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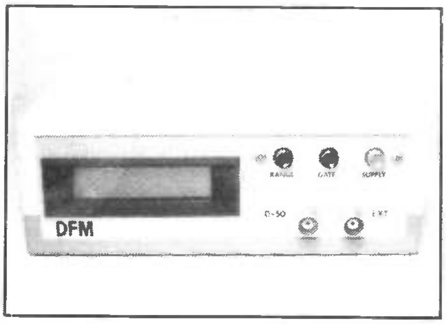

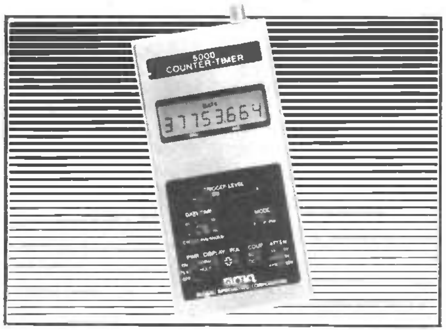

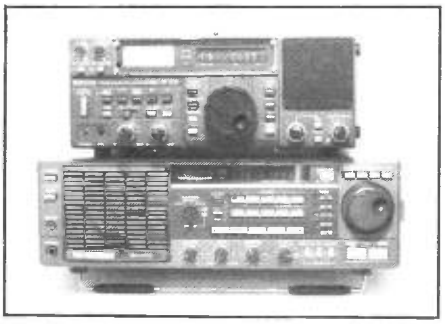

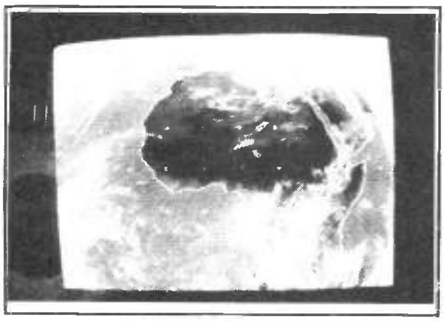

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Visible Agreement

Britain's position as a world leader in developing optical fibre communications has been given a further boost by agreements signed towards the end of March under which British Telecom will exchange its expertise with Standard Telephones and Cables (STC) to benefit telephone users making international calls.

STC will pay for research work carried out in British Telecom's Research Laboratories at Martlesham, Suffolk, which will also supply the company with special microchips.

For some years, British Telecom and STC have been working on agreed complementary research programmes concerned with the stringent requirements of undersea submarine cable systems. Now that commercial optical systems are being developed, these co-operative programmes are to be formalised.

There are two agreements, both relating to optical fibre communications used in the undersea cables which will span the world's oceans.

In one, British Telecom and STC will share the results of their research work applicable to optical submarine cable systems.

This will help to put STC — Britain's only firm making submarine cable systems — into a strong competitive position in the world's markets. And it will mean rapid commercial application for Telecom's investment in optical research.

In the other agreement, British Telecom's research laboratories will supply to STC high-reliability, long life silicon integrated circuit chips for use in the underwater electronic equipment associated with the cable.

'Slovak News

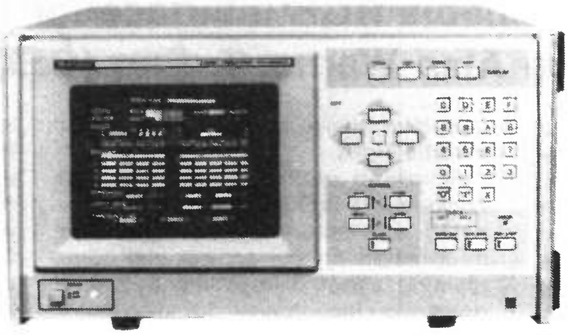
The Czechoslovak five-year industrial plan for 1981 to 1985 emphasizes the further development of electrical engineering and envisages a 40 to 50 per cent increase in production. The electrical engineering industry is to create conditions for increasing the export capacity of Czechoslovak engineering and other products, for reducing import needs, and for much wider international division of labour, especially between the socialist countries.

★ ★ ★ Nota Bene ★ ★ ★

Scanning through the industrial press, this news item from 'Micro Bulletin' caught our eye — probably it had something to do with the title: "Zilog sues Nippon Electric".

NEC must be beginning to wish it had never heard of the Z80: David Shirley of Computer Information Centre relates that his US partner, NNC Electronics, which supplies CiC with processor boards, took a trial consignment of 300 NEC "Z80"s, some of which were to go into boards for the CiC Executive 30. The chips seemed OK until the firms switched to faster, 120 nanosecond access memory, whereupon they "went haywire". The memory supplier insisted that the memory worked fine with other Z80s: the fault had to be in the CPU. Exhaustive logic analysis by a customer showed the chips some 20% below spec, with one or two serious logic faults - so the customer complained bitterly to Zilog. Zilog disowned the chips - but recognised the bugs as ones which had appeared in an interim design between the Z80 and the Z80A: now Zilog has a strong suspicion just which blueprints NEC got hold of. "What a wonderful story!"

SNIPPETS



WE At National...

Wessex Electronics Ltd of Bristol has been appointed by National Panasonic (UK) Ltd to market National measuring and testing equipment. Among the products Wessex will be distributing is a 20MHz. 32 channel logic analyser. The VP-3620A is a dedicated unit catering to a wide range of industrial needs. It contains a logic state analysing function for self-contained microprocessor operation analysis and a logic timing function for the evaluation of peripheral operations. With its multifunction capability, National's logic analyser is also able to display the traced data in disassembled mnemonic mode corresponding to each microprocessor in use.

Marconi Mobiles

Marconi Mobile Radio has received another order from the British Home Office for the 770H base station. 65 sets are to be supplied, bringing total Home Office orders for this equipment to more than £250,000.

Centronics For Atari

Centronics Data Computer have recently supplied six thousand model 739 mini printers to ATARI. The order was placed on the basis of an immediate requirement that could not be met by any other printer supplier.

The Centronics Model 739 is a highly reliable low cost dot matrix printer providing extensive paper handling capabilities as well as near letter quality proportional printing. It is extremely rugged, and can print true lower case descending characters, underlines and high resolution graphics.

Distributor Of '82

Texas Instruments has named macro as its Distributor of the Year for 1982. Despite already being TI'S biggest distributor. Macro increased its TI business by some 55%. The company has been TI's biggest distributor for nine years, and is the largest distributor of TI semiconductor components in Europe.

Harris And Tex

Texas Instruments and Harris Corporation have entered into an alternative sourcing agreement covering the design, manufacturing and marketing of gate array and standard cell semi-custom circuits with a standard user-friendly design interface.

DEC 1000

Just three years after the start of operations, Digital Equipment's Remote Diagnosis Centre in Basingstoke has announced its 10000th Customer as Glasgow Royal Infirmary, in the eastern district of the Greater Glasgow Health Board (GGHB).

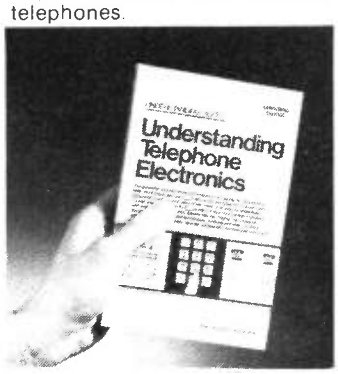
The biochemistry department of Glasgow Royal infirmary has a PDP-11/44 system which has been in use for nearly two years. This succeeded a PDP-11/34 originally installed in 1977.

The department use the PDP-11/44 for data management and collating results from analyses performed on (primarily) blood samples.

Telephones Explained—by TI?

Alexander Graham Bell described it in the late 1870s as "this grand system, whereby a man in one part of the country may communicate by word of mouth with another in a distant place". Telephone communication, a century old, is now — with digitisation — moving into its second major phase of development.

"Understanding Telephone Electronics" takes the reader step-by-step from the simplest explanation of telephonic principles through to an intermediate level of telecomms learning. The book covers the technologies incorporated in dialling, ringing, transmission, signalling, switching, digital techniques, modems and cordless telephones.



RF/RGB TV INTERFACE

A single board switchable RGB interface for the Ferguson TX9.
Design by Alan Warne, T. Eng (CEI) FSERT.

In the January **R&EW**, we presented a method for converting domestic televisions into dedicated RGB monitors, enabling a higher quality display, or colour graphics. To obtain the best possible bandwidth, the signals were applied via a set of amplifiers to the cathodes of the colour display tube, and the preceding tuner, SAW and video amplifier were removed. The author's original intention was to manufacture a monitor for RGB external displays only, since to incorporate off-air television signals would have required extensive switching and other modifications.

Following publication of that first conversion, the designer was inundated with letters requesting further information on the project and complaining about dismantling part of a good working receiver for modification. As one letter stated "I can convince the wife and family to have a second colour television for computing, so long as they can watch their television programmes as well!"

The design work for that unit was based on the earlier TX9 chassis, type PC1001. Since that time, two further updates have taken place — the PC-1040 and, latest in the line, the PC1044 which uses a switched mode power supply. Both of the later versions have facilities for adding teletext, since they employ the Mullard TDA3560 luma chroma processor with separate data inputs.

It is a well known fact that PAL signal decoding reduces the video bandwidth to less than 6MHz in a standard television receiver, whereas the standard television tube can produce signals with bandwidths greater than 6MHz depending on the type of tube. This is the reason better quality pictures are produced with direct RGB rather than by using the PAL decoder.

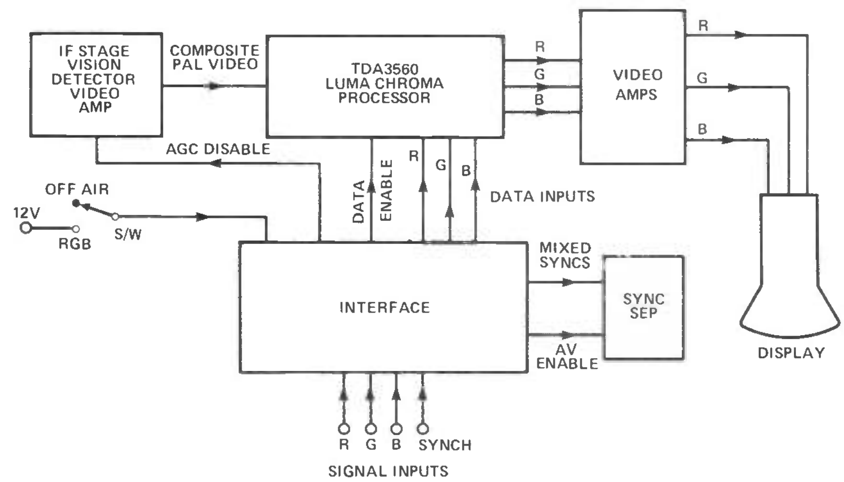


Figure 1. Block diagram showing connections for the interface.

Design

Retaining the TDA3560 allows PAL decoding to be carried out on the incoming television signal, but further RGB signals are applied to the IC, superimposed over the off-air picture (such as Teletext). A further facility exists so that incoming signals to the IC may be disabled and only RGB text displayed. In this mode the RGB signals pass in and out of the IC with negligible bandwidth limitation, but can be switched between off-air pro-

