JULY 82

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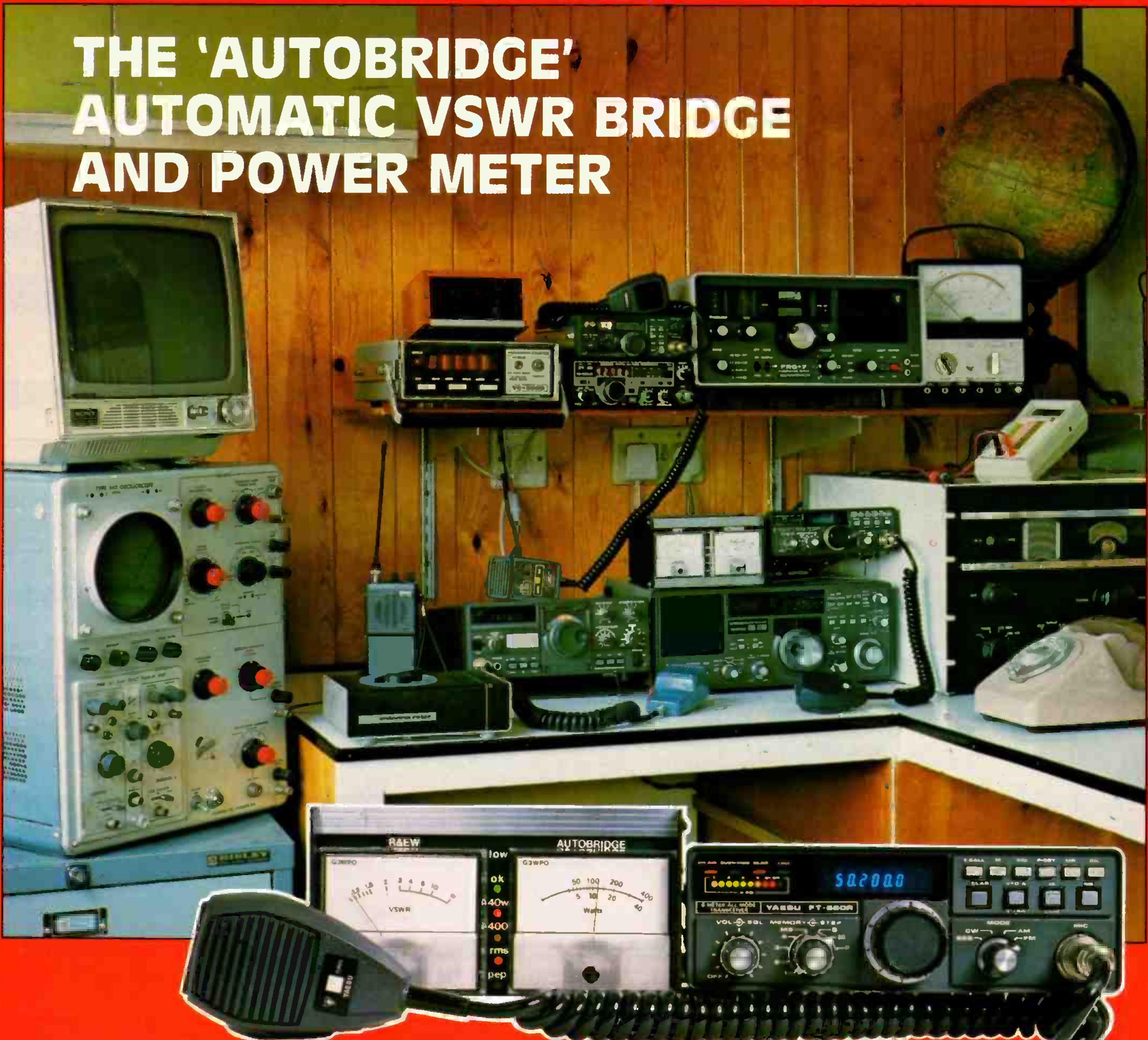
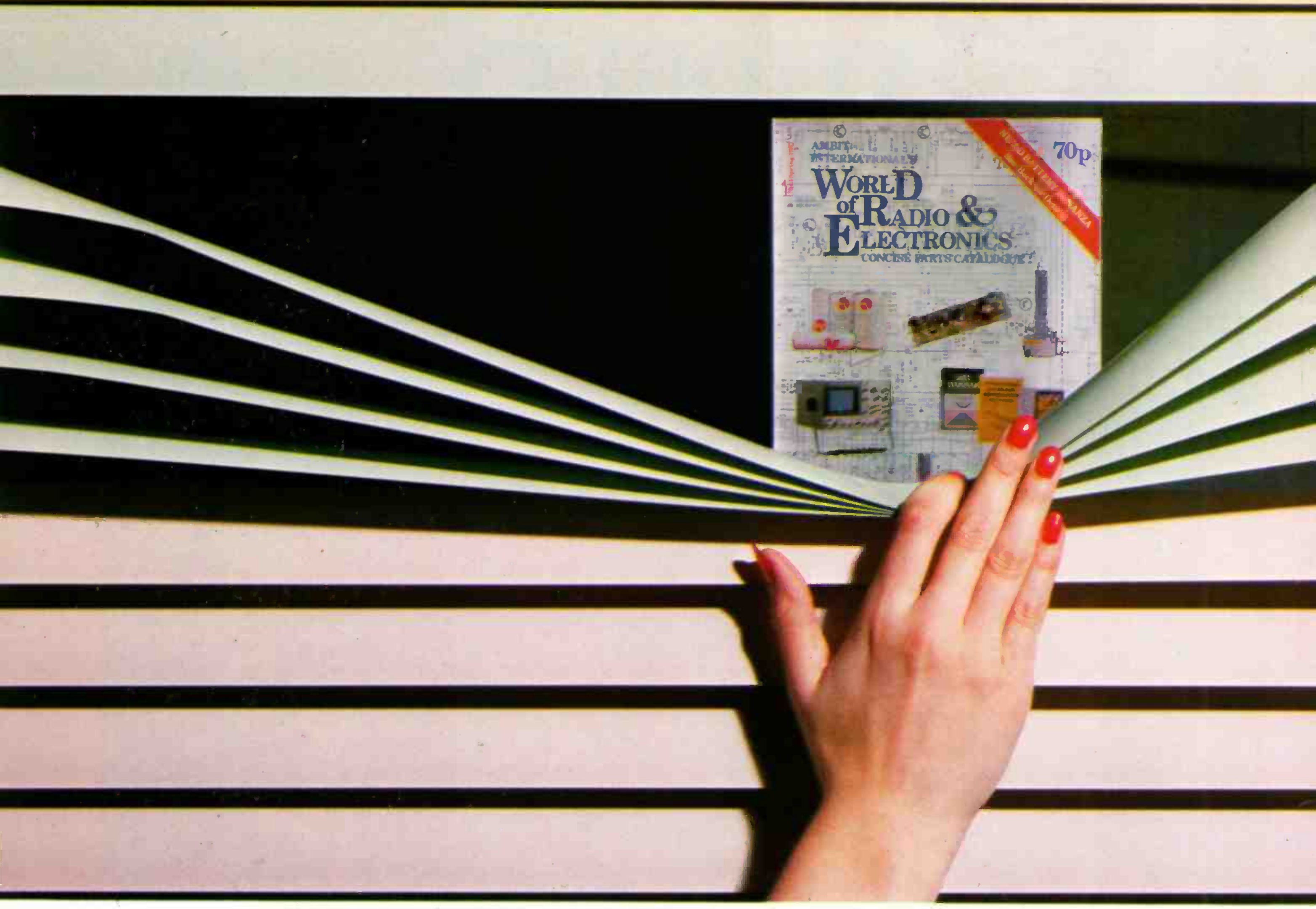


Electronic Ignition
SSB Exciter
Radio Control Receiver
Power Supplies Explained

Panasonic's RF 3100
Doppler DF System
Power MOSFET Circuits
Which Computer Do I Buy?

DISCOVER

'The World of Radio & Electronics'



The third issue of Ambit's new style concise *'price-on-the-page'* component catalogue is available now. We have listened carefully to the comments and suggestions arising from the first two issues, and are pleased to say that we have now managed to incorporate many of the aspects of stock and service policy that have been requested.

New ranges include:

'Fair-Rite' ferrite cores: toroids, baluns, tube cores, multihole ferrite beads etc., for HF/VHF RF designs. The Z8-TBDS and support systems. A new range of battery chargers, more instruments, more tools, more books, more components.

Prices have changed — in both directions, although mainly reduced. A further 3 £1 discount vouchers are included, making the initial investment of 70p immediately returnable with interest.

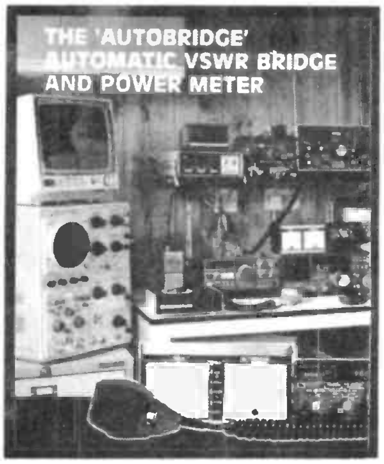
Thanks to a substantial expansion of the staff, orders are being despatched within 24 hours of receipt — and a new guaranteed *'Blue Chip'* service is available if you're in a panic at 4.30pm on a Friday.

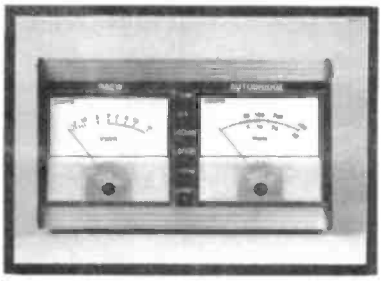
It all adds up to *more* of what you want, and *less* of what you don't want.

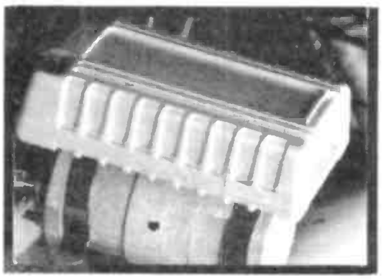
direct from:

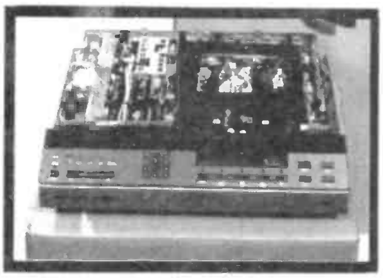
Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG

274 for further details









R&EW

JULY 1982
Volume 1 No. 10

Contents

ICOM

TRIED, TESTED AND TRUSTED

See revue in February Rad.Comm.

IC-720A
Possibly the best choice in HF. £883.inc.

The main problem that the amateur of today has to deal with is deciding just which rig out of the many excellent products available he is going to choose. Technology is advancing at such a rapid rate and getting so sophisticated that many cannot hope to keep up. Some go too far!

Perhaps one way of dealing with the problem is to look at just what each model offers in its basic form without having to lay out even more hard earned cash on "extras". The IC-720A scores very highly when looked at in this light. How many of its competitors have two VFOs as standard or a memory which can be recalled, even when on a different band to the one in use, and result in instant retuning AND BANDCHANGING of the transceiver? How many include a really excellent general coverage receiver covering all the way from 100kHz to 30MHz (with provision to transmit there also if you have the correct licence)? How many need no tuning or loading whatsoever and take great care of your PA, should you have a rotten antenna, by cutting the power back to the safe level? How many have an automatic RIT which cancels itself when the main tuning dial is moved? How many will run full power out for long periods without getting hot enough to boil an egg? How many have band data output to automatically change bands on a solid state linear AND an automatic antenna tuner unit when you are able to add these to your station?

Well you will have to do quite a bit of hunting through the pages of this magazine to find anything to approach the IC-720A. It may be just a little more expensive than some of the others – but when you remember just how good it is, and of course the excellent reputation for keeping their secondhand value you will see why your choice will have to be an IC-720A!

IC-PS15 Mains PSU £99

IC-2E £159.inc.
IC-4E £199.inc.
The World's most popular portables & now the marine version IC-M12

Nearly everybody has an IC2E – the most popular amateur transceiver in the world – now there is the 70 cm version which is every bit as good and takes the same accessories. Check the features

Fully synthesized – Covering 144 – 145.995 in 400 5KHz steps (430-439.999 4E)
Power output – 1.5W with the 9v. rechargeable battery pack as supplied – but lower or higher output available with the optional 6v or 12v packs. Rapid slide-on changing facility
BNC antenna output socket – 50 ohms for connecting to another antenna or use the Rubber Duck supplied (flexible ¼ λ whip – 4E)
Send/battery indicator – Lights during transmit but when battery power falls below 6v it does not light, indicating the need for a recharge.
Frequency selection – by thumbwheel switches, indicating the frequency. 5KHz switch – adds 5KHz to the indicated frequency
Duplex simplex Switch – gives simplex or plus 600KHz or minus 600KHz transmit (1.6MHz and listen input on 4E)
Hi-Low switch – reduces power output from 1.5W to 150mW reducing battery drain
External microphone jack – if you do not wish to use the built-in electret condenser mic an optional microphone speaker with PTT control can be used. Useful for pocket operation.
External speaker jack – for speaker or earphone. This little beauty is supplied ready to go complete with nicad battery pack, charger, rubber duck

A full range of accessories in stock.		£ p			
ICML1	10W mobile booster for IC2E	49 00	BC25	Mains charger as supplied	4 25
BP5	11 volt battery pack	30 00	DC1	12 volt adapter pack	8 40
BP4	Empty battery case for 6 x AA cells	5 80	HM9	Speaker microphone	12 00
BP3	Standard battery pack	17 70	CP1	Mobile charging lead	3 20
BP2	6 volt pack	22 00	IC123	cases each	3 60
BC30	Base charger for above	39 00		All prices include VAT	

The IC4E is going to revolutionise 70 CM!

ICOM

Free carriage on direct sales – call us.

Remember we also stock Yaesu, Jaybeam, Datong, Welz, G-Whip, Western, TAL, Bearcat, RSGB Publications.

See us at ELVASTON CASTLE RALLY JUNE 13th

Please note: Access Barclaycard owners – goods must be sent to address registered with credit card company

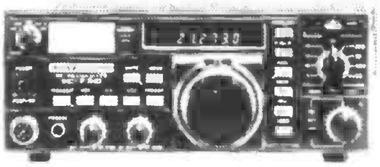
155 for further details

IC-290E £366./IC-490E £445.inc.
Multimode mobiles
290E-144-146 MHz/490E-430-440 MHz

IOW RF ouput on SSB, CW and FM. Standard and non-standard repeater shifts. 5 memories and priority channel.

Memory scan and band scan, controlled at front panel or microphone. Two VFO's LED S-meter 25KHz and 1KHz on FM-1KHz and 100KHz tuning steps on SSB. Instant listen input for repeaters.

IC-730 **The best for mobile or economy base station**
£586.inc.



ICOM's answer to your HF mobile problems – the IC-730. This new 80m-10m, 8 band transceiver offers 100W output on SSB, AM and CW. Outstanding receiver performance is achieved by an up-conversion system using a high IF of 39MHz offering excellent image and IF interference rejection, high sensitivity and above all, wide dynamic range. Built in Pass Band Shift allows you to continuously adjust the centre frequency of the IF pass band virtually eliminating close channel interference. Dual VFO's with 10Hz and 1KHz steps allows effortless tuning and what's more a memory is provided for one channel per band. Further convenience circuits are provided such as Noise Blanker, Vox, CW Monitor, APC and SWR Detector to name a few. A built in Speech Processor boosts talk power on transmit and a switchable RF Pre-Amp is a boon on todays crowded bands. Full metering WWV reception and connections for transverter and linear control almost completes the IC-730's impressive facilities.

IC-251 £499.inc.
IC-451 £630.inc.
Great Base Stations

ICOM produce a perfect trio in the UHF base station range, ranging from 6 Meters through 2 Meters to 70 cms. Unfortunately you are not able to benefit from the 6m product in this country, but you CAN own the IC-251E for your 2 Meter station and the 451E for 70 cms.

Both are really well designed and engineered multi-mode transceivers capable of being operated from either the mains or a 12 volt supply. Both contain such exciting features as scan facilities, automatic selection of the correct repeater shift for the band concerned, full normal and reverse repeater operation, tuning rate selection according to the mode in use, VOX on SSB continuous power adjustment capability on FM and 3 memory channels. Of course they are both fitted with a crystal controlled tone burst and have twin VFO's as have most of ICOM's fully synthesized transceivers.

IC-24G
Low-priced mobile
£169.inc.

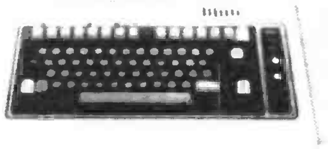
The famous IC-240 has been improved, given a face lift and renamed the IC-24G. Many thousands of 240's are in use, and its popularity is due in part to simplicity of operation, high receiver sensitivity and superb audio on TX and RX. The new IC-24G has these and other features. Full 80 channels (at 25kHz spacing) are available and readout is by channel number – selected by easy to operate press button thumbwheel switches. This readout can clearly be seen in the brightest of sunlight. Duplex and reverse duplex is provided along with a 12½ KHz upshift, should the new channel spacing be necessary.

Well worth thinking about!

IC-25E
The Tiny Tiger
£239.inc.

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

Tono RTTY and CW computers
7000E-£550/9000E-£650inc.

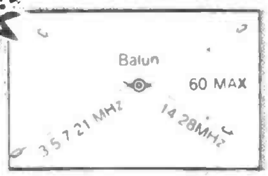


The TONO range of communication computers take a lot of beating when it comes to trying to read RTTY and CW in the noise. Others don't always quite make it!

Check the many facilities offered before you buy – especially look at the 9000E which also throws in a Word Processor. Previous ads have told you quite a lot about these products – but why not call us for further information and a brochure?

LOOK!

A new Trap Dipole!



The MT-240X Multi-band trap dipole antenna (80m – 10m) is a superbly constructed antenna with its own Balun incorporated in the centre insulator with an SO239 connector. Separate elements of multi-stranded heavy duty copper wire are used for 80-40-15 and 20-10 Metres. Really one up on its competitors. £49.50 inc. VAT

Thanet Electronics

143 Reculver Road, Herne Bay, Kent. Tel: 02273 63859. Telex 965179

Agents (phone first – all evening weekends only except Scotland)
Scotland – Jack GM8 GEC 031 657-2430 (daytime)
031 665-2420 (evenings)
Midlands – Tony G8AVH 021 329-2305
Wales – Tony GW3 FKO 0874 2772 or
0874 3992
North West – Gordon G3LEQ Knutsford (0565) 4040
ansaphone available

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Comment

R&EW is enormously flattered by the wry comments and positive reactions of several magazines that consider themselves the targets of our marketing drives. Is it our imagination, or do some (certainly not all) of the 'competitors' appear to have made a conscious effort to improve their standards and try to supply more interesting material?

Finance for Industry

Last month's 'News Background' mentioned that we were conducting some investigations into the various schemes run by the DOI to encourage the use of microelectronics in industry. Well, we have only just made 'contact' with the appropriate departments, and are endeavouring to gather information in the next few weeks.

We are also compiling a broader report on enterprise finance by submitting a couple of carefully prepared 'trial' proposals to a series of financial institutions to assess their reactions. If you have any recent experience in trying to raise funds for a high technology project, then we would be pleased to hear from you (in complete confidence). We have prepared a brief questionnaire that will help us assess the attitudes of those purporting to offer 'risk' capital.

The Unacceptable Face

The subject of the misuse of technology by 'the military' has long been a favourite subject of comment and correspondence in the technical press. No doubt recent events will bring forth another surge on the subject.

Perhaps the most tasteless sideline on the whole industry has been the recently reported glee of one of the executives of a French arms manufacturer. The demonstrable success of his wares will undoubtedly lead to full order books, but perhaps we might have expected that every one concerned with the Argentinian affair would refrain from gloating over the supremity of their electronic technology in this particular area.

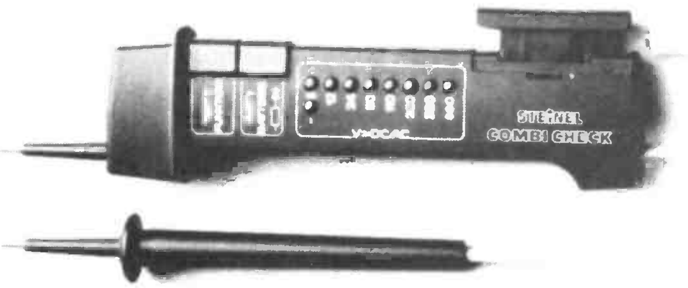
Personal Finance

As a consequence of the recent increase in our cover price we have been forced to increase our Subscription rate as of this issue.

Many people prefer to buy their copy of **R&EW** from the local newsagent. A form on which you can place a regular order for the magazine, making sure that you receive every copy, appears on page 55.

If you have any difficulty in obtaining **R&EW** perhaps you could write and let us know and we'll do our best to make sure that we get to your part of the world in future.

NEW PRODUCTS



Quick Check

The Steinel Combi-Check is a versatile voltage test probe that does not load the circuit under test by virtue of its high-resistance. The device incorporates its own voltage source and offers the following facilities:

AC voltage detection of 6/12/24/50/110/220/380/660V
Phase-to-ground testing
DC voltage detection
Polarity testing
Continuity testing
Diode testing

An extremely rugged instrument that, apart from limited resolution, can perform most of the tasks undertaken with a multimeter. For further details contact

Steinel UK
Unit 9
Small Heath Trading Estate
Armoury Road
Birmingham B11 2RS Circle 1

A Free Service

Circle 2

It is rather strange to find anything given away for nothing in these days, but a free service is now being provided by the National Wireless Museum in the Isle of Wight!

A very large collection of old workshop manuals, service-sheets, and wiring diagrams — dealing with tape-recorders as well as radios and television-sets — has been donated to the Museum by the widow of an electronic engineer.

If any reader is in dire need of technical information on a very old set, (such as the one which Great Aunt Agatha loves because of its beautiful "mellow tone") they should contact the Museum's hon curator:

Douglas Byrne, G3KPO, whose telephone number is Ryde 62513.

CMOS in Plastic

All the inherent advantages of MOSPOWER have now been encapsulated in eight n-channel and one p-channel Siliconix MOSPOWER FETs available in TO-92 and TO-237 packages. The new MOS devices designed to interface between logic circuits and power peripheral devices, can be driven direct from CMOS, TTL, DTL and MOS logic families and so afford more efficient and compact system design. Applications include use as high-speed line drivers, transformer drivers, LED digit strobe drivers also relay and solenoid drivers.

These new TO-92/TO-237 packaged devices feature the same characteristics and system cost saving features as larger MOSPOWER transistors: high switching speed (typically 10nS turn-on and turn-off times), operation at high frequencies which permits the use of smaller inductors and capacitors with resultant savings in size, weight and cost. The low threshold voltage and high input impedance of MOSPOWER, freedom from secondary breakdown, the ability to parallel several devices without current hogging are all features that result in simpler, more compact, efficient and economic system designs.

John Edwards
Siliconix Limited
Morriston
Swansea SA6 6NE Circle 3

Switch Modes

Now available from BICC-Vero Packaging are a range of six switched-mode power supplies designed for the internationally accepted KM6 sub-rack system. The new range of supplies, consisting of four single-output units, one dual-output unit and one triple-output unit, are plug-in modules which are fully compatible with sub-racks to the DIN 41494 specification.

All the supplies offer high efficiencies of 60-75%, and all use a ventilated aluminium plug-in unit with an integral heatsink, giving good heat dissipation and air ventilation. The use of switched-mode techniques means that the units are compact and light, and the extra efficiency makes them more economical than linear-regulated supplies for ratings of 25W or more.

The five units available and their voltage and current outputs are: Monovolt 25W, 5V/5A; Monovolt 50W, 5V/10A or 15V/3.2A; Monovolt 100W, 5V/20A; Bivolt 30W, adjustable +/—5-15V, 1A; and Trivolt 55W, 5V/5A and +/—5-15V/1A.

The range of power supplies includes features such as remote sensing and overvoltage and overcurrent protection, and all units incorporate either an H1 or H15 type DIN 41612 connector with leading earth pin.

Details from:

John Bush
BICC-Vero Packaging
Industrial Estate
Chandlers Ford
Eastleigh
Hants SO5 3ZR
Telephone 0794 5727 Circle 4

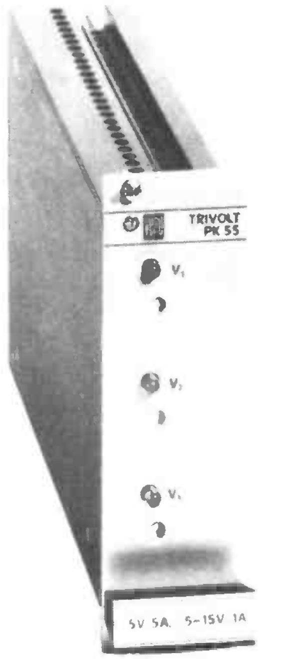
In Control

The Motorola TDA1285 together with a triac, provides all the functions necessary for speed control of universal (AC series) motors. Although primarily aimed for domestic appliances, the TDA1285 is equally useful for power tool motor control, and a wide range of other applications.

The device features Hall effect and inductive sensor capabilities due to a built-in sensor current source and an on-chip frequency to voltage converter.

Other important features are:
— Direct drive from AC line
— Full wave triac drive
— Controlled motor starting acceleration
— Repeated trigger pulse, if triac fails to latch.

The Literature Centre
Motorola Semiconductors
88 Tanners Drive
Blakelands
Milton Keynes Circle 5



Speaker's Corner

Celestion has published a Handbook of Loudspeaker Designs for professional musicians and sound engineers who like, for reasons of individual preference or economy, to build their own speaker cabinets.

Typical applications of the Celestion designs will be in stage PA systems, clubs and discos.

The handbook contains detailed design drawings, construction guides and performance indicators for more than a dozen professional cabinet types. Included are several bass housings, guitar cabinets, tweeter and mid-range boxes, and specialised units such as a tweeter wedge monitor that's used for 'foldback', enabling musicians behind the main PA stacks to hear all instruments and vocals clearly.

The 28 pages of the Celestion handbook also contain specific advice on cabinet construction do's and don'ts; a list of UK companies that supply cabinet finishing accessories; the tables of Thiele-Small parameters for loudspeaker performance, compiled from papers to the AES; and planner guides for both closed and vented boxes which indicate the suitability of Celestion power range drive units for variously sized cabinets.

The Celestion Cabinet Handbook is available at £1.00 plus postage from

David Inman
Celestion International
Ditton Works
Foxhall Road
Ipswich
Suffolk Circle 6

NEW PRODUCTS ~ COMPUTING

COMMODORE CHOSE THE recent Hanover Fair to introduce ten new products to their range of computers and peripherals. These ranged from a 'sub-VIC-20' games orientated machine to a top of the range business machine designated the 720.

VIC-10

Starting at the low end of the range and then working our way up, the first new machine is the VIC-10. This is described as a 'games computer and music synthesiser'.

The machine features a new Video Interface Chip, the 6566. This gives the machine a powerful hi-res. colour graphics capability (320 x 200 pixel), normal alpha display being a 40 x 25 line format.

Sound generation is taken care of by an IC rejoicing under the delightful name of SID. This provides three voices, each with a nine octave range — waveshape, envelope generation, and oscillator synchronization are all under software control. Also inbuilt is a programmable filter which is independently selectable for each voice with low pass, high pass and band pass characteristics available.

The VIC-10 does not feature an integral BASIC, however a mini BASIC is available as a plug-in cartridge. Cartridges will also be available with games and music packages along the lines of the Atari range.

The keyboard is of a touch sensitive design as featured on the Atari 400/Sinclair ZX81.

The machine, with 2.5K of user RAM will cost about £100 and is due for launch in September.

VIC-30

The VIC-30 is an up-market version of the familiar VIC-20 that features the new 6566 Video Chip and SID device of the VIC-10 as well as a 20K ROM operating system and 16K of RAM.

The keyboard is that of the VIC-20. A full typewriter keyboard that is comfortable to use.

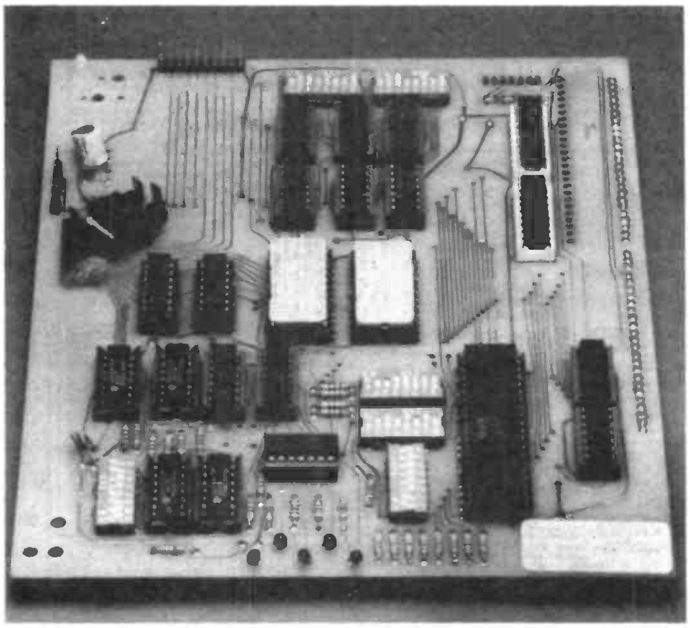
The machine can also be used in conjunction with any of the peripherals designed for the 20, devices such as the 1515/1525 printers, 1540 disk drives, joysticks/light pens etc.

The VIC-30 is to be priced around the £250 mark and is due for launch in January '83.

Commodore 64

The Commodore 64 machine is best described as a VIC-30 plus. The additions to the 30's spec' include a 64K RAM complement, the ability to accept a second processor, e.g. a Z80 to run CP/M and the fact that the machine's memory map can be re-organised to allow software written for other 40column' Commodore machines to be run on the 64.

The price is to be around £400 with launch due in October.



The Keynet Hardware.

Commodore 720

The 720 is the top of the range of this latest batch of new designs from Commodore. It has been designed to meet the new IEC specifications and boasts an 80 x 25 monitor screen as an integral part of the machine together with a keyboard that can be detached and moved away from the 720's main body.

Twin in-built floppy drives, 256K RAM DMA plus the communications facilities and second processor slot of the 500 series make the 720 a very attractive 'business' computer.

At around the £1,500 mark the 720 will be on stream around September.

Commodore 500 Range

The progress up the specification table is continued with the 500 range, a series of machines with internal memory capacities ranging from 64K to 256K.

Based on the 6509 processor and featuring the same video and sound IC's as the machines above, the 500 displays all the graphics and sound facilities of the smaller machines. This range of computers is however aimed at the 'systems' market and features full IEEE488 and RS232C facilities enabling their use with a wide variety of peripherals.

A slot for a second processor board is also part of the series' basic spec. Thus the machines can run under CP/M and other operating systems.

Available from September, the price for a minimal machine (the 510) is to be £695.

And the Rest

The new products slot into the existing Commodore range (VIC-20, 4000 series and 8000 series) giving Commodore a market base that offers a design for most peoples needs from low cost games applications at £100 to sophisticated office needs at £1,500. The range also includes a range of peripherals from the 8300 printer, a Diablo 630 based unit featuring an IEEE interface, to the 9060/9090 Hard Disk Drives.

KEYNET

Commodore's KEYNET is a local networking system that allows as many as 200 systems to be linked over distances as great as 1.8Km. KEYNET has been designed as a low cost, flexible system that is easy to install in any 4000 series machine or the 8032. Some 2000 series computers can be used — the system will be available for the 8096 and VIC-20 later in the year.

KEYNET consists of a single PCB for each computer in the network, these being identical except for EPROM's and switch settings. Most operations are handled by EPROM firmware with some simple software being used in conjunction with shared files.

Any of Commodore's range of peripherals can be used with a KEYNET network.

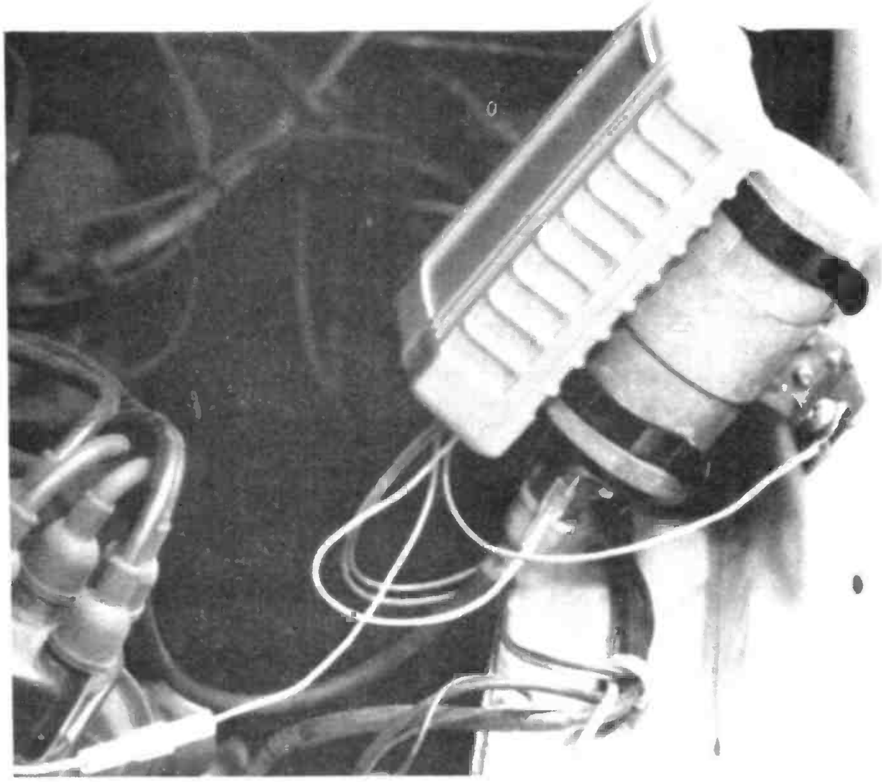
In use one computer is designated 'master' and the other, 'slaves'. Any one of the models mentioned above can be the master computer of the network, with different models able to be included in the same net.

The KEYNET PCB is easy to install in any computer and is not too expensive at around £200 for a single unit.

266 for further details

ELECTRONIC IGNITION

The ultimate in electronic ignition systems — design by EDA Sparkrite.



The ignition unit mounts conveniently on the vehicle's coil

THE BENEFITS OF electronic ignition systems in terms of increased performance and economy together with more reliable starting are widely recognised with such units now being fitted as original equipment to many of today's cars. The **R&EW** electronic ignition will allow any 12V negative ground car not so endowed to be brought into the 'electronic age'.

The design is fully supported by a kit of parts that ensures that the finished unit exhibits the ruggedness required if it is to give reliable performance in the harsh environment found in a vehicle's engine compartment.

POWERFUL PERFORMANCE

The unit features a Hall effect sensor which, together with a magnetic cam, replaces the vehicles contact breaker ('points') although, thanks to special current limiting circuitry, it can be triggered by existing contact breakers.

The three position switch on the ignition allows the device to be switched off, a useful security device or to be run in inductive or reactive modes.

In the inductive mode operation is much the same as a standard system except that the contact breakers are replaced by the Hall effect sensor and an 'electronic switch'. This mode of operation is designed as a back up system should the reactive system fail.

In the reactive mode an invertor provides a high energy pulse to the primary side of the coil providing a correspondingly energetic spark to the plugs.

The ignition is straightforward to install, the kit contains a range of triggerhead adaptors to fit most makes of car plus mounting hardware that allows the main unit to be quickly attached to the vehicle's coil.

Restoring normal operation should you wish to transfer the unit to another car or, in the unlikely event of complete failure, is also a speedy task.

CONSTRUCTION

In view of the specialised nature of many of the components we most strongly recommend that the unit is constructed using the kit of parts. This contains all the detailed instructions concerning the building of the kit which takes a couple of hours.

When complete the kit is given a coat of varnish, to prevent the ingress of moisture, and after this had dried, is fitted in the die-cast box ready for installation in the vehicle.

The first task here is to fit the trigger-head using the adaptor plates supplied in the kit. After that it is only necessary to make another five connections and the unit is ready for use.

IN USE

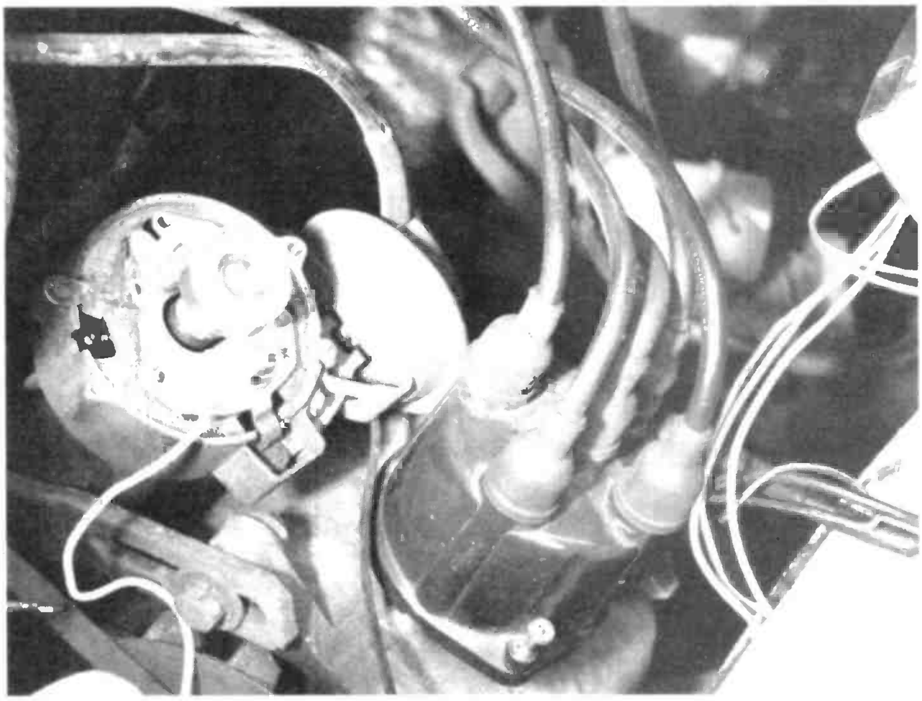
Assuming the unit is functioning correctly, the status lights of the ignition will illuminate and the inverter transformer will emit a high pitched whistle.

The static timing light of the ignition means that the vehicle's timing can be quickly and easily checked on completion of the unit's installation.

Many ignitions built to this design are in use and have proved reliable over many thousands of motoring miles.

ROUNDING OFF

The improvement in performance, the savings in fuel and the fact that adjusting the points becomes a thing of the past, make the electronic ignition an investment that will pay for itself over a relatively short period of time.



Close up view of the triggerhead mounted on the distributor.

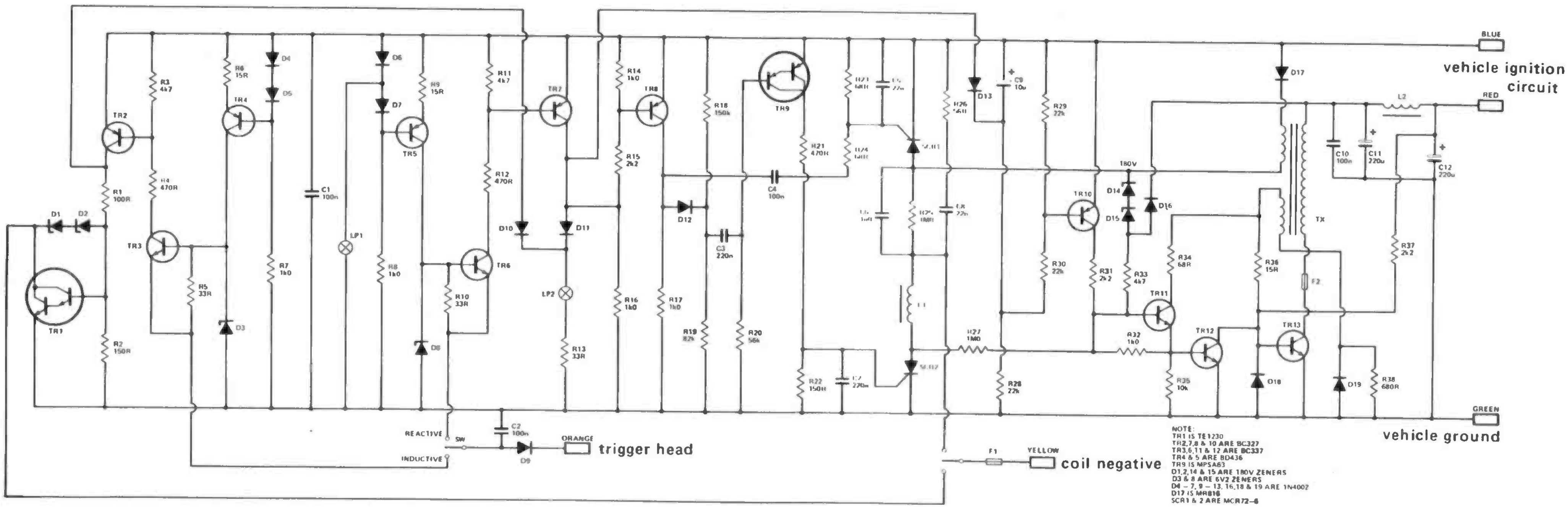


Figure 1: The full circuit diagram of the electronic ignition system.

CIRCUIT DESCRIPTION

The ignition will function in two modes, reactive in which an inverter provides a high voltage pulse to the vehicle's coil and inductive in which operation is much the same as a conventional system with the exception that the contact breaker is replaced by a Hall effect triggerhead and transistor switch.

Consider the three-position switch to be in the 'inductive' position. The triggerhead, one side of which is connected to earth through its fixings, works in such a way that when a magnetic south pole is adjacent to the front face, the current flowing in its lead is typically 35 mA, higher than the quiescent current which at all other times lies between 5 mA and 10 mA. The higher current corresponds to the 'on' state of the triggerhead and the quiescent current corresponds to the 'off' state; the typical currents given depend to some extent upon the triggerhead being supplied with a substantially constant voltage of about 5 volts.

The triggerhead derives its supply via D9, included to reduce the risk of damage due to incorrect connection of the triggerhead's lead, and the supply is decoupled by C2.

In the 'inductive' switch position, the current flows through R5, a resistor connected in parallel with the base-emitter junction of TR3. Approximately 0V7 is required across the base-emitter junction to turn TR3 'on', corresponding to approximately 21 mA. Hence when the triggerhead is in the 'on' state, TR3 must be 'on' also, and when the triggerhead is in the 'off' state, TR3 is 'off'.

Zener diode D3 maintains the voltage at the base of TR3 at 6V2, and allowing for the voltage drop in the base-emitter junction and D9, the supply voltage to the triggerhead remains at about 5V. The current for the triggerhead is derived from a constant current source based around TR4. Because the voltage dropped in D4, D5 and the base-emitter junction of TR4 is substantially constant, the voltage across R6 is constant and in consequence the current flowing through the transistor is also constant. This current is about 50 mA.

When TR3 is 'on', current flows through R4, turning TR2 'on' which, in turn, passes current through R1 to the base of the power Darlington transistor TR1 thus turning TR1 'on' also. The timing light LP2 is connected to TR2 collector via D10 and illuminates; R13 reduces the peak current in the bulb to a manageable value. The collector of TR1 is connected via the switch and a fuse to the negative terminal of the ignition coil. Hence when TR1 is 'on', current flows through the ignition coil.

When the triggerhead goes to the 'off' state, TR3, TR2 and TR1 turn 'off' simultaneously. The timing light extinguishes and the ignition coil produces a spark. A 'back EMF' appears at the collector of TR1 and in order to prevent damage to the transistor, zener diodes D1 and D2 damp this voltage when it reaches 360 volts by turning TR1 'on' momentarily.

Contact breakers can be used to trigger the circuit because of the effect of the constant current source TR4 preventing damage to current sensing transistor TR3 even though the triggerhead lead is effectively connected to earth (0 volts) when the contact breakers are closed.

In the 'reactive' position of the switch, the input circuitry is much the same as the 'inductive' circuitry with the exception that current for the function light LP1 is drawn through diode D6. The current source function is performed by TR5 and current sensing is performed by TR6; TR7 corresponds to TR2. When the triggerehead is 'on', TR7 is 'on' and the timing light is illuminated. The collector voltage of TR7 is close to the positive supply voltage and hence TR8 will be off; TR10 is also 'off', C9 being discharged by D13. The function of TR10 will be explained later.

When TR8 goes to the 'off' state, its collector voltage falls to OV. Diode D12 becomes reverse-biased and ceases conduction; (C4 charges through R17, R23 and R24 and eventually reaches the supply rail voltage). The potential divider network R18, R19 reaches equilibrium when C3 has charged through the base-emitter junction of TR9 (as this is a Darlington transistor, the base-emitter voltage will be about 1.4 volts in the 'on' state). As TR9 is turned 'on' and saturated because of current flowing in R20, SCR2 is turned 'on'. Capacitor C7 is included to reduce problems due to mis-triggering often associated with high rates of charge of voltage at the anode of the thyristor. The anode electrode is connected via L1 to the negative side of the ignition coil and hence current flows through the coil primary.

When the triggerhead turns 'off', and hence TR8 turns 'on', D12 conducts and hence the charge on C3 causes the base junction of TR9 to be raised momentarily above the voltage at the supply rail. This turns TR9 'off' for a period, and gate drive is removed from SCR2 for this period, thus allowing SCR2 to turn 'off' when commutated (when the anode-cathode junction voltage falls to zero or the device becomes reverse-biased). The charge on C4 is passed through the gate-cathode junction of SCR1, turning on the thyristor; C5 prevents spurious triggering.

Now consider the circuit surrounding power transistor TR13. Connected to its collector via fuse link F2 is the primary winding of the ferrite-cored transformer; the other side of the primary is connected to the positive supply rail via a smoothing filter network C10-C11-L2-C12 which prevents high-frequency electrical noise appearing on the battery supply. Assuming that, initially, TR12 is in the 'off' state, TR13 derives a small base current from the positive supply via R37. This causes the collector current to increase at a rate dependent upon the supply voltage and the inductance of the primary winding of the transformer. A feedback winding, connected to the base of TR13 through wire-wound resistor R36, is so arranged to increase the base current; in consequence D19 must be forward biased at this moment. In the early stages of conduction TR13 is driven into saturation and the primary winding supports almost the full supply voltage. A point is reached, however, at which the product of current gain (hfe) of TR13 and its base current equals the collector current and the collector current can no longer increase. This causes a reduction in base current and so TR13 very rapidly comes out of saturation and turns 'off'. The voltage across the feedback winding reverses polarity, D19 becomes reverse biased and R38 increases the time constant of the feedback network while TR13 is 'off'. To prevent the base-emitter junction of TR13 from being damaged, D18 conducts.

At the point when TR13 turns 'off', there is a large quantity of stored magnetic energy in the core of the transformer. A high-voltage pulse appears on the secondary winding, causing D17 to conduct and raising the voltage of the other side of the winding. This side is connected directly to C6 and consequently C6 charges such that the side connected to the anode of SCR1 is positive relative to the side connected to L1. If SCR2 is 'on' the charging current of C6 passes through it; if SCR2 is 'off', C6 is charged through the ignition coil. Mis-triggering of the thyristors due to the high inductance of the ignition coil allowing high voltage 'spikes' to appear from the oscillator is prevented by network R26-C8 which is included to suppress excessive rates of change of voltage.

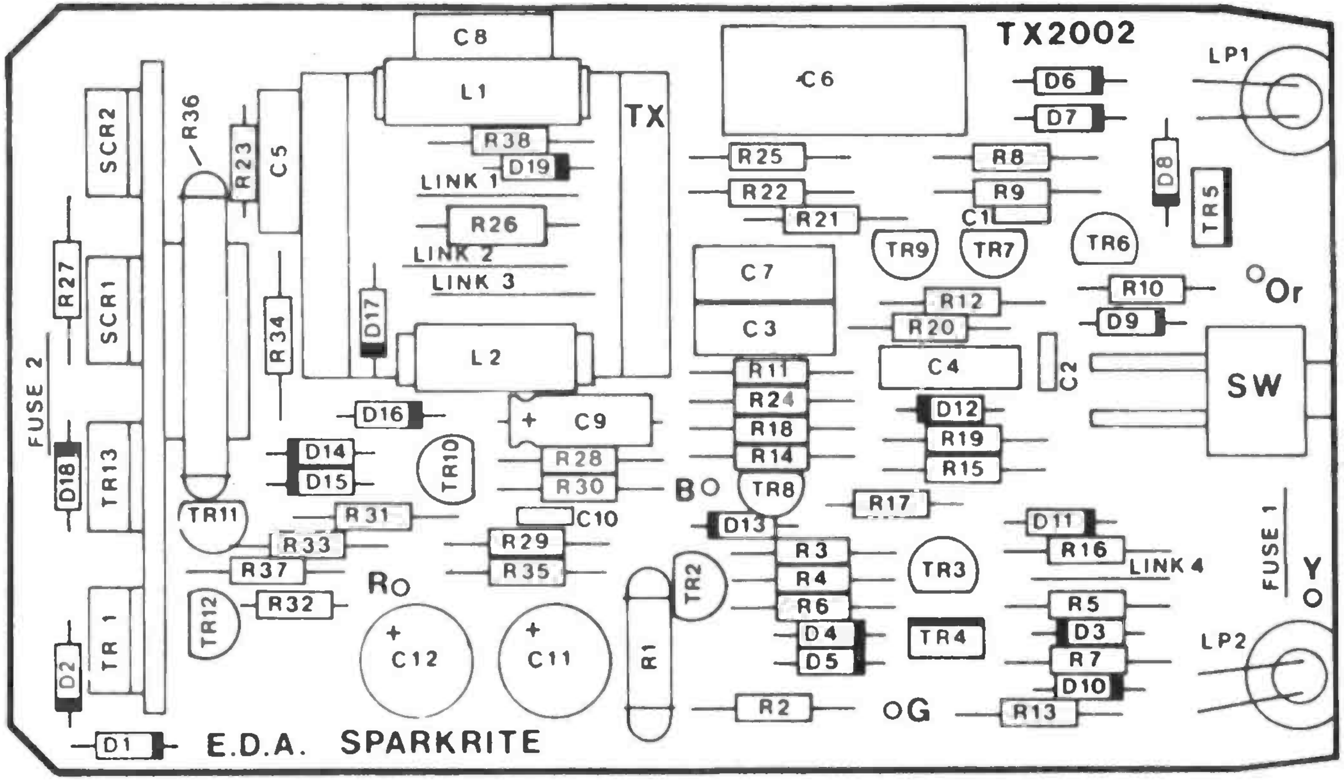


Figure 2: The PCB overlay for the ignition. Note the board design is copyright EDA Sparkrite.

PARTS LIST

Resistors (all .25W 5% unless stated)

R1	100R, 3W wirewound
R2,22	150R
R3,11,33	4k7
R4,12,21	470R
R5,10,13	33R
R6,9	15R
R7,8,14,16,17,32	1k
R15,31,37	2k2
R18	150k
R19	82k
R20	56k
R23,24,34	68R
R26	56R
R25,27	1M
R28,29,30	22k
R35	10k
R36	15R 5W wirewound
R38	680R

Capacitors

C1,2,10	100n ceramic
C3,7	220n polyester
C4	100n polyester
C5	22n polyester 400V
C6	1u0 400V
C8	22n metallised paper 400V
C9	10u 40V electrolytic
C11,12	220u 25V electrolytic

Semiconductors

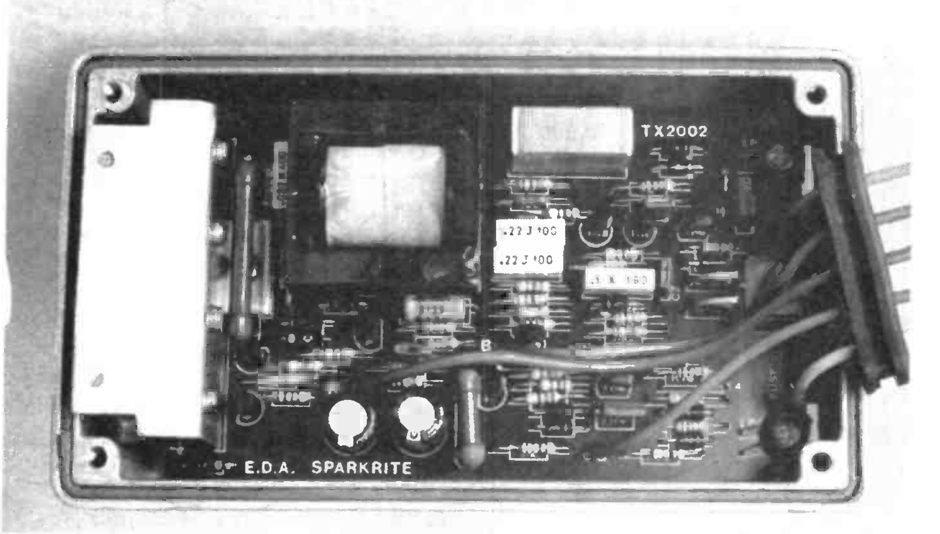
TR1	TE1230
TR2,7,8,10	BC327
TR3,6,11,12	BC337
TR4,5	BD436
TR9	MPSA63
TR13	TE1412
SCR1,2	MCR72-6
D1,2,14,15	180V zener
D3,8	6.2V zener
D4,5,6,7,9,10,11,12,13,16,18,19	IN4002
D17	MR816

Inductors

L1	17 turns 0.8mm enamelled copper wire on 3/16" ferrite core.
L2	26 turns 0.6mm enamelled copper wire on 3/16" ferrite core.

Miscellaneous

Inverter transformer, 14V 80mA bulbs, DPCO centre off switch, fuse links, PCB, connecting wires, die-cast case, mounting hardware etc.



primary and the negative terminal voltage rises to a positive potential governed by the characteristics of the ignition coil and its lead to the spark plug. Thus SCR1 commutates at the peak of the positive voltage, the inverter starts up again, and the process is set to repeat for the next spark.

When the triggerhead is 'off' or when the switch is in the 'inductive' or 'off' positions, TR6 and TR7 are 'off' and C9 charges through R28. After a short time delay, TR10 turns 'on' which turns 'on' TR11 and shuts down the inverter as previously described. As soon as TR7 turns 'on' again, C9 is discharged quickly by D13 and the inverter is allowed to oscillate; at moderate spark rates C9 cannot charge enough to turn TR10 'on' and hence the inverter can run continuously. Resistor R27 is included as a safeguard should the lead to the negative side of the coil become disconnected while the inverter is operative and prevents the voltage on the lead from rising to a very high value.

