to set up your tape recorder. The command tells you when it has finished writing.

Associated commands:

NEW, EDIT, LOAD, READEPROM, READTAPE, SET SPEED.

Demonstration

```
 * WRITE
 End of file seems to be %1DFE
 Type end address to confirm/alter ?%1DFE
 Specify EPROM (E) or tape (T) *E
 Type required title
 *DEMO
 Finished
 *
```

Note. So that files can be loaded from EPROM and run as programs, the end of the file must read "'line number' STOP".

Table 2. Glossary of commands and their operation.

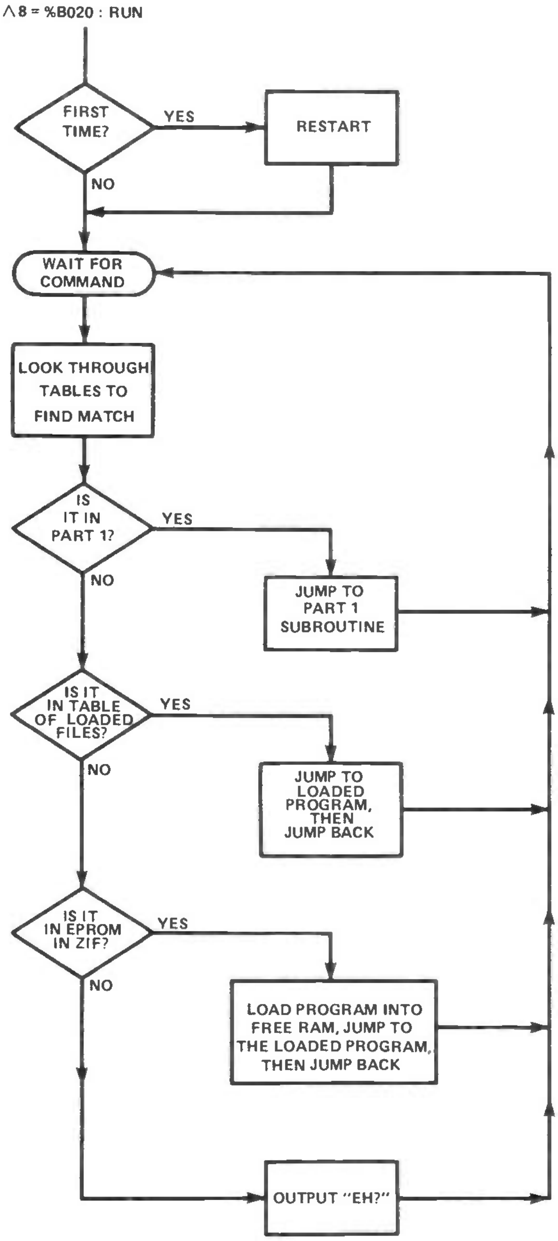


Figure 1. The heart of Z8 Exec.

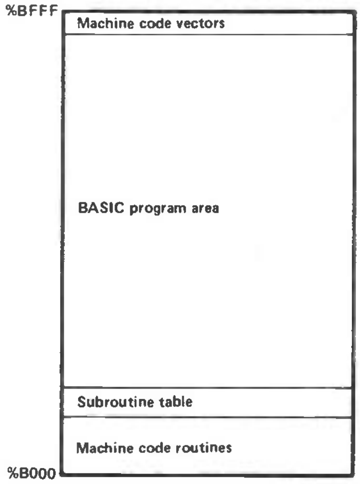


Figure 2. Memory map of Z8 Exec's Part 1 EPROM. This contains the command line interpreter.

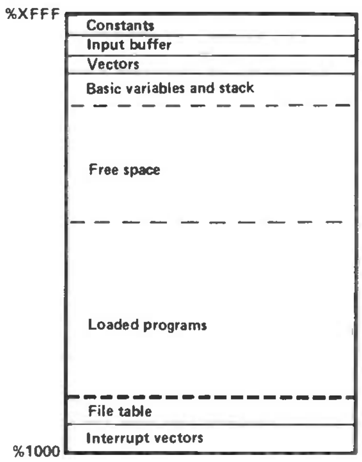


Figure 3. The Z8 Exec RAM memory map. A standard file format is used to enable easy location when loading files.

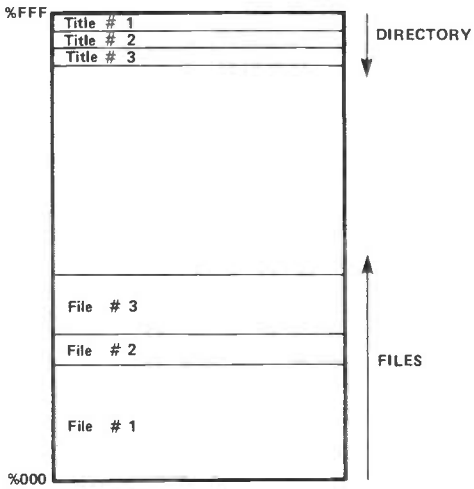


Figure 4. The EPROM memory map used by Z8 Exec.

File Format

As files are written to a new EPROM, Z8 Exec creates a directory listing file titles and addresses. It writes the directory on the same EPROM.

When Z8 Exec writes the first file on a clean EPROM, it writes the title, start address and end address in a 32 byte record starting at %FE0 and finishing at %FFF — the top of the EPROM. As new files are added, the directory grows in 32 byte records down towards the files themselves (*Fig. 4*). Z8 Exec keeps a check on the amount of space left so that you do not need to worry about running out of space as a new file is written. The WRITE command will simply say 'not enough space' and leave you to put the file on an EPROM which has more space available.

The 32 byte directory record is allocated as shown in ***Table 3***. When Z8 Exec loads a file to main memory, it copies the corresponding directory entry to its table of loaded files. It uses

Bytes	Purpose
0 to 21	File title
22,23	Start address
24,25	End address
26 to 31	Spare

Table 3. Allocation of the 32-byte directory record.

Bytes		Purpose
26	Hours }	timetable for
27	Minutes }	SCHEDULER
28		Spare
29		Cyclic order for SCHEDULER
30,31		Start address of file in RAM

Table 4. Utilising bytes 26-31 of the record in RAM for SCHEDULER attributes.

Bytes	Purpose
0 to 21	File title
22,23	Checksum
24,25	Number of bytes in the file
26 to end	File, as bytes copies from RAM

Table 5. The bytes providing information about files written to tape.

bytes 26-31 of the record in RAM (see ***Table 4***). Files written to tape by Z8 Exec comprise a string of bytes in the format of ***Table 5***, (the checksum used by Z8 Exec is simply the sum, modulo 2^{16}, of bytes 26 to the end-of-file).

Registers, Vectors And RAM Pages

Calling the top page of RAM '%yy--', Z8 Exec uses certain addresses, as shown in ***Table 6***.

Z8 BASIC/DEBUG shares the input buffer with Z8 Exec, but does not touch the other addresses in the normal course of events. Z8 Exec stores one interrupt vector in the bottom page of RAM from %100F to %1011. It causes a jump to the real time clock routine stored in the Part 1 EPROM. A block of vectors at the top end of the Part 1 EPROM stores jump instructions to the six machine code routines which are available to you.

Bytes		Purpose
%yy56,57	Start address }	
%yy58,59	End address }	RAM file table
%yy5A		Start of last loaded file
%yy5C		Start of free space
%yy68 to yyF1		Input buffer
%yyF7, F8		Terminal speed
%yyF9,FA		Tape speed.

Table 6. Addresses used by Z8 Exec when loading files.

Jump Address	Routine
%BFEE	Memory move
%BFF1	Calculate checksum
%BFF4	EPROM to RAM
%BFF7	Serial port to RAM
%BFFA	RAM to serial port
%BFFD	User response

Table 7. Jump addresses for machine code programming.

Machine Code Routines

To use the EPROM to RAM routine, you must include the instruction 'GO@%BFF4'. Give the routine EPROM start and stop addresses and a RAM start address. The registers you need to set before calling each routine are as follows (also see ***Table 7***):

MEMORY MOVE
∧%42 = (number of bytes to be moved minus one)
∧%44 = (start address of source)
∧%46 = (start address of destination)

Note: ∧%46 must be less than ∧%44 if the memory movement is shorter than the number of bytes to be moved.

CALCULATE CHECKSUM
∧%42 = (number of bytes minus one)
∧%44 = (start address for checksum)

Note: The checksum is in ∧%40 after the routine has been called.

EPROM TO RAM
∧%40 = (EPROM start address)
∧%42 = (number of EPROM bytes to be read, minus one)
∧%44 = (RAM start address, plus one)

SERIAL PORT TO RAM
∧%42 = (number of characters to be read, minus one)
∧%44 = (RAM start address, plus one)

RAM TO SERIAL PORT
∧%42 = (number of characters to be transmitted, minus one)
∧%44 = (RAM start address, plus one)

USER RESPONSE
@%30 = 0

Note: This routine transfers characters from the serial port to the input buffer until a 'return' character is found. It issues a * to the serial port when first called, and once a minute if no characters have been received in the past minute. On exit, characters will be found from %yy68 to %yy(@15).

Z8 Exec's machine code routines use registers %30 to %34, %3C to %3F, and %40 to %49. You can use all but %3C to %3F for your own purposes.

Putting It All Together

Remember the HELLO command you typed in at the beginning? Much larger programs can be entered and saved using WRITE in the same way.

But you can, using Z8 Exec, divide a large program into a set of small modules, each self-contained. You could, for example, have separate modules for input, processing and output. You can write and test these separately, then use SCHEDULER to link them together. What's more, if you want to use, say, the input module in another program, you can do so. All you have to do is load it and make sure that SCHEDULER knows when to run it — why not start a library of useful modules?

■ R&EW

Peter Luke takes a look at the political aspects of video recorder sales and at the new 8mm camera/recorder format.

"WE SEE A LOT OF IT NOWADAYS, IN MEDICAL CIRCLES IT'S KNOWN AS VIDEO CAMERA SHOULDER..."

The Japanese with their mass production skills seem to be able to dominate any market from cars to consumer products by virtue of the reliability and low cost of the finished product. The effect of these imports on the home base production (if any) can be fairly devastating. The pattern set by the motor trade in an effort to minimise the havoc caused by vast quantities of Japanese cars being imported into this country is about to be followed by the video trade.

As far as cars go, after much hard bargaining, the Japanese agreed to voluntary reductions in the number of exports sent to the UK. This was seen as a more attractive solution than to have provoked the British government into preparing legislation to effect the curb — something they would surely have had to do in the absence of the gentleman's agreement.

The same process is now to apply to the import of Japanese video recorders. As the vast majority of recorders on sale in the High Street originate in Japan (UK production plants are still in the main just a twinkle in the MD's eye) this is bound to mean that market forces send the price of recorders up in the next few months.

Various reports in the national press have quoted price rises of anywhere between £100 and £200 and put forward the very sensible idea that if you intend to get onto the video bandwagon sooner or later, it would be a good move to make it sooner.

These new measures are being pushed very much on their long term benefits, quite rightly as the consumer is not likely to be pleased in the short term. Those custodians of our balance of payments figures will be happy however, as will the various rental companies that have been forced to cut their rental charges to the bone in order to attract any customers at all.

It's also hoped that, as TV set manufacture went before, video recorders will follow. There is now quite a healthy UK TV production capability, with the likes of Sony earning healthy foreign currency from exports of sets produced in Britain. The quotas on import video machines will, it's hoped, add a touch of urgency to plans for UK assembly/production equipment investment in the very near future.

The old story then of short term disadvantages (primarily to the consumer) set off against long term gains to the industry.

Important Omission

One amusing aspect of the agreements referred to above is the fact that they apply only to the current generation of recorders and do not mention the 8mm recorder/camera combinations that could be on sale as soon as 1984. These are likely to create a new, multi-million yen market and could finally signal the end of the traditional cine film industry.

The standard for 8mm video is just about to be published as a result of an imminent Tokyo meeting at which more than 100 manufacturers will attempt to settle on a standard for the system.

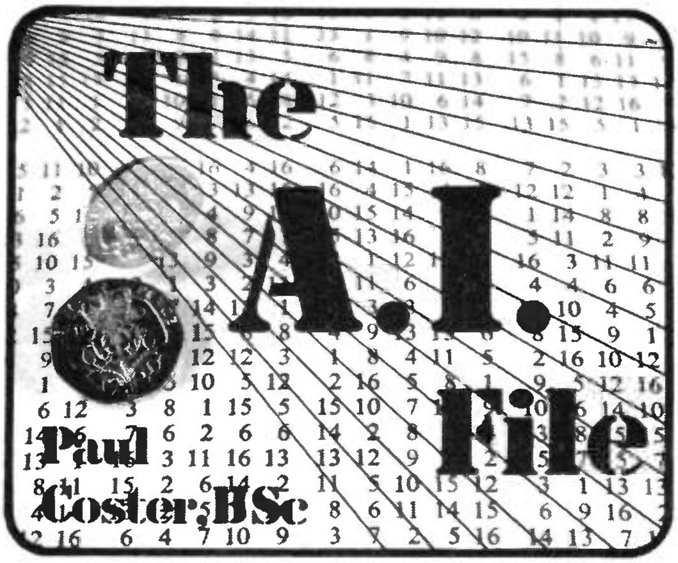
Philips, as may be expected, are the only European company with a development interest in the new format. They have been negotiating technical details with a number of Japanese companies, primarily Matsushita (Panasonic in the UK and a company that also has a healthy stake in JVC) JVC themselves, Sony and Hitachi. If these five companies can agree on a standard, and this now looks likely, the rest of the industry will have no choice but to follow.

The new format will offer a combined camera and recorder utilising a 'micro cassette'. This cassette is then, with the aid of an adaptor, used in a mains based machine for any editing, titling etc. At least that's the information I have to hand. If this is the plan it seems obvious that the new format will, by default, spawn a new domestic video format.

The reason for this is that while a range of mechanical adaptors would enable the 8mm standard cassettes to be transported in the various present day recorders the different recording techniques used by the likes of VHS, Beta and V2000 would preclude any playback of the recordings. It would, one supposes, be possible to have a camera capable of recording to the different formats, through if size and weight are an important consideration, the extra overhead in electronics may not be tolerated.

All in all a very interesting area of the video industry and one which will bear very close examination over the next few years with a number of traditional camera manufacturers already getting a foothold in video with label engineered versions of main line video producers the advent of the 8mm format is bound to spur additional activity in this traditional industry. If Kodak are not represented in Tokyo I shall be very surprised.

On a final note, full marks to all concerned on the attempt to agree a common standard. After the compact cassette it would seem to have been obvious that common formats were to the benefit of all. But no surround sound, current video recorders and a host of other examples have show that in general everybody wants their system to be the one that's adopted and agreement between the electronic giants is very rare. With CD and now 8mm video we can only hope that format wars will at last be a thing of the past.



Systems which appear to respond in an intelligent fashion often rely upon three basic elements: a database, an heuristic processor and some random operator. This month we examine the derivation and function of the third element in relation to producing strings of words.

A big advantage with computers when it comes to simulating one characteristic aspect of human behaviour — unpredictability — is the ability to make a seemingly random selection from a large range of options.

For instance, given a set of nouns to complete an unjustified response (one preceeded by the phrase '... to change the subject...'), the 'intelligent' system can escape from a tricky situation — inability to converse about a certain topic — by embarking on a different and novel subject. Interaction with such a system is usually fascinating as a direct result of the inclusion of this random element. It therefore becomes an important requirement for the AI entrepreneur to possess some knowledge of how these elements are derived.

In The Beginning

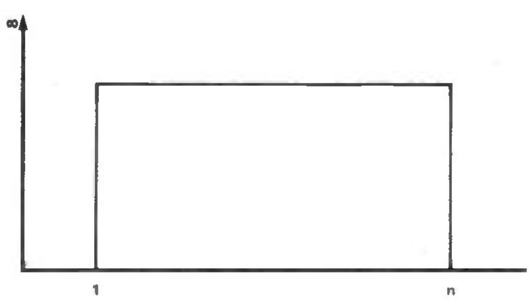
The first notable attempt to bring together theoretical and practical methods for generating random numbers, or more accurately *pseudorandom sequences*, was by Lehmer in the early Fifties. Literally huge systems (eg, ENIAC) were utilising various approaches, without much proven success, to generate sequences of numbers that possessed an unpredictable quality. The ideal of ensuring each number had an equal chance of occurring, however, had not been attained. This led to the development of a generation process to meet more stringent requirements, and the first generator to evolve was called the congruential type. ***Figure 1*** shows the theoretical and typical distributions obtained using this type of generator (the graphs also apply to other generators). With an infinite number of selections from 1 to n, the graph shows a rectangular distribution — every number has occurred an equal amount during generation. The second graph shows a practical situation for the numbers 1 to 5, where n represents the mean value.

```
FOR  N > 0 AND N < Mod

     N' = N x Mult  (Modulus 'Mod')

OR USING 'BBC' BASIC

     N1 = (N * MULT) MOD M
```

Figure 2. The congruential random number generator.

The Generation Game

The formula used to derive random sequences using the congruential method is shown in ***Fig. 2***. Its main attraction is the freedom from complicated operators, but it does tend to produce integers relatively prime to the modulus. A method which avoids this problem uses a generator called the mixed congruential type. This entails adding a constant to the original product before remaindering is performed. Alternatively, careful selection of modulus and multiplier, in the congruential type, will generate a sequence comprising every integer in the desired range. These special pairs of numbers are known as prime-primitive pairs and their values can be chosen from ***Table 1***. For the BBC Micro the largest integer that can be handled is $2^{31} - 1$, so any pairs in the table can be used (this is in addition to the BBC's own random number generator). If you wish to check a given sequence for randomness, there are a number of tests (eg, Knuth; Vol 2) that can be applied for specific criteria. It is interesting to note, however, that if a single test for true randomness existed, it could be used (by elimination) as a truly random number generator — impossible via any algorithmic process.



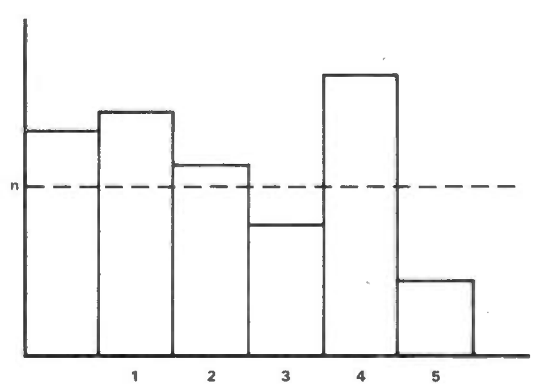


Figure 1. The two distributions associated with random numbers. The rectangular graph (above) is for an ideal situation, with the graph opposite showing a practical example.

POWER OF 2 (2^n)	PRIME (Mod)	PRIMITIVE (Mult)	PRODUCT (Mod x Mult)
2^{12}	127	29	3302
2^{13}	211	35	7385
2^{14}	211	41	8651
2^{15}	491	59	28969
2^{16}	491	84	41244
2^{17}	1103	117	129051
2^{18}	1103	156	172068
2^{19}	1223	421	514883
2^{20}	1987	451	896137
2^{21}	1987	1017	2020779
2^{22}	2741	1148	3146668
2^{23}	10657	735	7832895
2^{24}	10657	824	8781368
2^{25}	4409	4035	17790315
2^{26}	19423	3088	59978224
2^{27}	10657	7367	78510119
2^{28}	24281	9713	235841353
2^{29}	29443	13300	391591900
2^{30}	39971	20411	815848081
2^{31}	414971	4676	1940404396

Table 1. Prime-primitive pairs for congruential generators.

1	2	3	4	5	6
THE	BOOK	WAS PUT	ON	THE	TABLE
A	CUP	CAN BE FOUND	UNDER	THAT	CHAIR
HER	COAT	IS	NEAR	THIS	SIDEBOARD
HIS	VASE	WAS	NEXT TO	A	DESK

Table 2. Random string concatenation sequences.

Stochastic Strings

Armed with a technique for obtaining almost limitless random sequences, we will close with a few words on their intrinsic value within a 'conversational' program. Looking at ***Table 2***, its not difficult to imagine how some of the more basic programs put together lines of dialogue. Amazingly, the number of possible sentences that can be made from the table is 4^6 or 4096. The source coding for a program segment to print any one combination is quite straightforward involving READ and DATA statements to place the 'word-blocks' into an array. A random selection then being made from each column and the strings concatenated to form the sentence. Although this approach can hardly claim to exhibit 'intelligence', to the naive observer a system incorporating these random elements is quite convincing.

eg,

THE CUP CAN BE FOUND UNDER THAT CHAIR
HER BOOK IS ON THE CHAIR
A VASE WAS NEAR THIS DESK
HIS COAT WAS PUT UNDER A TABLE

Figure 3. Selected examples of random concatenation.

More sophisticated programs which can indulge in 'intelligent' interactions, tend to employ random interjection as a means of side-stepping subjects not covered within their database. Next month we shall take a detailed look at the techniques underlying these systems.

Bits And Pieces

Since we've been discussing random numbers, readers may like to note the following program for generating a set of random numbers on a programmable calculator (the TI57 in this instance). The seed — initial value of N — is stored in Memory 1 and the number required in Memory O. Then enter the maximum random number and run the program.

1	STO 2	19	RCL 3
2	2nd lbl 1	20	=
3	7	21	1NV SUM1
4	3	22	RCL1
5	6	23	÷
6	7	24	RCL 3
7	2nd Prd 1	25	X
8	RCL 1	26	RCL 2
9	÷	27	+
10	1	28	1
11	0	29	=
12	6	30	2nd Int
13	5	31	2nd Pause
14	7	32	2nd Dsz
15	STO 3	33	GTO 1
16	=	34	CLR
17	2nd Int	35	R/S
18	X		

■ R&EW

CD REVEALED

Outward appearances of a CD player are impressive enough — delve beneath the surface however and amazing technological achievement is revealed. Michael Graham and Mike Skeet take the lid off the CD format.

The damp squib that was the Philips laservision system introduced the idea that laser technology provided a means of storing digital information on a disc that was both robust and susceptible to mass production techniques. Compact Disc players provide another application for laser technology, this time for the less stringent requirements of an audio playback system. Philips are co-inventors of the system (together with Sony) and their work with lasers on the laservision players must have stood them in good stead during the development of the CD optical systems.

Disc Production

The first step in producing a Compact Disc is to convert the analogue audio signals into a stream of digital pulses. The PCM (Pulse Code Modulation) encoded signal is produced by sampling the input signal approximately once every 22mS and comparing this to 65,536 discrete voltage levels each corresponding to a 16 bit binary number. The digital code corresponding to the level closest to the instantaneous value of the input signal at the sample point. To put this in perspective, the system operating at this conversion accuracy and speed, generates over 800,000 bits every second.

The need for the speed and accuracy outlined above stems from the frequency response and noise performance demanded of the final system. Sampling theory states that the sampling rate must be at least twice the maximum frequency to be reproduced by the system (the exact sampling frequency of the CD system is 44.1kHz) and Quantisation theory shows that

$S/S_N = 3N^2/2$

where S = signal power

S_N = quantization noise and

N = quantization number.

The dynamic range can also be expressed

$D = 6x\ M + 1.76$ dB

With $M = 16$, the 98dB of the CD system is realised.

To Err Isn't Digital

In addition to the straight A/D conversion process an error correction code is appended to the digital data stream. The system adopted is the CIRC (Cross Interleave Reed-Solomon Code). This encodes the data stream in such a way as to minimise the effects of any corruption due, for example, to fingerprints or scratches on the disc's playing surface.

The exact protocols involved in the CIRC encoding process are shrouded in industrial secrecy but briefly each of the 16 bit samples are first divided into two eight bit samples. Before these samples are error encoded they are subject to a process known as EFM (Eight to Fourteen Modulation). Each eight bit sample is converted to a 14 bit block during this process. The reason for this is the fact that the read system of the players cannot tolerate long sequences of either ones or zeros. A long sequence of zeros would make tracking of the disc difficult while a long sequence of ones would saturate the laser pickup element, adversely affecting its turn-off time meaning that it might not detect a zero after a long sequence of ones. A further reason for prohibiting long chains of either logic level is the need for the system to generate some form of clock data during playback.

The CD specification dictates that there must be at least two zeros between any successive ones and that the maximum

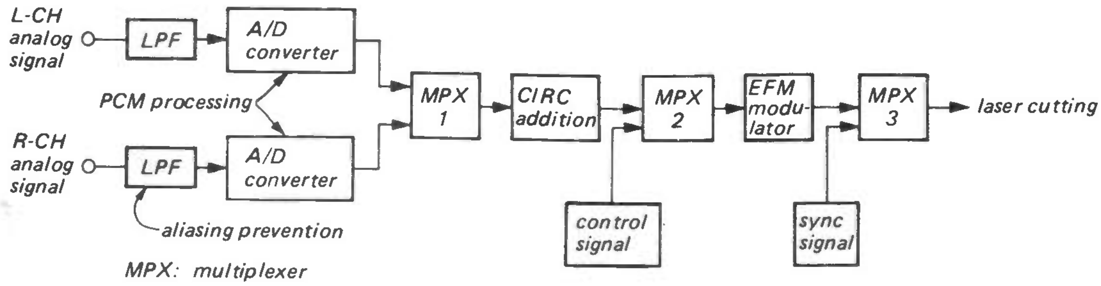


Figure 1: Block diagram of the A/D conversion system used in the production of CD discs.

number of zeros between ones must be equal to or less than ten.

14 Bits yield 16, 384 discrete bit patterns of which only 256 meet the above requirements. As there are 256 possible arrangements of our eight bit 'half sample' this means that by using a look-up table stored in a 14 bit ROM, we can encode the 8 bit PCM codes into 14 bit blocks that meet the system's requirements. When stringing together these 14 bit blocks, it is necessary to append three bit merging blocks in order that the ones/zeros constraints are not violated. These contain no information and are ignored by the decoder.

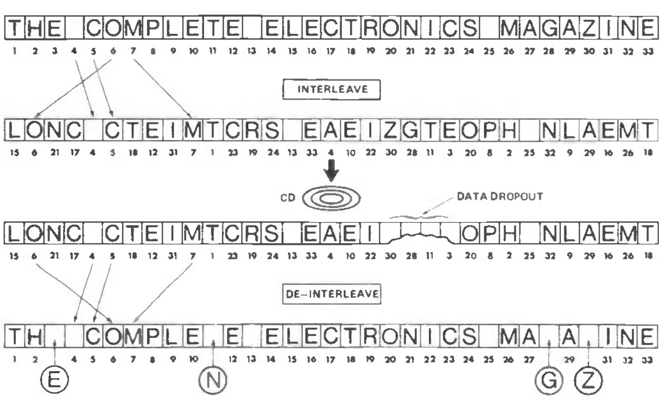


Figure 2: An illustration of the interleaving process which spreads individual data blocks over a larger area of the disc's surface. This minimises the effect of any drop-outs.

It's A Frame

Thus far, the system has converted the analogue input signal into a 16 bit PCM code, split this into two, 8 bit words and converted these words into a 14 bit pattern together with a 3 bit merging word. At this stage the blocks of audio data are 'interleaved' or re-arranged in time. The principle involved is shown in ***Fig. 2*** and it can be seen that this makes the system far more tolerant of data corruption at read out by effectively spreading each 'quantum' of audio data over a wider area of the disc than would be the case without interleaving. Thus a dropout at one point in the disc may affect a number of blocks of data but will only corrupt one or two bits from each block. By including a parity bit together with a correction system, the effect of errors in only a few bits can be completely compensated, and thus data integrity preserved.

The interleaved audio blocks are now arranged within a frame that starts with a 24 bit synchronisation pattern. This is followed by a block of 12, 14 bit audio blocks together with merging bits (6 audio samples worth) and then by a block of CIRC parity correction bits. A second block of audio and parity information completes a data frame. A frame thus consists of 588 bits of sync, audio and error correction data.

This bit stream is now transferred to the 120mm DA CD disc, by means of a laser. The process is outlined in ***Fig. 3***.

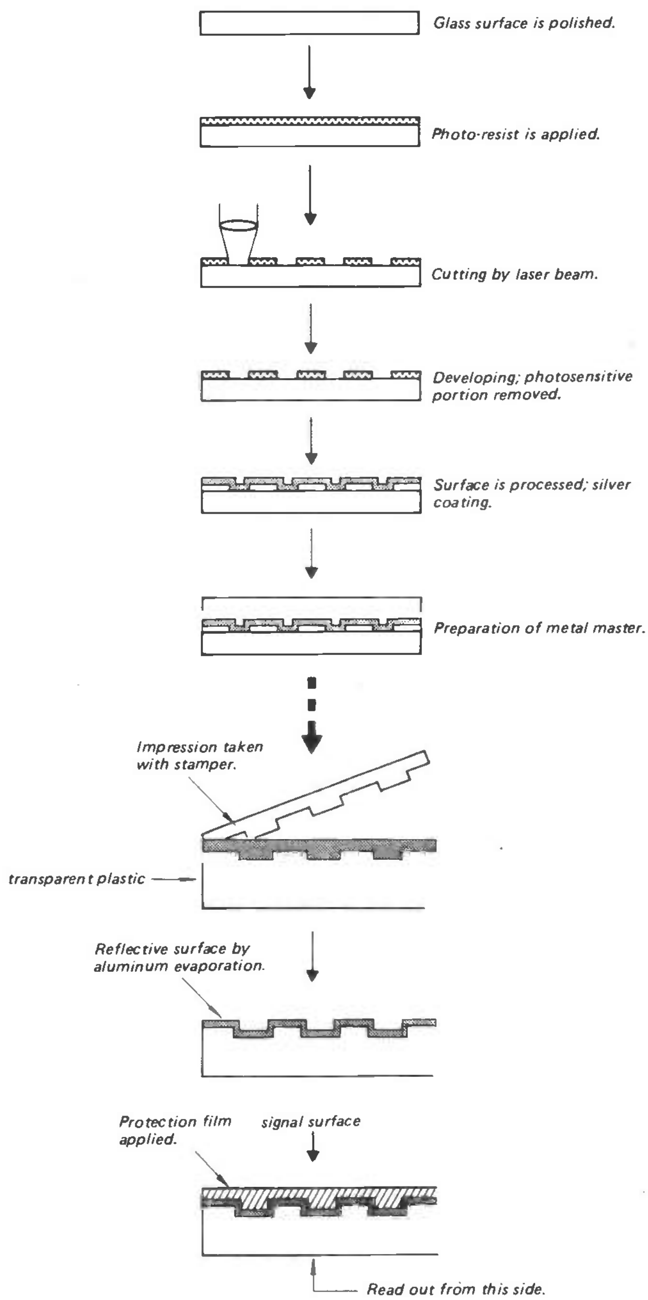


Figure 3: An illustration of the CD disc's manufacturing process.

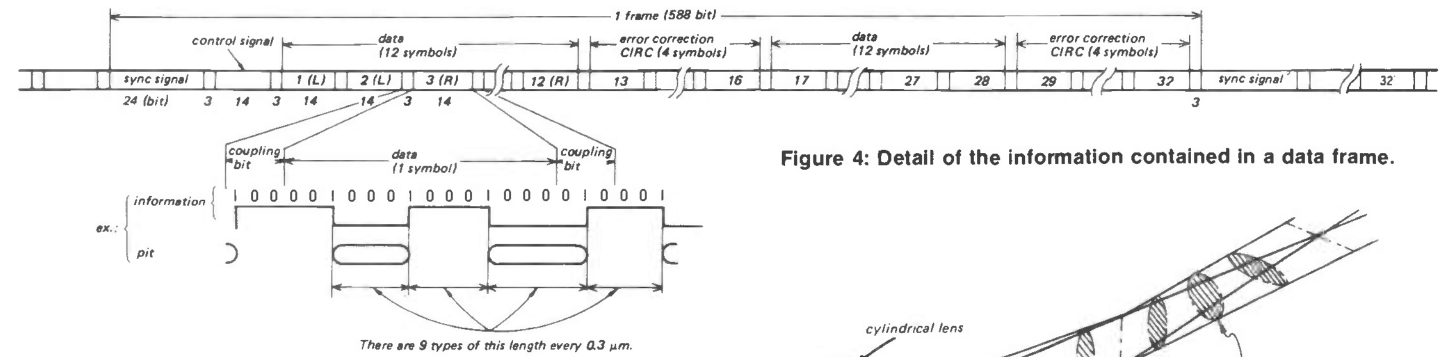


Figure 4: Detail of the information contained in a data frame.

Play It Again

The first stage in reconstituting an audio signal from the CD system is to read the digital information contained on the disc. All CD players use a semi-conductor laser and detector arrangement to scan the disc's surface. The disc scans from the centre outward (to facilitate the introduction of smaller CDs in future) the beam being carried across the disc on a servo driven housing.

As well as recovering the digital signal from the disc, the laser produces supplementary beams which are used by systems associated with the servo drive motors, to provide tracking and focus control. For tracking control, side spots are produced, and by comparing the outputs from detectors associated with these, tracking control may be achieved. Focusing may be controlled by monitoring the signal reflected from the disc with a quadrant of photo diodes. A circular (in focus) reflection would produce an equal signal in each quadrant, while an out of focus beam would produce an out of balance condition.