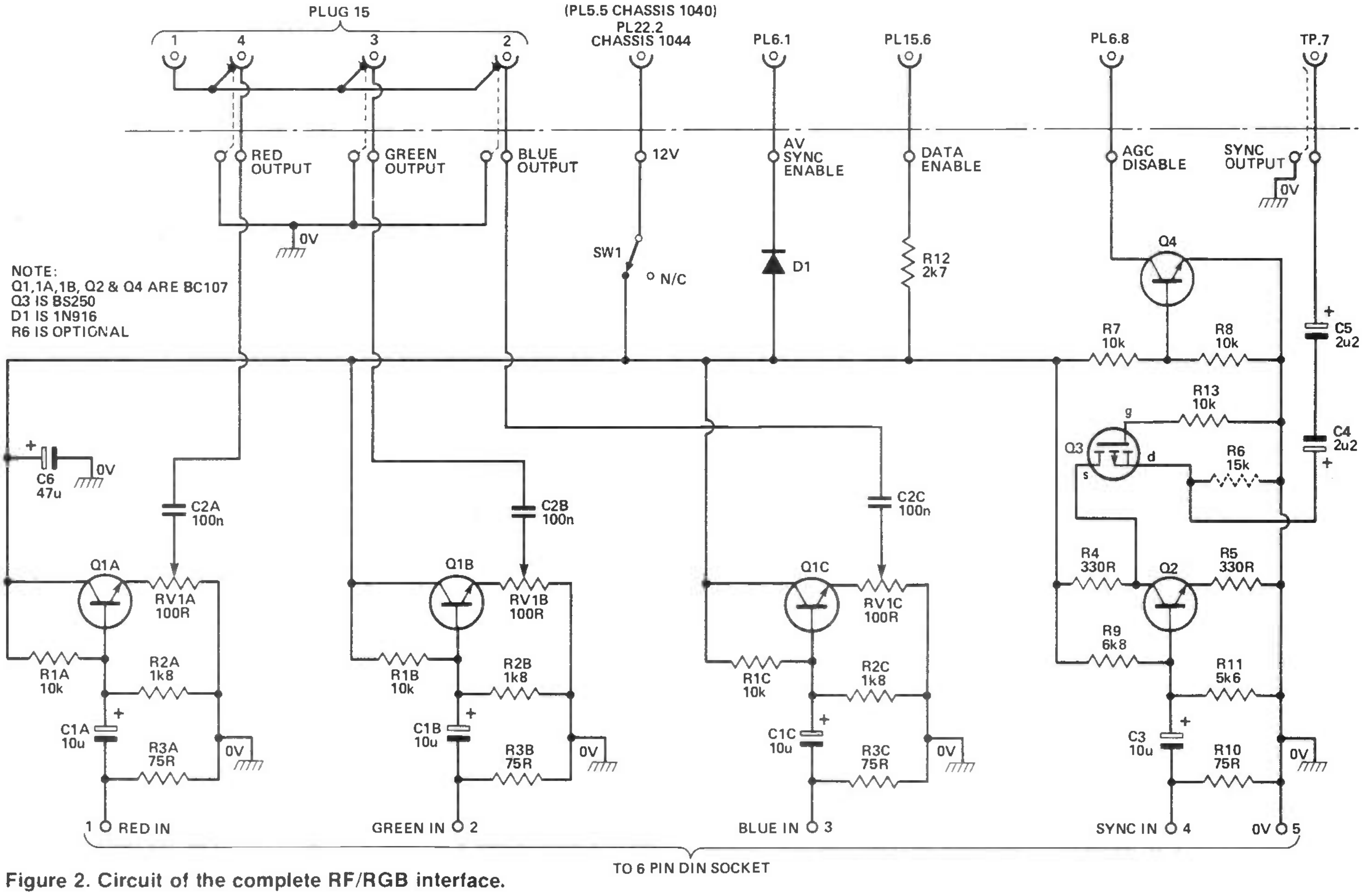


Figure 2. Circuit of the complete RF/RGB interface.

grammes or RGB inputs by controlling the data enable pin. As shown in ***Fig. 1***, the TDA3560 will allow external RGB signals from Teletext or Viewdata equipment, but can also accept external data from computers if interfaced correctly. At the push of a switch, off-air TV programmes or external data can be displayed.

The chassis compatible with our switched RGB can be identified by the type of luma chroma IC which is located in the centre of the printed board under the neck of the CRT. Signals from most computers have a video signal amplitude of 0.7 volts peak-to-peak Red, Green and Blue. However, mixed sync signals are 2 volts peak-to-peak negative going, and require 75R termination at the monitor input. Between these, the TDA3560 will accept direct RGB signals at 1 volt peak-to-peak at a maximum input impedance of 150R.

Construction

All components selected for the interface are mounted on a single-sided PCB. Input signals may be connected via BNC plugs and sockets, keeping the input leads as short as possible. Alternatively, connections are made using a 6-pin DIN plug and socket —

Circuit Description

The interface consists of three identical emitter follower stages for Red, Green and Blue Q1 A, B and C. Each stage is fitted with a preset emitter resistor for setting up signal levels RV1 A, B and C (***Fig. 2***).

When using data inputs on the TDA3560, the receiver contrast control is non-operative and emitter preset controls are adjusted to give a contrast level which is compatible with off-air pictures when the receiver is switched over. Mixed synchronising signals are connected to an inverter stage, Q2, to give a positive-going output. A VMOS FET Q3 couples these signals via C4 and C5 to the TX9 sync input. When TV is selected Q3 is switched off, isolating computer syncs from television syncs. The data enable pin on the TDA3560 requires a high to enable, which is given by R12. D3 then switches the TX9 sync separator into AV sync mode to improve the sync performance.

It was found in practice that when data enable had been selected, spurious signals from off-air programmes were visible at low level. This was unacceptable, and Q4 is used as a switch to short out the AGC line and prevent it. A 12 volt power source is required to power the board and this supply is readily available from the TV chassis via an on/off switch. When voltage is applied, off-air programmes are disabled and data and sync inputs are enabled.

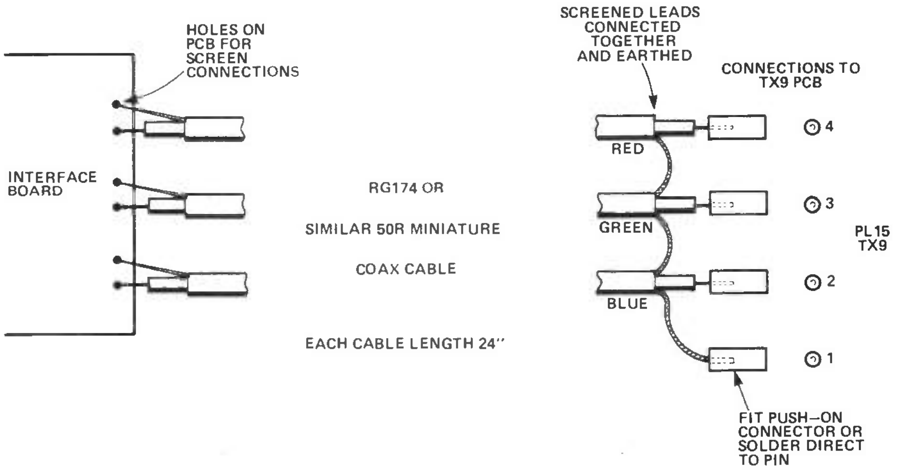
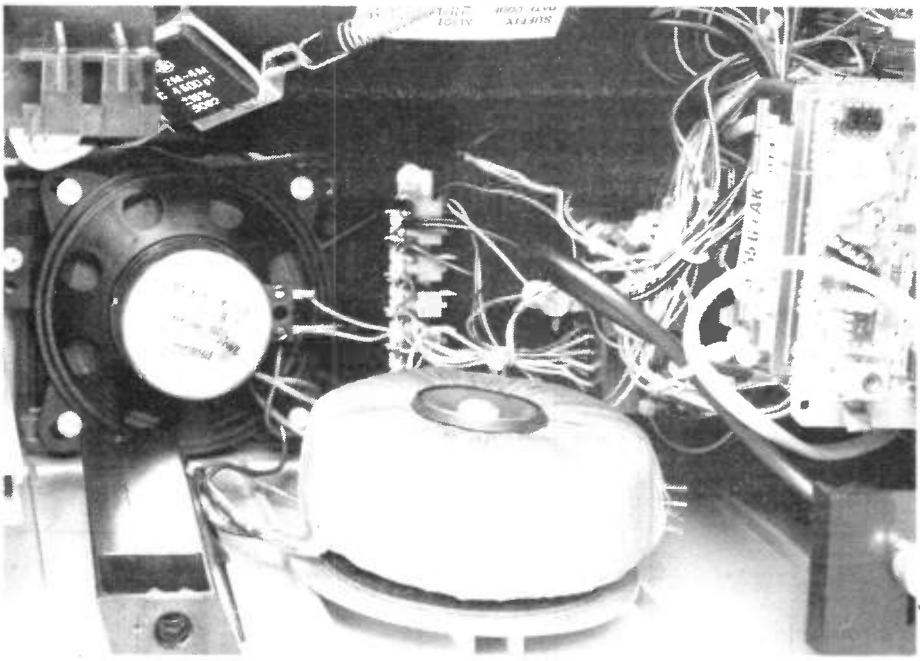


Figure 3. Wiring the interface to the TX9 PCB.



Positions for the board and transformer.

the popular home computer's RGB connector.

Red, Green, Blue and sync output signals are connected to the receiver chassis using miniature co-axial cable (RG174 50R), which should have the screened outers earthed at both the interface and chassis ends (***Fig. 3***). Other interconnecting leads must be multi-stranded conductors (16/0.2mm), PVC covered. ***Figure 4*** indicates the connecting points when using either PC1040 or PC1044 printed board. All connections to the PC1044 are push on, enabling the interface to be fitted within minutes. When using PC1040, with the exception of +12 volt, all connections are push on. The 12 volt lead does not have a convenient pin available and must be soldered into PL5.5 with the existing lead still in place. The PCB is mounted together with the DIN socket and on/off switch onto the aluminium side panel. An isolated mains supply must be used

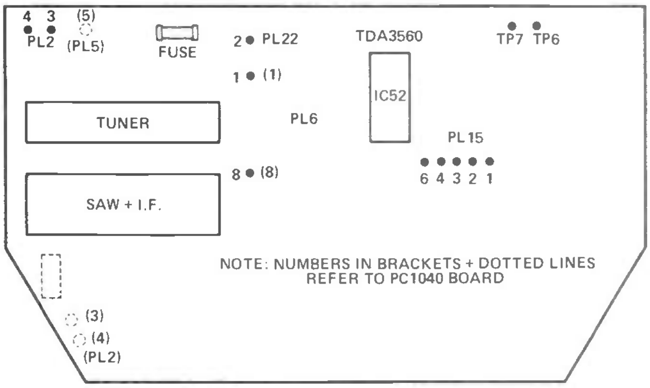


Figure 4. Connections on the TX9 printed boards.

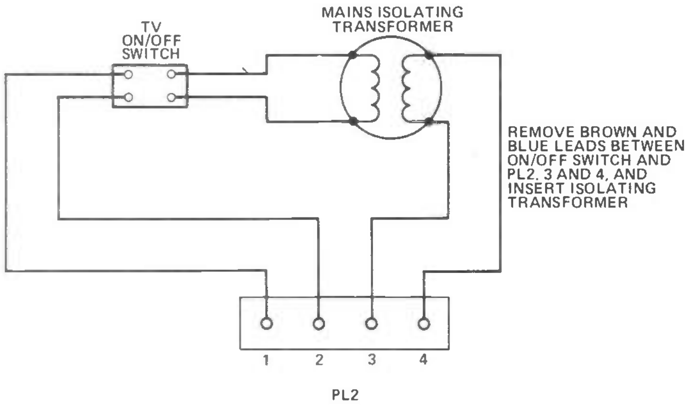
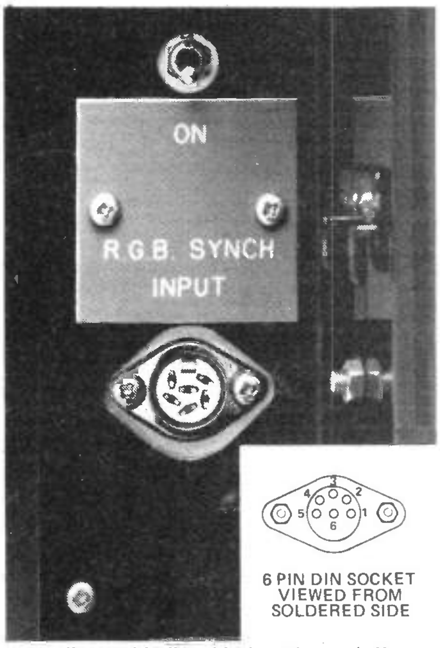


Figure 5. The TV on/off switch can be used to supply the isolating transformer.



A small panel is fitted below the on/off switch. The inset gives pin designations for the DIN socket.

PARTS LIST

Resistors

R1A,B,C,7,8	10k
R2A,B,C	1k8
R3A,B,C,10	75R
R4,5	330R
R6 (optional)	15k
R9	6k8
R11	5k6
R12	2k7

Potentiometers

RV1,2,3	100R min preset

Capacitors

C1A,B,C,3	10u 25V tant
C2A,B,C	100n 50V ceramic
C4,5	2u2 25V tant
C6	47u 25V tant

Semiconductors

D1	1N4148
Q1A,B,C,2,	BC107
Q3	BS250

Miscellaneous

SK1	6 pin DIN socket
T1	see text
SW1	SPST toggle (if required)
PCB, RG174	50R coaxial cable

A complete kit of parts, consisting of PCB, components, aluminium PCB mounting bracket, 14" transformer plate and bolt, DIN socket switch and cables (does not include mains isolating transformer) is available for £36.00 including post & packing. PCB's can be bought separately for £5.00 inclusive. Orders cheques and enquiries to A V Warne Electronics, 113 Queens Road, Vicars Cross, Chester.