■ R & EW

The oscillator (or inverter, as it is known) will provide charging pulses to C6 until D14 and D15 start to conduct at approximately 360 volts. When this occurs, TR11 turns 'on', turning TR12 'on' and thus shunting the base drive from TR13 to the OV line. The inverter shuts down until the output voltage falls below that which is required to turn the zener diodes 'on' and hence the output voltage is regulated to about 360V. When the supply to the unit is switched off, R25 discharges C6 slowly to prevent electric shock. Diode D16 conducts if TR11 or TR12 fails, as a 'last ditch' safety measure.

Reverting to the two thyristors, when the triggerhead is 'on', SCR2 is 'on' and SCR1 is 'off' and the ignition and coil passes current from the positive side of the ignition supply through SCR2; meanwhile C6 charges to 360 volts. When the triggerhead switches 'off', gate drive is removed from SCR2 and SCR1 turns 'on'.

Immediately SCR1 anode voltage falls from +360V to about +15V and hence C6 forces the coil negative terminal voltage to about —345 volts for an instant. This forces SCR2 to turn 'off' rapidly and induces a very high voltage in the secondary of the ignition coil. Inductor L1 limits the rate of change of current in SCR2 during the turn-off period to a safe value. While SCR1 is 'on', the output of the inverter is short-circuited and cannot continue oscillating until SCR1 commutates. Capacitor C6 discharges through the coil

A complete kit of parts for the project is available from EDA Sparkrite at 82 Bath StreetWalsall, West Midlands — their code for the unit is TX2002 and the price is £29.95 incl.

Your Reactions..........	Circle No.
Immediately Interesting	74
Possible application	75
Not interested in this topic	76
Bad feature/space waster	77

FEEDBACK

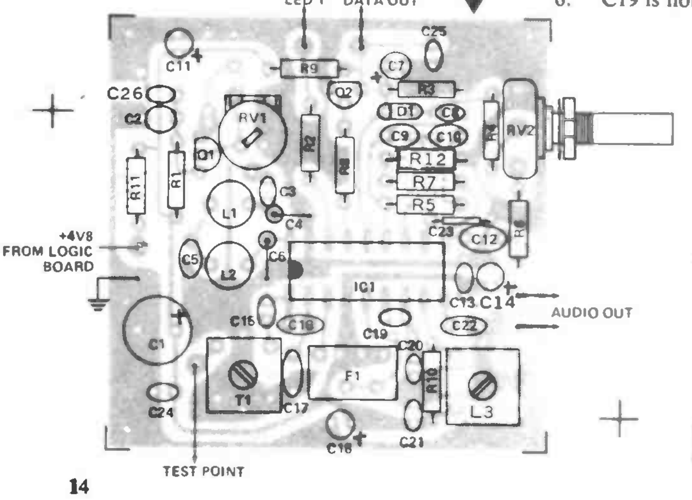
APRIL '82

HIGH PERFORMANCE 2 METRE PRE-AMP

On the circuit diagram *Fig 4* the values of C1 and C2 are interchanged as are the valves of C4 and C5. Also the (4:1) overlay of *Fig 1* is shown upside down. (See 2m Power Amplifier June '82 for correct circuit and overlay).

REWBICHRON

Correct overlay is shown in *Fig 1*. Annotated software listing is available from the **R&EW** offices at a cost of £10 a price that includes a royalty to the author.



MAY '82

UOSAT RECEIVER

1. T1 should be fitted in such a way that the high impedance winding connects to the filter, F2. Fit the transformer with the three pin winding facing F2.
2. R27 is labelled C27 on component overlay.
3. C33 should be 220n polyester on component list.
4. R11 should be 1k0 when using a ULN3859.
5. C16 is a 1n0 polystyrene.
6. C19 is not fitted.

4 CHANNEL DIGITAL PROPORTIONAL RC SYSTEM PART 1

Corrected overlay shown as *Fig 2*.

JUNE '82

2M POWER AMPLIFIER

On the circuit diagram (*Fig 3*) the 100R 2.5W resistor shown as R6 should in fact be R8, and the 10R resistor in series with C12 is R4. Also the low pass filter comprising C22, L8 and C23 was omitted, it goes between RL2 and the antenna connection. For DC switching from an FT290 C15 is replaced with a link, and D2 by 10k, this turns on Q3 during transmission.

TWO CHANNEL MAINS TIMER

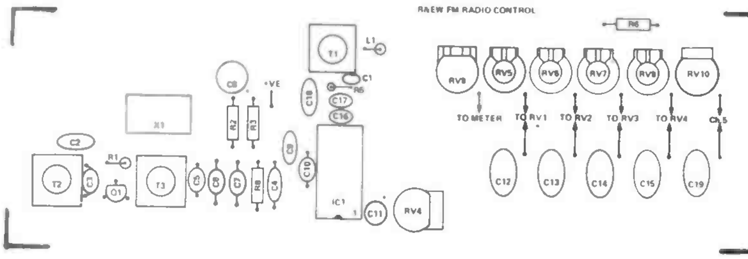
Figure 1. Capacitor from D12 anode to 0V is C4 and should be 2200uR19 should be replaced by link — PCB is correct. T1 and T2 out should be taken directly from Pins 21 and 22 of IC4.

Figure 2. Resistor from cathodes of D7 & 8 to —15V is R5.

Figure 3. C5 is 220n, unmarked capacitor on 'live' side of OTR1 is C6, 100n.

Figure 5. Diode next to C4 should be D12 (not D4).

This clears up the errors on the circuit diagram and overlays — in case of conflict with the parts list these should be taken as authority.



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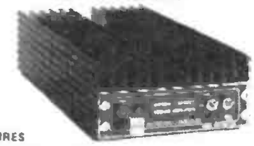

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R&EW Data Brief

HA12017

FEATURES

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LOW DISTORTION: THD = 0.002% typ. (f = 20Hz to 20kHz, Vout = 10Vrms, RIAA)
EXCELLENT SUPPLY RIPPLE REJECTION:
SVR(+Vcc) = 56dB typ. (f = 100Hz, Rg = 43)
SVR(-Vcc) = 45dB typ. (f = 100Hz, Rg = 43)

HA 12017 Low Noise — Low Distortion Preamplifier

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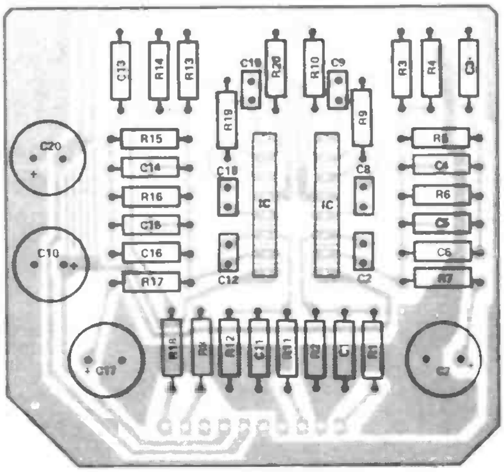
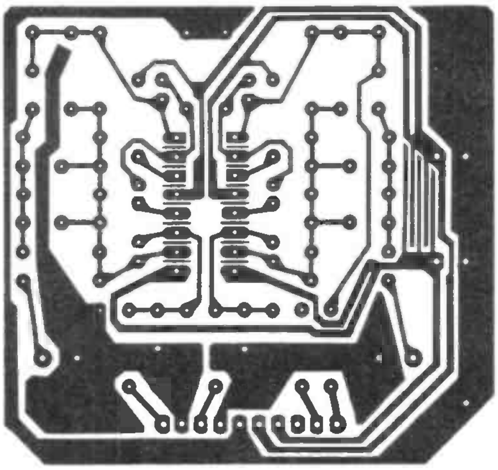
It offers a performance that compares favourably with discrete designs yet has a low external component requirement.

The combination of ultra low noise, low distortion and wide dynamic range make it suitable for the most demanding of applications.

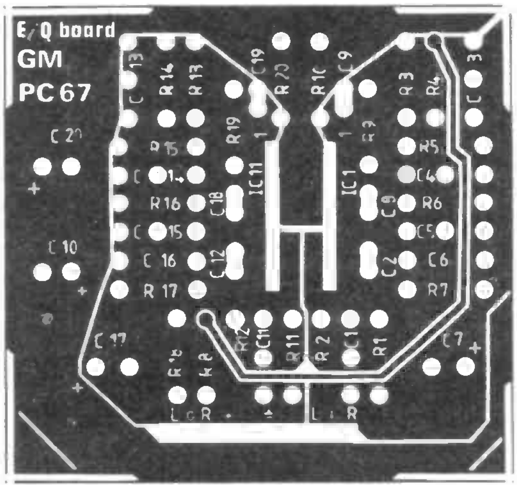
The Data Brief PCB has been designed as a plug-in module and is of small physical size all of which should make it possible to upgrade the performance of existing designs by replacing the input stages with the HA 12017 based design.

PCB Overlay

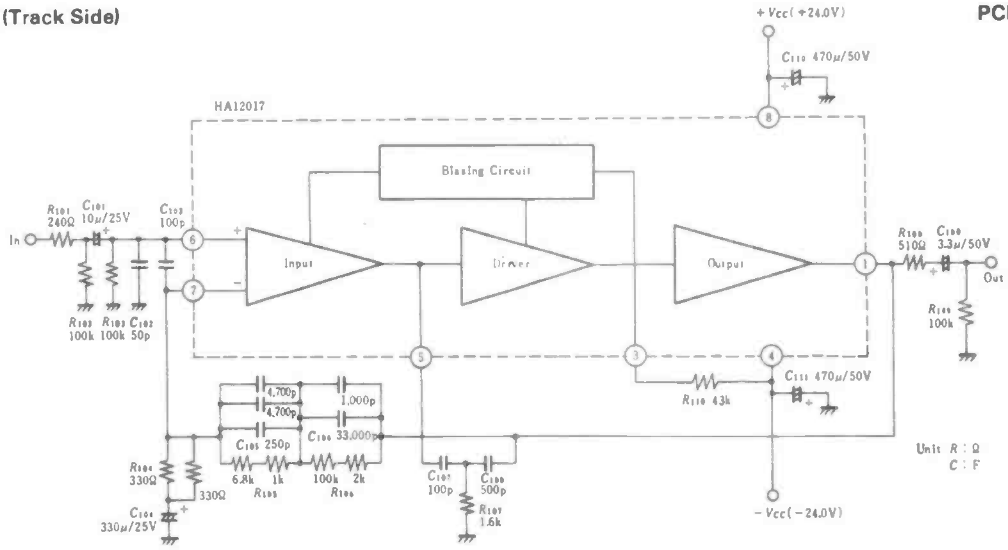




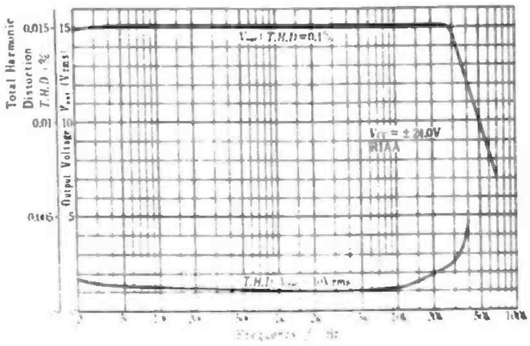
PCB Foil (Track Side)



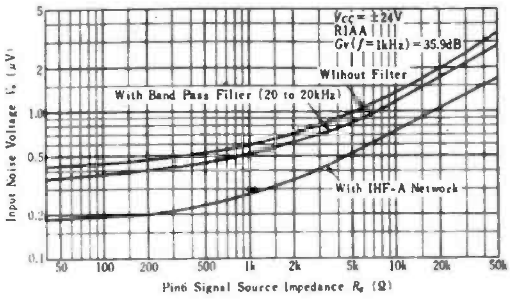
PCB Foil (Top Side)



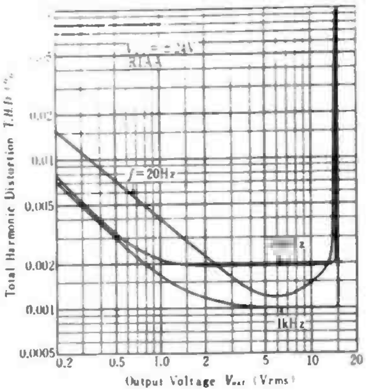
OUTPUT VOLTAGE AND TOTAL HARMONIC DISTORTION vs. FREQUENCY



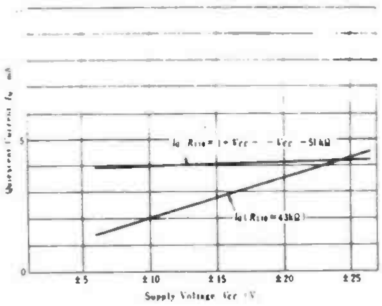
INPUT NOISE VOLTAGE vs. SOURCE IMPEDANCE



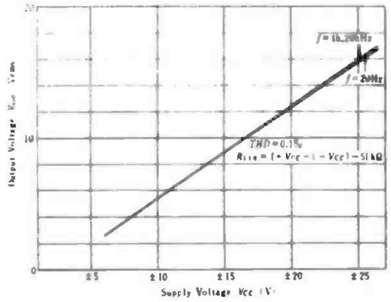
TOTAL HARMONIC DISTORTION vs. OUTPUT VOLTAGE



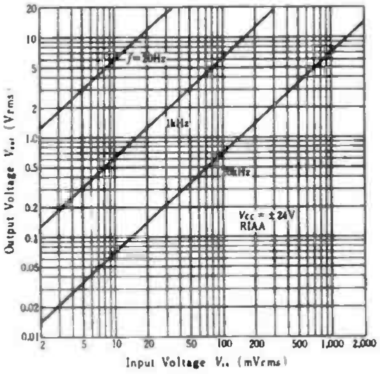
QUIESCENT CURRENT VS. SUPPLY VOLTAGE



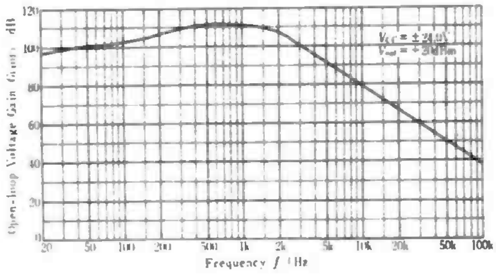
OUTPUT VOLTAGE VS. SUPPLY VOLTAGE



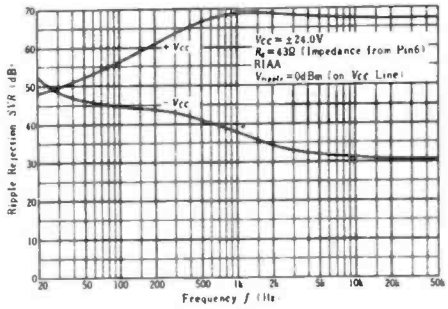
OUTPUT VOLTAGE vs. INPUT VOLTAGE



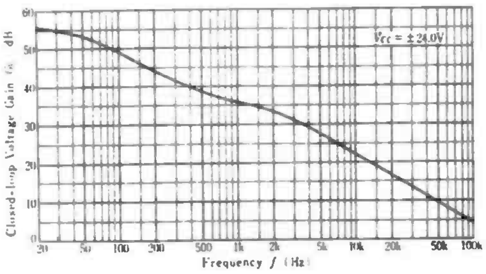
OPEN-LOOP VOLTAGE GAIN vs. FREQUENCY

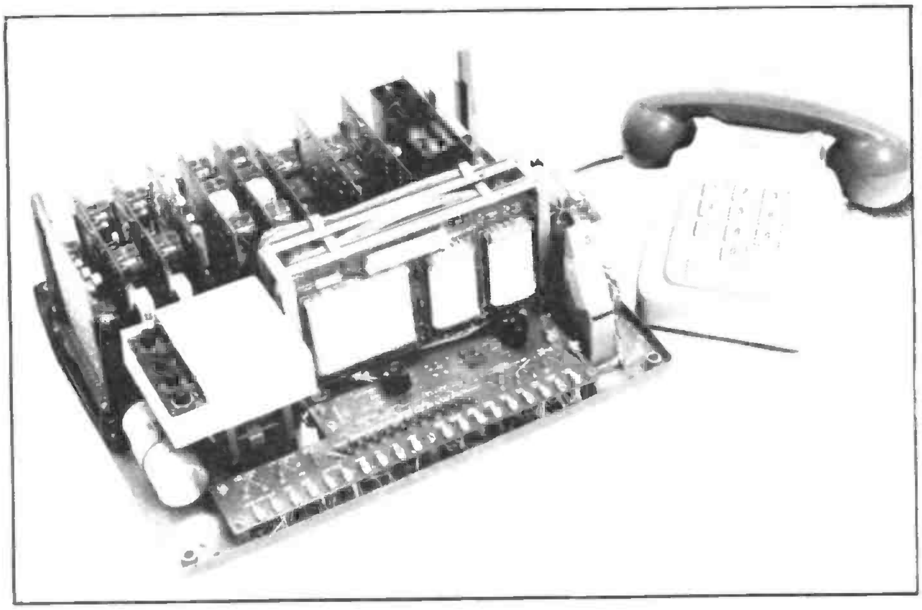


RIPPLE REJECTION VS. FREQUENCY



CLOSED-LOOP VOLTAGE GAIN vs. FREQUENCY





REWTEL

A new Prestel like service from Radio and Electronics World.

RECENT DEVELOPMENTS IN technology have made a number of electronic means of information dispersal possible. We have systems like Ceefax and Oracle which use redundant bandwidth in the public broadcast channels to convey a multipage direct access magazine, and the British Telecom based Viewdata/ Prestel system.

Unlike any previous means of information dispersal Viewdata offers an almost limitless number of 'Pages' available to anyone with a telephone-modem and a special Viewdata decoder/computer. Furthermore, it is possible to interact with the viewdata system and leave messages in the system for other users to access and view.

Whilst Viewdata would appear to be the answer to almost every modern day Caxton's dreams, a number of problems have prevented its acceptance as the be all and end all of electronic publishing, namely:

The cost to the publisher ("Information Provider" in Viewdata terminology) is rather high and requires the use of expensive, dedicated equipment to enter information into the database;

The cost to the user is high, both in terms of subscription charges, and because of the charge that is levied by the Information Provider for viewing his data. As well as the fact that a special dedicated terminal must be purchased to access and use the system (The Tantel adaptor is perhaps the best known of these costing around £170 for a 6502 based machine which connects between your telephone line and an ordinary domestic colour television giving complete access to the viewdata system).

ENTER THE MICRO

When Viewdata was originally planned it had to be based around the concept of the user having a dedicated terminal, as the technological thinking was based around receivers built out of discrete components, or maybe, if they were lucky, large lumps of LSI. Since the inception of the Viewdata service, however, the Personal Computer has arrived. This, by its very nature, is the ideal machine to convert an electronic message into a human readable form and display it on a medium such as a domestic television.

Already it is possible to buy a number of adaptors to connect certain personal computers to the Viewdata network. This approach however does not solve one or two important problems. First, the Prestel messages are encoded with graphics symbols and effects which only make sense if you have a terminal capable of responding to them. The cost of subscribing to and reading Prestel pages is still rather high. Finally, the lack of a completely broad spectrum of specialist Prestel Information providers means that if you are concerned with the Dow Jones Index, or the Futures market you will be amply satisfied, but information on the characteristics of a BF960 transistor is scarcer than supplies of piston rings for 1948 Humber Hawks.

ELECTRONIC BULLETIN BOARDS

These are very popular in the States although a number now exist in this country, particularly the Forum 80 service for Tandy machine owners. A bulletin board is where a number of computer users group together and agree a protocol for talking to a central computer at a central location using Modems. (A Modem converts the electronically encoded signal of the computer, into audio tones for transmission down the public telephone network. At the receiving end it converts the tones back into the electronic signal. Modem is a contraction of MODulator/DEModulator device.)

Most bulletin boardsystems can be accessed with a modem working at 300 baud, and a terminal capable of displaying at least 64 x 16 lines.

Also of note is the system currently being operated by Display Electronics in this country. The Display Electronics system, known as Distel, offers the chance to interrogate the Display Electronic's catalogue to find out what items are in stock, technical details about various items, and even to place an order over the telephone line using your credit card for payment. Facilities are offered to allow searching for parts by type, generic code (e.g. 7400) or by well known cross references.

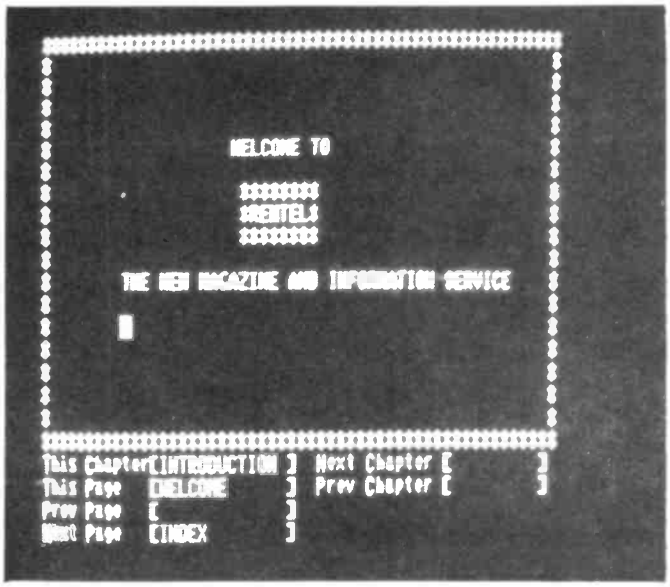
ENTER REWTEL

Every month we have to limit ourselves to a mere 500,000 characters of published information. This is far more than the monthly input, and we would dearly love to publish the rest, so we are going to, via the UK's first all electronic magazine.

The service, which from now on will be known as REWTEL, is already being implemented and by the time you read this should be available to anyone on a limited experimental basis during the proving stages (see later).

Initially, REWTEL will act as an adjunct to **R&EW**; the philosophy and structure of REWTEL is expounded upon below.

REWTEL will make available to anyone with a terminal, or a ▶



personal computer with the appropriate software and hardware plus a modem the following services:

MAGAZINE UPDATES:

Details of modifications, improvements and errors (?) in the current and previous issues of **R&EW**. Also, the virtually unlimited space in terms of pages which we can devote to REWTEL (at least 15,000 pages initially, more as time and hard disk space allow) will mean that we will be able to give greater in depth coverage of both the technical and practical aspects of the design, construction and operation of **R&EW** articles.

PRESS RELEASES:

Every month **R&EW** receives somewhere between 100-500 press releases about new products or services. Obviously, we are only able to publish the smallest proportion of these. However, with REWTEL we will be able to keep all of these on line ready for you to read at your leisure, and we will, of course, be able to catagorise them into subject groups so that you may, for instance, request to see all of the latest press releases on Single Board Computers.

In addition press releases will be flagged with a bingo card number so that you can request that further information on the product to be sent to you.

BINGO CARD FEATURES:

With REWTEL we will be able to offer a vastly improved bingo card system, offering electronic ticking of bingo cards via REWTEL so that you may respond to articles in the magazine, and REWTEL press release data, at the speed of light. As well as providing electronic ticking of bingo cards we will be trying to persuade advertisers to equip themselves with REWTEL terminals so that they may electronically discover who has requested information about their product;

USER GROUPS:

Some sections of REWTEL will be devoted to providing, information to special interest user groups. At least one of these has already been started and will be devoted to schools, colleges, etc using Z8s as the basis of educational teaching and projects.

INFORMATION EXCHANGE:

You will be able to use REWTEL to exchange information with other REWTEL users. We hope that this service will include everything from notices of club meetings, rallies, to a bring and buy sale of unwanted equipment, etc.

The REWTEL computer is already on line to our typesetter's photo-typesetting machine, allowing direct conversion of word processed documents into magazine ready photo-typesetting. To complete this chain REWTEL will allow authors to directly input their text into the computer where it can be edited by the magazine staff and page proofs sent out by return of post.

COST ACCESS AND AVAILABILITY OF REWTEL:

REWTEL will appear to the user as a large book, sub-divided into chapters and pages, each chapter will be subject-specific. Thus, typical chapters may be 'Software for TRS-80', 'Press Releases on Radio Equipment'', etc.

The access to each page is direct and under subscriber control. You can, therefore, go directly to the chapter on, say, Filter Products, without having to wade through pages of irrelevance to you at that particular moment. The cost of REWTEL will depend exactly on which of its facilities you wish to use. Thus, the magazine update and bingo ticking aspects of REWTEL will be free to any one with the right equipment who is prepared to contact REWTEL and sign on. Other services will involve the payment of subscription fees which will enable you to gain access (having paid the fee) to the service.

This may be simply an annual payment for services such as the datasheet facility or a small subscription coupled with a usage charge for other services such as the software exchange service.

For anyone who is worried by the possibility of illegal use of their REWTEL account an elaborate system of password protection is in use, and your REWTEL account should be no more accessible to an unauthorised user than your bank account.

EQUIPMENT REQUIRED

In order to access REWTEL you will need a personal computer or a standard VDU, plus either a 300 baud modem, or a Prestel like 1200/75 baud modem. The second option transmits data at approximately 4 times the speed of the 300 baud modem.

We will be publishing designs for acoustically coupled versions of both modems. This neatly avoids having to pay vast sums of money to British Telecom to have a direct coupled modem connected to your telephone line.

When you first sign on to REWTEL the REWTEL computer will ask you to define your equipment in terms of make etc. If we already know how to talk to it then REWTEL will install a special driver to talk to you, thus taking care of problems such as your screen size and cursor control characters. If not, then REWTEL will ask you enough facts to enable it to control your terminal remotely. Having signed on and determined your terminal configuration, the whole world of REWTEL will be at your disposal.

AVAILABILITY

By the time you read this the experimental version of REWTEL will be on the air. We would appreciate people giving it a 'go', so that we can obtain as much information and feedback about operating problems as possible. In order to access REWTEL during the initial phase, you will need a 300 baud modem and RS232 terminal, or a computer playing at being a terminal, capable of displaying at least 16 lines of 64 characters. Your terminal or psuedo-terminal must also support cursor up, down, right and left commands. Finally you need to know the telephone number which will be Brentwood (0277) 230936. During this first phase (approximately 4 weeks) the service will **ONLY** be available from 7 o'clock at night until 8:30 AM the following day. Don't be troubled if you can't make contact as teething troubles are bound to mean some 'down time'.

The issue after next (our birthday issue, incidentally) will contain full information of the complete REWTEL service including, we hope, final details of the costs etc., for the non-free services.

HOW YOU CAN HELP

We are looking for a band of brave volunteers, preferably within travelling distance of Brentwood, to help with the implementation of REWTEL. These people must own Personal Computers and have a good knowledge of the hardware and software aspect of their machine. We require this help to assist in writing and implementing the pseudo terminal driver software for various different personal computers. In return for their co-operation, the volunteers will receive a free REWTEL subscription plus a royalty every time the driver software for their particular machine is sold to a REWTEL user. Interested parties should write to me, Jon Burchell, c/o REWTEL, 200 North Service Road, Brentwood, Essex. ■ **R & EW**

A Doppler DF System

We look at the practical implementation of a Doppler DF system. Design by David Cunningham.*

THE RADIO DIRECTION-FINDING (RDF) system outlined last month can be broken down into a number of discrete circuit blocks. The circuit descriptions for each section of the circuit should be read in conjunction with the block diagram published last month.

ELECTRONICS CONSTRUCTION

If you wish to build the electronics from scratch, your best bet is to use wire-wrap sockets for all of the DIP integrated circuits and the discrete components (resistors, diodes, and small capacitors). Individual wire-wrap pins may be used for the larger components such as the electrolytic capacitors. All circuitry except the rf summer may be constructed on open perforated board with 0.1" spacing to accept the wire-wrap sockets. Be sure to bypass the +5 V DC using 47n or 100n disc ceramic capacitors near each of the TTL ICs and the CD4511s. Mount the 7805K regulator on a good heat sink. Be sure to use 5% resistors and either mylar or dipped mica capacitors for all of the audio filtering and digital one-shot circuits.

The rf summer circuit must be mounted in a shielded enclosure using construction practices consistent with the frequencies involved. Phono jacks work well for the antenna and receiver connectors. Keep all leads short and arrange the parts symmetricaly.

A professionally designed unit utilzing double-sided printed wiring boards with plated-through holes and an attractive enclosure is available, contact the **R&EW** project pack office for further details.

ANTENNA CONSTRUCTION

We do not have enough space within the pages of **R&EW** to describe the Antenna construction in any detail but full details are available from the **R&EW** offices.

INSTALLATION AND ADJUSTMENT

The RDF circuitry requires a 11.5 to 13.5V DC negative ground at 1 Ampere maximum. Ordinary 12V DC automobile battery power may be used, or, for fixed operation, an inexpensive 12.6V DC power supply may be used.

System interconnection without the serial interface is particularly straight forward as indicated in *Fig 8* of last month. While the external speaker connection can be used, you will probably find a more convenient connection to be the high and low ends of the receiver's volume control. This will enable the listening level of the receiver to be adjusted without affecting the audio input level to the direction finder.

The serial interface can be used in several ways Bearing data and receiver audio may be recorded simultaneously, virtually any audio tape recorder is adequate for this application because of the low baud rate and wide FSK shift used of serial data transmission. A stereo system is recommended so that the normal receiver audio (voice) information may be recorded with the bearing data.

Two systems may be connected as shown for remote data display. A switch could be installed at the central site to enable a single monitor point to display the bearing data received at two or more remote sites for triangulation. The possiblilites for more complex systems interconnects using digital processing for automatic triangulation and logging are exciting.

Calibration adjustments are very simple and should not be required after initial setup unless the antenna orientation is changed or a different receiver is used.

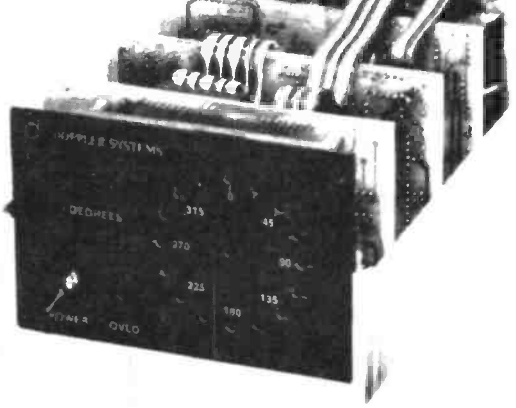
Allow the receiver and direction finder to warm up before making final calibration adjustments, however.

After setting the receiver's volume control, the direction-finder gain adjustment is made. Increase the gain until the overload LED flashes on voice peaks. (if this adjustment is very low, the display will remain blanked.) Setting is not critical, but the overload LED should blink with a duty cycle between about 10 and 50 percent during normal speech.

The direction-finder bearing control should then be adjusted so that the correct bearing is displayed for a known transmitted signal. Do not use a nearby transceiver for this calibration as local reflections are sure to result in an error. A repeater station which is within the line of sight of the antenna makes the best calibration source. Changing channels will have very little effect on system calibration, so any convenient station within the band may be used. The display should be calibrated to display bearing relative to magnetic North in a fixed station set-up and should correspond to straight ahead in a mobile application. The calibration range of the bearing control is approximately 90 degrees. If the system needs further correction, either rotate the antenna physically or switch the antenna inputs to the electronics. Be sure not to reverse the order of antenna rotation, however. The acceptable combinations for inputs A, B, C, and D are: Ant. A, Ant. B, Ant. C, Ant D; or Ant. D, Ant. A, Ant. B, Ant. C; or Ant. C, Ant. D, Ant. A, Ant. B; or Ant. B, Ant. C, Ant. D, Ant. A. See *Fig 2* for definition of antenna inputs to rf summer.

If the serial interface option is to be used, the receive frequency adjustment can be can be made by recording a few minutes of data, then playing it back in the Remote Display Mode while making this adjustment. Note the control settings where invalid data occur, then set the control midway between these settings. If valid data is received up to one of the ends of the control adjustment, use the end point as the invalid data point. The setting of this control is not very critical.

Accuracy tests have been performed using fixed-signal sources and a fixed-receiving site to eliminate changing reflection paths. The antenna was rotated on a calibrated turnstile and errors measured between the true bearing and the displayed bearing. These were generally well within 5 degrees except when the transmitted audio was unusually loud or deepvoiced. Even in those cases, better bearing data could be obtained by mentally averaging the displayed data. ▶



* This article first appeared in '73 magazine!

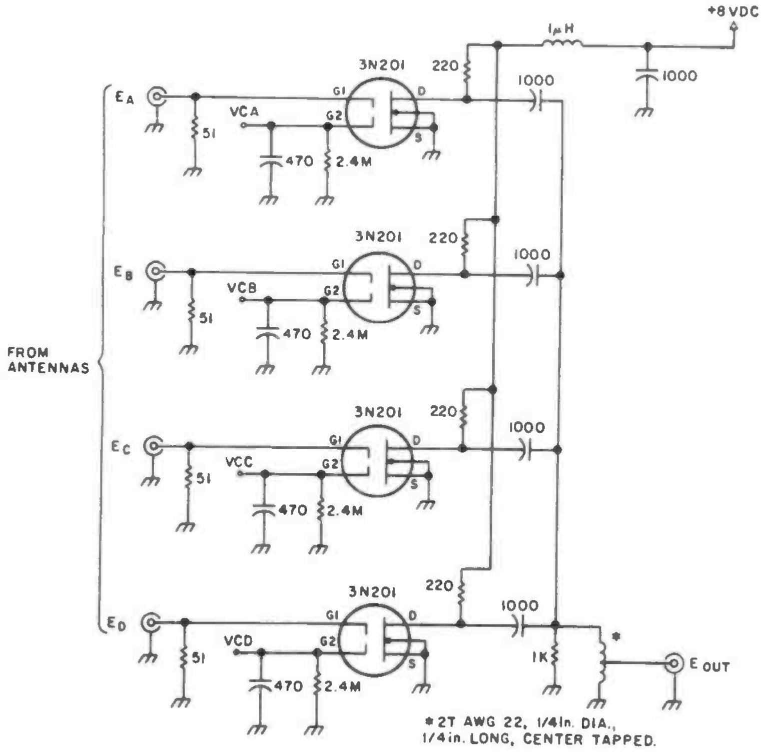


Figure 1: Circuit diagram of the RF summer circuit

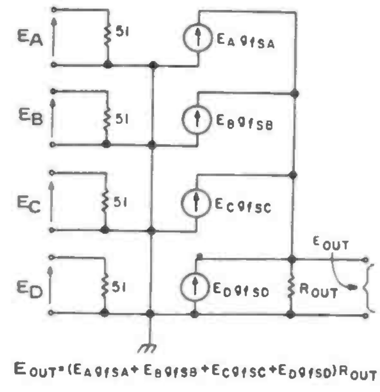


Figure 2: Equivalent circuit of the RF summer.

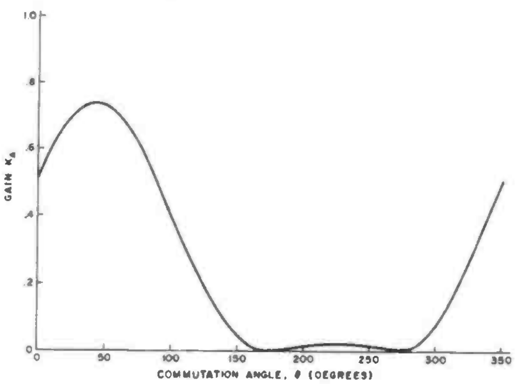


Figure 4: FET control voltage required to produce the amplitude variation shown in last month's Fig 5.

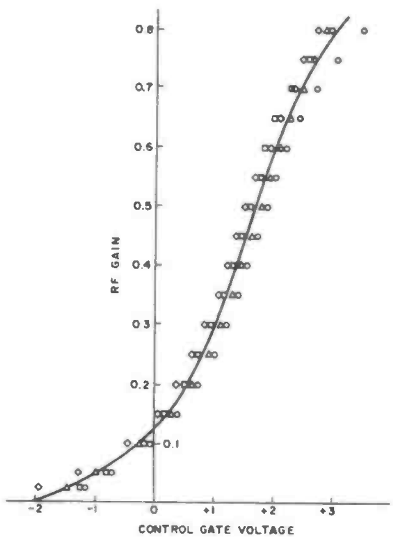


Figure 3: RF gain variation with control gate voltage for four typical FETs. The curve is a seventh-order polynomial fit to the measured data.

CIRCUIT DESCRIPTION

RF SUMMER

The circuit to be used for antenna summing should provide a low insertion loss, provide a stable and electronically-controlled gain characteristic, have negligible phase-shift variation with changing control voltage, be compatible with a 50-Ohm unbalanced input, and lend itself to operating into a 50-Ohm unbalanced output.

PIN diodes and voltage-controlled FET resistor devices were tried and eventually rejected for one or more incompatibilities with the above requirements. The dual-gate MOSFET operating in a common-source configuration was found to provide an excellent choice. *Fig 1* shows the final circuit.

The rf equivalent circuit is given in *Fig 2.* Each MOSFET acts as a current source into a common output impedance. The single, tapped inductor is used to cancel the combined output susceptance of the four MOSFETs. Device input impedance is extremely high and the circuit is broadband by virtue of the relatively low value resistors for line impedance termination at all inputs and the output. Some gain is lost, but it is quite acceptable (less than 6 dB) and could easily be made up with a preamplifier stage at the output if desired. The output voltage is the weighted sum of the four antenna voltages with the weighting determined by the transconductance of the FETs. Since the transconductance can be varied by the second gate control voltage, this provides the means for electronically combining the rf voltages.

Fig 3 plots the measured circuit gain (E_{out}/E_{in}) of four randomly selected devices together with a 7th order polynomial fit to the data. By combining the MOSFET rf gain characteristic of *Fig 3* with the desired antenna gain variation (see last month), the control voltage wave-form for antenna A can be found. This is plotted in *Fig 4.* The control waveforms for channels B,C, and D are identical in shape, but delayed by 90, 180, and 270 degrees respectively.

AUDIO SIGNAL PROCESSOR

Fig 6 shows the circuitry used to extract the 300 Hz Doppler modulation frequency from the receiver's audio output and generate a logic signal synchronized to the phase of this signal for the display generator. Threshold detectors are also provided to give an overload indication to assist in setting up the audio gain of the circuit and to blank the display when no signal is present.

Preamplifier A is AC coupled to the receiver and contains a gain

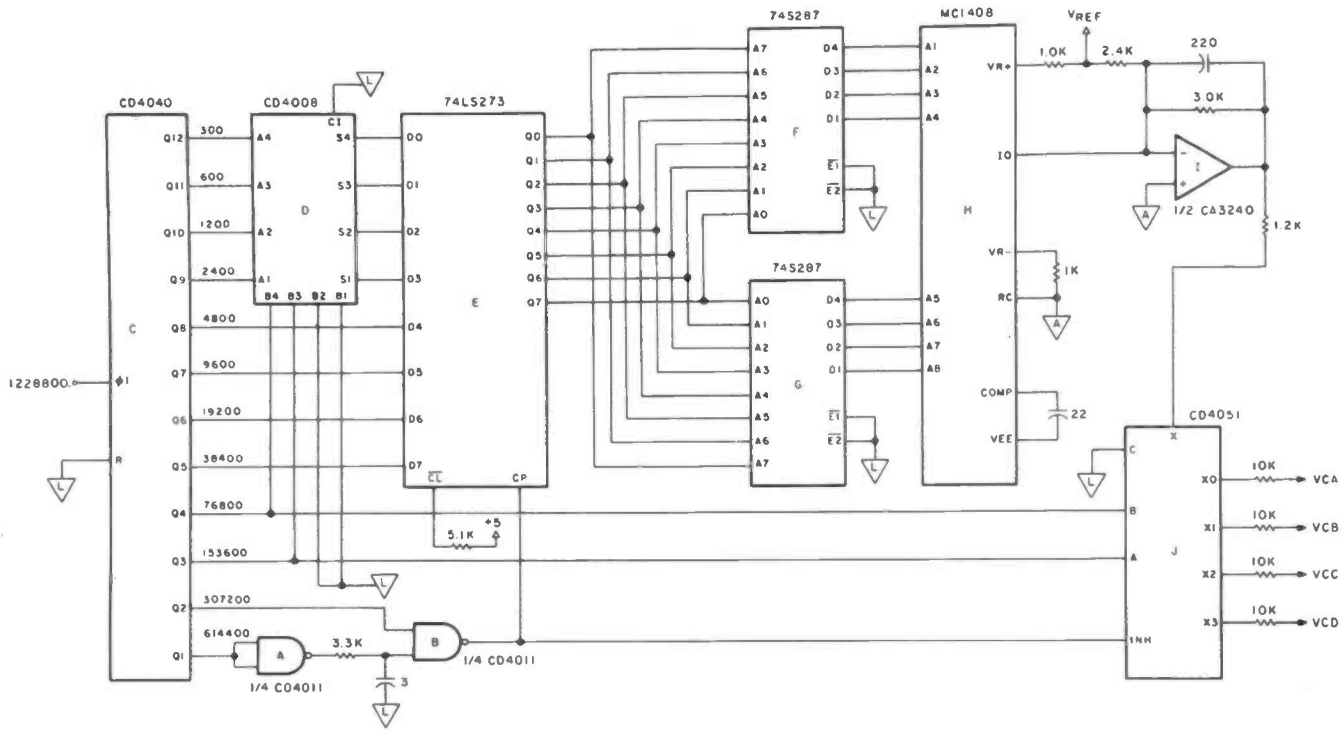


Figure 5: Circuit schematic of the control voltage waveform generator. Notes: Logic power is $V_{cc} = V_{dd} = +5$, $V_{ee} = -6$ V_{ss} = GND = ⏚ Op amp power is +5 and −6V dc.

CONTROL VOLTAGE WAVEFORM GENERATOR

Two PROMs are used to store the waveform plotted in *Fig 4*. The PROM address is multiplexed in multiples of 90 degrees commutation angle, and the PROM output, after conversion to an analog voltage, is demultiplexed at the same time so that the entire PROM memory is utilized to generate each of the four control voltages. *Fig 5* shows the schematic of the control voltage waveform generator.

The CD4040 is a 12-stage ripple-carry binary counter that produces an 8-bit incrementing address to the PROMs. When driven at a frequency of 1,228,800 Hz, the PROM address will cycle at a rate of 300 Hz, which is the commutation frequency of the system. To multiplex the PROM, the two most significant bits are modified by adding a O, 1, 2, and 3 sequentially to each of the PROM addresses using a CD4008 full adder. The resulting address is held temporarily in the 8-bit 74LS273 latch which synchronizes the otherwise skewed output of the ripple counter.

Together, the two 74S287 PROMs provide an 8-bit address by 8-bit output memory for the control waveform. Each address corresponds to 360/256 or 1.40625 degrees of commutation, while the output is scaled to cover the range −2.5 to +3.5 volts DC which provides a resolution of 6.0/256 = 0.0234 volts/step. The MC1408 digital-to-analog converter is used with a CA3240 BIMOS operational amplifier to minimize offset and noise.

The CD4051 is an 8-channel analog demultiplexer which directs the converter output into one of the four dual-gate MOSFETs. A small RC filter formed by the 10k resistors and 470p capacitors in the rf summer is sufficient to hold the demultiplexed control voltage between updates. NAND gates A and B are used to inhibit the demultiplexer except during that portion of the cycle when the D/A output is stable. They also provide the synchronizing pulse to the 74LS273 octal latch.

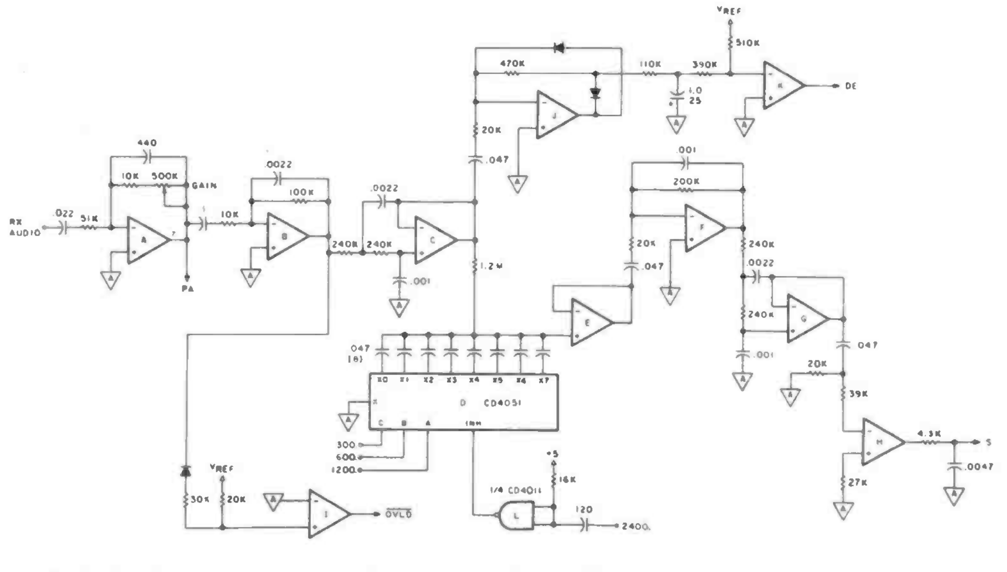


Figure 6: Audio signal processor circuit schematic. Notes: All op amps are 1/2 LM1458 except H, which is 1/2 CA3240. All diodes are 1N4148. Logic power is $V_{dd} = +5$, $V_{ee} = -6$, V_{ss} = ⏚ Op amp power is +5 and −6V dc.

adjustment variable over the range 0.2 to 10. Frequencies below 142 Hz are attenuated by the input filter and frequencies above 664 Hz are reduced by the feedback compensation. Amplifier B provides an additional gain of 10 and further filtering above 724 Hz.

Amplifiers C and G are identical second-order lowpass filters tuned to a frequency of 469 Hz with critical damping. These filters and the commutative filter described later were designed using the methods give in **Reference 1.**

The 8-section commutative filter, composed of multiplexer D and follower amplifier E, provides a 300 Hz bandpass synchronized to the antenna waveform frequency with a Q of 7540 RC where R is the series input resistor and C is the value of each of the switched capacitors. In *Fig 6*, R = 1M2 and C = 47n, providing a Q of 425. Since the Q of this circuit determines the speed of response of the system as well as the selectivity, a trade-off can be made in ▶

the selection of resistor R. The value shown provides a good compromise, but individual users may prefer a somewhat faster or slower responding display. The one-shot formed with NAND gate L is used to inhibit switching of the multiplexer during transition of its logic-select inputs.

Amplifier F provides an additional gain of 10 and helps to attenuate harmonics produced in the commutative filter above 796 Hz. AC coupling is used to attenuate frequencies below 169 Hz because the commutative filter does pass DC.

Amplifier H is used as a comparator to produce a square wave sync signal for the display generator. A CA3240 operational amplifier is used here instead of the LM1458s used elsewhere for its very high slew rate. AC coupling is employed to remove any DC offsets from the previous two stages, and a small RC filter at the output prevents extremely short sync pulses from being generated with zero input.

Amplifier 1 generates an overload signal which is helpful in setting the audio gain of the system. Blanking of the display in the absence of audio input (when the receiver is squelched) is accomplished by the halfwave rectification of amplifier J and the comparator operation of amplifier K. A blanking delay of approximately 100 mS is provided by the electrolytic capacitor.

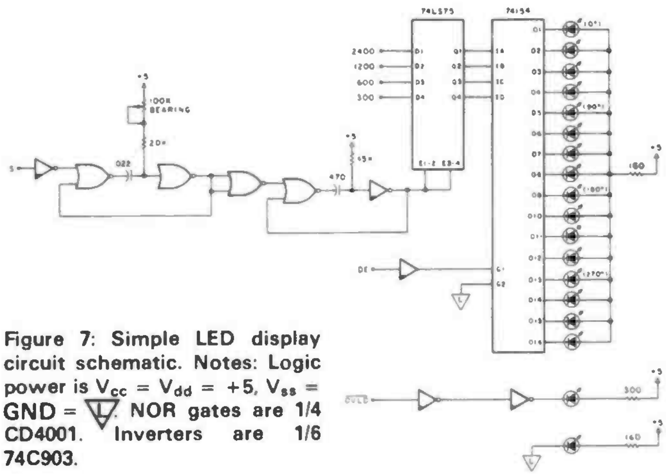


Figure 7: Simple LED display circuit schematic. Notes: Logic power is $V_{cc} = V_{dd} = +5$, V_{ss} = GND = ⏚. NOR gates are 1/4 CD4001. Inverters are 1/6 74C903.

DISPLAY

The circuitry required for a basic LED display is shown in *Fig 7*. Two one-shot circuits are used to convert square wave sync signal S to a short positive clock pulse which is used to latch the binary clock count into the 74LS75 quad latch. The first one-shot has an adjustable delay time to permit calibration of the display over a 90 degree bearing angle. (Rotation of the four antenna inputs is used for greater correction.) The second one-shot generates the 10uS latching pulse.

A 74154 decoder drives the 16-LED circular display directly. Two additional LEDs are used to indicate audio overload in the signal processing circuit and the power-on status.

When both LED and three-digit decimal bearing readouts are required, the circuit of *Fig 8* is used in place of *Fig 7*. This circuit is designed for compatibility with the optional serial interface to be described later and uses a 4-bit data bus to transfer data between temporary holding registers and the display latches. If the serial interface is omitted, the two signals SEND and MS must be tied to logic ground.

BCD counter latches H,I and J are driven by a 108,026 Hz clock signal and their contents are latched into tri-state latches O, P, and Q by the delayed sync pulse. The binary clock count is simultaneously strobed into latch R by the same sync pulse. Since the maximum count is (decimal) 359, the maximum BCD count required for the hundreds digit is 3 (binary 0011). Since the two most significant bits of this digit are always zero, these bits are used to transfer the overload (MSB) and the display enable (MSB-1) information. A one-shot is used to stabilize the overload flag for sampling.

Selection of the system clock frequency and dividers was made so as to produce compatible binary and BCD counter frequencies. Over a complete commutation interval of 1/300 second, the 4-bit binary input to register R will increment through 2400/300 x 2 = 16 counts. Each of these counts then corresponds to 1/16th of a revolution on the LED circular display. Over the same time interval, the clock input to the BCD counters generates 108026 .3736/300 = 360. 0879 counts, or approximately one count per degree. Although the error is very small (less than 0.1 degree) it will accumulate rapidly unless the BCD counter is periodically synchronized with the binary counter. The circuit consisting of flip-flop A and the surrounding gates is used to reset the three BCD counters every complete cycle (as defined by the binary counter) so that the BCD and binary counts remain synchronized.

At a rate of 2.34375 times per second (each 426.66 ms) data is transferred from tri-state registers O-R to latching registers S-V. Timing for the data transfer is obtained from the 12-bit conter, F, and the sequence is as follows for the case where a serial interface is not used. At the beginning of each transfer cycle (output of F all zeros), the input to registers O-R is disabled using the D1D2 control

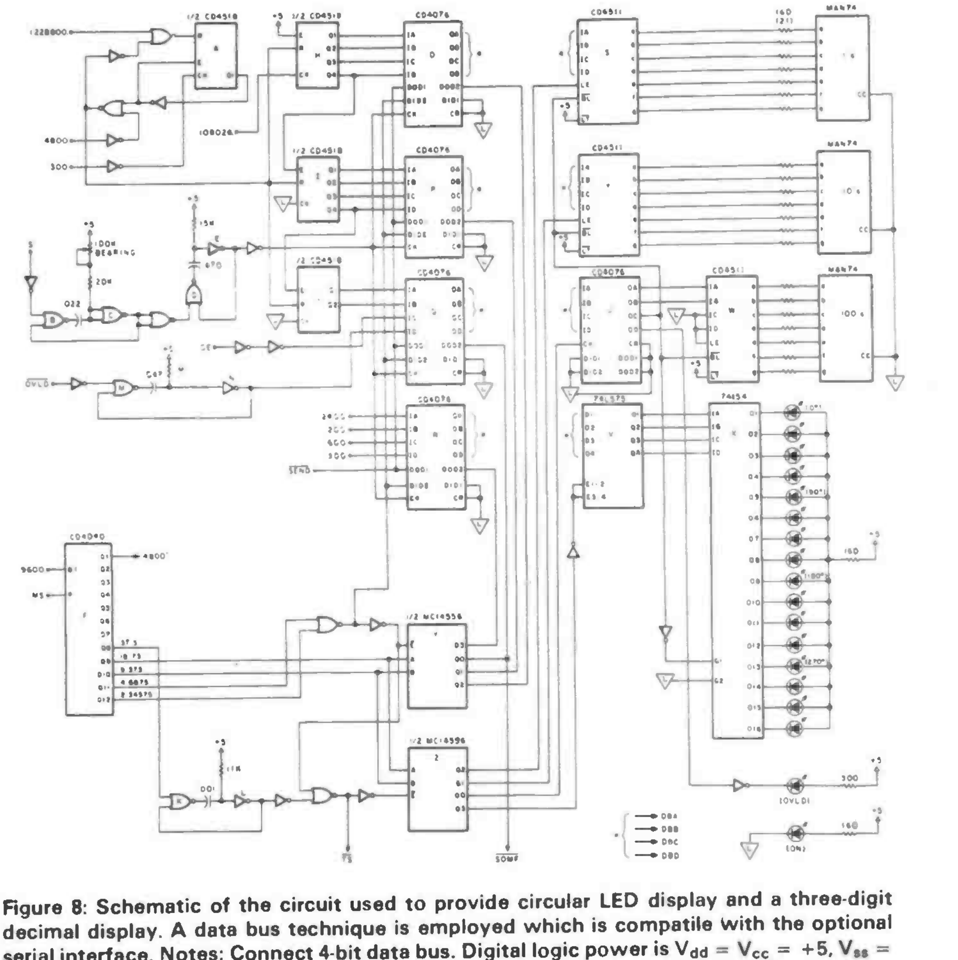


Figure 8: Schematic of the circuit used to provide circular LED display and a three-digit decimal display. A data bus technique is employed which is compatile with the optional serial interface. Notes: Connect 4-bit data bus. Digital logic power is $V_{dd} = V_{cc} = +5$, V_{ss} = GND = ⏚. All NOR gates are 1/4 CD4001. All inverters are 1/6 CD4069 except ▷o which are 1/6 74C903. Schematic is drawn for operation with serial interface. For no serial interface, add jumpers SEND to ⏚, MS to ⏚.

Page 26 ▶

DATONG
YET MORE INNOVATION

New

MODEL DF
DISPLAY UNIT

DOPPLER DIRECTION FINDER

Model DF is a direction finding attachment for use with existing narrow band FM receivers and transceivers.