The recovered data signal, at a rate of 4.3218 M bits per second is first passed to conditioning circuitry and to a Phase Locked Loop for clock regeneration.

The digital signal is then fed to a shift register until the synchronisation block is recognised. The subsequent 14 bit blocks are latched and converted back into eight bit blocks by way of a ROM look-up table similar to that used during recording.

The audio blocks of data are then fed to an error correction and 'jitter reduction' block that produces a signal whose data rate is solely dependent on the system's clock. If the 'jitter reduction' circuit operates, an error signal is generated and is used to modify the speed of the motor driving the disc.

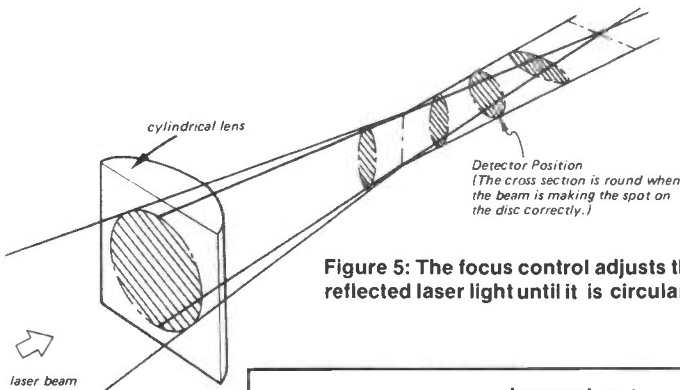


Figure 5: The focus control adjusts the reflected laser light until it is circular.

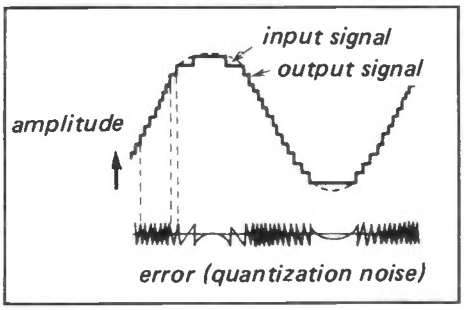


Figure 6: Maximising the number of bits in a PCM system minimises the quantisation noise produced.

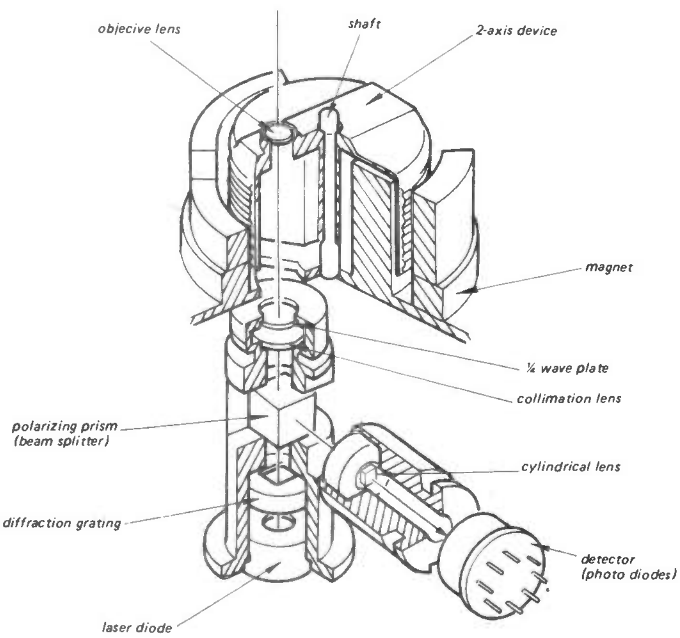


Figure 7: A schematic view of the Sony players optics.

De-Leaving

The signal at this stage is still interleaved: de-interleaving involves storing the 24 audio blocks and eight error blocks of one frame in RAM under the control of the Reed-Solomon circuitry. The decoder is able to correct one corrupted word but if the first parity bit shows more than one word in error the 24 audio blocks are written back to RAM unchanged, together with the second parity block (4 words). At the same time a flag to indicate the unreliable nature of the data is set. This second writing process further de-interleaves the signal and can correct up to two erroneous words with the aid of the second parity block. If the data was not capable of correction a second flag bit is set.

After 30 stereo samples have been stored in RAM the first is output as a 16 bit burst followed by an 8 bit gap and then another 16 bit group. An incorrect sample will have a flag bit associated with it while if two consecutive blocks are incorrect after de-interleaving a flag bit is inserted in the 8 bit interval immediately upon detection — that is 30 samples before the corrupted data appears at the output.

Data that is flagged as unreliable is fed to the muting and interpolation circuitry of a CD player.

Quiet Please

The muting and interpolation circuitry operates at three levels, with no error flags present, data passes unchanged. With an error flag associated with a single 16 bit block, the error is compensated for by replacing the erroneous sample by a process of linear interpolation. If an error flag is detected in the

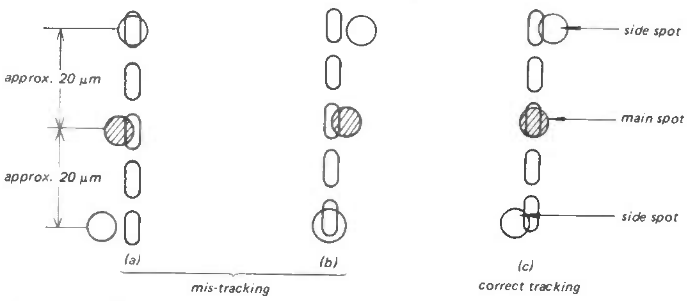


Figure 8: The tracking control system operates by monitoring the amount of light reflected back from the main beam's side spots.

8 bit interval between data blocks the value of the samples is immediately reduced and if such flags continue occurring, will be zero after 30 samples. This gradual reduction in output removes the likelihood of audible clicks being produced. The output will gradually be restored to full as soon as the error flag is re-set.

Up to 12,000 bits, or 8.5mm of track can be in error before output is reduced to zero and in practice this level of circuit action will rarely be encountered. When it's considered that even a 20mm section of unreadable track would only cause muting for about one hundreth of a second, the robustness of the system can be fully appreciated.

Back To A

The final part in the chain is the D/A converter and it's here that the major difference between the Japanese and European approach is revealed.

The oriental players adopt a 16 bit D/A converter followed by a brick wall filter (to remove sampling frequency breakthrough) that rolls off abruptly at just above 20kHz. This approach has two disadvantages, firstly 16 bit D/A's are expensive and secondly that the brick wall filter is prone to introducing phase distortion in the audio signal.

Philips have adopted a system designed to overcome these problems — it's based on a fast 14 bit (low cost) D/A that runs at four times the basic system's clock rate, ie, 176.4kHz. This is referred to as over-sampling and has the result of effectively quadrupling the bandwidth of the system to 88kHz. As the quantisation noise is spread equally throughout this band, only 25% of the noise appears in the audio bandwidth. In addition, the quantisation frequency is now shifted to well above the upper limit of the audio frequency band which means the requirement for a brick wall filter at the output is removed. In fact a 3rd order Bessel filter, possessing excellent phase linearity, can be employed.

These facts mean that the 14 bit D/A can turn in a performance equal to that of a 16 bit design.

Full Circle

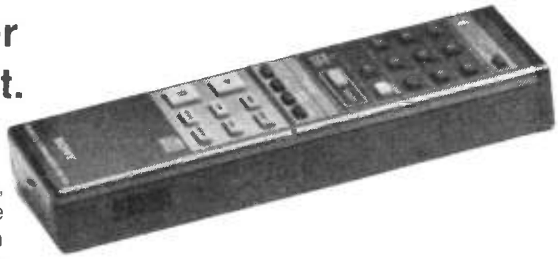
This brief description of the recording/replaying chain of a CD player has not done the intricacies full justice but has, we hope, given an insight into the techniques involved.

No matter how technically elegant the system is however, CD players will stand or fall on the quality they offer. Read the reviews elsewhere in this issue for a verdict on whether the technology has succeeded in producing the ultimate sound.

■ R&EW

Sony CDP101

Mike Skeet looks at Sony's player complete with remote control unit.



The Sony CDP101 player is finished black and is 353mm wide, 100mm high and some 340mm deep. Very much like a cassette deck but smaller than many, certainly packed tight with mechanics and electronics in contrast to many cassette decks which are full of 'air', mainly to get the size to match amplifiers and tuners. At the back, the transformer housing and power section heat sink, protrudes.

Of course, this report can only be somewhat subjective as there is not an established way of evaluating its audio output. Reputable standard test discs would be needed and as yet the only ones to exist are those used 'in house' at hardware and software factories. So this report will look at the ergonomics, user facilities and assess the sound quality and its reliability with the aid of four CDs to hand.

At the back, the most important thing is where the signal comes out. Two gold plated phono sockets provide this and 2 volts RMS maximum of signal level can apparently be expected. There is of course a finite peak output from a digital system. The average level out is very much the same as a modern cassette deck. Also at the back, there are switches labelled Auto Shock on/off, Auto Pause on/off, a socket for Sync out and a multiway accessory connector. The Auto Pause switch produces pause mode after the playing of each track on the disc. Mains input is by fixed lead with a switched mains output on a 2 connector IEC socket.

Now to the front business end. The disc loading is very neat indeed. It is called 'linear skate loading'. In other words a tray is driven out of the machine on pressing the open/close button on the front of the tray itself. The disc is laid label upwards in the tray. Centering is automatic once it has been drawn in. To play the disc, it is then necessary to press the play button. Alternatively pressing the play button only will retract the tray and commence the playing.

There is an average of 4sec before signal is heard after pressing the play button with the tray already retracted. From pause mode at the start of a disc or with a particular track selected there is around 2 secs before signal is heard. This was with the four CBS/Sony discs to hand. The assumption is that the disc 'cutting' specifications are strict and adhered to at the different plants. I mention this cueing aspect as the players must end up in broadcasting and disco use and with the disc hidden inside the machine, access has to be via the machine's controls. Pause can be used at any point and with the ability to slow and fast search up and down the disc, cueing should be respectably accurate.

A nice feature is the automatic engaging of play mode when pause is pressed. This probably cannot be applied to cassette decks as there is the record mode to consider.

To return to the remarkable feature of fast and slow search up and down the disc. When on pause, 10 minutes can be covered in 3 secs! When in play mode, 10 minutes takes 26 secs or so to scan depending exactly where one is on the disc. That's at high speed search. At slow speed there is just one rate, around twice real time. What is heard is not pitch shifted of course! A sort of staccato set of short excerpts as the temporary digital store is filled and emptied. But it is a recognisable signal allowing effective search. At least there are no funny wear aspects to consider, which always concerned me. about cassette cue and review.

The LCD read out informs when a disc is loaded and when scanning to different tracks is in progress. The track number being played is shown and there is a comprehensive timing display. In one mode the total time to go is displayed. So right at the start it is possible to find out the total playing time. In the other mode, as each track is played its elapsed time is shown. Individual tracks can be selected on the machine itself, either further up, or back down the disc.

Four of the small press buttons between the main mode buttons and the time readout display are grouped together. One allows track one to be repeated indefinitely if that is what is desired. Another allowing all to be repeated and a third letting a chosen section be repeated. This latter facility is produced by pressing it at the start of the desired section and again at the end of the piece required. The fourth button is labelled 'clear' to cancel whatever arrangement is set up.

When new-comers are introduced to the player and asked to stop it they initially look for a stop button. After all cassette decks have had such buttons for years. There isn't one as such on the CDP101 player. Pause, of course could be used but I think the intention is that reset be used. This will do just that, resetting the player to the beginning of the disc, cancelling any programming arrangements. There is evidence of 'early days' about the layout of the controls and their particular functions. I suppose one naturally looks for a similarity to the cassette deck. Also I keep looking for LED level controls indicating the program levels. Perhaps future models will be so equipped, though of course it is by no means essential! In fact the best way to an initial lowering of price would be a stripped down player which does just that, with at least track selection.

The CDP101 has a headphone output with level control and external timer on/off switch.

Remote Commander RM101

This duplicates all the CDP101's main controls. Infra red signalling is used and the general coverage is wide — it will work from behind the player if there are nearby objects to give reflections. The player has the option of a tone beep to announce reception of commands. The switch for this seems something of an afterthought as it is underneath the player. The disc drawer cannot be opened or shut from the commander, presumably as one would have to be present to handle the disc anyway.

The commander has additional buttons 1 to 0 to allow remote track selection. This involves pressing the appropriate button (or buttons for track ten upwards) and then pressing the start button. Remote controls for TVs provide control over sound level but this is not available with this compact disc package.

Software Portents

It is early days at the time of writing and only four discs were to hand. All of these were from the CBS/Sony stable. When I watched people handle them, I noticed the good housekeeping of handling LPs being followed. But this is supposed to be unnecessary, isn't it?

The laser scanned area is quite thickly covered in clear hand plastics but the label isn't. But it's more than the label, it is the reverse of the quite thin aluminium disc which is the heart of the whole affair. My impression was that this was sandwiched in the protective plastics.

I was deliberately ill-treating the four discs I was auditioning, imagining that the protection was double sided. Scratch and scuff damage on the playing side did not seem to affect the audio performance. This is to be expected, as the laser beam is out of focus at the surface of the disc. The label can be easily scratched and these penetrate through to the 'playing surface'. Small pin holes are handled by the error correction arrangements. A long scratch caused the player to jump in time, in a rather random way. Having the same thickness of protection over the label side would surely prevent this.

The CBS/Sony compact discs come in library cases which take some experience in opening! Almost a party trick to test the uninitiated. The music notes are in a booklet which serves to identify the album through the cover of the case — and difficult to remove without producing creases. The samples available were very dull in appearance — something the average LP sleeve does not suffer from. The shortcomings of the packaging design can, in fact, be laid at the door of Polygram as it's part of the Philips licensing arrangement.

What Is The Audio Like?

I have been regularly using in the last few months for location recording, the Sony PCM F1 Digital recorder which records on Beta video cassettes. This has been mainly in the classical music field for conventional LP and quality Real Time duplicated cassette in Dolby C. As mentioned in my 'write up' in **R&EW** Dec '82 it produces rather superb results when used with microphones capable of producing a decent signal. The PCM F1 LSIs are apparently the same type as used in the Sony CD players.

The compact discs so far heard directly on the CDP101 player consist of three classical releases, apparently from analogue masters, a Jazz influenced pop release from Weather Report, this from a digital master and via a PCM F1 tape copy the sound of a Dire Straits compact disc.

The three classical releases show what we must assume to be poor microphone and/or recording techniques. In particular the string sound is hard and tiring. Oh yes there is an absence of LP surface noise, clicks and pops and the analogue master tape hiss is accurately heard. All indications of listening to the original master, but it will need better examples to do justice to the transparency of the CD medium. The Weather Report disc was of a live concert and despite the Digital master was not technically satisfying in my view. The Dire Straits mastering was obviously of a much higher standard.

My personal experience with the PCM F1 recorder and a British Calrec Soundfield microphone in the classical field are in an altogether different class. Not just the nature of the instrumental sounds but the coherent imaging and ambience. Others who have heard the masters volunteer this view. So with the revealing nature of the CD system it is obvious that record producers and engineers will have to look to their mic types and techniques. After all it is not without interest that there seems to be a breath of fresh air in the sound from some re-releases on a well known budget LP label of 1960 recordings made with simple mic techniques.

HITACHI DA-1000

Peter Luke with a description of the facilities offered by Hitachi's implementation of the CD system.

Of the first wave of CD players launched during March, the Hitachi got off to perhaps the shakiest start. The reason for this less than auspicious start were the reports in some sections of the Hi-Fi press concerning the poor 'subjective' audio quality of the DA-1000. The problems were put down to design faults in the players D/A and output filter circuitry. These effects showed up on pre-production samples of the player and must have prompted a considerable amount of last minute design work as the production models appear to have been modified to overcome any shortcomings in the player's performance.

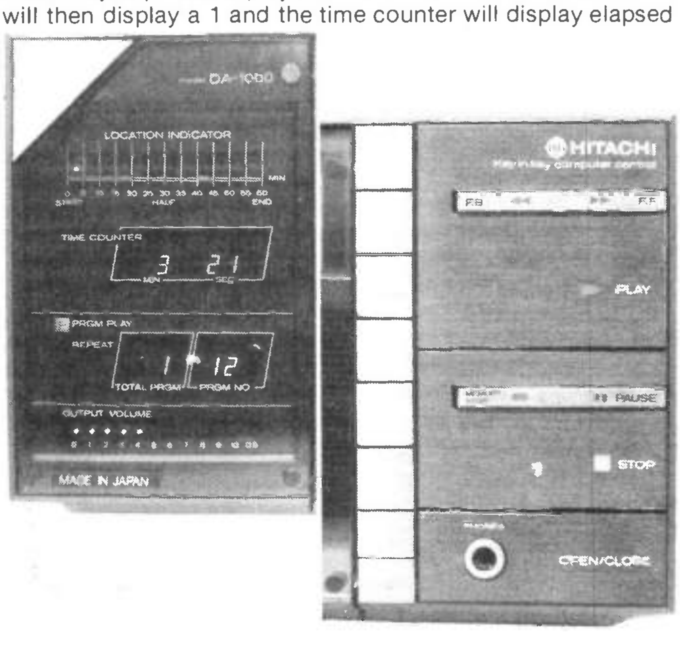
The player is front loading with the disc adopting a vertical position during play. This means that the Hitachi player is rather larger in size than Sony's machine, its front panel being dominated by the central disc draw. The left hand section of the ▶

front panel consists of various status and timing indicators while the right hand section is made up of some twelve or so control buttons. These control a range of 'trick' functions and in some peoples' opinion sales of any particular CD player will be determined not so much by the ultimate sound quality, but by the ancillary facilities offered — very much the way of the video market.

To play a disc, the open/close switch is pressed — this will cause the disc draw to swing down to about 20° from the vertical. The disc is now slotted into the draw until it's about half way in. It's a great temptation to push the disc further into the draw or to close the draw manually. These wayward thoughts must be resisted however, the player taking care of such mundane operations when the open/close switch is pressed.

Having got the disc into the playing position, the DA-1000 scans the disc's programme information track and displays the number of tracks on the disc in the total program display. This operation takes five to ten seconds and after it's completed, all displays are set to zero and the DA-1000 is ready for action.

To play a disc without making use of any of the frills it's only necessary to press the play button. The track selector indicator will then display a 1 and the time counter will display elapsed time in minutes and seconds. The volume level can be adjusted by means of an up or down control button its level being displayed by a series of LEDs at the lower left hand side of the player. There's no need to worry about the effect of an electronic attenuator on the quality of the audio signal — the up/down buttons drive a motor that controls an ordinary, passive, pot.



The DA-1000 programmed play facility is fairly straightforward in operation. The machine can store up to 15 different selections. To enter a track, the program button is pressed and then the track number entered by means of two buttons that increment the program counter in steps of 1 or 10. This method of selecting tracks is slightly less convenient than a keyboard entry system but in practice is not too much of an inconvenience.

When all tracks have been entered, pressing the play button will play the tracks out in the required order. At the start of each track,the time counter will briefly display the total time of the recording before reverting to zero and commencing a real time display.

The location indicator above the time counter will at all times give an indication of the position of the player's scanning diode on a scale from 0 mins to the full 60 mins recording time.

The player's call button can be used to display the contents of the program memory.

During unprogrammed play the player's fast forward and fast rewind controls can be used to skip forwards (or backwards) over one or more tracks, depending on how often the controls are pressed. The repeat control will allow the same track to be played until the instruction is cancelled.

One final facility available on the player is akin to the visual search of a video recorder. Pressing both play and fast forward or reverse will cause the player to skip over tracks for 30 seconds worth of material and then play one second of the track.

Impressions

Our sample of the DA-1000 performed well, the major omission in our minds being the lack of a remote control option.

Our player did not exhibit any of the audio problems reportedly exhibited on some of the pre-production models and with its fairly comprehensive range of features — looks to be a good buy.

■ R&EW

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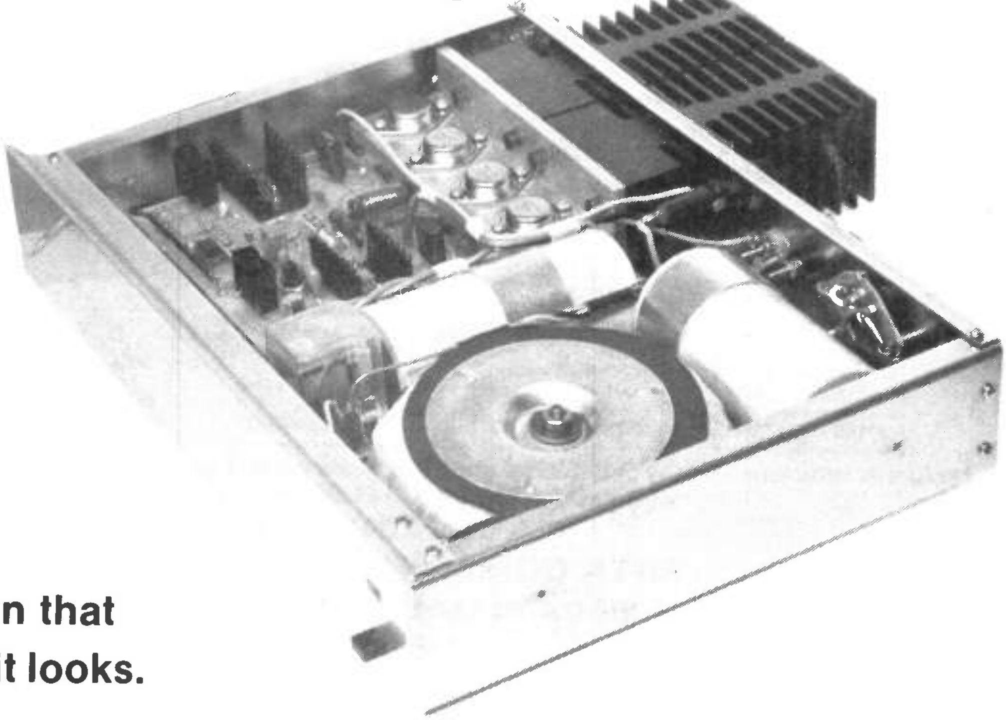


A monoblock design that sounds as good as it looks.

Design by Steven Marshall and Derek Frost.

Readers of R&EW will remember our last Hi-Fi amplifier project, which was well received overall. However, with the imminent arrival of the digital audio disc on the Hi-Fi scene, we felt that it was time to have another look at amplifiers in general. If the advance publicity for the digital disc were to be believed, the front end of any disc playing system, which has traditionally been the factor with the most influence on the final quality of even the highest quality system, was about to be replaced by a new, low distortion, low crosstalk, very wide dynamic range unit.

This would obviously be a new factor affecting amplifier design. Since with crosstalk figures of 80-90 dB available from the new disc unit, the traditional design of amplifier with a single common power supply would no longer be capable of doing justice to the signal.

Dynamic ranges of 80-90dB would also indicate that especially with todays inefficient loudspeaker designs, a larger reserve of output power than is currently normal with domestic amplifiers would also be required.

To this end we have burned the midnight oil (and our fingers sometimes) to bring you the ultimate in kit-design amplifiers, based upon new rugged bipolar transistors which produce amazingly delicate high frequency sounds and solid precise bass. This latter feature has so far eluded most MOSFET designs.

Monoblock design takes care of the crosstalk, and when used close to each loudspeaker enables the use of short heavy speaker cables. The power delivery is prodigious, even into loads of 2 ohms which means that literally any loudspeaker may be used without any problems. We have also gone to the trouble to design and produce an exclusive and professional metal cabinet with an extruded aluminium fascia, all in a durable attractive dark metallic finish, which will also be used extensively in future audio and other projects. Now that your appetite is whetted, read on and see how it works.

Listen With R&EW

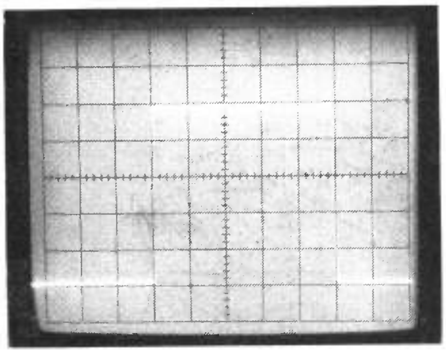
Not long after assembling and testing the first prototypes, we had the good fortune to acquire a digital disc machine along with a couple of discs, so of course we all assembled in the largest available space with the aforementioned disc machine, two amplifiers and a pair of Roger's Studio One loundspeakers.

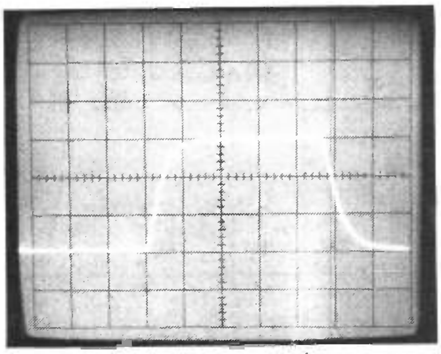
We switched on, held our breath (to a man) and turned up the volume on the disc unit. What a Revelation! We had never heard such sound. A visiting engineer from a very well known broadcasting body was heard to comment that it was the most realistic that he had heard. The dynamics on say a harpsichord were incredible, and kettle drums seemed to be in the room with the rest of the orchestra.

Since that time the amplifiers have been tried in every description of system from normal hi-fi to super-fi and even ultra-fi, always with the same kind of reaction, with or without digital discs. Try them yourself and we're sure you will agree that we have created a beauty, not a beast!!

SPECIFICATION

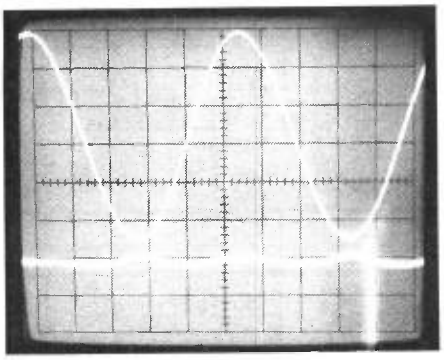
Frequency Response −3dB 1.5Hz and 86k
Rise Time 4μS
Slew Rate 23V/μS
THD 1kHz <.01% at rated output into 8Ω
THD 20kHz < .03% at rated output into 8Ω
IMD 10kHz & 11kHz output 85up/p into 8Ω <.03%
Power Output 200 watts into 4Ω
130 watts into 8Ω
80.0 watts into 15Ω
Input volts for 100 watts into 8Ω 0.725V
Dampling Factor > 150 10Hz - 20kHz at 100 watts into 8Ω
Signal to noise ratio unweighted > 96dB
Gain x39 (32dB)

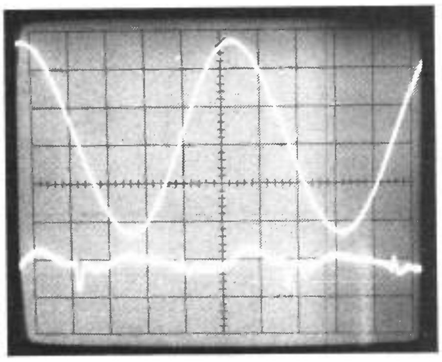




1kHz 20kHz(5us per div.)

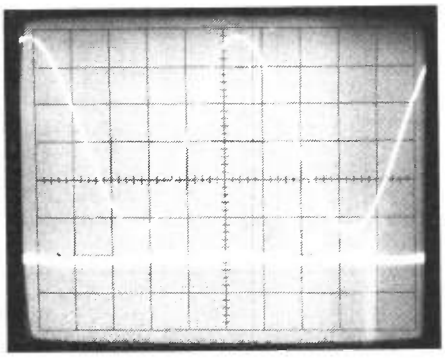
Square wave response of amplifier showing 4us rise time.

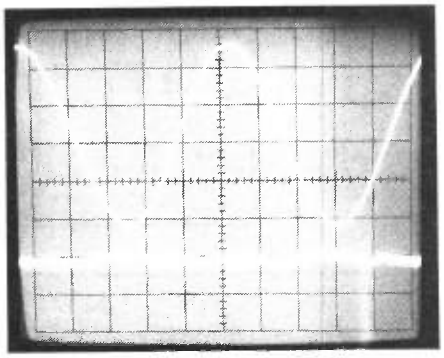




1kHz 20kHz

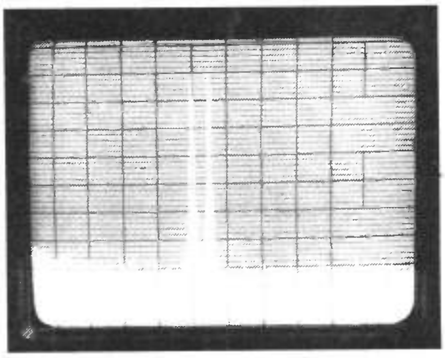
THD of amplifier at 100W into 8 ohm. Distortion trace is amplified by a factor of approximately 750.



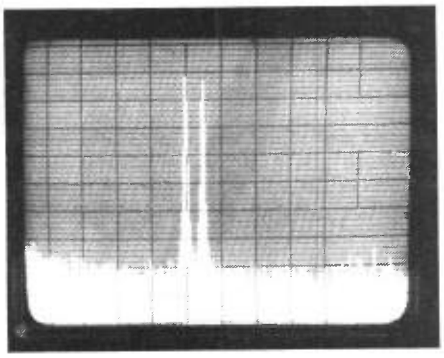


1kHz 20kHz

THD of amplifier at 1W into 8 ohm. Distortion trace is amplified by a factor of approximately 750.



10kHz & 11kHz
85V P/P into 8 ohm



10kHz & 11kHz
80V P/P into 8 ohm
in parallel with 2.2uF

Intermodulation distortion of amplifier measured on Marconi TF2370 Spectrum Analyser; Vertical scale: 10dB per div.; Horizontal scale: 2kHz per div.

Circuit Description

The mono power amplifier to be described is an AC coupled non inverting circuit with a conjugate complimentary output stage design delivering over 100 watts into an 8 ohm load with plenty of back up into 4 ohms and 2 ohms.

The input stage uses a BIMOS operational amplifier, IC1 well isolated from the positive and negative supply rails and running from a ± 5.1V zener regulated supply, R4.ZD1, and R5.ZD2. Q1 acts as an inverter buffer stage, the inverting output being directly coupled to Q2 and the non-inverting output across R7 providing local negative feedback via R10 and C6, with C6 blocking the DC potential from pin 2 of IC1 which would cause a large DC offset at the loudspeaker terminals. Q2 is the main voltage amplifier stage and provides the complete voltage output swing from the amplifier. Q4 with its associated components, D3, D4 and R8 form the constant current load for Q2 with Q3 acting as a Vbe multiplier to provide the adjustable quiescent bias for the output stages C5 and R9 form the main HF stabilization pole of the amplifier with D1 and D2 forming an anti-latching circuit allowing instant recovery from a large overload signal.

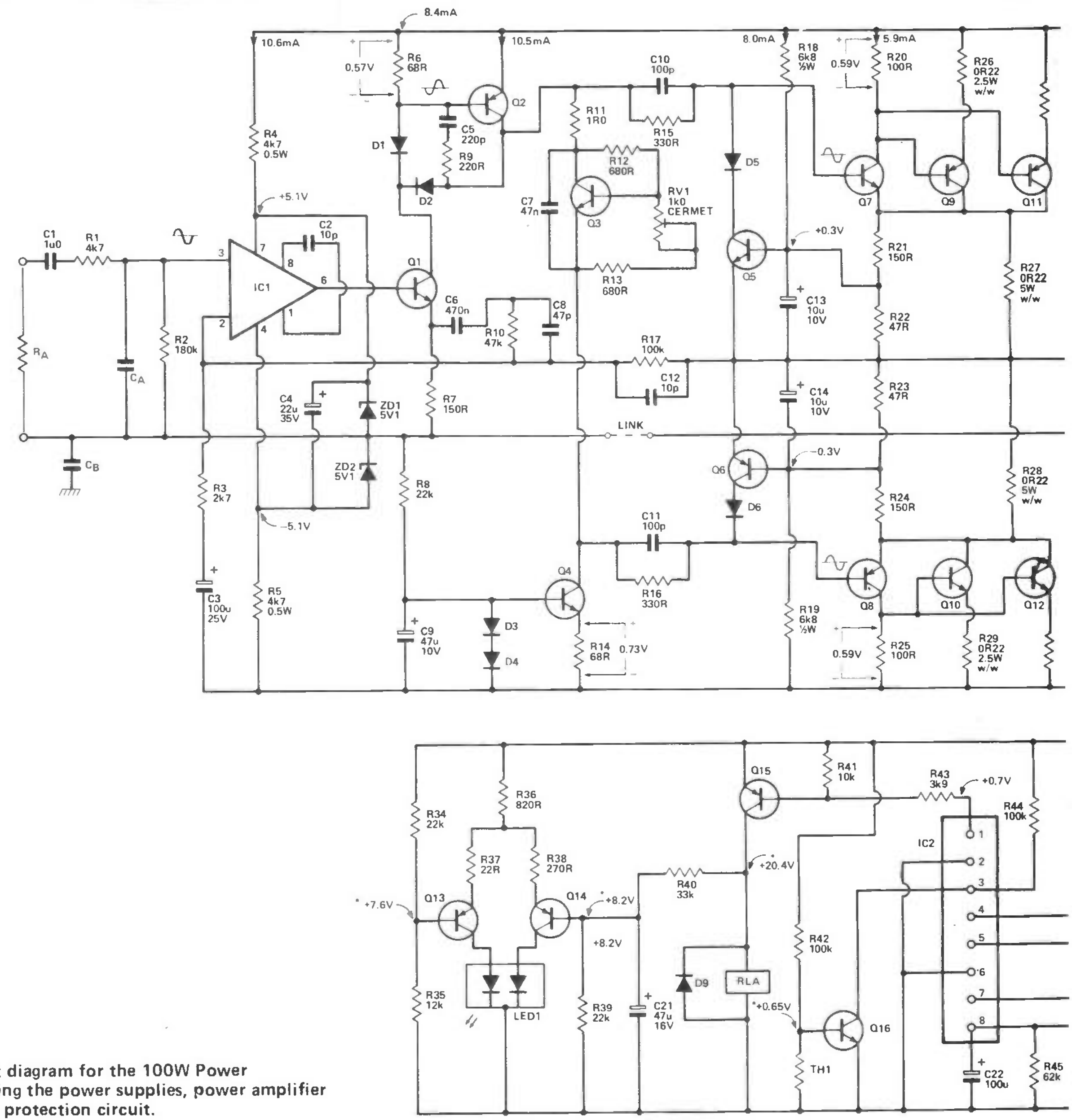
The conjugate complementary output stages are formed by Q7 feeding the parallel connected output transistors Q9 and Q11 which equates to an NPN Darlington stage and Q8 feeding the parallel connected output transistors Q10 and Q12 equating to a PNP Darlington stage. These stages have high current gain and unity voltage gain.