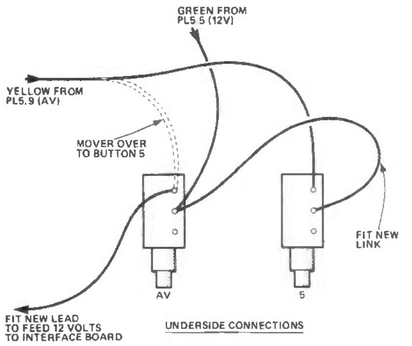


Figure 6. Alternative switching between RF and RGB using the AV button.

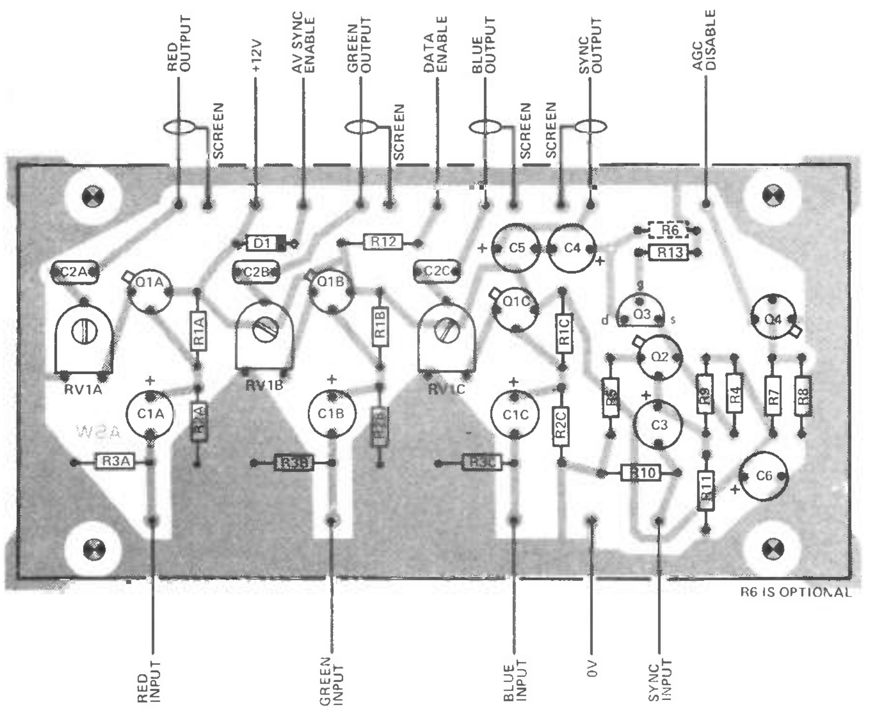


Figure 7a. Component overlay of the completed PCB.

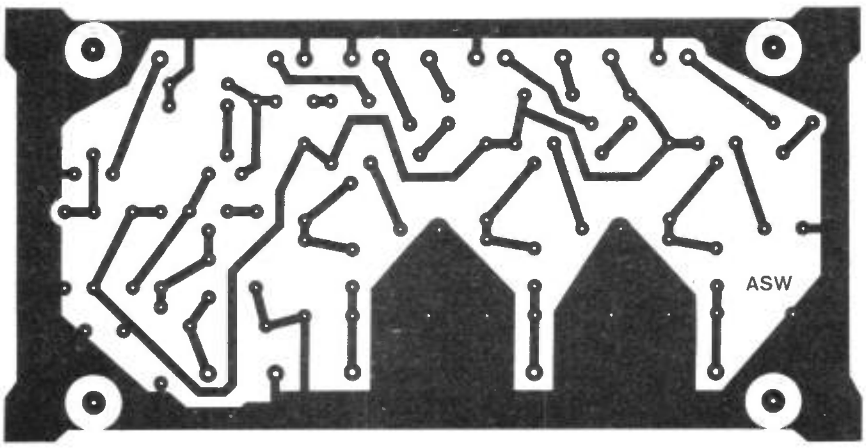


Figure 7b. Foilside of the above PCB overlay.

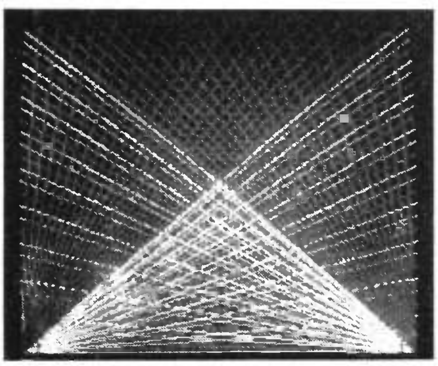
with this modification and a toroidal transformer is best suited for the application. When converting a 14" receiver, an 80 VA transformer is suitable and can be fixed with a single bolt to another aluminium plate. Alternatively, if a remote PCB is already in use, the transformer may be mounted directly on the rear. When a 20" or 22" large screen set is converted, a 120 VA transformer should be used and will fit on a right angled bracket behind the tuner draw.

All interconnecting cables from the interface board, including co-ax, should be 24" long.

An alternative for switching TV/RGB can be the channel select button marked "AV", which is neater and cheaper than using a separate switch on the rear panel. ***Figure 6*** shows how the present AV facility is moved to the next button, to retain AV when using a video recorder, and the now spare button relabelled and used for RGB switching.

Testing

Linear signals were fed to the RGB input and a greyscale wedge displayed using a Philips pattern generator and RGB decoder. Each preset on the interface board RV1 A, B and C was set to provide a good greyscale with adequate contrast compatibility when switching over to TV. When using a computer to drive the interface, signal levels were higher at about 4 volts TTL and each preset was turned down by a small proportion giving excellent results.



Demonstration of the improved definition provided by RGB inputs.

Conclusion

Many home and commercially manufactured computers offer direct RGB output signals as well as UHF signals, but there is no comparison between the two methods of interface. Direct RGB is superior and must be employed by the more discerning user who needs a good quality display at low cost. Alternative inferfaces may be produced using opto-isolating techniques, which avoid the use of a mains isolating transformer, but due to the bandwidth limitations of devices currently available and the manner in which they operate, problems arise in producing a linear transfer of data. The method utilised in the present design, avoids such problems neatly and reliably.

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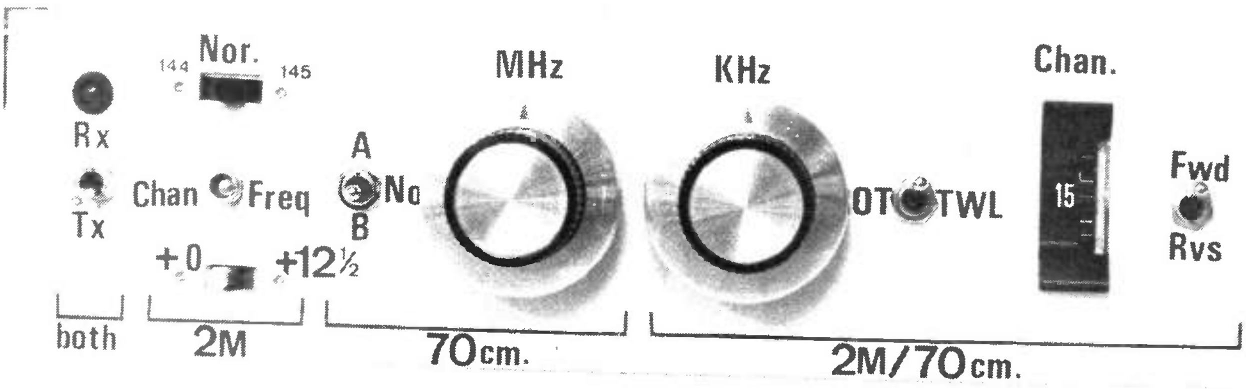


SYNTHESIZER CONTROL SYSTEM

- Operates on 70cm and 2m bands.
- 8-digit direct drive 7 segment LCD display
- Motorola 145151 synthesizer running at 68-74MHz (70cm) and 44-49MHz (2m).
- ROM code converter.
- 400 channel capacity.
- 25kHz spacing

A comprehensive transmitter /receiver synthesizer system for the 70cm and 2m bands.

Design by Ian Chapman.

Our synthesizer was developed when it became apparent that the FM activity on the 70cm band (in the London area) had increased to a point where the channel capacity of the author's rig could no longer meet operational needs. So, rather than invest several hundred pounds in a new rig, an interesting project would be the conversion of the set to synthesizer operation, thereby obtaining up to 400 channels at 25kHz spacing.

Instead of generating a basic frequency at 12 to 14MHz and employing a series of frequency multipliers for both transmitter and receiver, it was felt better to opt for the highest practicable VCO frequency, consistent with ease of conversion. After studying the circuitry of the mobile, it was decided that the VCO should operate between 68 and 74MHz, thus requiring a multiplication of six times in both the transmitter and receiver, and making the modification of the two multiplier units relatively straightforward.

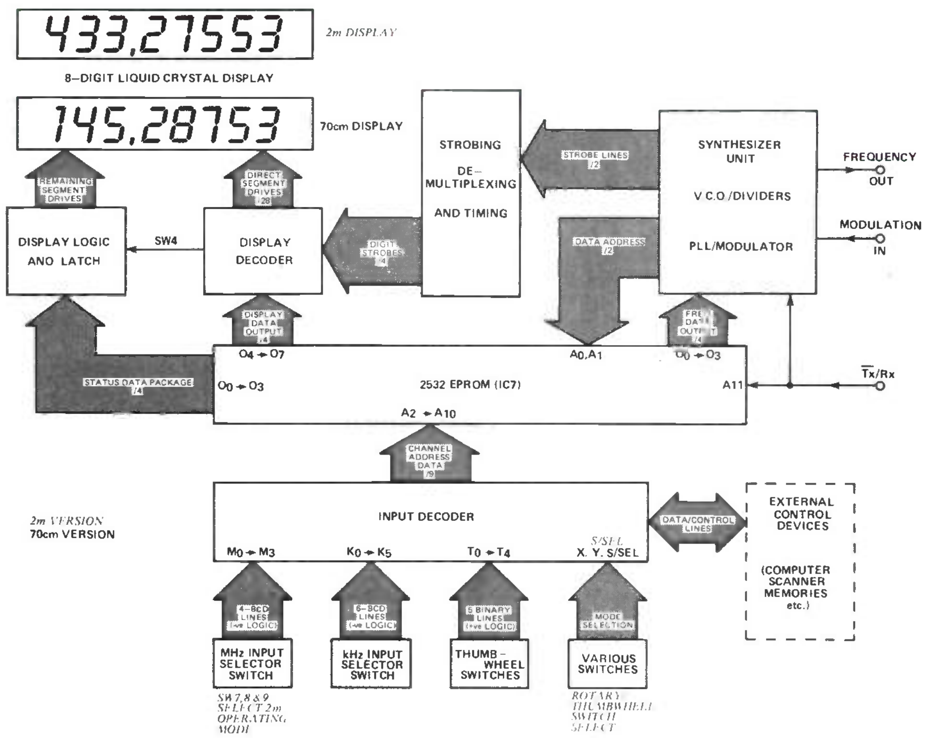


Figure 1: Synthesizer Control block diagram.