Two units, the display unit and the special antenna combiner convert your NBFM transceiver plus four omnidirectional antennas into a radio direction finder. A built-in r.f. activated antenna relay diverts the transceiver's output to the normal antenna during transmit or when the DF attachment is switched off.

Features

- Works with any existing narrow-band FM receiver or transceiver. No modifications are needed. 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.
- Display holds last reading when signal drops out.
- Very easy to use and install.
- Only a single coaxial cable needed between display unit and antenna combiner.
- Professional quality at remarkably low cost. Display unit uses two PTH circuit boards. Gasket sealed combiner unit houses two conventional double-sided PCBs.

Applications

Model DF costs between ten and a hundred times less than conventional RDF systems, and therefore opens up new application areas for both professional and hobby users. Possible applications include:- VHF amateur radio, Citizen's Band radio, aircraft spotting, tracking gliders and light aircraft, locating lost model aircraft, private mobile radio systems, coastal and marine radio, tracking and locating anti-social radio operators, locating 'tagged' animals in the wild, helping to identify or trace unknown transmissions, law enforcement.

MODEL DFA2 COMBINER UNIT

A complete system needs the display unit and the 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.

Suitable magmount quarter wave whips are available from Datong for VHF use.

***BASIC DF SYSTEM** (Model DF display unit with Model DFA1 combiner): £125.00 + VAT (£143.80)

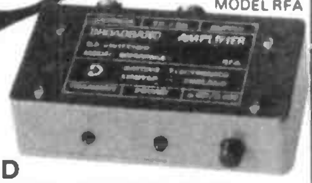
***DF SYSTEM**, as above but with mobile version of combiner, Model DFA2 (as DFA1 but fitted with magmount and 4 metre coaxial downlead terminated with PL259 plug): £131.00 + VAT (£150.70)

COMPLETE MOBILE DF SYSTEM (Model DF display unit, Model DFA2 combiner, and four Model MA1 quarter wavelength magmount antennas cut for 145 MHz): £173.50 + VAT (£199.50)

* Antennas not included

New

MODEL RFA



WIDE BAND PREAMPLIFIER - MODEL RFA

Eliminates separate tuned preamplifiers for each band.

Model RFA improves the sensitivity of any receiver or transceiver working in the range from 5 to 200 MHz. It connects in series with the antenna and built-in r.f. activated relay switches the pre-amplifier out of circuit during transmit or when the power is off.

Features:

- Extra wide bandwidth saves the cost of separate narrow band preamps.
- Handles strong signals without overload thanks to special low-noise negative feedback technique. Intercept point better than + 20dbm.
- Low noise figure.
- Carefully chosen gain level minimises receiver overload and cross modulation.
- R.F. activated bypass relay allows easy use with transceivers.
- Rugged diecast aluminium case with SO239 connectors and PTH printed circuit board.

Applications

Application areas include:- weak signal reception of all amateur and satellite bands from 5 MHz up to 200 MHz, long distance reception of VHF FM Broadcasts and VHF TV Signals, CB transceivers, private mobile VHF radio transceivers, reception of marine and aeronautical bands, VHF scanner receivers, compensating for signal loss in long antenna feeders.

The wide bandwidth of Model RFA makes it ideal for use with broadband antennas and scanner receivers.

Broadband Preamplifier, Model RFA: £25.50 + VAT (£29.32)

New

MODEL S
"CODECALL"

"CODECALL" SELECTIVE CALLING DEVICE - TAKES THE FATIGUE OUT OF LONG TERM MONITORING

"Codecall" is ideal wherever there is a need to monitor a well used radio channel for one particular call over long periods. "Codecall" gives the same convenience as a telephone bell, in that the receiver remains totally silent while monitoring. It therefore causes no disruption to other activities.

In fact the user can totally disregard the radio until a loud bleep from "Codecall" warns that the desired signal has been received. The loud intermittent bleep then continues, unless cancelled, for over ten minutes after the call is received.

"Codecall" ensures that the communications channel remains at full efficiency at all times. Without "Codecall" the desired call often blends into the general chatter and is missed by the listener, especially when the volume has been reduced to cut down the radio's nuisance level.

Features

- Each "Codecall" unit acts as a call generator and a call receiver.
- No electrical connection is needed at the transmitter, simply hold "Codecall" next to the microphone.
- At the receiver simply plug "Codecall" into the external speaker jack.
- Over four thousand different codes virtually eliminate the chance of false alarms.
- Internal 9 volt battery has long life since no current is used while monitoring a squelched channel.
- Works over any voice link, whether FM, AM, or SSB.
- Codes selected by either three 16-way switches (Model S) or by altering twelve internal wire links (Model L).
- Compact: only 4 x 2.4 x 1.05 inches.

Two Versions

Model S (as illustrated) has three 16-way rotary switches on the front panel giving a total of 4096 combinations immediately available. Model L has no switches, instead the code is set by altering twelve wire links inside the case.

Both models can be used in the same system. The switched version (Model S) is ideal where frequent code changes are required, whereas the linked version (Model L) is suitable where codes are not likely to be altered often, or for unskilled users who might accidentally set the wrong code.

Note: when used by UK Radio Amateurs all transmissions must be identified as required by the licence conditions.

"Codecall" Model L (Link programmed): £24.00 + VAT (£27.60)

"Codecall" Model S (Switch programmed): £25.50 + VAT (£29.32)

DATONG ELECTRONICS LIMITED

ALL DATONG PRODUCTS ARE DESIGNED AND BUILT IN THE U.K.

PRICES

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

FL1	59.00 (67.85)	AD370	45.00 (51.75)	RFA	25.50 (29.32)
FL2	78.00 (89.70)	AD270 + MPU	37.00 (42.55)	Codecall (Linked)	24.00 (27.60)
PC1	105.00 (120.75)	AD370 + MPU	49.00 (56.35)	Codecall (Switched)	25.50 (29.32)
ASP	69.00 (79.35)	MPU	6.00 (6.90)	Basic DF System ★	125.00 (143.80)
VLF	22.00 (25.30)	DC144/28	31.00 (35.65)	DF System ★	131.00 (150.70)
D70	43.00 (49.45)	DC144/28 Module	25.00 (28.75)	Complete Mobile DF System ★	173.50 (199.50)
D75	49.00 (56.35)	Keyboard Morse Sender	112.20 (129.00)		
RFC/M	23.00 (26.45)				
AD270	33.00 (37.95)				

★ See text for details.

Data sheets on any products available free on request – write to Dept R.C.

DATONG ELECTRONICS LIMITED

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236 for further details

inputs. These inputs remain disabled during the first quarter of the transfer cycle (106.66 ms). During this same quarter cycle, the 1-of-4 decoder, Y, places the tri-state output of registers O-R sequentially onto the bus using their DOD2 control inputs. The order of selection is Q (overload/blanking/hundreds), P (tens), O (units), and R (binary). Each register is connected to the bus for 26.66 ms. While a tri-state register is connected to the bus, a corresponding display register (S-V) is strobed by a short pulse generated by one-shot K-L and steered to the correct display register via a second 1-of-4 selector (Z). The data transferred to the display registers is held until the next update (426.66 ms later).

Consequently, the display appears stable, but is still reasonably responsive to changes in the bearing data. Also, the data displayed is consistent (i.e. the binary and BCD data displayed are sampled simultaneously even though they are transferred sequentially).

Registers S and T are CD4511 BCD-to-7-segment latching drivers which drive the units and tens displays directly. Latch U is a holding register which provides the 2 bits of hundreds data to the third CD4511 driver (W). The blanking information and overload data are also available from outputs C and D of latch U. Quad latch V provides the binary LED data to the 1-of-16 selector X.

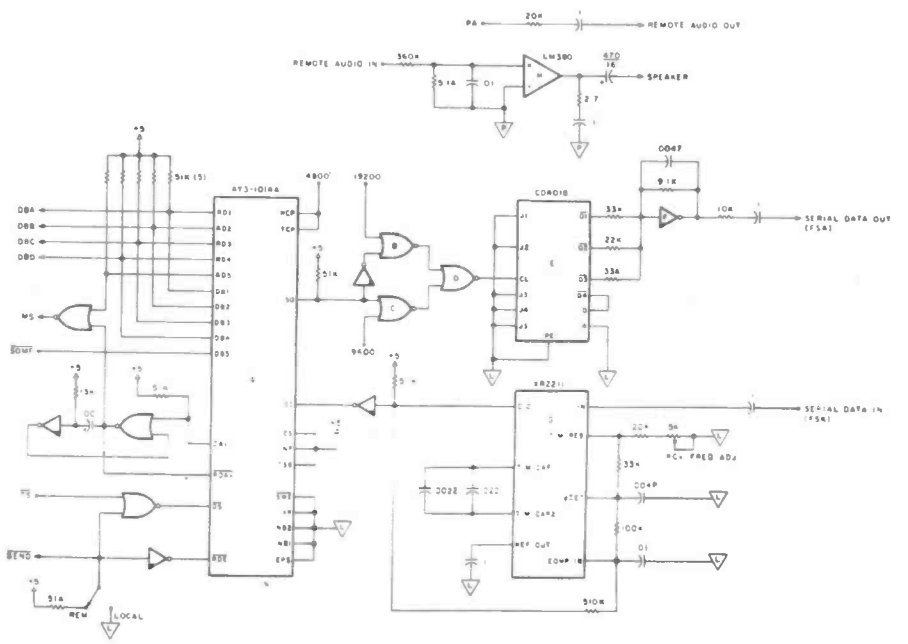


Figure 9: Optional serial interface circuit schematic. Notes: NOR gates are 1/4 CD4001. Inverters are 1/6 74C903. Digital logic power is $V_{cc} = V_{dd} = +5$, V_{ss} = GND = L. Amplifier H power is +13 switched (sw); ground is P.

SERIAL INTERFACE

An optional serial interface is shown in *Fig 9* which permits remote transmission or reception of the displayed data using standard 300 baud audio frequency shift tones. This data rate and the FSK tones used are compatible with data recording and playback using an inexpensive tape recorder so that this interface may also be used whenever unattended operation is desired.

The universal asynchronous receiver transmitter (UART), A, is shown programmed for five data bits no parity, and 11/2 stop bits per character. The first four data bits of each character are simply the four data bus bits transferred to the display registers S-V in *Fig 8*. The fifth bit is used to signal the first character of the four-character message; a zero represents the first character (overload/blanking/hundreds).

When locally received data is to be displayed, the UART operates in its transmit mode. The data transfer across the data bus operates exactly as explained before, and the data bus is strobed into the UART transmit buffer whenever any of the display registers is clocked. Thus, a four-character word of data is sent every 426.66 mS. At 300 baud, it requires (5 + 11/2)/300 seconds or 21.66 mS to send each character. Since data is taken from the bus each 26.66 mS this creates a gap of 5 mS between consecutive characters.

When display of remote data is selected, the timing changes somewhat. All of the tri-state registers are removed from the data bus using their DOD1 control inputs, and the UART tri-state received data output is connected to the bus (RDE = 0). When a first character has been received (bit 5 = 0 and UART data available), a pulse is generated at MS which resets 12-bit counter F in *Fig 8*. Data transfer into the display registers then proceeds as usual except that the UART supplies the data. The first data character is clocked into display register U at 13.333.. mS following data reception. Therefore, a large skew can be tolerated between local and remote clocks without affecting system operation.

In the local data display mode, digital data at 300 baud from the UART serial output is used to select which of two clock freqencies, 9600 or 19200, is applied to the 4-bit Johnson counter, E. The counter outputs are applied through summing resistors to inverter F configured to work as an operational amplifier. The weighting of the three summing resistors is chosen such that the filtered out-put of F approximates a sine wave of frequency 1200 Hz when the UART output is "0" or 2400 Hz when the UART output is a "1". Sine-wave distortion is below 5% with this arrangement, and the FSK freqencies are as accurate as the system clock (which is crystal controlled).

When the system is in the remote data display mode, FSK input is demodulated in the XR2211 decoder, G. The component values shown are optimized for 300-baud, 1200/2400 Hz operation using the procedure given in EXAR/s specification sheet for the XR2211.

The audio circuitry shown at the top of *Fig 9* is included as a convenience when using the system with a two-channel tape recorder. FSK data can be placed on one channel, and the received audio out of preamplifier A in *Fig 6* can be coupled through the RC circuit shown to the second channel for simultaneous recording. On playback, this audio is amplified by the LM380 (amplifier H) to drive a loudspeaker so that bearing data can be easily correlated with the received signal.

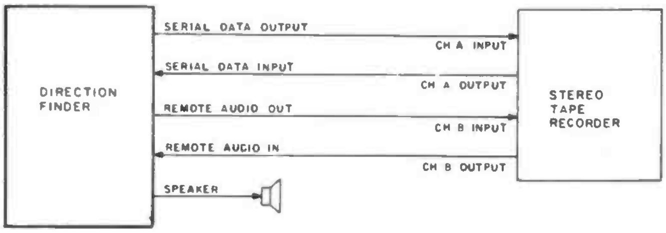


Figure 10: Serial interface connection for tape recording and playback.

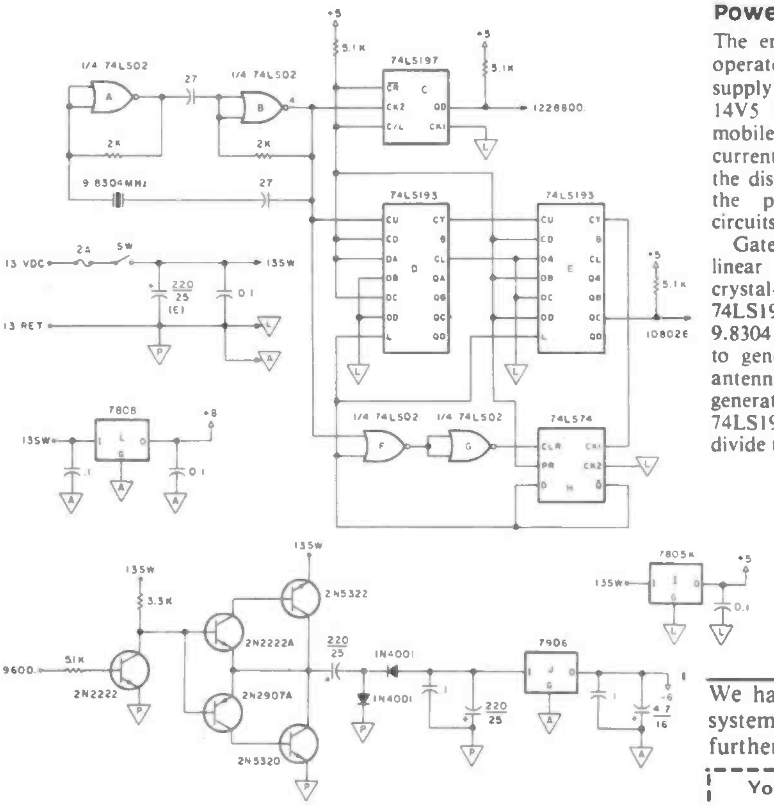


Figure 11: Schematic of the power supply and clock circuitry. Notes: Power to LM1458 is +5 and −6V dc. Logic power is V_{cc} = +5, GND = ⏚.

Power Supply and Clock

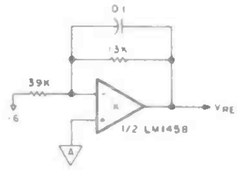
The entire system is designed to operate from a single unregulated supply voltage between 11V5 and 14V5 DC negative ground for mobile operation. Total input current is approximately 1A with the display enabled. *Fig 11* shows the power supply and clock circuits.

Gates A and B are connected for linear operation and form a crystal-controlled oscillator. The 74LS197 is used to divide the 9.8304 MHz clock frequency by 8 to generate 1.2288 MHz for the antenna control waveform generator and binary display. Two 74LS193 counters are connected to divide the clock frequency by 91 to generate 108026 Hz for the BCD display. Gates F and G and the 74LS74 flip-flop are used to load a count of 256 −91 = 165 into the two 4-bit counters. If the BCD display is not used, ICs D, E, and H may be omitted.

A 7805K regulator provides +5 V DC for the digital logic, operational amplifiers, and the displays. The 7808 regulator provides +8V DC for the MOSFETs used in the rf summer.

Negative voltage is generated by a switching inverter/voltage doubler circuit that produces approximately −8 V DC at the input to a 7906 regulator. The −6 V DC is used as the negative analog supply voltage.

Operational amplifier K generates the 2 VO DC reference used for D/A conversion and threshold comparison.



REFERENCE

1. Get notch Qs in the hundreds. *Electronic Design* August 2 1974 pp 96-101

■ R & EW

We have arranged to supply complete kits of the Doppler DF system described here. Contact the **R&EW** project pack office for further details.

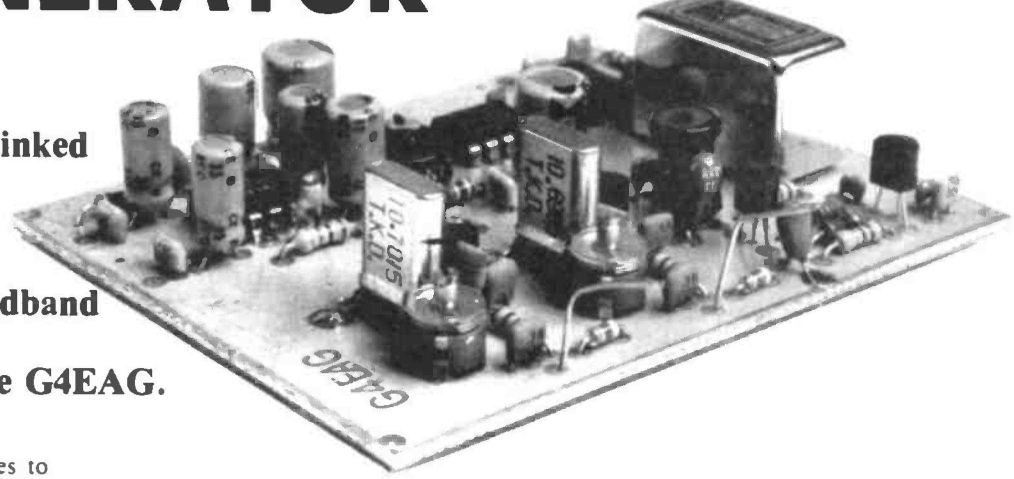
Your Reactions

	Circle No.		Circle No.
Immediately Interesting	31	Not Interested in this Topic	33
Possible Application	32	Bad Feature/Space Waster	34

R&EW PROJECT PACKS R&EW

10.7 MHz SSB GENERATOR

The first of a series of modules that when linked to the R1000 or FRG7700 will offer full facility SSB/CW/FM HF broadband transceive operation. Design by Simon Ruffle G4EAG.



THERE ARE SEVERAL advantages to building a transceiver around an existing receiver. Firstly, the central and critical part of the transceiver — the stable broadband VFO, band switching, and digital frequency read-out are already built and tested. Secondly, the receiver can be used to test and align the new transmitter by tuning to the various fundamental and product frequencies.

The R1000 and FRG7700 receivers both use the same high first IF, 48.055 MHz with local VFO tuning 48.055 to 78.055 giving 0 to 30 MHz receive coverage. The principle behind the transceiver is straightforward: Produce a transmit signal at 48.055, mix this with the receiver's VFO, pass through a low-pass filter with cut-off at 30 MHz and then on to a broadband power amplifier. A block diagram is shown in *Fig 1*.

The required transmit mode — SSB/CW/FM — is generated at 10.7 MHz, and mixed with the 37.355 local crystal oscillator and filtered to give the 48.055 signal. This is mixed with the buffered receiver VFO to give 0 to 30 MHz. The low pass filter removes the 96.11 to 126.11 MHz mixer products. The signal is then passed onto the broadband power amplifier.

The R1000/FRG7700 matching transmitter is built as a set of modules, each of which is a block of HF transceiver circuitry in its own right, which will have additional applications outside this project. The modules, therefore, are described in separate articles.

CONSTRUCTION

The 10.7 MHz SSB Generator module is very compact, is constructed on a double-sided printed circuit board, is straightforward to make and is easy to set up. The two crystal oscillators should be built first (don't forget R4) inserting the crystals last. Apply 12V to the two sideband-select pins in turn, listening for the carriers on a receiver tuned near to 10.7 MHz. They should be easy to pick up; do not bother to set them on frequency yet, but ensure that by adjusting VC1 and VC2 that the respective carrier frequencies vary slightly.

Next insert D1, D2 and the voltage regulator circuit. Again apply 12V and ensure that +6V is present on the 6V line whichever sideband is selected.

At this point, if it all is working so far, solder the earth leads on the top of the board where they pass through. Be careful doing this; don't solder any non-earthed leads by mistake. Earth the crystal cans with short lengths of wire.

Next, construct the circuits around IC1 and IC2. Carefully check polarities of electrolytics including C33.

Now couple the receiver to pin 5 of IC2 via a 1n0 capacitor, and switch on. By speaking into the microphone you should be able to tune into, and monitor the signal. Remember you will be listening to a double-sideband signal, and the only difference between the two carrier crystals will be a shift in frequency. Earth both microphone inputs and listen for the carrier. Rotate VR1 to the position where this is weakest. It should be well below the peak speech levels on the receiver 'S' meter. Note, that if you earth pin 7 of IC2 (a hole is provided for this on the board) that IC2 lets the full carrier through, but remember that the filter will reduce this significantly. It may, however be useful as a low power tune-up signal.

If all is working, you can solder the top earth-plane connections.

Now build the rest of the module. Couple the receiver via coaxial cable to the output, and switch both receiver and SSB board to USB. With one hand on the tuning control, one hand adjusting VC2,

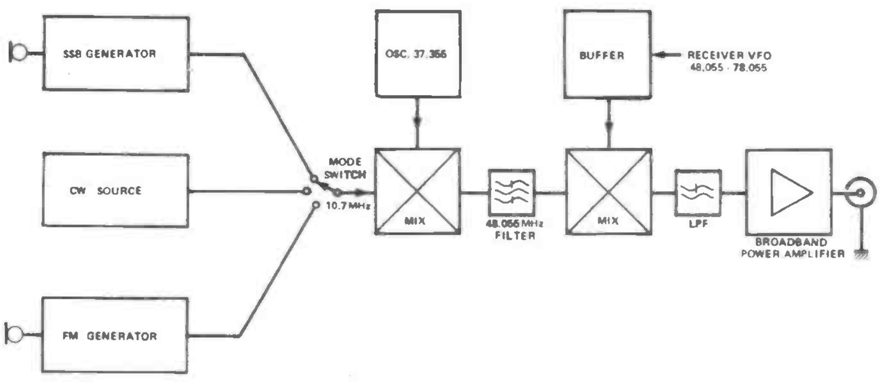


Figure 1: Block Diagram showing the interconnection of various modules to provide full facility SSB/CW/FM HF Broadband tranceive operation with either an R1000 or FRG7700.

speak into the microphone. As you sweep backwards and forwards, following with the receiver, the audio quality will vary from muffled to thin-sounding. Choose the crispest, most natural tone, then switch to LSB. Don't adjust the receiver tuning, but use VC1 to tune in your voice. Now switch both receiver and board backwards and forwards from LSB to USB. You should adjust for identical audio quality on both. It may take a little time adjusting VC1 and VC2 but it is worth it.

When satisfied, check the board over, and solder up any other earth connections on the top of the board.

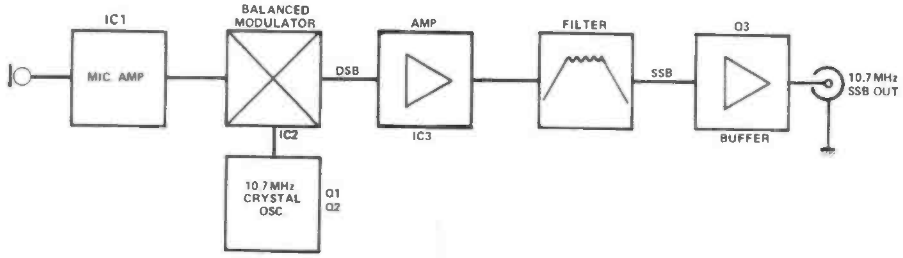
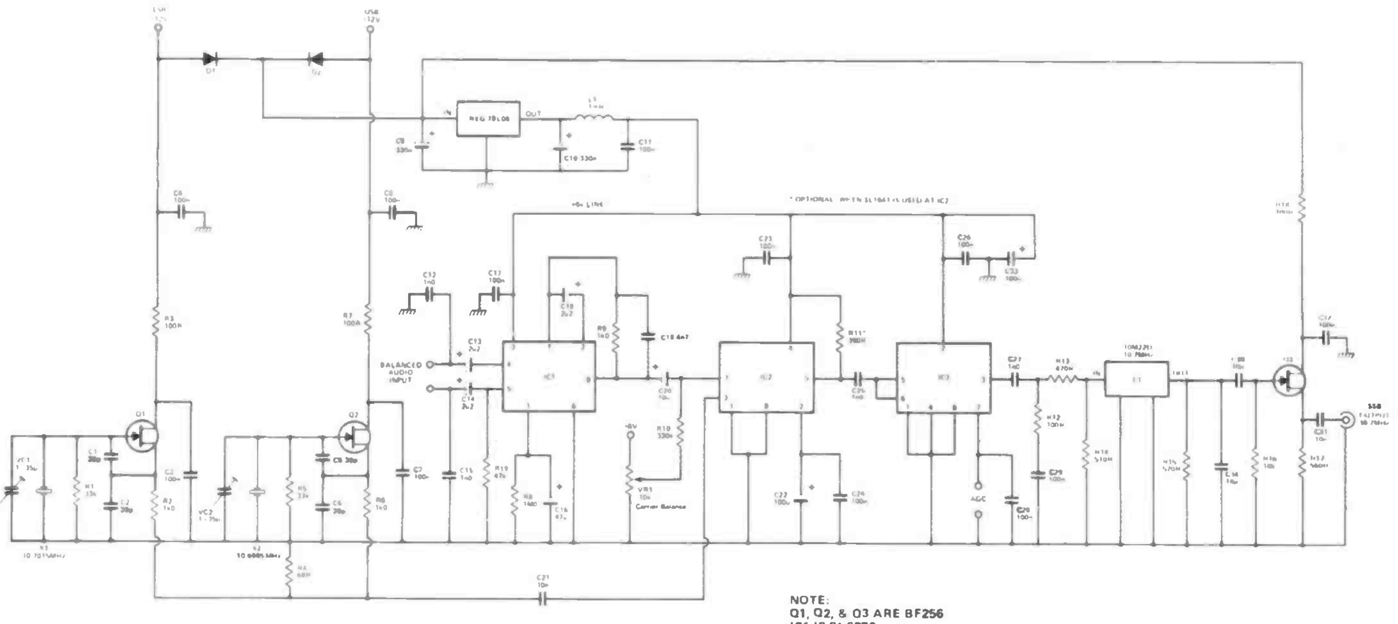


Figure 2: Block Diagram of the 10.7 MHz SSB generator.



NOTE:
Q1, Q2, & Q3 ARE BF256
IC1 IS SL6270
IC2 IS SL1640/SL1641
IC3 IS SL1610
REG. IS 78L06
D1 & D2 ARE 1N4148

Figure 3: Circuit Diagram.

CIRCUIT DESCRIPTION

The SSB generator is based on well-proved SL600/SL1600 series integrated circuits from Plessey and uses the filter method of single sideband generations. See *Fig 2*.

The audio input to IC1 the SL6270, may be balanced which will overcome the problem of RF feedback to the input. If a single-ended microphone is used then one of the inputs should be earthed via R19 and the other connected to the microphone live lead, RF decoupled by a 1nF capacitor and 1mH choke where it enters the equipment case. IC1 is a gain-controlled preamplifier, offering 40 dB of compression (60 dB if R9 is omitted). C18 controls the LF response, and R8 and C16 the attack/decay characteristics of the AGC.

Either an SL1640 or SL1641 can be used for IC2, but R11 is only included with the latter. VR1 is a fine tuning control for the carrier balance of the modulator.

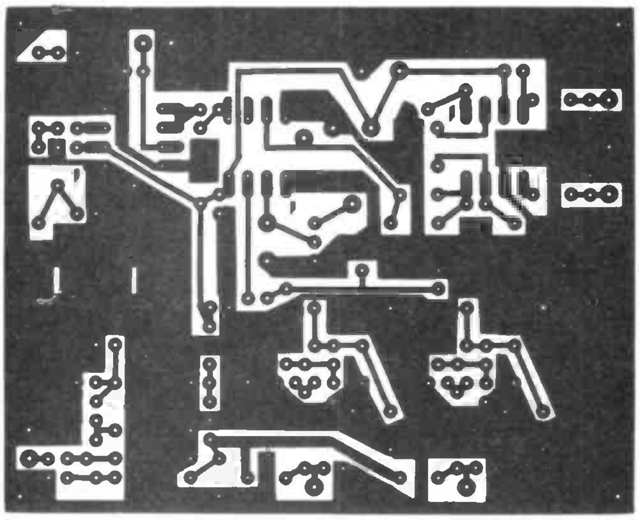
The SL1610 has a gain-control pin, which, when open-circuit gives full gain, but will offer up to 50 dB attenuation with 6 volts on pin 7. This facility may be useful to balance the output of the SSB generator with other mode sources, but overall system gain control should be provided later, not on the SSB board.

A carrier wave is produced by one of the two carrier oscillators — depending on which is DC-selected — and is fed to IC2, a double balanced modulator. Here it is mixed with an audio frequency signal from the micropone which has been amplified by IC1, a gain-controlled preamplifier.

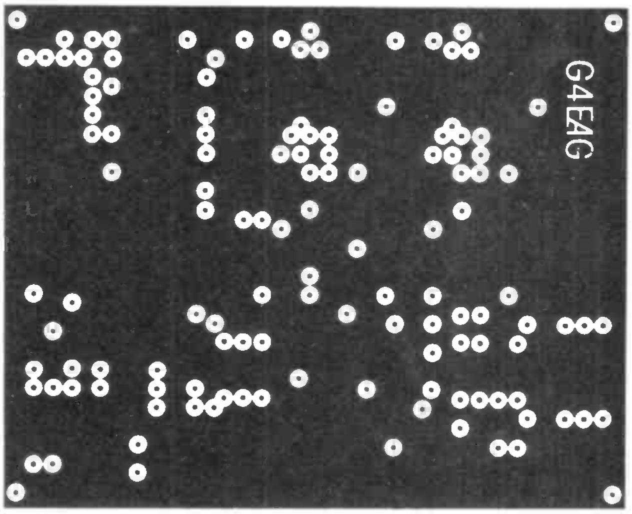
In the mixing process, the original carrier is balanced out, leaving the two modulation sidebands centred on the carrier.

This double-sideband suppressed carrier signal is amplified by IC3, and fed to a high quality eight pole crystal filter. The crystal filter passband is only wide enough to let one sideband through. This may be the higher sideband of the 10.6985 MHz crystal (upper sideband) or the lower sideband of the 10.7015 crystal, depending on which is selected.

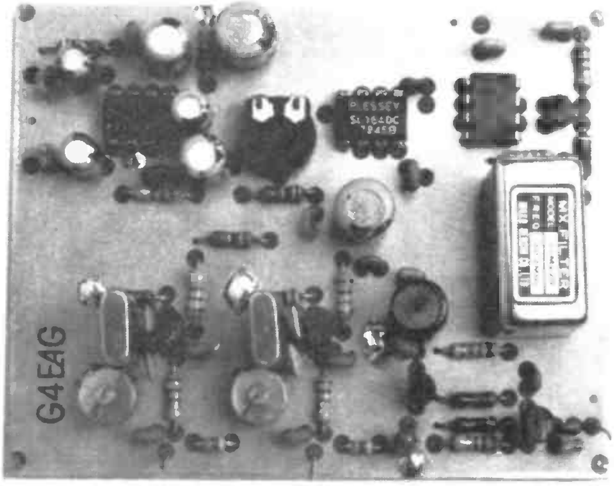
The DC arrangements allow for easy mode switching. Power is applied, via either diode D1 or D2, depending on the sideband selected, to the three IC s and Q3. When another mode (FM or CW) is selected the whole SSB board will be unpowered.

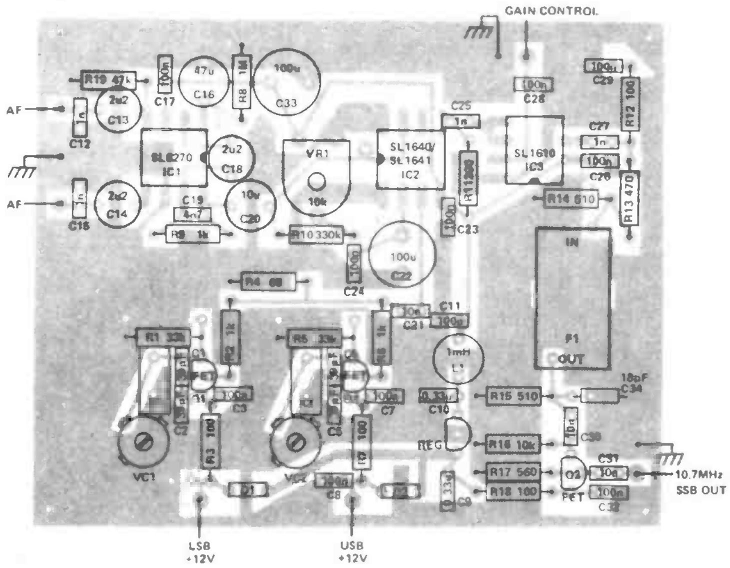


Bottom Foil Pattern



Top Foil Pattern





PCB Overlay

COMPONENTS LIST

Resistors (all .25W 10%)

R1,5	33k
R2,6,9	1k
R3,7,12,18	100R
R4	68R
R8	1M
R10	330k
R11	390R
R13	470R
R14,15	510R
R16	10k
R17	560R
R19	47k
VR1	10k potentiometer

Semiconductors

Q1-3	BF256
D1,2	1N4148
IC1	SL6270
IC2	SL1640/SL1641
IC3	SL1610
Reg	78L06

Crystals

X1	10.7015 MHz crystal
X2	10.6985 MHz crystal
F1	xtal filter M22D 10.7 MHz

Inductors

L1	1 mH choke

Capacitors

VC1,2	35p variable
C1,2,5,6	39p ceramic
C3,4,7,8,11,17, 23,24,26,28,29,32	100n monolithic
C12,15,25,27	1n min ceramic 0.1" lead spacing
C21,30,31	10n min ceramic 0.1" lead spacing
C13,14,18	2u2 10V low-leak electrolytics
C9,10	330n 16V tantalum
C16	47u low-leak electrolytic 10V
C22,33	100u low-leak electrolytic 10V
C19	4n7 ceramic
C20	10u low-leak electrolytic 10V
C34	18pF

PERFORMANCE

This SSB board gives excellent audio quality, mainly due to the high standard of the 8-pole crystal filter. The transmitted audio quality is often complimented over the air even before the other amateur knows that it is a home-made system. One cannot ask for more than that.

■ R & EW

The next article in the series, to be published in the September issue, will describe the mixer board, which when connected to the receiver and a 10.7 MHz signal source will provide broadband RF transceive output in the range 0-30 MHz.

Your Reactions......	Circle No.
Excellent - will make one	19
Interesting - might make one	20
Seen Better	21
Comments	22

FOR QUALITY CRYSTALS — AT COMPETITIVE PRICES. POPULAR FREQUENCIES IN STOCK

2 METRE STOCK CRYSTALS. Price £1.96 for one crystal. £1.74/crystal when two or more purchased.

	HC6/U 30pF TX	HC6/U 30pF TX	HC25/U 30pF and 40pF TX	HC25/U 20pF and 30pF RX	HC25/U 25pF and 20pF TX	HC6 & 25/U SR RX
RO	4.0277	8.0555	12.0833	14.9888	18.1250	44.9666
R1	4.0284	8.0569	12.0854	14.9916	18.1281	44.9750
R2	4.0291	8.0583	12.0875	14.9944	18.1312	44.9833
R3	4.0298	8.0597	12.0895	14.9972	18.1343	44.9916
R4	4.0305	8.0611	12.0916	15.0000	18.1375	45.0000
R5	4.0312	8.0625	12.0937	15.0027	18.1406	44.0083
R6	4.0319	8.0638	12.0958	15.0055	18.1437	45.0166
R7	4.0326	8.0652	12.0979	15.0083	18.1468	45.0250
S8	–	–	12.1000	14.9444	18.1500	44.8333*
S9	–	–	12.1020	14.9472	18.1531	44.8416*
S10	–	–	12.1041	14.9500	18.1562	44.8500*
S11	–	–	12.1062	14.9527	18.1593	44.8583*
S12	–	–	12.1083	14.9555	18.1625	44.8666*
S13	–	–	12.1104	14.9583	18.1656	44.8750*
S14	–	–	12.1125	14.9611	18.1687	44.8833*
S15	–	–	12.1145	14.9638	18.1718	44.8916*
S16	–	–	12.1167	14.9667	18.1750	44.9000*
S17	–	–	12.1187	14.9694	18.1781	44.9083*
S18	–	–	12.1208	14.9722	18.1812	44.9166*
S19	–	–	12.1229	14.9750	18.1843	44.9250*
S20	4.0416	8.0833	12.1250	14.9777	18.1875	44.9333
S21	4.0423	8.0847	12.1270	14.9805	18.1906	44.9416
S22	4.0430	8.0861	12.1291	14.9833	18.1937	44.9500
S23	4.0437	8.0875	12.1312	14.9861	18.1968	44.9583

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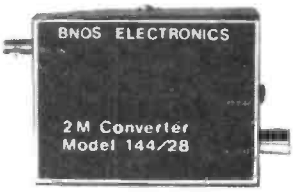

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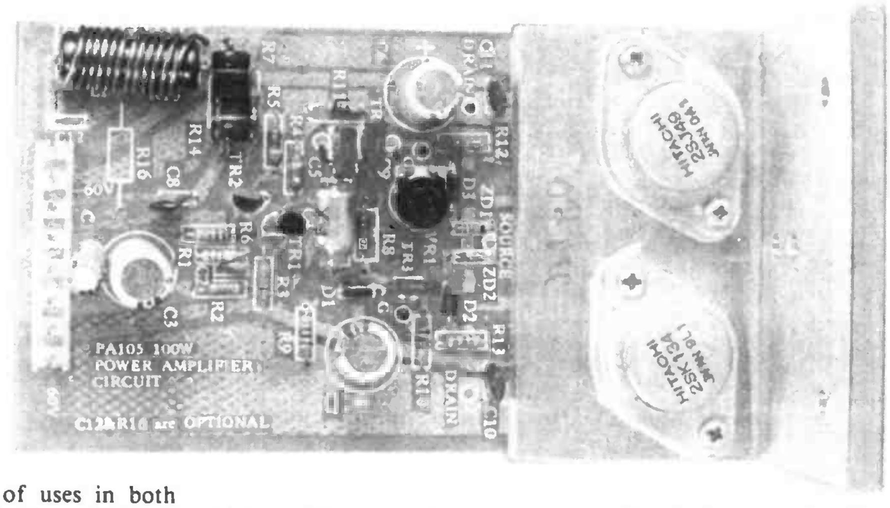
POWER MOSFETS Part 2



Ian Campbell looks at some practical applications of Power MOSFET devices.

POWER MOSFETS HAVE A wide variety of uses in both analogue (linear) and digital (switching) applications. Table 1 shows just how widespread these applications are and the circuits that follow show practical implementations of power mosfet designs in some of these areas.

LINEAR APPLICATIONS

Power mosfets are ideal for use in current regulator circuits, as they have high output impedances, relative insensitivity to temperature variations, and high output current capability.

Figure 1 shows a basic current regulator, where the base-emitter junction of a bipolar transistor is used to provide a reference voltage. The feedback action is such that the bipolar collector voltage, which is the mosfet's gate voltage, forces the mosfet to draw a current of approximately $0.65/R_S$. Resistor R_C provides the bias for linear operation. This form of regulator will give currents from 30 mA up to the maximum current rating of the power mosfet.

A linear two-stage AF amplifier with a 30 dB power gain and 2.5W output is shown in *Fig 2*. The circuit is quite straightforward and virtually self-explanatory: Note; however, the use of zeners across the primary of the output transformer, which protect the VN89AF from possible damage from inductive voltage spikes. Negative feedback is provided by R_f, and the output device is biased into its linear 'Class A' region by the potential divider formed by the 3M9 and 680k resistors connected to its gate.

When used in a crystal oscillator, a rather useful feature of the power mosfet is its high input impedance and high gain. This is especially true if we want a large output, low crystal dissipation, high stability and few components. *Fig 3* shows a 10 MHz oscillator which is capable of 5W output when used with a low cost parallel-mode crystal. Note that a potentiometer circuit can be connected to the V_{GS} terminal to provide the necessary 50 mA bias current.

Figure 4 shows a 10 dB-gain VMOS VHF RF amplifier with 10W output. C1, C2 and L1 match the impedance of the input circuit to the gate impedance of the DV1210, and C3, C4 and L2 match the device's output impedance to the load. For class AB operation, a bias voltage must be applied through R via a zener stabiliser and potentiometer (inset). For class C operation, R is connected to the earth plane and provides the earth leakage for the mosfet.

SWITCHING APPLICATIONS

The plethora of switching applications for power mosfets must mean that they have something going for them. The truth is that their switching times are a lot faster than bipolars, so the energy dissipated during switching transitions is far lower. The power mosfet can operate more efficiently and at much higher frequencies than bipolar transistors, and does not suffer from secondary breakdown problems, etc.

Let us now enter the world of switching by examining *Fig 5*, where the low ON resistance and fast switching speed makes the power mosfet an ideal device to use in a DC lamp dimming circuit. A VN66AF is driven by a CMOS 4011 square-wave oscillator, the duty cycle of which is varied by the ratio of R1 to R2. The brightness of the lamp is controlled by varying R2 and,

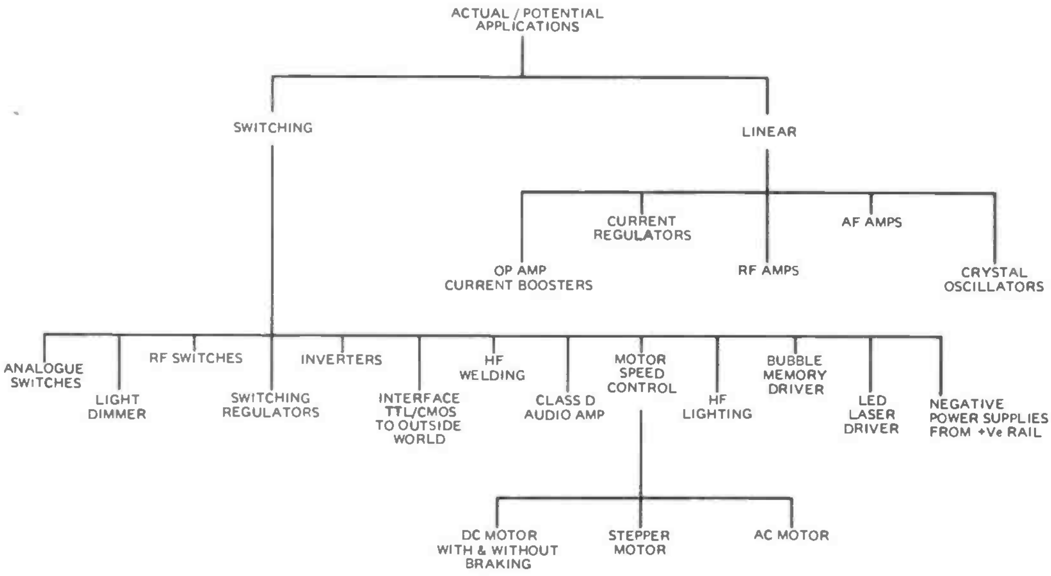


Table 1: Key to power mosfet applications.

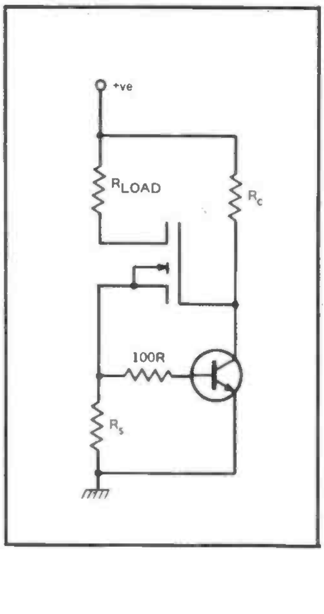


Figure 1: A simple current regulator.

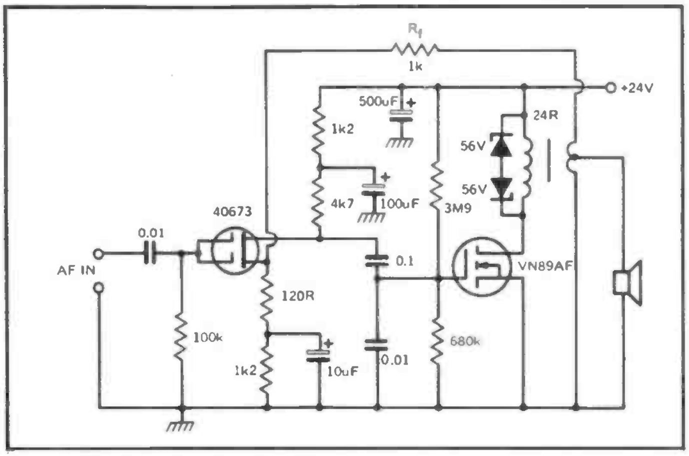


Figure 2: Class A output audio amplifier.

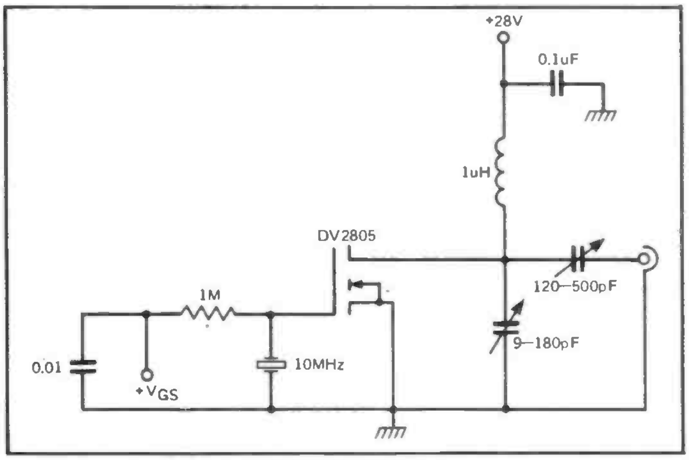


Figure 3: 10 MHz crystal oscillator.

since the VN66AF is either fully ON or fully OFF, it dissipates very little power.

The Class D pulse-width-modulation type of audio amplifier is another ideal application of power mosfets, where their high switching speeds offer great advantages. *Fig 6* shows the basic building blocks of such an amplifier, which offers the possibility of high efficiency coupled with small size and high fidelity.

Using power mosfets in inverter circuits has many advantages, largely because of the following favourable characteristics — no secondary breakdown, high switching speed, parallelability to reduce ON resistance, and low switching losses. Inverters convert DC at one voltage to DC at another. *Fig 7* shows the basic scheme.

It would be a good idea at this juncture to look at an inverter which converts 12 volts DC into 20 volts DC. *Fig 8* illustrates a flyback inverter circuit, at the heart of which is a Pulse Width Modulator (PWM) which provides a control pulse to the VMOS switch in the flyback circuit. The output of the PWM is a pulse whose width (and duty cycle) is determined by an input control voltage, and whose frequency is controlled by an external clock. The input control voltage to the PWM stage is generated by an error amplifier which compares the output voltage of the converter with a reference voltage. The error voltage thus determines the ON-OFF switching ratio of the VN64GA VMOS device, and hence the final output voltage of the circuit. The 'boosted' output voltage is produced by switching the supply via the inductor. The system is in fact a form of servo loop, with the reference and the error amplifier acting as the feedback part.

Figure 9 shows a practical realisation of such a circuit. Using the VN64GA as the power switch, the circuit is capable of generating +/—20V outputs at 35W from 12-16V DC input. U1 is a Schmitt-trigger oscillator with a duty cycle of 50%. The output from U1 is buffered by Q4 and by U2-6 and then used to modulate Q5. Q2 is the feedback amplifier whose reference

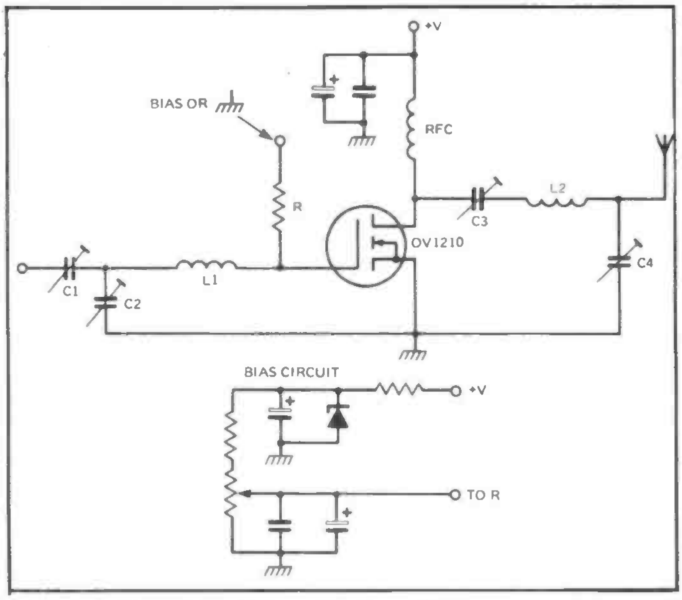


Figure 4: A VHF class AB or C RF amplifier.

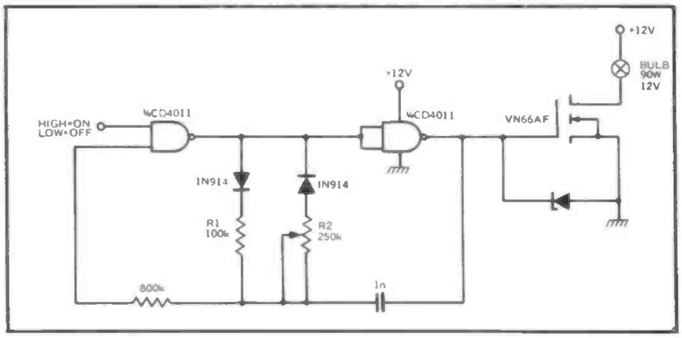


Figure 5: An efficient light dimmer.

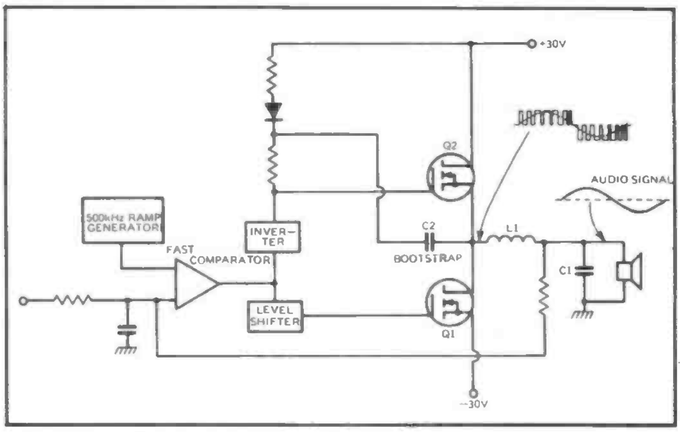


Figure 6: A class D audio amplifier.

voltage is provided by the 18V zener and whose output controls the duty cycle. Q3 and its 21V zener clamp the gate of Q5, preventing the output from soaring if the feedback circuit develops a fault. Q1 and the 1N914 diodes switch Q2's discharge current away from C during the time the inductor's field discharges, thus shortening the period that current is drawn through it.

Figure 10 shows how a VFET can be used to generate a low-power negative supply from a positive supply rail. The circuit acts as a charge pump, with a CMOS 74C14 used as an oscillator drive for a Siliconix VN10KM. When the VN10KN is off, capacitor C charges up to the supply voltage via the 33R resistor. When the VN10KM switches on, C delivers a negative voltage through the series diode which is smoothed by the 10u capacitor and limited to ▶

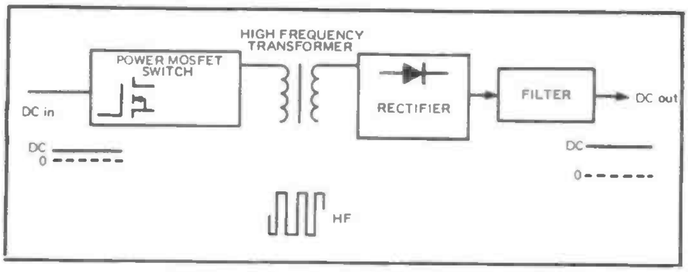


Figure 7: Basic inverter.

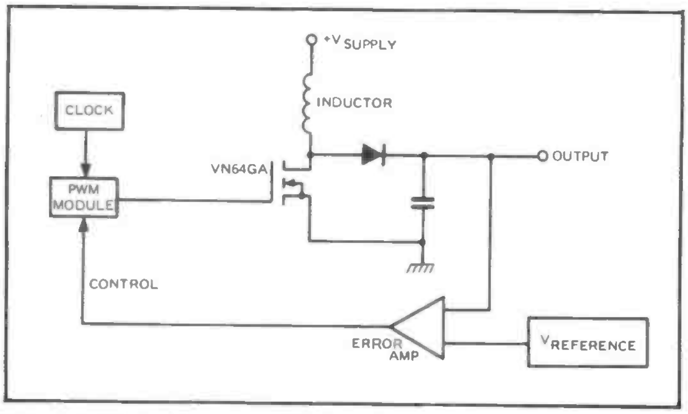


Figure 8: Block diagram of "flyback" inverter.

—5V by the zener. The smart bit about this circuit is that the VN10KM is being switched at 100 kHz, and this allows the system capacitors to be small and the system efficiency to be high.

MOTOR-CONTROL CIRCUITS

One of the advantages of the power mosfet is the ease with which it can be interfaced with microprocessors. One application where this may be usefully employed is in the drive circuitry of a stepper motor (stepper motors can be used for the positioning of record/replay heads in disc operating systems of computer memories). The power mosfets may be placed in the basic circuit of *Fig 11*. Here, control signals placed on gates 1-4 allow currents to flow in the appropriate phases of the stepper motor. Resistors R2 limit the maximum phase current when a higher-than-normal voltage is used to drive the motor windings. The use of this high voltage, which improves the motor's torque at high stepping rates, is called "overdrive".