Overall negative feedback is provided by R17, R3 and C3, with C3 becoming an open circuit at DC when the closed loop gain becomes unity, which ensures a DC offset of less than 5mV at the loudspeaker terminals. The AC closed loop gain is 32dB(x39). C10 and C11 in conjunction with R15 and R16 respectively are phase advance networks in the forward path of the amplifier to counter the phase delay in the output transistors in the megahertz regions, a similar function is provided by C8 and C12 in the negative feedback paths.

R32 and C28 form a stabilizing lag circuit across the output of the amplifier and also provide a restricting AC load for Q3, when the amplifier is feeding into an open circuit. L1 in parallel with R53 are connected in series with the output from the amplifier to isolate it from the effects of capacitive loading (not the 2u often used in test procedures, but much lower values in the 100p — 100n region).

Q5 and Q6 form part of the protection circuit for the output transistor and taking the positive half cycle protection R18 and R22 feed a proportion of the DC volts across the output transistors Q9 and Q11 to the base of Q5 and R21 and R22 feed a proportion of the voltage developed across R27 (which is proportional to the current following through the output transistors) to the base of Q5. In conditions of overload Q5 will be turned on, diverting part of the current supplied to the output stage. R15 acts as a current limit when Q5 is turned on.

A similar procedure is enacted on the negative half cycle except for the fact that R16 although in circuit, is not required for a current limit function. Diodes D5 and D6 prevent the forward bias of the collector/base junctions of Q5 and Q6 during normal operation. The resistor values for the voltage sum circuit have been adjusted so that protection only becomes operative above 200 watts into 2 ohms and with ▶



Complete circuit diagram for the 100W Power Amplifier, showing the power supplies, power amplifier and loudspeaker protection circuit.

the additional protection provided by supply line fuses FS1 and FS2 one might rightly ask whether the electronic protection circuit is necessary. This can be answered from past experience where amplifiers for repair have been found fitted with brass rods instead of fuses, or the original blown fuse wrapped in silver paper.

The fuses FS1 and FS2 in the positive and negative supply lines are for sustained overload protection and are specified at 7A quick blow. When one considers that 200 watts into 2ohms draws 4.5A DC from the supply, they are not going to flinch during normal operation of the amplifier. With a sustained overload and the limited space available for a heat sink in the low profile cabinet, a thermal sensor bolted to the output transistor mounting plate has been included which will be described in the following paragraphs.

The loudspeaker is protected from any amplifier malfunction that would cause a DC offset of greater than ±1V at the output terminals by relay RLA operating contacts RL1-2. This relay has contacts rated at 20A,AC + is operated from the Hitachi multipurpose protection chip IC2 which operates as follows.

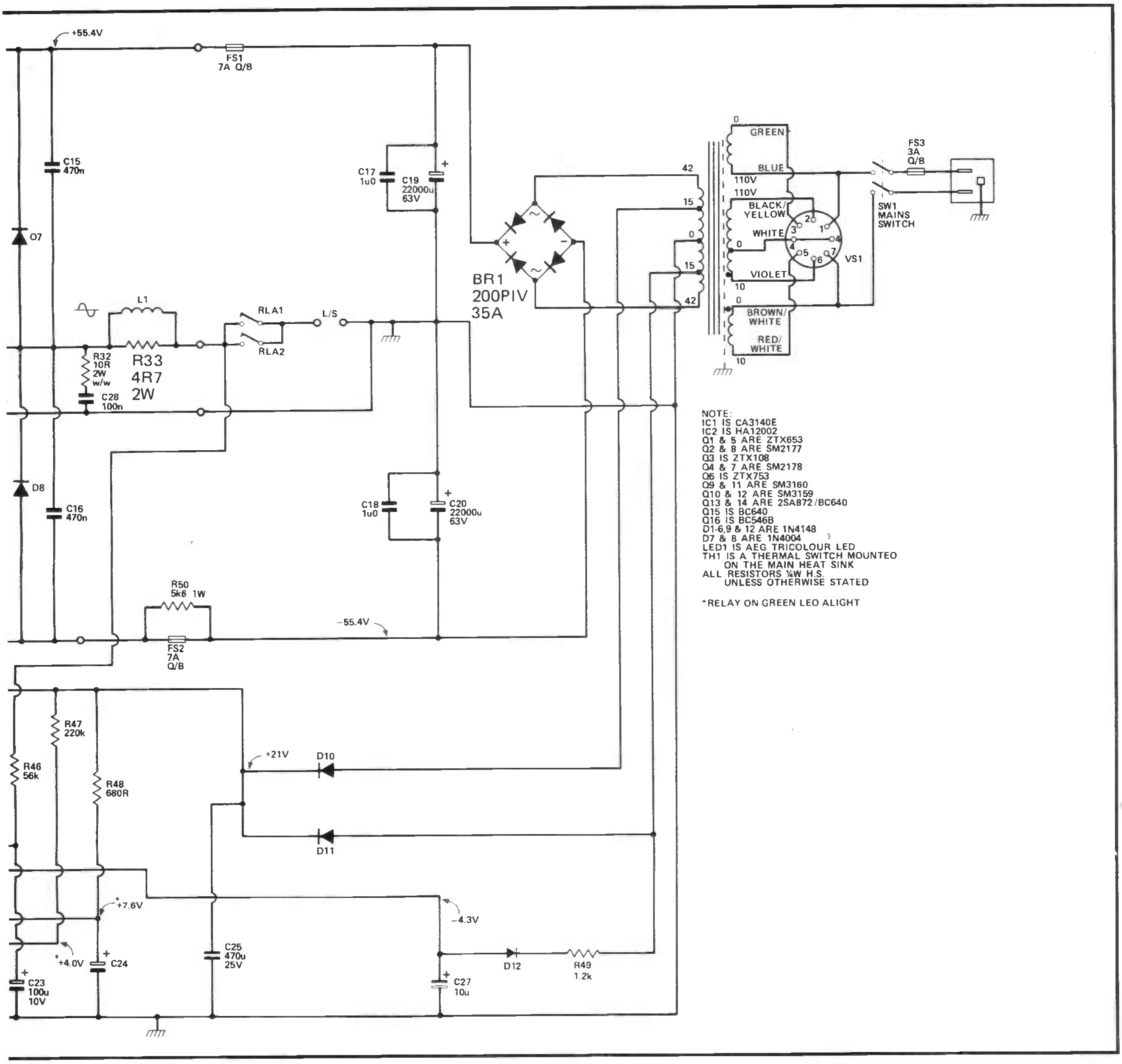
The output from the amplifier is fed via R46 into pin 4 of IC2 which detects any DC offset of greater than ±1V by switching itself off. With IC2 switched off the potential at its pin 1 rises to the ±21V rail turning off Q15, which in turn releases relay RLA. The time taken for IC2 and hence RLA to switch off is determined by the time constant of R49, C27 controlling the decay of the negative voltage applied to pin 5 of IC2. It also determines how quickly the supply can be turned on again while still retaining the relay switch on delay, which is also a function provided by IC2, by means of R45, R47 and C22. In this design a time constant of 8-10 seconds has been allowed for the amplifier or any switched input signal to settle down before the relay operates to connect the loudspeaker.

An indication that the amplifier is ON and the relay operated is given by the tri-colour LED mounted above the power on/off switch on the front panel. Q13 and Q14 form a bistable pair and when the amplifier is first switched on, Q14 is turned on because its base is returned to earth via R39, R40 and RLA. This lights the red section of LED1. After a delay of 8-10 seconds and on condition that there is no DC offset greater than ±1V IC2 will draw current from the +21V rail via R41 and R43 which will cause Q15 to turn on, which in turn returns R40 to the +21V rail operating RLA, and turning off Q14, whose base has now become +ve. With Q14 off, the bistable action causes Q13 to turn on, lighting the green LED. The transition from red to green via a mixture of both (yellow) is made gradual by the addition of C21 to the base circuit of Q14.

IC2 carries out one further function already mentioned as a heat sink temperature controller.

TH1 is a negative temperature coefficient thermistor mounted on the output transistor heat sink, and connected between earth and base of Q16 which is normally tuned hard on, virtually earthing pin 3 of IC2. At 75°C the resistance of TH1 drops from many thousands of ohms to a few hundred ohms, very quickly turning off Q16 and causing pin 3 of IC2 to rise to the +21V rail via R44. This turns off IC2 and hence disconnects the loudspeakers from the amplifier via relay RLA. With a thermally stable amplifier the heat sink temperature will gradually reduce allowing Q16 to turn on again and hence the reconnect of the loudspeaker.

The power supply is centred on a 250VA toroidal mains transformer with an electrostatic



screen between primary and secondary, feeding a centre tapped bridge cct. BR1 is a 35amp bridge rectifier feeding the massive 22000u reservoir capacitors C19 and C20. These are the largest capacitors that the chassis size will accomodate, and the extra effort in fitting and wiring them in a confined space, is well worth it considering the improved low frequency performance it gives to the amplifier. To maintain a low impedance at the higher audio frequencies, 1u polyester capacitors are connected across each reservoir capacitor. C15 and C16 carry out a similar function on the power amp board where the wiring between the power supply and power amp boards will introduce some inductance and hence impedance at the higher frequencies.

A sophisticated voltage selector, usually only fitted to the more professional of commercial amplifiers has been catered for when designing the mains transformer for this kit. It allows for the selection of six mains voltages, which cover the requirements of Europe and most of the United States and some of Japan. For the home constructor, 240V will be the one to select, though at the end of a long power line in country areas the 230V tap will make up the lost watts. The reservoir capacitors, the power transistors, the driver transistors and the pre-driver transistor have been generously rated to accept the use of the amplifier on a varying mains supply with (in UK) the voltage selector set to 230V.

The input circuit design has been left till last because it can be tailored to suit individual requirements.

In this design the input impedance to IC1 is high, allowing the use of a non-electrolytic type coupling capacitor.

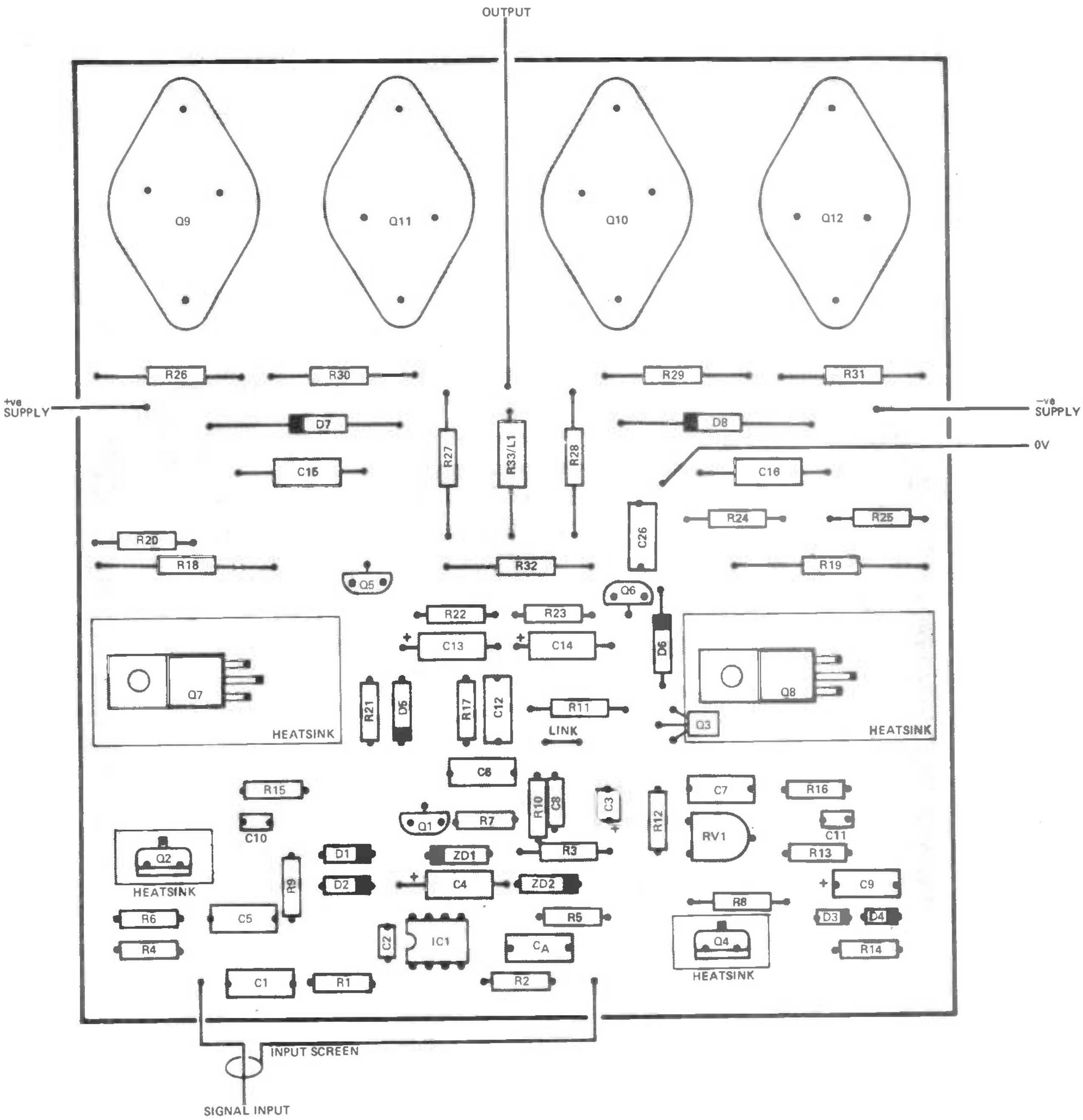
The low frequency and phase response of the amplifier is defined by C1.R2, C3.R3 and C6.R10, and with C1=1u and R2=180 and R3=2k7 and C3=100u, the low frequency response starts falling at 10Hz with a phase advance of 10° at 10Hz down to -3dB at about 1Hz. This can be varied as required, and by making C1=100n the -3dB point can be raised to 10Hz.

The high frequence response of the amplifier can be defined by R1.CA and with R1 = 4k7 and CA = 470p, a -3dB point of about 60kHz is obtained. This assumes that the amplifier is driven from a low source impedance compared to R1 ie, 470 ohms or less. If the source impedance is equal to R1, then the -3dB point reduces to 30 kHz. There is no advantage in allowing the amplifier to accept and amplify/detect unwanted high frequency signals so it is essential therefore that CA should not be omitted.

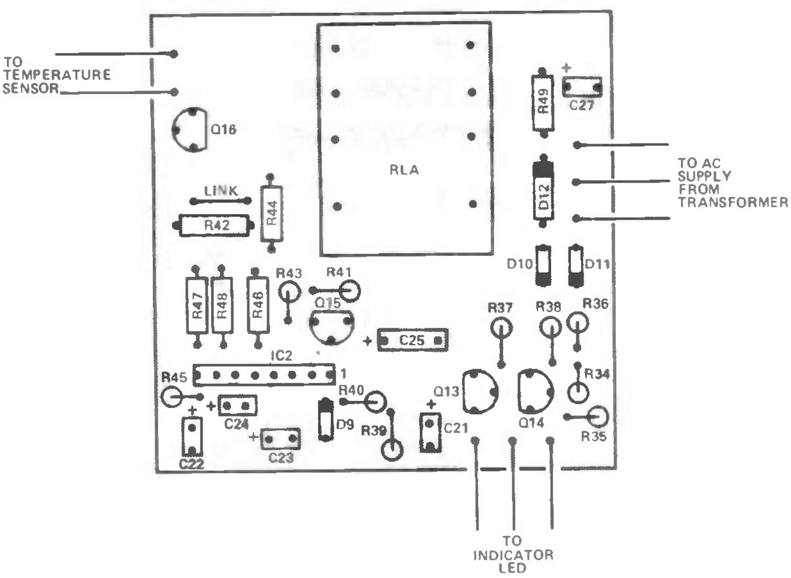
If one requires to define the input impedance of the amplifier at a lower value than the present design allows, then a suitable resistance may be inserted across the input connections of the amp (RA on circuit diagram).

Earth loop problems can arise when using separate preamplfier/power amplifier combinations, and this has been catered for in the following way. The loudspeaker -ve terminal is earthed to the chassis central earth point, and the input socket is isolated from the chassis. In certain cases it may be found desirable to earth the input socket to the chassis, and in this case, the earth link on the main amp board must be broken.

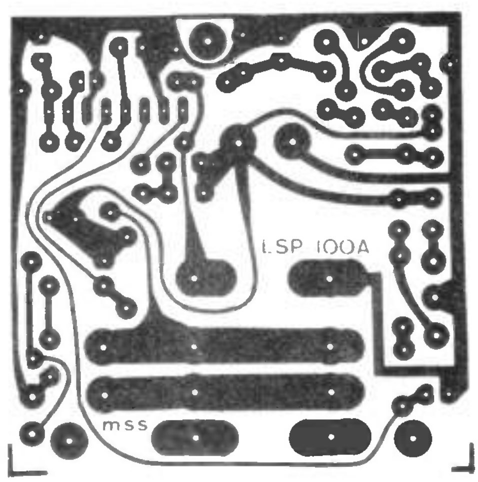
In cases where the socket remains isolated from the chassis a 47p ceramic capcitor (CB on circuit diagram), should be connected between body of phono input socket and adjacent chassis for which a solder tag and mounting hole is provided. ▶



Component overlay for the 100W Power Amplifier.



Component overlay for the loudspeaker protection board.



Foil pattern for loudspeaker protection board.

Foil pattern for the 100W Power Amplifier.

PARTS LIST

Resistors

(All ¼W 5% carbon film unless stated)

R1	¼W metal film 1%	4k7
R2	¼W metal film 1%	180k
R3		2k7
R4,5	½W	4k7
R6,14		68R
R7,21,24		150R
R8,34,39		22k
R9,38		220R
R10		47k
R11		1R0
R12,13,48,36		680R
R15,16		330R
R17,42,44		100k
R18,19	½W	6k8
R20,25		100R
R22,23		47R
R26,29,30,31	2.5W wirewound	5% OR22
R27,28	5W wirewound	5% OR22
R32	2.5W wirewound	5% OR22
R33	2W	4R7
R35		12k
R36		22R
R40		33k
R41,49		10k
R43		3k9
R45,46		56k
R47		220k
R50	1W	5k6
RV1	Cermet Preset	1k

Capacitors

C1	Polycarbonate	1u
C2,12	Ceramic	10p
C3	Tantalum 100u	25V
C4	Electrolytic 22u	35V
C5	Polystyrene	220p
C6	Polycarbonate	470n
C7	Mylar	47n
C8	Ceramic	47p
C9	Electrolytic 47u	25V
C10,11	Polystyrene	100p
C13,14,24,37	Electrolytic 10u	16V
C15,16	Polyester	470n
C17,18	Polyester	1.0u
C19,20	Electrolytic 22000u	63V
C21	Electrolytic 47u	16V
C22,23	Electrolytic 100u	10V
C25	Electrolytic 470u	25V
C26	Polycarbonate	100n
CA	Polystyrene	330p

Semiconductors

IC1	CA3140E
IC2	HA12002
Q1,5	ZTX653
Q2,8	SM2177,258720
Q3	ZTX108
Q4,7	SM2178,25D753
Q6	ZTX753
Q9,11	SM3160
Q10,12	SM3159,2SD753
Q13,14,15	BC640 or 2SA872A
Q16	BC546B
ZD1,2	Zener Diode 4mW 5% 5v1
D1-6,9,10,11	1N4148
D7,8	1N4004
BR1	35A 200PIV Bridge rectifier
LED 1	V518 Tri - colour
TH1	Thermal Sensor
FS1,2	Fuse 1¼" x ¼" Q.B. 7A
RS3	Fuse 20mm Q.B. 3.15A

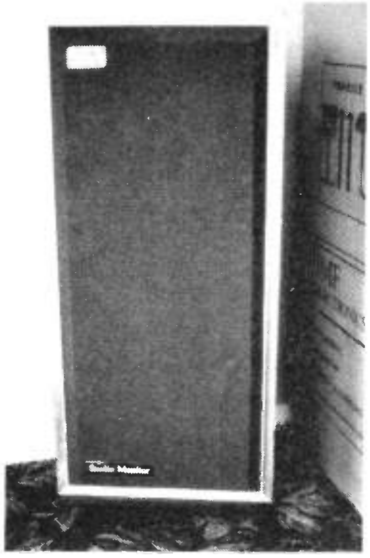
Miscellaneous

TR1	250 VA Toroid 42-0-42V, 15-0-15V
VRS	Voltage Selector
SW1	Mains switch alps SDS 5A
B1	Button for above SW1
MS1	Mains fused socket-Bulgin
FH1,2	Panel fuse holder 1¼"x¼"
HS1,2	TV21 Heatsink
HS3,4	PF745 Heatsink
HS5,6	Special Heatsink
RLA	IMO Relay 20A

Hardware

PCBs, case hardware, sockets, connecting cable, etc.

Continued next month with construction and testing details.



IMF STUDIO MONITORS

Paul Coster listens to a pair of up-market transmission line speakers from IMF and is impressed by their quality and realism.

If there's one thing we British can take a pride in, it's our ability to produce top quality speakers that put foreign competition to shame. Even the Japanese — renowned for their prowess at manufacturing popular consumer electronics and selling them at half the average market price — have yet to come up with a speaker that *sounds* as good as it looks. However, not all British designs live up to the reputation shared by the majority and when an established company launches a new range, it's important to judge the sound without regard to what's gone before. Bearing this in mind, the author approached IMF Electronics in order to gain an insight into some of the latest design philosophies and to review their new domestic transmission line speaker — the Studio Monitor.

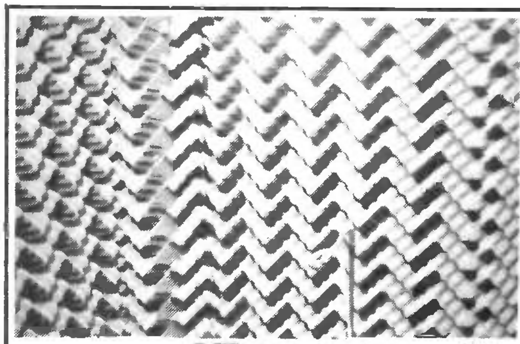
The Company They Keep

IMF Electronics is not a huge corporation, yet over a period of some twenty years they've gained the respect of enthusiasts and critics alike. During the past few years, however, their efforts have been concentrated on the export markets of Europe and the United States. This mean't old favourites like the ALS40 and TLS50 had to compete with many new 'flavours of the month', without pandering to the whims of so-called revolutions in design (does anybody *still* buy speaker cable for £10 per metre?).

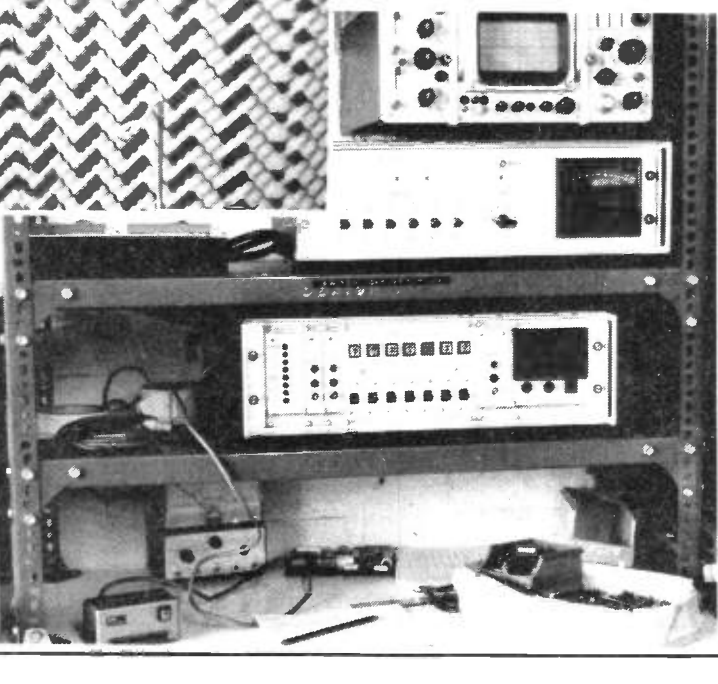
The policy at IMF is to spend considerable time and effort during the research and development phase, then present a series of models to suit the widest range of tastes over the next few years — the basic design tenet being that a speaker should reproduce the input signal as faithfully as possible.

The company's aims were brought a stage nearer seven years ago when they started building their own drive units at a plant in Tottenham, North London. Subsequently they also took control of a previously sub-contracted cabinet company near Oxford, which set the scene for the production of speaker systems almost totally 'in-house'. Drive units are now custom-built to suit particular design specifications and meticulous detail is paid to selecting the right materials to construct and bond the cones. Even the cabinet panels are veneered on both sides to minimise resonances.

With all these refined techniques to control factors which influence the sound produced by their speakers, IMF put an emphasis upon quality, rather than keeping pace with the latest craze. Indeed, they boast that many customers, having purchased one model, are loathed to upgrade it for fear of losing a sound they've grown to love — and this reviewer, having felt a great loss after returning the speakers supplied, can testify to a certain empathy with them.



Above: Part of the smaller of two anechoic chambers used for measuring drive unit responses. In the foreground is the Bruel & Kjoer microphone needed for making standard tests (as shown on the next page).



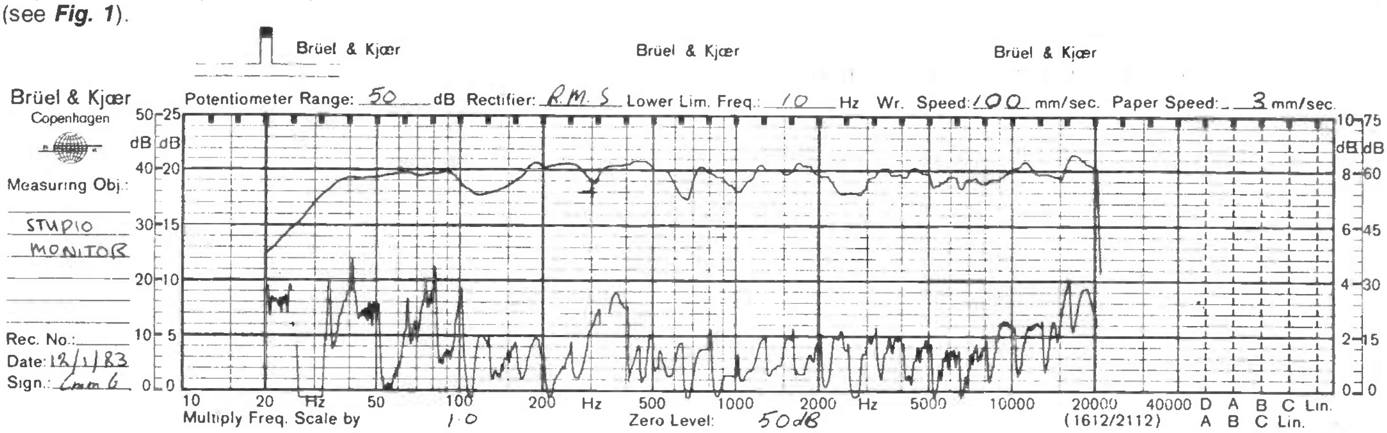
Below: The racked testing system for IMF's crossovers. The two instruments under the 'scope are custom-built for easy operation.

Choosing Your Subjects

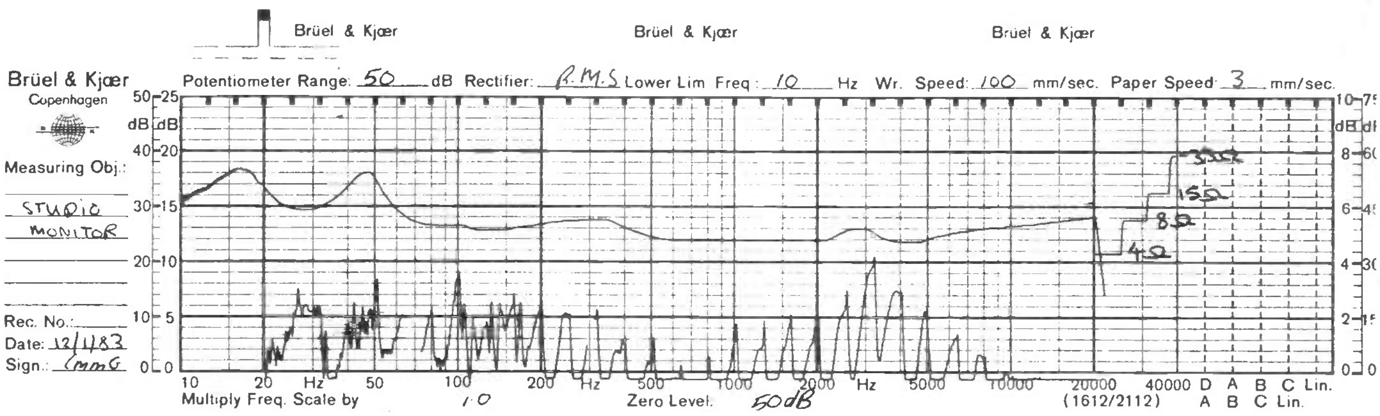
There are seven production models in the new IMF range. These extend from a two unit bookself design, the CM2, up to the Special Application Control Monitor at just over a grand apiece. We chose to review the Studio Monitor, since it's the smallest unit to include full transmission line loading — an IMF speciality.

At just under seven hundred pounds a pair (including stands), the Studio Monitor can hardly claim to be one of the cheaper speakers on the market. It does, however, include a number of interesting features, not least of which is the damped transmission line leading to two foam filled ports. The three drive units are tightly packed ('close-clustered') towards the top of the front baffle. This configuration is possible since, unlike many other similar units, the tweeter does not have an integral mounting flange. In fact, the HF unit employed in the Studio's is also to be found in the Professional Monitor — a reference speaker currently gaining popularity in America, as well as the UK. The tweeter is ferro-fluid damped to effectively filter out any stray modulation and takes the response of the speakers up to 40kHz (see ***Fig. 1***).

Fitting the contoured foam to the sides of the tapered transmission line. A special adhesive is used to make sure the foam is fitted securely. Each cabinet is then thoroughly checked before passing onto the next stage.



Upper Curve Frequency Response - 1 metre on Mid Axis 5 Volt Input.
Lower Curve - Second Harmonic Distortion Raised By + 20dB.



Upper Curve - Impedance Modulus.
Lower Curve - Third Harmonic Distortion Raised By + 20dB.

Figure 1: Frequency response, impedance and distortion curves for the Studio Monitors.

The mid-range driver ('squawker') is mounted just above, and in-line with, the tweeter. It has a polymer cone and wide frequency response. Behind the unit is a tapered, damped line, which provides isolation from bass feed-through. A surprising aspect of this separate enclosure, is the amount of space it consumes inside the cabinet without causing any detrimental effect to the low frequency performance of the monitors — a clear example of conscientious design.

The 200mm bass unit is located adjacent to the mid-range and HF drivers. It is loaded by a severly damped transmission line, leading out to the front of the cabinet via two rectangular ports. The contoured foam, which provides the damping, is one of the few items not made by IMF — a special grade is required.

The crossover has roll-off points at 375Hz and 3kHz, with each driver fed from a separate network. The slope obtained using this technique is 12dB/octave, though it might be conjectured that a less steep slope would be feasible, since the frequency characteristics of the drive units can be pre-selected. Another contentious point is the use of lamenate-cored coils. Despite IMF's rigorous testing procedures and the coil's resistance advantage over air-cored types, the author still prefers the latter. Taking into account the comments regarding slope, perhaps this is one area where quality has taken second place to practical considerations.