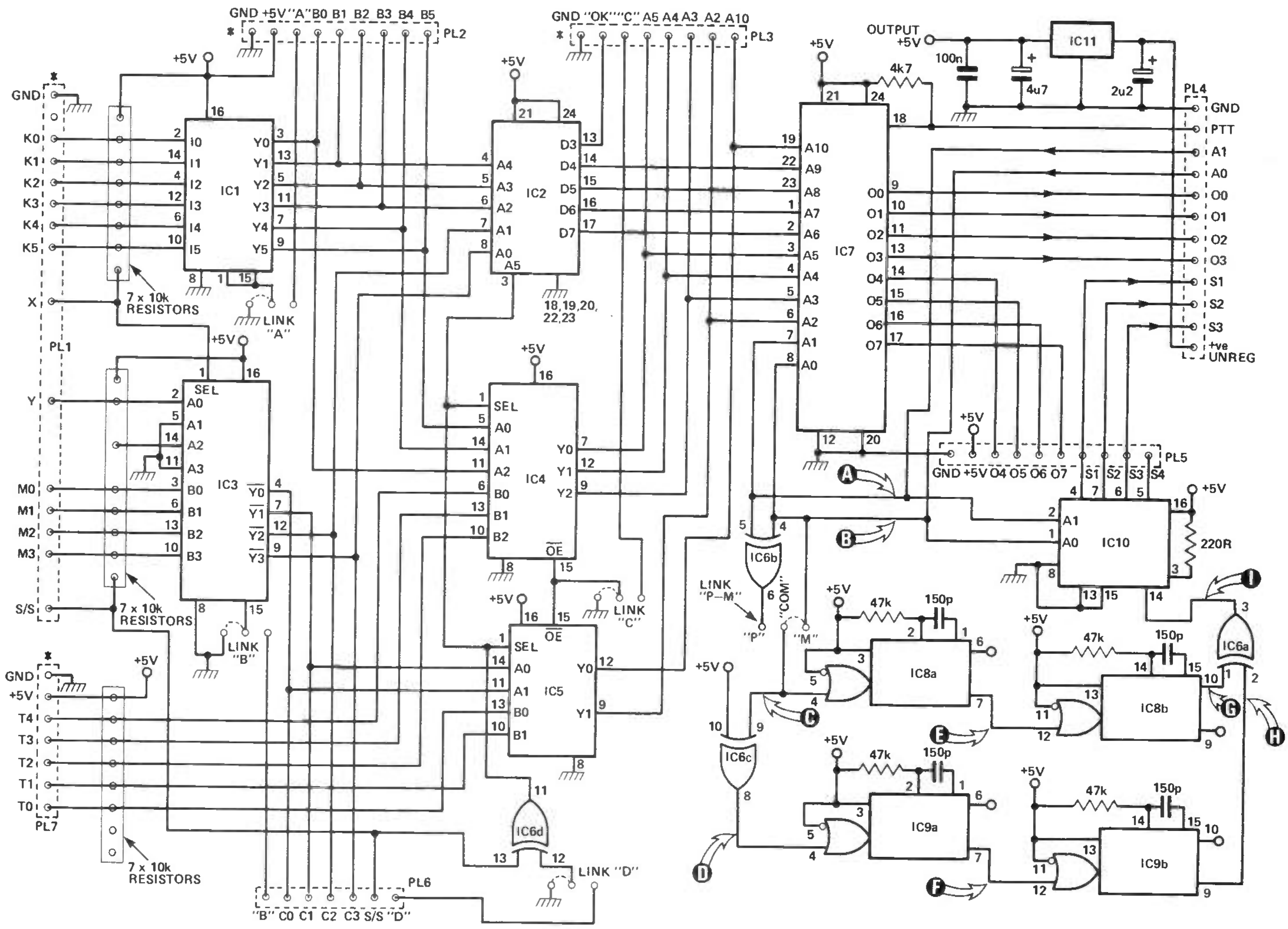


Figure 2: Synthesizer Control circuit diagram.

NOTE:
IC1 IS 74LS366
IC2 IS 2716
IC3 IS 74LS258
IC4 & 5 ARE 74LS257
IC6 IS 74LS86
IC7 IS 2532
IC8 & 9 ARE 4528
IC10 IS 74LS256
IC11 IS 7805

Circuit Description

Referring to the block diagram shown in ***Fig. 1*** and the circuit diagram in ***Fig. 2***, it can be seen that the 2532 data outputs are used by two devices — the synthesizer unit, and the display. Thus the lower 4 bits of the output (00 — 03) are dedicated to outputting the data for synthesizer frequency control, whilst the upper 4 bits (04 — 07) carry the data outputs for the corresponding display decoder.

The 2532 is addressed by three binary information sources. The Motorola synthesizer IC requires 12 bits of binary data, and these are clocked out of the EPROM as three 4-bit chunks using two strobe lines holding a binary address, which are connected to the A0 and A1 inputs of the EPROM. A RECEIVE/TRANSMIT line is also needed on A11 to provide an IF offset on the frequency data, and, if necessary, a frequency change for split frequency operation. The other nine address lines (A2 — A10) hold a binary code corresponding to the channel selected, which comes from the switch interface circuits (see later).

The strobing n A0 and A1, which comes from the synthesizer board, is in the form of a binary count from 0 to 3, generated by an oscillator counter pair on the frequency synthesizer board (Motorola), and has a count period of approximately 1½mS during which data is strobed not only into the synthesizer, but also into the display decoder (04 — 07), the data output being synchronous with the A0/A1 addressing from the synthesizer unit.

Channel selection for the synthesizer is derived from two 40-way CB type rotary switches with BCD outputs (see ***Fig. 3***). The common contacts of these switches are grounded, and pull-up resistors are connected to the appropriate input pins of IC1 and IC3, so that inverse binary coded decimal data (negative logic) is obtained from both switches. One rotary switch (S1) is used to input the MHz band to work in, and on rotating clockwise, counts 0-9 four times. The other rotary switch (S2) increments the frequency in 25kHz steps, working from 43X.00 to 43X.975, where X is the MHz band that has been selected on S1. Thus, any frequency of the form 43X.YYY in 25kHz steps can be set up, where X is set on switch S1, and YYY is set on switch S2.

Since this method of setting frequency can be cumbersome when moving between commonly used channels, other options are available. A three-way switch (S3) is provided which, when in the centre position allows direct input of frequency as described above, but, when displaced from the centre, allows access to two completely independent groups of 40 channels, which can be anywhere in the 70cm band, in 25kHz steps. In this mode, S1 has no effect, but S2 moves through the 40 pre-programmed channels. One bank of 40 channels is accessed when S3 is down, the other when S3 is up. Thus, up to 80 favourite channels can be programmed into these positions for instant access, whilst still retaining full frequency agility when S3 is in the centre position.

One further option is available as a result of this design. it is often useful to be able to switch rapidly between two channels, where one is commonly used and the other is less commonly used. This design allows for another 32 channels to be pre-programmed as regular channels (eg, calling channels, repeater channels and working channels), and allows these to be quickly selected *without* disturbing the rotary switch S2, by the operation of S4, and then by using the switches S5/S6 which can be a thumbwheel type and a toggle switch or any other suitably coded switches. A binary switch is preferable, as it allows access to all 32 possible channels, but a BCD switch can be used, although it will limit the number of available channels to 20. Operation of the two-way switch S4 decides whether the channel is set up on the rotary switches (S1 and S2), or on the multi-way switch (S5/6). As a result, two frequencies are immediately available, one on S5 and the other on the rotary switches S1 and S2, and switching between them is effected by operating S4.

The switch decoder for the synthesizer comprises 5 integrated circuits (LSTTL), IC1 to IC5, and converts the binary coded decimal from the rotary switches (S1 and S2), which occupies 10 data lines, into binary as needed by the synthesizer EPROM IC7, for which only 9 data lines are needed. It also allows for the extra 80 channels to be accessed with the three-way switch S3, and adds the facility to have independent channels available on S5 (see **Figs 2** and **3**).

The 40-way switch S2 produces 6 data lines (coded k0 to k5, k0 being least significant). The data presented is *negative logic* and comprises a binary representation of the tens digit of the position of the switch (0-3) on k4-k5. A BCD representation of the last digit of the switch position appears on k0 to k3. Thus the data appears on these lines as 0 to 39, inverse logic. The data is first inverted by IC1, which is a tri-statable inverting buffer (74LS366). This tristate ability allows for the future addition of an independent controller (for example, a frequency scanner or computer). The outputs from the tristate inverter IC1 and the OE on Pins 1 and 15 are brought out to an external connector PL2 when LINK "A" is set appropriately.

In order for an external device to take control, it is necessary for IC1 Pins 1 and 15 to be taken high and then data can be supplied via the data lines B0-B5 (see **Fig. 2**). For the basic unit, however, the tristate input is linked low at link "A" to force IC1 to output all the time.

The coding of the 40-way switches is such that K0, K4 and K5 assume all possible states (when switch S2 is turned, K0 alternates 0,1,0,1..., and after each 10th turn, K4 and K5 change in the sequence 00,01,10,11,00...). Thus, these 3 bits are already pure binary, and do not need any adjustment. However, the other three bits, K3, K2, K1, only assume certain states (k3,K2, K1:000,001,010,011,100 = 5 combinations out of a possible 8). To code them in true binary, therefore, these bits need correction. They are fed into an EPROM (IC2) with a special program "burnt" into it (see **Fig. 5**). A 74188 Bipolar PROM was used in the original design, but later replaced by the 2K EPROM as it was felt that in due course a considerable saving a power consumption could be effected by the use of CMOS EPROM devices. This program will be discussed fully shortly.

The MHz 40-way switch S1 produces 6 data lines, but only the lowest 4 are used, as it is only necessary to count from 0 to 9: the tens digit is neglected and the unused two bits are left unconnected. The lower 4 bits are fed into a quad 2 line to 1 line inverting tristatable multiplexer, a 74LS258 (IC3). The data lines are again brought out to a connector PL6 so that an external device can read from or place data onto this bus via C0 — C3. The output enable line from pin 15 of the multiplexer IC3 is linked low at link B on the basic unit, to force IC3 to output, but by repositioning link "B" it can be brought out to "B" on PL6, so that an external device can tristate the bus and place data on it. Assuming that IC6 Pin 11 is high, and the data is routed through the multiplexer and inverted, so that it becomes positive logic. By examining the binary coding for each bit, it can be seen that whereas M0 and M1 assume all states, and can be left unaffected, M2 and M3 only assume three of the possible four states (00,01,10) and so need correcting: these are also routed to the EPROM (IC2).

At the EPROM, 5 lines enter. The three "K" lines can take 5 states, and the two "M" lines can take 3 states. Thus, the total number of combinations possible is 3 x 5 = 15, which can be coded into 4 binary bits (2^4 = 16). With an appropriately programmed EPROM, therefore, 5 lines can be compacted into 4 by assigning a unique 4-bit code to each 5-bit combination. The codes assigned range from 0000 to 1110. The four active outputs of the EPROM 04 — 07 are then routed to the address lines of IC7, the synthesizer EPROM, A6 to A9.

The other lines from the rotary switches that are already binary, and which are not routed to the EPROM IC2 are input to a non-inverting multiplexer. This consists of two 74LS257s (tristatable quad 2 line to 1 line multiplexers IC4 and IC5) configured as a 10 line to 5 line multiplexer. When the select lines (Pins 1 of IC4/5) are low, the data from the rotary switchs (S1 and S2) is routed through to the address lines A2 to A5 and A10 of the 2532 EPROM. The outputs from the multiplexers are also brought out to an external connector PL3, along with the output enable line "C", so that, if required for a scanning facility, an external device can take control of the system by driving the enable line "C" high and putting its data on the lines A5 to A2 and A10. In the basic system, the tristate line is linked low at link "C", to force the multiplexers to pass data normally.

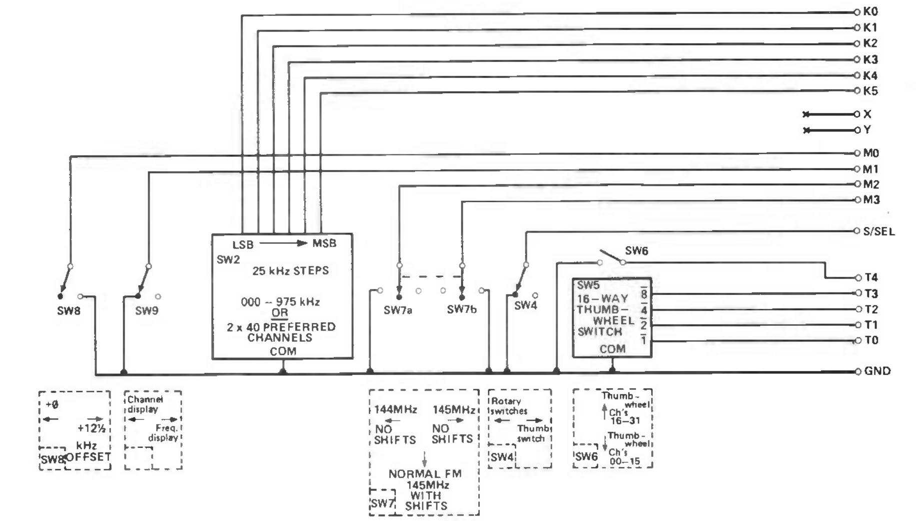


Figure 3a: 2m data switching.

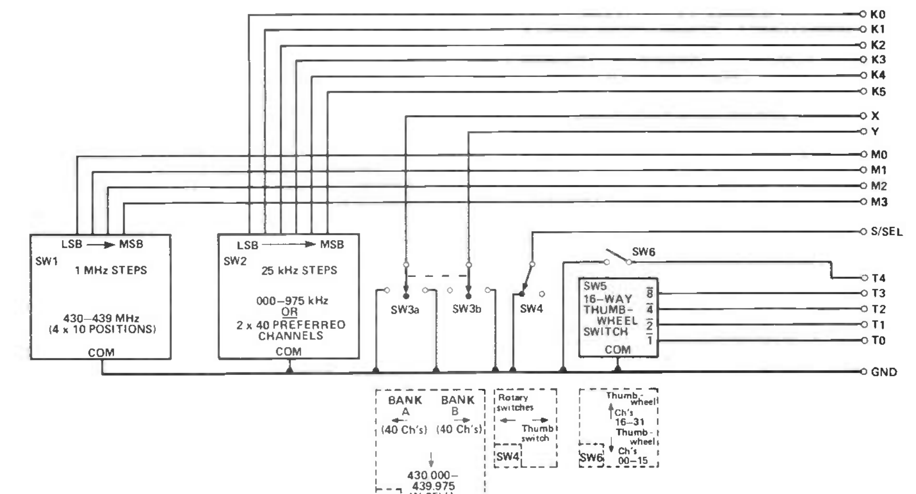


Figure 3b: 70cm data switching.