"Chopper" techniques are more efficient than resistive ones in motor speed control, due to the lack of power loss in the resistors. The potentially high switching speed of the power mosfet may, therefore, be more usefully employed in the circuit of *Fig 12*. The microprocessor is programmed to output the necessary "bits" of information which, when passed through the 74C08 gates and the CD40109 level shifters, rapidly switch the driver VN64GAs on and off. This effectively chops the high voltage (applied to the motor phase windings) into a series of width-controlled pulses, which provide full control of motor speed. The circuit is also provided with an LM319 comparator, whose switching threshold voltage is set by the ratio of R1 and R2 to equal $R_L \times I_{max}$, at which value the phase current of the stepper motor reaches its rated value and the MPU control signals become blocked as the 74C08 gates are turned off.

Advantages of this type of control system include low drive requirements, low power dissipation in the control circuitry, high efficiency, and great flexibility of operation available from the stepper motor.

Let us now look at the electronic control of ordinary DC motors via power mosfets. As you will no doubt remember, there is an integral reverse diode in power mosfets. The diode has as great a current carrying capacity as the mosfet, and its presence is shown in the next few diagrams.

Figure 13 shows a motor-control circuit using a HEXFET.

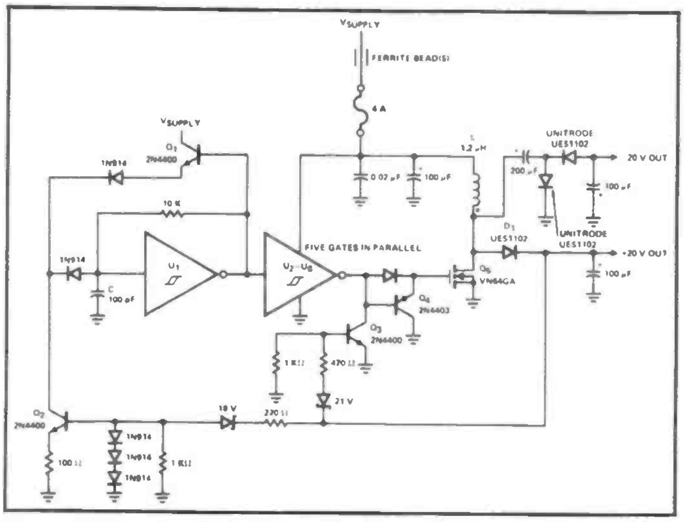


Figure 9: Circuit of DC-DC flyback inverter.

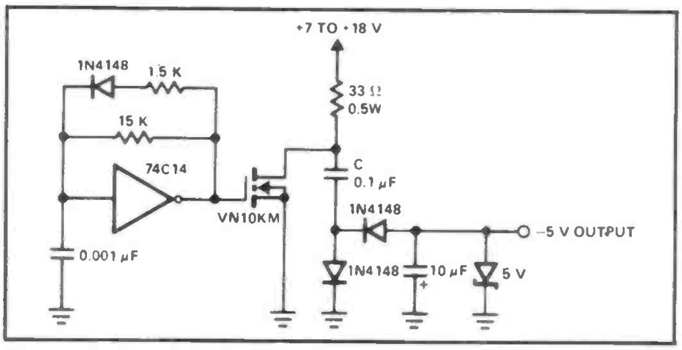


Figure 10: A positive input/negative output charge pump.

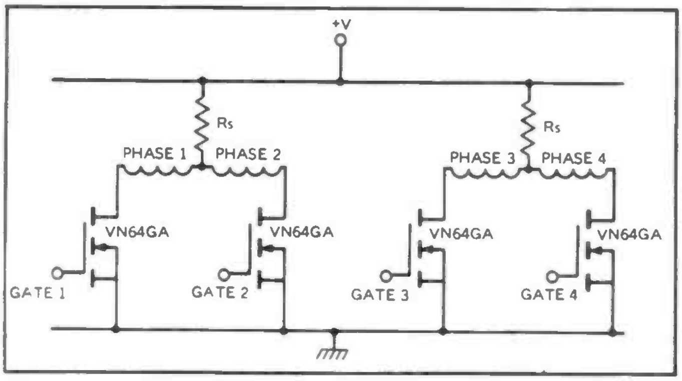


Figure 11: A basic stepper motor control unit.

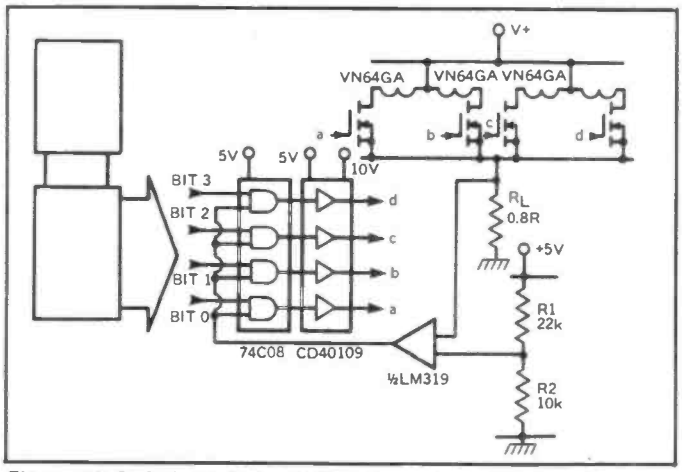


Figure 12: Switch-mode controller employing phase current sensing to block microprocessor control signals to the VMOS power FET array.

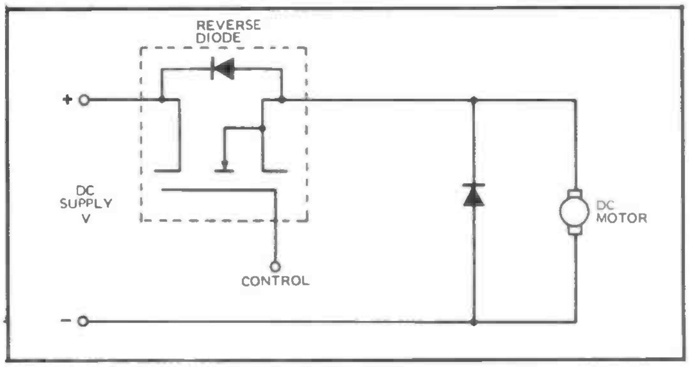


Figure 13: DC chopper circuit for motor speed control.

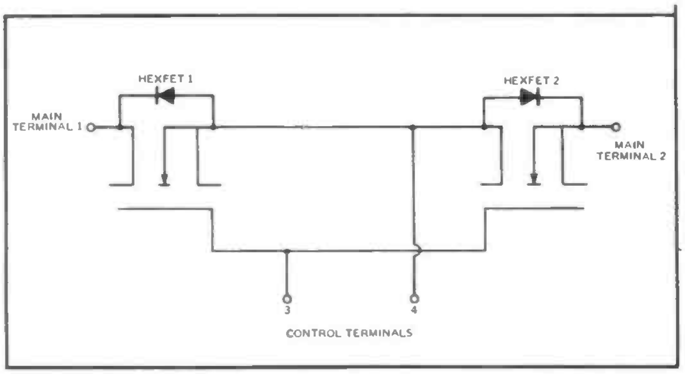


Figure 15: Bidirectional AC switch using HEXFETs.

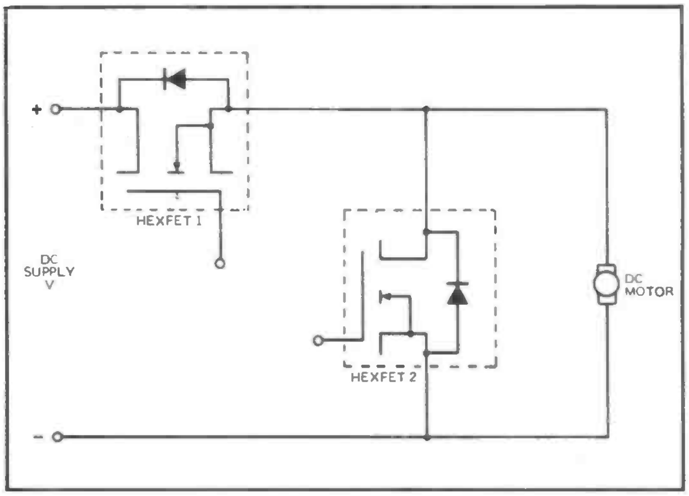


Figure 14: Circuit for providing speed control and regenerative braking of DC motor.

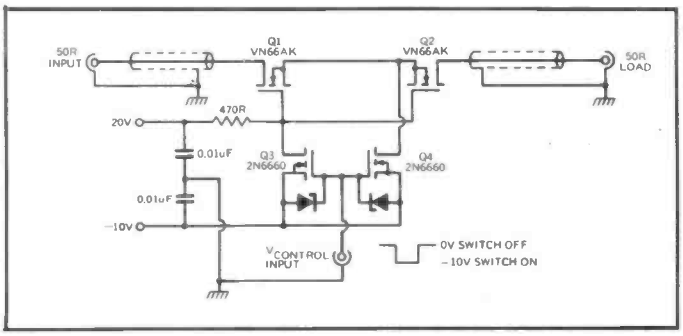


Figure 16: RF switch.

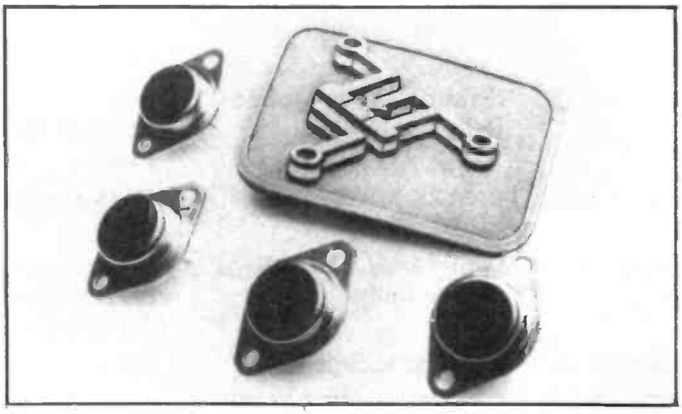
The reverse diode has no significant effect. The DC supply is taken to the motor via the HEXFET, which is switched on and off by a suitable control circuit to its gate (not shown). The ratio of this switching controls the speed of the motor. The diode across the motor damps its back EMF when the HEXFET is instantaneously off, and is called a 'freewheeling' diode.

The *Fig 13* circuit provides full control of the motor speed, but provides no form of dynamic or 'regenerative' braking to the motor. *Fig 14* shows how the circuit can be modified to give such braking. It works in the motoring mode, just as the circuit of *Fig 13*, except that the reverse diode of HEXFET 2 acts as the freewheel diode. In the braking mode, HEXFET 1 is turned off and HEXFET 2 is turned on, thus allowing the motor-generated (dynamo-effect) currents to flow to ground HEXFET 2 thus acts as a 'dynamo load' and provides dynamic braking.

ANALOGUE SWITCH CIRCUITS

The integral reverse diode can also be of use when power mosfets are used in an AC switch, as shown in *Fig 15*. Here, when control terminal 3 (which is connected to the gates of HEXFETs 1 and 2) is positive with respect to terminal 4, both HEXFETs are on. Current flows in via terminal 1 through the transistor of HEXFET 1 and then out through the integral diode of HEXFET 2. In the reverse direction, it flows in through the transistor of HEXFET 2 and out through the integral diode of HEXFET 1. When control terminal 3 is at the same potential, or negative, with respect to terminal 4, the transistors of both HEXFETs are off, and so is the switch. This means that, since the integral diodes of the HEXFETs are back-to-back current cannot flow through them either.

Whilst on the topic of switches, *Fig 16* shows an RF analogue switch which has good performance up to 50 MHz, with turn-on and turn-off times of 50 nS. Isolation at 10 MHz is 60 dB with a 20V pk-pk signal. With a 50 ohm load, insertion loss is only 1 dB. ON-state is brought about by Q3 and Q4 being turned off by placing, via the control input, —10V on their gates (remember this is 0V when referenced to their sources). The sources of Q1 and Q2 become, in consequence, isolated from ground and their gates are pulsed to +20V by the 470R resistors. This rise in gate voltage turns Q1 and Q2 on. When the control input is taken to 0V, the gates of Q3 and Q4 will have a gate potential 10V above their sources, so they turn on. This pulls the gates and source of Q1 and Q2 to —10V with respect to earth plane of the circuit. Since gates and sources are at the same potential, Q1 and Q2 are switched OFF. Their integral reverse diodes are back-to-back, which inhibits signals in either direction. ■ R & EW



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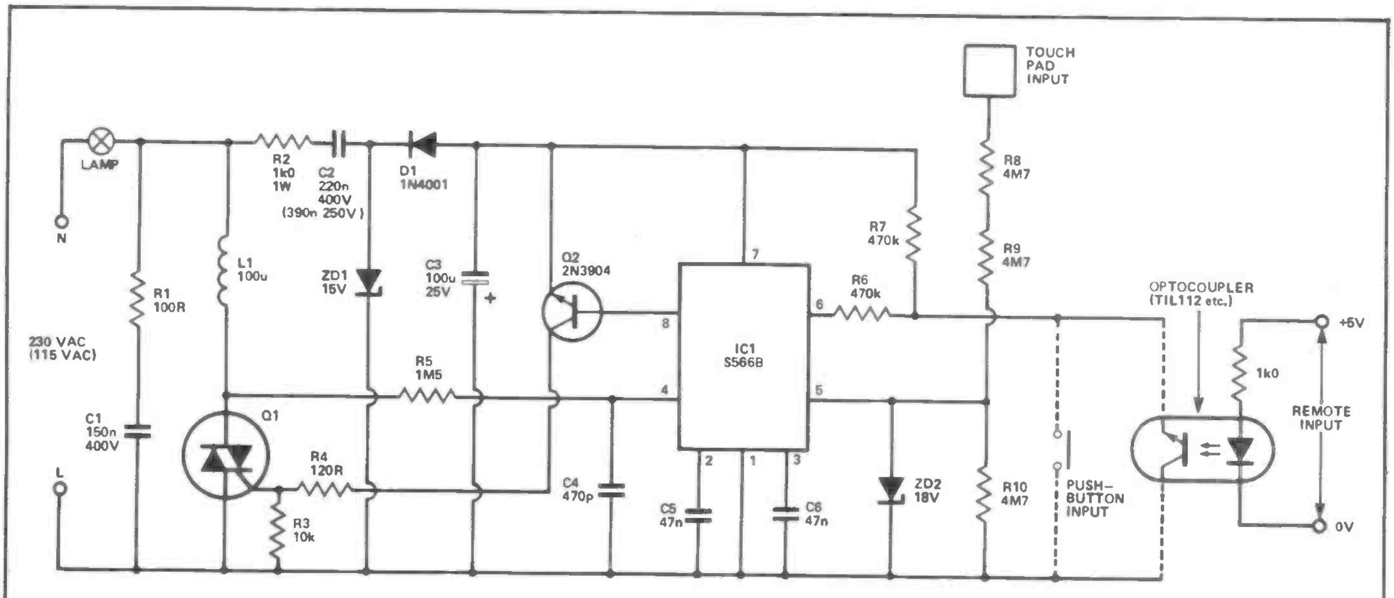
CIRCUIT BLOCKS

A 'smart' lamp dimmer — design by Ray Marston

THIS CIRCUIT SHOWS how a dedicated IC, the Seimens S566B 'Touch Dimmer' chip, can be used as a 'smart' lamp dimmer that can be controlled by either touch pads, push button switches, or via an infra-red link. The action of this chip, which gives a phase-delayed trigger output to the Triac, is such that it alternately ramps up (increases brilliance) or ramps down (decreases brilliance) on alternate operations of the touch or push-button inputs, and 'remembers' and holds brilliance levels when the inputs are released.

The IC incorporates 'touch conditioning' circuitry, such that a very brief touch or push input causes the lamp to simply change state (from OFF to ON, or vice versa), but a sustained (greater than 400mS) input causes the IC to go into the ramping mode, in which the lamp power slowly ramps up from 3% to 97% of maximum and then down to 3% again, and so on. The touch pads used with this circuit can be simple strips of conductive material; the operator is safely insulated from the mains voltage via R8 and R9.



Circuit diagram of the 'smart' lamp dimmer.

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21	22	23	24	25	26	27
28	29	30				

June 13th	Elvaston Castle Mobile Rally	Elvaston Castle Country Park	Ian Cage, G4CTZ, Derby 71875
June 13th	RNARS Mobile Rally	HMS Mercury	A G Walker, G4DIU, 103 Torrington Road, North End, Portsmouth PO2 0TN
June 20th	Denby Dale & DARS Mobile Rally	Shelley High School, Skelmansthorpe	J Clegg, G3FQH
June 27th	Longleat Mobile Rally	Longleat	B L Goddard, G4FRG, Tel 0272 848140
June 27th	Rolls Royce ARC Mobile Rally	Rolls Royce Sports and Social Club	L Logan, G4ILG, c/o 19 Fenton Ave, Barnoldswick, Colne, Lancs BB8 6HB.

NB. Would Rally organisers please send details of forthcoming events to the Editor — and please also include a list of exhibitors.

SELCALL UPDATE

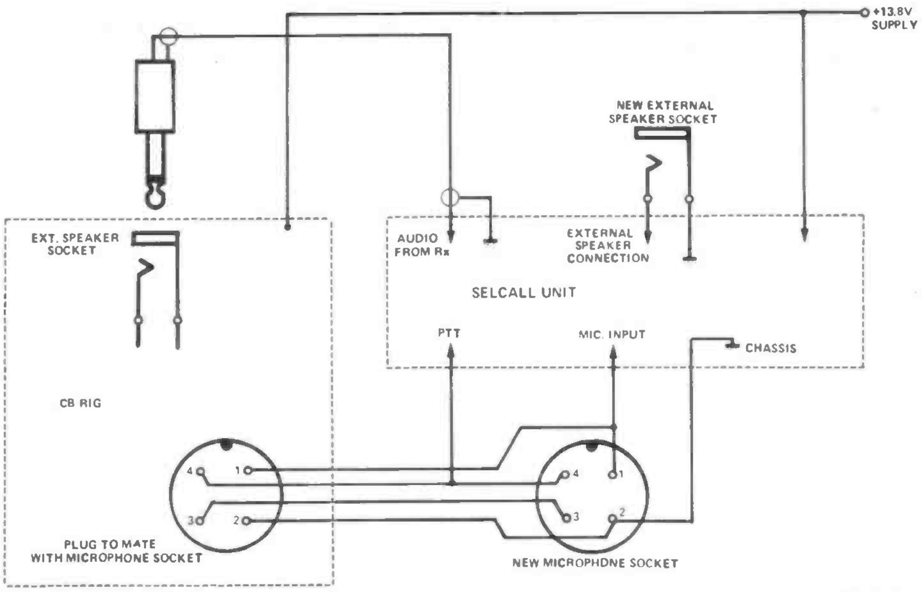


Figure 1: Connecting the Selcall Unit to an Amstrad CB 901.

THE SELCALL UNIT CAN be fitted to most CB rigs with a minor amount of modification, although on some the task is easier than on others. The installation is easiest on rigs that already make provision for Selcall.

A good example is the Shogun which features an external 'Selcall' socket. In this case it is simply a matter of extending the six connections from the Selcall board to a matching plug on the CB rig.

In other cases the Selcall board can be wired into the transceiver, although this necessitates finding the correct connections internally. This is not too difficult if a circuit diagram is available, but in many cases modification of a new rig may be regarded as undesirable.

The alternative is to use connections external to the rig. Generally this can be done by using the output from the external speaker socket, the 13.8 volt supply and the connections available on the microphone socket. The only problem with this approach is that an external speaker has to be used and a spare microphone plug and socket obtained. *Fig 1* shows the connections for an Amstrad CB901 although in practice the diagram applies to other rigs as well, generally the only difference being the order of connections to the microphone plug/socket.

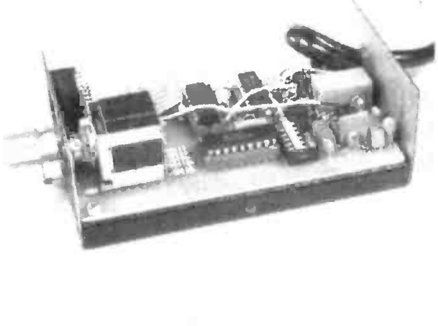
The R&EW Selcall system described last month has proved very popular. As a result of experience gained by building a number of units, Roger Ray looks at the installation and use of the R&EW design.

MODIFICATIONS

Extensive testing of several Selcall units has brought to light a couple of worthwhile modifications. One is to change R4 to 10K this allows the volume control on the receiver to be turned fully up (as long as distortion is not occuring) without affecting the operation of the Selcall unit. It is worthwhile noting at this point that the Selcall will not work if the volume control is set to its minimum position, because it is then not 'hearing' any output from the receiver.

As long as the volume is set to a normal listening position (from quiet to maximum) the Selcall will work satisfactorily, this corresponds to an audio input level between 75 mV and 4 volts p-p of audio. The other modification is to change R10 to 4k7 this makes any loading across the microphone insignificant.

In the original circuit diagram (*Fig 4*) R9 was incorrectly shown as 6k8, it should be 68k as in the parts list. The rail connecting C1, R2, Q1 and R5 is connected to Vcc (8V0). A couple of spurious characters found their way onto the foil pattern (*Fig 8*) the only one of any consequence looks like a piece of track joining pin 6 of IC2 to an adjacent pad, it should be removed if the foil pattern is copied. Also on the overlay (*Fig 9*) C10 and R13 are interchanged in position. VR1 omitted from the component list is a miniature 4k7 preset potentiometer, and R43 a 100k resistor.



Internal View of the Selcall Unit.

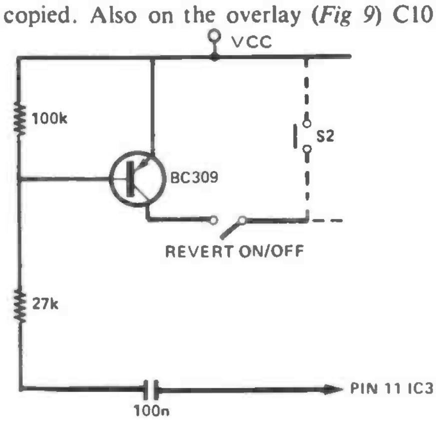


Figure 2: Circuit for adding 'revert' to the basic Selcall.

REVERT

Some interest has been expressed in adding revert to the basic Selcall sytem. For the uninitiated the revert feature will, after a call has been successfully decoded, automatically transmit a Selcall back to the station initiating the call. Adding the additional circuitry shown in *Fig 2* will provide this function. A disadvantage of using revert is that the display will not flash after a call has been received, although the transmitter being automatically activated should provide a similar warning. The 'interrogating' station of course knows the call has been decoded, and as the speaker has been reconnected can converse in the usual way. Depending on how quickly the original call was decoded, it is possible for the reverted call to itself be decoded.

■ **R & EW**

Your Reactions......	Circle No.
Excellent - will make one	23
Interesting - might make one	24
Seen Better	25
Comments	26

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150 to 159.9kHz HC6/U	£11.32	18 to 63MHz (3O/T) HC6, 18 & 25/U	£4.87
160 to 399.9kHz HC6/U	£7.83	60 to 106MHz (5O/T) HC6, 18 & 25/U	£5.61
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800 to 999.9kHz HC6/U	£11.01	150 to 179MHz (9O/T) HC18 & 25/U	£12.75
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Dr. Ian Logan answers the often asked questions.

WHICH COMPUTER DO I BUY — IF ANY

FROM THE ZX81 AT £50 to the Tandy Model III at £500 there is at the present time an overwhelming choice of microcomputers on the market for the hobbyist. But, which one do you buy?

Well as the subject concerns computing let me suggest an algorithmic approach to the problem, that is to say make up a set of sub-problems that when put together result in the correct solution.

DO I NEED A MICRO? (Sub-problem i)

To this question you do really have to make up your own mind. The ad-men would of course say that 'life without a micro of one's own is a life not worth living'. Your friends will all say 'you're not letting me near my own machine so go and get yourself one — or else'. Whereas only the lack of ready money or the pursuit of other activities can stop you. I presume here that no-one is in doubt that the home-micro is the most important step for making since the invention of 'sliced bread' and that we should all become fairly familiar with the capabilities and limitation of microprocessor-based machines.

IS THE CHOICE OBVIOUS? (Sub-problem ii)

Of all the machines on the market there is only one machine — the ATARI - that has been made as a games machine. This machine has genuine high-resolution graphics that are astounding and the machine is cheap (for what it is) because it is being manufactured in huge numbers. Therefore if you want a machine to play 'space invaders' or 'breakout' then look no further, simply buy an ATARI and you, and your machine will be happy ever after.

DO I HAVE MORE THAN £100? (Sub-problem iii)

Again a simple question and if the answer is 'NO' then the action to be taken is also simple. The Sinclair ZX81 with 16K RAM, is a superb machine for its price, and no-one who is limited by the amount of money that they can spend on a microcomputer should ever have any regrets about buying one of these machines.

DO I NEED A PROPER KEYBOARD? (Sub-problem iv)

A pure hobbyist can always survive with a machine that does not have a full-size 'QWERTY' keyboard but if there is a wish for a large keyboard, or the tasks for which the computer is going to be used involve a lot of keyboard use, then do not buy a ZX81 or a SHARP machine.

DO I NEED COLOUR? (Sub-problem v)

'Colour is beautiful' and adds a whole new dimension to microcomputing as it used to be on the ZX80/81, ATOM, PET & TANDY etc. Nowadays there are available the VIC-20, the BBC

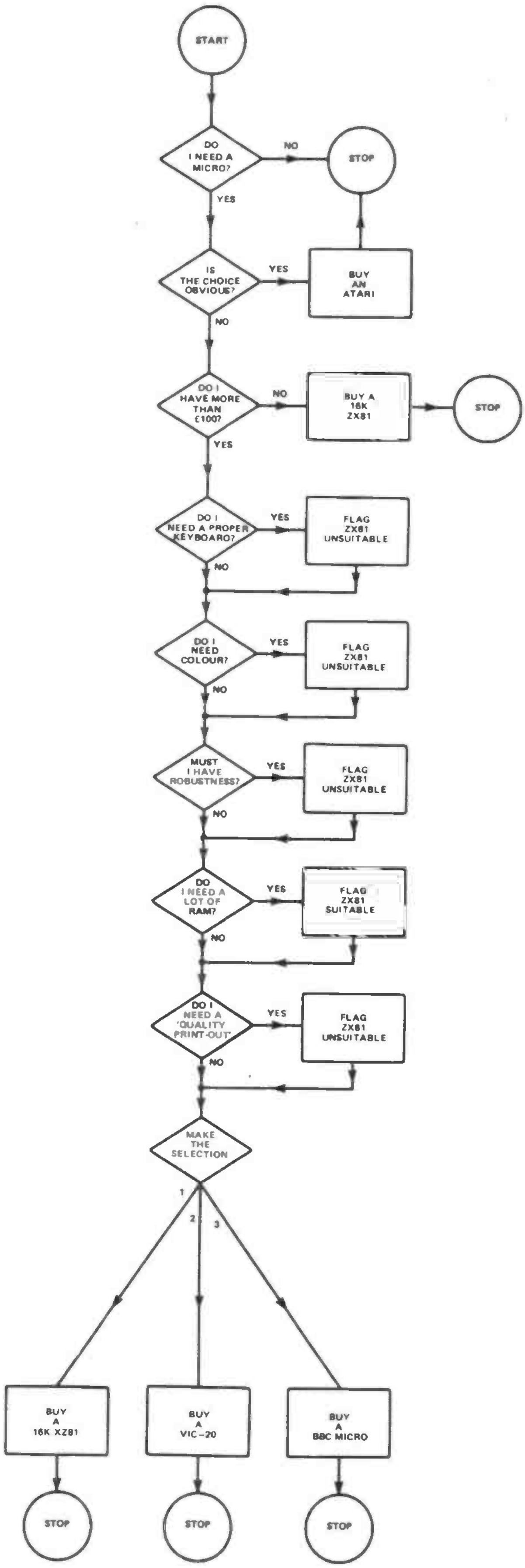


Figure 1: Follow the flow chart through to decide which of the three micros covered in the text is most suitable for your purposes.

micro and the TANDY COLOUR, and each of them will perform marvellously, but colour is expensive, as compared to black and white. The answer to the question is, I feel, very easy to answer. Unless you cannot afford a colour machine and TV then do not consider any of the black and white machines.

MUST I HAVE ROBUSTNESS? (Sub-problem vi)

In many ways 'robustness' in a machine is just a reflection of the price. A Sinclair ZX81 is not a robust machine — it has to be handled carefully, it has to be matched to a suitable cassette player and even then it is prone to mains interference and can turn off only too often. However all the other machines on the market are robust although the use of some of them result in a maze of wires going hither and they can no longer be considered to be very portable.

DO I NEED A LOT OF RAM (MEMORY)? (Sub-problem vii)

It is strange to find that it is the cheapest machine available — the ZX81 — is the one to which it is easiest to fit a lot of RAM but there are really very few occasions when more than 16K of RAM is wanted by the hobbyist.

DO I NEED A 'QUALITY PRINT-OUT'? (Sub-problem viii)

Once again this question leads the user to the more expensive machines. The ZX81 printer is a fine machine for the £60 that it costs but it hardly gives a 'quality print-out' and even the standard VIC-20 printer which is good value for its £200 still produces a 'type' that obviously comes from a computer.

As the market is at the present time, a user requiring a fine printed copy must expect to be paying considerably more for his printer than ever he does for his micro.

MAKE THE SELECTION (Sub-problem ix)

The following comments on the different machines available should now enable the prospective buyer to come to his/her decision.

THE BOTTOM LINE

It is certainly the author's opinion that the three machines detailed in *Table 1*, are at the present time, the only machines that are worth considering. Although there are many other machines available to which due credit for their particular advantages has perhaps not been given in this article.

POSTSCRIPT

The news of the Sinclair Spectrum and the additions to Commodore's range of machines mean that this picture of the choice available to those wishing to purchase a computer is likely to change over the next few months. The machines mentioned here are, however, available at the present time while delivery dates for the Spectrum and VIC10s and 30s are still an unknown quantity.

We'll return to this subject in a few months time and see just how the market has changed.

SINCLAIR ZX81 — a magnificent machine for the price. Available for under £100 with 16K RAM included.

Advantages —	Real computing power. A fine BASIC. Easy to program in machine code. Value for money.
Disadvantages —	A fragile machine. A miniature keyboard. Black & white display only.

VIC-20 — A colour machine that is widely available (£180 — 5K RAM).

Advantages —	In colour. Big keyboard. Very nice to use. Rather tricky to use machine code but very possible.
Disadvantages —	Very small user RAM on basic machine. The BASIC is a little 'dated'. POKE instructions have to be used to change the colour and the sound and hence it is possible to 'crash' from BASIC. No syntax checking line-by-line. A really terrible handbook

BBC MICRO — A fine colour machine. (16K for about £300.)

Advantages —	In colour Big keyboard. Machine code programming is simple. The BASIC is very 'advanced' (well its new)
Disadvantages —	The most expensive of these first three machines. The BASIC is complicated (perhaps an advantage rather than a disadvantage?). A new design so still having teething troubles — and there will continue to be more and more.

TABLE 1

■ R & EW

Your Reactions

	Circle No.		Circle No.
Immediately Interesting	38	Not Interested in this Topic	40
Possible Application	39	Bad Feature/Space Waster	41

A CLOSER LOOK AT FIVE MODELS

Last month we discussed the general principles behind Colour TV transmission systems and the way in which the different, competing, domestic video recorders set about recording TV signals. This month we look at four current models in more depth, with an eye to the quality of recording they offer, and at another machine's performance over an extended period of time.

Video Recorders

PANASONIC NV2000

PANASONIC
Typical Retail Price
£499

The Panasonic is a VHS machine, that although budget in price, offers a good range of facilities. The most notable feature on a machine of the NV2000's price is the provision of picture search, although this only operates in the forward direction. The timer is of a limited one event type although this can be set up to 14 days in advance.

Setting up the machine was an easy task and once in operation the picture quality was acceptable although chroma noise and displacement was more evident than on the two Beta machines.

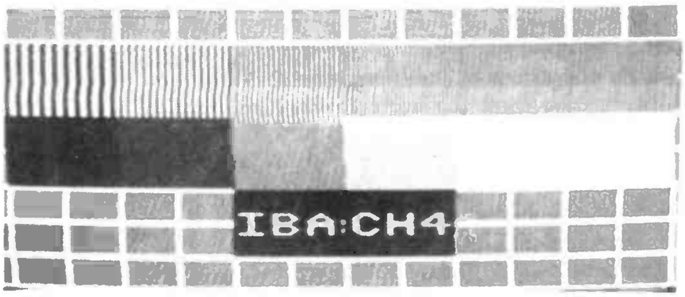
Sound quality was, as is usual with video recorders that do not feature Dolby, and lamentably few do, marred by a poor S/N ratio.

Clean edits were possible with the machine, a facility which is a must for anybody wishing to use a recorder for anything other than just recording off-air programmes in their entirety.

The freeze frame performance of the machine was marred by noise bands as was the fast forward search function. This problem is apparent on most VHS and Beta machines and the NV2000 was about the same as the other machines in this respect.

The machine lacks a memory device on the tape counter, a minor ommision, but also lacks remote control which some might regard as a major minus point but very few budget machines provide this facility.

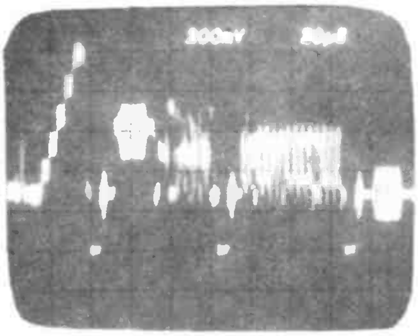
The NV2000 machine provides an adequate performance at a low price and the inclusion of a fast search facility might tip the balance in the machine's favour when selecting a recorder from this price band.



Off air

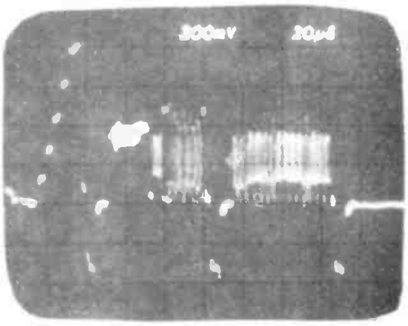
Playback

To assess the video frequency bandwidth of each machine the series of frequency gratings (at 1.5, 2.5, 3.5, 4, 4.5 and 5.25 MHz) from the IBA Channel 4 test card was photographed 'off-air' and during playback.
The 'scope pictures show the engineering test signals, transmitted 'teletext' like during the vertical blanking period. They provide a good test of a recorder's record/playback performance.



BEFORE: The engineering test signal. Part of this pattern is a signal at colour burst frequency, occuring here during the second line.

AFTER: Note the reduction in the amplitude of the colour burst test waveform.



Video Recorders

SANYO VTC5300

SANYO
Typical Retail Price
£450

Sanyo adopted the Betamax format for their machines and the VTC5300P is their low/middle of the range recorder. The model features a relatively limited one event, seven day timer, and an eight channel manual tuner although, thankfully, the low price of the machine does not mean mechanical piano key transport controls.

Initial setting up is aided by a test signal generator and aligning the recorder's eight channels by means of small rotary presets is a quick and straightforward operation.

The picture quality of the VTC5300P matches the best that can be expected from a domestic format recorder with negligible chroma noise/displacement and an adequate resolution.

The sound S/N ratio was acceptable although not Hi-Fi, but this is an area in which all domestic video recorders fall short of the ideal. The transport controls were reliable in operation and a record interlock prevents accidental recording — a useful feature.

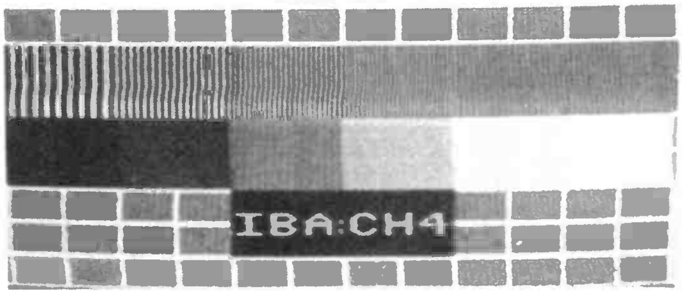
The pause facility allows clean edits to be produced.

As mentioned above, the timer is rather limited, in fact about as limited as possible, this does however mean it is easy to set up although the machine's prompts as one goes through the setup operation are not as comprehensive as those found on many other models.

The Sanyo machine provides a full range of audio and video input/output connections the video connections being made via BNC connectors a much better system than the phono plugs used for video input on some machines.

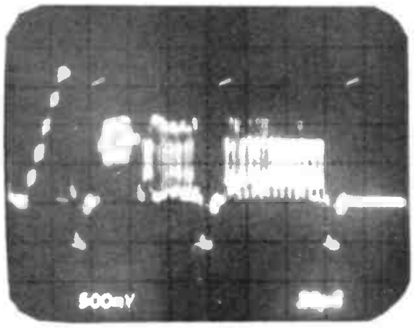
Missing from the VTC5300P is a search facility which of all the 'trick' functions is the most useful, but this, the limited timer and the lack of remote control are the only clues as to the budget nature of the Sanyo machine.

The VTC5300P offers excellent value for money with its low price being achieved not by any sacrifices in performance but by discarding some of the extra gimmicks found on its more costly relatives. If finance is limited and £100/£200 seems a high price to pay for search facilities and remote control then the Sanyo model should be near the top of any shopping list.

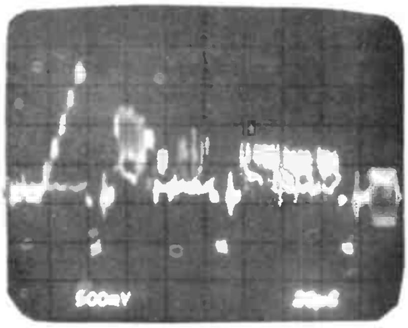


Off air

Playback



BEFORE



AFTER: Once again a recorded test signal confirming the acceptable performance of the 5300, although this is not as good as that of the C7.

Video Recorders

SONY C7

SONY C7
Typical Retail Price
£599

The SONY N7 is pictured with its budget price range relative the C5.

The Sony C7 is the flagship of Sony's range, indeed of the Betamax camp, although competition for this honour is hotting up. The model features all the 'trick' facilities expected in a top of the range machine (picture search, still frame, slow motion etc) as well as a comprehensive, four event, 14 day timer and full logic control of transport functions.

The C7 is easy to set up, an in-built test signal generator aids alignment of the TV set while the recorder's 12 programme channels are brought in with a straight-forward to use electronic tuner.

The picture quality of the C7 was excellent with good definition and little in the way of chroma noise or displacement. Sound quality was not as good however, with a lower than average S/N ratio and slight vision on sound.

The pause function and the ability for switch to record with the machine put into pause from the play mode means that the machine is capable of producing excellent edits with little in the way of sound/vision disturbance.

The timer was versatile and easy to master although as ever it pays to read the instruction book carefully as it is in this area that most people seem to have problems when encountering a new machine.

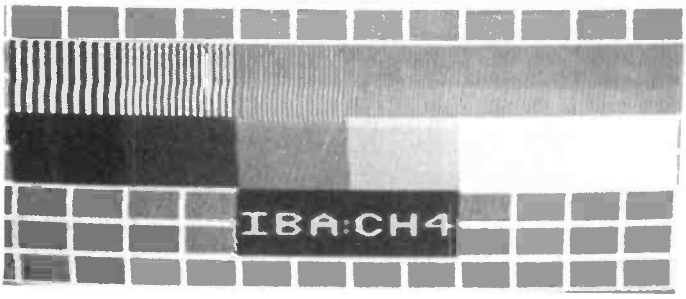
Noise bands were present on all 'trick' speeds with the exception of x3 although the picture was still perfectly viewable and without the dynamic track following techniques of the Video 2000 format these will always manifest themselves in fast/slow modes.

The remote control unit offers control of all the machine's functions via an infra red link and should be considered a must on all but the lowest priced of machines.

Our review model ran very hot with a 'hot electronics' smell becoming obvious after the machine had been running for half-an-hour or so but this did not seem to affect the performance of the C7 in any way.

The Sony C7 is a well made machine offering many 'luxury' features combined with a sensible, ergonomically pleasing arrangement of controls. It offers excellent picture quality, rivalled only by the Sanyo and would have been the best of the models reviewed here if it were not for the sound problem referred to above.

The C7 should be a serious contender for anyone considering the purchase of an up-market video recorder.



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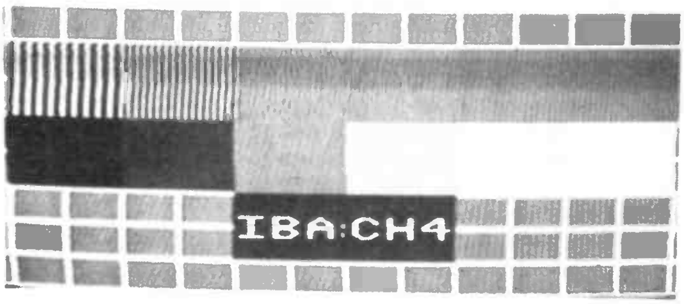
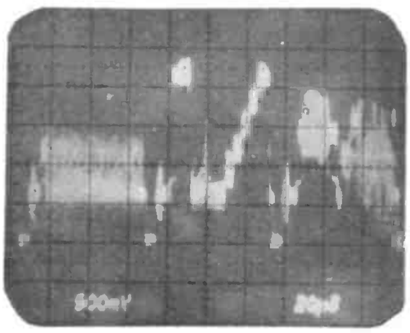
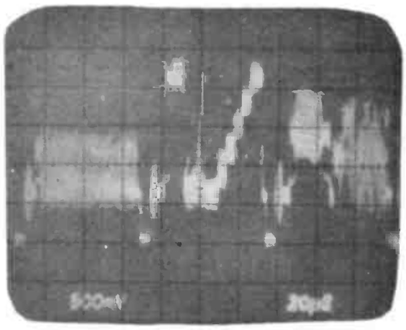


Playback



BEFORE



AFTER: The superior performance of the C7 is confirmed by a test signal showing very little degradation on playback.

Video Recorders

ITT 580

ITT
Typical Retail Price
£550

The Video 2000 format came to the market late in the day and these machines have a lot of ground to make up before rivalling VHS and Beta recorders in terms of consumer popularity. The ITT580 is derived from the Philips VR2020, Philips together with Grundig having developed the format.

The most obvious difference between the Video 2000 system and the other domestic formats is that the video tape is used in the same fashion as an audio tape, being turned over at the end of one side to offer a 2 x 4 hour recording capability from one tape.

This machine was the least liked of those we saw with the picture quality being particularly bad although after the machine had been in use for some time and the heads had 'worn in', some improvement was noted.

Audio quality was better than average with the quoted S/N ratio being some 10 dB better than the average.

The controls of the machine show a remarkable lack of thought, with the tuner and timer being extremely difficult to set up and use. After a lot of practice however, the five event 16 day timer can be fast to use.

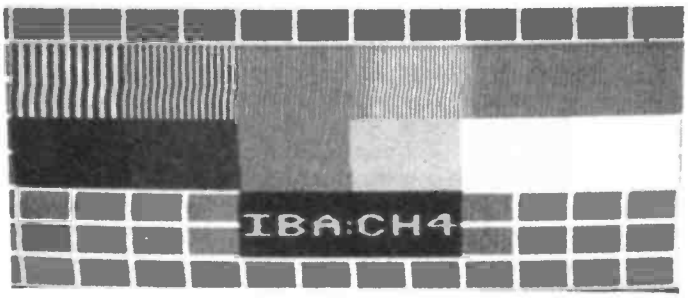
The GOTO facility enables the recorder to locate any spot on the tape which is useful and is a feature found only on V2000 machines.

The Dynamic Track Following that is a part of V2000 system means that the still frame and fast speed performance of the machine is superior to that offered by VHS and Beta machines, quality being about the same as that in the play mode.

The machine may be used with an optional remote control unit (infra red) which is a very useful extra to have on any video recorder.

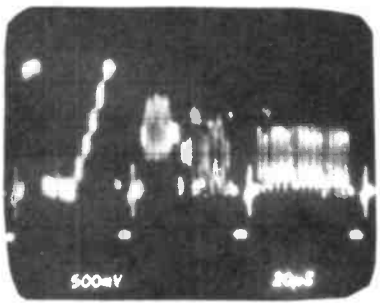
A major draw back in many circumstances, other than straightforward off-air recording, is the lack of any audio/video in/out facilities.

The ITT 580 was the least liked of the four machines and the feeling was that until the Video 2000 format machines begin to offer a better quality picture they cannot be recommended. Add to this the 580's unnecessarily complex tuner and timer controls and you have a machine that is neither easy to use nor capable of producing an acceptable record/playback performance.



Off air

Playback



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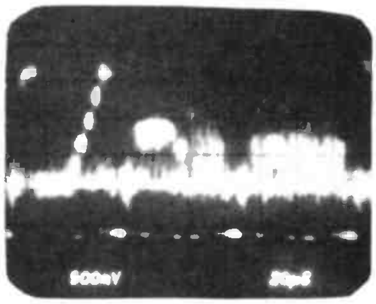


AFTER: Need we say more?

Video Recorders

HITACHI 8500

Gary Evans takes a long hard look.

Most reviewers of video recorders have the machines in their possession for only a week or two before having to produce their report. During this time a skilled reviewer, and there are few of these about, can give a good ipression of how the machine behaved and how well it is likely to perform in a domestic environment. They may also measure a recorder's performance with regard to video bandwidth, chroma noise/displacement and audio channel quality.

What this sort of review *cannot* do is to comment on a model's behaviour over an extended period of time wth particular regard to reliability.

I have used an Hitachi 8500 VHS machine for over a year and what follows is a subjective view of my time with the machine, a time during which it has been subject to moderately heavy use.

OVERVIEW

The 8500 has recently been replaced by the 8700, although it may still be available. It is the same machine as that rented by Granada, in which case it is known as the WH3.

The recorder comes towards the 'top of the range' in terms of features offered, having a five event, seven day time (perhaps rather limited by current standards) and a range of playing speeds, still/pause etc.

GETTING ACQUAINTED

The machine was straightforward to set up having a built-in test signal generator — producing the familiar black and white split screen — to aid tuning a spare TV channel to the frequency of the recorder's RF modulator. The modulator's output can be varied between channels 30 and 39, useful if its output happens to be near an occupied channel as in this case, on screen patterning would result.

As always it pays to read the manual before starting to set up the recorder as any problems likely to be encountered are probably dealt with on its pages.

From experience gained with a number of machines it probably also helps if the remote control unit is not removed from its packing until the basic operation of the machine has been mastered. At first the 8500 refused to move from the STOP position despite numerous attempts to coax it into operation, the reason being that some playful little fingers were at work with the remote unit.

The Hitachi has a *memory* facility which will stop the machine when the counter reaches 0000 during a fast forward/reverse operation. This facility is nowhere near as useful as *index* which records a short signal on a control track, at the start of each recording. This facility is used extensively but can be rather temperamental. When winding back/forwards through a tape with a number of index pulses the machine, after having stopped, seems to 'stick' on the index pulse. Several operations of the appropriate function button are necessary to get it going again.

GOOD TIMING

Operation of the timer caused a certain amount of initial confusion, and can still do so in lax moments. The complication is caused by the fact that it is a 12 hour timer and hence requires the use of AM/PM commands. Normally not a problem but one that can manifest itself while recording the late night movie. To record a programme starting at say 23:30 Sunday and ending at 01:00 Monday the sequence is

SUN
11 ENTER 30 ENTER PM
01 ENTER 00 ENTER AM
CHANNEL

This seems unnecessarily complex a complexity that could be removed by the use of a 24 hour timer.

The IR control unit is used most of the time and duplicates all front panel controls with the exception of CHANNEL, the remote sequentially switches channels.

Tuning in the 12 TV channels was simply a matter of adjusting the corresponding manual presets hidden behind a hinged panel at the front of the machine. The Hitachi's tuner appears to be slightly less sensitive than that of the Sony 14" portable the recorder is used with, and this, coupled with a slight insertion loss if the aerial signal is simply fed through the 8500, means that in all but the strongest of signal areas an adequate aerial is essential.

END OF STORY

Over a period of more than a year the 8500 has given an excellent performance with no notable degradation in performance. The quality of playback matches that of most recorders and apart from noise bars on 'trick' speeds (a problem common to most VHS machines) is of excellent quality. The tape transport has been faultless in operation, and has not caused any damage to tapes to date.

My experience with this machine has shown that any fears of rapid head wear and consequent lowering of playback quality or of mechanical/electronic reliability in such a complex machine were unwarrented.

LOADED WITH FEATURES

The machine is top loading with a smooth well damped cassette mechanism and full logic control of all functions with LED indicators to show in which mode the machine is operating. The transport system has not failed once and is quite happy to go from Fast Forward Search to Fast Reverse Search without any sign of complaint. Despite using some old, well worn cassettes the machine has not shown any tendency to chew these to pieces the only sign that the tapes are past their best being an increase in video drop outs — only to be expected.

One feature that would be a welcome addition to the machine is a system whereby the user would receive an audible warning if attempting to record with a cassette that has had its record prevention tab removed. Piano type transports give an immediate, tactile, indication of this state of affairs whereas the Hitachi merely ignores the record command and goes to play a close eye on the LED s is necessary if one is to be aware of the problem.

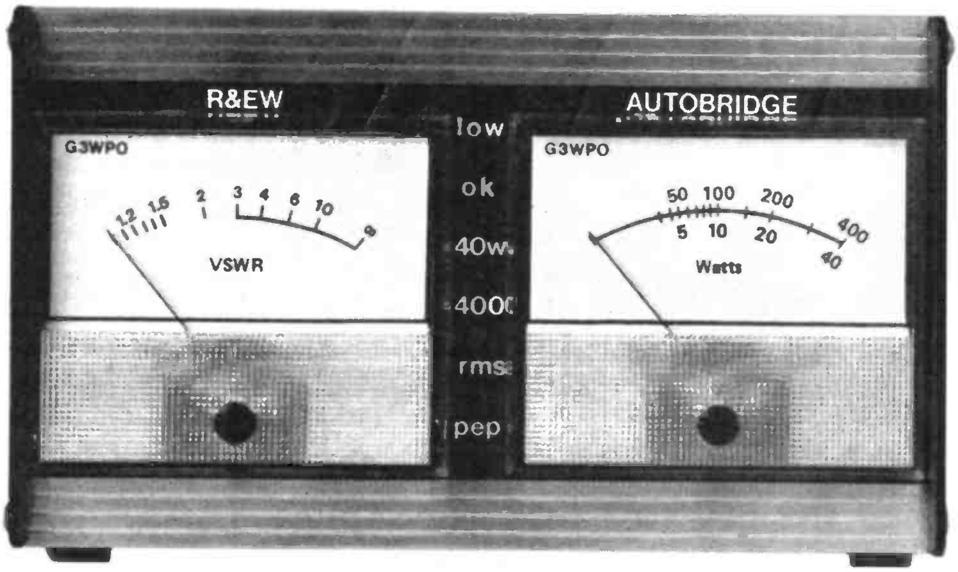
The Hitachi looks like going on for a long while yet and when it does eventually become obsolete Hitachi will be firm favourites to supply the new video.

Your Reactions..........	Circle No.
Immediately Interesting	104
Possible application	105
Not interested in this topic	106
Bad feature/space waster	107

AUTOBRIDGE

An automatic power tracking VSWR bridge and self-ranging rms/peak power meter.

Design by Tony Bailey, G3WPO.



FEATURES

* Twin meters — one for VSWR, the other for Forward Power
* Self tracking of power on VSWR — no adjustments needed for continuous VSWR indication from 4W to 400W output over 1.8 - 54 MHz
* 2 power scales — 40W and 400W FSD — automatic range selection incorporated
* RMS or peak power indication — the latter allows steady readings on SSB (or CW)
* LEDs for status indications
* Wideband current transformer for RF sampling — may be located remotely if required.

HOW MANY TIMES HAVE you wished that while tuning-up your transmitter, you didn't continually have to calibrate the VSWR scale whilst simultaneously adjusting the ATU, or that you could see the peak power output reading steadily on SSB?

Here is the answer to your problems — the AUTOBRIDGE.

SOME NOTES ON VSWR MEASUREMENT

This is a subject that has had a lot written about it, and where misconceptions abound with the majority of people.

The prime purpose of your VSWR bridge is not to indicate the VSWR present at the aerial — the actual VSWR at the antenna feed terminals is often vastly different to that at the transmitter end, depending on the cable loss and its length at the frequency in question. What it will do is enable you to adjust (either by pruning the aerial or by using an Aerial Tuning Unit) the load impedance seen by the transmitter to its design value — normally 50 ohms.

Maximum power can then be delivered by the transmitter to the feeder — NO AMOUNT of adjustments at the transmitter end will have ANY effect on the VSWR of the feeder itself. If you measure the VSWR on your multiband aerial plugged straight into the bridge as 10:1, then insert an ATU after the bridge and adjust for 1.2:1 VSWR, the VSWR at the end of the feeder into the ATU is still 10:1.

This matching adjustment becomes of more importance with modern rigs having semiconductor output stages, where a VSWR in excess of as low as 1.5:1 will cause degradation of the power output, either by automatic circuitry incorporated in the rig, or by pure mismatch of the output stage.

Many people have it in their minds that obtaining a 1:1 VSWR ratio is a matter of life or death and without this vast quantities of power are being lost somewhere!

Consider for a moment that a VSWR of 1.3:1 represents 98.2% of the available power being delivered to the load, and that an increase of one half of an 'S-point' at the receive end requires a doubling of your power output, and you may reconsider this opinion!

BASIC VSWR MEASUREMENT

The operational principle behind all VSWR bridges is that a sampling device looks at the feeder and produces two voltages - one proportional to the forward power in the line and the other to the reverse power. The reflection coefficient is then obtained from the formula:

$$r = \frac{\text{V reflected}}{\text{V forward}}$$

For most instruments, the VSWR is shown this is derived from the formula:-

$$\text{VSWR} = \frac{1 + r}{1 - r}$$

The method of sensing the RF voltages is usually down to one of two options. In the first, a short (relative to frequency) pair of coupling lines are used adjacent to the centre conductor of a coaxial line. While these can give excellent results, they suffer from the problem of being frequency sensitive, and the output increases as the length of the coupling lines become a more significant part of a wavelength as the frequency gets towards the high or low end of the range.