The Studio Monitors are constructed using high density particle board, epoxy bonded and veneered on both sides — the exterior in America Walnut. Input is provided by two 4mm sockets situated inside a recessed plate on the back panel. This plate also houses the three position 'perspective' switch, permitting a degree of control over the mid-band and high frequency response.

Monitoring The Sound

The most important part of any audio review is the final sound. It's quite possible for a piece of hi-fi equipment to give excellent results on the test bench, yet sound awful when it comes to the listening test. So, during the course of many long evenings and weekends spent indoors, the speakers were connected to a variety of sources in an attempt to assess the quality of reproduction as fairly as possible. The following is a list of the equipment used to evaluate the monitors:

Amplifier — Rotel RA713, Naim 42, Conrad-Johnson power and pre-amp, **R&EW** MA100 power amps.

Record deck — Rega Planar 3, Dual CS505, Micro Seiki DQL-120 (SME arm). Also the *Hitachi Compact Disc Player*.

Cartridge — ADC XLM3, Denon 301 (QED head amp), Audio Technica AT30E.

Speakers (AB) — Monitor Audio MA3, Kef B200+B139+T27 in reflex system, Meridian M2 (not AB).

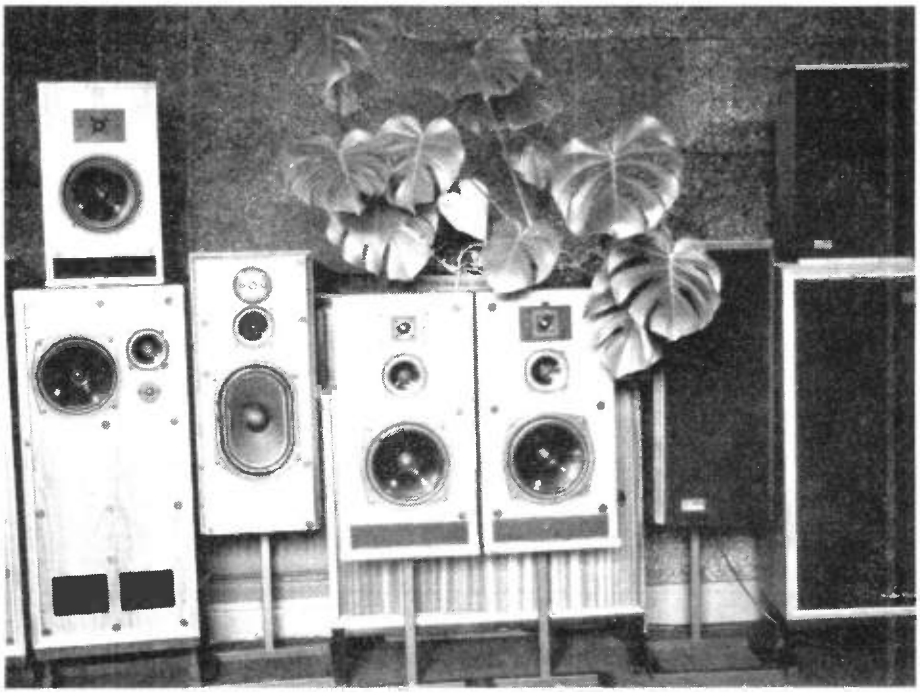
The first, and potentially the most revealing set-up, brought together the MA100's and Compact Disc player. Despite high expectations, however, the results seemed only to support the author's view that CD has a fair way to go before it lives up to the title of 'ultimate sound source'. Undaunted by this disappointment, other combinations were tried and slowly certain facets of the speaker's sound became apparent.

Initial impressions — entering a room with the Studio's playing — were neither unfavourable nor enthusiastic, typically people tended to compliment the appearance and solid construction, rather than remark upon the sound. After five or ten minutes, however, encouraging comments began to materialize. This leads to the important conclusion that any demonstration of the Monitors should last at least ten minutes, especially since it is not unusual for another pair of speakers, found to be instantly appealing, to become fatiguing during extended listening periods. Indeed, IMF have laboured with phase characteristics to ensure that the sound from their speakers will never become tiring in this manner.

So, on to the appraisal proper — the 'sit back and listen' test. Various musical tastes were catered for here, ranging from intricate classical pieces to heavy rock. Now, at last, the Studio's true quality became apparent. Instruments not only possessed a realistic sound, but could be placed precisely within the room. Vocals were remarkably natural, almost to the point where you could 'feel' the atmosphere in the recording studio — listen to somebody singing in a cold, damp room and you'll know what I mean. Soloists seemed to acquire prominence without leaping forward and smacking you in the face. Drums were reproduced with amazing verve and attack, though snare drums did possess a slight harshness which extended to cymbal smashes. After several hours concentrated listening, swapping of equipment and changing records, the slight upper mid-range colouration was the only slur on an otherwise stunning performance.

Overall, the Monitors produce a realistic sound with excellent imagery and separation. Bass is well extended and full without being boomy — a difficult balance to achieve using transmission lines. Middle and high frequencies are handled smoothly, yet without lacking detail, giving rise to natural sounding vocals and distinction for instrumental solo's. If you enjoy hearing the individual sounds which make up a recording, without those sounds seeming unnatural or artificially boosted, then the author strongly recommends you arrange an extended listening session with IMF's Studio Monitors.

■ R&EW



A selection of speakers arranged in IMF's listening room. During trials, units are re-positioned for optimum separation and imagery - the plant stays where it is!

Circuit Blocks

A sophisticated auto train controller
Design by I.M. Attrill.

Designs for automatic model train controllers (in which the train automatically stops at a certain point on the track and then proceeds after a short delay) usually provide unrealistic results with the train stopping almost instantly and then rocketing away at high speed after the delay has elapsed. Another drawback of most designs is the fact that the train stops on every lap of the track, and with all but the largest layouts this results in numerous short bursts of operation and thus, a distinct lack of realism. This design provides gradual and well controlled stopping and starting, and the train can be made to stop at anything from every lap to every sixth lap. It is more complex than most auto controllers, but it can also be used as a normal pulse type train controller for manual control of the train, and gives excellent results.

Design

Figure 1 shows the full circuit diagram of the Auto Train Controller, and this is powered from your existing train controller. This does not need to be a smoothed or stabilised supply since smoothing is provided by C1 while IC1 provides a regulated 15 volt output. The current limiting provided by IC1 prevents an output current of much more than about 1 amp from flowing, and protects the circuit in the event of a short circuit on the output.

In Use

The trigger signal for IC4 is obtained using the usual reed switch under the track (S2) plus bar magnet on the train, but divider IC5 is interposed between S2 and IC4. IC5 can be used to divide by any integer from one to six by setting S3 at the appropriate position, and thus S3 therefore controls the number of laps covered between stops. C10 resets IC5 at switch-on, and the unit starts with the train operating. It stops the first time S2 is activated, and thereafter S3 sets the number of laps between stops.

Circuit Description

IC2 is used as an oscillator which triggers IC3, 555 monostable circuit. RV2 controls the duration of the output pulses, and when this is at minimum value these are so short that the average output voltage is very low and there is insufficient output power to operate the train. At maximum value the average output voltage is virtually equal to the full supply potential and the train is driven at maximum speed. RV1 is used to shunt RV2 and prevents the output pulse length from becoming excessive (which would give a divide-by-two action and produce a drop to only about half power with RV2 at around maximum resistance). Q2 is an emitter follower buffer stage which gives the circuit a suitably low output impedance.

IC4, another 555 monostable, when triggered switches on Q1 which then produces a control voltage of practically zero at pin 5 of IC3. This reduces the output pulse length of IC3 to only a fraction of its normal level so that the output power falls to such a low level that the train halts. When the output pulse from IC4 ends Q1 switches off, IC3 functions normally, and the train starts again. However, due to the inclusion of R7 and C7, Q1 switches on and off only gradually so that the train starts and stops smoothly. RV3 controls the stop time of the train and this can be varied from about 3.5 seconds at minimum resistance to around 40 seconds at maximum value.

■ R&EW

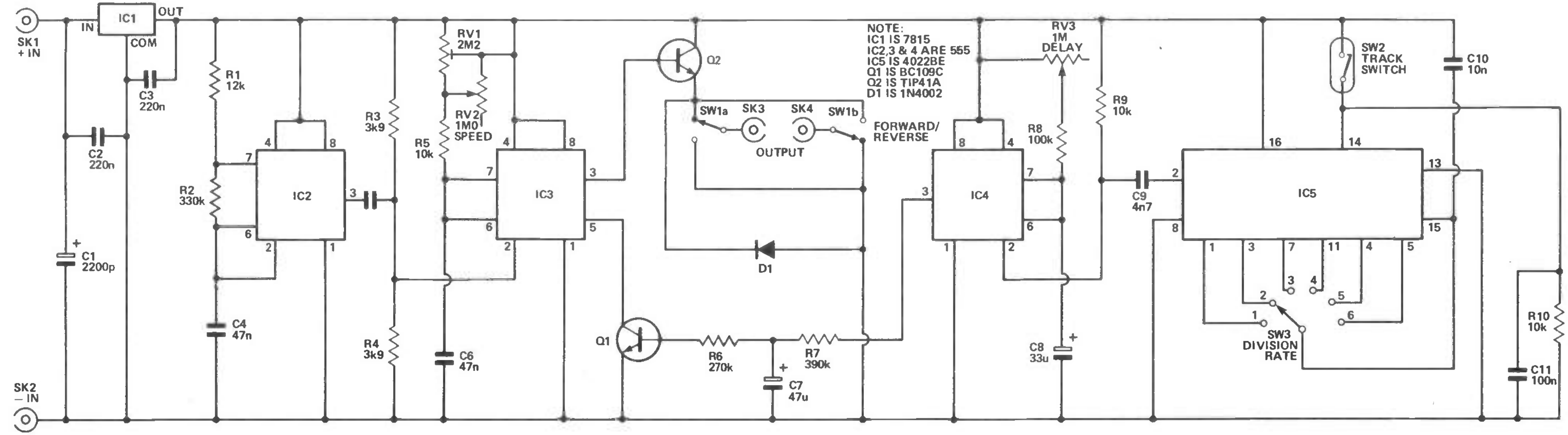


Figure 1: Circuit diagram of the Auto Train Controller.

AUTO-SCAN 5000

Ken Alexander with a report on a CB rig at the luxury end of the market.

CB equipment has been known to provoke very strong feeling amongst radio amateurs who see the system as a Mickey Mouse communications medium in which no technical or theoretical skill is demanded of the users. There's also the assumption that the CB bands are populated by hordes of mentally deficient teenagers with nothing better to do than to pollute the airwaves with stories of their nocturnal activities.

Now there may be a grain of truth in this view of CB users but adopting the stance of live and let live, the existence and potential usefulness of CB can at least be recognised. The above scenario is also only likely to be encountered in the larger towns and cities, the countryside of the UK offering relatively little in the way of inane copies.

It should also be acknowledged, that CB has helped to popularise the activities of the more legitimate side of radio communications with the more aware CB'er going on to get his ticket.

Having got that lot out of the way, it's time to get down to a look at Magpie's Autoscan 5000 rig. This is a model that, as well as providing a comprehensive range of facilities, turns in an excellent technical specification. The fact that its been designed and built entirely within the UK is also an added attraction.

The first thing to strike anyone glancing at the receiver is the absence of the ubiquitous 40 way channel select switch. Instead two buttons marked 'up and down' take care of channel selection. Pressing and holding down either one of these controls will step up (or down) the 40 available channel with wrap round at 40/01. Pressing both simultaneously will select the breaker channel (14).

The channel control selectors can also be used with the 3 position search control. With this switch in the centre position the scanning operation is as described above. However, in the 'busy' position, pressing either of the scan buttons will cause the rig to step through the channels until it encounters a busy channel. it will then halt, allowing that frequency to be monitored. Pressing a scan button again, will cause the rig to search for the next busy channel.

The search control also has a 'free' position which works in a similar manner to 'busy', but not unnaturally searches for vacant channels.

Operation of these facilities is, fairly obviously, dependent on the setting of the squelch control.

The channel number selected at any time is displayed on a large, and easy to read, fluorescent display — far more visible than LED readouts in high ambient light levels. The display dims automatically at night.

More Mundane

As well as the sophisticated search controls the Autoscan 5000 must obviously provide the more mundane controls of a rig. Audio volume of course (combined with the on/off switch — not

SPECIFICATIONS

GENERAL

FREQUENCY RANGE:	27.60125 MHz – 27.99125 MHz.
CHANNELS:	40 channel 10 KHz spacing PLL synthesized. Frequencies in accordance with home office requirements published in MPT1320.
CHANNEL SELECTION:	Internal electronic counter selection controlled by push buttons on Microphone or front panel.
CHANNEL DISPLAY:	7 segment vacuum fluorescent display with automatic dimming.
SPECIAL FEATURES:	a) Search mode enables automatic search for busy channel or free channel as required. b) Instantaneous channel 14 selection.
OPERATING TEMPERATURE RANGE:	–5°C to + 45°C.
POWER SOURCE:	+10.8V DC to + 15.6V DC (+13.2V DC nominal).
CURRENT DRAIN:	Approx. 300mA on receive. 1.2A on transmit (fused at 2A).
DIMENSIONS:	Width 182mm (7.16") Height 56mm (2.2") Depth 175mm (6.9")

TRANSMITTER

OUTPUT POWER:	4W high power setting. 400mW (–10dB) low power setting.
FREQUENCY ACCURACY:	Better than ± 1.5 KHz over temperature range.
TYPE OF MODULATION:	FM
DEVIATION	Nominal ± 1.5 KHz. Max. permissible ± 2.5 KHz for + 20 dB input overload from 300 Hz to 3KHz.
SPURIOUS EMISSIONS:	a) Adjacent channel <10 microwatts b) Out of band <10nW within the bands: 80–85 MHz 87.5–118 MHz 135–136 MHz 174–230 MHz 470–862 MHz <250nW elsewhere

RECEIVER

CIRCUIT TYPE:	Dual conversion superheterodyne.
SENSITIVITY:	1μV for 20dB noise quieting (typical 0.7μV)
IF BANDWIDTH:	>± 3 KHz (–6dB)
ADJACENT CARRIER REJECTION	> 80dB (typical 100dB)
IMAGE REJECTION:	> 60dB
AM REJECTION:	> 40dB
2 TONE INTERMODULATION:	3rd order intermodulation products for 2 inputs of 1mV typically <0.25μV.
RF GAIN CONTROL:	30dB.
SQUELCH RANGE:	0.3μV to 10μV.
AUDIO OUTPUT POWER:	1.5W into 8 Ω 3W into 4 Ω

to my personal taste but an almost universal practice), a squelch control and output power control (4w in the high position — labelled hi . . . ugh and 10dB down at 400mW in the low (Lo) postion).

The RF and microphone gain controls are useful and welcome controls while the PA and channel 9 priority facilities are to be expected on a rig at this end of the market.

Breakdowns

Don't be alarmed by the above heading it wasn't the autoscan 5000 that suffered from any technical problems, but the **R&EW** Spectrum Analyser. Perhaps we'll be able to return to the rig when the 'scope doctor has paid us a visit but for the meantime we'll present a subjective view of the rig.

The model was used in both static and mobile applications and was extremely well liked. The autoscan facility was particularly well liked, the up/down buttons are duplicated on the microphone and the easy access that this gives to channel 14 in a mobile application is particularly handy.

All in all a superb performer and it's nice to note the ruggedness that has been built into the receiver. Most notable in this context is the use of a VMOS output device. This ensures that the output stage will not be damaged even if the rig is used with a mismatched antenna.

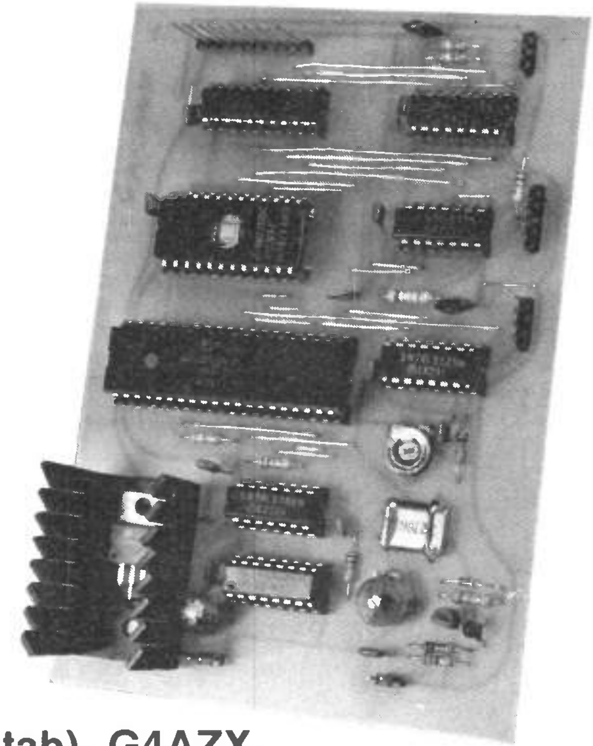
The auto scan 5000 can be recommended to any one with an interest in the serious side of CB.

The rig costs £119.00 inclusive and further information is available from:
Magpie Electronics Ltd.,
P.O. Box 35,
ANDOVER,
Hants,
SP10 2LG.
The phone number of Magpie is 0264 66361.

■ R&EW

REWBICHRON 2

* Drives any 4- or 6-digit numeric display (via suitable decoder/drivers)
* Pre-multiplexed display output
* Simultaneous parallel interface output
* 12 or 24 hour display, time only or alternate time and date
* Continues running if MSF fails
* Excellent noise immunity; Majority Vote pulse detection, PLL simulation and full parity and validity check.



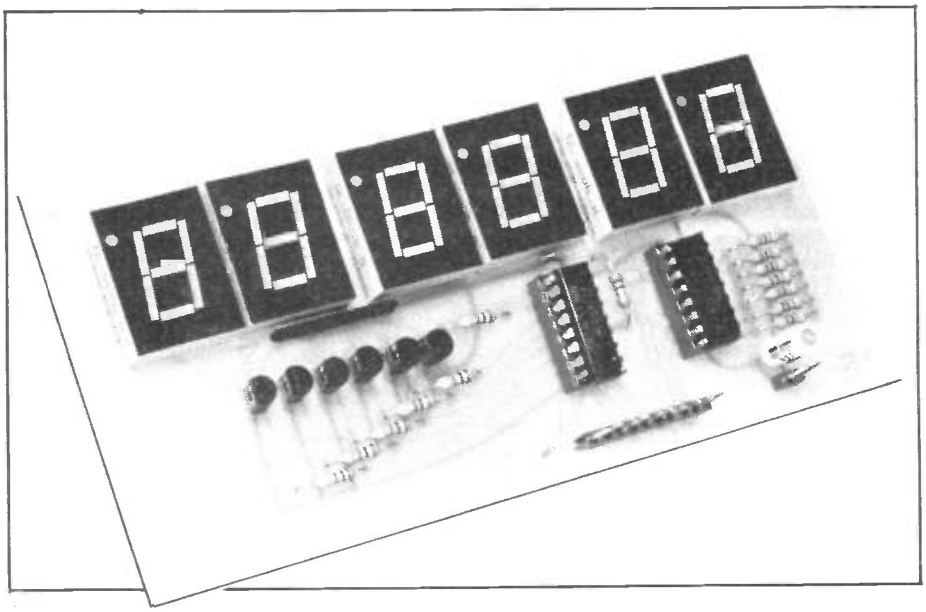
This month we describe the construction of our MPU based Rugby clock.

Design by John Robinson, MA (Cantab), G4AZX.

Testing

It is wise to test the receiver head first, on its own. In the case of the module published with the Mk1 version, align it as per instructions given in the previous article and verify that the LED flashes on briefly once per second. If possible, check that a logic signal is present on the output — low most of the time, with a positive pulse each second (this is slow enough to be seen with a multimeter). Connect to the logic board, preferably with twin screened cable, and place well away from the logic and display boards if these are not in a metal case.

Set RV1 to mid-range and switch on. The display should now indicate, on the left two digits only, the received logic pulses. If the display appears unbelievably bright, switch off immediately and check the wiring around IC8a (logic board) and IC1 (display board). If there is no activity on the display, check that the CPU is receiving clock and interrupt



The Rewbichron display board.

PARTS LIST — LOGIC BOARD

Resistors

R1	10M
R2	390R
R3,9	1k0
R4,11	68k
R5	10k
R6	22R
R7,8	3k9
R10	10k

Potentiometers

RV1	50k 10mm horizontal preset

Capacitors

C1	33p
C2	60p trimmer
C3	1u tantalum
C4,6,8,9,11	100n
C5,12	10n
C7	10u 16V
C10	100p

Semiconductors

D1	1N4148
Q1	BC239
IC1	4060
IC2	74LS74
IC3	Z80A CPU
IC4	2716
IC5,6	74LS365
IC7	74LS02
IC8	74LS123

Miscellaneous

X1 3.2768 MHz crystal, PCB IC sockets, 10 way molex connector.

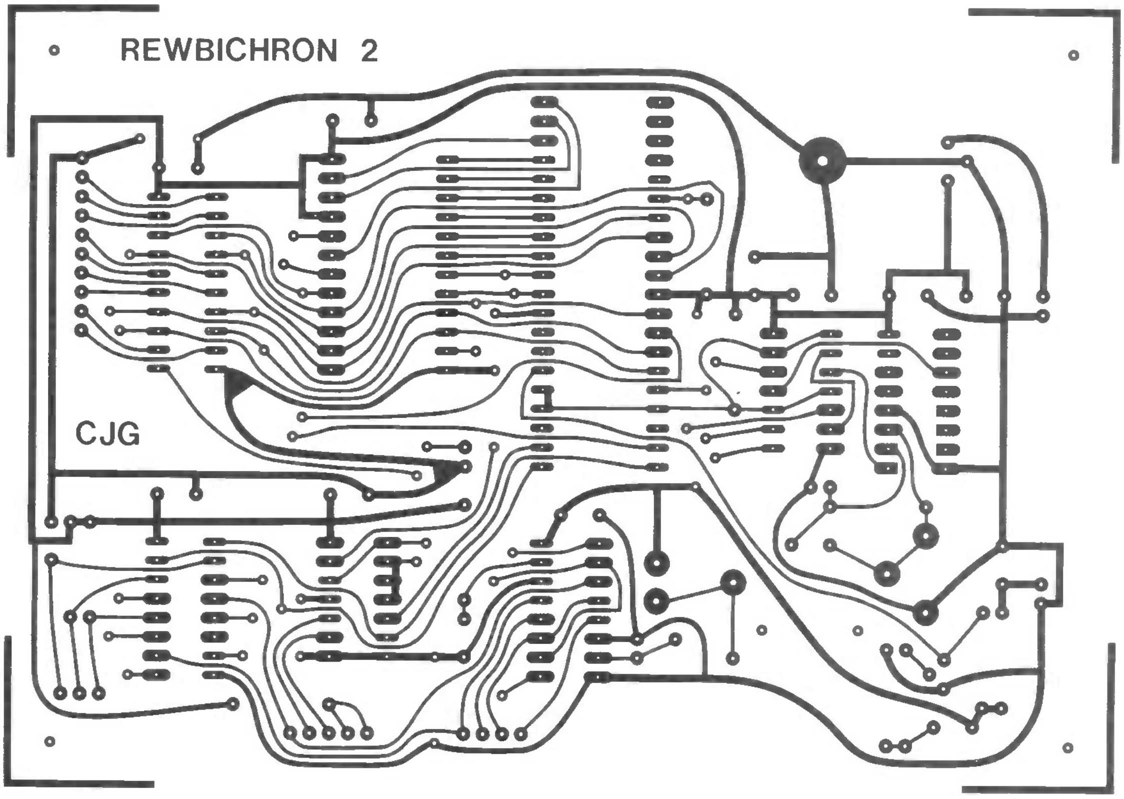


Figure 9. The logic board's foil pattern.

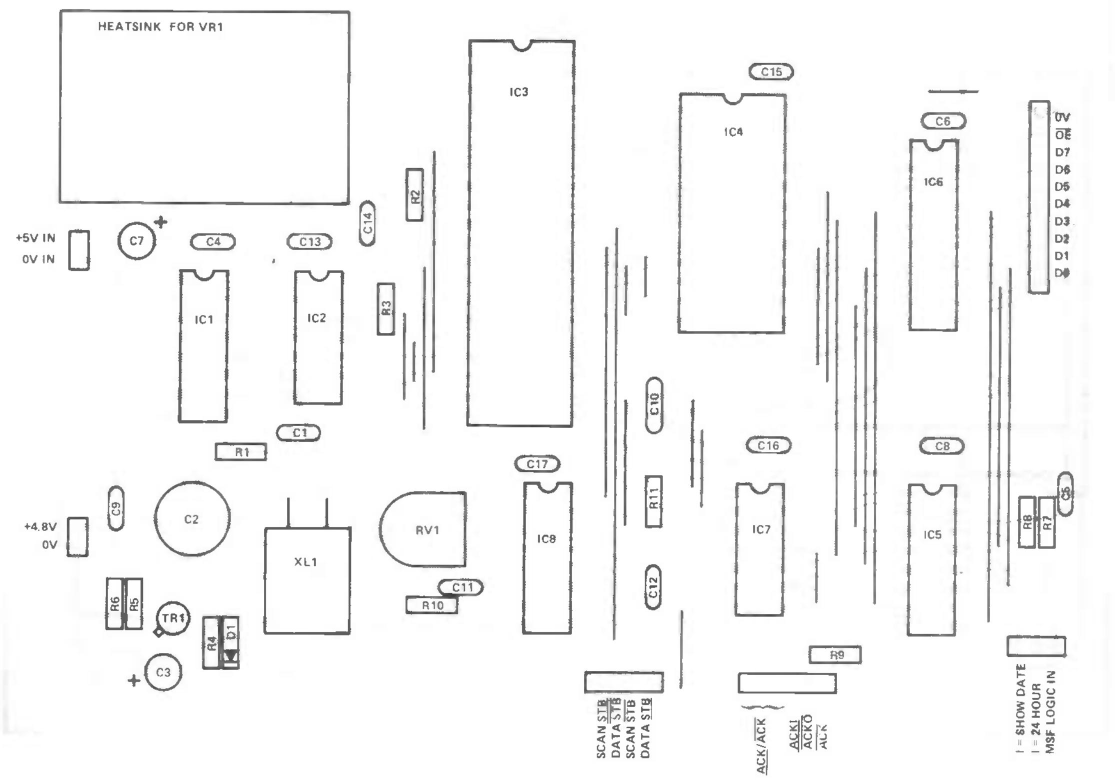


Figure 10. Overlay of the Rewbichron's logic board.

PARTS LIST — DISPLAY BOARD

Resistors

(All ¼ watt 5%)

R1-6	470R
R7	6x1k single in line
R8-15	47R

Capacitors

C1	10u 10V radial
C2	100n

Semiconductors

Q1-6	BC307
IC1	74LS138
IC2	7447

Miscellaneous

Six GL9R06 displays, 10 way, 2 way molex connectors, one p.c. half pin, P.C.B.

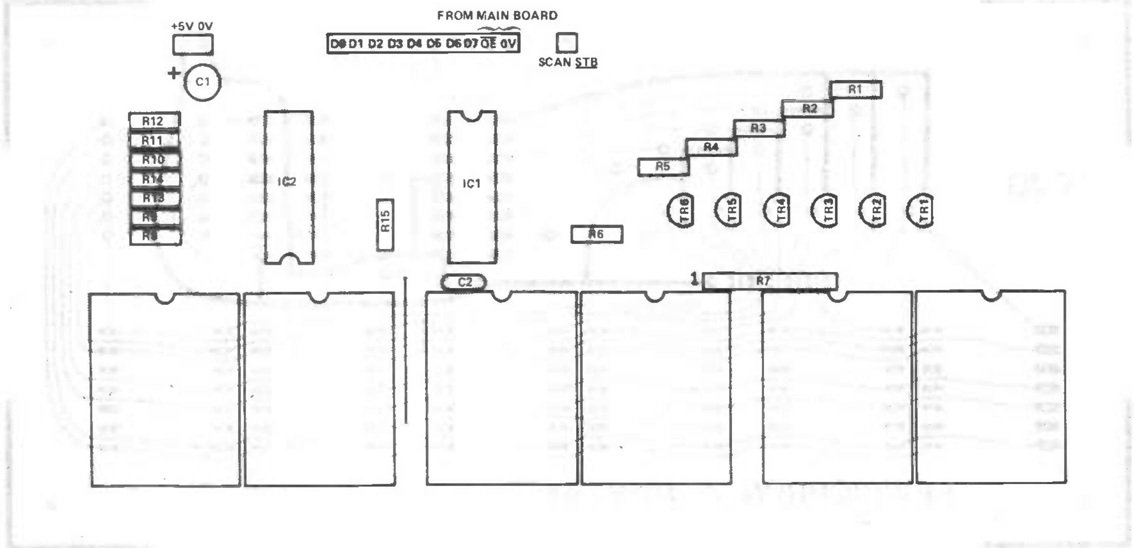
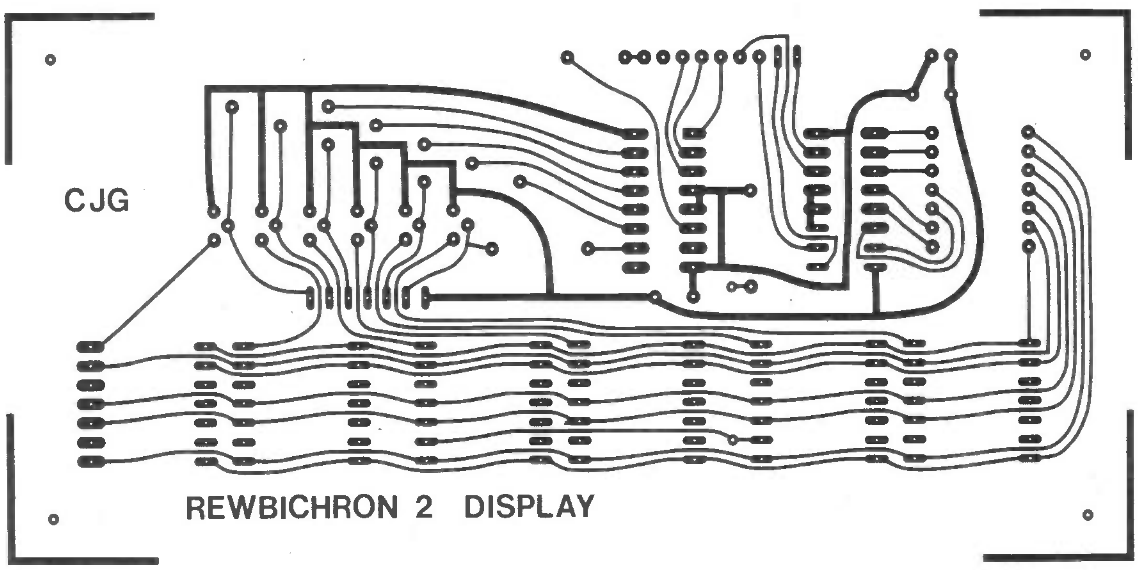


Figure 11. (Above) shows the display board's overlay and Figure 12. (Below) foil pattern.



signals (for those without scopes, a 100Hz buzz should be produced in high impedance phones between IC3 pin 16 and OV).

Before panicking, remember that 99% of faults are caused by bad construction, and 90% of these will not result in any permanent damage to components. So check very thoroughly for solder splashes, missing or wrong connections, etc (which you should have done before switching on...)

If all is well, wait until the unit has been receiving a stable MSF signal for at least 50 seconds before an exact minute, whereupon (on the minute) the display should leap into action. Adjust RV1 for the desired brightness (see above).

A display of 99.99.99 on switch-on means that the CPU was not able to access all of the PROM (IC4) during its initial self-test sequence. This could mean that IC4 was not correctly programmed, but could also mean that some of the address lines between IC4 and IC3 are faulty.

Further points to watch are that MSF is usually off air for maintenance on the first Tuesday of each month, and that TV sets and monitors radiate a strong signal at 62.5kHz, which can make MSF reception difficult.

The free-run accuracy of the clock may be adjusted by C2. Either use a frequency counter (eg, IC1 = 51.2kHz) or display the 100Hz interrupt pulses against a standard such as the MSF carrier on a scope, and adjust for zero relative movement.

Software

One fact that has come to light after the Mk1 project is that many people do not realise the value of the software in a project of this nature. One reason for not publishing the program for the REW-BICHRON is that most of the design work (particularly for the Mk2) has involved writing software, and this is therefore a valuable component which can no more be given away than can the Z80 CPU. Having said this, ***Fig. 13*** does give a fairly good insight into the structure of the program.

The Z80 Assembly Language was used to write the program, within the limitations imposed by no RAM (No stack, therefore no callable sub-routines). All 'variables' in the flow diagram are Z80 registers (the 'Data Register' and 'Time Register' are each several concatenated 8-bit registers) and the 'Flags' are individual bits within a register.