Design

The design philosophy was to create a basic system which used readily available components and offered sufficient flexibility for other devices (such as a scanning controller, a read/write memory or a computer) to be interfaced with only very minor circuit changes. A modular design evolved, and as a result many different display formats can be catered for. Also, the design can be modified for use on other frequency bands, particularly 2 metres, where channels at 12.5kHz spacing can be accomodated and displayed. By carefully designing the hardware, a system has been devised that is simple to use for the inexperienced operator, yet powerful enough to equal many of the Japanese 'black boxes' on the market.

Since it is inadvisable to use an IF as low as 10.7MHz in a receiver covering the entire 70cm band (due to the ▶

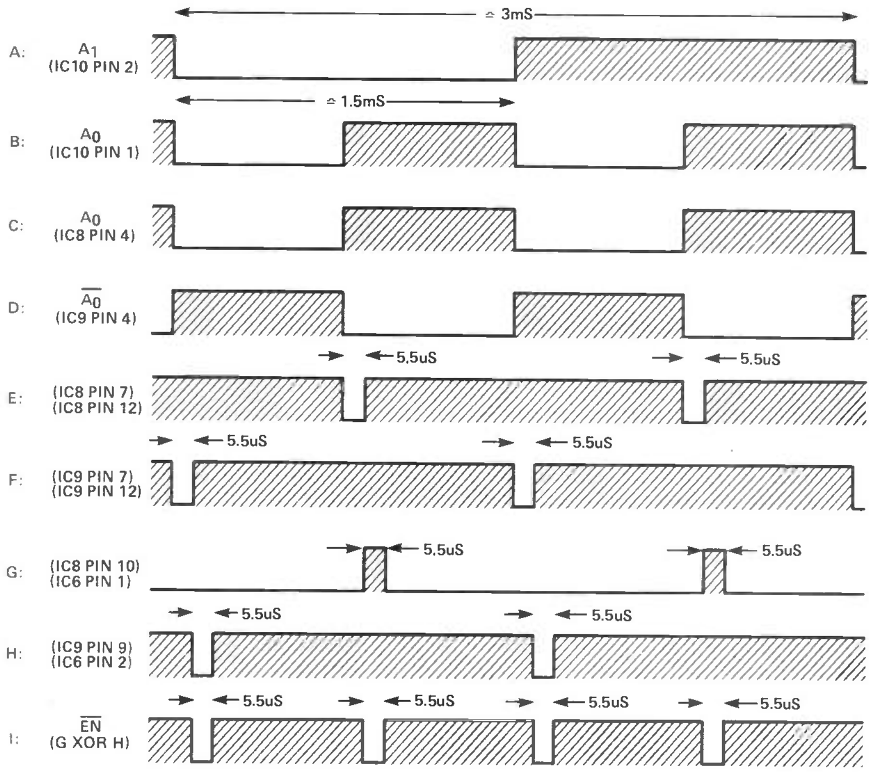


Figure 4: System timing diagrams.

inherent poor image rejection), 21.4MHz was chosen. An EPROM chip was then programmed for 70cm, using this IF and containing the channels described in ***Fig. 5***.

The block diagram in ***Fig. 1*** shows the complete synthesizer system. The frequency multiplier stages for both transmitter and receiver are not described since the design of these follows standard practice. If low power consumption is a requirement, then the EPROMs can be replaced with their CMOS equivalents. Some of the 74LS devices do not as yet have direct CMOS equivalents.

The ROM used in this synthesizer design is the source of much of the flexibility of the system, as its programming determines, (for any given channel selection):

1. The transmission frequency.
2. The receive frequency, and the IF offset.
3. The output shown on the digital display, with any special display if desired.
4. Any indication of a frequency shift when using split-frequency working. (eg, repeaters).

In choosing a ROM, several considerations had to be taken into account:

At least 400 channels were needed to be able to access the entire 70cm amateur band in 25kHz steps. Thus, 9 address lines were needed for this (2^9 = 512 channels). Three other address lines had to be provided — two for clocking the frequency data into the synthesizer IC and for indicating TRANSMIT/RECEIVE status, and so a total of 12 address lines are used. For this reason a 4K x 8 or larger ROM is necessary.

The device used had to be standard, easily programmable, and alterable, so an EPROM was chosen. At the time of writing, few facilities were available for programming the 8K x 8 EPROM (the 2764), and so the 2532 or 2732 had to be used. As will be described later, the use of this EPROM means that special interfacing to BCD coded switches is needed, but this in turn means that all of the 512 channel selections available in the EPROM can be accessed.

The system had to be compatible with a receive-only design since the TRANSMIT/RECEIVE line is not then not needed, the standard 2K x 8 (2716) is the ideal choice for a programme EPROM. For this to be possible using the same PCB, the 4K x 8 EPROM used in the transceiver design had to be pin compatible with the 2716. This limits the choice of EPROM to the Texas 2532, *NOT* the Intel 2732. Then, to use a receive-only design with the 2716, the TRANSMIT/RECEIVE line (connected to CE on the 2716) should be permanently strapped to the ground line.

System Operation

A typical example of the use of this system is putting out a call. If the calling channel (SU20 — 433.500 MHz) has been programmed as one of those selectable on S5, then the rotary switches are free to set up another channel: for example, a simplex channel to move to after the CQ call is answered. S4 can be operated to select the calling channel, set up on S5, and the CQ call put out. When a reply is received, the desired simplex channel can be rapidly checked using S4, to ensure that it is still clear, the message to change to the simplex channel can be passed on the calling channel, and then both stations can change frequency for the contact. The only switch operation needed is S4 to change frequency. Note that, even if the proposed simplex channel is not free, the frequency can be adjusted up or down in 25kHz steps with the rotary switch S2. Clearly, this system can be very efficient. If a new frequency had to be selected using S1 and S2 each time it were necessary, the process of changing channel would be much more laborious, particularly when operating mobile.

When a frequency shift on transmit is needed, such as with repeater operation, it is useful to have the channels set up in three ways, as normal "forward" repeater channels (+1.6 MHz shift on transmit), simplex channels (no shift on transmit), and "reverse" repeater channels (-1.6MHz shift on transmit). To do this, three distinct channel selections are necessary. This is easily arranged using the facilities of the unit and has been found to work very successfully.

Note that, even when the transmit and receive frequencies are the same, the VCO outputs from the synthesizer will be different, due to the IF offset needed on receive.

For operation in different modes from the basic "dial-up frequency" way of entry, the system operates in another way. The three-way switch S3 is a double pole, centre-off type switch that is connected to the IC3 multiplexer (see ***Fig. 2***). The select line on the multiplexer (Pin 1) is pulled up by the resistor when S3 is in the centre (off) position, forcing the data from S1 onto the outputs. however, if S3a is displaced from its centre position, the select line is forced low, and the other data is forced on the outputs. The upper 3 bits of this alternative data is hard-wired on Pins 5, 14 and 11 of IC3 to be the combination 010, which will emerge after inversion as the combination 101, which is the one legal combination on these lines not used by S1 and is free for use to access other channels. This corresponds to the code for either 10 or 11 decimal, depending on the state of the lowest bit. Thus, for both 10 and 11, there exist 40 channels that can each be accessed with the 40-way switch S2. S3b determines the state of the lowest bit — if the switch is set to "band A", pin 2 of IC3 is pulled high by the pull-up resistor; if the switch is set to "bank B", then pin 2 is forced low. Thus 80 extra channels are provided by the "X" and "Y" lines, which can be dialled up using S3. This completes the range of codes from S1 (0000 to 1011).

The thumbwheel switch combination (S5 and S6) provides further channel options. Since the inputs to the EPROM IC2 can take 15 states, and four binary lines can take 16 states, there is one remaining output state left. This is 1111 or 15 in decimal. This cannot be accessed unless one of the address lines (A5) on the 2516 EPROM is taken high. When this occurs, the combination 1111 is output on the data lines, regardless of the states of the other address lines. Thus, if a switch S4 is connected to this line, pulling the input high with a switch position will cause the remaining address combination on the synthesizer EPROM to be accessed. At the same time, S4 is connected to the select lines (pins 1) on the two tristating multiplexers IC4 and IC5. When S4 is switched to ground, the data is routed normally, from the rotary switches S1 and S2, and the EPROM is free to take the 15 normal states. If, however, S4 is opened, IC2 output is forced to 1111 and entirely new and different data is enabled into the multiplexer from the other input, permitting 32 further channels ($2^5 = 32$) to be accessed. The data on this line could come from a hexadecimal thumbwhell switch (range 00 to 15) and a simple switch S6, in which case all 32 channels are available on lines T0, T1, T2, T3 and T4. Alternatively, a standard BCD thumbwheel switch could be used, together with S6, in which case 20 channels are available. The code used should provide a positive logic output, although negative logic can be catered for by programming the synthesizer EPROM differently.

The EPROM IC2 used in this decoder is specially programmed for the job of decoding the BCD data into binary combinations. Any program which assigns the codes 0000 to 1110 to each input combination uniquely will suffice, but different versions will result in incompatibility and so one "standard" form has been chosen (see ***Fig. 5***).

ADDRESS						OUTPUT DATA				
A_5	A_4	A_3	A_2	A_1	A_0	O_7	O_6	O_5	O_4	O_3/OK
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	1	0	1	0
0	0	0	0	1	0	1	0	1	0	0
0	0	0	0	1	1	1	1	1	1	1
0	0	0	1	0	0	0	0	1	0	0
0	0	0	1	0	1	0	1	1	1	0
0	0	0	1	1	0	1	0	0	1	0
0	0	0	1	1	1	1	1	1	1	1
0	0	1	0	0	0	0	1	0	0	0
0	0	1	0	0	1	0	0	1	1	0
0	0	1	0	1	0	1	1	1	0	0
0	0	1	0	1	1	1	1	1	1	1
0	0	1	1	0	0	1	1	1	1	1
0	0	1	1	0	1	1	1	1	1	1
0	0	1	1	1	0	1	1	1	1	1
0	0	1	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	0	0	0	0
0	1	0	0	0	1	1	1	0	1	0
0	1	0	0	1	0	0	1	1	0	0
0	1	0	0	1	1	1	1	1	1	1
0	1	0	1	0	0	1	1	1	1	1
0	1	0	1	0	1	1	1	1	1	1
0	1	0	1	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1	1	1
0	1	1	0	0	0	1	1	0	0	0
0	1	1	0	0	1	1	0	1	1	0
0	1	1	0	1	0	0	0	0	1	0
0	1	1	0	1	1	1	1	1	1	1
0	1	1	1	0	0	1	1	1	1	1
0	1	1	1	0	1	1	1	1	1	1
0	1	1	1	1	0	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
1	X	X	X	X	X	1	1	1	1	0
A_5 (3)	A_4 (4)	A_3 (5)	A_2 (6)	A_1 (7)	A_0 (8)	O_7 (17)	O_6 (16)	O_5 (15)	O_4 (14)	O_3 (13)

ADDRESS LINES $A_6 \rightarrow A_{10}$ ARE ALL AT LOGIC 'LOW' (0) FOR THIS CODING.

FOR ALL OTHER ADDRESS INPUT COMBINATIONS, OUTPUTS SHOULD BE CODES TO '11111' (ALL HIGH).

OUTPUT O_3 IS A STATUS FLAG AND SHOULD REMAIN '0' THROUGHOUT OPERATION. A '1' OUTPUT ON THIS LINE INDICATES AN ILLEGAL CODE ERROR

0 = LOGIC 'LOW'
1 = LOGIC 'HIGH'
X = 'DON'T CARE' (all values)

Figure 5: EPROM (IC2) program.

An additional output is available from the 2516 EPROM on 03. This line, termed "OK", is a debugging tool. So long as valid BCD data from the rotary switches appears on its input lines, the EPROM with flag "OK" with a logic "0" on 03. This indicates that the system is behaving itself. If, for any reason, an "ERROR" state is flagged in the form of a logic "1", it is clear that something is amiss with the hardware or the BCD switches.

When external devices are to be attached to the board busses (eg, a scanning controller, read/write memories, a computer), the four links "A", "B", "C" and "D" should be changed from the "INT" position to the "EXT" position. In the "internal" position a ground is held on the enable line of the device outputting data onto the respective busses. Thus, the output device is allowed continuous access to the bus in question. If the link is moved to the "external" position, the ground is removed from the enable line of the bus driver in question, and this enable line is brought out onto an external connector so that it can be controlled by an outside device. When the outstide device wishes to force data onto the bus, it drives high the enable line on the bus concerned, tristating it and so allowing data to be pushed onto it. When normal control of the bus is wanted, the outside device grounds the enable line.