The method used in this instrument is the alternative of a toroidal current transformer T1 (*Fig 1*). In this, a transformer is used for coupling to the line, with a short length of coaxial feeder acting as a 1-turn primary, and a secondary winding wound on the toroid itself.

The outer conductor of the coax is earthed to form an electrostatic shield, with the secondary coupling to the magnetic component of the leakage field around the short length of coax.

In order to be able to generate the required voltages, the load on the current transformer secondary is centre tapped by R1 & R2, causing equal but out of phase voltages to appear at each end of the secondary winding. If a voltage, derived from a capacitive divider sampling the transmission line, and adjusted to be equal to the voltage developed across one half of the secondary, is now fed into the centre tap, under matched conditions the in-phase voltage will be doubled (forward voltage) and the out-of-phase voltage nulled (reflected voltage),

Any change in the load from this matched condition will cause the transformer to become unbalanced, and corresponding changes will occur in the voltage outputs.

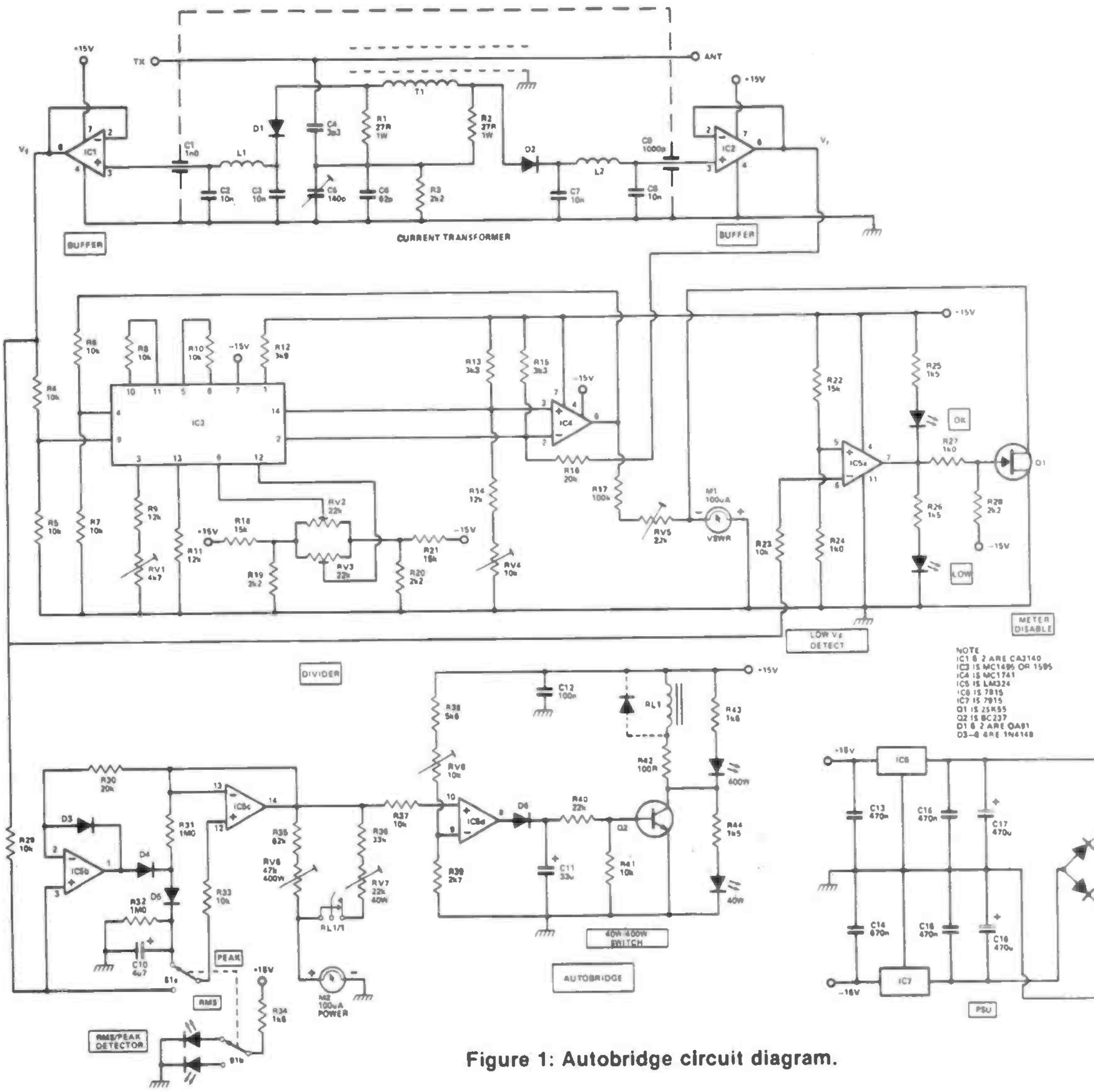


Figure 1: Autobridge circuit diagram.

CIRCUIT DESCRIPTION

Referring to *Fig 1*, the heart of the instrument is IC3, a monolithic analogue four-quadrant multiplier. Readers interested in the full data on this chip are referred to the Motorola Data Sheets which provide comprehensive information on theory and application circuits from which this circuit was designed.

In essence, the chip has two inputs, X and Y (pins 9 and 4 respectively). Reference currents are established into pins 3 and 13 (I_3 and I_{13}). The differential output current is then given by the formula:

$$1_A \cdot 1_B = \Delta 1 = \frac{2V_XV_Y}{R_XR_YI_3}$$

Where IA and IB are the currents into pins 14 and 2 respectively, and Vx and Vy are the X and Y input voltages at the multiplier input terminals.

However, the Autobridge requires division rather than multiplcation, but by placing the multiplier in the feedback path of an operational amplifier (IC4), as a divide or ratio function can be obtained.

The operational amplifier will maintain a "virtual ground" at the inverting (-) input, and conveniently provides the single ended output voltage required to drive our VSWR meter, with the output voltage from pin 6 of the op-amp being the ratio of Vz to Vx.

The quoted linearity of the MC1495 is 2% as a multiplier, but in the divide mode, this accuracy is strongly dependent on the setting-up accuracy of the circuit, and is also governed by the magnitude of the voltage appearing at the X input.

Below about 0V5, the accuracy degrades rapidly and this is used as the lower limit for the metering circuit - at 0V1 input this inaccuracy is of the order of 200%. As the inputs have 2:1 resistive dividers (R4/5, R6/7) 0V5 is equivalent to 1V from the RF sensor or about 4 watts of power.

The upper limit of voltage for the X input is set by circuit design, and in this case is 5V0, or 10V at the RF sensor. This equates to over 400W, and so the bridge is capable of continuously measuring VSWR over a 100:1 power range, from 4 to 400 watts.

There are 4 presets associated with the divider, RV1 controls the scale factor or the magnitude of the output voltage compared with the ratio of the input voltages, here set at 0.1. RV2 and 3 are output offset adjusts for the multiplier input internal op-amps, and RV4 the multiplier output offset adjust.

Having looked at the heart of the design, the remainder of the circuit can now be examined.

T1 is the current transformer mentioned in the introduction, with the primary formed by a short length of RG58-U coaxial cable, the outer earthed as an electrostatic screen. The secondary is wound on a small ferrite core, using 18 turns of 0.56mm enamelled copper wire. It is important that the correct grade of ferrite is used in a current transformer -several designs have appeared using dust iron toroids — these are unsuitable and, in theory, are unusable for such applications!

The important points in the design are that the material has a high permeability, and that the secondary winding has sufficient inductive reactance at the lowest frequency of operation. At higher frequencies, the ferrite core itself plays less and less of a role until it becomes electrically invisible. The limitation then becomes the interwinding capacitance of the secondary at high frequencies.

The transformer will generate approximately 10 volts of output at 400W of RF, sufficient to drive IC3 as designed.

R1 and R2 are the transformer load resistors and should be 5% tolerance types (1W rating each), R3 providing a DC return for the detector diodes, D1 and D2. These are germanium, type OA91, and should be matched for forward voltage output using the circuit of *Fig 2* to avoid tracking errors between the forward and reflected voltages.

The RF sampling head is located in a separate die-cast box for efficient screening, the circuit constructed on the foil side of a printed circuit board. The rectified and RF filtered DC voltages from the head are fed to the main circuit via feedthrough capacitors C1/C9. ▶

If required, the sampling head can be located remotely from the indicating unit, either to place it close to the transmitter output, or possibly at the feed point of the aerial if measurements are required at this point. In the latter case, additional RF filtering will be required on the indicator proper to remove any RF picked up on the leads.

To avoid any loading effects on the detector diodes, both outputs are buffered by FET op-amps ICI and 2, connected as voltage followers and providing a low impedance output to drive the measurement circuitry.

As mentioned, the computing circuit is innacurate below about OV5 input, so IC5a, one section of an LM324 quad op-amp, detects voltages below 1VO (prior to the 2:1 divider) and drives status LEDs to indicate whether the input voltage is within range. This output also drives Q1, a 2SK55 FET, which disables the meter by shorting it to earth when the input voltages are out of range, preventing display of erroneous readings. Due to the extreme sensitivity of the divider circuit at very low input voltages, this also masks the random readings which will occur with no voltage inputs.

POWER MEASUREMENT

The remainder of the circuit is concerned with the RMS or peak measurement of power output. The current transformer has a broadband response over the frequency range of interest, so V forward can be used to determine the forward power output in watts. As the detector diodes have a non-linear output below about 1VO, the lower limit of accurate power measurement coincides with the VSWR low limit indication, so 4W is the lower limit of useful power indication.

IC5b and c provide the peak/RMS detector circuit. In RMS mode, IC5b is out of circuit, and IC5c functions as a voltage follower, driving the indicator meter, M2, via the calibration networks R33/34, RV6/7. IC5b is switched into circuit in peak mode, and drives the peak detector R28/D3/D4. C9/R30 provide a long time constant on IC5b's output, which in turn drives IC5c via the selector switch S1a. This enables pep measurement on SSB — the time constant chosen will give a constant reading of power output with unprocessed SSB.

The peak mode may also be used for CW and plain carrier power measurement, as the measured power will be the same in both modes providing the RF carrier is free of hum and harmonics — the presence of either of these will generate an innacurate reading of a false 'peak' power. A two-tone oscillator used to feed an SSB transmitter, will give a peak reading of four times power compared with that of a single tone.
peak reading of twice that of a single tone.

This is the only part of the circuit which is manually switched. An attempt was made at an automatic peak detector but it is difficult to distinguish between processed SSB and fast CW without a lot of spurious mode changing taking place. As it is, the need to change modes is usually infrequent.

The automatic power ranging is accomplished by IC5d, detecting a voltage level, set by RV8, and equivalent to just over 40W output. IC5d then changes state to high and switches on the relay via Q2, changing ranges by opening the relay contacts.

As the ranges would be continually changing on SSB or CW, a time constant is introduced by C11/R40/R41 which allows the ranging to stay at 400W for about three seconds after RF output has ceased. D6 allows the capacitor to charge instantly, but prevents reverse discharge back through the op-amp. This time-constant was found acceptable on the prototypes but can be changed by altering the value of C11 or R39

Status LEDs are provided for the auto-ranging and peak/RMS modes.

A mains PSU is incorporated for the instrument, supplying +15V and —15V. This needs little explananation, and uses two 3 terminal regulators to do the donkey work. Fuse F1 protects the transformer. No mains switch is provided as it was felt that while power was applied to the station, the VSWR bridge would also require power.

VSWR ONLY VERSION

A VSWR measuring only version can easily be built if the power measurement facility is not required. This saves on the cost of a meter, and a few components, see later for details.

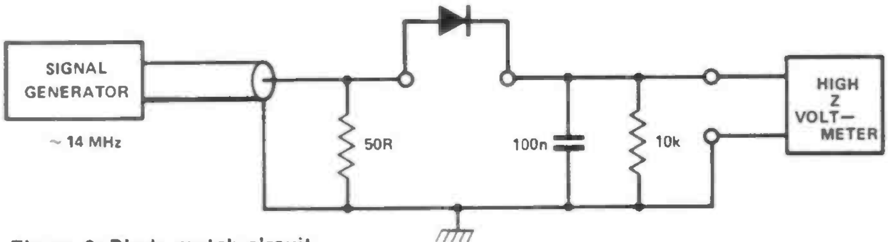


Figure 2: Diode match circuit.

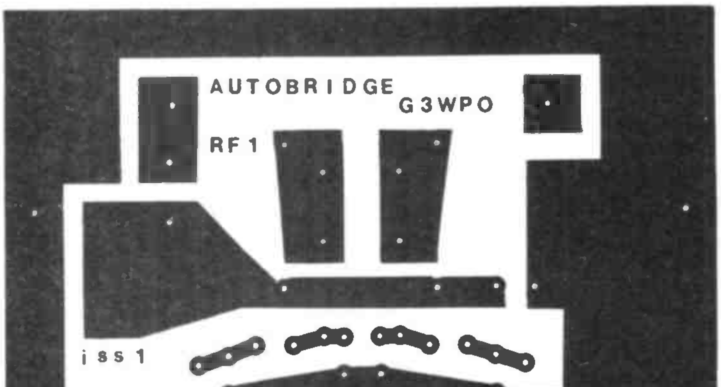


Figure 3: RF sense head PCB.

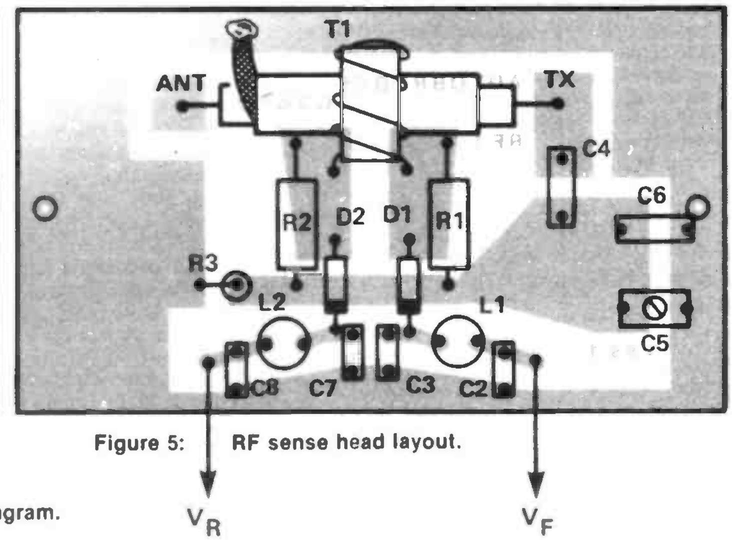


Figure 5: RF sense head layout.

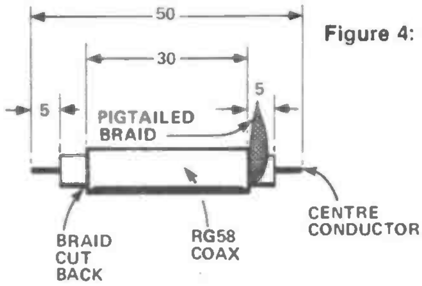


Figure 4: Coax primary cutting diagram.

WHY AN AUTOBRIDGE?

At this point, a normal manually operated SWR bridge would be adjusted by setting a meter to FSD when connected to V forward, using a series potentiometer, then switching to V reflected and reading the SWR on a suitably calibrated scale. However, every time the power output of the transmitter is changed, the bridge has to be switched and readjusted for FSD and the process repeated - otherwise you end up tuning for minimum power output instead.

As you will recollect, the Reflection

Factor was obtained by dividing Vr by Vf. If, instead of feeding these voltages to a switch and potentiometer, we instead send them to an electronic circuit which carries out the division process for us, then we have an automatic VSWR bridge - which is what the AUTOBRIDGE is all about!

CONSTRUCTION

Construction should begin with the RF sense circuit. Before soldering the components to the PCB, place the PCB foil side up centrally on the inside of the die cast box lid and mark through the positions of the 4 holes to be drilled (2 for mounting and 2 for the SO239 spigots)

All components mount on the foil side of the PCB, the chokes and variable capacitor standing proud of the track. Try to keep a symmetrical layout with leads as short as possible, especially those of C4 and C6. Mount into the lid of the die-cast box, with the SO239 connectors already in place. The board is spaced from the lid by 3 x 6BA half nuts and a lock washer. Use a very hot iron to firmly solder the SO239 centre conductors to the PCB.

T1 can now be wound, spacing the 18 turns as evenly as possible, starting with a piece of wire 50cm long (be careful not to strip the insulation as you wind). Cut and strip the coax length as indicated in *Fig 4*, slide the transformer over the outer, and solder all connections to the PCB keeping T1 leads short.

The RF head can now be aligned by connecting it to a transmitter, preferably operating on 7 or 14 MHZ (i.e. mid-range) connecting a voltmeter to the reflected voltage output and a non-inductive accurate dummy load of 50 ohms to the output socket. Adjust C5 for minimum voltage reading, increasing the transmitter power to get the 'best minimum' which should be very close to OV.

At this point you can check the output of the head with an RF input, using a high impedance voltmeter if available. As a guide, 400W will give around 10V, 100W about 5V and 25W about 2V5 as a forward voltage when matched into 50 ohms.

MAIN PCB

Refer to *Figs 6 & 7* for the PCB and component layout. There is nothing particularly critical about the construction but the following order should be followed to ease assembly.

1. Solder in PCB connection pins, inserting from the underside, then all IC sockets, resistors and presents.
2. Solder in BR1, the transformer, then the remainder of the components. Make the links on the underside of the PCB with insulated wire.

Check for solder bridges etc. Now, BEFORE inserting any ICs into the sockets, apply mains to T1 and check that

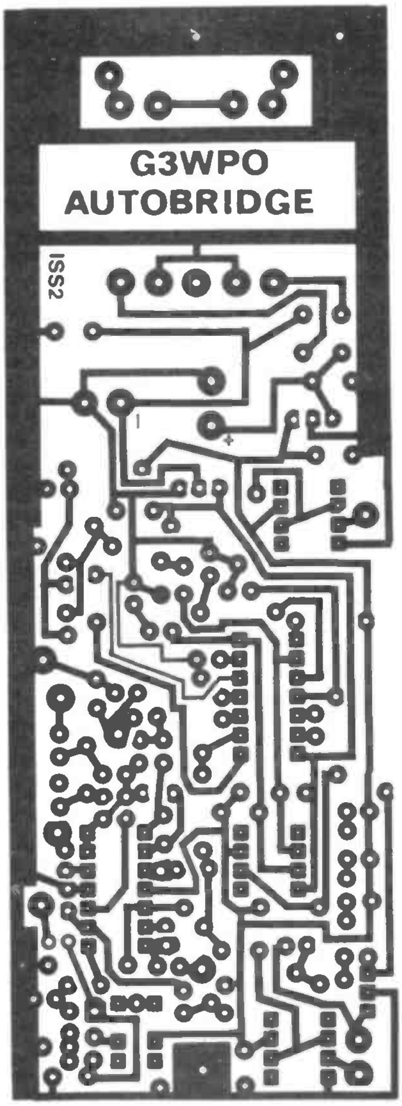


Figure 6: Autobridge PCB

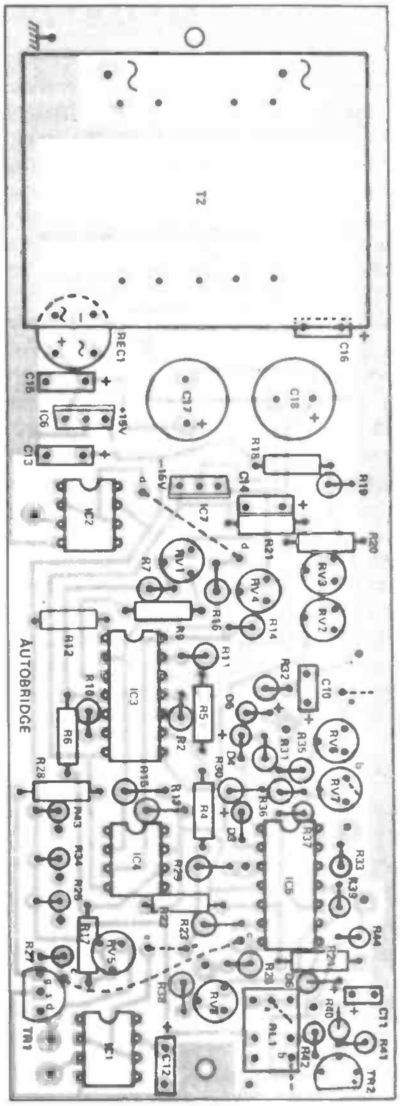


Figure 7: Autobridge PCB layout.

the +15V and -15V lines are correct.

Insert the ICs. The divider circuit can now be aligned as follows:

a) You will require a variable voltage source of +1V to 10V, either a pot connected to the +15V supply rail or a variable PSU.
b) Connect the meters to the appropriate terminals (ensuring the VSWR meter has its -ve terminal to the PCB output) and set all presets to mid-travel.
c) Connect Vref input to earth and Vforward input to the voltage source.
d) Apply power with +10V on V forward, and adjust RV2 until the meter reads just off zero. Now vary the external voltage from +1V to +10V output and adjust RV4 until the meter reads a constant value (not necessarily OV) as the voltage is varied between these limits. Then adjust RV2 for OV on the meter scale with +10V applied. (Bear in mind that the meter is disabled below 1VO input).
e) Disconnect Vref input from earth and parallel across to Vforward input. Again, vary the voltage between the same limits, adjusting RV3 until the meter reads a constant value somewhere near full scale (adjust RV5 if the meter goes over full scale).
f) Adjust RV1, while varying the applied voltage between +1V & 10V until a near constant reading of FSD is achieved. If a constant reading occurs just below or above FSD, adjust RV5 for FSD.
g) Go back to step c) and repeat through to step f) until no further improvement can be obtained. This will probably only be necessary once.

This completes the adjustment of the VSWR section. The calibration of the power section requires another power meter of known calibration in series with the Autobridge, after making the necessary interconnections with S1 and the RF sense head, which should be in its screened case at this point, and its output ▶

voltages taken to the main PCB via the feedthroughs.

The status LEDs may be temporarily connected if desired to check operation after soldering to their PCB. If sufficient power output is available from the transmitter, each range should be adjusted as near to FSD as possible for maximum accuracy — failing this the highest available powers should be used. For SSB transmitters, single tone input should be used for calibration.

Initially adjust the 400W range using RV6, then the 40W range using RV7. The crossover point between ranges is set with RV8, and should be set such that the switch is made at just over 40W output.

New calibration scales are required for the meters. The existing scales should be changed by carefully removing the 2 fixing screws and the new scales fixed with adhesive over the old before replacing - be very careful not to hit the meter pointer while doing this!

The instrument can now be cased. Once everything is in place and wired up, switch on and check that everything is still functioning OK.

In case of difficulty, *Table 1* gives typical voltages to be expected when the instrument is aligned, with no RF input.

VSWR ONLY VERSION

This is fairly self-explanatory, as it is only necessary to omit the power meter, and all components associated with the power measuring and range changing circuits. All of the ICs are still required, but all components associated with IC5 b,c and d, Q2/RL1 may be omitted. Otherwise the construction is the same.

USING THE AUTOBRIDGE

As there are no controls to adjust during operation, there isn't much to say about using the device. As with all tuning operations, start tuning at low power until a lowish VSWR is obtained, then make final adjustments at full power. If an attempt is made at tuning with in excess of 200W output and a high VSWR, it is possible that the coax in the current transformer will get hot and the dielectric fail. Always start low and work up.

Note that the VSWR and power read-

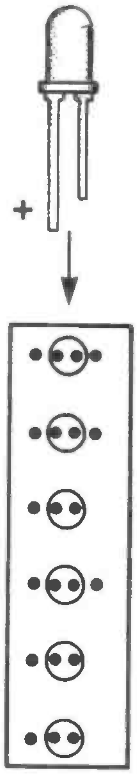
Pin No.	IC1	IC2	IC3	IC4	IC5
1	0.1	0.1	6.2	-15.2	0
2	0	0	9.7	9.7*	0
3	0	0	-14.0	9.7*	0
4	0	0	0*	-15.2	15.0
5	0.1	0.1	-4.0*	-15.2	0.9
6	0	0	-1.1*	0*	0
7	15.2	15.2	-15.2	15.2	13.0
8	0.1	0.1	0.2	0	0
9	–	–	0	–	13.4
10	–	–	-1.3*	–	0
11	–	–	-1.0*	–	0
12	–	–	1.0*	–	0
13	–	–	-14.0	–	0
14	–	–	9.7*	–	0

* indicates voltage may vary depending on chip offsets and drift around zero.

TABLE 1: Voltage reference figures.

TABLE 2: Scale Calibration points

% FSD on meter	Power High	Power Low
100	400	40
86.6	300	30
70.7	100	20
61.2	150	15
50	100	10
47.4	90	9
44.7	80	8
41.8	70	7
38.7	60	6
35.3	50	5
31.6	40	4



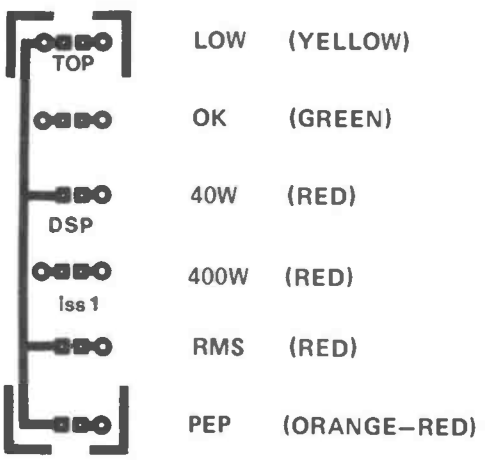


Figure 8: LED display PCB and layout.

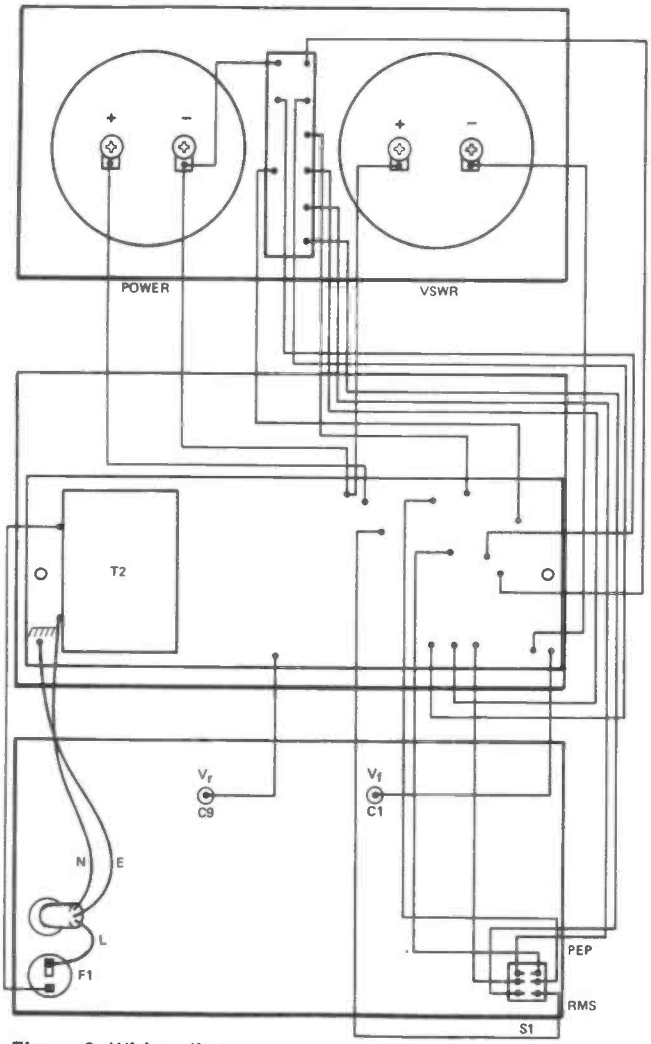


Figure 9: Wiring diagram.

COMPONENTS LIST

Resistors (all 1% metox unless stated)

R1,2	27R 1 watt 5% carbon film
R3	2k2 carbon film
R4,5,6,7,8,10,23, 29,33,37,41	10k
R9,11,14	12k
R12	3k9
R13,15	3k3
R16,30	20k
R17	100k
R18,21	15k
R19,20	2k2
R22	15k
R24	1k
R25,26,34,43,44	1k5 carbon film
R31,32	1M0 carbon film
R35	82k
R36	33k
R38	5k6
R39	2k7
R40	22k carbon film
R42	100R carbon film

Potentiometers

RV1	4k7 ALPS cermet preset
RV2,3,5,7	22k ALPS cermet preset
RV4	10k ALPS cermet preset
RV6	47k ALPS cermet preset

Capacitors

C1,9	1n screw-in feedthrough
C2,3,7,8	10n disc ceramic
C4	3p3 silver mica
C5	140p max compression trimmer
C6	68p silver mica
C12	100n tantalum 16V min
C10	4u7 miniature electro or tant 16V minimum
C11	33u 16V miniature electro or tant.
C17,18	470u 25V min electro pc mount
C13,14,15,16	680n 25V tant

Semiconductors

D1,2	OA91 (matched pair - see text)
D3,4,5,6	1N4148
BR1	WO-005 bridge rectifier
LEDs	3mm flat face round: 3 x red, 1 x green, 1 x yellow, 1 x orange-red
Q1	2SK55 or similar
Q2	BC237 or sim. npn
IC1,2	CA3140 (dil)
IC3	MC1495 or 1595
IC4	MC1741 (8 pin DIL)
IC5	LM324
IC6	7815
IC7	7915

Miscellaneous

M1,2	100uA FSD linear type ML52
RL1	Sub-miniature relay type OUC
L1,2	TOKO type 8BA 1mH
T1	18 turns 0.56mm en Cu wire wound on ferrite core type 5961001101
T2	Drake PO315 pcb mount 0-15, 0-15, 3VA
F1	500mA in panel mounting holder
Case	Centurion type DX2
RF head enclosure	Die-cast box size 114x64x30mm
	DPCO miniature toggle

PCBs, Cable, Sockets, etc.

ings are only accurate at the load impedance for which the bridge was set up. If you move to a 75 ohm system then the calibration process will have to be repeated.

So go ahead and enjoy the benefits of "hands-off" tuning-up which the AUTOBRIDGE brings.

OTHER POWER RANGES

As described, the AUTOBRIDGE is designed for a power range of 4-400W output. If a lower FSD is required, this can be achieved by recalibration of the power scale, and changes to the number of turns on T1 secondary winding.

The formula for calculating the required number of turns is:

$$N = \frac{R}{Ed}\sqrt{P/R1}\ \text{turns}$$

where R = transformer load resistance
R1 = bridge load impedance
Ed = voltage developed across T1 secondary
P = power output for FSD

R, R1 and Ed are known, in this case at 54 ohm, 50 ohm, and 10V respectively. Hence for an FSD of 200W,

$$N = \frac{54}{10}\sqrt{\frac{200}{50}} = 10.8 \text{ or } 11 \text{ turns}$$

with scale calibrations divided by a factor of 2.

Note that increasing the number of turns on the secondary decreases the output voltage. For lower power FSDs, the calculation is complicated by the need to maintain sufficient inductive reactance of the secondary winding at 1.8 MHz. In this case a minimum of 10 turns is needed if correct current transformer action is to be obtained.

In order to increase the number of turns and maintain 10V output, R1 and R2 must be increased, e.g. for 50W FSD, increase R1/2 to 47 ohms each, then:

$$N = \frac{94}{10}\sqrt{\frac{50}{50}} = 9.4, \text{ say 10 turns}$$

Changes to the capacitive divider network will also be needed to achieve a complete null, with C6 decreasing as the FSD power is reduced. C4 must not exceed 8p (for satisfactory capacitive reactance at 30-50 MHz). This latter example would enable power measurement over a range of 0.5-50W, in 2 ranges of 0-5 and 0-50W, with scale calibrations divided by a factor of 8 (see Table 2 for scale calibration points).

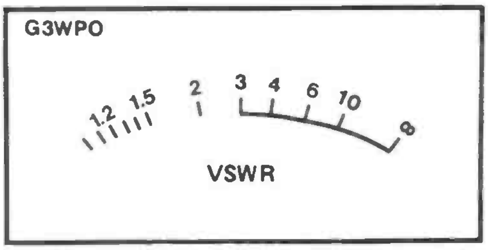
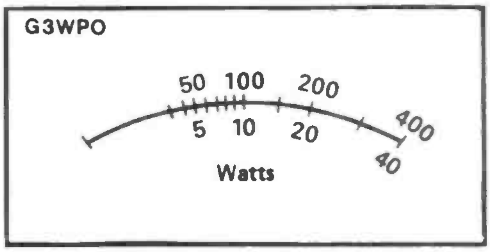


Figure 10: VSWR and power meter scales shown full size.



These scales are shown correct size for use 100uA ML52 type meters.

■ R & EW

Your Reactions.........	Circle No.
Excellent - will make one	68
Interesting - might make one	69
Seen Better	79
Comments	70

POWER SUPPLIES

—UNDER THE SURFACE

Despite their apparent simplicity, the design of power supplies involves more than meets the eye. J. Stuart examines some of the common pitfalls and presents a few design notes.

IN DATA FILE No. 1 (R&EW Dec. '81) a wide range of general-purpose power supply circuits were described. Many of them provide excellent performance from few components and are ideal for inclusion in all but the most demanding of applications. Despite their apparent simplicity however, a surprising number of attempts by engineers to run up PSUs like these fail to live up to expectations. On more than one occasion a designer has declared his earth-shattering new digital floggle-toggle project is just about finished — "all I've got to do is bung the PSU on it..." Many mods later...

SO WHAT GOES WRONG?

The most common faults are:
— Insufficient output voltage
— Too much ripple or instability
— Smoke
— Frequent failed regulators

Let's take the last one first because the DATA FILE gave the usual answers. IC regulators and transistors go pop because you put voltages where they don't like them, typically when you power on or off. Read the data sheet carefully and check reverse voltage limits, then remember that a reservoir capacitor holds volts when the power collapses. In the example (*Fig 1*) C1 should be bigger than C3 to keep the regulator pin 1 above pin 3. Diode D5 would protect against input shorts. If you have a capacitor in the reference lead (pin 2), provide a discharge path like D6 of *Fig 3*. Also, use rectifiers with a reverse volts rating of at least twice the transformer output.

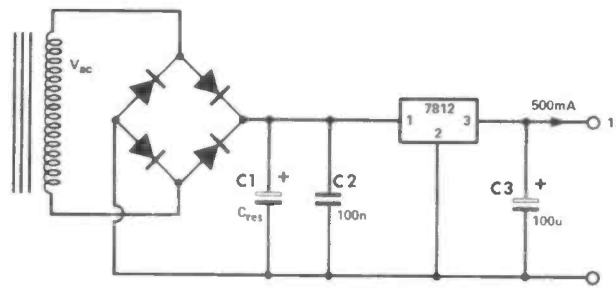


Figure 1: Typical three terminal regulator PSU design. Component values need to be chosen with care despite the apparent simplicity of the design.

INSUFFICIENT OUTPUT VOLTS

There are four factors to consider:
— Transformer regulation
— Diode drops
— Regulator headroom
— Reservoir capacitor size

The term reservoir rather than filter is used because the purpose of the capacitor is to store charge and supply current during the time that the AC. Voltage is less than the stored voltage. *Fig 2* shows what is happening. The diodes only conduct when forward biased — at the peaks of the AC. This is a fraction of each cycle and the reservoir capacitor has to recover during that time all the charge it has supplied to the following circuits. If we have a PSU supplying 100 mA and we allow 5% ripple on the reservoir then the diodes would be on for about 20% of each cycle, during which they would pass 500 mA. Five times the current for one-fifth the time.

This means we have to select a transformer that will provide the required voltage at five times the current our circuit is taking. The larger the reservoir we choose the smaller the diode conduction time becomes, worsening this problem — a 1% ripple circuit needs a transformer regulation chosen at 11 times nominal current. PLEASE NOTE this does not mean you need a transformer rated at this higher current, only that you should know the output voltage at that current, if necessary by guessing from rated output regulation or just choose the next higher output voltage than you think you need!

To allow for regulator headroom and diode drops the usual way is to add 0V7 for each diode (i.e. 1.4 for full-wave bridge) and 2V for the regulator. Next remember that this headroom must be available at the bottom of the ripple on the reservoir.

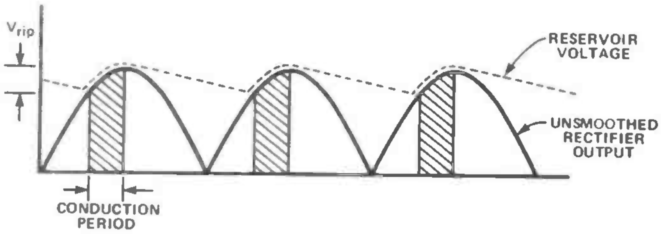


Figure 2: The reservoir capacitor supplies current during the time that the AC voltage is less than its stored voltage.

TOO MUCH RIPPLE...

Most cases of excess ripple are caused by the same problems just described — if your input volts are down then each time the ripple dips below the headroom needed by the regulator, the output volts collapse momentarily, giving nasty 100 Hz hum or upsetting the logics.

...OR INSTABILITY

One other possibility arises when using some IC negative regulators such as the 79XX series. These must have output capacitors of a minimum size to avoid instability — read the data sheets again! These devices also have internal thermal protection so if your output is down and you know you have plenty of headroom try a finger on the case — sizzling noises indicate time for a rethink...

SMOKE

Don't assume that a 1 Amp component will always give 1A happily. Check the thermal limits and compare with I x (volt drop across device). Also check what heat sink the spec. assumes (given in °C/Watt).

WORKED EXAMPLE

Let's assume we need a 12V 500mA PSU. We'll use a 7812 IC for simplicity, which is rated at 1A. *Fig 3* gives the circuit. First, consider the power dissipated in the IC:

P = I x (Vin - Vout) = 500 mA x (Vin - 12) ≈ 2 Watts (free air)

This gives a max. input voltage of 16V, min. 14V to give 2V headroom. Next choose an input ripple say, 0V5pp. This puts our min. to 14V5 and defines the reservoir cap.:

$$C_{res.} = I/2fV_{rip} = 500mA/\ 2 \times 50 \times 0.5 = 10\,000u$$

Now the transformer. Add 1V4 for the diodes V_O = 16V to 17V4)

$$V_{ac} = 0.71 \times V_O = 11V3 \text{ min to } 12V3 \text{ max.}$$

It looks as though we will use a 12V nominal transformer which will give 1.4 x 12 = 17V peak. Next work out the current taken during the conduction period:

$$\text{Conduction angle} = \arccos(1 - V_{rip}/V_O) = \arccos(1 - 0.5/17) = 13.9°$$

$$\text{Current } I_{secondary} = I_O \times 90°/13.9° = 3.5\text{Amps}$$

3.5A peak is equivalent to a 2.5A rms rating so we would need a 30 VA unit (12V x 2.5A) which may be surprising since the PSU is only delivering 6W.

The problem with this apparently good design is that we have not allowed for tolerances. A typical small transformer could be ± 10% or ± 1.7V peak and we only have 1V of leeway in our DC line. If we pick a 15V transformer (usually the next one up) we will overheat the regulator whose internal protection will shut down the output. We need a heatsink on it. 15W is allowed on an infinite sink so let's try 10W and find a heatsink give 10°C/W.

$$V_{in}(max) \quad 12V + 10W/500mA \quad 32V$$

$$V_{ac}(max) \quad 0.71 \times (32V + 1V4) \quad 23V6$$

We can now use our 15V transformer to give 21V2, selecting a 40VA unit (15V x 2.5A), or try to be clever with the regulation. 10% regulation at rated power is common and if we tried a 20W unit we can expect to lose another 10% to around 19V DC, still well above our 16V min. A 10W one would be running at four times rated current and would be 30% down at 14V8 which is inadequate, even though it has 1.5 times the PSU's output rating! This is a common pitfall.

That completes the design except for choosing working voltages. Use 50V diodes (1N4000 etc) and 25V capacitors or higher and you should be OK.

Now you see the techniques you should be able to extend them to any PSU you need.

■ R & EW

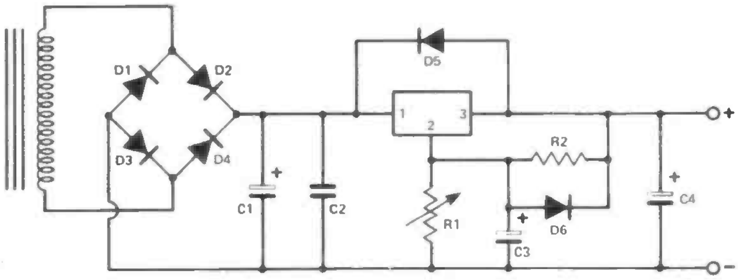
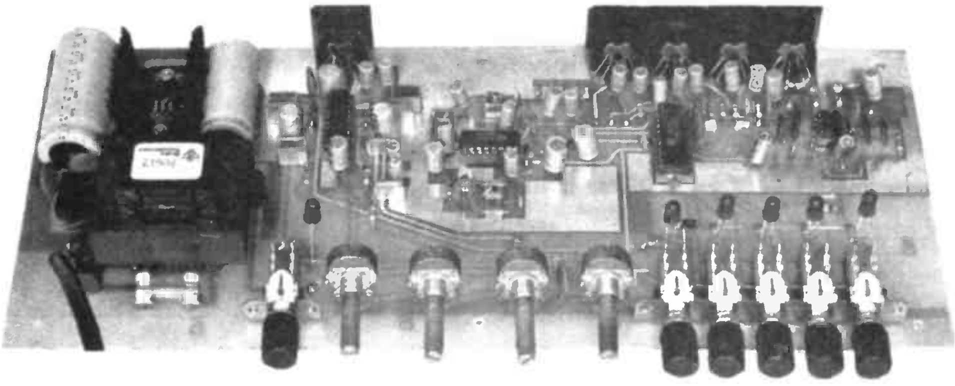


Figure 3: A 12V 500mA PSU. The component values are derived in our worked example.

Back copies of R&EW, December '81 are available from our back issues department. Details on page 5.

Your Reactions

	Circle No.		Circle No.
Immediately Interesting	60	Not Interested in this Topic	62
Possible Application	61	Bad Feature/Space Waster	63



DC PREAMPLIFIER

A design that offers the possibility of remote control.

THE ABILITY TO ALTER a preamplifier's volume and tone control settings and to select the different inputs available to it via a DC voltage has a number of advantages. Remote control of the amplifier becomes a possibility, either by means of a wire link or via an IR system based on one of the many chip sets custom designed for such tasks.

A wire link system, while not favoured for armchair control of an amplifier — an IR system is essential for this — would provide ideally as part of a car's hi-fi system. The expensive pre/power amplifier combination could be hidden, leaving only the control panel at the mercy of any potential thief. In this case the mains PSU and RIAA section would, of course, be omitted.

A DC control system also means that all signal paths, subject to RFI, particularly in these days of CB, are confined to the PCB, making layout problems almost non-existent.

HEART TO HEART

Recently introduced ICs provide the heart of the design overcoming the problems associated with CMOS switches and of the introduction of FETs to signal paths.

The amplifier offers four inputs, three at line level and one suitable for use with a magnetic cartridge. A mute feature ensures that switching between sources is a 'noiseless' operation.

Control of Volume, Balance, Bass, and Treble is provided and in addition a DC switched Loudness function provides the Bass and Treble boost that many people like when listening at low volume levels.

CONSTRUCTION

The preamplifier should pose no problems during the construction stages. The overlay provides the necessary guidance. It's usually worthwhile to give the completed board a final check before applying power, paying particular attention to the orientation of polarity sensitive components.

The only adjustment necessary to the completed unit is to ensure that the supply line is at 15V. Connect a meter to the positive side of C39 and to ground and adjust RV1 until the supply is at the correct value.

CIRCUIT DESCRIPTION

The preamplifier is based around four IC's, details of two of them having been published in previous **R&EW** Data Briefs (TK10321 — Feb 82, LM1035 — June 82).

The RIAA equalisation stage is configured around an NE542 IC1. This is a low-noise dual preamplifier whose response is tailored to meet the demands of the RIAA 'frequency law' by its associated components.

The signal from the RIAA stage, together with line inputs from the three other input lines are fed to IC2. This is an anlogue switch IC that provides the dynamic range and noise performance demanded in this application.

The IC comprises a four channel audio switch, with single push-to-make momentary switching with full interlock guard and a priority scheme to ensure that only one input can be selected at any one time.

The IC features a 'mute' output which is connected to IC3's 'mute in' to ensure noiseless switching between sources.

The IC 'remembers' the channel selected when the amplifier is switched off and when power is re-applied the last channel selected remains the selected source.

The signal selected by IC2 is fed to IC3 an AF amplifier with muting system KB4438.

The amplifier provides a gain of approximately seven, this is to make up for any losses in the previous stages and to provide an adequate drive level for any following stages of power amplification.

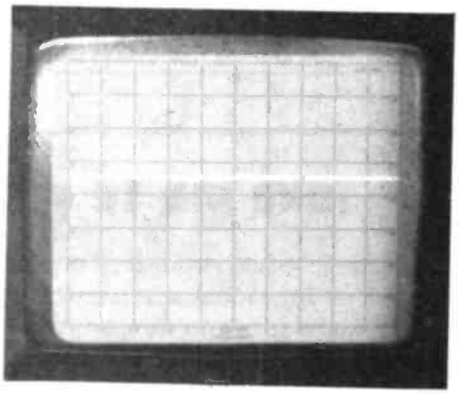
This IC also features a mute control which is fed from IC2 and mutes the signal during switching of sources thus ensuring a noiseless transition between sources.

The final section of the amplifier is based around IC4, LM1035.

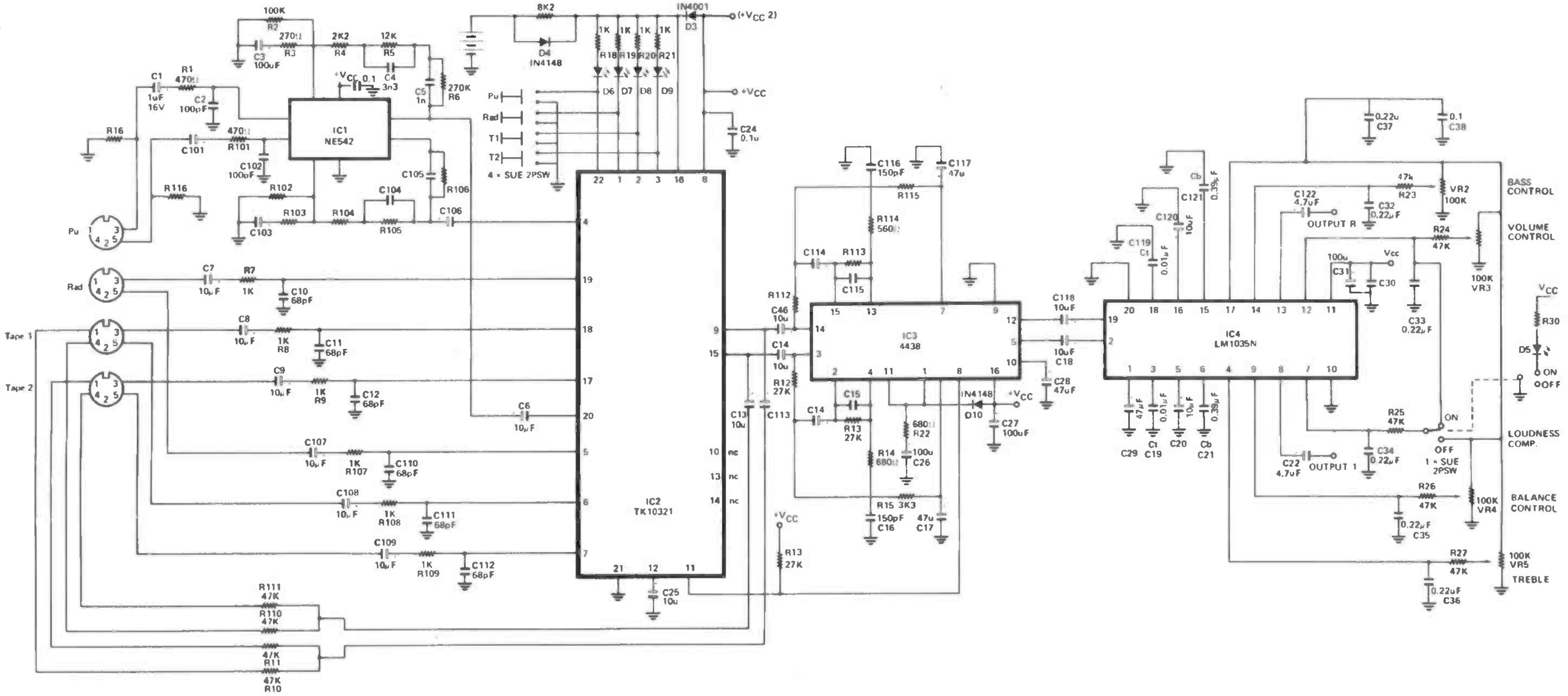
This is a DC operated Volume/Tone/ Balance IC custom designed for use in 'mid-fi' audio applications.

The volume control function of the IC is controlled by the DC voltage on Pin 12, Treble by a voltage on Pin 4 and Bass and Balance by the voltages on pins 14 & 9 respectively.

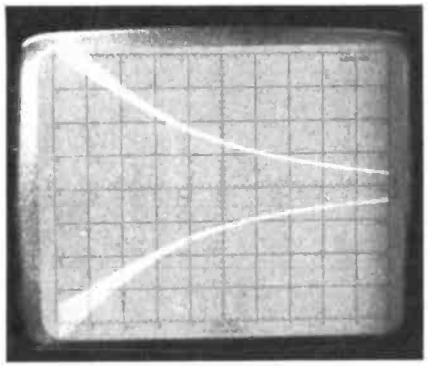
Capacitors C21 and C119 define the bass and treble characteristics of the ZC as well as the loudness compensation contour which is engaged by a voltage on pin 7.



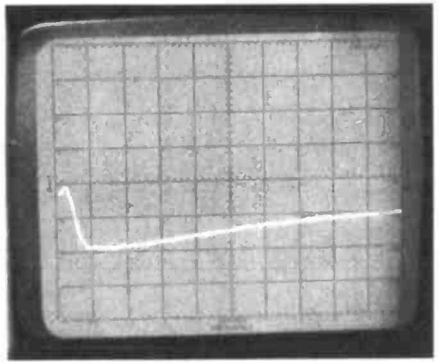
Response 0 - 20KHz,
Controls set to zero (2KHz div., 10dB div.)



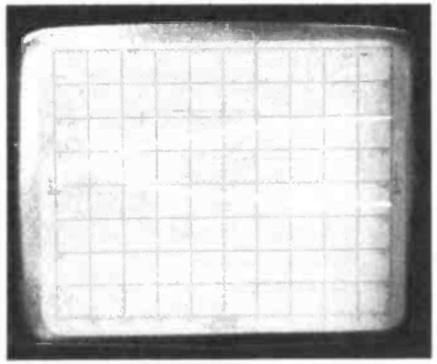
Circuit Diagram of the DC Controlled Pre–amplifier.



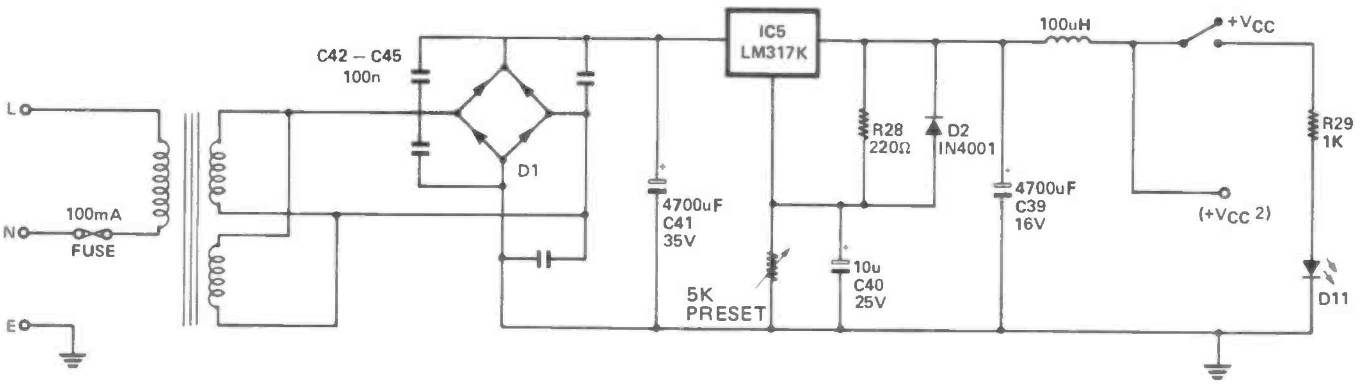
Bass cut/boost.
50Hz div, 2dB div.



Loudness
1KHz, 10dB div. 0 - 10KHz.



Treble cut/boost.
2KHz div, 10dB div.



Circuit Diagram of the Power Supply.

COMPONENTS LIST

Resistors

R1	470R
R2	100K
R3	270R
R4	2K2
R5	12K
R6	270K
R7,8,9	1K0
R10,11,16,23-27	47K
R12,13	27K
R14	680R
R15	3K3
R17	8K2

Capacitors

C1	1u0 Tantalum
C2	100p Ceramic
C3,26,27,31	100u Electrolytic
C4	3n3 Mylar
C5	1n0 Mylar
C6,7,8,9,13,14,18,20,46	10u Electrolytic
C10,11,12	68p Ceramic
C15	47p Ceramic
C16	150p Ceramic
C17	47u Electrolytic
C19	10n Polycarbonate
C21	390n Polycarbonate
C22	4u7 Electrolytic
C23,24,30,38,42,43,44,45	100n Ceramic
C25	10u Electrolytic
C28,29	47u Electrolytic
C32,33,34,35	220n Polycarbonate
C36,37	220n Polycarbonate
C39,41	4700u 16V Electrolytic
C40	10u 25V Electrolytic

Inductor

L1	100 uH

Semiconductors

IC1	NE542
IC2	TK10321
IC3	KB4438
IC4	LM1035N
IC5	LM317K
D1	BRIDGE RECTIFIER
D2,3	IN4001
D4	IN4148
D5-D11	5mm RED LED

Switches

SW1-SW4	2p MO (ALPS)
Sw5	2p Latching
SW6	2p Latching

Miscellaneous

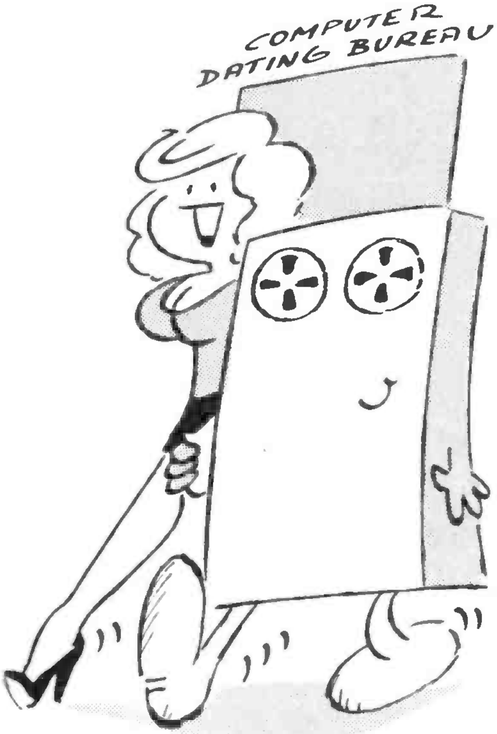
PCB, Mains Transformer (PB 0617), Fuse (100mA), 5 Pin DIN Sockets, etc.