■ R&EW

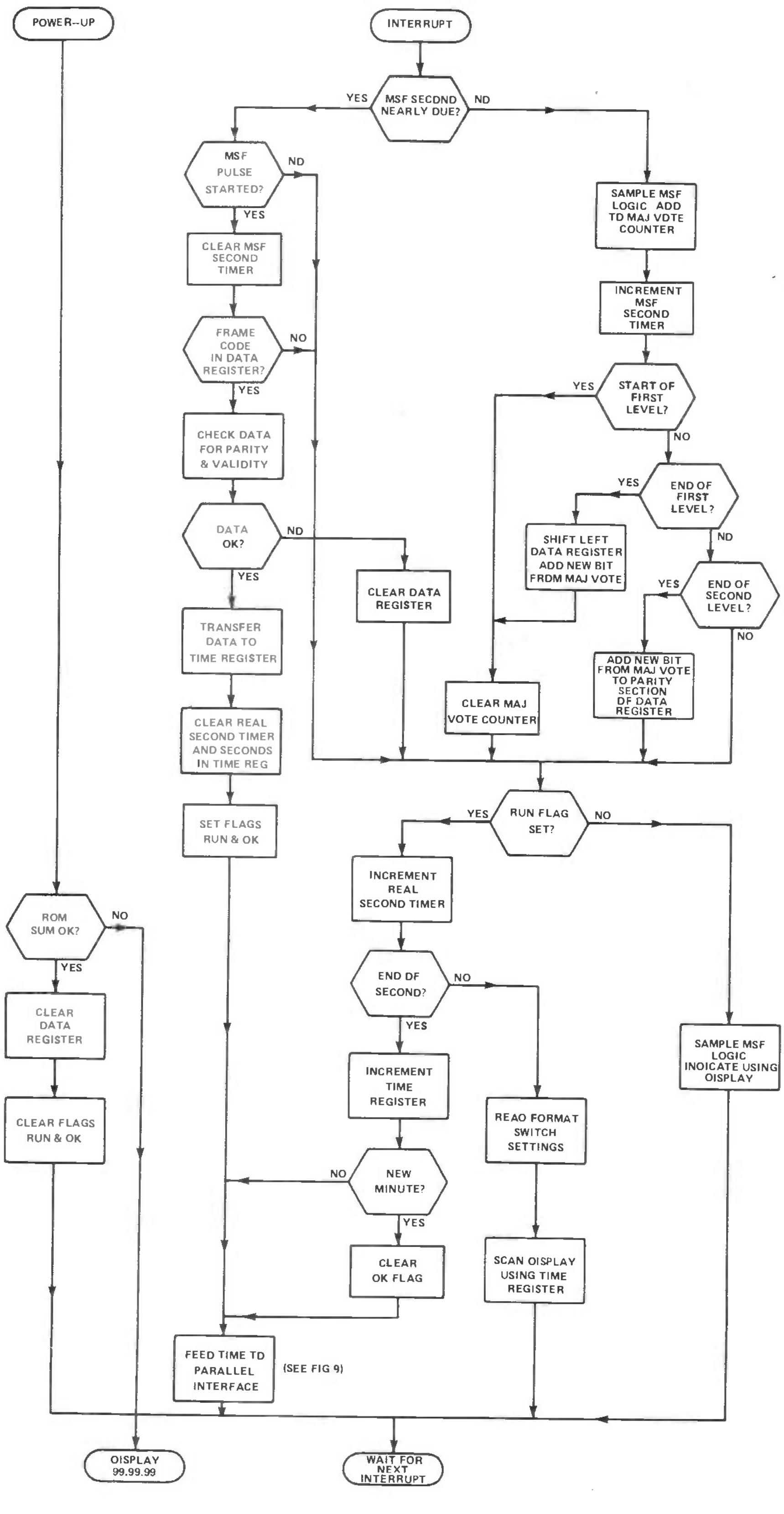


Figure 13. An overview of the Rewbichron's software.

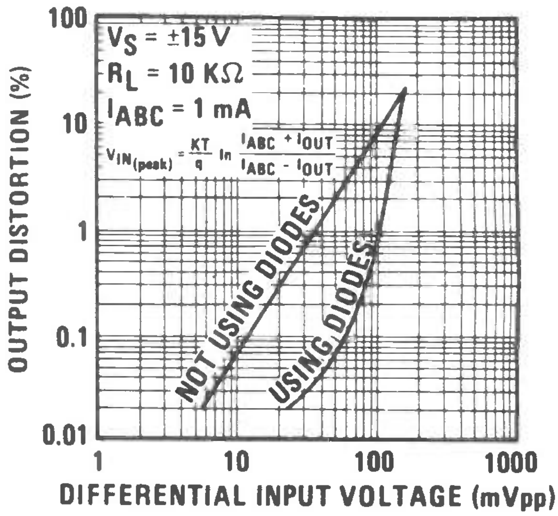
R&EW Data Brief

LM13600

A state variable filter from two OTAs.

The LM13600 package contains two operational transconductance amplifiers with dual buffers. The two amplifiers share a common supply but are otherwise independent; each featuring linearizing diodes at the inputs to reduce distortion and permit higher input levels. The IC is particularly useful as a current controlled amplifier, filter or oscillator and has excellent matching between its two OTAs for stereo applications (although distortion is quite high — see ***Table 1***).

For differential input voltages greater than a few millivolts, the transconductance becomes increasingly and significantly non-linear. Then internal diodes linearize the transfer function of the amplifier, (provided the diodes are biased with a suitable current source). In practice, replacing the current source components with resistors will generate insignificant errors in the characteristics as long as the input signal current does not exceed half the diode bias current.



Graph of output distortion vs differential input voltage to show the effect of linearizing diodes.

▼ Table 1: Electrical characteristics of the LM13600

PARAMETERS	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
Input Offset Voltage (V_{OS})			0.4	5		0.4	2	mV
	Over Specified Temperature Range						5	mV
	I_{ABC} 5 μA		0.3	5		0.3	2	mV
V_{OS} Including Diodes	Diode Bias Current (I_D) = 500 μA		0.5	5		0.5	2	mV
Input Offset Change	5 μA ≤ I_{ABC} ≤ 500 μA		0.1			0.1	3	mV
Input Offset Current			0.1	0.6		0.1	0.6	μA
Input Bias Current			0.4	5		0.4	5	μA
	Over Specified Temperature Range		1	8		1	7	μA
Forward Transconductance(gm)		6700	9600	13000	7700	9600	12000	μmho
	Over specified Temp Range	5400			4000			μmho
gm Tracking			0.3			0.3		dB
Peak Output Current	RL = 0, I_{ABC} = 5 μA		5		3	5	7	μA
	RL = 0, I_{ABC} = 500 μA	350	500	650	350	500	650	μA
	RL = 0, Over Specified Temp Range	300			300			μA
Peak Output Voltage								
Positive	RL = ∞, 5 μA ≤ I_{ABC} ≤ 500 μA	+ 12	+ 14.2		+ 12	+ 14.2		V
Negative	RL = ∞, 5 μA ≤ I_{ABC} ≤ 500 μA	− 12	− 14.4		− 12	− 14.4		V
Supply Current	I_{ABC}=500μA,Both Channels		2.6			2.6		mA
V_{OS} Sensitivity								
Positive	$\Delta V_{OS}/\Delta V+$		20	150		20	150	μV/V
Negative	$\Delta V_{OS}/\Delta V-$		20	150		20	150	μV/V
CMRR		80	110		80	110		dB
Common Mode Range		± 12	± 13.5		± 12	± 13.5		V
Crosstalk	Referred to Input (Note 5) 20 Hz < f < 20 KHz		100			100		dB
Diff.Input Current	I_{ABC} = 0, Input = ± 4 V		0.02	100		0.02	10	nA
Leakage Current	I_{ABC} = 0 (Refer To Test Circuit)		0.2	100		0.2	5	nA
Input Resistance		10	26		10	26		KΩ
Open Loop Bandwith			2			2		MHz
Slew Rate	Unity Gain Compensated		·50			50		V/μSec
Buff. Input Current	(Note 5)		0.4	5		0.4	5	μA
Peak Buffer Output Voltage	(Note 5)	10			10			V

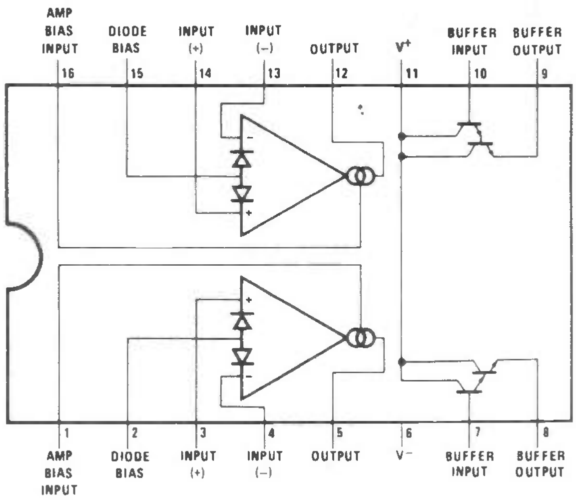


Figure 1: Internal block diagram.

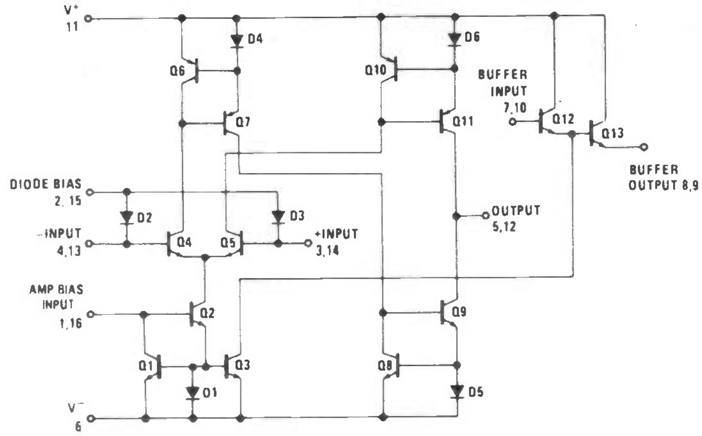
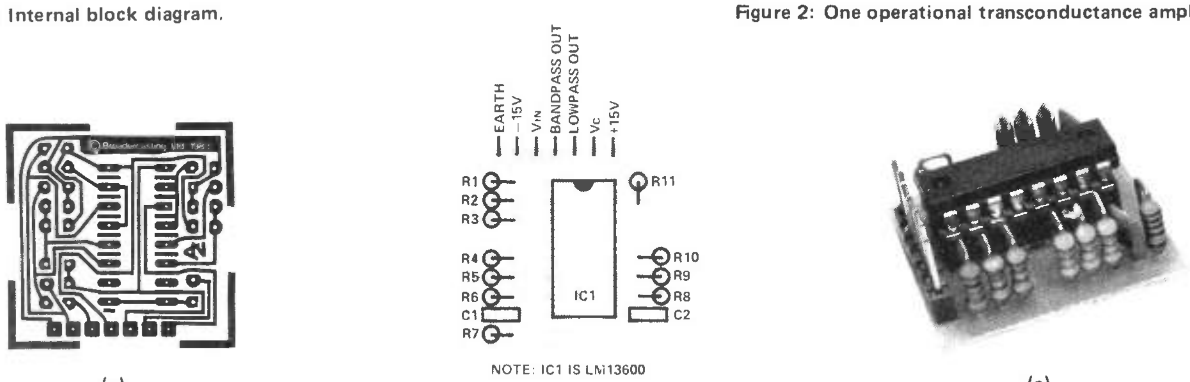
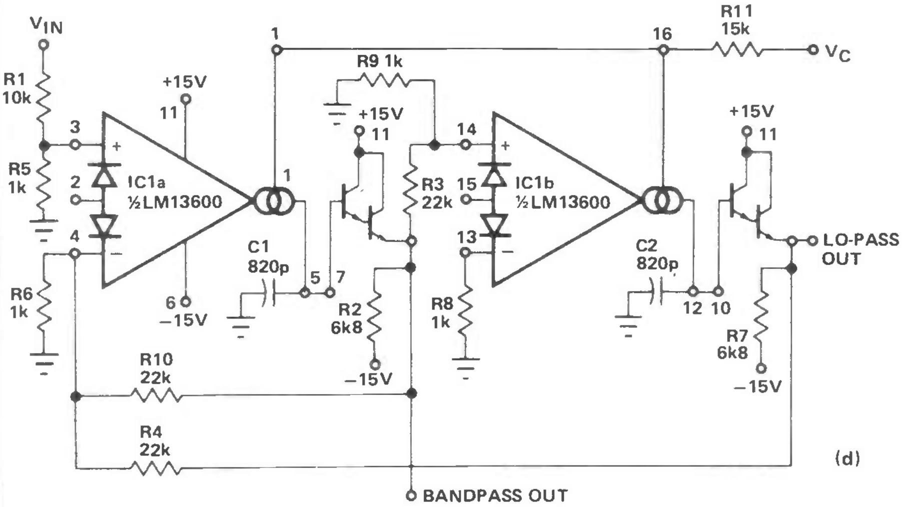


Figure 2: One operational transconductance amplifier.



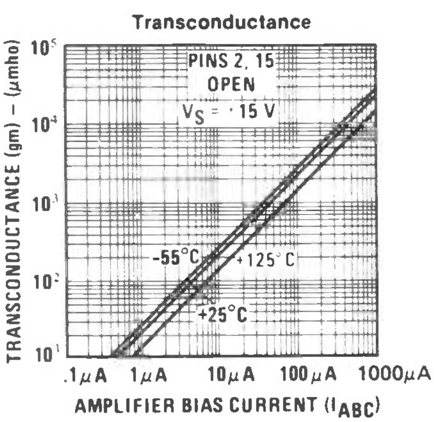
(a) (b) (c)

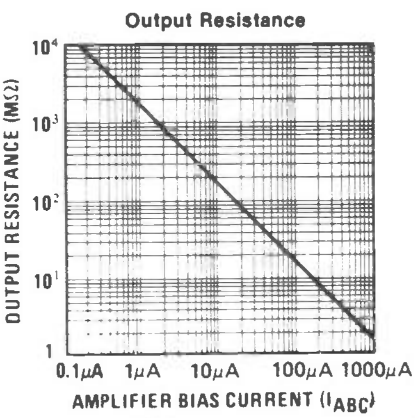


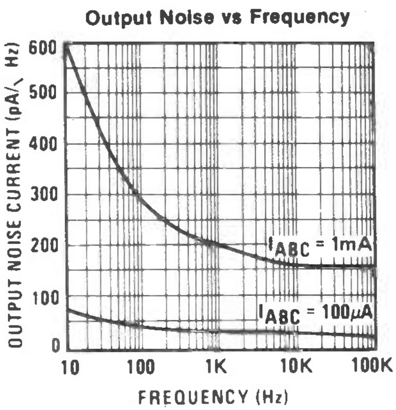
At very low values of output current, a buffer, which has very low input bias current, is desirable. A FET follower satisfies the low input current requirement, but is somewhat non-linear for larger voltage swings. Therefore, the controlled impedance buffer provided is a Darlington pair, which modifies its input bias current to suit the need. The bias current for Q12 (see ***Fig. 2***) is provided by Q3 (at higher levels) and is proportional to the output current, giving a fast slew rate.

One typical application is the state-variable filter shown. Due to the good transconductance tracking of the two amplifiers, and the varied bias of the Darlington pairs, the filter performs well over several decades of frequency.

Figure 3: State-variable filter: (a) PCB foil pattern; (b) Component overlay; (c) Photograph of board; (d) Schematic diagram.

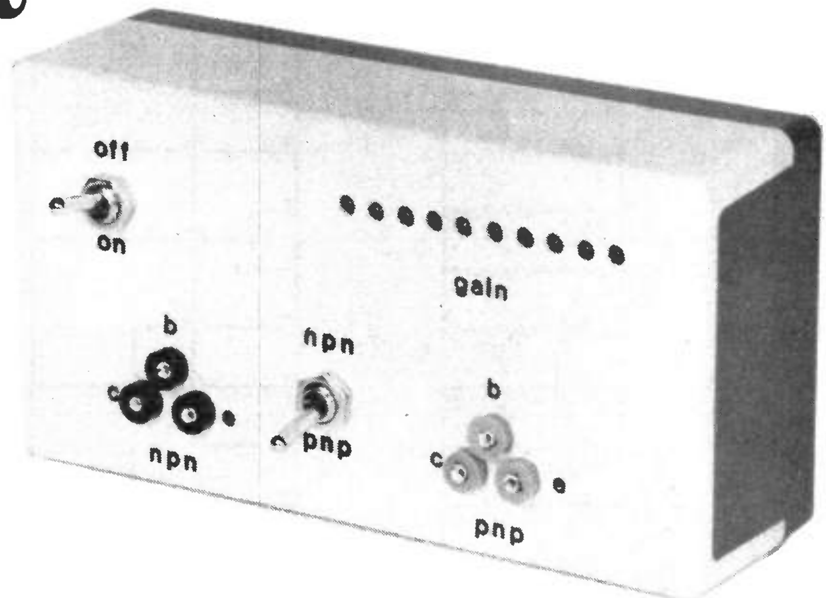






TRANSISTOR TESTER

Design by R.A. Penfold.



Transistor checkers normally fall into one of two catagories; basic units where a flashing light indicates serviceable devices, or calibrated metering circuits which give a rough indication of current gain. Our design is really a cross between these two. It uses a flashing 10-LED bargraph to indicate whether or not the transistor is usable — the number of LEDs activated gives an indication of current gain. This novel system enables checks to be made very rapidly and easily, as well as providing more reliable and informative results than a single LED checker.

Design

The basic set-up used in the Transistor Checker is shown in ***Figure 1***. Diagram (a) shows the block connections for testing pnp transistors and (b) shows the slightly different arrangement needed when checking npn devices.

Looking first at the pnp mode; a low frequency oscillator drives the base of the test device via a resistor which sets the base current. The transistor is thus only switched on when the output of the oscillator is in the low state (it is cut off when the output is high). A zener diode is used to give a stable output voltage from the oscillator, so that a reasonably stable base current results.

The bargraph driver and display are fed with the voltage developed across the collector load resistor. Circuit values are chosen so that a very low gain device only produces sufficient voltage to activate one or two LEDs, while a very high gain device will activate all ten. So, with a serviceable device being tested, the LED display should flash on and off, and the number of LEDs will indicate the gain.

In the npn mode, an oscillator, zener stabiliser, and series resistor are again used to pulse the base of the test transistor with a reasonably stable current. However, there is a minor complication in that the voltage developed across the load resistor is relative to the positive supply, whereas the bargraph driver requires an input voltage referenced to the negative supply rail. A unity gain inverting amplifier is therefore used between the load resistor and the display driver to give a suitable input signal for the latter.

Construction

Practically all the components are fitted on the printed circuit board, the only exceptions being the battery and the sockets. Details of the PCB wiring are provided in ***Fig. 3***. If the specified case is used, the two cutouts in the corners of the board are necessary to mount flush with the pillars inside the case.

It is essential that the mounting holes for SW1 and SW2 are accurately positioned on the front panel. One way of ensuring a good fit is to use the board as a template. It is probably best to initially drill small guide holes of about 1mm in diameter.

Construction of the PCB is quite easy, but note that IC2 has a MOS input stage. Although IC1 is a CMOS device it does not require any special handling precautions. The tags of SW1 and SW2 should be pushed right down into the board before these components are soldered into place.

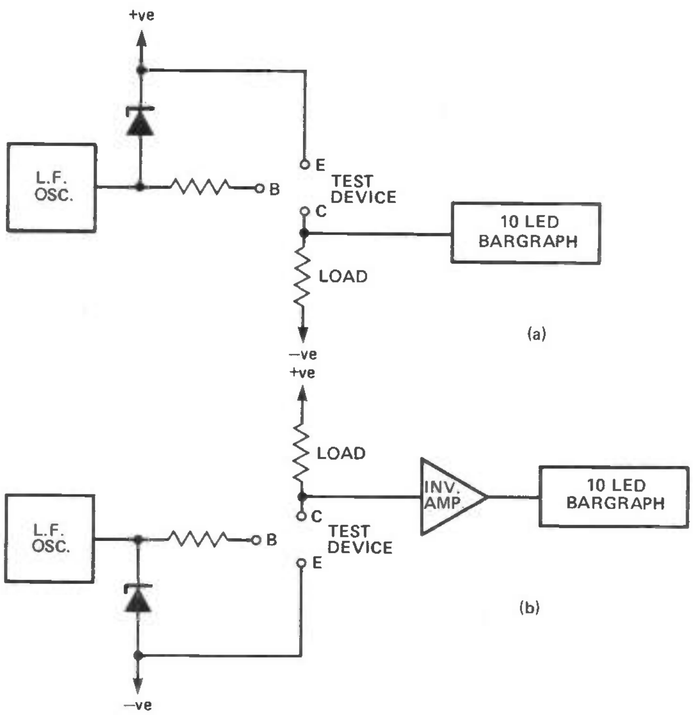


Figure 1. The two basic circuit configurations for testing NPN and PNP transistors.

TRANSISTOR TESTER Project

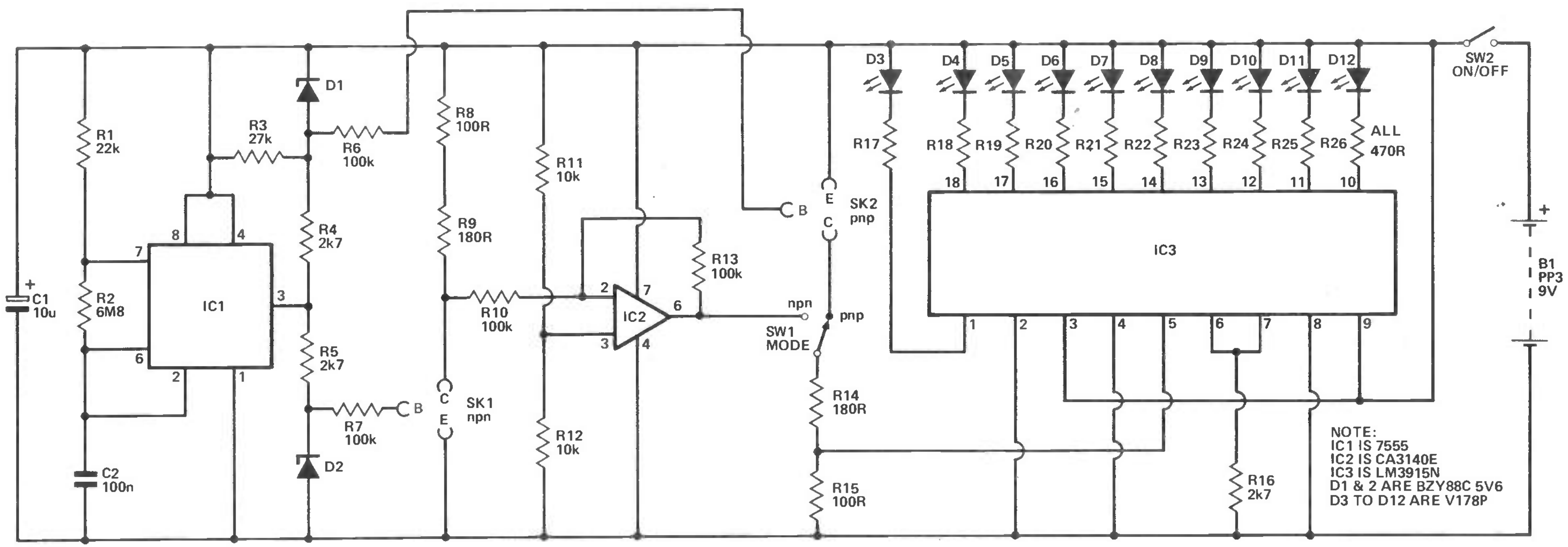


Figure 2. Complete circuit of the tester.

Circuit Description

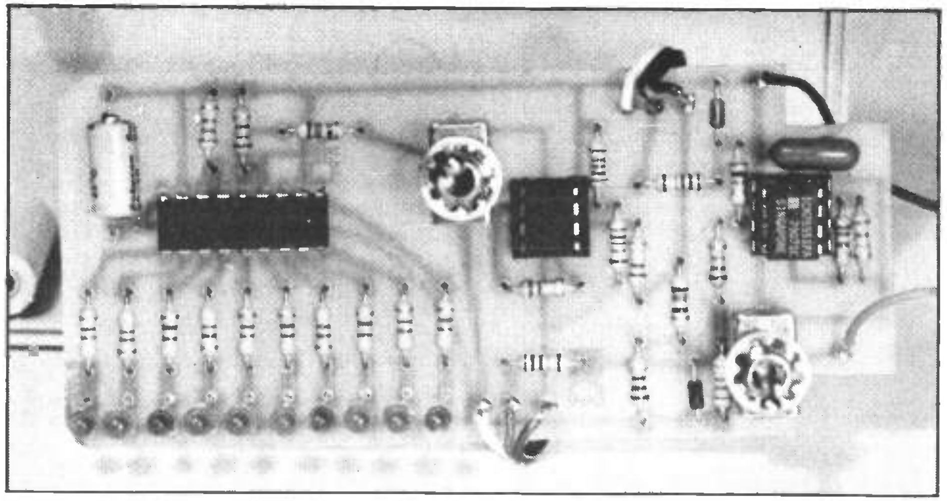
The full circuit diagram of the transistor checker is shown in ***Fig. 2***. The LF oscillator is a straightforward 7555 astable, operating at a little over 1Hz. IC1 is a CMOS version of the 555, used primarily because of its low current consumption. In order to permit the use of very simple npn/pnp switching, separate npn and pnp test sockets are used, as well as separate zener stabilisers and base resistors. In the prototype there was a tendency for very high gain pnp transistors not to cut off properly due to the output of IC1 going slightly less than fully positive on the appropriate output half cycles. This problem was completely overcome by making R4 and R5 a little higher in value, and adding R3; which have no significant effect on circuit operation in other respects.

The closed loop gain of the circuit is accurately set at unity by R10 and R13. R6, R7, R11 and R12 are close tolerance components so that consistent results are obtained when moving from pnp mode to npn.

R8 and R9 form the load resistance for npn devices, while R14 and R15 are the load resistance for pnp devices. The value of R15 sets the operating current range of the unit. It varies from about 450uA, with one LED switched on, to around 12mA with all ten activated. This gives a reasonable operating current for low gain devices, whilst removing the need for excessive current flow when high gain transistors are being tested. R14 is added in series with R15 merely to provide additional current limiting if a closed circuit device is checked.

Switch, SW1, is all that is required to give npn/pnp switching. It switches the input of the display circuit to either the output of IC2 or the pnp-collector test socket (note that IC2 has a class A output stage which enables its minimum output voltage to swing down to near the negative supply potential).

The display driver is an LM3915N integrated circuit (IC3), which is similar to the popular LM3914 device. The LM3914 has ten *linear* LED threshold voltages, whereas the 3915 has a *logarithmic* scale with the LED threshold voltages at 3dB intervals. This enables a wider range of current gain values to be covered, with the maximum value being about thirty times higher than the minimum. R16 controls the LED operating current, and the specified value provides around 4.5mA.



Internal view of the transistor tester.

PARTS LIST

Resistors

(¼W 5% unless stated otherwise)

R1	22k
R2	6M8
R3	27k
R4,5,16	2k7
R6,7,10,13	100k(1%)
R8,15	100R
R9,14	180R
R11,12	10k (1%)
R17 – 26	470R

Capacitors

C1	10u 25V axial
C2	100n polyester

Semiconductors

IC1	ICM7555
IC2	CA314OE
IC3	LM3915N
D1,2	BZY88C5V6
LED1-10	V178P (3mm red LEDs)

Miscellaneous

SW1,2	SPDT min toggle switch
B1	9 volt (PP3) battery

SK1,2 1mm wander sockets (see text) plastic case(120x65x40mm), battery connector, PCB, pins,wire etc.

The test sockets are two groups of three 1mm sockets, and provided each set of three is tightly grouped it will be possible to fit most transistors directly into these without difficulty. A set of test leads can be used to make connections to transistors that will not plug into the sockets. The tags of the sockets should be bent at right angles so that they do not come into contact with the PCB when it is fitted into the case.

Operation

In use the mode switch is set for npn or pnp, and the test device is connected to the correct sockets. If the device is functioning properly, the LED display should flash on and off with a suitable number of LEDs being switched on. It is a good idea to test a number of transistors of various types, known to be fully operational, so that you know the approximate number of LEDs that should be activated when testing a suspect device.

If the LED display lights continuously, this indicates that the device under test is closed circuit; but check SW1 is in the right position and that the device is connected correctly. If not all the LEDs switch off, this indicates that the test device is faulty and has a high leakage level, but again, check that it is connected correctly and that SW1 is in the right position. Also, do not hold the transistor in the test sockets touching the base and collector leads. This could supply a small current into the base of the component giving a high enough collector current to activate one or two LEDs. If the display fails to light at all, it indicates that the transistor under test has gone open circuit.

■ R&EW

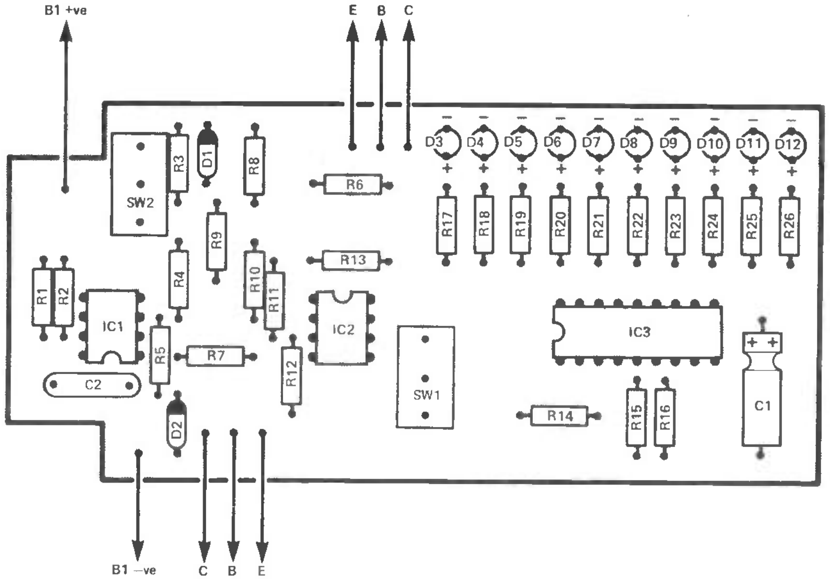


Figure 3. Component placing on the tester PCB.

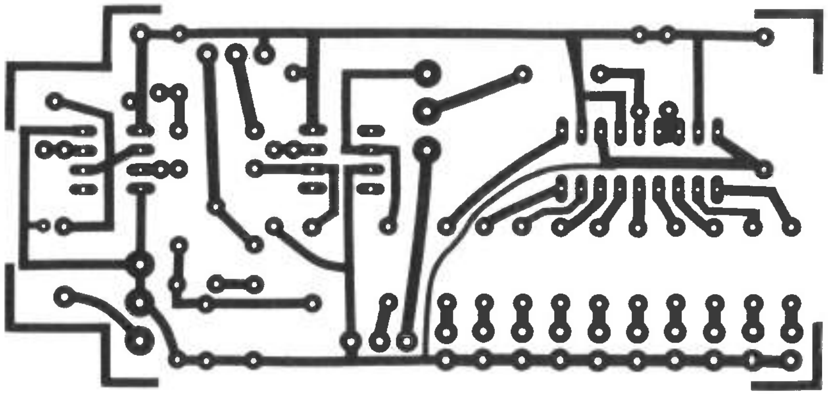


Figure 4. PCB foil pattern for the transistor tester.

AMATEUR RADIO SATELLITES PART II

Getting started on the amateur radio satellites.

Arthur C. Gee 2UK

In the first part of this feature, we outlined the principles of, and requirements for, predicting the orbital path and timing of an amateur radio satellite and what was needed in the way of a radio receiver for listening to these satellites. We will start this second part, by considering the question of aerials for this mode.

As we said last time, the purpose of these two articles is to show how, with pretty simple equipment, we can get going on this mode, thus acquiring some experience of satellite working. Once you've "got your feet wet" so to speak, we're pretty sure your enthusiasm will be raised to the point where you'll want to get into it "much deeper". By then, you'll have learnt enough about the subject to be able to help yourself to acquire much of the information which is available to the satellite enthusiast to help him on into more complex satellite communication systems.

First then what do you need in the way of an aerial? It is possible, with a good sensitive receiver, perhaps helped with a 28MHz preamplifier, to use a simple dipole antenna on the 10 metre and the 2 metre bands, and get quite good results. However, much better results can be had by using an antenna specially designed for the purpose. We said too, that to start with, we'll content ourselves by listening for satellites which are passing close to our location ie, those going as near overhead as possible. A simple dipole, erected up in the clear, with a not too long lead in, will do this quite nicely, but it is advisable to put something a bit better than this up, if you can. One of the best antennas for listening to the 10 metre down-link signals, is that known as the "turnstile" crossed dipole. Two halfwave dipoles are rigged up at right angles to one another and by means of a quarter wave long "stub" and a similar "matching section", a 90 degree phase relationship is obtained between them. The polarisation of such an arrangement becomes circular which is ideal for the changing polarisation of signals from the OSCARs, caused by their tumbling around in space. Erected more or less horizontally, this type of antenna is particularly useful for overhead or near-overhead orbits, the ones we are most interested in.