In a basic board, links "A", "B", "C" and "D" can be wired permanently to ground. However, if it is felt that the "external" option is one that may be wanted, four miniature DIL switches could be fitted on the board to make changeover easy.

In the context of external control, another use of the "OK" line comes to light. When, for example, a computer is the external controller, it will be placing binary data onto the busses as required. If, for any reason, non-BCD data is output, a spurious and undefined condition could arise. However, the "OK" line flags this condition, allowing action to be taken (for example, gating out the transmit line). Since the "OK" line could be very useful, it is brought out onto external connector PL3.

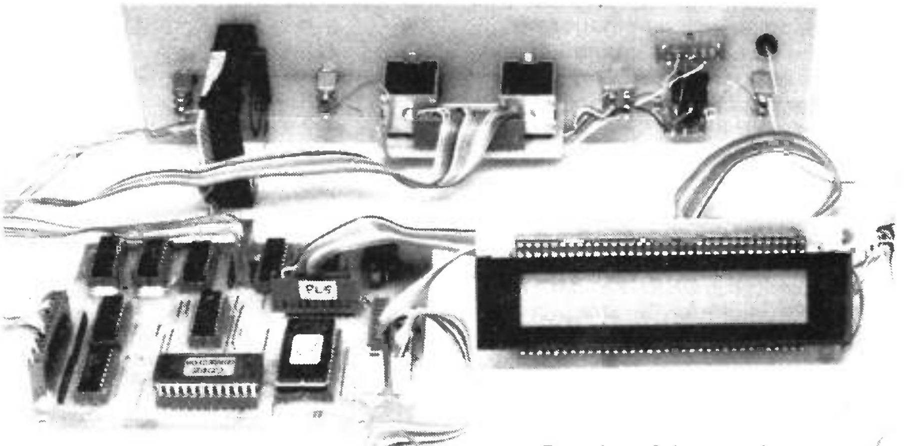
With the link in the "M" position (for the Motorola synthesizer), A0 is used as the fundamental timing pulse (see timing diagram). A0 is used since it is the output which changes state each ▶

time the address on lines A0 and A1 lines changes. This output is then split between two sets of monostables. One line is taken to a monostable IC8a with a period of about 5uS which is set to trigger off the positive-going edge of the input signal. IC8a will trigger from alternate changes of address. The other line from the exclusive-OR output is inverted by another exclusive-OR gate and presented to another monostable with a similar period to that of IC8a. This also triggers off a positive edge, which was a negative-going edge before inversion through IC6. Thus, this second monostable, IC9, will trigger off those changes other than those that cause IC8a to trigger. As a result, both monostables between them trigger off every address change. The delays on both of these cause the strobe pulse to occur conveniently about 5uS after the transistions, thereby allowing the display driver time to set up and stabilise. When each monostable times out, further mono-stables (IC8b and IC9b) are triggered to determine the data input period (also set to around 5uS). Thus, a "time window" is provided, well into the data entry time, to strobe the display decoder whilst the data on the lines is stable. The outputs from the two monostables are combined with another of the exclusive-OR gates available in IC6, producing an output at pin 3 which goes to logic "0" during the entry period (the Q output of IC8b and the Q output of IC9b are supplied to the exclusive-OR gate so that the output at IC6 pin 3 is of the correct polarity). This output is connected to the enable (E) input of the 74LS256 (IC10). As a result, data is gated onto the outputs only during the given display data input time, thus resolving any timing problems that would otherwise occur.

In this way, the data output and addressing signals from the synthesizer EPROM are arranged to suit the display driver, completing the interfacing between the input switching, the synthesizor EPROM, and the display.

Channels And Devices

In the prototype design, the channels available were assigned in a way that proved to be very effective (see ***Fig. 5***). The band was accessible in 25kHz steps as described. One bank of 40 channels (S3 to BANK "A") contained all the usual simplex channels (SU16 — SU55). The other bank (S3 to BANK "B") was used for all the repeater channels (forward and reverse shift — simplex was selected when the channel was dialled up directly on S1 and S2). The 32 thumbwheel switch S5/S6 channels were programmed with all the locally used channels: simplex, calling, and repeater channels.



Rear view of the control system.

The data for the display driver has to be presented in the correct format and with the correct timing. From the discussion of the EPROM used it is clear that the data for the display is clocked out of the EPROM on the upper 4 data lines 04 — 07 of the EPROM, following the strobing on the A0 and A1 lines, as described earlier. The display driver requies 4 data lines to be strobed in, and so the data lines can be connected directly to the display decoder. However, the display driver also requires four individual strobe lines, as opposed to two binary coded lines, and the timing on these lines is critical. As a result, there has to be some decoding and retiming of the lines to the display decoder to strobe in the data. This is accomplished by four ICs (see ***Fig. 2***). The first, a 74LS256 (IC10) is a dual 4-bit addressable latch, which is used as a 2 line to 4 line demultiplexer, to decode the addressing from the synthesizer IC. For use in this mode the CLR and D_B lines are grounded and the D_A line is pulled high. As a result, the device will decode the addresses on A0 and A1, pulling high the appropriate output Q_{xa}, provided that the E line is held low. If E is taken high, then all the outputs are forced low (inactive). The Q_a outputs are the lines used in this mode — the Q_b outputs are not connected. The enable line is used to provide the correct timing for the display decoder IC. For the display driver concerned (7211B) the data strobe line must only be strobed after the data has settled down on the input lines. Thus, it is only permissible for the strobe lines to the display driver IC to be high for some of the time whilst the data is present, and therefore the enable line is used to delay the strobe until the time is right. The timing is provided by a 74LS86 (TTL quad exclusive-OR gate IC6) and two 4528Bs (CMOS dual monostables, IC8 and IC9).

Options

Either the 144MHz or the 145MHz band can be selected. If the three-way switch S7 is set to '144' then the 144MHz band will be stepped through in 25kHz steps by rotating the 40-way switch S2, with no frequency shifts (transmit frequency = receive frequency).

If the 3-way switch S7 is set to '145' then the 145MHz band will be stepped through in 25kHz steps by rotating the 40-way switch S2, also with NO frequency shifts (ie, NOT repeater mode).

If the 3-way switch S7 is set to 'NOR' then the normal band will be stepped through in 25kHz steps by rotating the 40-way switch S2: the 145MHz band with repeater shifts when appropriate: +0.6MHz on transmit between 145.000 and 145.1875; no shift from 145.200 to 145.5875; -0.6MHz on transmit between 145.600 and 145.7875 (2m repeaters) and no shift from 145.800 to 146.000 (satellites).

A +12.5kHz offset can be placed on transmit and receive using switch S8 — this allows the new 'interwoven' channels to be used. This offset applies to all but 'thumbwheel switch' mode.

The two-way switch S9 allows the selection of either a frequency or a channel number on the display. Set to 'FREQ', a display such as '145.550' is seen: set to 'CHAN', a display such as 'S-22' or 'P-05' (R5) is seen.

If 'thumbwheel switch' mode is selected on switch S4, then 32 channels are available on the 16 way thumbwheel switch S5 and the switch S6. These are set in the 'standard' 2532 EPROM to be a selection of common repeater and simplex channels.

Next month we conclude the project with construction and display details.

■ R&EW

R&EW Data Brief

ICM7226

A 10MHz universal counter system

The frequency meter featured in this issue uses the Intersil ICM7226, a versatile IC worthy of closer inspection. The pin-out is given in ***Fig. 1***, and below is a description for each pin.

Pin 1: *Control*. If a selected digit line is connected via a diode, various control functions will be enabled, according to ***Table 1***. These allow, amongst other things, the display to be blanked, or tested, or the switching in of an external oscillator, eg, a 10MHz source phase-locked to Droitwich. The 1MHz select allows the use of a 1MHz crystal with the same multiplex rate. However, the resolution will be one digit less.

Pin 3: *measurement-in-progress out*
Pin 5: *store out*
Pin 32: *reset out*

These provide the various timing pulses as outputs for controlling other devices.

Pin 4: *Function*. This will, upon connection of various digit lines (***Table 1***), switch the counter into its various modes. In 'Time Interval' and 'Frequency Ratio' the two inputs, pin 2 and pin 40 are used. Otherwise only pin 40 is used.

Pins 8-16 (except 12): are the segment BCD output of the count being displayed, used in the frequency meter to control an LCD driver. The data is multiplexed at a rate of 500Hz.

Pins 8-16 (*except 12*): are the segment outputs for an 8 digit CA multiplexed display. There is an interdigit blanking time of ≃ 6us to prevent ghosting.

Pin 19: *Reset*. Connecting this pin to 0V will reset the whole counter.

Pin 20: *Ext d.p. input*. When enabled (D8 to pin 1) the connection of a digit line will light the appropriate decimal point.

Pin 21: *Range*. There are four internal ranges available, depending on which digit line is connected, with the D1 line giving 10ms gate, and the D4 line giving 10s. However by connecting D5, an external range can be applied to pin 31.

Pins 22-30 (except 25 = +V): are the digit lines, and it will have been realised that these are used for many operations. They also connect to the CAs of the displays, D1 being the least significant digit (on the right looking from the front).

Pin 33: *External osc in*. If enabled with D1 to pin 1, an external oscillator signal can be fed into this pin, and if for example one of the Plessey high speed dividers up to 1.5GHz is used, a 2.5MHz frequency will give the correct reading.

Pins 34,37: are not committed and should be connected either to +V or 0V for best stability.

Pin 35,36: are the oscillator pins, normally used with a 10MHz crystal.

Pin 38: *Buffered osc out*. This gives the crystal output, and is capable of driving one TTL load (LS), without loading the main oscillator. However, capacitive loading should be kept to the absolute minimum. With reference to the description of pin 33, the 'osc out' could be divided by 4 using a 74LS74 to give the 2.5MHz signal which is then fed back into pin 33.

Pin 39: *Hold input*. This should normally be tied to 0V, but if switched to +V the display will freeze with the last reading. This same switch will blank the display if D4 is connected to pin 1 at the same time.

A test circuit is given in ***Fig. 3***, which will demonstrate most of the capabilities of the device. The inputs should be TTL level, and should not exceed the supply by more than 0V3.

When in 'frequency ratio' mode, Fa (pin 40) should be greater than Fb (pin 2).

For single or 'one-shot' time interval measurements, input A, then input B, must have a high to low transition to 'prime' the counter, prior to any measurements being taken using external circuitry. For repetitive signals this occurs automatically.

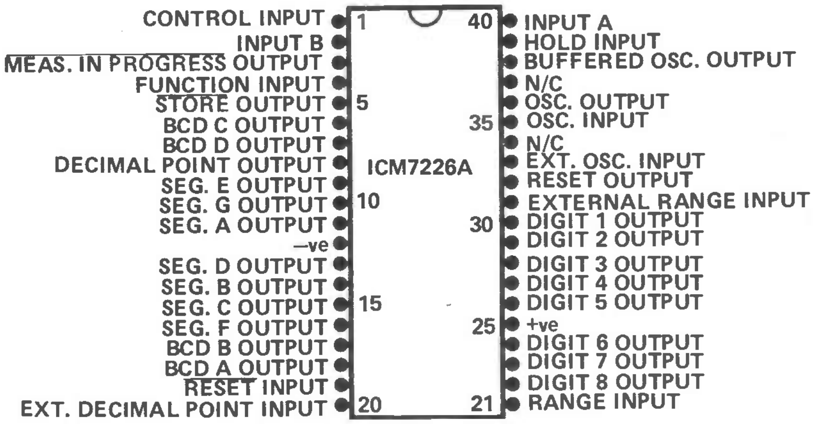
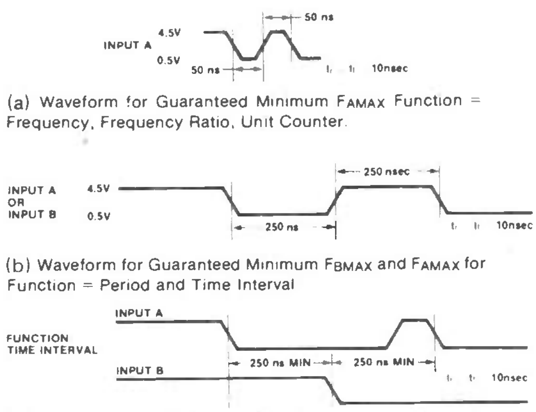


Figure 1. Pin designations for the 7226A.



(a) Waveform for Guaranteed Minimum F_{AMAX} Function = Frequency, Frequency Ratio, Unit Counter.