NOTE: Right hand channel component numbers are preceded by the number 1. Components duplicated in both channels are not included in the component list. Full details in next month's issue.

Due to pressure of space the PCB foil pattern and overlay details have been held over until next months issue.

R&EW

Your Reactions.........	Circle No.
Excellent - will make one	145
Interesting - might make one	146
Seen Better	147
Comments	148



163 for further details

SPREADING THE WORD: Spare a kHz or two for R&EW in 2m......

SUBSCRIBERS MAY HAVE noticed that the first issue of the Newsbrief (one of the added extras these fortunate folk get when the issue is mailed out) contained a few words on the subject of a lecture by the American IEEE being broadcast in the 144MHz band for the benefit of New York listeners.

Good grief! What is 'amateur' radio coming to these days?

Apart from an amazingly sound source of income for the Japanese communications industry, the answer seems to be "not a lot". It provides an interesting and enjoyable social facility for its many followers, affords the opportunity to serve on committees that might otherwise not present itself, but it doesn't seem to be doing as much as it might to enhance the technical and technological knowledge of its adherents.

The concept of using it as a means of broadcasting to specialised sections of the community with minority interest features seems to be worthy of very close examination. The RSGB provides a weekly news service on the HF and VHF bands, which they do very well - but this is only scraping the surface of the possiblities that exist for using the medium for informing and advising the technical community of what's going on.

Read all about it

There are very many publications seeking to attract the attention of the technical community in this country. (A free sub to the first reader who can submit a complete list of everything allied to electronics, communications and computing). The industry is widely recognized as being the major growth industry in the world, and our educational system is being whipped up into a better appreciation of the whole business with stickers and teeshirts to remind us that this is IT. (The year of Information Technology).

The existing broadcast media are not visibily contributing greatly to the dissemination of technical knowledge (hats off to the BBC computer programme, even if they couldn't resist the temptation to waste the first ten minutes of the first programme by wandering around Stonehenge). Arguably, it is not their job to do so - as one producer once said in a reply to the writer of this piece, "our job is to entertain the viewers". Well, they don't make a conspicuously brilliant job of that either - but we won't split hairs.

One of the major frustrations occurs when you wander into work/college and everyone says "did you see that terrific programme on computers last night??" and you realize that Aunty has managed to sneak in another Horizon gem without you noticing it. The feeling is even worse when you discover that you had been dozing in front of something like 'The Good Old Days' while it had been going on surreptitiously on the 'other side'.

So how about VHF/UHF narrowband communications for the dissemination of minority programming - and also computer programmes in ASCII?? And how about using a few kHz of existing amateur communications bands to forestall the usual technical garbage about band occupancy and the like. There are a few kHz of two metres devoted to unloved, abused and unwanted repeaters that might usefully be used for such a service.

What's the catch?

Well, apart from the question of the political standpoint on such a concept, it seems fair to assume that the catch is the one of organisation and policing. The IBA would doubtless wish to pass an opinion, and the RSGB are doubtless going to have something to say. Nevertheless, it seems fair to ask the Home Office to consider sanctioning an experimental service along these lines, since it is hardly likely to cause any upset to anyone.

So you will be interested to learn that R&EW telexed the HO for just such a facility, so that we might experimentally broadcast a nightly 7pm news report on 144.500MHz to cover the London and South East on NBFM from Brentwood. The content would be based on matters of interest to the technical community (not just amateur radio), and we hope to use this to draw other persons from outside amateur radio into the general concept. Perhaps the broadcast could be repeated at 5pm and 6pm to catch listeners on their way home from work.

We will keep you advised of the progress we make with the HO. A copy of the telex, together with a reasoned argument as to why it should be allowed to go ahead was sent to the Minister for Information Technology, the Rt. Hon. Kenneth Baker MP., since the argument is not one of technical feasibility, but one requiring a political decision.

Perhaps such a medium would afford a better place to communicate changes in the amateur radio licence conditions than in the London Gazette.

Don't miss it

If, and it's a big 'if', we get the go ahead, we suggest that you put aside a single channel receiver specifically for the purpose of monitoring G4REW the UOSAT receiver described in the May issue would be ideal, together with a suitable on off timer so that you can be sure you don't miss it. If you're outside a 60 mile radius of Brentwood and will feel frustrated at being unable to take part, then wait and see if we can squeeze an HF allocation on 80m - but that's going to be a whole lot more difficult.

The same channel might be used by any number of minority interest programmes, using a digital selcall technique to identify their 'classification' for the benefit of listeners.

Meantime, if you like the idea (or if you don't), write to us, and write to Kenneth Baker MP at the House of Commons - London SW1A OAA. We are keen to get comments from the trade tosee if they too would welcome such a concept which we feel might do a great deal to advance the interests of the scientific community (and other minority interest groups) in this country.

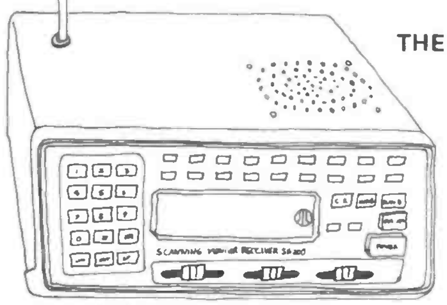
PS

G4REW (if we can get the callsign, otherwise G8CYK) will be trying to make an effort to organize a net on 2m on Wednesdays, starting at 6.00 pm on 144.500MHz, with a coverage within a 60 miles radius of Brentwood. This will not be a (broadcast) as such until we get the permission, but you may find it interesting and worthwile to join in and get up to date on what's on. We might also be able to answer problems with R&EW projects -but more probably we will set up another time for such a clinic session. Circle number 5 if you think you may want to take part, and we will get an idea of how best to organize the schedules.

All but two of the editorial staff are licenced radio amateurs, so the operators are likely to be rotated as the vocal chords expire.

GAREX (G3ZV1)

SX200–N



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FM Package 2 (Synthesised)	70PAC2	163.00	128.00
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500mW to 3W	70FM3	19.65	13.25
500mW to 10W	70FM10	30.70	22.10
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FM Receiver	144FM2R	64.35	45.76
Synthesiser (2pcbs)	144SY25B	78.25	59.95
Synthesiser Transmit Amplifier	SY2T	26.85	19.40
Bandpass Filter	BPF 144	6.10	3.25
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Kits are available from the following agents:

Amateur Radio Exchange, Northfield Road, EALING. 01-579 5311.
J. Birkett, 25 The Strait, LINCOLN. 0522 20767.
Darwen Electronics, 13 Thorncliffe Drive, DARWEN, Lancs. 0254 771 497.
United Trading AB, Box 16024, 200 25 MALMO, SWEDEN. 040 94 89 55.

9 HILLCREST, TADLEY
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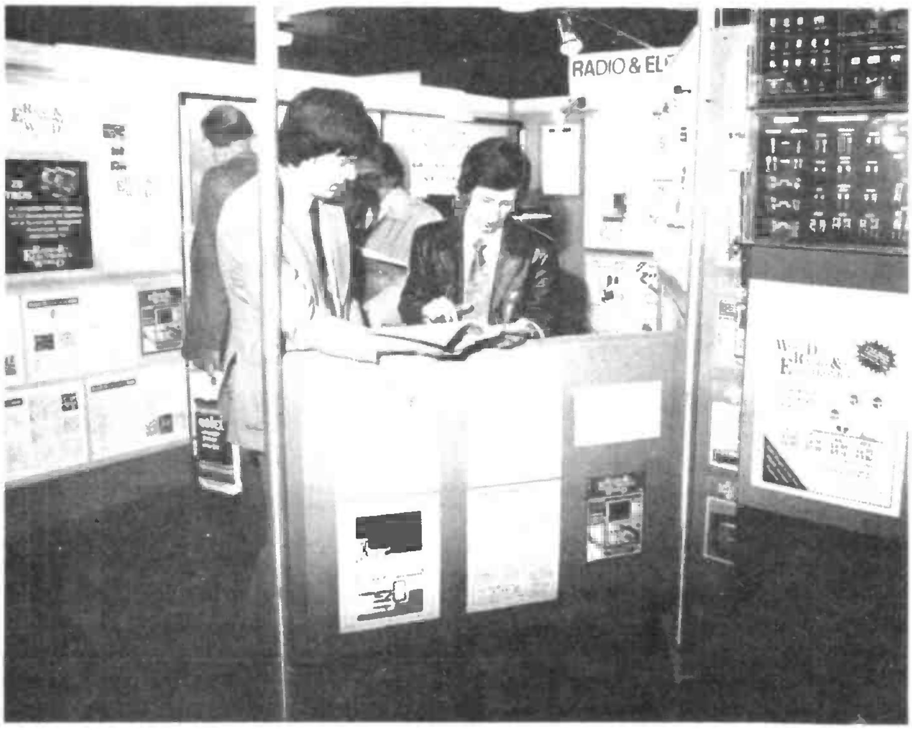
271 for further details

NEWS BACKGROUND



THE ALL ELECTRONICS SHOW'S inaugural event at the Barbican Exhibition Centre was enormously popular. Following the rumblings of discontent at the last Grosvenor House exhibition, Mr. Steadman was a very happy man indeed by lunch time on the first day, when it was already apparent to most exhibitors that this show was going to be 'worth the trouble'.

By the end of the exhibition, he had already booked space for another 200 exhibitors, and was exuding a justifiable confidence that maybe here was the event to replace the fabled Paris Components Exposition as the premier European event. The manageable stand size (and cost), coupled with the excellent communications of the Barbican location will mean that those extra 200 stands will be sold long before next April.

The fact that Communications '82 at Birmingham was staged at the same time was a matter of considerable frustration for many of us who wanted to see both, but couldn't really spare the time. Reports carried back from darkest Brum indicate that attendance there suffered from the greater attraction of the new Barbican extravaganza.

THE WORLD WAS THERE

R&EW attracted crowds throughout the show and it was apparent that we were introducing many lost souls to the benefits of being an **R&EW** reader. Several 'deals' were struck for future articles, and we have received an interesting invitation to present the Z8 system for consideration in High Places.

Over 1.5 tons of catalogues and back issues (minus the vouchers, of course) were presented to eager and enthusiastic electronics persons, and a good time was had by most people. The usual problems of trying to deal with five enquirers at once led to the frustrations that affect most shows — agitated would-be enquirers hovered around whilst old friends were engaged in conversation, and if you were one of those who found the crush on our stand too severe, our apologies. You are always welcome to come along and see us at the editorial offices, although you will need an appointment to see any specific member of the team.

SOUND AND VISION

One general complaint arose from the continual drone of the background music system. The choice of music wasn't too awful, but the inevitability of it was. Please, no more next time — or at least provide the stands with volume controls.

This show saw the breathtaking innovation of a closed circuit TV system run by *Electronics Weekly*. Your scribe only caught the occasional glimpse (thankfully) but it was truly memorable for the awfulness of the interview conducted with some Hitachi representative rabbiting about 64K RAMs in plastic. The rivalry between *Electronic Times* (nominal sponsors) and *Electronics Weekly* (interlopers and exhibitors) was quite impressive to behold.

SERIOUS STUFF

The semiconductor Sales Manager of AEG, Brian Perks, tried hard to look concerned when we told him of our problems in obtaining BFT95s and BFR91s, but they were having such a good show (particularly on Opto products) that he just couldn't help seeing the funny side.

George English (of George English Electronics) was just about ready to start dismantling the stand when we called on him at 4pm on the last day. The bijou GEE bar had just about run out, and George was generally as well pleased with the whole affair as anyone else. Those of you who still remember 'Beat the Clock' may care to muse upon the backdrop to his beaming visage.

Recent Queen's Award winner for technology, Howard Buckenham of Neotronics was spotted amongst the drawing boards on Fred Cox's stand. If you've read this far and you manage to spot Howard in his alter ego, and you are one of the first five readers to approach him waving this edition of R&EW, with the immortal words:

"You are G3PGN, and I claim the free R&EW tie...."

ALL IN ALL

Most of the exhibitors breathed a sigh of relief that it looked as if the AES was sufficiently successful as to effectively forestall any attempts at immitation or dilution. There are enough 'shows' in this business already, and it would seem sensible to hope that the expanded AES can perhaps encompass a broader range of topics next year. ■ **R&EW**

PANASONIC RF3100

Although not generally seen on the amateur communications market, this set is a delight. William Poel reviews.

PANASONIC (one of the many brands under the massive Matsushita umbrella) came to our notice by chance, when thumbing through a shortform catalogue. In view of the ubiquity of the Sony ICF2001, (they still won't reply to our technical enquiries about some strange effects we found with a review model), we thought that it was strange that this receiver was so little known in this country.

The helpful people at Panasonic delivered one promptly after our request. In fact, so efficient was the Panasonic service that we feel obliged to say that we were delighted. The only problem was that they wanted it back in such a short space of time, that we were only able to become fleetingly acquainted with its virtues.

The RF3100 is a fully battery/mains portable counterpart of the Trio R600, with the FM band thrown in for good measure. It sells for around £180 (including VAT), and was generally reckoned by all who had the chance to use it, to be a charming and easy-to-use set.

TABLE 1 SPECIFICATIONS

SW1~29

Frequency Range:	SW1	1.6~2.0 MHz (187~150 m)	
	SW2	2.0~3.0 MHz (150~100 m)	
	⁓		
	SW29	29.0~30.0 MHz (10.6~10 m)	
Type:	Double Superheterodyne with Phase-Locked-Loop Synthesizer		
IF:	1st IF: 10.695 MHz		
	2nd IF: 455 kHz		
Sensitivity: (Modulation 400 Hz, 30%, for 50 mW)		S/N 6 dB	S/N 26 dB
	5 MHz	1.2μV	12μV
	12 MHz	1.4μV	14μV
	23 MHz	1.0μV	10μV
Selectivity:	WIDE	±3.5 kHz (−6 dB)	
		±7 kHz (−50 dB)	
	NARROW	±1.5 kHz (−6 dB)	
		±4 kHz (−50 dB)	
Image Interference Ratio:	5 MHz	50 dB	
	12 MHz	40 dB	
	23 MHz	45 dB	

LW/MW

Frequency Range:	LW	150~410 kHz (2000~732 m)	
	MW	520~1,610 kHz (577~186 m)	
Type:	Single Superheterodyne		
IF:	455 kHz		
Sensitivity: (Modulation 400 Hz, 30%, for 50 mW)		S/N 6 dB	S/N 26 dB
	LW	70μV/m	600μV/m
	MW	35μV/m	400μV/m
Selectivity:	WIDE	±3.5 kHz (−6 dB)	
		±7 kHz (−50 dB)	
	NARROW	±1.5 kHz (−6 dB)	
		±4 kHz (−50 dB)	
Image Interference Ratio:	LW	40 dB (at 200 kHz)	
	MW	40 dB (at 1,000 kHz)	

FM

Frequency Range:	FM 87.5~108 MHz
Type:	Single Superheterodyne
IF:	10.7 MHz
Sensitivity:	2.5μV/75Ω (−3 dB Limit Sens)
	2.5μV/75Ω (S/N 26 dB)
Image Interference Ratio:	25 dB (at 98 MHz)

Frequency Display

Display Type:	7-segment Fluorescent Tube
Precision:	Direct Readout to 1 kHz for AM
	Direct Readout to 10 kHz for FM
Number of Figures:	5 digits
Frequency Stability:	Within 500 Hz during any 30 minutes after warm-up (SW)

General Specifications

Semi-Conductors:	IC	11
	FET	5
	Transistor	63
Output Power:	DC Max 2 W	
	AC M.P.O. 1.5 W	
Speaker:	9 cm ($3\frac{1}{2}$") PM Dynamic Speaker (8Ω)	
Power Source:	AC 110~125/220~240 V, 50/60 Hz, or DC 12 V (Eight "D" size Flashligh Batteries) (National UM-1 or equivalent)	
Power Consumption:	15 W	
Jacks:	Earphone/External Speaker (8Ω)	
	Headphones (8Ω)	
	Rec out/phono (DIN Type)	
Antennas:	Telescopic Antenna for FM & SW1~29 (1053 mm)	
	Ferrite Core Antenna for MW & LW (10∅×160 mm)	
	External Antenna	
Dimensions (W×H×D):	371×122×241 mm ($14\frac{5}{8}\times4\frac{13}{16}\times9\frac{1}{2}$")	
Weight:	3.2 kg (7 lb. 0.9 oz.) without batteries	

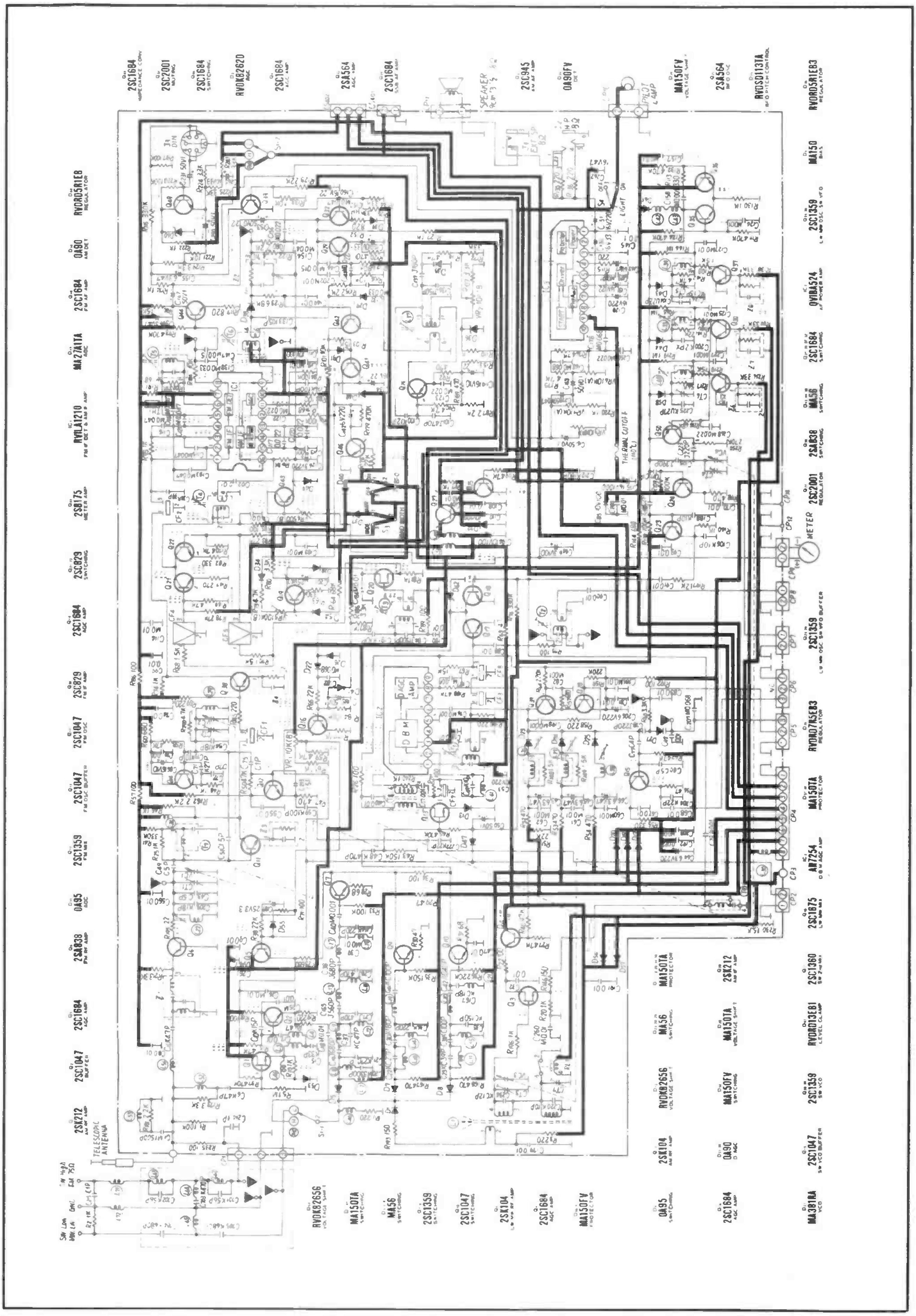


Figure 1: The signal processing circuit diagram. Supply connections are emphasised with bold lines. The test voltages shown in the manual have been lost in our reproduction process. ▶

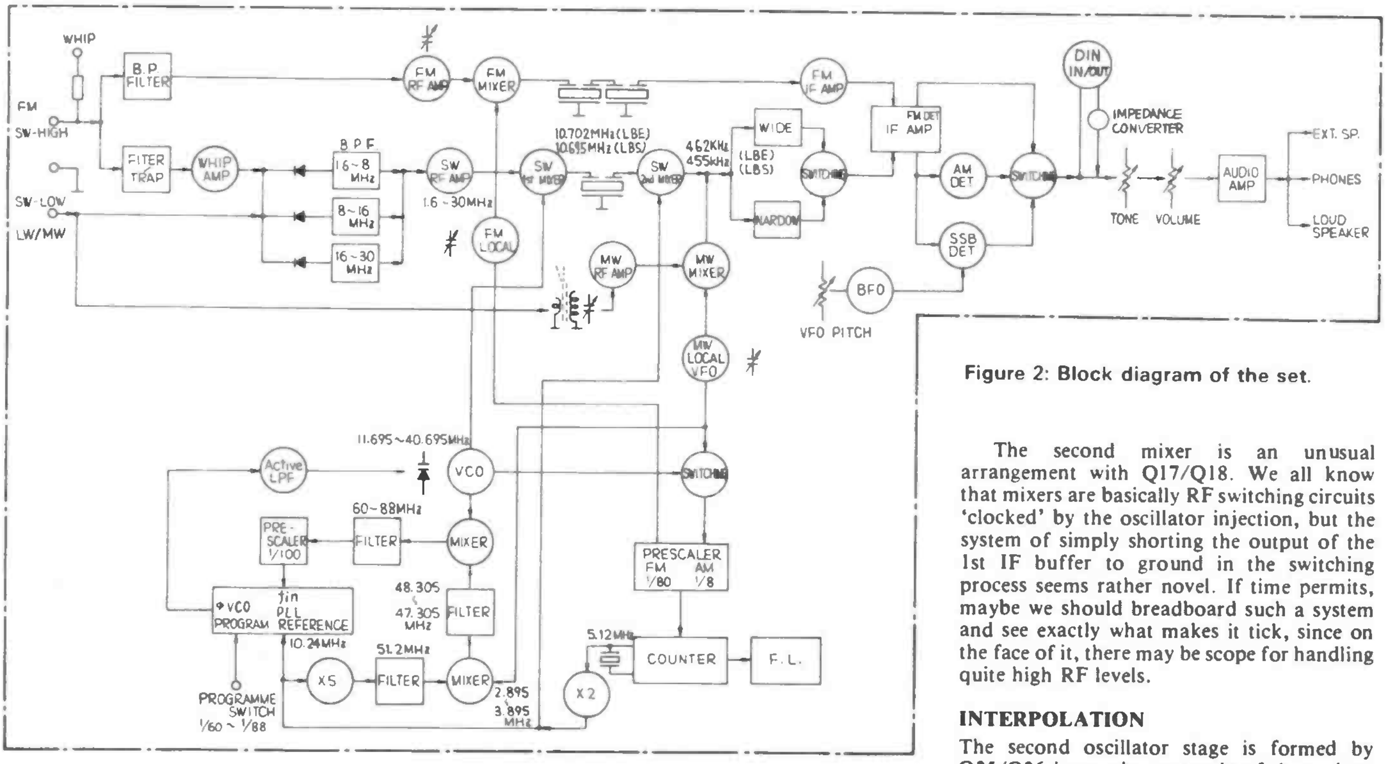


Figure 2: Block diagram of the set.

CIRCUIT DESCRIPTION

Like all major Japanese manufacturers, Panasonic provide a handbook that is so well illustrated and comprehensive that the enterprising could set up a production line to make the receiver simply using that alone. The block diagram is shown in *Fig 2* while *Fig 1* shows the circuit diagram of the signal processing circuitry.

The set suffers the usual compromise at the antenna input, with the conflicting interests of the telescopic antenna, external antenna, and the need for FM coverage as well. The external antenna sockets attempt to get to grips with this dilemma, by recognizing that the MW/LW external antenna (coupled onto the ferrite rod L1 via S1-1 and D1) is likely to be a low impedance at HF, with suitable length to pick up enough signal to feed directly into the band pass filter, selected by D5, D7, or D8. In fact, any additional amplification is more likely to encourage the onset of IMD than do anything worthwhile to the usable S/N.

The 'high impedance' antenna position (which includes the internal telescopic whip) places a broadband source follower/emitter following stage (Q1/Q2) with a broadly tailored response to transform the high impedance into one that can be recognized by the filter input. IF traps and approximate bandpass shaping are added at the antenna socket for good measure, and one interesting feature is the use of Q5/Q16 to provide AGC on the source follower stage, plus Q's 7, 9 and 10 immediately after the bandpass SW filters.

This AGC is derived at the output of Q17/18 at the second mixer, which is still a relatively broad (around 50 kHz) point, implying that strong adjacent signals will cause this AGC loop to operate.

The output of the appropriate SW filter is selected both by the diode switch at the front, and applying bias to the required amplifier at the back. The first mixer is preceeded by another FET gain stage (Q13), but the transformer in the drain of this stage is described in the parts list as an 'IF trap'. Have we caught the mighty Matsushita here? T8 must surely be a wideband coupling transformer, too bad we don't have the set still to check.

LEARN FROM OTHERS

The next section of the circuit contains some very interesting elements for the radio designer. From the disputed T8, the signal passes through CF7, which is a ceramic trap filter. The I/O connection is bridged with 100R, followed by another IF trap. Bearing in mind the fact that the first IF lands in the middle of the SW coverage at 10.702 MHz, it's understandable that Panasonic should take severe measures to keep this out of the signal path. There is certainly a hole in the coverage at this point — but it's nowhere nearly as significant as we had feared. In fact, bearing in mind how little actually goes on at the frequency, you really don't notice it at all.

The mixer utilizes an AN7254 IC, which also incorporates an AGC amplifier control function. The mixer output passes through a pair of ceramic filters, and it seems a shame that such a comprehensive set could not have used 2 pole monolithic crystal filters instead. In view of the problems with access to the circuit board, only the daring should attempt to rectify this situation themselves.

The first oscillator is an interesting implementation of the emitter coupled negative reactance oscillator(Q39/Q28)that is now almost universal in IC radio devices. The single terminal tuned circuit used in this configuration readily lends itself to DC switching, and you will see that a separate coil is selected to correspond with the selection of the bandpass filters covering:

SW1: 1-7 MHz (not exactly octave filtering)
SW2: 8-15 MHz
SW3: 16-29 MHz

The output of the oscillator is buffered by Q15.

The second mixer is an unusual arrangement with Q17/Q18. We all know that mixers are basically RF switching circuits 'clocked' by the oscillator injection, but the system of simply shorting the output of the 1st IF buffer to ground in the switching process seems rather novel. If time permits, maybe we should breadboard such a system and see exactly what makes it tick, since on the face of it, there may be scope for handling quite high RF levels.

INTERPOLATION

The second oscillator stage is formed by Q35/Q36 in another example of the emitter coupled system. But this time the tank circuit switching is used for selection of MW and LW LO, and interpolation of the 1 MHz steps on SW. The LW/MW bands use a standard heterodyne circuit in conjunction with the internal ferrite rod, with Q3 as a source follower supplying the RF signal to the base of Q18. There isn't much finesse about this approach, but it obviously serves its purpose well enough.

The final IF (462 kHz in the UK set, 455 kHz for the US version) offers the option of two bandwidths. CF4 is rather narrow for 'easy' AM listening, so when conditions permit, the 7 kHz option (CF5) provides a welcome alternative to what sounds (by comparison) near FM quality.

THE MIXING SCHEME: A SHORT CUT TO AN EXPERIMENTER's R1000

There isn't enough space allocated here for more than a cursory glance through this set — so we will have to stop at the bits you should all (by now if you're a regular reader) know and recognize. We have concentrated on the more novel aspects so far — but there is one other novel feature as yet not mentioned.

Refer back to the block diagram, *Fig 2*, and analyse the local oscillator and mixing processes. The final circuit of this system is perhaps not relevant, since it relies on devices that are quite unrecognizable to the UK reader — but the basic approach is perhaps a good deal more accessable to the receiver 'fiddler' who finds 10.7 MHz filters easier to get to grips with than the more esoteric up-conversions used elsewhere.

The actual PLL device used is a RV1MM55126N (told you so), but this can be quite readily replaced using one of the MC145151 family, featured in previous issues (refer to Databrief February and CB Transceiver March). The frequency display system can use an Ambit DFM7, which has a 10.7 MHz IF offset option with 1 kHz resolution, and so can be hung directly onto the first LO.

BRIEFLY

As with most receivers of the type, the manufacturers produce a variety of versions to suit a particular market. The UK model we saw had a track tuned LW/MW section, and a SW section featuring interpolated 1 MHz steps up to 30 MHz. FM was a conventionally tuned superhet covering 87.5 to 108 MHz.

The digital frequency readout had 1 kHz resolution on AM bands, and 100 kHz on FM — which corresponds to the average tuning ability of the broadcast listener. Resolution of SSB and CW was not completely satisfactory using only the main tuning dial, and the BFO pitch control came in handy. The SSB filter is around 3 kHz wide so as to double up for 'narrow' AM reception, so the precision of the BFO location is not too crucial.

The bass and treble controls give a clue to the consumer origins of the marketing strategy, which is probably one of the reasons why the set is not generally seen on the amateur communications market. When we enquired into the marketing policy at Panasonic, we found that the dealer arrangements were such that it was not practicable for them to supply the RF3100 to the specialist retail trade. Which is a pity, since if you want to have a hands-on fiddle with the RF3100, the chances are that you can tread around a good many Panasonic dealers before you will find one that has the nerve to stock what looks like a very expensive portable radio.

We asked a couple of official dealers in our area, and they said they would be pleased to get one in for us to buy — but they couldn't arrange to demonstrate one. Catch 22.

Conclusions

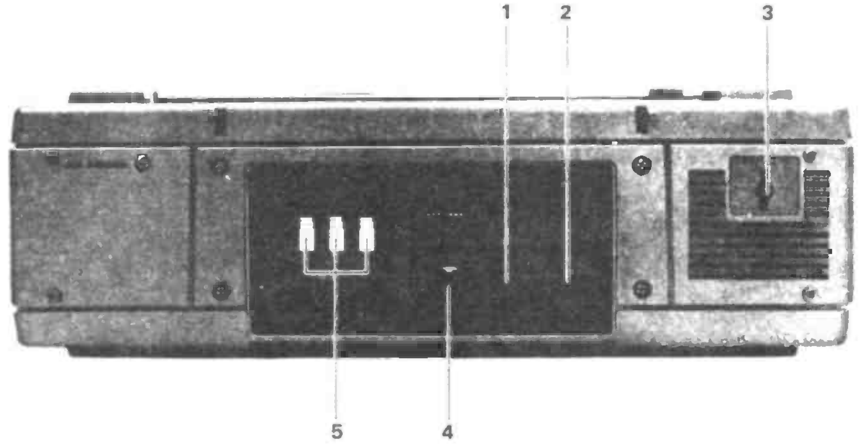
The set is a delight. The FM quality is excellent, the AM quality is excellent, and the 'communications' performance outshines the Sony ICF2001 by a long, long way. Despite the fact that the Sony set boasts a micro with a few memories and scanning facilities, the Panasonic set will be the first choice of any inveterate radio enthusiast.

The bits we found that were compromised were minimal, and in the context of the price and versatility of the set, not worth worrying about. The FM section of the set is reminiscent of a £10 Hong Kong Horror (HKH), but that is no reflection on the audio quality, merely the single tuned RF stage and its willingness to let other things through at the slightest provocation. Like the IF image at —25dB.

An NBFM adaptor would be a handy addition, not just for CB, but also to turn the set into a useful VHF/UHF converter tunable IF. Despite the daunting prospects of getting inside the circuit, it is relatively easy to get to a suitable IF output point to attach something like an ULN3859 for this purpose. The 7 kHz filter is even just about wide enough to cope with the majority of 2m FM signals without unacceptable degradation, although tapping into the IF at the source of Q20 would then leave bandwidth selection up to the user.

As already hinted, getting inside the RF3100 is not for the faint hearted. The fact that the interpolation 2nd oscillator tuning is carried on using a cord drive system was sufficient grounds for us to chicken out of going the whole hog, in case we never got it back together again in time. Taking the back off allows access to the IF mentioned above, and that's where you should stick. A copy of the manual is a must for any owner — or anyone else interested in intrigueing RF design practice.

■ R & EW



1 Radio/Phono Selector (RADIO/PHONO) and Antenna Selector
2 Earphone/External Speaker Jack (8Ω)
3 AC Voltage Selector (VOLTAGE SELECTOR)
4 DIN Connector Jack
5 External Antenna Terminals
6 Light Switch
7 Speaker [9 cm (3 ½"), 8Ω]
8 Signal/Tuning Indicator (INDICATOR)
9 Operation Indicator (OPERATION)
10 Bandwidth Selector (BANDWIDTH)
11 Telescopic Antenna
12 Digital Frequency Display (FREQUENCY DISPLAY)
13 BFO On/Off Switch (BFO)
14 Band Selector (FM/LW/MW/SW1/SW2 . . . /SW29)
15 Battery Compartment Cover
16 Radio Switch (RADIO)
17 Tuning Control (TUNING)
18 BFO Pitch Control (BFO PITCH)
19 RF Gain Control (LW/MW/SW RF GAIN)
20 Treble Control (TREBLE)
21 Bass Control (BASS)
22 Volume Control (VOLUME)
23 Headphone Jack (8Ω)

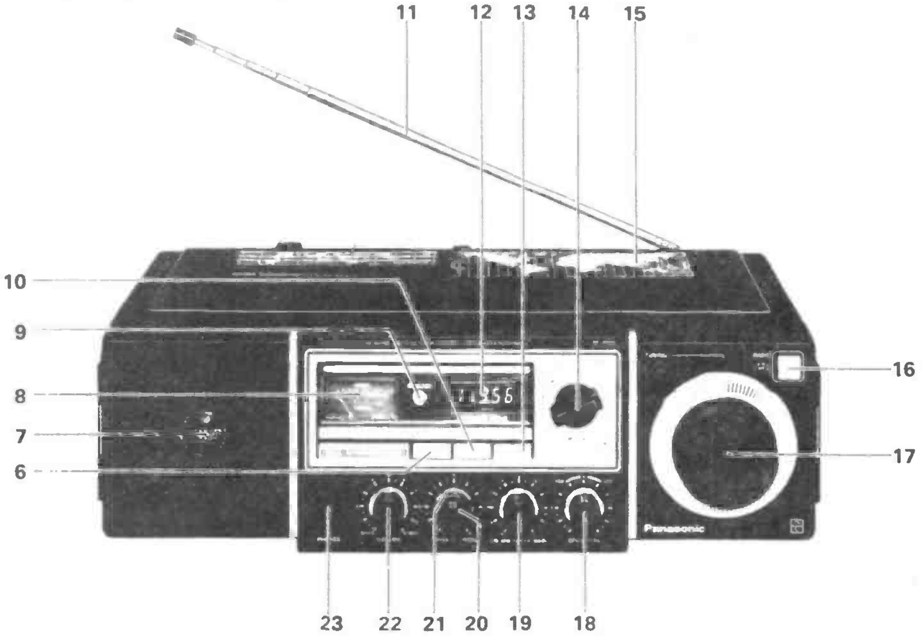


Figure 3: Front and back panel layouts of the RF3100.

Your Reactions..........	Circle No.
Immediately Interesting	64
Possible application	65
Not interested in this topic	66
Bad feature/space waster	67

COMPUTING NEWS

ZX SPECTRUM

Not the ZX82, very definitely not the BBC computer but Sinclairs new license to print money, the ZX Spectrum. Gary Evans went to see the machine launched.

AFTER MUCH SPECULATION as to Clive Sinclair's next move in the increasingly competitive 0-£500 computer market, his new machine - the ZX Spectrum - burst upon the scene at the Earl's Court Computer Fair in late April. Clive has done it again and the Spectrum is destined to shake up the small computer market place, as most of his competitors are forced into a retail price war in order to retain their share of the market.

The ZX Spectrum is quite a different animal to the ZX81, a fact Sinclair convey by failing to call the machine by the obvous name - ZX82. It makes up for many of the 81's shortcomings, offering all that is expected of today's consumer computer (colour, sound, graphics, full size keyboard etc.) but follows the ZX81's 'price breakthrough' philosophy with its £125 price tag for the 16K version .

At the machine's launch, in what was an almost Churchillian gesture at the BBC/Acorn computer, Clive Sinclair pointed out that the Spectrum offers more features than the BBC model A configuration at less than half the price.

FULL SPECTRUM

The Spectrum shows its ZX81 heritage, being Z80A based and using a 'superset' of Sinclair BASIC. This version of BASIC is destined to become the nearest thing to a standard implementation of the language by virtue of the massive sales of the ZX81, 350 000 to date, and the undoubted sales potential of the Spectrum.

The Spectrum, which unlike previous Sinclair computers is not being made available as a kit, is based around just 14 ICs. The Z80A MPU, 16K ROMand the RAM ICs account for 10, a ULA another one, which leave just three ICs to take care of all other functions - an elegant design indeed.

KEY ISSUES

The Spectrum's keyboard is a vast improvement over the 81's touch sensitive design but although described as typewriter spaced and being a mechanical design, this is one obvious area in which ecconomies have been made. Not many touch typists would be at home with the rather 'fiddley' keys.

The keyboard features autorepeat and caplock facilities as well as generating ASCII codes all steps forward from the ZX81 particularly the use of ASCII codes in preference to the 'personalised' codes used within the 81.

As with previous ZX machines, upto five functions are available from a single key. Thus all BASIC commands and functions, the 16 graphics characters, 20 control codes and 21 user definable graphics characters are available via single keystrokes.

A FINE DISPLAY

The Spectrum's display combines the best of the 81's FAST and SLOW modes, providing a flicker free display with reasonably fast execution of programs.

The display is organised as 24 lines of 32 characters with the lower two lines displaying editing/Syntax checking information. It displays both upper and lower case alpha characters, numerics plus the familiar Sinclair graphic blocks. Text can be mixed with graphics without any problems.

An important feature of the machine is that, under software control the display can be reorganised so as to become teletext compatible.

In its high-res graphics mode the screen is divided into 256 x 176 pixels, addressable by PLOT, DRAW and CIRCLE commands.

The display is memory mapped, with an 'attribute' byte being dedicated to each character position (8 x 8 pixels). This defines foreground and background colour, brightness level (normal or highlight) and a flashing or steady mode.

Eight colours can be generated - black, blue, red, magenta, cyan, green yellow and white - and all can be assigned to foreground, background or border. The eight colour capability is rather restricted when compared to some other machines but in practice all but graphic artists should find the choice adequate particularly when combined with the two levels of brightness.

SOUPED UP BASIC

As mentioned above, Spectrum BASIC is a 'superset' of ZX81 BASIC and, as such, features the excellent editing and line by line syntax checking of that machine. Amongst the new commands to control the spectrums additional capabilities are:-

-BEEP This controls the sound output and is used in conjunction with two parameters defining pitch and duration. The output covers ten octaves and is reproduced via an internal speaker as well as being available for use with an external amplifier.

—INK, PAPER, BRIGHT, FLASH. These commands control, Globally or locally, foreground colour (ink), background colour (paper), brightness and select either steady or flashing characters.

-BORDER. This defines the border colour.

-VERIFY, MERGE. Two commands that allow stored data to be checked (verify) and the combining of two or more programs (merge)

-READ, DATA, RESTORE. Familiar BASIC commands for handling data input, missing from the ZX81 and a welcome addition to Sinclair BASIC.

-BIN. A command that allows binary numbers to be entered directly, of considerable use when using the Spectrums's hi-res graphics power.

-DEF FN. User definable functions which support up to 26 numeric and 26 string arguments and yield string or numeric results.

The BASIC is floating point and stores numbers (in binary form) as a five byte block. Numbers in the range $+3 \times 10^{-39}$ to $+7 \times 10^{-38}$ are catered for with accuracy of 9.5 decimal places.

The Spectrum can handle multistatement lines and features a real time clock.

A very powerful BASIC indeed, perhaps the most obvious ommision being a RENUMBER command, but Sinclair has to stop somewhere.

CAN I USE IT WITH ....?

The Spectrum is compatible with the ZX81 printer which is capable of reproducing the high definition output of the Spectrum without any modification. It is not compatible with the ZX81 16K RAM pack. No doubt though that adaptors to take care of this will soon appear and a 32K machine is quite enough for most peoples's needs.

The cassette interface of the Spectrum is an improved version of the ZX81's troublesome design featuring a tone leader, to overcome AGC circuits and runs some six times faster than its predecessor.

A network interface is part of the basic machine and allows several Spectrums to be connected together.

An RS232 interface is under design (it will sell for about £20) and this will enable the Spectrum to be used with a wide range of printers and terminals.

THE BASIC MANUAL

The Spectrum is supplied with two manuals, one a 'get it up and running' guide for beginners the other being a well written (Robin Bradbeer editing the words of Steven Vickers), in depth, guide to the BASIC. Appendices along the lines of those in the ZX81 manual detail the error codes, system variables, expansion socket connections etc., as well as a number of sample programs.

HOW IT WORKS

The machines demonstrated at the launch worked well, producing a steady display with well defined colours. The program run at the launch to demonstrate the Spectrum was loaded from Sinclair's microfloppy. This amazing little box will store 100K on an interchangeable floppy transferring this in about 3.5 seconds. It will be available later in the year at about £50. The prototype and the Spectrum worked perfectly.

Sinclair will continue production of the ZX81 as they see the Spectrum complementing rather than replacing this machine.

All in all the Spectrum is a machine that will change the shape of the low cost computer market - it will be interesting to observe the reactions of the likes of Commodore and Atari.

One wonders what Mr. Sinclair will come up with next - the £1,000 electric car?

■ R & EW

See Page 40 for Dr. Ian Logan's asessment of the Home Computers currently available.

Your Reactions..........	Circle No.
Immediately Interesting	48
Possible application	49
Not interested in this topic	50
Bad feature/space waster	51

An NBFM RC Receiver for 35/27MHz

THE FIRST DIY approach to FM radio control design appeared in 'Radio Control Models and Electronics' a few years back (ref1). Terry Platt's thoughtful design took advantage of an IC that hitherto had only appeared in its primary guise as an NBFM IF subsystem, and the novelty of the design coupled with the move from AM to FM at about the same time created a substantial following for the basic design.

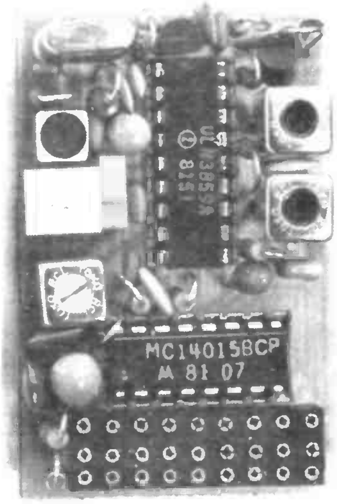
The IC was, of course, the MC3357/MPS3501, which has seen a good deal of active service in the meantime, recently to be superceded by the MC3359/ULN3859 that has already featured in an R&EW 'Databrief' and starred in the MSF time code receiver head.(April 82), and the UOSAT receiver system. However, amongst our various experiences with CB, we came across the problems associated with strong signal overload and the MC3357. This problem has also been spotted by users of the RC system, where it comes to light when a group of RC modellers gather together to fly/race/sail etc. The onset of overload with the MC3357 occurs at around 1v of RF - which sounds fair enough, until you start to add up the various stage gains preceding it in a CB receiver. 25 to 30dB in the RF stage alone will turn the MC3357's mixer to jelly.

CLOSE ENCOUNTERS OF THE 3rd ORDER KIND...

The original RCM&E receiver uses an FET RF stage, preceded by a bandpass pair. Good news and bad news - the good being the superb sensitivty achieved by such an approach, and the bad news being the fact that the mixer in the IC overloads significantly with an antenna input of over 5mV. Where two or three aircraft are being flown in close proximity, this cannot be overlooked, and the channelised nature of RC leads readily to problems of the 3rd order kind. The prime sensitivity of the MC3357 is around 8 to 10 microvolts for a useable signal, which improves to a microvolt or less with an FET up front.

The ULN3859 has a basic sensivity of around 2 microvolts, obviating the need for an external RF stage, but still not necessarily providing the sort of overload margin required by the most discerning RC user. So the receiver described here has been conceived after due consideration of all these factors, and uses and external FET mixer, which remains unconcerned as the RF input ranges from 2 microvolts to 2 volts. We may subsequently have time to evaluate the internal mixer, but this version plays safe.

With space at a premium, this design has retained the internal osciallator, but included a buffer so that source injection can be used to provide the best high level performance. Without the buffer, strong signals appearing on the source of the mixer can seriously influence the oscillator performance.



Left . A prototype of the radio control receiver board.

The oscillator in the IC is basically a Colpitts configuration intended for fundamental mode crystals, modifying this for use with 3rd overtone crystals requires that the fundamental mode be suppressed. The emitter load is thus a low impedance at the fundamental frequency, but high at resonance: a parallel tuned circuit.

The rest of the design philosophy remains the same: the use of the 4015 shift register as an RC decoder is widely appreciated, with up to 8 outputs available, although only 5 channels are used in conjunction with the transmitter described last month. The ULN3859 provides the necessary logic shaping functions, courtesy of the mute and scan circuitry.

CONSTRUCTION

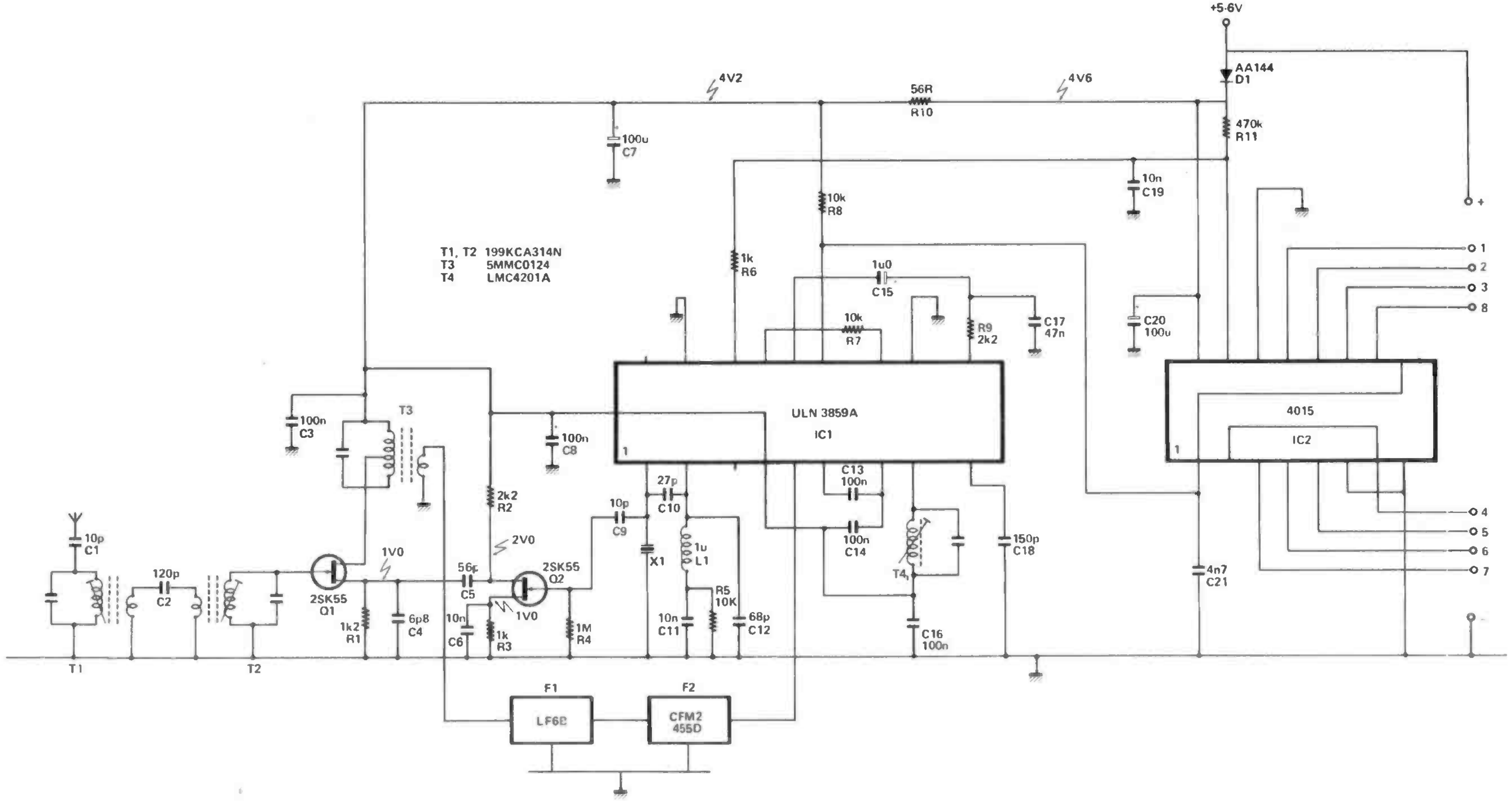
The receiver has been crammed down into the same dimensions as its predecessor, using a standard box and servo connector. Crystal accessibility is straightforward enough, and cage jacks are used in preference to the bulkier (and less reliable) sockets that are found in some equipment.

The cage jacks should be fitted by first plugging them on the end of a crystal, and then using this to establish the correct fitting dimensions whilst fitting and soldering. They should only be pushed about 2 to 3mm through the PCB, or the bottom of the case will not fit properly.

The alignment of the servo connector block with its holes in the PCB may try your patience: it is likely to require a good deal of joggling before dropping exactly into place. In view of the vibration likely to be experienced in many applications, the use of sockets sould be restricted to those with severe retention properties - such as the Zetronix family. The use of other types may cause the ICs to drop out or work loose at a crucial moment.

The photographs of the PCB together with details of the overlay should provide sufficient information for construction. If you find this information is not adequate, then you are strongly advised to seek the assistance of a friend to check out the unit as you go along, since we do not want to hear about tales of disasters and carnage on the flying fields. In fact, the regulation of model aircraft control systems is now quite severe, and your equipment must match up to standards laid down by the Society of Model Aero Engineers (SMAE) before most clubs will allow you to fly using it.

This system has been designed to comfortably exceed these requirements when constructed *correctly*. Please do not use a freshly constructed system on an airborne model under any circumstances, always take great care to ensure that the basic system is fully functional on land based models before risking anything airborne.



CIRCUIT DESCRIPTION

STARTING AT THE ANTENNA...

The input filter is a bandpass pair tuned to 35MHz (there is no reason why the circuit will not work at 27MHz, using the appropriate RF coils type 199CCA127EK). The bandwidth is determined by the value of the coupling capacitor, C2, which has been selected to provide approximately 500kHz bandwidth at the 3dB points. The antenna is coupled to the top of the tuned circuit, and effectively adds capacitance to the tuned circuit formed by T1. As with any parallel tuned circuit of reasonable 'Q', the impedance is very high, so sufficient coupling will result from the use of a small capacitor - which means that the capacitance of the antenna should not affect the tuning of the input circuit. However, purists may want to tweek the final receiver when attached to the antenna in situ - the proximity of metal etc., will have a discernible effect on the overall affect.

Q1 is a 2SK55 JFET - but it may equally well be a J310 or similar RF N-channel device. The local oscillator is injected at the source to provide the best dynamic range, with the 455kHz IF selected at the drain by T3 to match into the IF channel filters, F1 and F2.

Two filters are used - one to provide a well tailored bandpass response (F1) and the other (F2) to provide good skirt rejection, and immunity to signals more than +/- 100kHz away. The FM system is a good deal more particular with regard to frequency accuracy and the shape of the IF filtering. The group delay (a funtion of the phase linearity of the system) can have a very serious effect on pulse waveforms, distorting them beyond recognition, and putting enough ripple on the waveform to cause the schmidt trigger squaring circuits to feed spurious edges onto the decoder circuit. The trimming of T3 will have a considerable bearing on the overall group delay of the IF filter, but it is fortunate that in this system, maximum signal level also corresponds to the best tuning for group delay. This is not always the case in FM systems.

If the transmitted signal deviates grossly outside the passband of the receiver's filtering, then the resulting signal will break up and become noisy. During development of the R&EW receiver, we discovered that one example of the transmitter was running with around 15kHz deviation - and the resulting break up of the signal caused all sorts of problems that were attributed to non-existant defects in the receiver. The photographs of the pulse train at the detector illustrate the effects of incorrect tuning. In an AM system, there is a good deal more tolerance of adjustment, although the overall argument in favour of NBFM seems to have been accepted throughout the modelling fraternity.

The signal from the filter stages is fed to the limiting IF amplifier in IC1, whence it emerges at pin 8 at the quadrature detector stage, T4. The coil is adjusted so that the mid point of the 'S' curve sits at 455kHz - and this can be assessed by the DC voltage appearing at pin 10, which will sit between the positive and negative supply when T4 is correctly adjusted - when receiving no signal. An incoming signal that is exactly on frequency will not affect the quiescent DC level at this point, although any frequency error will be apparent as a DC offset which may be used for AFC purposes.

In view of the assymetrical nature of an RC control signal, the optimum tuning point is sometimes slightly offset, those of you with oscilloscopes should set up the detector for the best demodulated waveform.