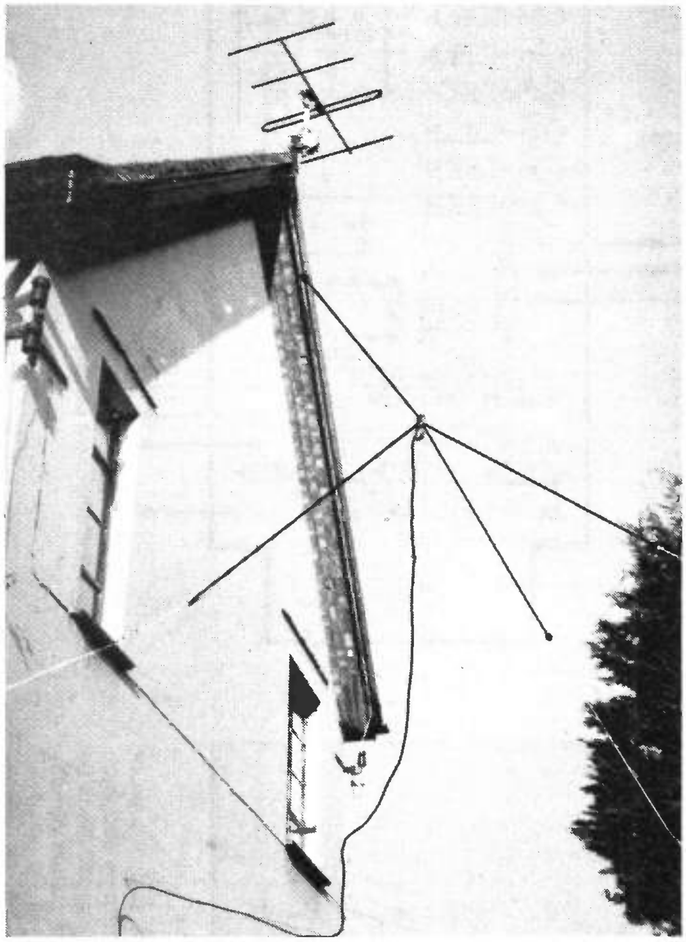


Figure 1. Arrangement of 10 metre crossed dipole antenna, showing coiled up stub, matching section and feeder. 2 metre Yagi with directional control on pitch of roof.

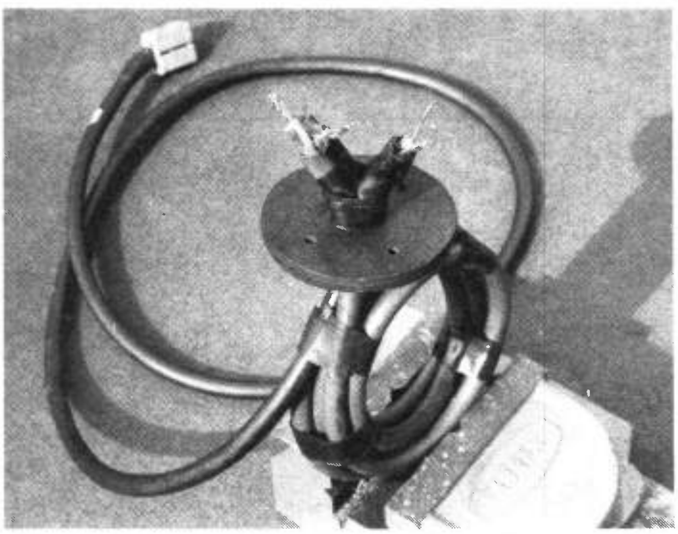


Figure 2. Arrangement of stub and matching sections of coaxial cable and insulating disc for ends of dipoles for the 10 metre crossed dipole antenna .

The components needed are shown in ***Fig. 1***. Each arm of the dipoles is 8 foot long — giving a total overall length for each dipole of 16 feet or so. The usual type of aerial wire is used. As can be seen from the diagram and photographs, each arm of the dipoles is soldered at their inner ends to the coaxial feeder and to the stub and the matching section which are also made up from coaxial cable. The coaxial cable forming the stub and the matching section is of 50 ohms, whilst the aerial feeder cable is of 75 ohms. The stub and the matching section are each 4 feet long. The stub is the "U" shaped part in the diagram; the matching section is the straight part connecting to the aerial feeder. The "U" shaped stub should be coiled up into several loops, a couple of inches or so in diameter and held in place by some strips of insulating tape. Some mechanical ingenuity is needed to sort out suitable insulating arrangements at the centre of the aerial, where the ends of the dipole wires and the stub, matching section and feeder coaxial cable come together all need supporting in some way. The writer solved the problem by cutting a circle of quarter inch thick insulating material such as Paxolin or fibreglass, or whatever the junk box will produce, drilling a hole in the centre large enough to accommodate the bunch of coaxial cables, then drilling four holes equally spaced around the circuit of insulating material to take the ends of the wires forming the dipoles. The connections can then be soldered and the ends of the coaxial cables protected with Araldite. Similarly, protect the junction of the 75 ohm feeder to the matching section.

Ideally, the antenna should be rigged up to four poles, eight to ten feet high or so, but this arrangement is unlikely to be obtainable. Such was the case in the writer's location. The most suitable place for stringing the aerial up was over the garage roof at one end of the house. It was possible to rig one dipole from the end of the pitch of the roof, down to one corner of the garage roof and to stretch the other dipole down to opposite corners of the garage roof. The coaxial feeder from the antenna then hung down conveniently and could be brought into the radio room in a reasonably short run. Whilst the dipoles were not truly at right angles to each other, nor horizontal, which of course would have been the ideal, this compromise arrangement works very well indeed. There was a noticeable improvement over previously used long wire and simple dipole antennas and in spite of the crossed dipoles being screened to the west by the side wall of the house, little difference has been noted between orbits to the west of the house from those to the east, where the aerial is clear and unscreened.

So much for the 10 metre down-link signal from the satellite. We need something similar for reception of a 2 metre down-link such as that from UOSAT and if we are planning to progress to full operational facilities, ie., transmitting to the satellite as well as receiving from it, we shall need a 2 metre antenna for transmitting as well as receiving. A crossed dipole type of antenna will perform these duties on 2 metres just as well as the 10 metre crossed dipole design. As its design works out much smaller than the 10 metre one, its construction and rigging up can be much more conveniently arranged than in the case of the 10 metre one.

The 2 metre crossed dipole used by the writer is shown in the accompanying photos, and as can be seen, consists of a crossed dipole array mounted above an artificial earth. This artificial earth is an important item in the system, as, by mounting the dipole array at the correct height above it, the vertical radiation pattern of the array can be increased, giving good reception of, and transmission to, overhead passes. This earth mat is made up of a circuit of expanded metal, strengthened by being fixed to a circular outer ring and radial rods as shown in the photograph.

This assembly can be home constructed using stiff galvanised wire or, if preferred, it can be made up at a local metal prefabrication works or a blacksmiths. The photographs give a good idea of how the earth mat is assembled. Its size is not critical; in the writer's case the mat is 4 foot in diameter. Arrangements must be made for fitting a short metal 'mast' to the centre to support the crossed dipoles. The dipole elements can be cut from old TV aerial tubing. The arms supporting the dipoles are of wood, with four thick pieces of insulating material such as Paxolin, etc., at each end, drilled to take the tubes forming the dipoles. The inner ends of the dipoles are supported on small stand-off insulators. The wooden arms require a good coat or two of varnish to protect them from damp.

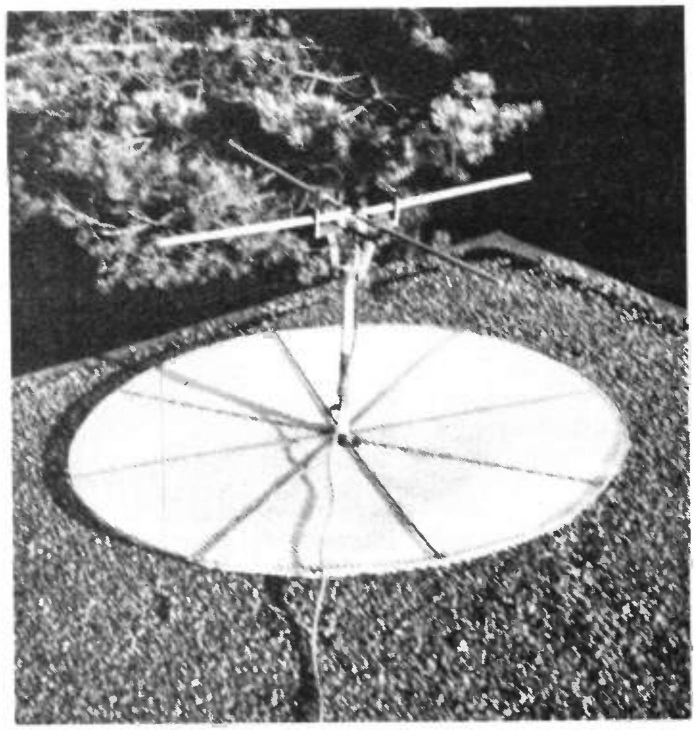


Figure 3. General arrangement of the 2 metre crossed dipole and earth mat to give good vertical radiation.

The length of each dipole element is 18½ inches, whereupon, taking a gap of about 1 inch between the elements, the overall length of each dipole is 38 inches. The dipoles have to be cross-connected with a phasing stub — as in the case of the 10 metre one — and in this case the "U" shaped piece is of 75 ohm coax, as is the aerial feeder itself. In the aerial shown, the "U" shaped piece (B) should be 10½ inches long, and the 50 ohm matching section (A) connecting the dipoles to the feeder is 11¾ inches long.

The height at which the crossed dipoles are mounted above the earth mat will determine the radiation pattern and in the writer's case, satisfactory vertical radiation was obtained by having it 20 inches above the mat. No connection need be made to the earth mat nor to the short mast supporting the dipoles. Four stiff wires attached to a sleeve to go round the top of the mast and attached to the wooden arms sup–

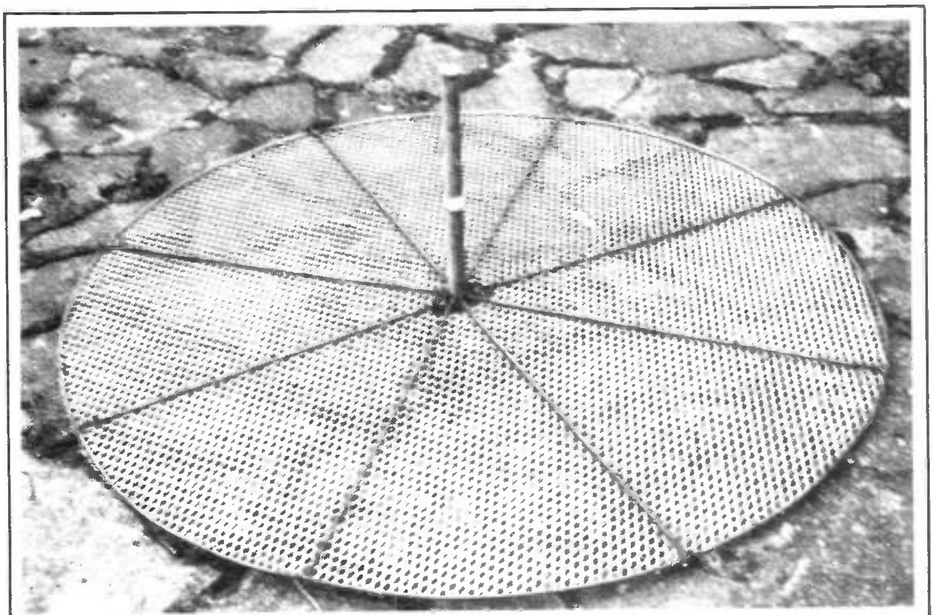


Figure 4. Detail of construction of earth mat and supporting 'mast' for the 2 metre crossed dipole.

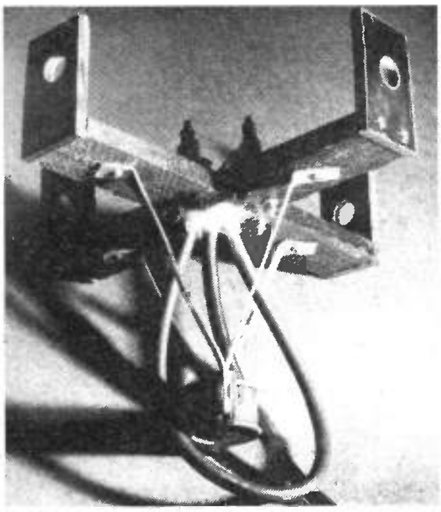


Figure 5. Detail of support inner ends of antenna tubes for 2 metre crossed dipole, showing attachment arrangement to earth mat 'mast', and arrangement of stub and matching section coaxial cables.

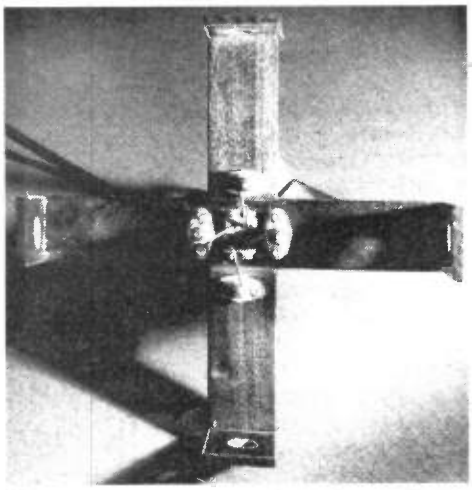


Figure 6. Top view of supporting arm for 2 metre crossed dipole and supports for antenna tubes.

port the dipole supporting frame. The antenna can be placed directly on the shack or garage roof as shown, or on any other suitable horizontal surface.

With these two aerials and the knowledge you should have acquired from our first article, you should now be able to find any specific satellite and listen to it. But we can hear you say, "What happens if, when we look up our Orbital Prediction Calendar, we find that there isn't an overhead orbit to listen to at a time which is convenient to us"? Well, not to worry, you should be able to hear orbits quite distant from our "ideal' overhead one, though not of course, so well as if they are 'near' overhead. We will have a bit more to say about this aspect of the matter later in this article.

So, having succeeded in finding and hearing our satellite, how do we go about transmitting to it?

Well again, we want to keep things as simple as possible and our expenditure on equipment as low as we can — to start with at any rate. So we'll concentrate on working overhead orbits only — to begin with — and for this we will use our 2 metre crossed dipole antenna as the transmitting aerial. The Russian satellites and Oscar 8 — when it's in Mode A — transmit down the on/10 metre satellite band down-link and receive on the 2 metre up-link. So we can use our 10 metre aerial to listen to them on, and our 2 metre aerial to send signals up to them. At this point, we have to consider what power do we need to do this? What sort of transmitter do we need and what must its power be to do this effectively?

There are two ways of approaching the question of transmitting up to the satellite; we can either use a low power transmitter and a high gain aerial or we can use a high power transmitter and a low gain aerial. As our 2 metre crossed dipole is a low gain antenna, we are stuck with the second alternative. It is generally accepted that the ERP, ie, Effective Radiated Power, needed to access these satellites is around 100 watts. The ERP is the antenna gain, times the transmitter output power. 100 watts ERP is equivalent to a 10 watt output transmitted feeding a 10 dB gain antenna. As our crossed dipole antenna has very little gain, we appear to need a transmitter giving an output of nearly 100 watts. No, not necessarily, as a matter of fact, it *is* possible to access these satellites with much less than 100 watts ERP and the writer's transmitter runs nearer to 50 watts output than 100.

The next point to make is that the transmitter must be tunable, ie, its frequency of emission must be able to be varied across the input frequency of the particular satellite we wish to use in the same way as was required for our receiving equipment. In the case of Oscar 8, this is 145.85 to 149.95 MHz. The Russian satellites require an up-link frequency in the range 145.91 to 146.00 MHz.

A further point we should note is that either SSB or CW are the usual modes for satellite communication and CW is by far the most popular so to start with, confine your activity to CW.

So, the question of what type of transmitter do we need, resolves itself into something which fits in with the above requirements. If you have a 2 metre transceiver, which is tunable over the frequencies specified above, you can use the transmitting section of this to feed a linear amplifier giving you 50 to 100 watts out. Or you can use your HF transceiver or transmitter to feed a 2 metre transverter. Usually, these accept a 28 MHz signal and convert it to 2 metres. This is then used to drive a 2 metre linear amplifier. If you are lucky, you may be able to find a second-hand, separate, two metre transmitter, which was popular before the "black box" type of 2 metre gear became available and this can be used to drive directly a linear amplifier. The gear used by the writer is of this type. The transmitter is a Telford Communications TC 10 Multimode 2 Metre Transmitter which is unfortunately not in production now, but if you can find one on the second-hand market, it makes an ideal basis for a satellite station. The writer's TC 10 drives a home built 2 metre power amplifier which is to the design given in the "VHF-UHF Manual", published by the RSGB, for a "Medium Power Amplifier for 144MHz", using a QQV06-40 type double tetrode valve. The writer has had this transmitter in use for a number of years and found it a very satisfactory set-up and used with the crossed dipole it has given him very many satellite QSOs indeed.

Figure 7. The writer's "Satellite Station". Top — home built 2 metre power amplifier; below Telford T.C. 10, 2 metre transmitter; bottom 2 and 10 metre receiver.

One final point. You may be thinking, once again, "well supposing there are not any overhead orbits at a convenient time, what do we do then?" Well, that takes us on to the next phase of our satellite experience, in which we have to use a directive antenna, such as the Yagi shown in one of the photos illustrating this article, but that must be left to another time. Get some experience on 2 metre overhead orbits first — there will be some at a convenient time, as the orbits of the satellites mentioned in this feature progress several degrees with each orbit, so that their overhead orbits change from day to day.

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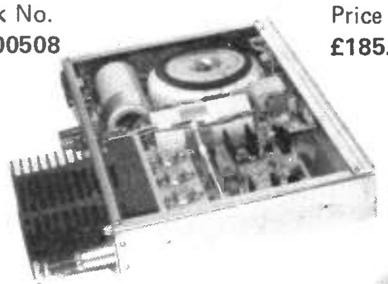

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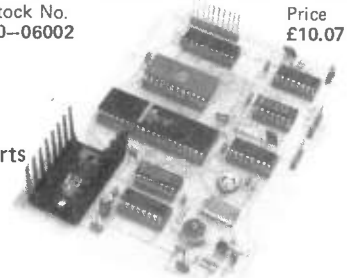

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Data File

Ray Marston continues his description of the extremely versatile Norton Amplifier.

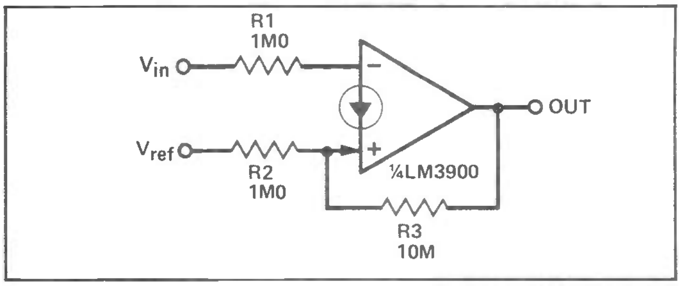


Figure 15: Inverting Schmitt trigger.

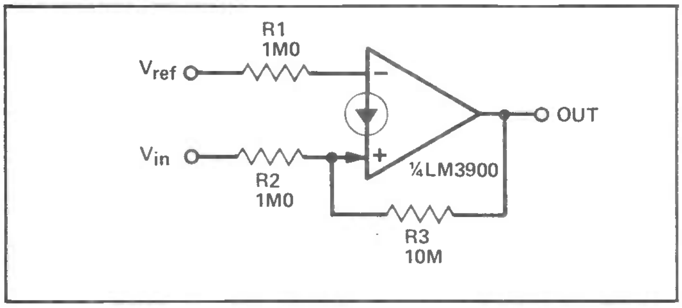


Figure 16: Non-inverting Schmitt trigger.

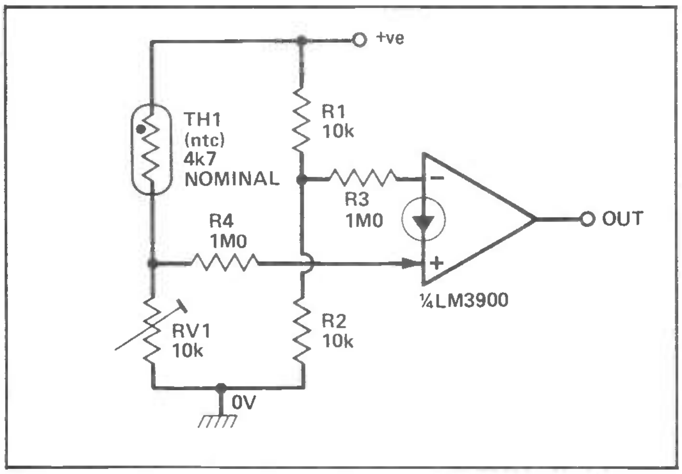


Figure 17: Over-temperature switch.

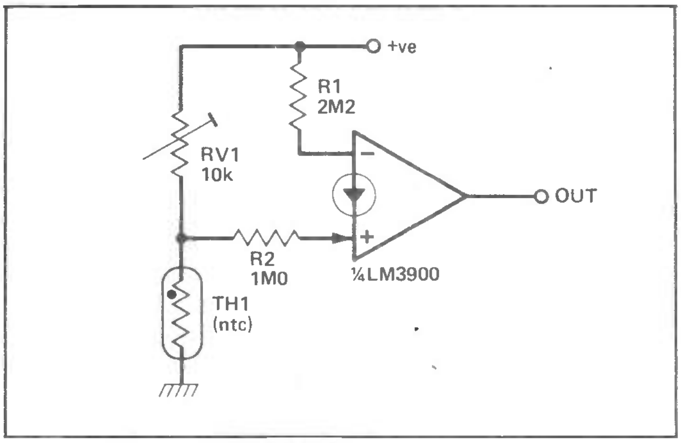


Figure 18: Under-temperature switch.

Hysteresis can easily be added to the comparator circuits shown last month, so that they act as Schmitt triggers, by simply connecting a high-value resistor between the output and the non-inverting terminal, as shown in ***Figs. 15*** and ***16. Fig. 15*** gives an inverting Schmitt action, and ***Fig. 16*** gives a non-inverting Schmitt action. The R2-R3 ratio determines the hysteresis magnitude.

Comparator Applications

Figures 17 to ***21*** show some useful applications of voltage comparators. The ***Fig. 17*** design is that of an over-temperature switch, the output of which goes high when the temperature of negative-temperature-coefficient (ntc) thermistor TH1 exceeds a value pre-set via RV1. Potential divider R1-R2 feeds a fixed half-supply reference voltage to R3, which then feeds a reference current to the inverting terminal, and TH1-RV1 form a potential divider that feeds a variable current to the non-inverting input via R4. The potential on the TH1-RV1 junction rises with temperature, and the op-amp output switches high when this voltage exceeds half-supply value. The trip temperature of the circuit can be pre-set via RV1.

Note that the operation of the ***Fig. 17*** circuit can be reversed, so that it operates as an under-temperature switch, by transposing the TH1-RV1 positions. Also note that, since RV1-TH1-R1-R2 are wired in a Wheatstone bridge configuration, the trip point of the circuit is independent of variations in supply rail voltage.

Figure 18 shows a useful variation of the above circuit, connected as an under-temperature switch. In this case the reference (inverting) current is derived from the supply rail via R1, and the variable (non-inverting) current is again derived from the RV1-TH1 junction. Since, however, the R1 value is (approximately) double that of R2 and generates a current that is proportional to the supply rail voltage, the trip point of this circuit is also independent of variations in supply rail voltage.

A variant of the above is shown in ***Fig. 19***, which gives a high output when the supply voltage falls below a value determined by ZD1. If ZD1 has a value of 5V6, the op-amp output switches high when the supply rail voltage falls below approximately 11

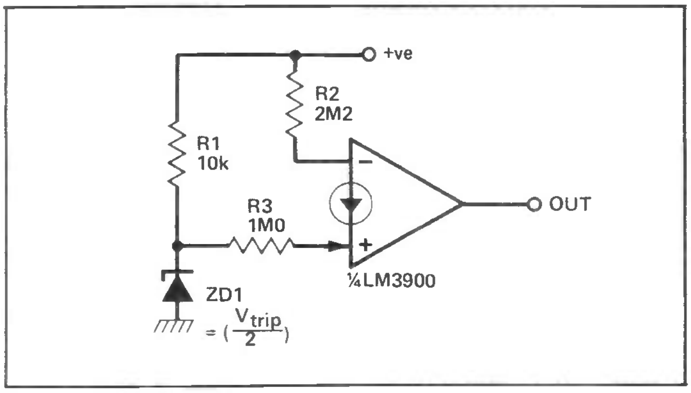


Figure 19: Supply under-voltage detector.

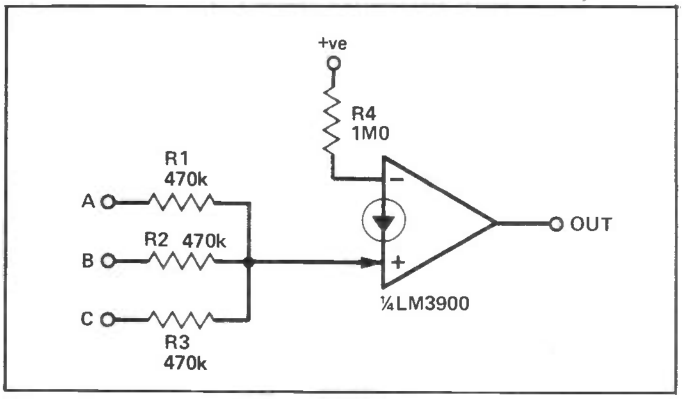


Figure 20: 3-input OR gate (can be converted to a NOR gate by transposing the op-amp inputs).

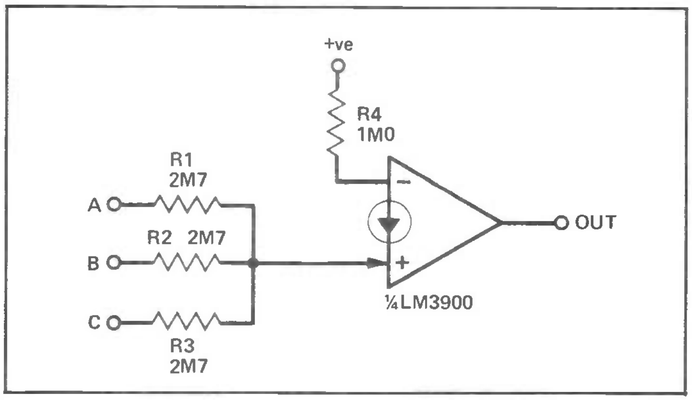


Figure 21: 3-input AND gate (can be converted to a NAND gate by transposing the op-amp inputs).

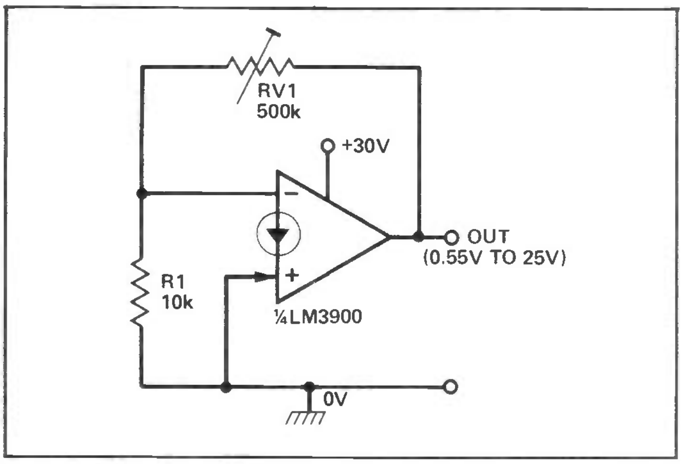


Figure 22: Simple variable-voltage reference.

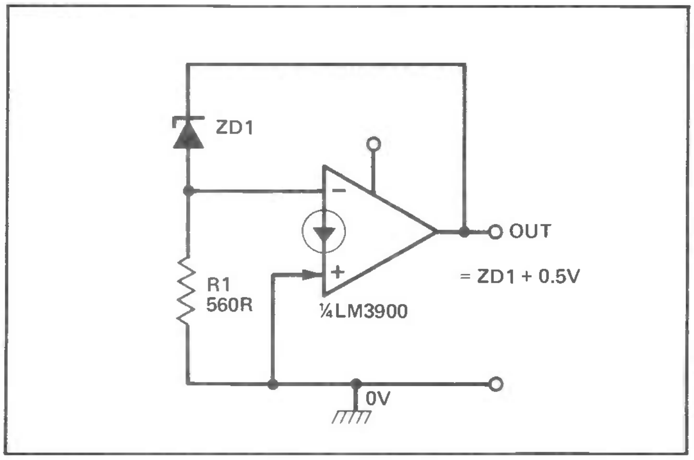


Figure 23: Fixed-voltage reference.

volts the precise trip point can be varied by replacing R3 with a series-connected 820k resistor and 470k pot.

Finally, ***Figs. 20*** and ***21*** show how the comparator can be made to act as a 3-input logic gate. In ***Fig. 20***, a reference current is fed to the inverting pin via R4, and a greater current can be fed to the non-inverting pin via any of the R1 to R3 resistors, thence causing the output to switch high if any of the input terminals go high; this circuit thus acts as a 3-input OR gate. Note that, since the input terminals of the LM3900 op-amps act as transistor base-emitter junctions, their direct input voltages cannot exceed 550mV or so. Consequently, any high input generates a proportionately high input current to the circuit, with very little current loss through the low inputs. The circuit can thus accept a large number of OR inputs. Note that this circuit can be converted to a NOR gate by simply transposing the input connections of the op-amp.

The ***Fig. 21*** circuit is that of a 3-input AND gate, which gives a high output only when all three inputs are taken high so that the non-inverting terminal current exceeds that determined by R4. This circuit can be converted to a NAND gate by transposing the input connections of the op-amp.

Voltage Regulator Circuits

Figures 22 to ***26*** show various ways of using LM3900 op-amps as simple voltage regulators and references. The ***Fig. 22*** circuit is a simple but useful variable-voltage reference. The non-inverting terminal of the op-amp is disabled, and the circuit uses the V_{be} potential of the inverting terminal as a reference, and has a voltage gain determined by the RV1-R1 ratio. When RV1 is set to zero, the circuit gives unity gain and gives an output of 0.55 volts. When RV1 is set to maximum value, the circuit has a gain of 50 and gives an output of about 25 volts. The circuit has good regulation and can supply output currents of several mA; note, however, that the output voltage is not temperature compensated.

Figure 23 shows a fixed-voltage reference circuit, which generates a well regulated output that is slightly greater than the ZD1 voltage. R1 sets the zener current at about 1 mA. The ***Fig. 23*** circuit can safely supply output currents of only a few mA, but this can easily be boosted to tens or hundreds of mA by wiring an npn current-boosting transistor into the output feedback loop of the circuit, as shown in ***Fig. 24***.

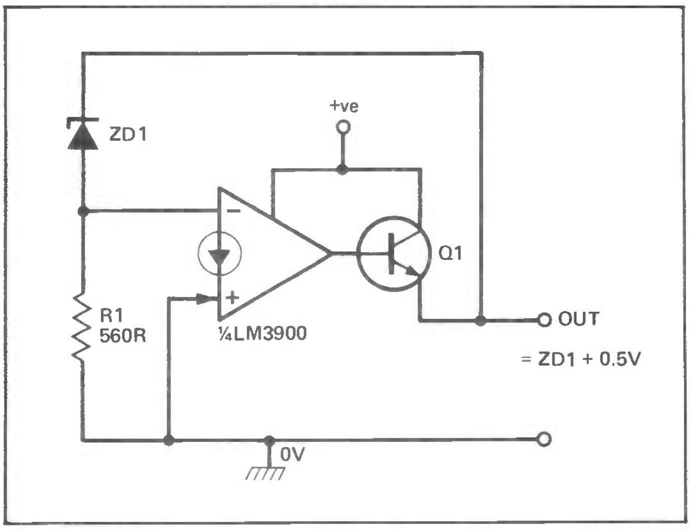


Figure 24: Current-boosted voltage reference.

Figure 25 shows an alternative type of voltage regulator, which gives a well regulated variable-voltage output. In this case the op-amp is wired as a x2 non-inverting DC amplifier (with gain determined by the R3-R2 ratio), and the input voltage is variable between zero and 15 volts via ZD1 and RV1. The output voltage is thus variable over the approximate range 0.5 volts to 30 volts. ***Fig. 26*** shows how the available output current can be boosted to tens or hundreds of mA with the aid of an external transistor.