(b) Waveform for Guaranteed Minimum F_{BMAX} and F_{AMAX} for Function = Period and Time Interval

(c) Waveform for Minimum Time Between Transitions of Input A and Input B.

Figure 2. Waveforms for guaranteed minimum frequencies when used as a counter (a), tuner (b) and during AB transitions (c).

	FUNCTION	DIGIT
FUNCTION INPUT PIN 4	Frequency	D1
	Period	D8
	Frequency Ratio	D2
	Time Interval	D5
	Unit Counter	D4
	Oscillator Frequency	D3
RANGE INPUT PIN 21	.01 Sec/1 Cycle	D1
	.1 Sec/10 Cycles	D2
	1 Sec/100 Cycles	D3
	10 Sec/1k Cycles	D4
External Range Input PIN 31	Enabled	D5
CONTROL INPUT PIN 1	Blank Display	D4&Hold
	Display Test	D8
	1MHz Select	D2
	External Oscillator Enable	D1
	External Decimal Point Enable	D3
	Test	D5
EXTERNAL DECIMAL POINT INPUT, PIN 20	Decimal Point is Output for Same Digit That is Connected to This Input	

Table 1. Control functions for selected digit lines.

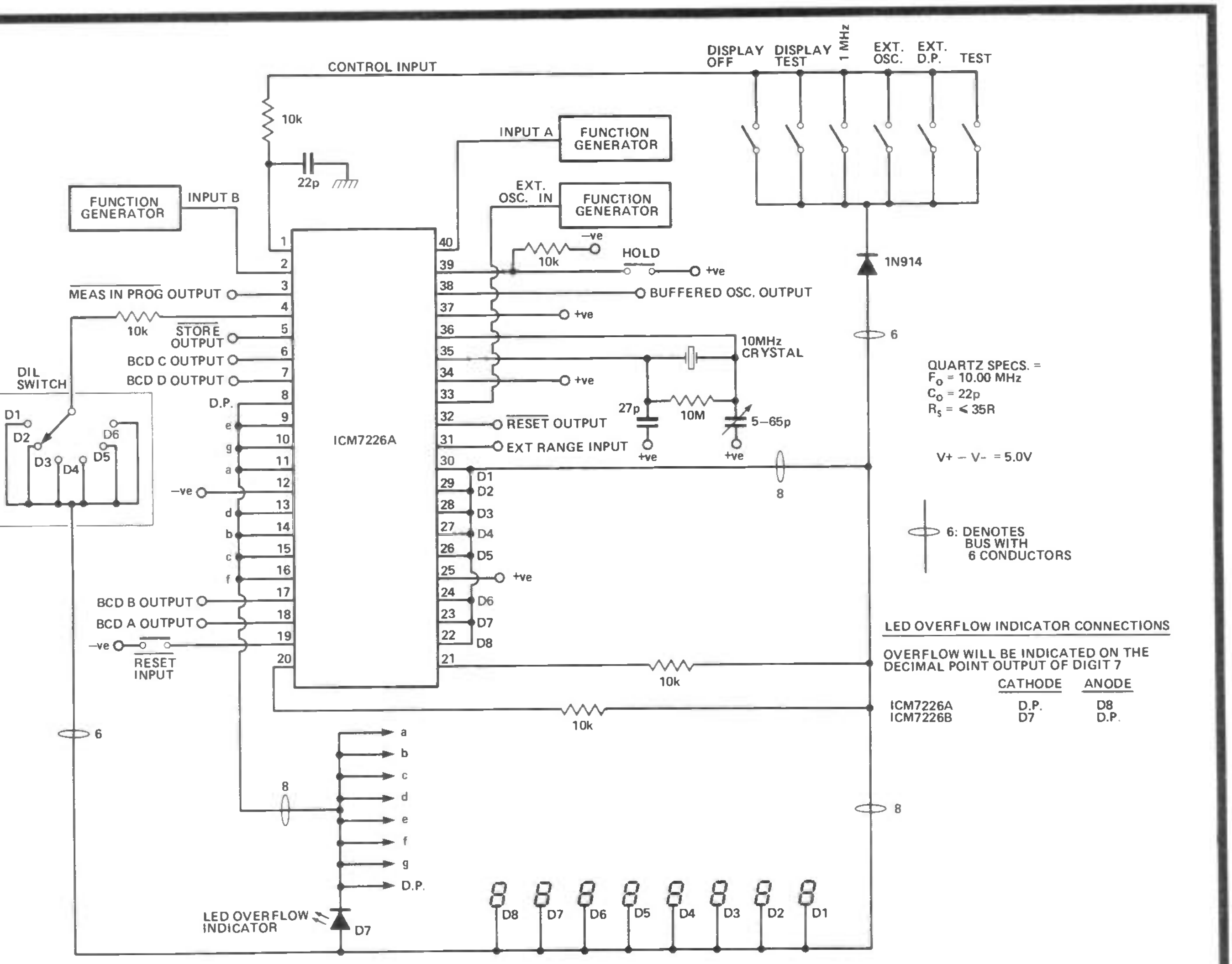


Figure 3. Circuit to demonstrate typical applications for the 7226A.

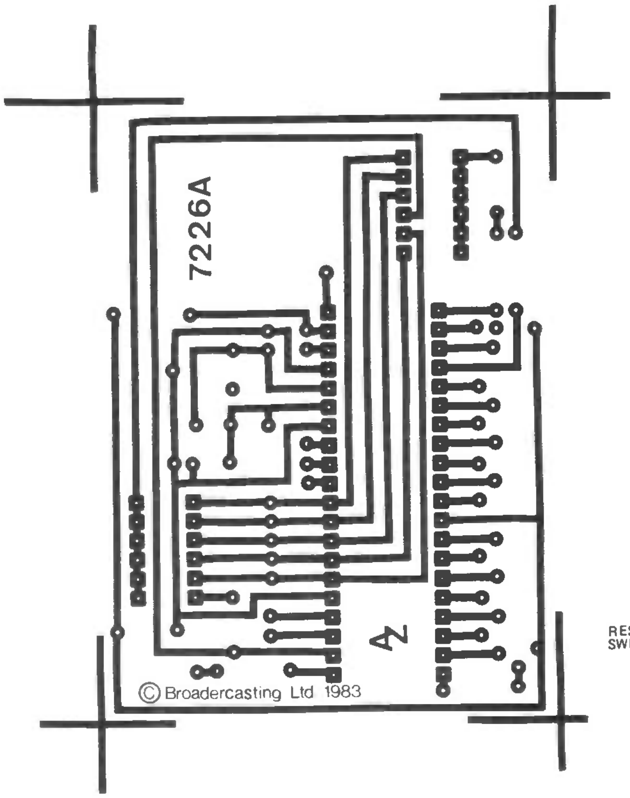


Figure 4. Foil pattern for the test circuit.

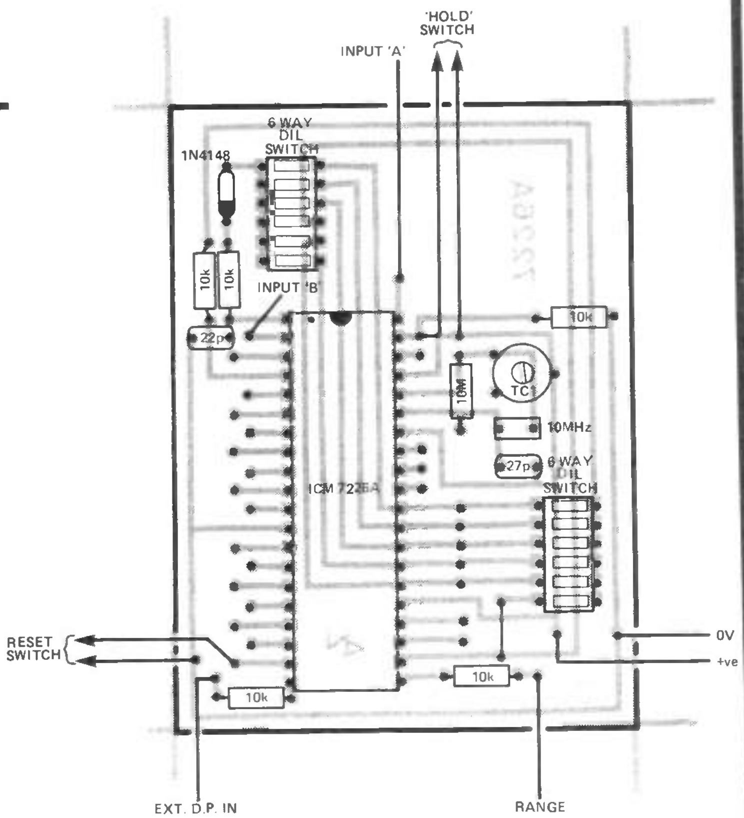


Figure 5. Component placing on the PCB.

THE NEC RALLY

A personal view, by Stephen Ibbs.

It is refreshing to see the RSGB moving to the NEC for their rally. The well-known problems of space, access, and parking, associated with 'Ally Pally' were immediately resolved, but at what cost? Listening to the locals travelling back from the show revealed some interesting thoughts....

Clearly many people appreciated the move to the new venue as a breaking away from the old London Wireless Club image that still lingers rightly or wrongly. Two London amateurs told me they preferred it at 'Ally Pally', because it *was* the local London rally for them, and blow the rest of the country — friendly bunch, Radio Hams!

The entrance fee of £2, admittedly including parking, seemed somewhat high, but this did at least enable a feeling of more room, and the space to breathe. When will exhibition organisers place just a few seats around the place so that weary travellers can rest without having to buy food first. The catering was, I thought, awful. Catering firms presumably have to pay a large fee to get the NEC franchise and I felt they were taking their revenge out on us with the now traditional soggy roll and thimble of coffee. Some exhibitors were determined to recoup their stall fee in their sales and items of second-hand equipment were being offered at absurd prices. However, other stalls were also offering some excellent bargains, and I was able to stock up on ceramic capacitors and get 2 dynamic microphones at excellent prices. The Wood and Douglas stand was doing a brisk trade in their new amplifier kit, and it was nice to put a face to June, their superb telephone receptionist. Anybody who has phoned W & D will know what I mean.

One section of the hall had been given over to various societies — RAIBC, RAYNET, RN, RAF etc, and I spent an enjoyable time learning about their various interests. The RAIBC stand had a talking frequency meter that must be a real boon to white-stick operators, and it is refreshing to see how amateurs *do* help each other get over disabilities.

The prize for the best exhibit must surely go to the brilliant 10GHz transceiver display by the Midland Microwave Society. This contraption, which was mounted on 'chip' board, (pun intended by them), had a brass cold water tap attached, what looked like a watering can funnel, and various bits of plumbing — useless but eye-catching, a comment suitable for many 'essential' bits of paraphernalia I suspect.

Conclusion

For certain sections of the amateur fraternity this must have been a good rally. Signposting for the various lectures should have been better, and I would have preferred more second-hand stalls, a 'flea market' and a 'bring and buy'. I hope it stops in the Midlands to bring the RSGB to the country as a whole, and if the catering can be improved, it will be entered in next year's diary for me at least.

■ R&EW

EVENTS: MOBILE RALLIES

June 1983

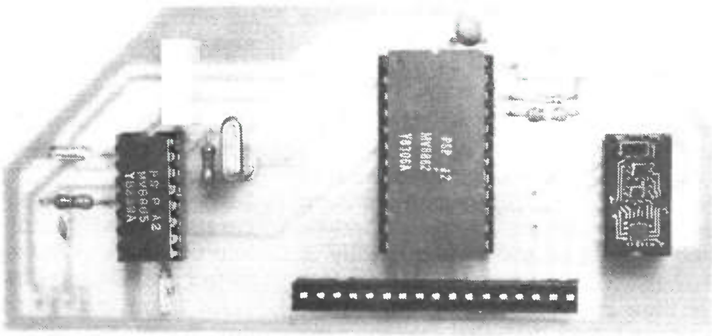
May 10-12th	Cable '83 Online Conference	Wembley Conference Centre	Northwood (09274) 28211
May 10-12th	Tomorrow's World Micro City 1983	Bristol Exhibition Complex	Bristol (0272) 292156
May 22nd	B.A.T.C. Amateur TV	Posthouse, Leicester	G8CJS (0532) 670115
May 22nd	RS Welsh Amateur Mobile Rally	Barry College of Further Eduction	GW4FOM R. Rowles Cardiff 565656
May 25th	Lincoln Short Wave Club Annual General Meeting	City Engineers Club	G5FZ,G6C01
May 29th	East Sussex Wireless Revival	Civil Service Sports Ground Ipswich	J. Tootill GLIFF (0473) 44047
June 5th	Spalding & DARS Mobile Rally	Springfields, Spalding	I. Buffham G3TMA

In the Next Issue of R&EW

The Complete Communications Magazine

DTMF Decoder

A Dual Tone Multi-Frequency signalling system, which acts as an excellent receiver for control/ data transfer via the telephone lines.