The demodulated waveform at pin 10 is too ragged for edge triggered logic to handle. Fortunately, the mute amplifier and trigger components in IC10 can be adapted to provide the necessary trigger and inversions (the ULN3859A scan output is the inverse of that found on the MC3357, so the inverting amplifier used originally for the bandpass noise amplifier stage is pressed into service as an inverter). The time constant provided by C17 and R9 helps clean up the input to the trigger - noise at the trigger input is bad news for the decoder, but this is only generally a problem at 'threshold' conditions, since the receiver is effectively muted under very weak or no-signal conditions. The output does not chatter with no input, since the white noise output of the detector is insufficient to trigger the schmidt stage.

C21 helps to remove glitches from the decoder input, and provides a degree of noise immunity arising from the supply noise - which is probably the most nebulous problem facing the user. Servo motors operate at high current levels, and are frequently very badly suppressed - so a lot of decoupling has been provided in the overall receiver circuit to try and overcome these problems. Ideally, the servos should be run from a separate supply, and the very low current consumption of the basic receiver makes it a lot easier to implement. The low consumption also makes for effective RC decoupling, since a substantial amount of resistance in series with the supplies to both ICs is not going to materially drop the voltage beyond acceptable limits.

The frame reset facility is graphically illustrated by reference to the oscillogram. C19 and R11 integrate the output from pin 16 if IC1, providing a reset when the voltage at pin 15 of the 4015 reaches 66% of the supply voltage. In view of the fact that the decoder is capable of handling 8 proportional channels, and only 5 are sent from the basic R&EW transmitter, outputs 6,7 and 8 of the decoder IC are not to be used.

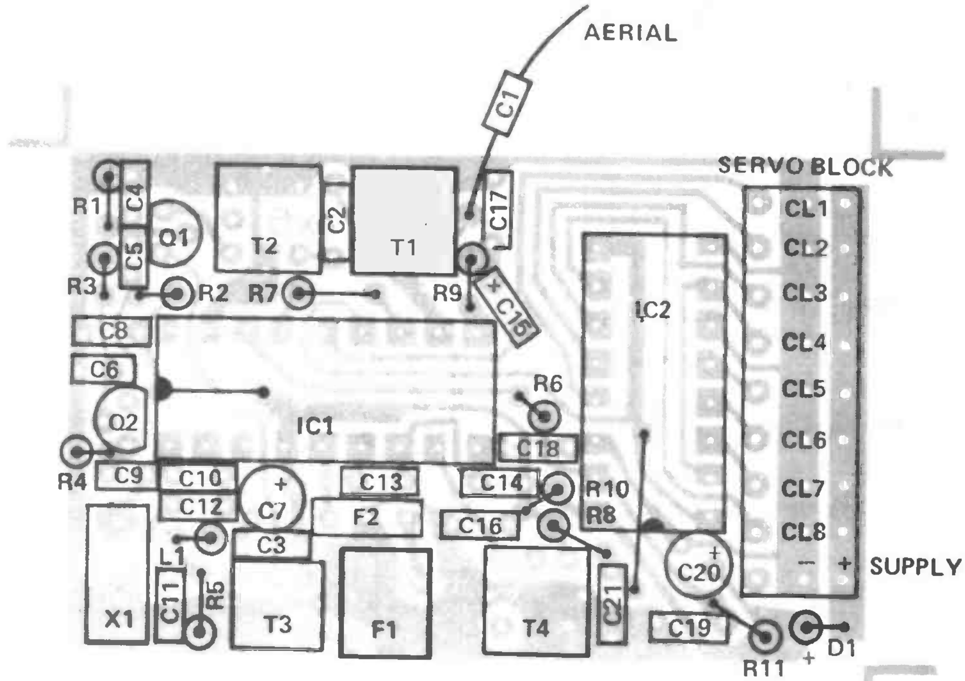
In cases of difficulty, the standard pulse width of the encoded transmission may be increased, and the frame rate slowed down until a reliable decoded output is obtained. In the case of the KB4445/TK10170 encoder device, the standard pulse is nominally 200uSec, but increasing C17 to 20nF doubles this up without compromising the rest of the operation. The decoder will drive virtually any servo - we have yet to find one that it won't, so let us know if you can!

DEVIATION CONTROL

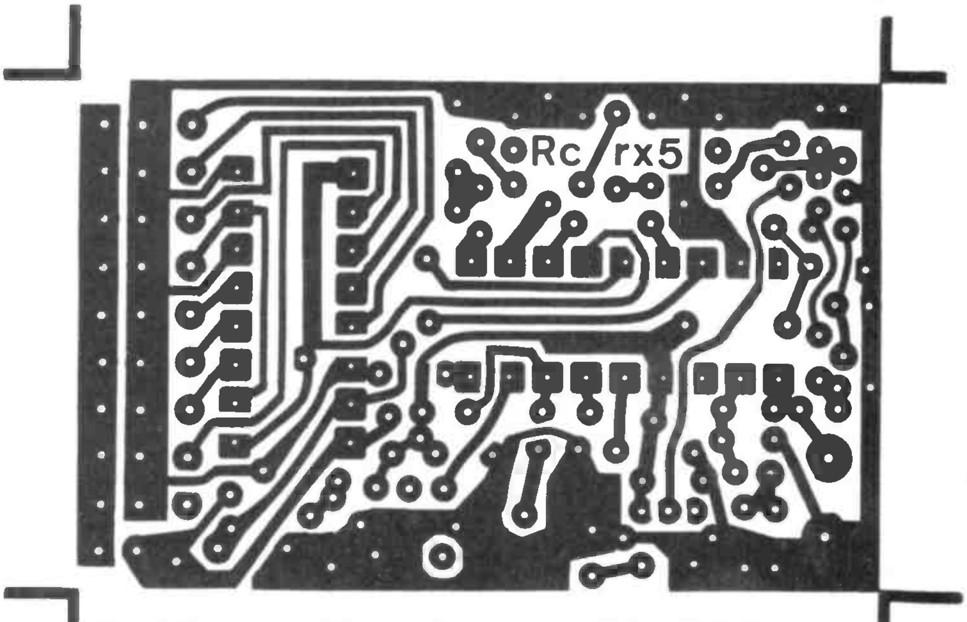
The transmitted deviation should be kept to around 2kHz in a 10kHz channelised system (where have you heard that before?). Increasing it beyond this will lead to problem in receivers designed for 10kHz operation - and the R&EW transmitter circuit in the last issue should be set up for this level if you have access to suitable equipment. We have found that increasing C7 to 68pF keeps deviation within limits - but then C7 must be replaced by a trimmer capacitor of approx 30pF in order to trim the exact operating frequency.

The importance of accurate frequency control has already been stressed with regard to distortion of FM signals - and unless you invest in very expensive close tolerance crystals, you may need to check the accuracy of crystal pairs with a DFM.

We are working on a practical implementation of the AFC facility of the ULN3859, and will report in due course. It is essential in UHF applications, and we hope to move onto these in a few issues time.



PCB overlay

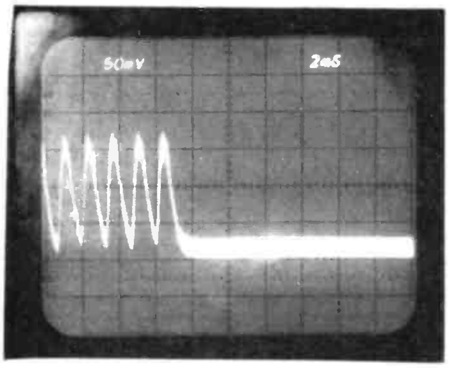


The foil pattern of the receiver. Twice Full Size.

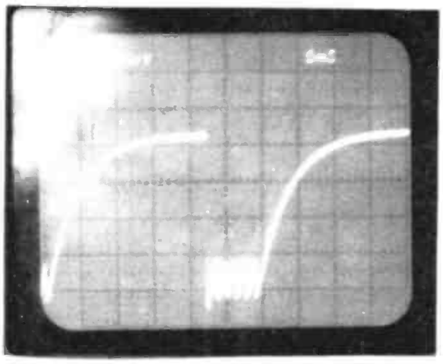
COMPONENTS LIST

Resistors	
R1	1k2
R2,9	2k2
R3,6	1k
R4	1M
R5,7,8	10k
R10	56R
R11	470k
Capacitors	
C1,9	10p ceramic
C2	120p ceramic
C3,13,14,16,8	100n mono
C4	6p8 ceramic
C5	56p ceramic
C7,20	100u 6V tant
C10	27p ceramic
C11,19	10n ceramic
C12	68p ceramic
C15	1u0 tant
C17	47n
C18	150p ceramic
C21	4n7 ceramic

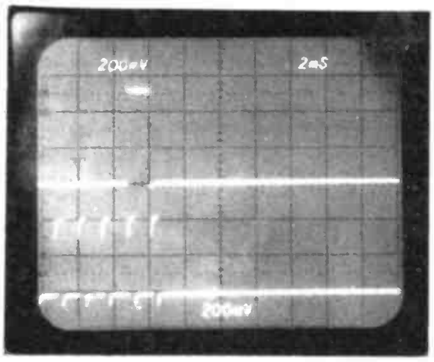
Semiconductors	
D1	AA144 or OA47
Q1,2	2SK55
IC1	ULN3859A/MC3359
IC2	4015
Inductors	
T1,2	199KCA314N
T3	5MMCO124
T4	LMC4201A
L1	1uH choke
Miscellaneous	
F1	LFB6
F2	CFM2455D
X1	3rd O/T crystal
IC sockets	
PCB	
Servo block	
Case	



The demodulated output on pin 10 of I.C. 1.



The reset output across C19.



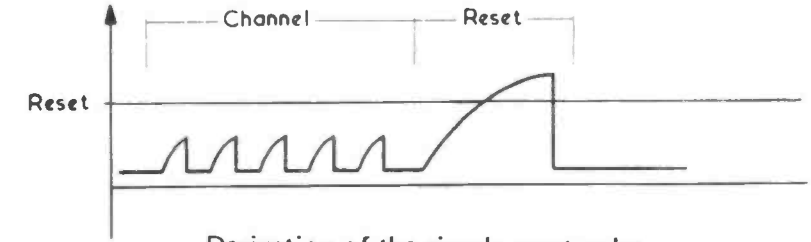
The decoder input (pin 2 IC2) is shown on the lower trace. Upper trace is the decoded channel 4 output.

SETTING IT UP

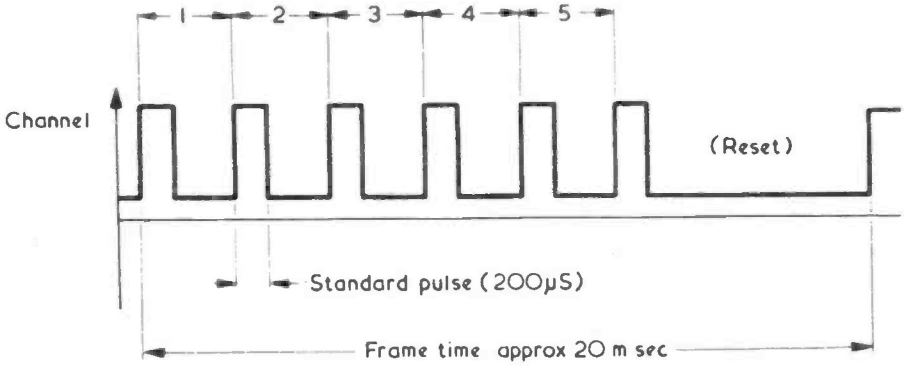
The 'how it works' setion will give the constructor a good deal of insight into the way the system needs to be set up for best operation. However, the first thing to establish is that the receiver is drawing the right amount of current (8.5mA at 5v supply), and that the crystal oscillator stage is functioning correctly. A brief check with a GDO should confirm that the crystal is oscillating - and if you have a transmitter nearby, then you should be able to begin to receive a recognizable signal even at this early stage.

A crystal earpiece or piezo resonator (PB2720) fixed from pin 10 to ground will allow you to monitor the sound of the received signal, which will be a steady buzz at around 50Hz when the system is correctly aligned and receiving a digital proportional control signal. T1 and T2 should be peaked for maximum sensitivity, and avoid tuning to the oscillator injection frequency, which is very close at only 455kHz LF of the RF signal. Q1 can then behave as an effective injection locked oscillator - tuning the core down actually increases frequency, so a half turn clockwise will tune the RF freqency in the right direction.

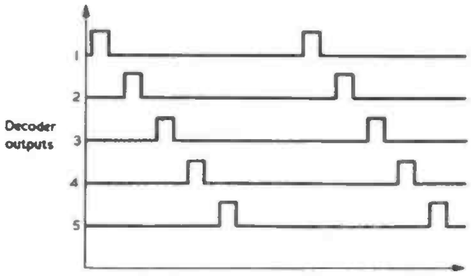
T3 is tuned for maximum signal, and if you have access to an oscilloscope, this should also correspond to the best waveform at pin 10 of IC1. T4 is tuned so the DC voltage at pin 10 sits between the supply rails (as mentioned) - T3 and T4 are iterative adjustments to achieve the best overall detected waveform consistent with good sensitivity.



Derivation of the simple reset pulse on C19 of the receiver/decoder.



The control waveform at the decoder input.



Decoded output pulses to drive the servos.

The decoder is self adjusting (or should be) so provided the right sort of data is being fed in - the right decoded outputs will appear. If the outputs are garbled, but all else seems satisfactory, then slow down the transmitted frame rate, and check the supply voltages. The receiver adjustments should finally be retrimmed with a weak input (disconnect the antenna or take the transmitter down the garden).

The most common problem at this stage is likely to be the accuracy of the transmitter and receiver crystal frequencies - depending on the accuracy of the load trimming, it is possible for an error of as much as 10kHz to accumulate, and the only really satisfactory solution is trim in the frequencies using a digital frequency meter. The transmitter output can be effectively coupled with a simple piece of wire on the input, but the receiver frequency should be monitored at the drain of Q2 to avoid loading effects.

A typical crystal in the receiver (20pf parallel load) runs about 300Hz HF in the basic circuit: this is within the bandwidth tolerance of the system, and well within the tolerance of a 50 ppm crystal. The transmitter crystal is likely to be the more variable element in the system, although if you stick to one brand, then there is a good chance you can maintain easy inter-changability. Nevertheless, don't wait until you're airborne before you find out!

AND FINALLY, CYRIL

This completes the basic system electronics - future installments will start to look at the more esoteric aspects, starting with a synthesised transmitter system that will not only cut out the costs of multiple transmit crystals, but provide a far more consistent deviation and frequency control than is possible with discrete crystals. Watch this space for details. ■ R & EW

Your Reactions..........	Circle No.
Immediately Interesting	100
Possible application	101
Not interested in this topic	102
Bad feature/space waster	103

R&EW Data Brief

Ferrite Cross Check

NEOSID GRADE	μ	NEOGID GERMANY	VOGT	DRALORIC DRALOWID KERAPERM	COFELOC	MULLARK	PHILIPS	SIEMENS	SEI	ITT	TDK	CRL	TELE FUNKEN	KASKE (KAHAFER)	LTT FRANCE	KRUPP	FAIRITE USA	INDIANA GENERAL
F5	MIN 1600	–	F1322	420	B50	A16	3C8	N27	–	–	H3S H3M H3V	420	–	–	–	C23	–	O5
F6	1200	–	F1311	417	B30 B42	A9	3C6	N22 for E.U.&I	–	–	–	424 Trans	–	–	3001	C21	–	–
F7	1800	–	–	–	–	–	–	–	R1	500T	–	–	–	–	–	–	72	–
F8	100	F02	Fi1310	407	–	A1 A4	3B 3B3	–	–	–	L6 L7	407	–	K3/1200/0,1	–	C2 C24	34	–
F9	3500	–	Fi340	421	T6	A8	3E1	N30	T2	601	H5A	421	K4	–	2003	D1S1	75	Q6
F11	500	Fis F1	Fi260	615	B10	A10	–	N25	–	–	–	615	–	K3/600/0,5	–	E3	3	–
F13	MON 650	F08	–	–	–	B1	–	–	–	–	–	–	–	–	–	–	–	–
F14	220	F2	Fi22	612	H20	B2	4B1	–	K4	–	Q1C	612 606	–	K3/250/1	1102	E4	64	–
F16	125	F5 is F10B	Fi212	602	H30	B10	4C1 4C6	K1	K10 K6	–	Q5B	602	M7	K3/125/10	1103	E5	61 65	Q1
F22	19	F.20	Fi130 Fi120	818	H52	B5	–	K12	K8	–	–	818	M11	–	–	E7	–	–
F25	50	F40	Fi150	704	H50	B4	4D1	–	K2	–	Q5M	764	–	K3/40/40	1104	E7	63	Q2
F29	12	F100	Fi110	814	H60	–	4E1	U17	–	–	M3D	814	M8	K3/12/100	1105	–	–	Q3
P10	MIN 1600	–	Fi320	–	T22	A5	–	M22 T26	P	–	H6A	M3	–	–	2002	–	–	–
P11	1800	–	Fi321	–	T14	A13	3H1 3H2	N28 29 & 32	Q3	503	H6B H6D	–	M3	–	1004	D1S3 D1S2	–	–

Ferrite Material Cross Reference
Courtesy of Neosid Ltd

The following chart provides guidance as to the compatibility of various manufacturers ferrite materials. Due to the notorious difficulty of obtaining an exact match even between batches from one source, this table should be regarded as a guide rather than an absolute equivalents table.

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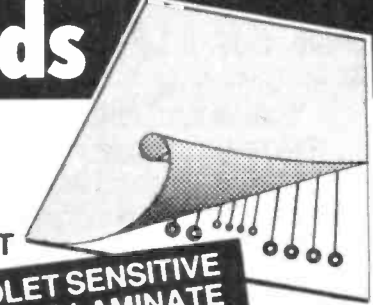

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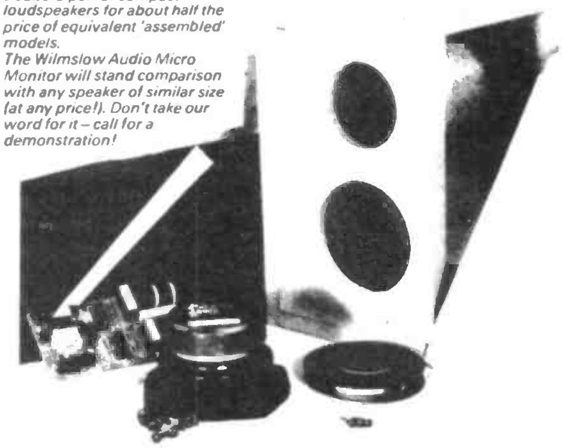

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COMING NEXT MONTH IN R&EW

PROJECTS, DATA, REVIEWS, FEATURES, NEWS, COMMENT IT'S ALL IN THE AUGUST ISSUE OF R&EW

MULTIBAND UP CONVERTER

Receive 10/6/4M and CB on a 2M Receiver

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Uses broadband techniques which simplify alignment — only one coil to adjust per band.

GaAs FETs

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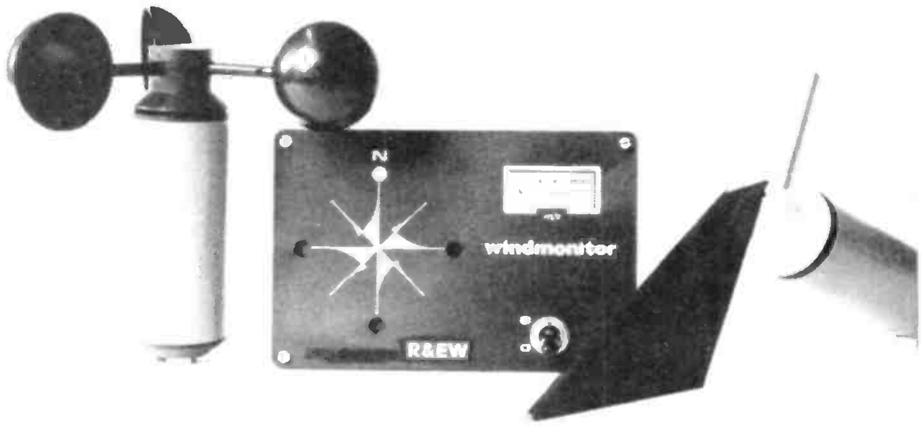
Next month we look at the devices currently available, at their physical characteristics and show how to design circuits based upon them.



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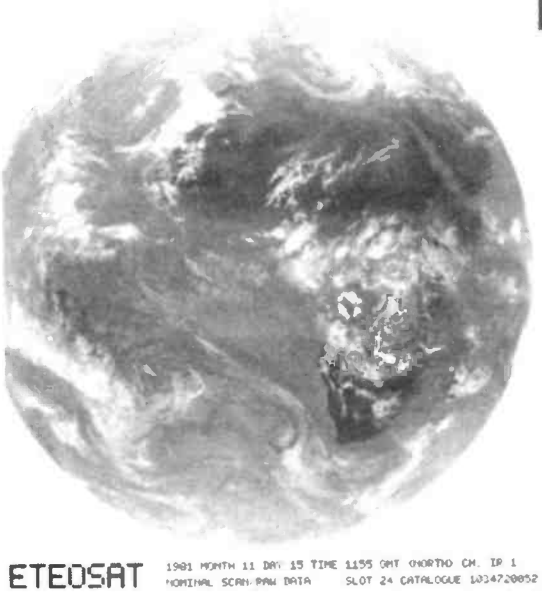
ZX80/81 MEMORY EXPANSION AND I/O PORTS

A design that provides

- Up to 14K RAM expansion
- Three 8 bit directly addressable ports
- Directly addressable D/A converter
- Status port indicators

A design that aims to provide maximum expansion for minimum expense.

R&EW — THE BETTER VALUE FOR MONEY ELECTRONICS MAGAZINE



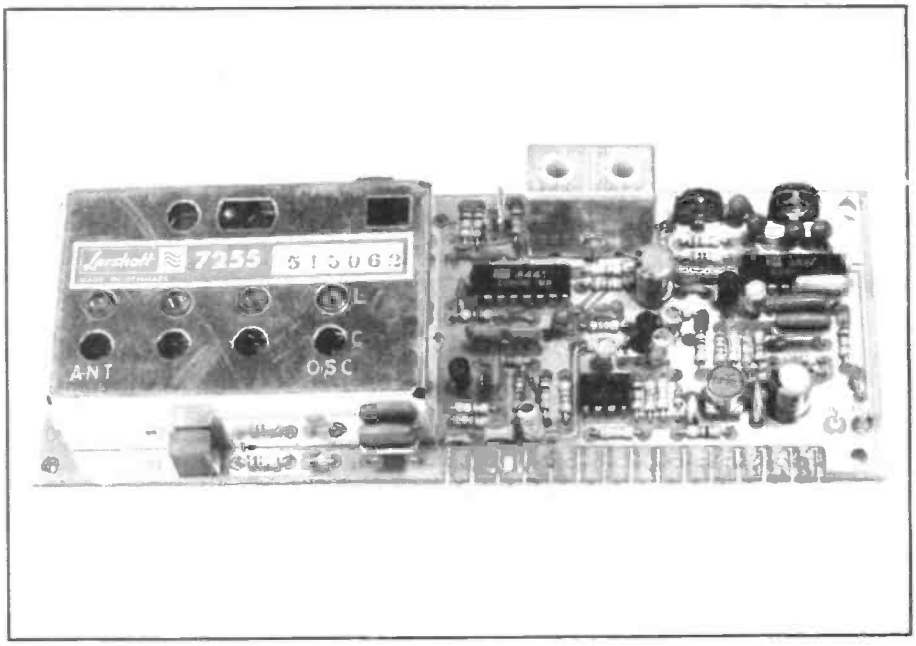
METEOSAT

A look at Meteosat 2, Europe's contribution to the Global Atmospheric Research programme.

The article takes a close look at the satellite's systems and also describes a receiving station capable of decoding the WEFAX transmissions.

ARTICLES DESCRIBED HERE ARE SCHEDULED FOR THE AUGUST ISSUE, HOWEVER THE FINAL CONTENT MAY VARY TO SOME EXTENT.

LARSHOLT'S LATEST: 7255 FM STEREO TUNERSET



LATEST IN A LONG LINE of complete 'antenna to audio' FM tunersets comes the Larsholt 7255. This unit incorporates several facilities now commonplace on the top end of the tuner market, including:

Switched IF bandwidths
55kHz post detector filter
Pilot cancel stereo decoder
Linear phase double-tuned detector

The circuit *(Fig. 1)* reveals that the front end uses a very similar approach to that of the well established 8319 from the same company. In view of the exemplary thermal stability of the latest versions of the 7252 tunerset using this front end, that's no bad thing. The component numbered *60* in the oscillator circuit (a 1N4148 diode) is largely responsible for the thermal tracking of the tuning diode.

Outside the tunerhead, the BF240 (drawn in one the 'Euro' symbol formats that never quite caught on) buffers the IF filter array, where a single narrowband (189kHz) ceramic filter is either used in series with the main linear phase filters (280kHz bandwidth) by switching pin 6 of the tunerset to the positive supply - or it is bypassed by the switching diode when pin 6 is grounded.

The overall impedance match is good, as evidenced by the distortion and separation performance of the overall system in both narrowband and wideband modes. The photograph of the swept separation response illustrates the difference between the two available bandwidths. The main IF system uses the latest member of the CA3089 families, with improved S/N and peripheral facilities.

The meter output pin of the IF system supplements the AGC action at pin 15 of the device with a transistor. A step function of the mute voltage is taken from pin 2 of the IF system for the purposes of scan control - the unit has been designed to provide most conceivable facilities.

The input to the stereo decoder is preceded by an L/C low pass filter stage, buffered by an emitter follower that is biased directly from the DC voltage present at the detector stage output. The base of the subsequent stage is supplied with an optional 'high blend' facility, which simply introduces some high freqency phase shift before the decoder, so that the separation is reduced at high

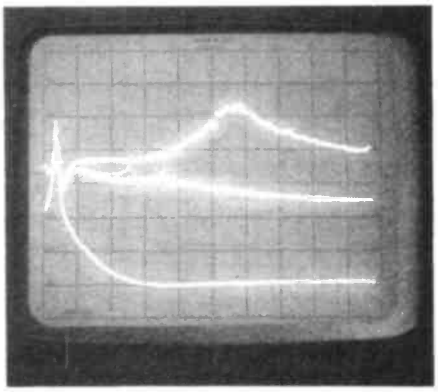


Figure 1: Stereo separation 0–20KHz R–Nar–Wide 10dB/div.

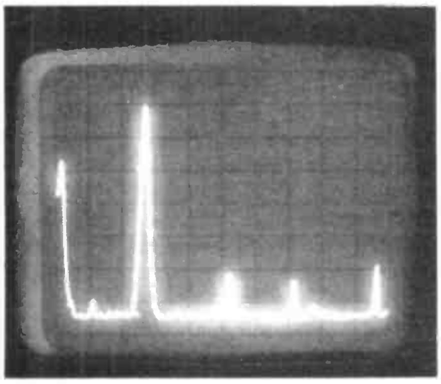


Figure 2: Intermodulation products and harmonics from a 1000uV 5KHz input signal.

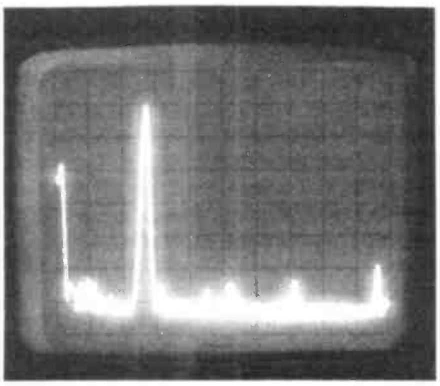


Figure 3: Intermodulation products and harmonics from a 100uV input signal.

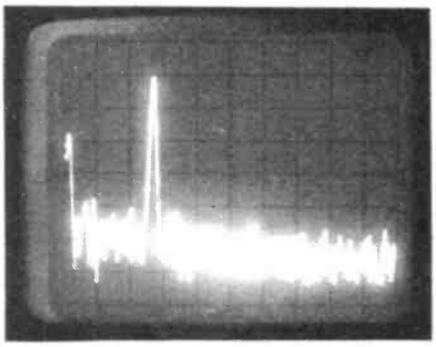


Figure 4: Intermodulation products and harmonics from a 10uV input signal.

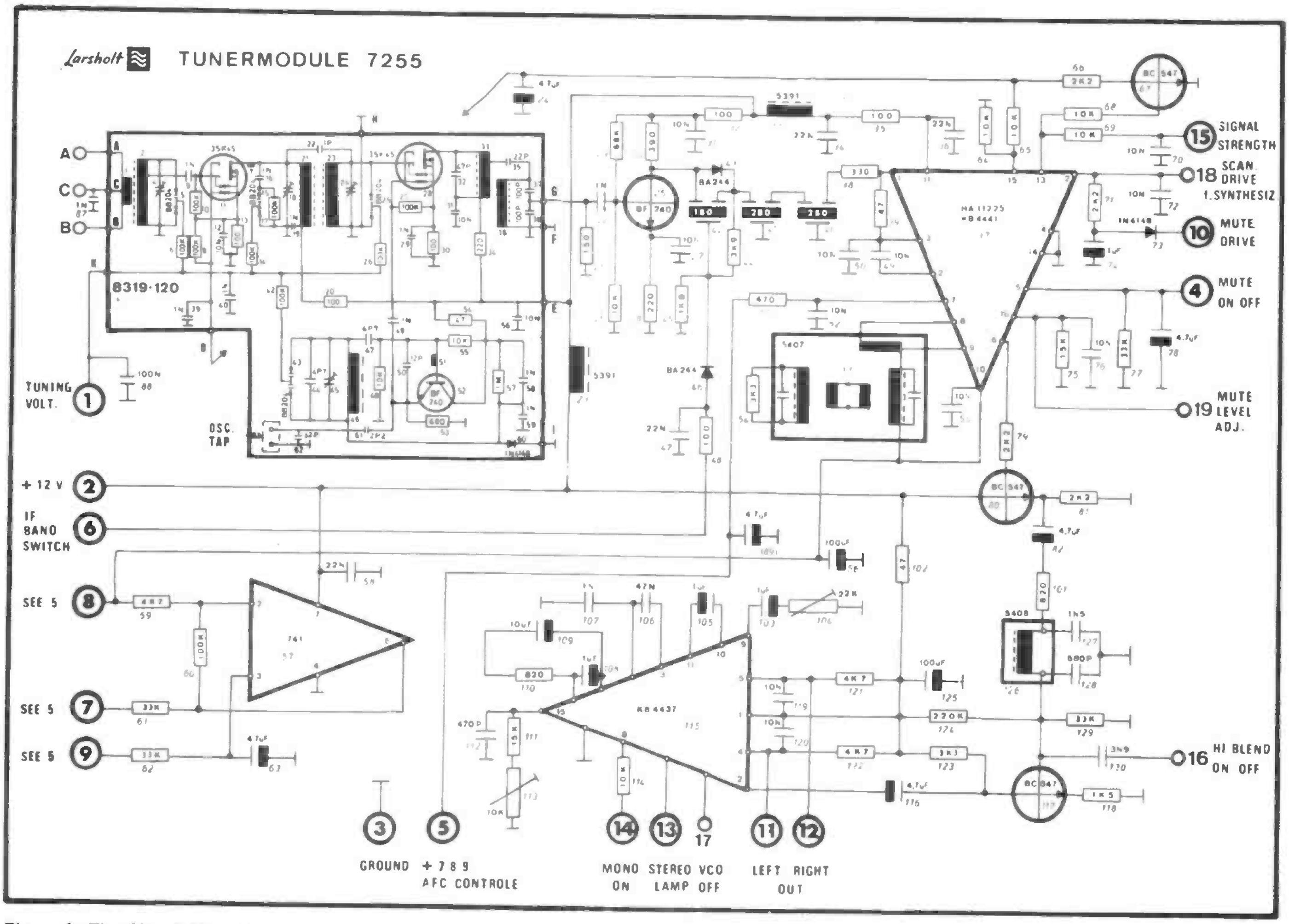


Figure 1: The Circuit Diagram.

frequencies, to reduce the noise content of weaker stereo transmissions. A degree of gain is included here, since the best S/N performance is obtained with the decoder driven fairly hard.

The stereo decoder uses the TOKO KB4437 pilot cancel PLL device, similar to the Hitachi HA11223, but with a VCO killer facility to provide a DC technique for muting the VCO if used in conjunction with AM systems. The output of the decoder device is open collector (like most ICs of this type), so the supply fed to the top of the load resistors is immediately reflected in the audio output. In other words, any hum or noise gets straight into the audio path, so a substantial degree of RC decoupling is provided to avoid this occuring. Note that deemphasis is provided, so if a subsequent preamplifier/pilot tone filter stage is used, watch out for duplication.

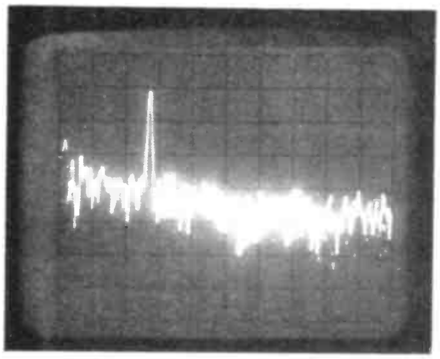


Figure 5: Intermodulation products and harmonics from a 1uV input signal.

LISTENING IMPRESSIONS

The tunerset circuit is very similar to that found in several very expensive tuners on sale in the HiFi market, so it's not too surprising to find that the overal sound quality is impressive. The performance figures for tuners rarely manage to convey too much about sound quality since most tests fail to analyse the effects of multiple HF intermodulation products, which is where many apparently 'good' tuners fail quite dramatically. A glance at the pictures taken from an audio spectrum analyser (using a modified Radiometer signal source) reveal that the 7255 keeps these products well down at full modulation.

Sensitivity is good. There are very few tuners that manage to exceed the specification of 7255 in this respect, although we would once again remind readers of the necessity to trade off between absolute sensitivity - and composure in the face of strong signals. It is also important to note that the distortion performance remains very consistant with increasing signal levels, whilst the noise level falls below the noise present on an average transmission.

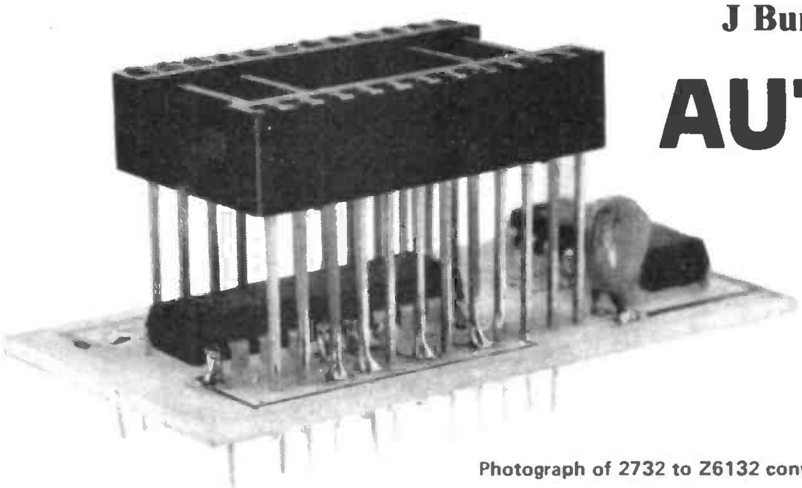
CONCLUSIONS

The 7255 will tempt many owners of the earlier Larsholt tunersets to upgrade, and there is a distinct audible improvement to accompany the peripheral feaures of the system. For the unwary RF constructor, Larsholt tunersets have always provided a short cut when assembling an FM tuner, although not quite achieving 'ultimate' performance. The 7255 fills this gap admirably, and will doubtless be found lurking inside a few commercial tuners before much longer.

Your Reactions.........	Circle No.
Immediately Interesting	96
Possible application	97
Not interested in this topic	98
Bad feature/space waster	99

J Burchell describes two techniques for

AUTOSTARTING THE Z8 TBPDS



Photograph of 2732 to Z6132 converter.

THE Z8 BASIC/DEBUG development system was first published in the February '82 issue of **R&EW** and since then we have been busying ourselves readying a number of Z8 based projects for publication. The first of these is the minimum chip based system, due for publication in the September issue.

One of the main features of the Z8 system is it's ability to automatically execute a BASIC program held in ROM on power-up. The development system provides the means to develop these programs by providing RAM memory at the right place (An auto-start program must start at 01020 Hex with a line number between 0 and 255) and by providing an on-board EPROM programmer.

Once the program has been developed and placed into EPROM the EPROM will probably be unplugged and placed into the target system. Prior to doing this (or perhaps prior to the finalisation of the hardware of the target system) it would be useful to be able to test the auto-start program. Unfortunately the Z8 board alone cannot achieve this. There are however, two approaches which may be adopted to allow a program held in EPROM to be plugged into the Z8 TBPDS and automatically execute on power-up.

APPROACH ONE

As stated earlier, the auto-start program must begin at 1020 hex and in the current version of the Z8 development system, the memory slot from 1000 to 1fff hex is occupied by a Z6132 RAM chip. This is intentional and allows the development of programs which will later occupy ROM at the same locations.

The obvious solution is to unplug the Z6132 RAM chip and replace it with a 2732 EPROM containing the program to be tested. The pinouts of the two devices are almost the same making the mechanical interface straightforward. Unfortunately the electrical interface is slightly harder is as much as the Z6132 talks directly to the multiplexed address data bus of the Z8 whereas the 2732 will require this to be demultiplexed. Luckily the demultiplexing signal is available on one of the Z6132 socket pins, thus making it possible to construct a small module carrying an EPROM which contains the auto-start program to plug into the vacated socket of the RAM chip.

The full circuit diagram and PCB layout of this approach is shown in *Figs 1 and 2*. The circuit consists of an 8-bit latch (74LS373) to demultiplex the address bus and a single quad NOR gate package (74LS32) to provide the correct logic levels from the signals available at the Z6132 socket to drive the latch and the EPROM.

The mechanical construction of the unit is shown in the overlay of *Fig 3*.

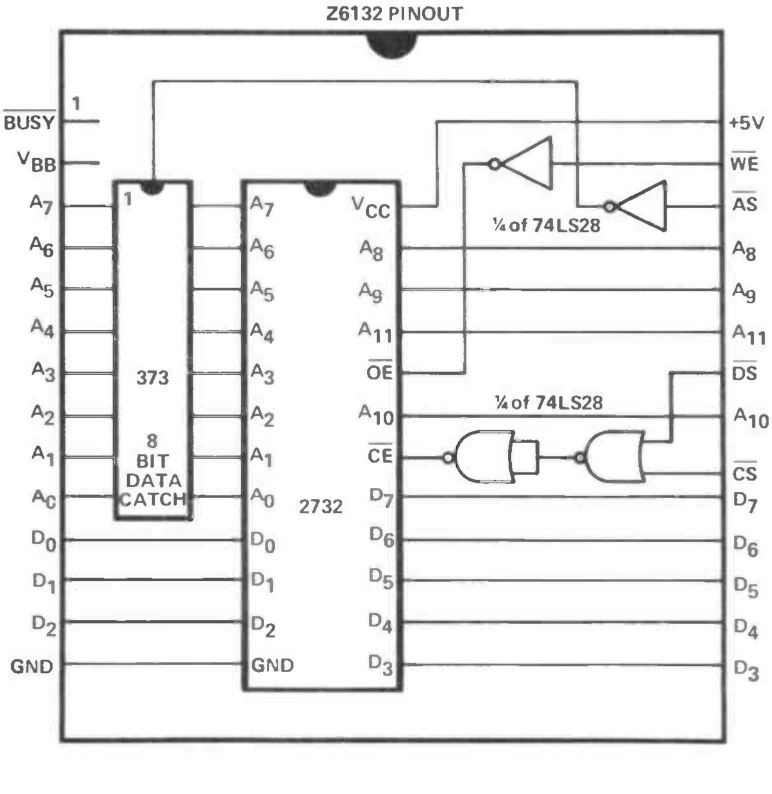


Figure 1: 2732 to Z6132 converter circuit diagram.

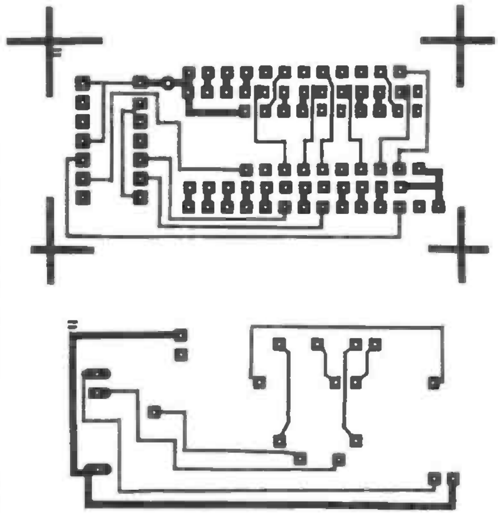


Figure 2: PCB Layout of 2732 to Z6132 converter.

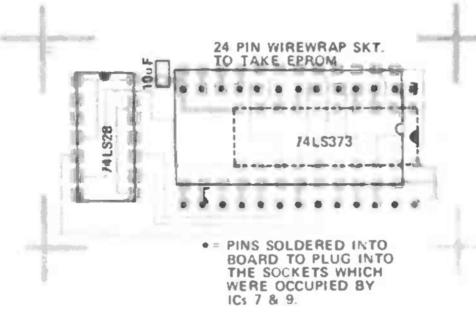
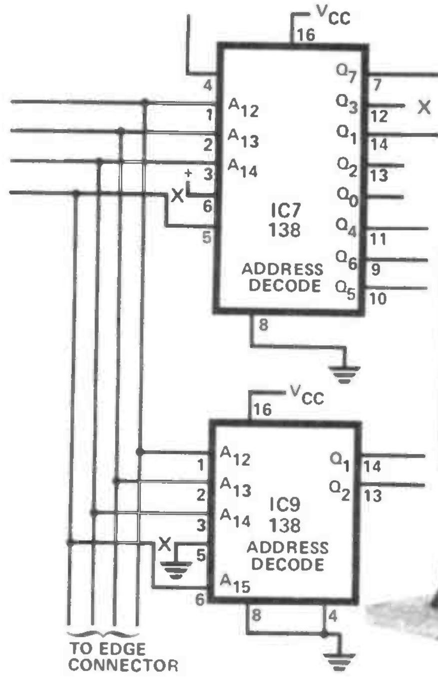


Figure 3: Overlay of 2732 to Z6132 converter.

THE SECOND APPROACH

An alternative approach would be to try and move 'in memory terms' the location occupied by the Utility EPROM to %1000 hex, and to move the RAM elsewhere. This can be achieved by modifying the address decoding from the original circuit diagram to that shown in *Fig 4*. As can be seen the effect is move the Utility EPROM socket to %1000 and the RAM to 9000-Afff. The implementation of this technique requires that the two 74LS138 address decoders on the Z8 board are removed and replaced by the module of *Fig 5*. The module modifies the decoding and routes the jumbled address lines to a pair of 74LS138s carried on the PCB. The overlay should help with the mechanical construction. In the prototype the pins for the socket were obtained by dismantling a pair of 16 pin insulation displacement connectors, and slightly trimming the pins in the header so that it would fit through the board. NB the PCB is used with the track uppermost. One disadvantage of this approach is that the memory map of the Z8 has been completely upturned, any code which was not position independant (NB all programs written in BASIC only and not using direct memory access will be position independant) must be rewritten.

Note that because the baud rate switches have been moved it will be necessary for software to carry out an initialisation of the UART timer prior to using the UART, on the other hand the approach is certainly the neatest mechanically.



NEW MEMORY MAP	
IC6	1000 – 1FFF
IC8	4000 – 4FFF
AUX RS232	5000 – 5FFF
AUX RS232	6000 – 6FFF
BAUD RATE	7000 – 7FFF
IC3 RAM	9000 – 9FFF
IC4	A000 – AFFF

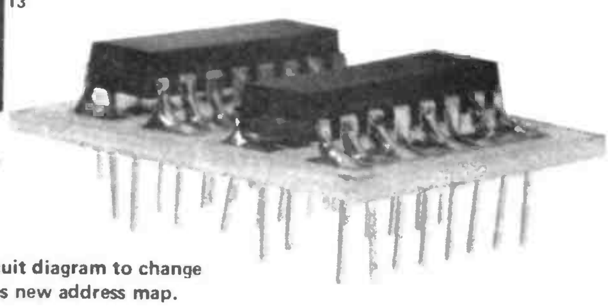


Figure 4: Modifications to original circuit diagram to change address decoding on Z8 board. Includes new address map.

WRITING AUTOSTART PROGRAMS

The Zilog manual is not overly informative about general Z8 program writing techniques, so here are some hints and tips from experience gained as a result of actually doing it.

A) On power-up the Z8 is distinctly upset if the Serial input pin is not in the MARK state, (presumably it hangs up waiting for the terminal to finish sending a character), thus if you are not using a terminal in your auto-start program you must ensure that the RS232 input is pulled into the mark space on power-up.

B) On power-up the Z8 does a read of location FFFD hex to determine the baud rate speed required, if the switches are not there then the speed is initialised to a default value of 300 baud (as a result of reading FF hex from an unoccupied location).

If you wish to use serial communications you must first initialise the baud rate generator under these conditions. If you know the speed that you require will always be the same, then the following code will work:

10 355 = (baud rate) :rem see table, sets baud rate in timer
20 241 = 3 :rem initialise timer counter.

The various values for different baud rates are:

19200 = 1 : 9600 = 2 : 4800 = 4 : 2400 = 8 : 1200 = 16 : 600 = 32 : 300 = 64 : 150 = 128 : 110 = 175 :

Alternatively the following line of code will read the value set on the baud rate switches and store the correct baud rate value into the timer counter. This has the advantage that despite having placed the software in EPROM it still remains configurable as far as communications speed is concerned. In order to work an 8 byte table as follows must be stored in memory started at tableloc.

Tableloc 80,01,02,04,08,10,af,40
10 244 = (%tableloc + and(%switchloc,7) :rem get value

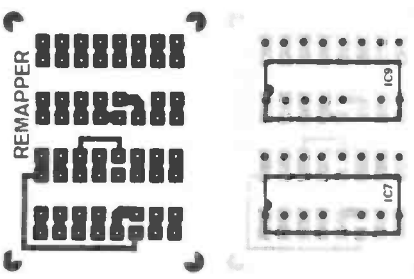


Figure 5: PCB layout and component overlay.

20 241 = 3 :set up timer

switchloc is the address of the baud rate switches.

Line 10 reads the value set on the switches and then adds this to the base address of the table, and uses the value stored at the location thus pointed to to set into the timer.

Finally it is worth knowing that the Z8 will automatically assign the stack and variables to external RAM if it discovers RAM in the system.

WHAT'S GOING ON, WHAT'S GOING ON

Readers might like to know of some of the Z8 projects which are under way as part of our 'Think of a good idea, and we'll help you' scheme, these include a sophisticated heating controller, a complete colour print processor which automatically feeds in the correct chemicals at the right time, an Assembler to reside with the Utility EPROM, and an expansion mother board system. Anyone else who would like to take part is invited to send in their proposals and we will do our best to support them.

■ R & EW

Your Reactions......	Circle No.
Excellent - will make one	15
Interesting - might make one	16
Seen Better	17
Comments	18

Data File No. 8

As a follow-up to last month's SCR/Triac 'theory' article, Ray Marston now presents practical SCR/Triac 'application' circuits.

IN LAST MONTH'S EDITION of 'Data File' we dealt with the theory of SCRs and Triacs, and gave particular attention to the principles of synchronous and non-synchronous triggering. This month we present a collection of practical circuits for use on either 115 volt or 230 volt AC power lines. In these designs, the user must simply select the Triac or SCR rating to suit his own particular application; where applicable, component values for use on 115 volt power lines are shown in parentheses in the circuit diagrams.

Let's start off, then, by looking at some practical Triac power switch designs, for use in ON/OFF AC power-line switching applications.

NON—SYNCHRONOUS DESIGNS.

As was explained last month, Triacs can be triggered (turned on) either synchronously or non-synchronously with the mains voltage. Synchronous circuits ALWAYS turn on at the same point in each mains half-cycle (generally just after the zero-crossing point), and usually generate minimal RFI. The trigger points of non-synchronous circuits are not invariably synchronised to a fixed point of the mains cycle, and the circuits may generate significant RFI, particularly at the point of initial turn-on. Triac turn-off is always automatically synchronised to the mains, as the devices main-terminal currents fall below the minimum-holding value at the end of each mains half-cycle.

Figures 1 to *8* show a variety of non-synchronous Triac power switch circuits which can be used in ON/OFF line switching applications. The action of the *Fig 1* circuit was explained last month, being such that the Triac is gated on from the mains via the load and Rl shortly after the start of each mains half-cycle when SW1 is closed, but remains off when SW1 is open. Note in this circuit that the trigger point is NOT synchronised to the mains when SW1 is initially closed, but becomes synchronised on all subsequent half-cycles.

Figure 2 shows how the Triac can be triggered via a mains-derived DC supply. C1 is charged to + 10 volts on each positive half-cycle of the mains via R1-D1, and the C1 charge triggers the Triac when SW1 is closed. Note that all parts of this circuit are 'live', making it difficult to interface to external electronic control circuitry.

Figure 3 shows how the above circuit can be modified so that it can easily be interfaced to external control circuitry. In this case SW1 is simply replaced by transistor Q2, which in turn is driven from the 'photo-transistor' side of an optocoupler. The 'LED' side of the opto-coupler is driven from a 5 volt or greater DC supply via R4. The Triac turns on only when the external supply is connected via SW1. Opto-couplers have typical insulation potentials of several thousand volts, so the external circuit is fully isolated from the mains, and can easily be designed to give any desired form of automatic 'remote' operation of the Triac by replacing SW1 with an electronic switch.

Figure 4 shows an interesting variation of the above circuit. In this case the Triac is AC triggered on each half-cycle of the mains via C1-R1 and back-to-back zeners ZD1-ZD2. Note that the mains impedance of C1 determines the magnitude of the Triac gate current but that C1 dissipates near-zero power. The bridge rectifier (D1 to D4) is wired across the ZD1-ZD2-R2 network and is loaded by Q2. When Q2 is off, the bridge is effectively open-

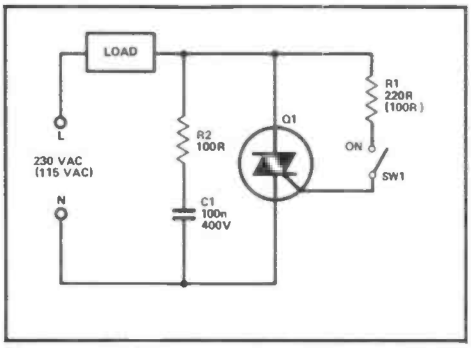


Figure 1: AC power switch, AC line triggered.

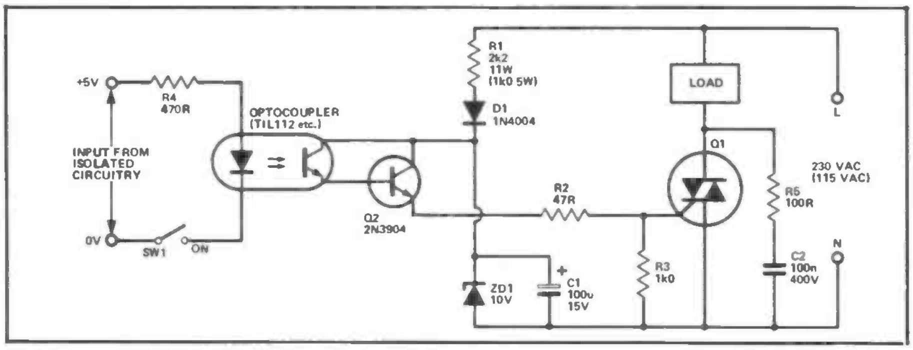


Figure 3: Isolated-input (optocoupled) AC power switch, DC triggered.

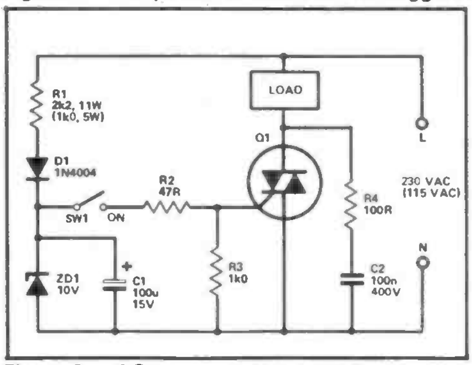


Figure 2: AC power switch with line-derived DC triggering.

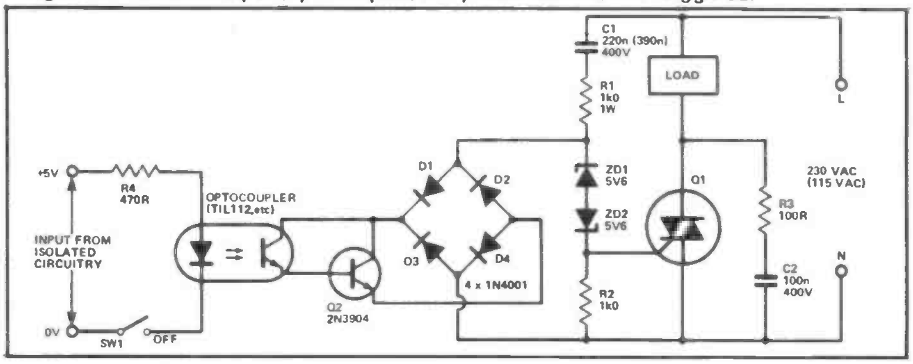


Figure 4: Isolated-input AC power switch, AC triggered.

▶

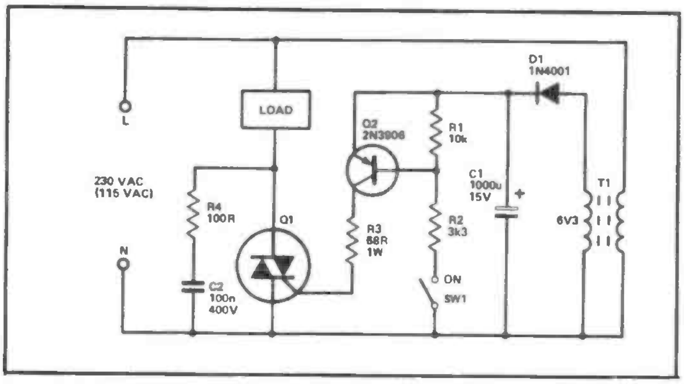


Figure 5: AC power switch with transistor-aided DC triggering.