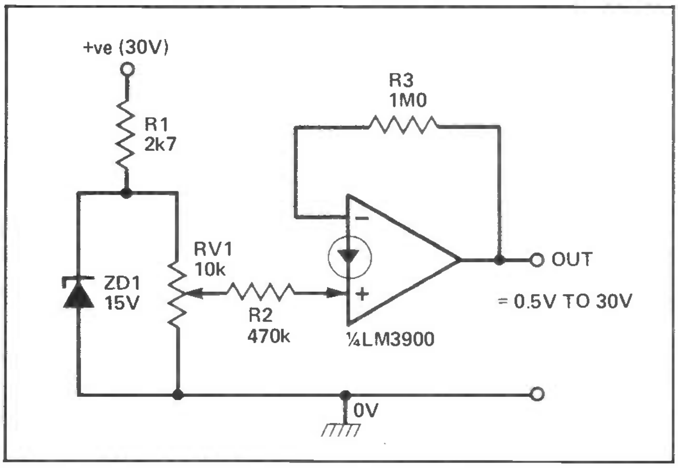


Figure 25: Variable-voltage regulator.

Current Regulator Circuits

Figures 27 to ***30*** show various ways of using the LM3900 to make fixed-current regulator circuits. The ***Fig. 27*** design acts as a fixed (1 mA) current source, which produces a fixed current into a load connected between Q1 collector and ground, almost irrespective of the load impedance (in the range zero to 14k). The circuit is powered from a regulated 15 volt supply. Potential divider R1-R2 applies a 14 volt reference (15V — 1V) to R3, so the op-amp output automatically adjusts to provide an identical voltage at the R4-R5 junction. This produces 1 volt across R5, resulting in an R5 current of 1 mA. Since this current is derived from Q1emmiter,and the emitter and collector currents of a transistor are almost identical, the circuit acts as a fixed-current source. The source current can be doubled, if desired, by halving the R5 value, etc.

Figure 28 shows a simple variation of the above circuit, in which the source current is independent of variations in supply rail voltage. In this case the input is set to 2V7 below the supply

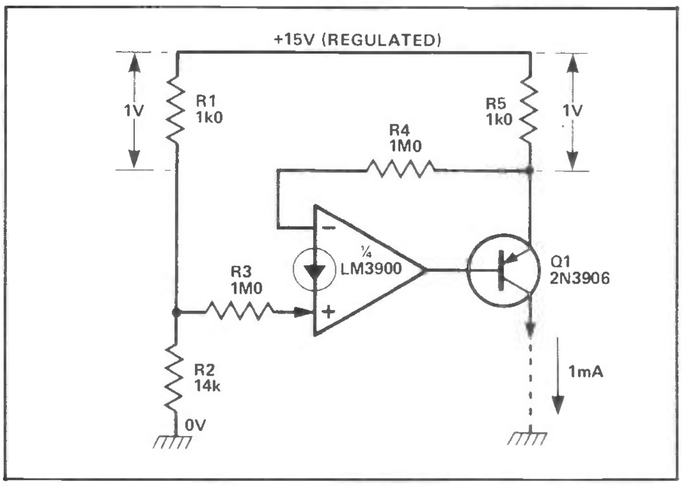


Figure 27: Fixed-current source (1 mA).

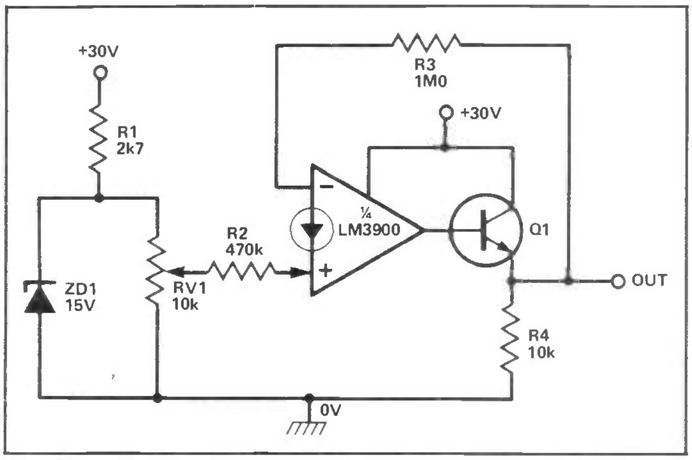


Figure 26: Variable-voltage regulator with boosted output.

rail value via ZD1, so 2V7 is automatically set across R4, which has a value of 2k7 and thus produces a fixed 1 mA source current from Q1.

Figure 29 shows a simple 1 mA current sink, in which a fixed current flows in any load connected between the positive supply rail and Q1 collector, almost irrespective of the load impedance. Here, the non-inverting terminal of the op-amp is disabled, and 100% negative feedback is used between the output of the circuit (Q1 emitter) and the inverting terminal. The voltage across R1 is thus equal to the V_{be} of the inverting

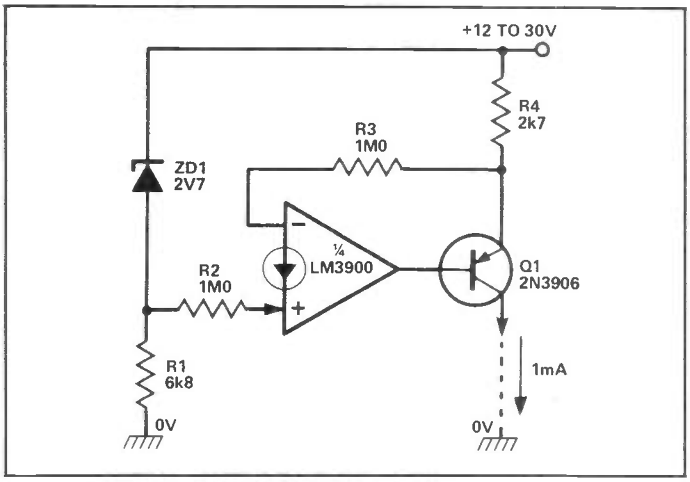


Figure 28: Alternative current source (1 mA).

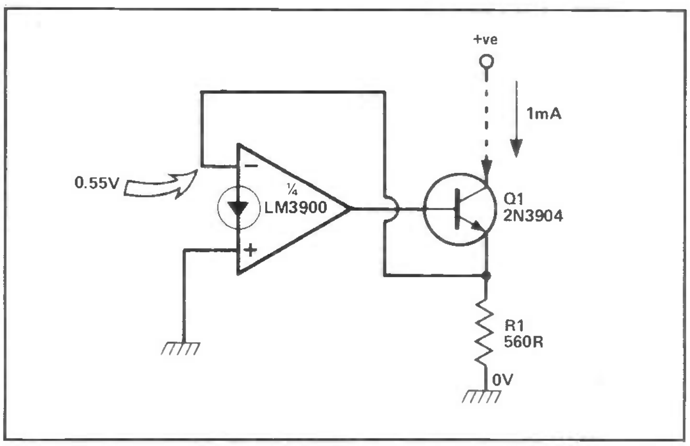


Figure 29: Simple 1 mA current sink.

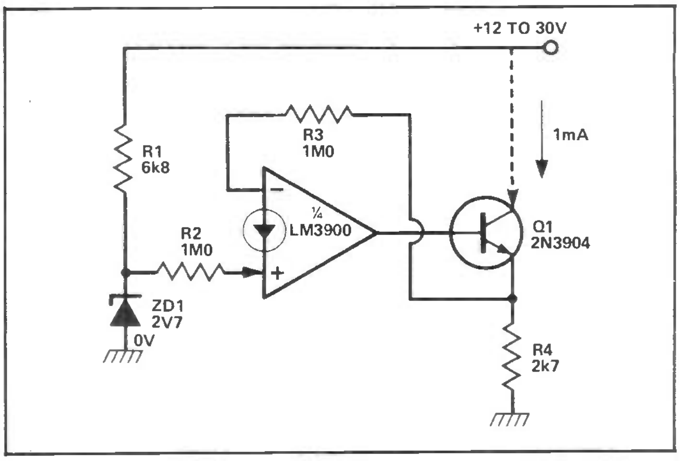


Figure 30: Improved current sink (1 mA).

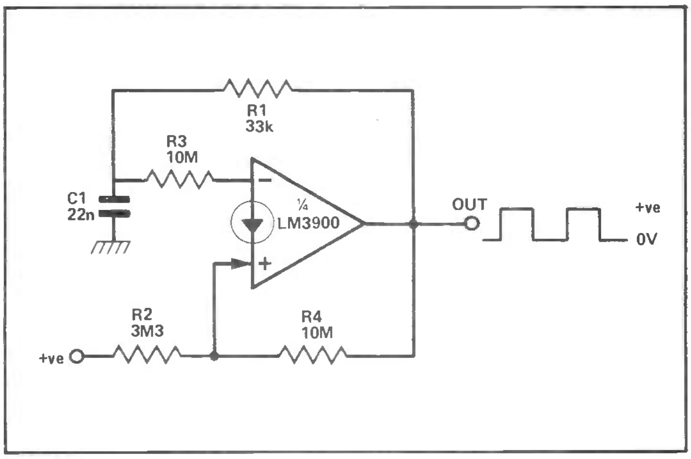


Figure 31: 1 kHz square-wave generator.

terminal and, since this equals approximately 0.55V, a fixed current of about 1 mA flows through Q1 emitter and R1, and thus into Q1 collector from any load that is connected. Note that the sink current of this circuit is not temperature compensated.

Finally, ***Fig. 30*** shows an alternative type of current sink. In this case the op-amp is fully enabled, and has a fixed reference of 2V7 applied to the non-inverting terminal via R2. Consequently, the circuit automatically adjusts to generate 2V7 across R4 which, since it has a value of 2k7, generates a current of 1 mA in the emitter and collector of Q1. This current can be varied, if required, either by varying the value of R4 or by varying the input voltage feed to R2.

Waveform Generator circuits

To conclude this look at the LM3900, ***Figs. 31*** to ***33*** show some useful ways of using the op-amps to make simple waveform generators. ***Fig. 31*** shows a 1 kHz square-wave generator, in which C1 alternately charges and discharges via R1. When the output is high, R3-R4 are effectively connected in parallel, and C1 charges via R1 until the current flow into R2 equals that flowing into the non-inverting terminal of the op-amp; this point occurs when the voltage across C1 rises to approximately 2/3 (V_{supply}). At this point the circuit switches regeneratively, the output switches low, and C1 starts to discharge via R1. Under this condition R4 is effectively disabled and the input current to the non-inverting terminal is determined only by R3, so C1 discharges until the R2 current falls to slightly below that of R3; this point occurs when the C1 voltage falls to about 1/3 (V_{supply}). At this point the circuit again switches regeneratively, and the output goes high again.

The ***Fig. 31*** circuit is useful for generating square waves with frequencies up to a maximum of only a few kHz. Note that, because of the poor slew rate characteristics of the LM3900 (0.5V/uS), the output waveforms have rather poor rise and fall times. The circuit generates a symmetrical square wave output.

Figure 32 shows how the basic ***Fig. 31*** circuit can be modified to act as a gated 1 kHz astable or square-wave generator by taking R3 to ground via R5, rather than directly to the positive supply rail. The circuit becomes active only when the gate terminal is pulled high (to the positive supply rail).

Finally, ***Fig. 33*** shows how the ***Fig. 32*** and ***Fig. 17*** circuits can be combined to make an audible-output over-temperature alarm, which generates a 1 kHz tone in the PB-2720 transducer when the TH1 temperature exceeds a value pre-set via RV1.

■ R&EW

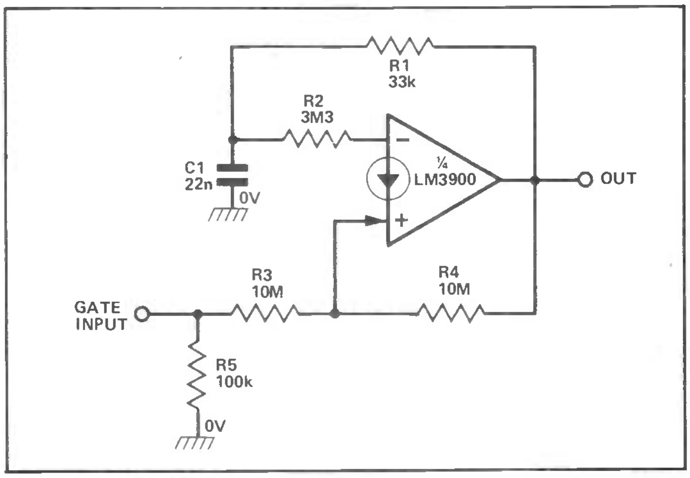


Figure 32: Gated 1 kHz astable.

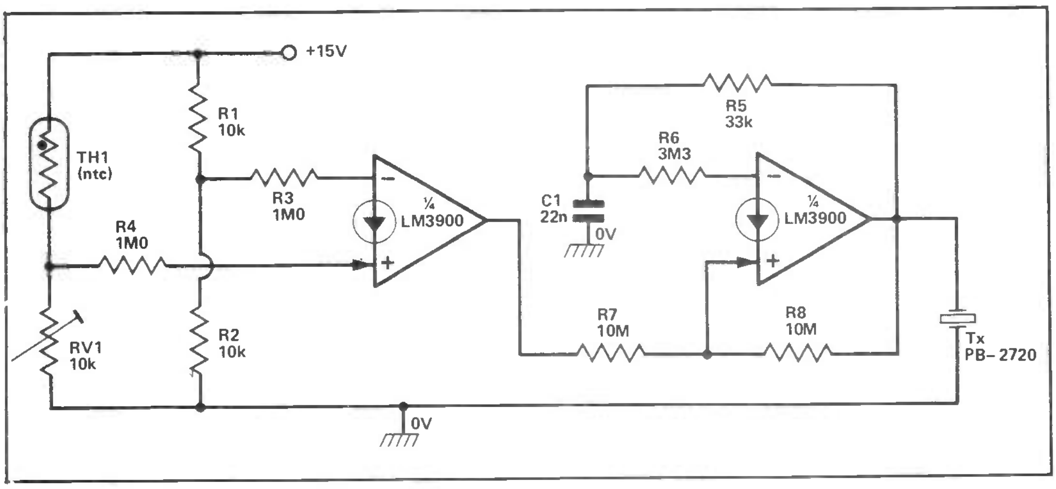
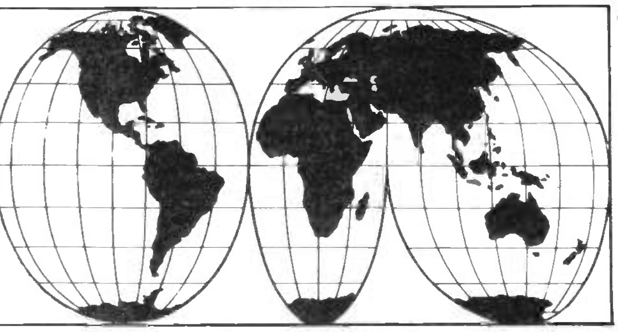


Figure 33: Audible-output over-temperature alarm.

SHORT WAVE NEWS FOR DX LISTENERS

Frank A. Baldwin



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

Having dealt with the reception of some of the Far Eastern stations in the last few issues of this journal, I now draw the attention of my readers to that area of the globe termed by most short wave listeners as Latin America or simply LA. The 'season' for the logging of these transmitters with the best possible chance of success is now upon us, lasting from approximately April through to September, at which latter period the Far Eastern 'season' starts all over again.

Although Latin American stations can be logged on other broadcast bands, the great majority of them are to be found on the Tropical Bands which extend from **2300** to **5100** as far as I am concerned. For the present however it is intended that the 60 metre band (**4750** to **5060**) will be reviewed.

During the Summer months here in the U.K., the signal path from LA is in total darkness from around 2330 through to 0330, although eastern countries such as Brazil will of course be dark from around 2200. It is under these conditions that we can get busy logging these short-path signals.

For relative beginners at the LA game, I suggest firstly a try at some of the easy stations which are most often logged and reported by SWL's. Make a start with the following, Venezuelans, probably some of the best signals on the band from Latin America.

Tune to **4800** where you will find Radio Lara in Barquisimeto operating from 0900 through to 0400. With a 10kW transmitter, it is one of the most reported stations in the short wave listener press.

On **4830** there is Radio Tachira in San Cristobal which is scheduled on the air from 1000 to 0500 with a 10kW signal. This one is now often reported by listeners although for a considerable period during last year it was absent from most lists sent in by various reporters to the SWL journals.

Other Venezuelans of note for beginners are Radio Valera on **4840** from 0900 to 0400 it identifies as "Su Nueva Radio Valera"; Radio Maracaibo on **4860** where it operates from 1000 to 0400 with a 1kW transmitter; Radio Juventud, Barquisimeto on **4900** where it is scheduled from 1000 to 0400 with a power of 10kW as is also Radio Yaracuy, San Felipe on **4940**. Then there is Radio Sucre, Cumana on **4960** from 1000 to 0400 at 1kW; Radio Rumbos, Caracas on **4970** from 0900 to 0500 (1000 to 0400 on Sunday) with 10kW; Ecos del Torbes, San Cristobal on **4980** on which frequency it operates from 0900 to 0400 with a power of 10kW or you could try **4990** for Radio Barquisimeto 10kW which is on the air from 1000 to 0400.

To wind up the Venezuelan 'easy' stations review, attention is called to Radio Reloj Continente in Caracas on **5030** where it operates from 0900 to 0500 (Sunday from 1000 to 0400) with a power of 15kW and Radio Maturin on **5040** from 0900 to 0400 with 10kW power.

Changing now to a mix of LA countries in order to provide some variations, tune the dial to **4805** where you should find the Brazilian Radio Difusora Amazonas located in Manuas operating from 2230 to 0130 with a 5kW signal; flip the pointer next to **4832** where you will almost certainly log Emisora Radio Reloj in San Jose, Costa Rica which is on the air around-the-clock with a 1kW transmitter and is very regularly logged here in the U.K.

Then there is SRS Paramaribo in Surinam which can be found on **4850** and is scheduled from 0900 to 0430 (Saturday until 0530) with a power of 10kW or, if you fancy a visit to Colombia then try **4865** for signals from La Voz del Cinaruco in Arauca operating from 0900 to 0400 and often putting a good strength transmission into our own islands.

Although this review will continue in the next issue, I leave you with details of yet another country, this time Ecuador in the shape of Radio Quito on **4920** and scheduled from 1000 to 0500 (Sunday until 0400). With a 10kW signal, it identifies as "La Voz de la Capital".

Around The Dial

In which are presented for the interest of readers the times to listen, the frequencies to tune and the programmes to expect.

Netherlands

Radio Netherlands, Hilversum on **15560** at 0810, YL with a talk in the Dutch programme directed to Africa, South East Asia and the Middle East, scheduled from 0730 to 0820. This transmission was also logged in parallel on **21480** to the Middle East and on **25970** to South East Asia, both via the Madagascar Relay.

The English programme on **15560** beamed to Europe and West Africa may be heard from 0700 to 0720, being logged at 0712 according to the entry in my book.

Finland

Helsinki on **15265** at 0816, OM with the Finnish programme for Europe, the Far East and the Pacific, timed from 0700 to 0825 on Sunday only.

Italy

Rome on **15330** at 0830, interval signal then OM with station identification and announcements at the start of the Italian transmission intended for Australia, scheduled from 0830 to 0930. All this was followed by a newscast of both world and local events.

Austria

Vienna on **15410** at 0834, OM with a news commentary during the English programme to Europe, the Middle East, the Far East and Australasia, listed from 0830 to 0900.

Switzerland

Berne on **15305** at 0838, the unmistakeable lilt of Swiss music followed by announcements during the German programme directed to Australasia, the Far East, South Asia and Europe from 0830 to 0900.

Berne on **15430** at 1127, OM with the English programme — all about tourism in Switzerland — timed from 1100 to 1130.

Berne on **21520** at 1104, OM with the English programme to Africa, on this channel from 1100 to 1130.

Belgium

Brussels on **21810** at 1122, YL with a Dutch pop song in that language programme direct to Africa from 1100 to 1230 but not on Sunday. Also logged in parallel on **26050**.

West Germany

Cologne on **15275** at 1405, OM with news and comment during the German transmission for Europe, the Middle East, South and South East Asia, scheduled from 1400 to 1600.

Cologne on **15240** at 1424, OM with announcements in the Arabic service to the Middle East, timed from 1345 to 1500.

Vatican

Vatican City on **15405** at 1408, OM with announcements during the Spanish programme for the Americas, scheduled from 1400 to 1430.

Vatican City on **21485** at 1129, OM with a religious talk during the English transmission to Africa, on this channel from 1115 to 1130.

Romania

Bucharest on **15365** at 1412, OM with the Arabic programme — complete with Arabic music — in the scheduled 1400 to 1430 transmission. Also logged in parallel on **15250**.

Bucharest on **15345** at 0705, YL with a news commentary in the English programme for the Pacific, timed from 0645 to 0715.

Bucharest on **15250** at 1137, YL with a newscast in the French programme to Africa and Europe, listed from 1130 to 1200.

Poland

Warsaw on **15120** at 1415, OM with an Arabic programme directed to the Middle East from 1400 to 1500.

Hungary

Budapest on **15160** at 1340, OM & YL with announcements in the German transmission to Germany, listed from 1330 to 1400 (Sunday only).

Spain

Madrid on **15395** at 1012, YL with announcements, OM with a ballad, all during the Spanish programme for European consumption and featured on this channel from 1000 through to 2145.

Madrid on **21595** at 0724, OM and YL with the Spanish programme for Australia, the Near and Middle East, being scheduled from 0600 to 0930.

Turkey

Ankara on **15220** at 1125, Turkish music in typical style, YL with a song in the Turkish transmission for North Africa, the Middle East and Europe, timed from 0700 through to 1600, this being a programme for Turks abroad. The "Voice of Turkey" was also logged in parallel on **11955**.

Malta
"Deutsche Welle" Cologne via the Malta Relay on **7265** at 2108, OM with the Maghribi programme for Africa and the Middle East, scheduled from 2045 to 2120. Also logged in parallel on **6000**.

Albania
Tirana on **14320** — the frequency is correct, right in the 14MHz amateur band — OM with a talk in the Chinese programme for China, scheduled from 1100 to 1200. Logged at 1135.

Ghana
Accra on **4195** at 0602, YL with local news items in English. This is GBC-1 which presents programmes both in English and vernaculars from 0530 to 0800 (Sunday through to 2305) and from 1200 to 2305. The power is 10kW.

Cameroon
Garoua on **5010** at 2110, OM with a newscast of both local and world events, this programme being featured from 2100 to 2115 in English. Radio Diffusion Nationale operates from 0425 to 0800 and from 1645 to 2200, the power being 100kW.

Uganda
Soroti on **5027** at 2008, YL with a pop song in English in the National Programme which is on the air from 1300 to 2100 on weekdays, Saturday and Sunday from 0300 to 0545 and from 1400 (Sunday from 1430) to 2100. The power is 250kW but transmissions are apt to be irregular.

Mauritania
Nouakchott on **4845** at 0602, OM with quotes from the Holy Quran. This one is on the air from 0600 (Sunday from 0800) to 0900 from 1800 (Saturday and Sunday from 1700) to 2400.

Nigeria
Lagos on **4990** at 0610, OM with a newscast of African events in English. Channel 1 programmes are scheduled from 0430 to 1000 and from 1700 to 2310 in both English and vernaculars. The identification is "Radio Nigeria".

Lagos on **15120** at 0945, OM with an English programme all about Nigerian industrial production. This transmission is intended for North Africa and Europe and is timed from 0830 to 1000.

Egypt
Cairo on **15475** at 1010, OM and YL alternate with announcements in the Arabic language "Voice of the Arabs" programme directed to the Middle East, North Africa, Central and South Asia and Europe, being scheduled from 0600 to 1400 and from 1600 to 1850 on this channel.

Kuwait
Radio Kuwait on **15495** at 1048, OM with a newscast during the Arabic language Domestic/External Service which is on this frequency from 0500 through to 0015.

Madagascar
Radio Nederlands Relay on **21480** at 0733, OM with a newscast of world events in the Dutch programme for North West Africa, the Middle East, South East Asia and Europe being timed from 0730 to 0820.

Australia
Melbourne on **21680** at 0742, OM with announcements in the English programmed General Service to Europe and the Pacific, on this channel from 0400 to 1000 but with some weekend variations.

Melbourne on **9770** at 1520, OM with announcements in English during a programme of Australian pop records in the General Service to Asia and the Pacific and timed on this channel from 1100 to 1730.

Melbourne on **6035** at 1903, OM with announcements and station identification, a newscast of both Pacific and world events, including current Australian affairs, in the English transmission for the Pacific and Papua/New Guinea, timed on this frequency from 1530 through 2200.

Japan
Tokyo on **17870** at 0803, OM with a newscast followed by YL with a news comment programme during the English transmission to Europe, timed from 0800 to 0830.

North Korea
Pyongyang on **15245** at 0813, YL presenting a programme of both news and comment in the English programme for South East Asia and scheduled from 0800 to 0950 on this channel.

China
PLA (People's Liberation Army) at Fuzhou, Fujian on **4045** at 1542, OM with a song in Chinese, local-style music. Fuzhou operates to the listed 1300 to 0530 but from March to October the schedule is 2100 to 0145 and from 1000 to 1800.

Radio Peking on **9945** at 0934, YL presenting a programme in Chinese directed to Australia and New Zealand and timed from 0900 to 1000.

Radio Peking on **15195** at 0844, YL with a newscast then some Chinese music during the English programme for Australia and New Zealand, scheduled from 0830 to 0930. Also logged in parallel on **15435**.

Radio Peking on **15165** at 1008, OM with a talk in the Cantonese programme for Australia and New Zealand, timed from 1000 to 1100.

New Zealand
Wellington on **15485** at 0810, YL with a talk in English, OM with announcements and a time-check at 0817 and "This is the National Programme".

Pakistan
Karachi on **21485** at 1347, OM with a newscast in the Urdu programme during a World Service presentation to the Persian Gulf and the Middle East, scheduled from 1330 to 1600.

India
AIR (All India Radio) Delhi on **9665** at 2038, OM with a cricket commentary in both English and Hindi in the General Overseas Service. According to their schedule, this would be the English programme directed to the UK and North and West Africa from 1945 to 2045.

AIR Hyderabad on **4800** at 1549, OM with a news commentary in English. Hyderabad on this channel is scheduled from 0025 to 0215 and from 1200 (March to April from 1130) to 1740. There is an English language newscast at 1230 and at 1530. The power is 10kW.

Sri Lanka
Colombo on **4870** at 1545, OM with a talk in Sinhalese followed by a programme of local-style music. SLBC Colombo is on the air from 0000 to 0300 and from 1000 to 1730. This is the Home Service 2 in Sinhala.

Nepal
Kathmandu on a measured **5004** (listed **5005**) at 1547, YL with songs in Nepali complete with local orchestral backing. The schedule here is from 0020 to 0350 (Sunday until 0450), from 0730 to 1050 and from 1150 to 1720. The power is 5kW.

Now Hear These

The sting being in the tail, the following 'quickies' are listed for your interest. Not easy to log of course but not so impossible, some being more difficult than others. Have a go at —

The Mongolian on **4763** at 2243 — when logged here. This is Ulan Bator with the Home Service 1 in Mongolian from 2200 to 0115.

The Tibetan on **4750** at 0148, this being Xizang PBS, Lhasa with Chinese-type music, YL with songs. This one is in Chinese during this particular session which is timed from 2230 to 0200.

The Chinese regional Xinjiang PBS, Urumqi on **4735** at 1520, local-style music, YL with songs in the Uigher Home Service, this section of the schedule being from 1045 to 1730.

With which parting shots, I'll leave you until next month.

■ **R&EW**

NOTES FROM THE PAST

Even in the days of valves, dedicated constructors were working on personal Hi-Fi Systems as Centre Tap's column from the early fifties reveals.

One sometimes hears of enthusiasts who claim they have followed the hobby from way back to the crystal set days, but they all admit that their interest has diminished for some period at least — usually to return with a still stronger appeal. My own interest was born long before broadcasting, and although I cannot perhaps fairly describe myself as an "average enthusiast", I must confess to two lapses when my interest was temporarily eclipsed. These episodes, both comparatively brief, were more or less in the nature of short holidays. It would be interesting to know of the longest sustained purely amateur interest. Among the old-timers there will, of course, be some who have held their transmitting licences since pre-1914 days, but even they have had their spells of voluntary QRT and constructional inactivity.

Variety

Readers will have noticed that in writing 'Radio Miscellany' I never settle down to write in any particular vein. For my part, I attribute this to an uncertainty of knowing the type of enthusiasts who I am addressing, or even the proportion of each class making up the readership. In the course of correspondence from readers there may be a succession of those from beginners, or perhaps from SW fans, enthusiastic TV constructors, or high fidelity merchants. These might easily lead one to think that their particular interest is of a higher percentage than is actually the case. Nothing short of an actual census would really show the true position.

A few weeks ago readers in widely separated areas who had converted the various RF Units invited me to form a club for enthusiastic Conversionists. The best I could do was to put them in touch with one another to form a sort of Correspondence Group, whence several pen-palships came about. Their enthusiasm, based on so limited a sphere, could hardly be regarded as having a sufficiently permanent interest to maintain a Club, but a good time was had by all in swapping experiences, and perhaps a few lasting friendships have been founded.

Generally speaking the only consistently flourishing groups seem to be among the SW fraternity; chiefly by virtue of their large number. Others with specialised interests, such as Recording. Quality, Amplifiers, Model Control, Ionospheric Observation, etc. are rarely locally sufficiently numerous to be able to form into personal contact groups. This is a serious handicap, and leaves them without an organised voice, but they are all, at some time, catered for in the pages of the "Constructor", and if their letters do not seem to bring immediate results, they do help to maintain a fair balance.

Opportunity For The Miniaturists

It is unfortunate that among those who are primarily interested in a specialised subject, there are few who feel able, or willing, to write of their experiences on constructional work. I know of one particular case — a very keen and capable constructor whose aim is to build midget and personal receivers, each smaller than the last. They are, of course, not simply "novelty" sets, but very practical receivers capable of standing up to hard usage and to frequent travelling. Attempts to get him to describe them are invariably countered with the excuse that he has got a still better idea for his next — perhaps then he will get down to writing about it.

There is, by the way, plenty of scope for the development of vest-pocket personal receivers, with the availability of almost microscopic components and valves used in deaf-aids, and those interested in this aspect of the hobby should be in their element.

Gadget Merchants

One runs into the Gadgeteer in all hobbies. As an amateur photographer you find him building tripods from discarded curtain rods, lens hoods from pill boxes, and an enlarger from an old biscuit tin and a reading glass. When he takes to motoring he busies himself with windscreen defrosters, foot warmers, or lighters powered by the battery.

As a radio constructor he finds the hobby a wonderful background in which he can indulge his strange urge to the full.

I have now discovered radio's "Gadgeteer No. 1" and his radiogram, as you might well guess, was far more fascinating to *watch* than to listen to. It simply bristles with bits and pieces, most of which seemed to serve a highly improbable purpose, and all of which seemed to have an indicator light, and their constant flashing on and off reminded me for all the world of a pin-table machine clocking up a record-breaking score.

Among the gadgets were to be found:-

Concealed turn-table lighting which came on automatically on raising the lid.

A spot light beamed on the pick-up to assist needle changing.

A three-speed stroboscope lit by neon lamp to make "daylight" use more effective.

A brush fitted to the pick-up arm to sweep the record grooves before the needle reached them.

A cup for used needles from which they ran down a length of hose-pipe into a large internally fitted container — for easy and less frequent emptying.

Clock-controlled on/off switch.

Scratch filter.

Extension speaker network for maintaining different volume levels on each extension.

Remote volume control operated from beside the telephone.

A front-door-bell indicator.

Room intercommunication system.

Magic eye in a masked recess.

Coloured dial-lamps for the 4 wavebands.

Push-button tuning.

Tone control ganged to switch-in tweeter when set to maximum top.

This list by no means catalogues *all* the gadgets. Indeed, only by the hardest thinking could I imagine any device he had not included. That, I finally decided, was a press-button which would blow a note of disapproval in the broadcast studio to signify the radio artiste, or items, which he did not like!

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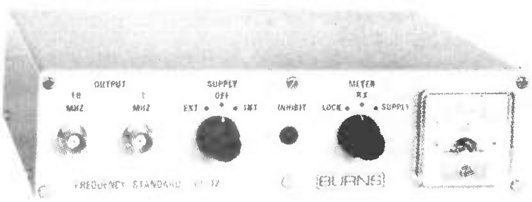

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FEATURES

★ Works with any existing narrow-band FM receiver or transceiver without modification. The only connections required are to the external speaker and antenna jacks.
★ Gives a clear directional readout on a circular array of sixteen bright green LEDs.
★ Easy to use and install.
★ Only a single coaxial cable needed between display unit and antenna combiner.
★ Broadband from 20 to 200 MHz, operating frequency determined by the chosen antennas and receiver.
★ Magmount option for combiner unit.

APPLICATIONS in which Model DF is already being used successfully include: finding PMR transceivers with stuck microphones, locating pirate transmitters, tracking mobile transmitters of various kinds, location of anti-social CB or amateur radio users (see review in "Citizens Band", January, 1983), retrieving stolen transceivers. Existing customers include both professionals and hobbyists.

COMBINER UNIT MAIN UNIT

SYSTEM DETAILS

A complete system comprises display unit and antenna combiner plus four antennas mounted at the corners of a square spaced apart by 0.05 to 0.3 wavelengths.

For fixed station use, four dipoles are suitable while four magnetically mounted quarter wave whips are ideal for mobile use. Depending on the choice of antenna, the system will operate from 20 to 200 MHz.

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* Basic System (model DF display unit with Model DFA1 combiner) £149.00 + VAT (£171.35)

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Reception Reports

Compiled by
Keith Hamer & Garry Smith

What a treat for the DX-er January turned out to be! The excellent Quadrantids meteor-shower at the beginning of the month produced signals as high as channels E5(175.25MHz) and E6(182.25MHz) in Band III during the first four days. Sporadic-E reception was well represented during the first half of the month with signal strengths as good as anything received during the summer. Fortunately most reception was positively identified which made the log more interesting and complete. On the 22nd, an excellent tropospheric lift produced signals throughout all the television bands, much to the displeasure of domestic viewers! Those magic words "co-channel interference" were heard on more than one occasion on the BBC channels. So, to celebrate the first birthday of this DX-TV column, here is the log for January in full:-

1/1/83: Unidentified programmes from 2000 onwards via Meteor-Shower(MS) on channels R1 and E5/R6.

2/1/83: Unidentified progs on E5/R6 via MS throughout the day; MTV (Hungary) on R1 with a film from 1505 until 1620 Sporadic-E (SpE), BRT(Belgium) on channel E10 with the PM5544 test card (weak trops).

3/1/83: TVP(Poland) R1 with the PM5544; CST(Czechoslovakia) R1 with the "EZO"-type electronic test card with the identification "RS-KH"; ORF-(Austria) E2a and the "ORF FS 1" PM5544; SR(Sweden) E3 on PM5544 test card carrying "TV 1 SVERIGE" ident; unidentified stations on R1,E3,E5/R6 and E6 throughout the evening via SpE and MS.

4.1.83: CST R1;NOS(Netherlands) with the "PTT-NED 1." PM5544 via weak trops; unidentified signals on E3 and E5/R6 via MS.

5/1/83: CST R1;MTV R1 with the frequency-grating test pattern; NOS E4.

6/1/83: Unidentified educational prog with female announcer on R1;NOS E29.

7/1/83: TSS(USSR) with news prog via strong SpE; unidentified progs on R1 via SpE.

8/1/83: Various signals via MS and SpE.

10/1/83: TSS "0249" monoscopic test card on R1;CST "RS-KH" test card on R1; ORF E2a(MS); TDF(France) with "Antenne 2" progs on E39 and FR-3 progs on E42; NOS E4; BRT E10 via trops.

11/1/83: Unidentified signals on R1 and E4.

12/1/83: CST R1.

13/1/83: CST R1; unidentified stations on R1 and E3.

14/1/83: ORF E2a.

15/1/83: Unidentified signals throughout the day via MS on channels R1,E3 and E4.

16.1.83: Programme on E4 via MS; RTE(Eire) IH with 1st network progs via trops.

17/1/83: Signals on R1 via SpE; RTB:F(Belgium) E3 with teletext captions; RTE IH; BRT E10; A2(Antenne 2,France) E39 via trops.

18/1/83: ORF E2a(SpE);RTVE(Spain) E3 with a regional test card;MTV R1 with the frequency-grating pattern followed by the "MTV 1 BUDAPEST" PM5544; CST R1;unidentified receptioned on R1 and R2; RAI(Italy) IA with "Telegiornale" News prog via SpE; possible West German reception from ARD on E3 with a news prog via SpE.

19/1/83: PM5544 on E3 via MS;TSS R1 with the colour electronic test card; CST R1; various unidentified signals via SpE and MS on R1 and R2.

20/1/83: CST R2; ORF E2a with the PM5544 and the "ORF FS 1" monochrome Telefunken TO 5 test card.

22/1/83: RTB:F E8,E11;RTE clock caption and progs on IH;ARD(West Germany) E10,E9,E11;TDF "Antenne 2" PM5544 on E39;NOS E39;DDR:F(East Germany) with progs on E12;CST with news prog followed by closedown sequence at 2345 GMT on channels R10 and R11 in SECAM colour! All reception on this day via tropospheric ducting.

23/1/83: From 0730 GMT:ZDF(West Germany) E33 with the 'Ostfriesland' transmitter identification caption (known as "Senderdias"), 'Pfurzheim' E34 caption, 'Ludenscheid' caption on E37;ARD with the "WDR 3" FuBK test card on E40;NOS E39 with the "PTT-NED 1" PM5544 but with the EBU Bar on E5,E45,E55,E27 and E32; TDF on E42 with the "TDF FR3" PM5544; ARD E44 and E55 with the "SW3 BADN" FuBK test card and "WDR 3" FuBK on E46, E48 and E50; Belgium on E52 with the "RTB:F 1" PM5544 plus the identification "PROFONDEVILLE CANAL 52"; A2 PM5544 on E21,E22; TDF E27 with the first network PM5544 carrying the ident "TDF tf 1"; RTB:F E28 with the "WAVRE CANAL 28" PM5544; CST on R10 and R11(!) with progs; RTB:F E11 with the "LEGLISE CANAL 11" PM5544; ARD E10 and the "NDR 1 ON" FuBK; ZDF "Saarbrucken" transmitter ident caption; ARD "WDR 1" FuBK E9; ZDF "Monschau" ident caption E21; ARD "SWF BADN 1" FuBK(from Sudwestfunk) on E10;DDR:F test card followed by progs on E5,E6 and E12; ARD on E8 from Hessischer Rundfunk with the "hrl-8" FuBK; E43 "BRT TV 1" PM5544;E49 "BR MCHN 3.PROGRAMM" FuBK from Bavarian Television based in Munich; E50 "hr3 FFTM" FuBK with a large superimposed digital clock from West Germany; "DR.DANMARK" PM5544 on channel E10 from Denmark. All reception logged above was via enhanced trop conditions which were due to an anticyclone of 1038mbs centred over Europe.

24/1/83: West German and Dutch reception noted via trops on UHF.

25/1/83: French and Belgian trops plus unidentified signals on R2 and E3 via MS.

27/1/83: TVP on R1 with the PM5544 displaying the usual dark background; RTB:F E3 with sample teletext pages plus the PM5544; various progs on R2.

28/1/83: TVP R1.

30/1/83: Unidentified science prog on R1 via SpE.

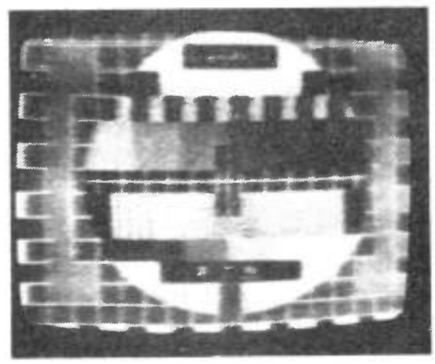
Service Information

Greece: A new transmitter has been brought into service on channel E33 with an ERP of 160kW. The outlet is located at Plaka-Alexandroupolis.

France: A new law will bring about changes to the state-owned television networks operated by Telediffusion de France(TDF). Regional television programmes, which are currently the responsibility of France-Regions 3, will be produced by local companies.

USA: The CBS network has applied to the FCC for permission to experiment with a high-definition television broadcast(HDTV) satellite system to operate in the 12-GHz band. Four geostationary satellites are envisaged to provide nationwide coverage.

Zimbabwe: The Zimbabwe Broadcasting Corporation is planning to install new equipment to provide a greater proportion of the population with a television signal. Four 1-kW transmitters have already been ordered. Despite



Satellite reception of Moroccan Television (RTM). Photograph by courtesy of Hugh Cocks (East Sussex).

various rumours, programmes produced by ZTV at Zimbabwe's two television centres (Harare and Bulawayo) will continue to be broadcast in PAL rather than SECAM.

Band I: The Future

There is speculation that the UK 405-line television service will close down completely by January 31st 1984. At the moment, many transmitters are working on reduced power and, on occasions, have not been switched on until about 0830, much to the annoyance of anyone wishing to see Breakfast television on this system! Unfortunately the future of Band I (and Band III) looks bleak for the DX-TV enthusiast. This is because various two-way communication lobbyists are determined to have their own way rather than the bands be re-allocated for local television use as sensibly suggested by the IBA. A recent report by the Merriman Committee suggested that the bands should be re-used mainly for land mobile services with provisions for outside broadcast links, electronic news gathering and a 6-metre amateur radio band around 50MHz, the latter being the most puzzling suggestion of the lot. Oh, and let's not forget the cordless 'phones which still operate illegally on 49MHz. The Committee is issuing its final report in June of this year so hopefully we will have more information on how DX-TV will be affected.

Television throughout Europe operates on internationally agreed channels between 48MHz and 68MHz in Band I and 175MHz to 230MHz in Band III. Band I concerns enthusiasts mostly because the majority of DX is received within this spectrum. We hope that the Merriman Committee is considering the allocation of frequencies outside these limits (especially in Band I) for the proposed services if only to prevent interference throughout Europe during Sporadic-E activity. It is worth noting that it is relatively easy to remove an interfering vision or sound carrier from a wanted television signal but it isn't quite so simple to remove a multitude of narrow-band communication signals from a television signal!

While we support amateur radio as a hobby, we feel that the 6-metre band is being welcomed in the UK for the wrong reasons. Frequencies around 50MHz provide interesting propagation studies: Sporadic-E sees to that. Unfortunately, SpE propagation is usually limited to approximately 1,100 miles and as these frequencies are reserved for television broadcasting in Europe, where will the 6-metre signals come from? One may indeed ask: Is it hoped that 6 metres will be widely used throughout Europe within the next few years? On the credit side, amateurs in Southern England will be able to work Scotland and, on rare occasions, trans-Atlantic stations.

The 6-metre band can only therefore become just another crowded amateur band for use within the UK.

Reception Reports

Andrew Webster(Billinge, near Wigan) intends to construct a 3-element wideband Band I array for the forthcoming Sporadic-E season. At present he uses a pair of crossed dipoles, these being phased by means of a wideband coupling unit. During the enhanced trops he saw Luxembourg using the FuBK test card on channel E27 with "ECOUTEZ RTL" identification. It is interesting to note that this particular channel transmits PAL colour on System B while the E21 outlet radiates SECAM on the French System L. Many West German transmitters were on test card during the morning of the 23rd and positive identifications included Sudwestfunk (SWF BADN 1) on E11 and E32, Westdeutsches Fernsehen (WDR 1) on E9 and E32 and the West German second network Zweites Deutsches Fernsehen(ZDF) on E35 and E37 Belgian test patterns were also seen with RTB:F 1 identification from Liege (channel E3), Wavre(E8) and Leglise (E11). The Flemish network (BRT) was also seen from the Wavre outlet on E10.

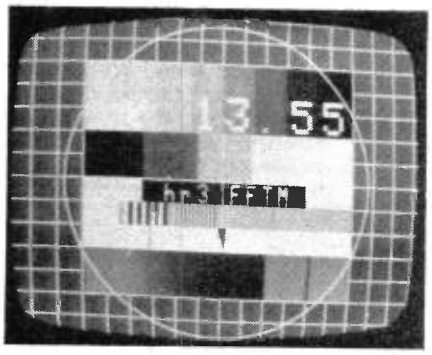
Dave Taylor(Eastwood, Nottinghamshire) has successfully constructed a DX-TV converter which feeds a standard UHF receiver. The output of the DX tuner is fed via a G8 selectivity filter, which is peaked to reduce the IF bandwidth, to an upconverter stage. A further advantage of the system is the ease with which video recordings may be made of DX reception since the output of the converter is at UHF. We hope to give full details of such a conversion system shortly.

Roger Bunney (Romsey, Hampshire) comments that East German television (DDR:F) from the Inselsberg transmitter on E5 was noiseless at times between 0800 and 1000 GMT on the 23rd, while during the evening, Denmark on E7 and E10 was noted at fair strength. He warns that Soviet television(TSS) may be received on unusual channels this coming season such as E4 on System B. This is due to the Soviet forces services in East Germany taking USSR programmes via the Gorizont satellite for re-broadcasting on System B channels.

While monitoring the R1 video frequency of 49.75MHz, Cyril Willis (Little Downham, Cambs) received someone discussing tax evasion over an illegal cordless 'phone system. The culprit has now been in contact with the supplier who has now modified the equipment to operate on the legal frequency of 47MHz. Cyril has received a variety of countries during the month such as Spain (RTVE) on E2,E3 and E4, Russia on R1, Czechoslovakia on R1 and R2, Hungary on R1 and R2, Norway (NRK) E2, Italy(RAI) on channel IA, Yugoslavia(JRT) on E3 and Finland (YLE) on E2. During the trops on the 23rd, several amateur television stations were observed on the 70-cm band(this is just below UHF channel 21), one of which originated in France using a PM5544 type of pattern. It included a digital clock in the lower rectangle and the call-sign was 'F 1EOM'.

The 7th was an impressive day for Sporadic-E reception according to Clive Athowe (Blofield, Norfolk). The Russian colour electronic test card appeared on R1 while on E2, the Spanish test pattern was noted. Later, a Russian signal was noted as high as channel R3(77.25MHz) which is unusual for a winter SpE opening. A news programme called "Aktuelle Kamera" was seen at 1730 GMT on channels R1 and R2. This originated from Estonia (EESTI-TV). This could cause some confusion as East Germany also radiate a news programme of the same name but on channels E3 and E4. At 1930 on R2 the news from Romania(TVR) appeared along with a wildlife film from Hungary on R1. A programme thought to have originated from Yugoslavia was noted via SpE on channel E3.

Finally this month, Simon Hamer (Presteigne, Powys) reports an exceptionally good trop opening with numerous stations within the UK being noted. From Europe, Simon received Belgium on channels E43 and E46, France on E29 and E48 and West Germany in Band III on E9 plus a host of UHF channels. One of the programmes included live coverage of the national lottery results, "Lotto Zahlen".

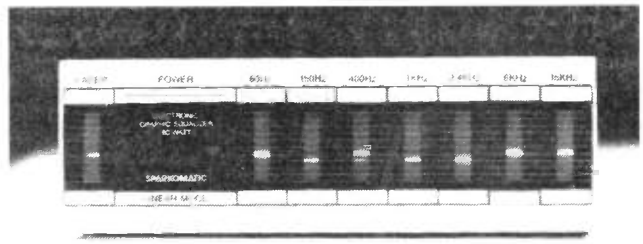


The Hessischer Rundfunk test card received in January via enhanced tropospheric conditions.

RTB:F 2 (Belgium) clock caption with forthcoming programme details.

■ R&EW

NEW PRODUCTS



Sparko Who?

The name Sparkomatic is not a name that's familiar to us Brits at present. The name suggests, perhaps some exotic ignition control system or a sophisticated spark plug. In reality though the company are America's No. 1 In Car Entertainment suppliers.

Their products are soon to be marketed over here and a massive advertising push, using magazines as diverse as 'Penthouse' and the 'Sunday Express Magazine', is a about to break. This is designed to reach some 60% of the adults in the UK and ensure that people don't react to the name Sparkomatic in the manner of our heading for this piece.

Among the wide range of in-car goodies covering everything from cassette/radio combinations to 4 way speakers taking in power boosters on the way is a fully electronic graphic equaliser.

Designated the GE70, this unit features touch controls for each of the seven frequency bands as well as for its electronic fader. A series of LEDs indicates the exact status of the unit. At about £90 the GE70 is not cheap but you get an 80 watt power booster thrown in for the money and the unit presents a very stylish appearance.

The philosophy of the Sparkomatic boys (Sparkies?) is to offer top quality prducts at competitive prices. In fact they are so sure of their quality control standards that they offer to replace any unit that develops a fault during its warranty period with 'no questions asked'.

Look out for Sparkomatic's adverts and distinctive sales displays in your local ICE store.

HeatSink Resistors

The Ashburton Resistance Company are now producing their HS range of aluminium housed power wirewounds fitted with 'moulded-in' cable terminations; designed for applications where maximum protection is required against the possiblity of shorting between termination and chassis or heat sink. They are available in six wattage sizes between 75 and 300 watts. The leads have an operating temperature range of -75 to +250°C combined with the best di-electric properties of any known flexible insulator.

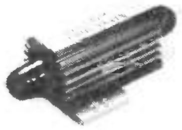
For further details:
The Ashburton Resistance Company,
Threemilestone Industrial Estate,
TRURO,
Cornwall TR4 9LG.

Knitting for Beginners

RFI Shielding announce a knitted wire material, designed to protect signal cables from either absorbing externally generated radio frequency interference or to prevent the cables from radiating interference.

The material, which comprises an open-mesh, is knitted from a single continuous wire, into a cylindrical stocking and then flattened into a two-ply tape. Shieldmesh is normally 'bandaged' onto a cable using half overlap to provide an effective four layer mesh shielding cover.

Although usually knitted from Monel wire, shieldmesh can also be supplied in Copperweld (tin-plated, copper-clad steel), aluminium, tinned copper, and stainless steel. Choice of material depends on the degree of shielding required and the environmental conditions.



Arc-de-triumph

Cambridge based Arcom Control Systems Ltd, introduce a new 16-bit single board computer that employs the power Z8001 segmented 16-bit processor and a range of Zilog Z8000 family peripheral devices.

Known as the ARC8000, the new computer has been developed in conjunction with Zilog UK Ltd, and the Department of Industry.

The ARC8000 employs the segmented Z8001 processor, running at clock speeds up to 10 MHz. There is provision on the board for four EPROMs of 2,4,8 or 16K, byte capacity giving a maximun of 64K bytes of EPROM, and for eight CMOS RAMs of 2 or 8K byte capacity giving a maximum 64K bytes of CMOS RAM.

A Zilog 8030 SCC has RS232 ports, each with its own baud rate generator capable of operating up to 1M bit/second in asynchronous or synchronous (Bisync, Monosync, SDLC and HDLC) modes. The computer can handle almost any serial protocol, with provision for encoding in NRZ, NRZI or FM and decoding for NRZ, NRZI, FM and Manchester formats. Other features included are twin baud rate generators, two phase-locked loops and provision for auto echo and local loopback.

Parallel I/O is provided on the board by a Zilog 8036 C10 with two independent 8-bit, double-buffered bidirectional input/output ports, plus 4-bit special purpose I/O port. These can be configured as a parallel printer port if required. The C10 has twenty I/O lines with many features, including four handshake modes and pattern-recognition logic. The interrupt configuration logic is extremely versatile, allowing the device to operate as a sixteen input interrupt controller if required.

There are two bus connectors on the double-eurocard sized board. One is used to interface the ARC8000 with the existing range of single-eurocard Arcom I/O boards, the second is a VME bus connector. Arcom I/O boards currently available include 8 and 12-bit A/D and D/A converters, digital I/O and high power controllers, an IEEE 488 interface and an EPROM programmer. Since these boards are available now, an industrial control system can be configured very quickly.

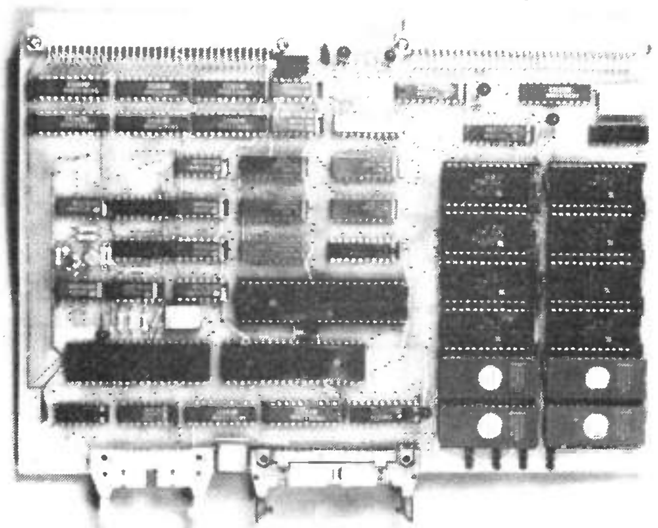
The second bus connector, which interfaces to the VME bus, allows the ARC8000 to work in multiprocessing systems with a wide range of readily available VME CPU, memory and I/O boards from several major manufacturers. The VME bus is used if the processor needs to access addresses off the board. This increases the system processing speed and reduces bus congestion.

A low-cost version of the ARC8000, without the VME bus interface, is available.

The ARC8000 single board computer is supplied with an on board monitor containing a wide range of system utilities. In addition, Zilog has licensed Arcom to supply their ZRTS real-time software package, which will be available already set up for use on the board.

Future software products will include a compiler for the BCPL system programming language.

For further information:
Zilog (UK) Ltd.,
Zilog House,
Moorbridge Road,
MAIDENHEAD,
Berks. SL6 8PL.



SUPPLIERS & SERVICES INDEX

NEW PRODUCTS

HP From Rapid

Rapid Recall can supply Hewlett-Packard's powerful 16-bit computer based on the Motorola MC68000 that has been designed for use by the professional engineer and scientist as well as for business applications.

Extremely compact and manufactured to the very highest standards, measuring only 11.1 inches high by 12.4 inches wide, it incorporates a nine inch monitor with a high resolution 300 x 400 pixel display and a full QWERTY keyboard. Memory capacity is 128K bytes as standard, expandable to 768K bytes. The HP-IB (IEEE 488-1978) interface included as standard can be used to connect up to fourteen peripheral devices, including floppy and Winchester disc drives, printers, multi-colour graphics plotters and graphics tablets. The Model 16 is fully hardware and software compatible with the recently introduced 3.5 inch floppy disc drive units (9121 family) that offer 270K bytes of formatted storage per drive.

The Model 16 is available with two high level programming languages — BASIC and PASCAL. The BASIC includes some of the characteristics found in FORTRAN and ALGOL and has excellent graphics, mathematical and extended I/O capabilities. HP PASCAL is an extension of standard PASCAL. IT includes powerful I/O and graphics procedure libraries with full peripheral support, extensive debugging capability, and access to MC68000 assembly language.

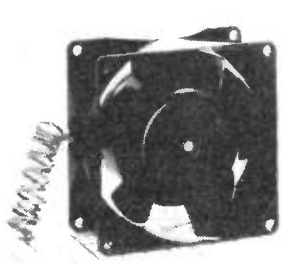
Further details of the new Series 200 Model 16 and other HP personal computer systems, from:

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

Cool It

Papst Motors introduce a 3 inch 5V DC sleeve bearing fan that has been developed for cooling applications in a wide range of electronic equipment. Known as the 8105G, it consumes only 3 watts and has a free air moving capability of 60 m^3/hr (36 cfm). An advantage of the new fan is that it has a noise level of only 38dB(A).

The noise/air moving performance of the new fan is achieved using aerodynamically designed fan blades and a venturi housing developed by Papst. The fan blades are directly attached to the external rotor of the drive motor, providing a high inertia which maintains a constant airflow, even if there are short term local variations. The 8105G has a typical life expectancy in excess of 35,000 hours even when operated at its maximum permitted ambient temperature of 65C. The motor drive shaft is mounted on sleeve bearings which, in addition, to ensuring very quiet running, require no maintenance for the life of the fan. For further information



Papst Motors Ltd.,
Parnell Court,
East Portway,
ANDOVER,
Hants. SP10 3LX.

Selective Call System

Model PTS-1 adds selective calling to existing 2 way FM radio systems cheaply and easily and is aimed primarily at CB users who want to monitor for a specific call, but do not want to listen to the multitude of other signals that abound on the 40 channels available.

With Model PTS-1 installed, the radio receiver remains silent until the desired call is received. It adds a special electronic 'label' to each transmitter in the system. Sixtyfour different 'labels' are possible, therefore the likelihood of another group in the area using the same 'label' is remote.

The receiving end of the system, silently monitors the receiver output. If the correct 'label' is not present, it keeps the receiver quiet, but as soon as the correct, pre-arranged 'label' is received, Model PTS-1 allows the squelch on the receiver to open, the desired message is then received. The squelch will remain open only as long as the 'label' is present. As soon as the 'label' disappears, the receiver's squelch will close. This means that other transmissions on the frequency that have no 'label' or an incorrect 'label' will never be received.

Setting the desired tone is easily accomplished by the user. Five DIL switches are set in the desired pattern, and are accessible to the user through a hatch at the base of the unit.

Model PTS-1 requires no batteries each unit is powered by the equipment it is used with. All connections are made via a five pin DIN socket on the base of the unit. A five pin DIN plug and multicore connecting cable is supplied with each PTS-1. The free end of the cable is connected to the user's equipment so that the PTS-1 can control the squelch, microphone circuits, etc.

A comprehensive set of installation instructions are supplied with each PTS-1. Each transmitter/receiver in the group requires one PTS-1. The price £45.99 including VAT, PTS-1 represents excellent value for money.

Datong Electronics Ltd.,
Spence Mills,
Mill Lane,
Bramley,
LEEDS LS13 3HE.

The Complete Kit

Litesold have recently introduced a complete soldering/de-soldering kit for the electronics hobbyist. The kit is centred around a high efficiency 18 watt mains iron, constructed to latest electrical standards, fitted with a 3.2mm copper bit (there are two alternative bits included 1.6 and 2.4mm):

Also provided are a reel of 3 metres of 18 SWG, solder, stainless steel tweezers, three double-ended soldering aids and a reel of de-soldering braid.

The new SK18 kit provides all that is required for soldering and de-soldering on almost any electronics project, and is ideal for beginner or expert. The kit comes in a clear PVC wallet, and is available direct from Litesold at a special mail order price of £14.55 inclusive of VAT and postage.

Further details:
Light Soldering Developments Ltd.,
97/99 Gloucester Road,
CROYDON,
Surrey CR0 2DN.

CLASSIFIED ADS

QSL CARDS printed. 50 for £9.90, 100 for £11.55, 500 for £23.35. State preferred background colour and send copy and payment to: Gainsborough Studio, P.O. Box 3, Liverpool, L10 4YY.

TRIO R1000 receiver, 200kHz — 30MHz. Complete, leads, manuals, etc. Original packing. Very little use. £275.00 plus free 40 channel CB. Phone: Telford 606451 evenings.

TRIO R1000 Communication Receiver, 0.2 to 30MHz, perfect working order, £180. Also Marconi signal generator TF 995/A AM/FM modulation 2-200MHz various mod. facilities, £120. Phone:- (Croydon) 01-657-1753.

TELEPHONE CORDS, new style, 4-way with B.T. modular plug £2.95. New style sockets, master £5, secondary £4. P&P. 50p. Jacks, terminal blocks, s.a.e. for list. M. Wallace, 35 Metcalfe Lane, Over, Cambridge, CB4 5PA.

AERIAL BOOSTERS. Improve weak radio and television reception, (indoor types) from £7.00. S.A.E. Leaflets. Electronics Mailorder, Ramsbottom, Lancashire, BL0 9AGR.

ULTRA-VIOLET EXPOSURE UNITS. Print your own photo-etch PCBs and enjoy the freedom of being able to change your circuits without ruining hours of artwork. UV-300 unit (240 x 150mm/2 x 8 watt) — £35.00 + VAT. UV-800 unit (240 x 350mm/4 x 15 watt) — £85.00 + VAT. The UV-800 is controlled by ZN1034 precision timer. Prices include UK postage. Available direct from the manufacturers: ELECTRONIC ASSISTANCE LTD., Unit 1, Brynberth Industrial Estate, Rhayader, LD6 5EN (Tel. 0597-810711).

RADIO CONSTRUCTOR. Wanted: Volumes 1 to 8 (1947 — 1955), bound or unbound. High price offered. Marcel Volery, Poste Restante, CH-8953 Dietikon/2, Switzerland.i

NEW BARGAINS. CB Radios **£15.95**. Murphy stereo cassette recorders, mains-battery, built-in microphones **£39.95**. Pen/watches **£4.99**. L.C.D. watches **£3.99**. Meters **£4.10**. 17 PCE socket sets **£3.99**. P&P 50p per order. Components/kits/tools/etc. Illustrated Catalogue 45p. S.A.E. enquiries E. Foley, 95 Albert Road, Levenshulme, Manchester.

THE BRITISH AMATEUR ELECTRONICS CLUB for all interested in electronics. Four Newsletters a year: library of technical books and magazines: help for members by experts: annual exhibition. Subscriptions only £4.50 per year, UK & Eire, if joining before 1st July 1983. Details from the Hon. Sec., J.G. Margetts, 113 South Road, Horndean, Hants., PO8 OER.

OSCILLOSCOPE C.R.T. TUBES. Dual-beam, boxed. G.E.C., Centronic types. £42.50 each inc. P&P Details, specs.,: Coventry (0203) 463999.

SANSUI SR-222 + ORTOFON VMS20EII. With Microsorber feet and 'auto-lift'. Good condition, £60 ono. Box No. REW 34.

HITACHI TRQ-299. Mains/portable cassette recorder. Tape counter, cue and review, pause and chrome switching. One year old, excellent condition £30 ono. Box No. 32.

MANUALS. For test and communications equipment. Send s.a.e. for lists. P. Mack, 14 Court Eight, Hemingway Road, Witham, Essex, CM8 2QU.

TS12OS £320. YC355D 200 MHz Counter £55. IC260E £230. MML144/100S 100W 2M linear £100. Tel: 0277-228134 after 6 p.m.

LECSON — COMPLETE SYSTEM FOR SALE. Comprising ACI control unit, APIX Power Amplifier, SFM1 tuner + HL1 Horn speakers. Superb Dynamics with effortless power. £400 ono. May split. 0277 216064 eves or wkends.

SX200N SCANNING RECEIVER. Unwanted gift, absolutely as new. £200 or will exchange good 2 metre mobile. Phone Aldershot 26732.

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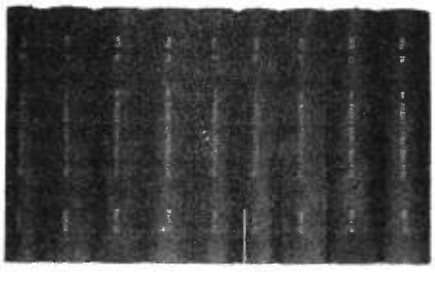

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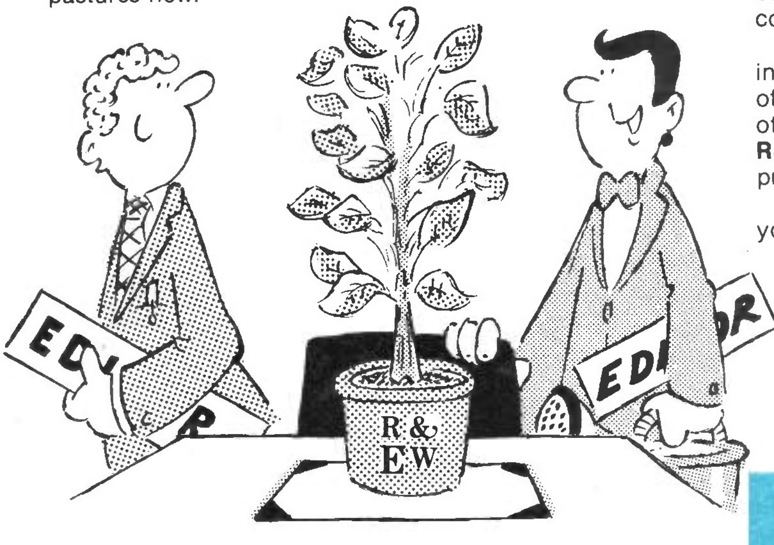
Gary Evans with the last....

R&EW has been in existence for a little over one and a half years now, although students of rewology will know that the magazine through its links with 'Radio & Electronics Constructor', can trace its history back to the early forties.

In the present revitalised form all of us at **R&EW** have aimed to give the electronics enthusiast a magazine that sets the pace rather than following the lead of other journals in the field. I have been happy to have been associated with the magazine, firstly as Assistant Editor and latterly, in charge of things, as Editor. The time has come however when I must move on to pastures new.



THE MOVING EDITOR, HAVING WRIT, MOVES ON..."

For such a young magazine to have had three Editors to date and now another change of captainship is perhaps, in publishing terms, unusual. The field of electronics is however itself, such a volatile and dynamic industry that it is perhaps, not surprising, that anybody associated with the business will be affected by the pace. Of the ten or so people involved with me on the first magazine I worked for I know of only one person who is today doing a similar sort of job for the same publishing house. When you consider that I began my journalistic endeavours only some five or six years ago, it does demonstrate that a year is a very long time in publishing.

I would also like to say that although I am moving across to take charge of another title, the rest of the **R&EW** crew will still be here continuing the task of making **R&EW** not only the complete electronics magazine but also the best in its field.

I would like to take this opportunity of thanking all those involved with me over the past year or so on **R&EW**. The names of many of them appear on our contents page but there are others that are always there in the background. As well as the **R&EW** crew I would also like to thank our distributors and our printers.

I wish **R&EW** and its staff all the best in future months and you, the reader, can rest assured — you are in good hands.

Gary Evans

LAST WORD.

Advertisers' Index

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