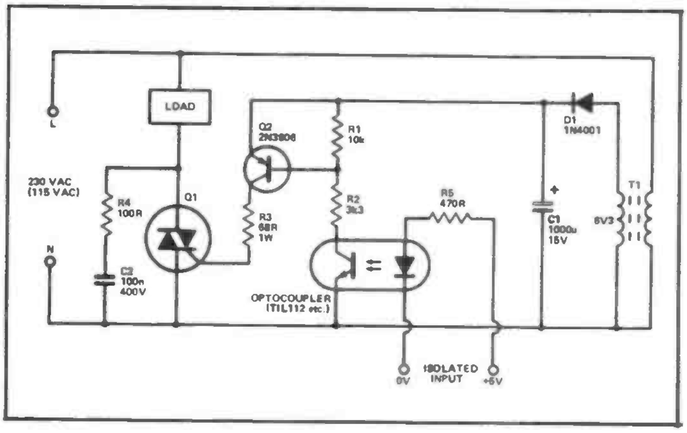


Figure 6: Isolated-input AC power switch with DC triggering.

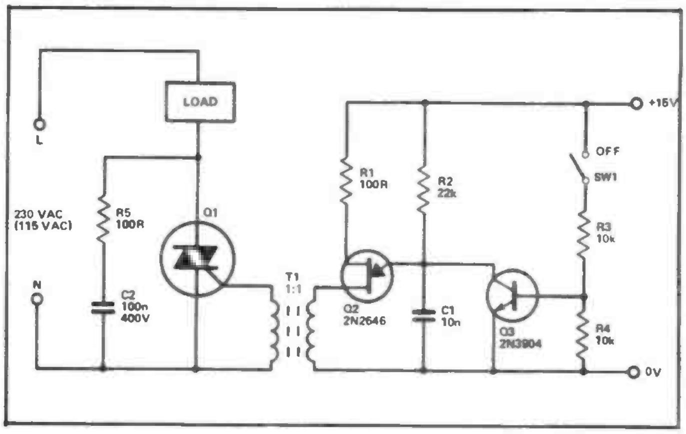


Figure 7: Isolated-input (transformer-coupled) AC power switch.

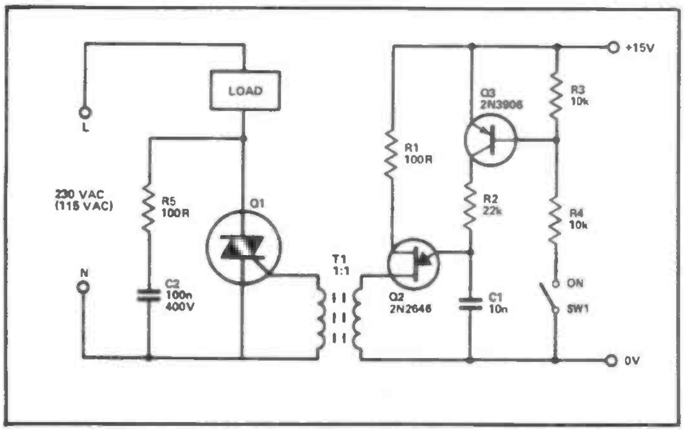


Figure 8: Isolated-input AC power switch.

circuit and the Triac turns on shortly after the start of each mains half-cycle: when Q2 is on, a near-short appears across ZD1-ZD2-R2, inhibiting the Triac gate circuit, and the Triac is off. Q2 is driven via the opto-coupler from an isolated external circuit, so the Triac is normally on but turns off when SW1 is closed.

Figures 5 and *6* show ways of triggering the Triac via a transformer-derived DC supply and a transistor-aided switch. In the *Fig 5* circuit, the transistor and the Triac are both driven on when SW1 is closed, and are off when SW1 is open. In practice, of course, SW1 can be replaced by an electronic switch, enabling the Triac to be operated by heat, light, sound, time, etc. Note, however, that the whole of the *Fig 5* circuit is 'live'. *Fig 6* shows how the circuit can be modified for optocoupler operation, so that it can be activated via fully-isolated external circuitry.

Finally, to complete this section, *Figs7* and *8* show alternative ways of obtaining Triac triggering from a fully isolated external circuit. In these two circuits the triggering action is obtained from Unijunction oscillator Q2, which operates at a frequency of several kHz and has its output pulses fed to the Triac gate via pulse transformer T1, which provides the desired 'isolation'. In the *Fig* 7 circuit, Q3 is wired in series with the UJTs main timing resistor, so the UJT and Triac turn on only when SW1 is closed. In the *Fig* 8 circuit Q3 is wired in parallel with the UJTs main timing capacitor, so the UJT and Triac turn on only when SW1 is open. In both of these circuits, SW1 can be replaced by an electronic switch.

SYNCHRONOUS DESIGNS.

Synchronously-triggered Triac circuits ALWAYS turn on at the same point in each mains half-cycle. Usually, the trigger point occurs just after the 'zero-crossing' point at the start of each half-cycle, in which case the Triac generates minimal RFI. *Figs 9* to *18* show a number of 'ON/OFF' power switching circuits that use this form of triggering.

Figure 9 shows the practical circuit of a 'transistorised' synchronous line switch that is triggered near the zero-voltage cross-over points of the mains. The Triac gate trigger current is

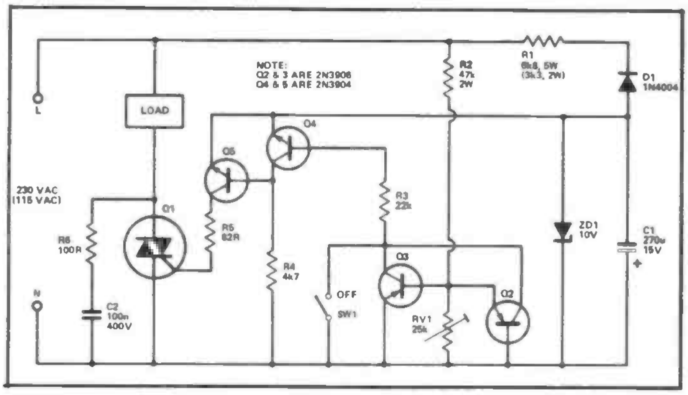


Figure 9: 'Transistorised' synchronous line switch.

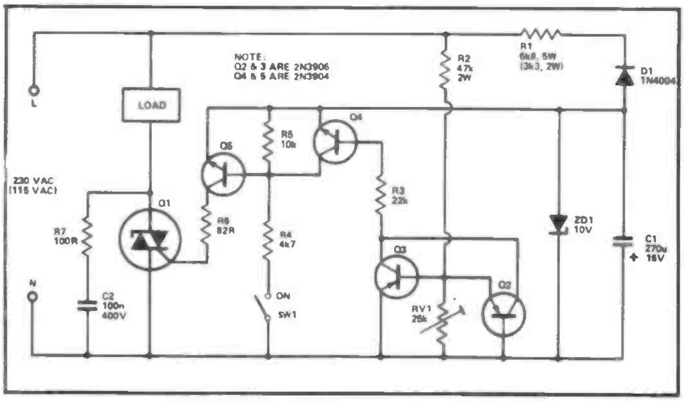


Figure 10: Alternative version of the 'transistorised' line switch

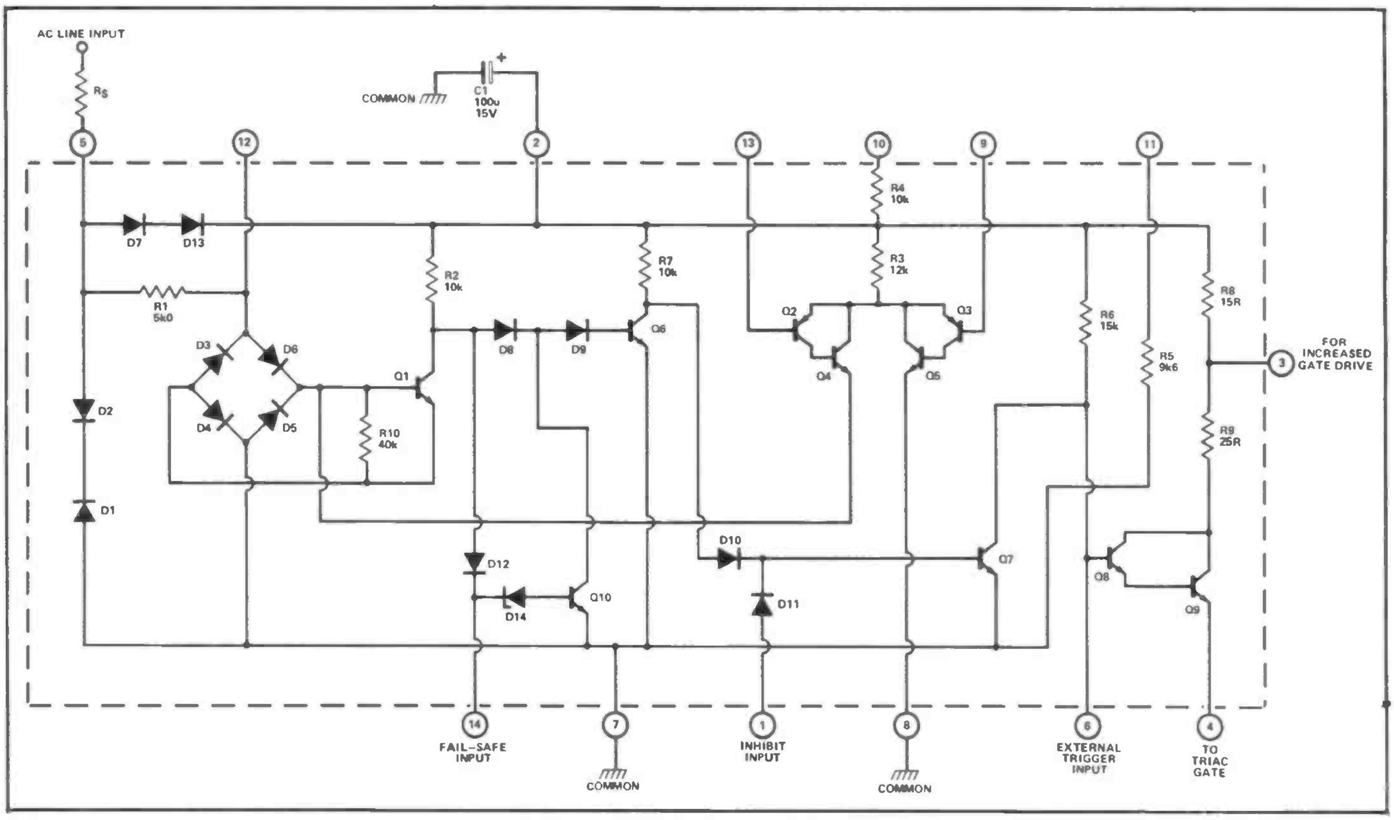


Figure 11: Internal circuit and minimal external connections of the CA3059 synchronous 'zero-voltage' Triac driver.

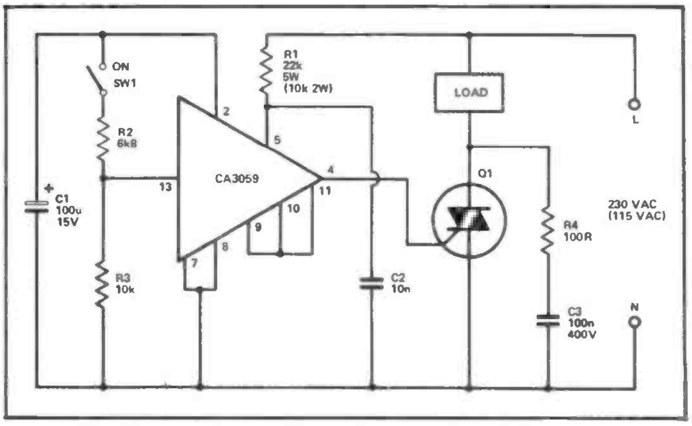


Figure 12: Direct-switched IC-gated 'zero-voltage' line switch.

obtained from a 10 volt DC supply that is derived from the mains via R1-D1-ZD1 and C1, and this supply is switched to the gate via Q5, which in turn is controlled by SW1 and zero-crossing detector Q2-Q3-Q4. The action of Q5 is such that it can only turn on and conduct gate current when SW1 is closed and Q4 is off. The action of the zero-crossing detector is such that Q2 or Q3 are driven on whenever the instantaneous mains voltage is positive or negative by more than a few volts (depending on the setting of RV1), thereby driving Q4 on via R3 and inhibiting Q5. Thus, gate current can only be fed to the Triac when SW1 is closed and the instantaneous mains voltage is within a few volts of zero. The circuit thus produces minimal switching RFI.

Figure 10 shows how the above circuit can be modified so that the Triac can only turn on when SW1 is open. Note in both of these circuits that, since only a narrow pulse of gate current is sent to the Triac, the MEAN consumption of the DC supply is very low (one mA or so). Also note that SW1 can be replaced by an electronic switch.

A number of special-purpose synchronous zero-crossover Triac-gating ICs are available, the best known examples being the CA3059 and the TDA 1024. These devices incorporate mains-derived DC power supply circuitry, a zero-crossing detector, Triac gate drive circuitry, and a high-gain differential amplifier/gating network.

Figure 11 shows the internal circuitry of the CA3059, together with its minimal external connections. Mains power is connected to pins 5 and 7 via limiting resistor Rs (22k, 5W when 230 V mains is used). D1 and D2 act as back-to-back zeners and limit the pin 5 voltage to +/—8V. On positive half cycles D7 and D13 rectify this voltage and generate 6V5 across the 100u capacitor connected to pin 2. This capacitor stores enough energy to drive all internal circuitry and provide adequate Triac gate drive, with a few mA of spare drive available for powering external circuitry if needed.

The bridge rectifier (D3 to D6) and transistor Q1 act as a zero-crossing detector, with Q1 being driven to saturation whenever the pin 5 voltage exceeds +/—3V. Gate drive to an external Triac is via the emitter (pin 4) of the Q8-Q9 Darlington pair, but is available only when Q7 is turned off. When Q1 is turned on (pin 5 greater than +/—3V) Q6 turns off through lack of base drive, so Q7 is driven to saturation via R7 and no Triac gate drive is available at pin 4. Triac gate drive is thus available only when pin 5 is close to the 'zero-voltage' mains value. When gate drive is available, it is delivered in the form of a narrow pulse centred on the cross-over point, with pulse power supplied via C1.

The CA3059 incorporates a differential amplifier or voltage comparator, built around Q2 to Q5, for general purpose use. Resistors R4 and R5 are externally available for biasing one side of the amplifier. The emitter current of Q4 flows via the base of Q1 and can be used to disable the Triac gate drive (pin 4) by turning Q1 on. The configuration is such that the gate drive can be disabled by making pin 9 positive relative to pin 13. The drive can also be disabled by connecting external signals to pin 1 and/or pin 14.

Figures 12 and *13* show how the CA3059 can be used to give manually-controlled 'zero-voltage' ON/OFF switching of a Triac. These two circuits use SW1 to enable or disable the Triac gate drive via the internal differential amplifier of the IC. Remember, the drive is enabled only when pin 13 is biased above pin 9. In the ▶

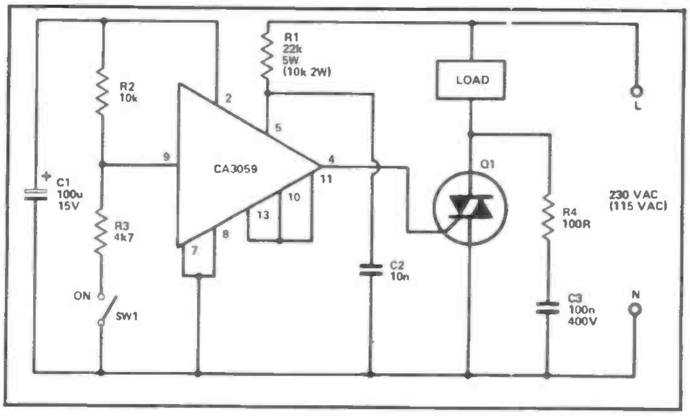


Figure 13: An alternative method of direct-switching the CA3059 IC.

Fig 12 circuit, pin 9 is biased at half-supply volts and pin 13 is biased via R2-R3 and SW1, and the Triac turns on only when SW1 is closed.

In *Fig 13*, pin 13 is biased at half-supply and pin 9 is biased via R2-R3 and SW1, and the Triac again turns on only when SW1 is closed. In both of these circuits, SW1 handles maximum potentials of 6V and maximum currents of only 1 mA or so. In these designs the capacitor C2 is used to apply a slight phase delay to the pin 5 'zero-voltage detecting' terminal, and causes the gate pulses to occur after (rather than to 'straddle') the zero-voltage point.

Note in the *Fig 13* circuit that the Triac can be turned on by pulling R3 low or can be turned off by letting R3 float. *Figs 14* and *15* show how this simple fact can be put to use to extend the versatility of the basic circuit. In *Fig 14*, the Triac can be turned on and off by transistor Q2, which in turn can be activated by on-board CMOS circuitry (such as one-shots, astables, etc) that are

Figure 14: Method of transistor-switching the CA3059 via on-board CMOS circuitry, etc.

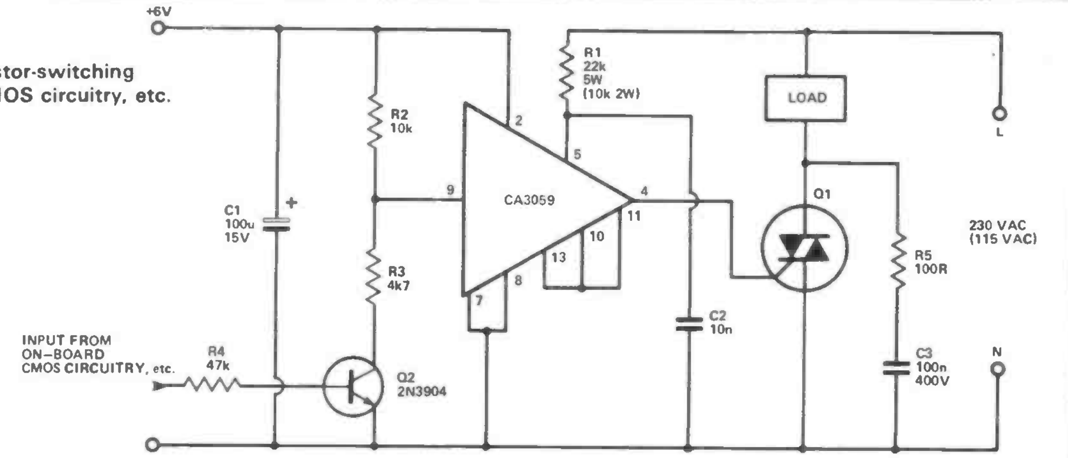


Figure 15: Method of remote-switching the CA3059 via an optocoupler.

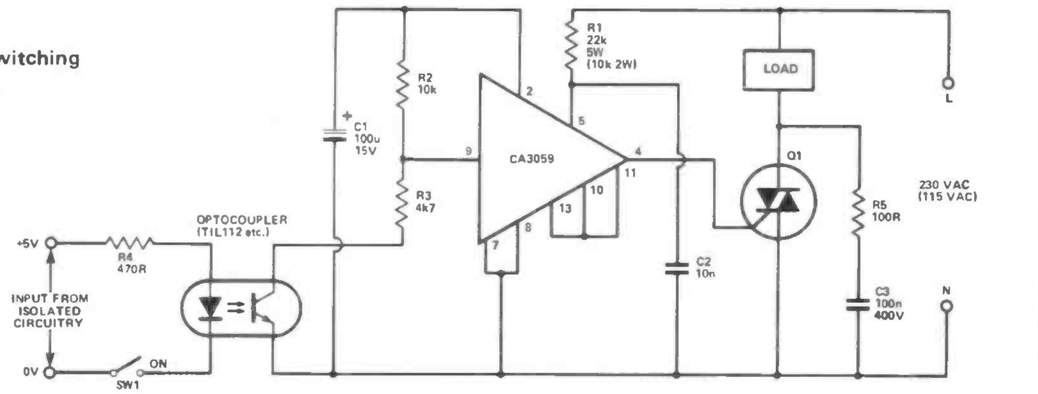
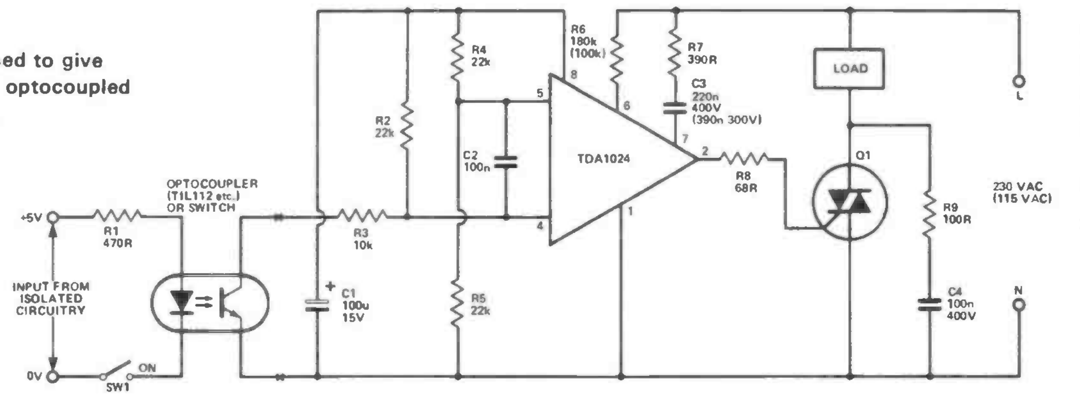


Figure 16: The TDA1024 used to give either directly switched or optocoupled 'zero-voltage' Triac control.



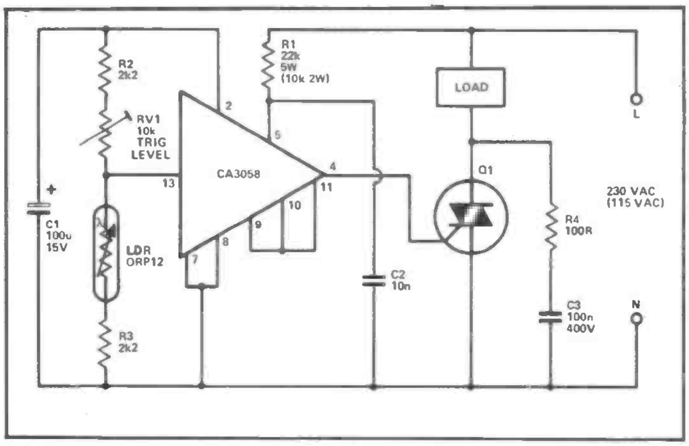


Figure 17: 'Dark-activated' zero-voltage switch.

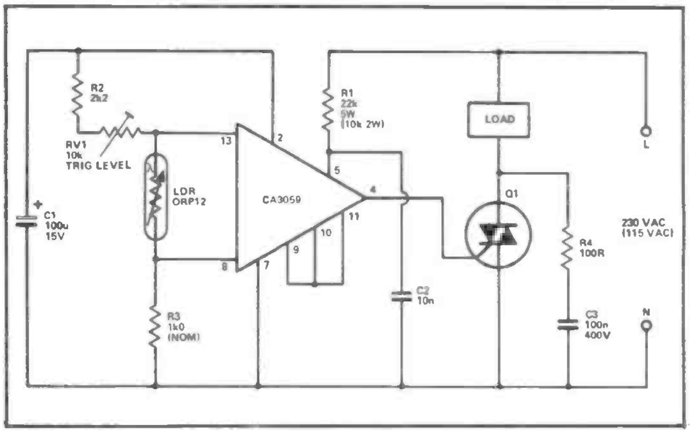


Figure 18: Dark-activated zero-voltage switch with hysteresis provided via R3.

powered from the 6V pin 2 supply.

In *Fig 15*, the circuit can be turned on and off by fully-isolated external circuitry via an optocoupler, which needs an input in excess of only a couple of volts to turn the Triac on.

Alternatively, *Fig 16* shows how the TDA 1024 can be used in place of the CA3059 to give either directly switched or optocoupled 'zero-voltage' Triac control.

Finally, to round off this month, *Figs 17* and *18* show ways of using the CA3059 so that the Triac operates as a light-sensitive 'dark-operated' power switch. In these two designs the built-in differential amplifier of the IC is used as a precision voltage comparator that turns the Triac on or off when one of the comparator input voltages goes above or below the other.

Figure 17 is the circuit of a simple dark-activated power switch. Here, pin 9 is tied to half-supply volts and pin 13 is controlled via the R2-RV1-LDR-R3 potential divider. Under bright conditions the LDR has a low resistance, so pin 13 is below pin 9 and the Triac is disabled. Under dark conditions the LDR has a high resistance, so pin 13 is above pin 9 and the Triac is enabled and power is fed to the load. The precise threshold level of the circuit can be preset via RV1.

Figure 18 shows how a degree of hysteresis or 'backlash' can be added to the above circuit, so that the Triac does not switch annoyingly in response to small changes (passing shadows, etc) in ambient light level. The hysteresis level is controlled via R3, which can be selected to suit particular applications.

■ R & EW

Your Reactions

	Circle No.		Circle No.
Immediately Interesting	44	Not Interested in this Topic	46
Possible Application	45	Bad Feature/Space Waster	47

NOTES FROM THE RADIO SHACK...

By Frank A. Baldwin

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

In the previous issue the opening gambit to this monthly rendering ended by threatening to regale my readers with more information about some of the currently operating clandestine stations and having made the threat I had better carry it out.

"Radio Unidad" commenced operations at the beginning of this year and claims to be located in Usulutan Department of El Salvador although statements with respect to locations are always suspect when dealing with clandestines. Hostile to the Government of El Salvador it transmits on **7000** in Spanish from 0100 to 0200 on Saturdays and Sundays.

"Radio Farabundo Marti" like Radio Unidad and Radio Venceremos supports the Farabundo Marti National Liberation Front. The present schedule is from 0100 to 0200 Tuesday through Saturday, from 0130 to 0230 Sunday and Monday. The programme language is, of course, Spanish and the frequency is variable from the limits **6895** to **6905**. It is claimed to be located in Chalatenango Province (El Salvador).

"Radio Venceremos", details of which were published last month, now has the schedule 0000 to 0100 Tuesday through Sunday and from 0230 to 0330 daily. In case you have mislaid your copy of June's **R&EW** - shame on you - the QRG varies from **6905 to 6911**.

All the times stated above are those during which listeners here in the UK will stand some chance of logging these clandestines. Other times in their schedules have been ignored.

"Voice of the Iraqi Revolution" is a pro-Kurdish transmitter operating over the frequencies **6900** to **7100** although it was last reported as being on **6905** (plus or minus a few kHz). Probably the best chance of hearing this one - I haven't logged it myself - would be from 1600 to 1700 (not on Mondays or Fridays). I wish you luck in catching up with it!

AMATEUR BANDS

Listening on these bands makes a change from chasing clandestines or looking for Laos or searching for Surinam or even pursuing Peru. A change is as good as a rest so why not wrest your dial to one of these bands and start to list some of the DX - even if it is only on SSB!

Operating as usual only on the CW ends of the bands some fun and games were to be enjoyed - as the following will show.

1800 - 2000 kHz

Always a favourite with me, Top Band can often provide some interesting signals just when least expected, the Russian calls listed here all coming through on two successive evenings.

DL7EM, EI9J, LZ2KRR, OK1DLE, OK1HBW, OK2UD, OK3KFF/P, OL2BCC, OL4BDY, OL6BEJ, OL8CMQ, OZ3Y, SM3EVR, SM5CRV, SM6AOQ, SM6EHY, UA3WD, UB5TBD, UC2RDX, UK3MAV, UK5WBE, UP2BCG, UT5AB.

No early morning sessions took place during the month, this resulting in a lack of across-the-pond signals to report.

14000 - 14350 kHz

Ah! - good old twenty metres - the DX provider of many years standing for most of us, what on earth would we do without this band I wonder, although the next band up is fast becoming a contender. Sticking my head close to the speaker - I rarely ever use the headphones - the following CW signals were heard.

FG7XE, JA2TH, JA5JTE, JA7FS, KV4AA, LU6AMW, PY1AFM, PY1HQ, PZ1AP, SU1UM, YV4DDT, ZS1XR, ZS4GV.

21000 - 21450 kHz

One late evening and one morning session on this band produced the following calls, which was rather pleasing as the time spent in the radio shack was curtailed somewhat owing to the annual events that must take place in the garden - digging the vegetable plot and sowing the seeds for example. Do you also suffer?

CM7OR, CX4GL, CX5RV, EA8ZH, EA9KS, JA4AQZ, JF2KNT, LU4ACN, VK2DZD, YB2IA, ZS6BUT.

And that lot, apart from logging CE3ZW on 28 MHz, just about rounds up the month on the Amateur Bands.

BROADCAST BANDS

For those who prefer to tune over these bands, the following stations are listed as a guide for your interest.

AUSTRALIA

Melbourne on **15410** at 0950, a programme of English pop records in the Indonesian service to South and South East Asia and scheduled from 0900 to 1400.

Melbourne on **11820** at 0740, OM with announcements in the English programme for Papua New Guinea and the Pacific Islands and timed from 0700 to 0845.

Melbourne on **21680** at 0746, a discussion in English about local radio programmes in answer to a listener query. The prize for that best question went to a listener in Vanuatu. Then followed a weather report including that for the Coral Sea. All in the English transmission to Europe, Papua New Guinea and the Pacific area and scheduled on this particular channel from 0700 to 0930. Also logged in parallel on **9570** and on **17725**.

TAIWAN

Taipei on **9685** at 1132, OM (Old Man equals male announcer) with the Chinese programme for South East Asia, timed from 1100 to 1200.

JAPAN

Tokyo on **17785** at 0700, musical box interval signal followed by OM with station identification in English, YL (Young Lady announcer) with identification in Japanese in the English/Japanese General Service programme scheduled from 0700 to 0730. All this was followed by a summary of local news in English.

Tokyo on **21610** at 0804, OM with a newscast in the English directed to Europe and scheduled from 0800 to 0830.

MALAYSIA

Kuala Lumpur on **15295** at 0953, OM with the Malay programme to Australia and New Zealand, scheduled from 0830 to 1025. Signal blotted out by Moscow signing on at 0958.

VIETNAM

Hanoi on **10040** at 1910, OM with the English programme for Europe, timed from 1900 to 1930.

CHINA

Radio Peking on **17765** at 0922, Chinese classical music in the English programme for Australia and New Zealand and timed from 0830 to 1030.

Lanzhou, Gansu on **4865** at 2319, OM with a talk in Chinese, this section of the schedule being from 2130 to 0200.

Radio Peking on **4905** at 2032, Chinese classical music in the Home Service First Programme, scheduled here from 2000 to 2300 and from 1100 to 1735.

POLAND

"Radio Polonia", Warsaw on **7285** at 1830, OM with station identification in the English programme for Europe, timed from 1830 to 1900.

BULGARIA

Sofia on **9700** at 1949, OM with station identification and a programme entitled Mailbag during which listeners' letters are answered, all in the English transmission for Europe scheduled from 1930 to 2000.

YUGOSLAVIA

Belgrade on **6100** at 2003, YL with a newscast of world affairs during the English transmission for Europe, the Middle East and Africa and scheduled from 2000 to 2030.

FINLAND

Helsinki on **11755** at 1946, OM and YL with the English programme for Europe and Africa, scheduled from 1930 to 2000. At 1950 there was an interesting programme called 'Notebook' in which subjects raised by listeners were dealt with at some length. On this occasion it was all about the birth of the Finnish nation.

ALBANIA

Tirana on **9500** at 1952, YL with the English programme for Africa featuring Albanian folk songs and music. This transmission is timed from 1930 to 2000.

SPAIN

Madrid on **11840** at 2000, YL with station identification and announcements at the commencement of the English transmission to Europe, scheduled from 2000 to 2100.

SWITZERLAND

Berne on **21520** at 0925, light music followed by YL with announcements at the end of the English programme directed to Australasia, the Far East and South Asia, timed from 0900 to 0930.

PAKISTAN

Karachi on **21485** at 1540, YL with songs, local-style music in the

Urdu programme for the Persian Gulf and the Middle East, scheduled from 1330 to 1600.

INDIA

AIR Delhi on **9950** at 1548, OM with a talk about foreign affairs in the English Domestic Service. This English segment is timed from 1530 to 1545 and is simply listed as a newscast in their schedule. Either they were running late or an alteration to the schedule has taken place.

EGYPT

Cairo on **9755** at 1611, the Holy Quran Station with quotes from the Holy Quran. This transmitter is on the air from 0300 to 0900 and from 1200 to 2100 and the programmes are entirely religious in nature.

Cairo on **17670** at 1606, quotations from the Holy Quran in the Domestic Service, also logged in parallel on 9850, 11665 and on 12050.

Cairo on **17690** at 1600, chimes time-check followed by OM with station identification in Arabic ("Al Kohera") then into the Urdu programme for South and South East Asia, scheduled from 1530 to 1700.

AFGHANISTAN

Kabul on **11755** at 1901, OM with station identification and frequency announcements then into a newscast of local affairs in the English programme for Europe, scheduled on this channel from 1900 to 1930

MALI

Bamako on **4838** at 1950, OM with a talk in French. Bamako is on the air weekdays from 0600 to 0800 and daily from 1800 to 2400. An English programme is listed from 1820 to 1900 on Saturdays and the power is 18kW.

GABON

Libreville on **4777** at 2055, OM and YL with a duet in vernacular. On with announcements in French at 2100 then into a newscast in that language. The schedule is from 0430 (Sundays from 0530) to 0630 and from 1630 to 2400. The power is 100kW.

LESOTHO

Maseru on **4800** at 1930, OM with songs in Sesotho with a background of local-style music. This one is on the air from 0400 to 0700, from 1100 to 1200 and from 1500 to 2035 (Wednesdays and Sundays until 2105). The power is 100kW.

UPPER VOLTA

Ouagadougou on **4815** at 1935, a chorus of YL's with chants in vernacular, drums and local instruments as a backing. This one operates from 0530 (Sundays from 0700) to 0900 and from 1700 to 2400 and the power is 20kW. Some years ago I saw this station listed by an exasperated SWL as 'you know where', I can't say I was surprised!

NAMIBIA

Windhoek on **4965** at 1950, OM with a talk in Afrikaans. This is the South West African Broadcasting Corporation transmitter working to the schedule 0400 to 0615 and from 1515 to 2200 and including some relays of the SABC programmes. From 2200 to 0400 it relays the SABC All Night Service. The power is 100kw.

NIGERIA

Lagos on **4990** at 0443, OM with a religious talk in English. This is Channel 1 which operates from 0430 to 1000 and from 1700 to 2310 in English and vernaculars. The indentification is "Radio Nigeria" and the power is 20kW.

PERU

La Voz de la Selva, Iquitos on **4825** at 0410, Peruvian instrumental music, OM announcer in Spanish. The schedule is from 1000 to 0500 and the power is 1kW.

CITIZENS' BAND

Not a great deal has been done on any of the forty channels during the past four weeks, at least on the transmitting side although there have been a few contacts but more time spent in earwigging other breakers whilst carrying out other jobs within the shack.

The contacts made were at good poundages although no great distances were recorded. The Wotpole twig continues to give a good account of itself despite the fact that it is mounted on the side of the house just above guttering level - and this to avoid any possibility of TVI troubles with neighbours. I must confess however that the SWR isn't all that good, a reading of 1.7 being the best that I can obtain although I suspect that the SWR meter on the home base unit reads a little on the high side.

Notwithstanding all that, my thanks are due to the following breakers for the pleasurable contacts that I did make - Three Wheeler, Hot Pot, Fisheye (but see below), Silver Key, Hornet, Medallion, Trail Boss, Sparky, Buck Rogers, Street Machine, Wandering Wombat, Jackal, Catweazel, Battleaxe, Pink Budgy, Lone Ranger, Frosty Chip and a special thanks to Leo Lady - we had a long contact, partly about how we both gave up the smoking habit and for that reason became slightly wealthier.

My thanks are also due to reader Fisheye of Batley in Yorkshire for informing me of the similar handles in his locality to those being used here in East Anglia which have been mentioned in these columns - I suppose handles must be duplicated many times here within the UK

So for now break-a-break and ten-ten till we do it again.

Your Reactions.........	Circle No.
Immediately Applicable	56
Useful & Informative	57
Not Applicable	58
Comments	59

DX-TV

Reception Reports

Compiled by Keith Hamer and Garry Smith.

UNUSUALLY FOR MARCH, the month produced some quite interesting long-distance broadcast television reception. On the 5th there was some F2-layer propagation with the USSR(TSS) on channel R1(49.75MHZ vision) with an electronic test card at 0846GMT. Reception suffered from the characteristic 'smeary video' phenomenon which is normally associated with F2-layer propagation. On the 11th, on channel E2(48.25MHZ vision) with the aerial directed to the south-east, a Philips PM5544 electronic test card was received which could possibly have been ZTV-Zimbabwe. During the same early afternoon period a mystery grey-scale/frequency-grating pattern was received, again on channel E2. The signal was noted for only a few minutes but the same pattern has been received on several occasions during F2/TE(Trans-Equatorial) activity and it is thought that the test signal originates from Ghana or even Kenya.

During a tropospheric 'opening' on the 24th at 1810 GMT, a weak signal was received from a south-easterly direction. Initially the channel was thought to have been E 11(217.25 MHz vision). A clock caption was noted followed by "Coronation Street" and as the signal strengthened the sound channel was resolved, unexpectedly on the 6MHZ standard. European services operating in Band III normally use either the 5.5 MHz or the 6.5 MHz standard, so the aerials were rotated towards Eire since the 6 MHz system is in use there. Strangely the signal strength became virtually zero and only increased with the aerials directed to the south-east. There is a high power RTE-2 (Erie) transmitter operating on channel IJ(215.25 MHz vision) at Kilkenny but just why the signal should appear from a totally different direction remains a mystery.

Signals from BRT-Belgium, including the US programme 'Dallas', were also received on the 11th from the channel E10 transmitter located at Wavre (100kW E.R.P.).

On March 25th, reception from the near-Continent was noted by a number of enthusiasts due to enhanced tropospheric conditions(Trop). At 0740 GMT, the Dutch networks (NOS) were received on channels E4(VHF Band I,62.25 MHz vision), E29 and E32, these two channels being within the UHF spectrum. Transmissions consisted of the monochrome "EBU Bar" which has been used by NOS for many years. At 0820 several West German stations were received including a Schools Television caption (Schulfernsehen) on channel E48, a ZDF(West Germany's Second network) transmitter identification caption on channel E35 indicating the Ostfriesland outlet, plus another identification caption (or "Senderdia" as they are known in Germany) for the ZDF channel E32 transmitter at Bremen. An electronic test card from East Germany(DDR:F) was noted at about 0820 on channel E31 from a Second network transmitter located at either Inselsberg or Dequede. Both outlets have an E.R.P.(Effective Radiated Power) of 500kw.

All the stations operating in the UHF band mentioned above could have been received on a standard domestic receiver although the sound channel would not have been detected due to the different sound/vision spacing employed on the Continent. For readers to R&EW who may be interested in DX-TV but do not want to go to the expense of buying specialised equipment, a check on the UHF channels during periods of high-pressure (anticyclones) over Europe may reveal stations from West Germany, Belgium or the Netherlands provided the aerial is pointing in the right direction. Even if Continental stations are not received, other UK regions may well be present and be of entertainment quality. A check on the prevailing weather conditions can be made by watching the weather forecasts on BBC-1 each weekday at 1757 or 2125 BST.

On March 31st there was some Sporadic-E(sp.E) activity with reception of the PM5544 from Poland(TVP) on channel R1 plus signals from an unidentified source on channel R2(59.25 MHz vision). The mystery grey-scale/frequency-grating pattern noted earlier in the month was also logged, this time at 1812 BST. The signal (on channel E2) lasted for about 30 minutes and the aerial was directed towards the south. It was noted that the frame blanking pulse was much narrower than the standard pulse. We would be pleased to hear from anyone who has positively identified this pattern.

DX NEWS

A new Moroccan transmitter is reported to be operating in Bank I, on channel E4(62.25 MHz vision), with an ERP of 250kW at Laayoune. This transmitter is officially listed as being in the African Broadcasting Area rather than European.

RTP-Portugal have brought into service a new transmitter operating on channel E4 at Valenca Do Douro. The ERP is 35W and it is the only E4 transmitter operating on the mainland. RTP have E4 transmitters located in Portuguese territories overseas.

The indentification "YLE TV1" has been seen on the Finnish FuBK test card in place of the usual "YLE HLKI".

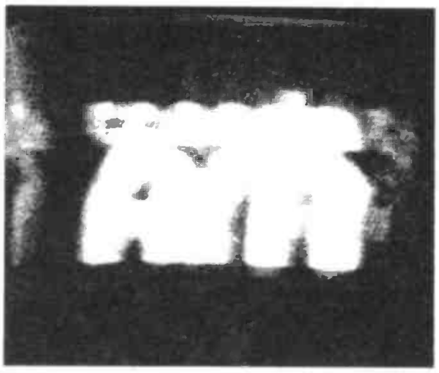


Figure 1 : Reception on channel A2 of a Canadian News programme caption via F2-layer propagation. Note the 'smeary video' effect. Canada uses the 525-line standard.

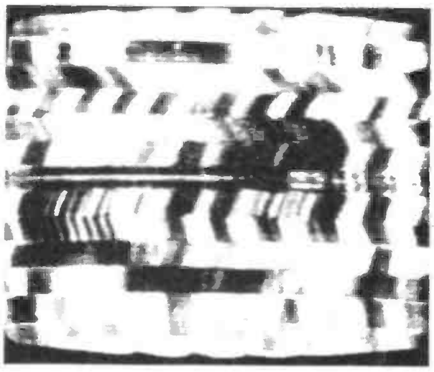


Figure 2: The PM5544 test card received on channel E2 from Zimbabwe via F2/TE (Trans-Equatorial skip).

RECEPTION REPORTS

Clive Athowe, an experienced DX-TV enthusiast at Blofield near Norwich, has written with details of his recent reception of Zimbabwe on channel E2 via F2/TE. He received this service from the transmitter located at Gwelo(to the south-west of Zimbabwe's capital, Harare) with a transmission of the PM5544 test card with the identification "ZTV" at the top and a digital clock insert on the central black bar. A similar idea is used by NRK-Norway and CBE-Canada. After receiving Clive's report, we also noted ZTV using the PM5544 but with the additional inscription "TV" or "TV 1" at the bottom. With reception occurring via F2/TE it is very difficult to decipher identification due to the smeary video effect mentioned earlier.

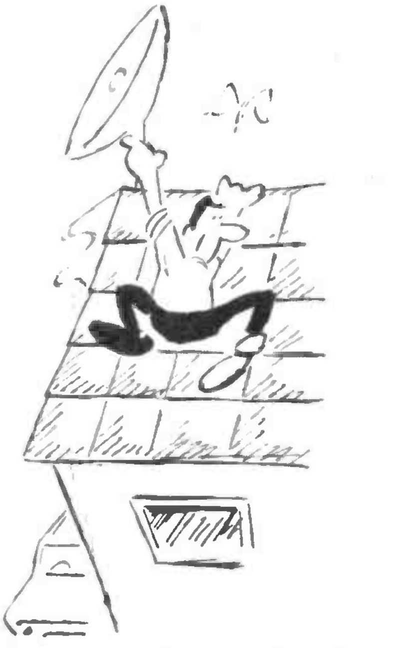
Down in Romsey(Hampshire), another experienced DX-er, Roger Bunney, has also logged ZTV on channel E2 via F2/TE plus signals from RCTV-Dubai in the Persian Gulf. This United Arab Emirate State employs transmission system "B" with PAL colour. An unusual version of the PM5544 test card is used in that the central circular area is replaced by a 'squared' version.

Hugh Lloyd-Bennett, currently soaking up the sunshine in Saudi Arabia, has written from his location in Dhahran to report reception on channel A4(67.25 MHz vision, 525 lines System M) each Thursday and Friday of a television service which does not appear to use any identification captions. Hugh thinks that it may well be an American military station (AFRTS) operating from somewhere near the Straits of Hormuz. Presently, Hugh is attempting to receive transmissions from the Stat T Ekran satellite which is beaming programmes on channel 51(714 MHz) but so far he hasn't had much luck.

From Gosta van der Linden (Rotterdam, Netherlands) comes information about proposed UHF transmitters in West Germany, due to come into service next year. They will be at Hamburg(channel E28,500kW) serving the Niedersachsen region, Tarkau/Molln (channel E53,20kW) serving the Schleswig region, and Brockstedt/Neumunster (also serving the Schleswig region) on channel E56 with an E.R.P. of 500kW. Gosta has recently been receiving programmes from BBC-Scotland and Grampian TV plus several signals from France (TDF). A number of DX-ers in the Netherlands have been receiving good quality signals from Sweden(SR) on UHF and also in the VHF Band III spectrum. Due to strong signals being received from an SR-1 outlet on channel E41, there is speculation that Sveriges Radio have brought a new UHF transmitter into service.

Following the first DX-TV article which appeared in the May issue, Mr. A. Hill (Midhurst, West Sussex) has written to say that he has now purchased a Plustron TVR 5D(highly recommended). We trust that the present Sp.E Season will provide him, and others, with lots of 'exotic' signals!

Simon Street from Bromyard (Herefordshire) wondered whether we were serious when



" ALL THIS TROUBLE, JUST SO WE CAN SEE THE MUPPETS IN EIGHT LANGUAGES ! "

we mentioned reception from the USSR using a length of standard wire for an aerial. Yes, we were. Indeed, signals have been noted using a small screwdriver inserted directly into the aerial socket. However, we only mentioned that fact to give readers an idea of signal strengths which can be attained during an intense Sp.E opening. For serious DX-TV reception via Sporadic-E, particularly when signals are weak, a more eleaborate aerial system is necessary.

Finally in this month's reports section we have received details about DX conditions in, dare we mention it, Argentina. Anselmo Roccaforte in Buenos Aires has logged signals on channels A4 and A5 (77.25MHz vision) from Montevideo in Uruguay. Anselmo has also received programmes from Chile and Brazil. The cost of equipping oneself for DX-TV in Argentina is very high due to their rapacious inflation. ■ R & EW

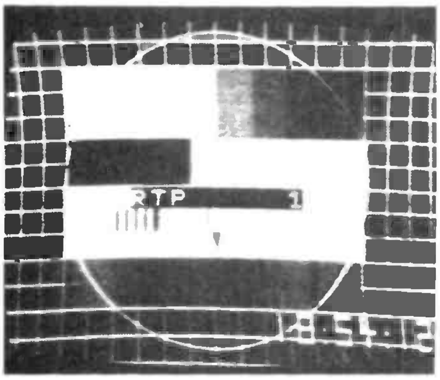


Figure 3: The FuBK electronci test card received from RTP-Portugal via Sporadic-E ionization.

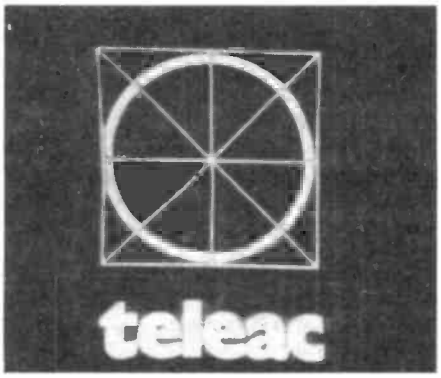


Figure 4: A programme caption (received in colour) from NOS-Netherlands via enhanced Tropósperic conditions.
Photographs 1 to 4 show typical examples of four propagation modes.

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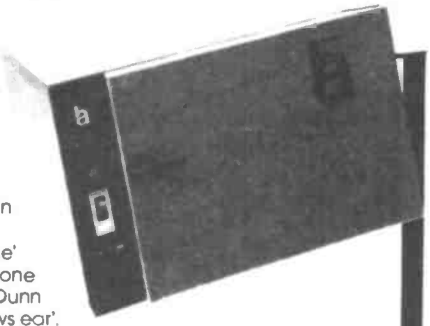

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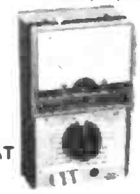

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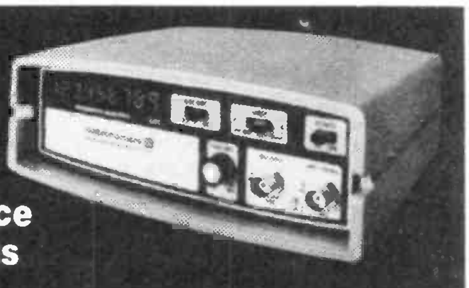

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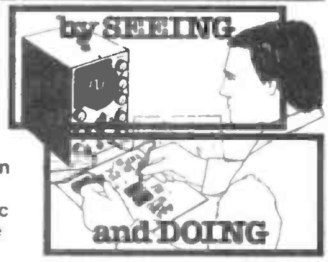

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OBITUARY

CALL SIGN G8RL, Leslie Francis Woodhams, of Rugby died March 30th 1982.

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THE LAST WORD.

The weekly exploits of Dr. Who and his Tardis are avidly watched by millions of viewers. If Dr. Who's tardis malfunctions we all know about it and worry that the good doctor's safety may have been jeopardised by equipment failure.

This month we heard of another Tardis, recently commissioned, which has also had its share of electrical breakdowns. It seems that this Tardis, lavishly equipped with the latest in test and measurement equipment, was lying idle for a long time before those for whom it had been bought learnt to 'drive' it.

When they began to have an idea of what the various items of gear should do, they realised they weren't! We hear its finally working, however, in fact we're sure of it as it seems to have transferred everyone who uses it to a time, we judge to be, circa 1940.

SINCLAIR LOSES HIS WAY

The quality of organization evident at the various press do's that **R&EW** weaves its way into, varies considerably. The criteria we use to judge the standard of such events is not, as some would suggest, the speed at which alcohol is dispensed to the assembled scribes.

Mr Clive Sinclair has had plenty of practice when it comes to the launch of a new product and the launch of the Spectrum saw him in top form with Acorn and the BBC coming in for a few pointed comments.

Everything had been thought of and as part of this total concept in media events a coach had been ordered to whisk those hacks wishing to travel to the opening day of the Earls Court Computer Show away, almost as Clive finished speaking.

It's here that the Hi-Tech event met a snag. Under normal daytime conditions the drive from Marble Arch to Earls Court takes about half-an-hour and does not involve crossing the Thames. It seems that the coach driver's usual 'run' was to Brighton or some such place and it was not until he had crossed the Thames and was well on the way to the A23 that those aboard managed to persuade him of our need to get to Earls court. Back across the river and half-an-hour in the traffic of Chelsea Embankment and the vehicle, complete with Clive Sinclair arrived at the show.

Clive was almost late for the launch of his own machine.

THANKS MICK

The grand Guildhall Banquet on the night of April 20th featured the 'Tobie Awards', sponsored by *Electronic Times*, with Editor Mick McClean performing well as the MC. **R&EW's** publisher failed to win the Personality of the Year Award — but then, we don't have as many employees as Mr Wilmott at ICL. Too bad Robb wasn't there to collect, although perhaps it would have been appropriate if he sent along a Fujitsu representative instead.

Mick McClean was good enough to remark upon the sudden and widespread popularity of **R&EW** — his dig at us as being aimed at the 'amateur market' didn't entirely fool the audience who had been assembled from the ranks of the industry, many of whom were confessed **R&EW** readers.

We were all grateful to *Electronics Weekly* who dished out gifts for all and sundry. It may take the men a while to unpick the embroidery from their quaint gift packed handerchiefs, and the ladies were disappointed to find that the rather strange batteries in their gifts were flat, but thanks anyway.

Advertisers' Index

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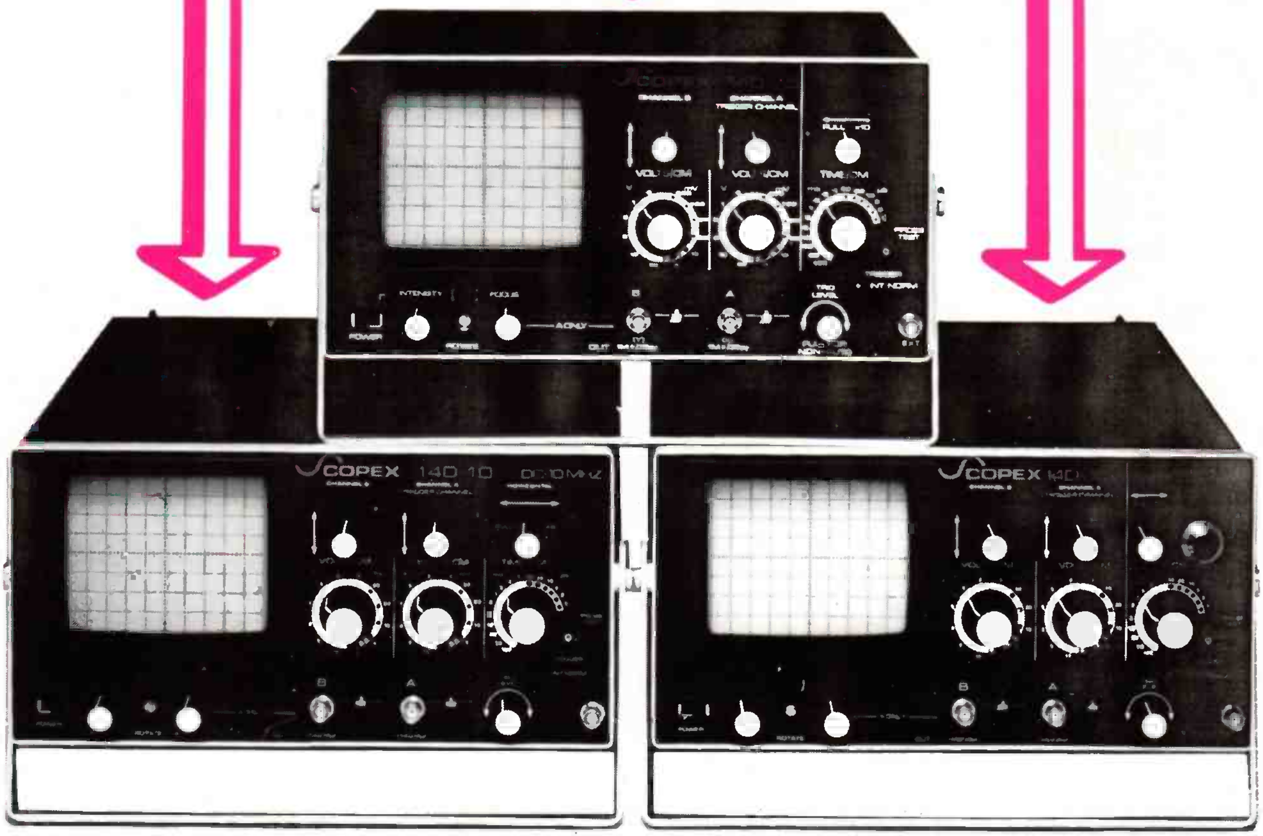

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