Digital Capacitance Meter

To complement this month's high quality LCD frequency meter, we asked the designer to come up with a unit of the same standard for measuring capacitance. The project he produced exceeded all expectations, and we present it next month.

HF RECEIVER DESIGN II

The second part of this informative series analyses the complexities of receiver performance, with an in-depth explanation of the many confusing parameters encountered.

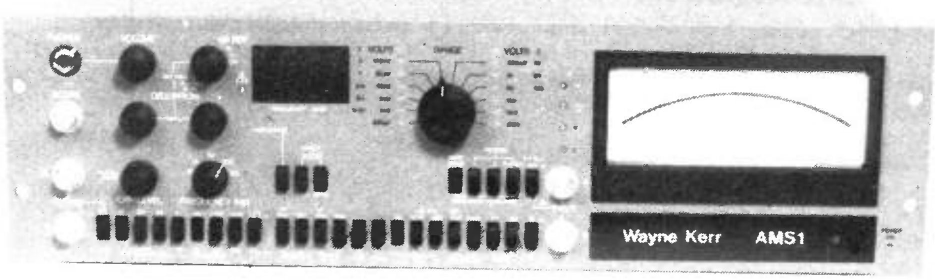
RADIO AMATEUR'S TEST CARD

An extremely interesting and useful project for DXers everywhere (. . . but the exact details we're keeping secret until next month).

July edition
On Sale 2nd June

Plus:
SSB for the SX200N – a neat add-on.
Z8 Backplane – an essential interface.
Datong Automatic Notch Filter – reviewed and explained.

AUDIO BRIEF



AMS 1

AUDIO MEASURING SYSTEM

A comprehensive piece of test equipment from Wayne Kerr, reviewed by our Audio Engineer, David Strange.

Basically, the AMS1 consists of an oscillator and a meter, with a large amount of sophisticated electronics in between, which may be selected to carry out the wide range of measurements required by the audio engineer.

The tests accommodated by the AMS1 are: Frequency Response, Level (including programme and noise), Wow and Flutter, Rumble, Distortion and Phase. The measurements may be monitored by oscilloscope and headphones from sockets arranged on the front panel.

Quad Stab Osc

The oscillator is a quadrature type, stabilised by a thermistor. This, unfortunately affords no long term amplitude stability, but was probably not deemed a problem because there is no absolute calibration of output level. Instead, the output may be continuously varied by a potentiometer, with three push buttons to enable attenuation in two 30dB steps and a switch at the back of the potentiometer giving an additional 20dB step. Overall the level may be varied across the range -90dB to +20dB, ref to 0dB (0.775). When checked against the meter section of the test set, the oscillator steps were in disagreement by about 0.2dB.

As well as the normal sinewave output from the oscillator, a clipped square-wave version is also selectable. The frequency range of the oscillator is 15Hz to 150kHz selected in 4 decade steps by pushbuttons and continuously varied within each step by a more or less uncalibrated potentiometer. The frequency is read from a 4 digit 7 segment display with a rather slow rate of sampling. Setting a specific frequency, for say distortion measurements, proved to be very difficult because of the second or two inertia in the system.

On the subject of the frequency counter, it may also be used to measure the frequency of an incoming signal — useful when checking the long term drift or speed variation of a tape recorder. Here the frequency variation would be noted and the percentage drift calculated accordingly.

Metering The Functions

The meter is, of course, used as an indicator for a number of instrument functions besides level. Dealing with level first, we find five different measuring methods at our disposal:

1. Volts true RMS
2. Volts RMS
3. DIN 45405 (for CCIR noise measurement)
4. BS 4297 (for programme measurement)
5. ANSI C16.5VU (for programme and noise)

To perform the measurements to these characteristics, not only are different time constants required, but also different arithmetic functions. Before the signal gets processed this far, it is first amplified. Despite having the appearance of possessing two inputs the amplifier is unbalanced and the inputs commoned for all functions of

OSCILLATOR (Parallel A and B outputs with ON/OFF switch)	
Frequency Range:	15Hz to 150kHz in 4 decade ranges
Output level:	25µV to 7.75V (- 90dB to + 20dB ref 775mV) Frequency and Output Level may be monitored using Check Freq and Check Level functions
Output flatness:	Normal range (- 70dB to + 20dB) 15Hz to 30kHz ± 0.2dB 15Hz to 150kHz ± 0.5dB - 20dB position (- 90dB to 0dB) 15Hz to 30kHz ± 0.5db 15Hz to 150kHz ± 1.5dB (- 80dB to 0dB)
Output impedance:	50 ohm nominal
Sine wave distortion:	15Hz to 20kHz less than 0.01% (typically 0.005%)
Square wave output:	Normal range (1mV to 5Vpk-pk) Rise time to 90% < (1% of period + 1.5µs)
Wow and flutter carrier oscillator:	3150Hz (3000Hz optional) ± 3Hz
LEVEL MEASUREMENT (From selected A or B input or Oscillator output)	
Range:	300µV to 100V FSD on Vrms range - 92dB to + 42dB on dB range (ref 775mV)
Measurement:	Switchable between true rms Volts or dB, on a linear centre zero dB scale
Frequency response:	15Hz to 30kHz ± 0.2dB 10Hz to 150kHz ± 0.5dB (300µV range ± 1dB)
Input impedance:	1M ohm or 600 ohm (switchable)
Frequency counter:	4 digits - may be used to measure incoming frequency or oscillator frequency
Programme Measurement	
Ballistics switchable between PPM characteristics (BS4297) and VU characteristics (ANSI C16.5 1954). (Other parameters as per Level Measurement Section above for frequencies in the range 20Hz to 20kHz).	
NOISE MEASUREMENT (A or B input)	
Indication:	True rms Volts, Quasi-peak dB (CCIR Rec 468-2) or VU characteristic (ANSI C16.5 1954)
Frequency response	Wideband (10Hz to 150kHz ± 0.5dB). Two further positions, to accommodate plug in option filters to CCIR, DIN, IEC, and NAB standards (other parameters as per Level and Programme measurement sections above)
WOW AND FLUTTER MEASUREMENT (A or B input)	
Range:	0.03% to 10% FSD with 3150Hz or 3000Hz carrier
Residual reading:	< 0.003%
Input level range:	50mV to 100Vrms. (Warning light indicates if signal too small)
Standard:	To CCIR Rec 409-2 (Weighted and Unweighted)
RUMBLE MEASUREMENT	
Range:	- 92dB to + 42dB (ref 775mV)
Indication:	dB to DIN 45549 (Weighted and Unweighted)
DISTORTION MEASUREMENT (A or B input)	
Range:	0.03% to 100% FSD (0.1% min at 16kHz)
Frequencies:	80Hz, 1kHz, 5.6kHz, 16kHz (switchable)
Input level range:	100mV to 4.5Vrms (100K ohm input impedance) 3.5V to 100Vrms (12K ohm input impedance)
Inherent distortion:	Less than 0.005%
Residual noise:	Less than 0.007% relative to 100mV (Less than 0.015% at 16kHz)
NARROW BAND FILTERS	
For measurement of signals masked by noise (eg, Crosstalk)	
Frequencies:	80Hz, 1kHz, 5.6kHz, 16kHz switchable (other parameters as per Level Measurement section above)
PHASE MEASUREMENT (A input relative to B input)	
Range:	± 120° (on centre zero meter scale) with phase invert
Input Level Range:	50mV to 5Vrms. (Warning Light indicates if signal is outside this range)
Resolution:	2°
POWER MEASUREMENT	
Range:	1mW to 1kW into external 8 ohm load on linear scale
MONITOR FACILITIES	
dc output	1V at FSD
Scope output	1Vrms at FSD
Phones output	Adjustable, for high or low impedance headphones
SUPPLY VOLTAGE	115 or 230V ± 10% ac 50-60Hz
TEMPERATURE RANGE	Operating 0 to 40°C Full specification 10 to 30°C
WEIGHT	4.9Kg.
DIMENSIONS	(Overall inc knobs) 483mm x 134mm x 250mm

Table 1: Technial specifications.

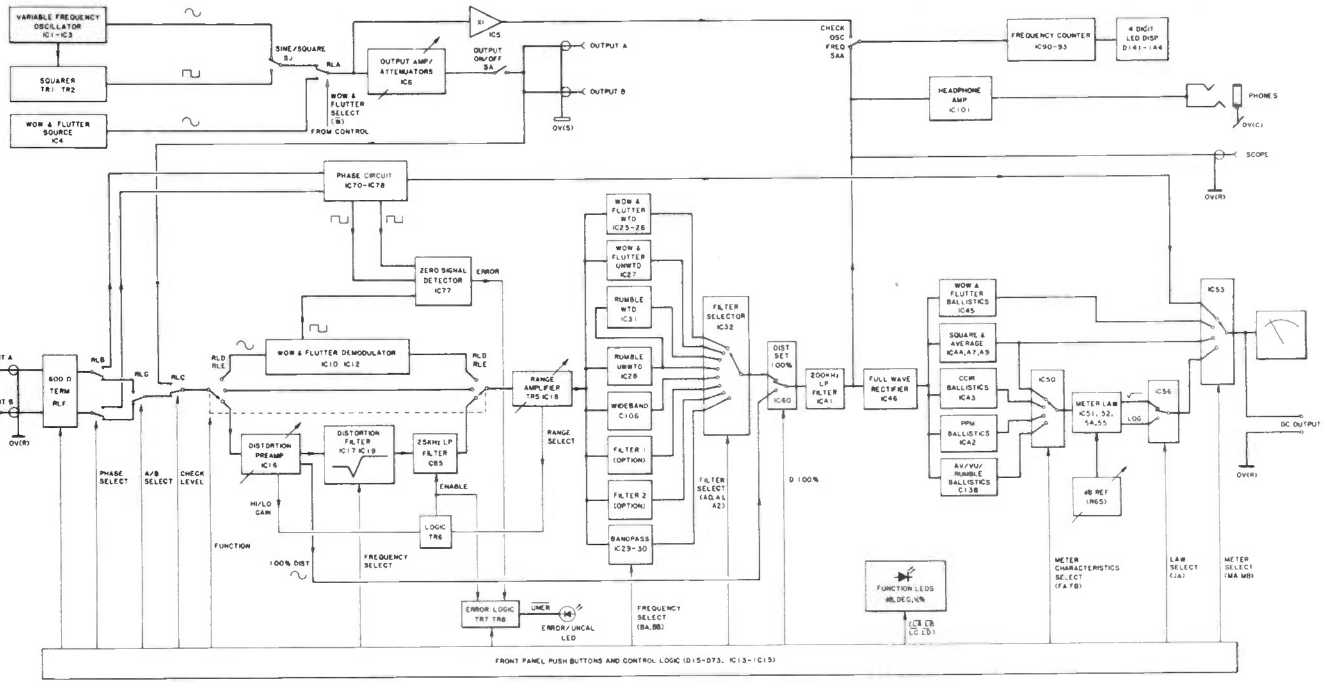


Figure 1: Block diagram of the AMS1.

the instrument apart from when phase determination is required. The input impedance may be a high (1M ohm) or low (600 ohm) as selected by a pushbutton, and the gain of the input amplifier is changed by an input attenuator and recycling amplifier feedback resistor network. When monitoring with an oscilloscope and headphones, it was easy to find the point where the feedback network started its next recycle because it was accompanied by increased amplifier noise. However, after the range amplifier there follows various filters, some of which are customer options concerned with noise measurement. The options are necessary, because at the moment there are so many ways of measuring and reporting signal-to-noise figures (interestingly enough, all the filters are active). After filtering, the signal is then full-wave rectified and a choice of meter characteristics may be selected. First of all the time constants get selected to set meter ballistics, the VU meter has equal attack and delay times, the PPM fast attack and slow decay, CCIR 468-2 slow attack and fast decay, and so on. The rectified DC signal, with its appropriate time constant, is then subjected to one or two mathematical transformations before being applied to the meter. The meter, for instance, is calibrated in linear dB's and in order to fit the scale the signal passes through a logarithmic function generator. Squaring for the true RMS conversion is also produced from log and anti-log function generators — the DC is transformed into log doubled and anti-logged to obtain V^2 from V^2 = anti-log (2 x log V).

The Classics

Distortion is determined in the instrument by quite a classical method and can be measured at four discrete frequencies, 80Hz, 1kHz, 5.6kHz and 16kHz. The main problem occurs when setting the measuring frequency, which is not automatically selected and required manual adjustment of the oscillator against the frequency counter. As this has to be performed to some degree of precision, since a high pass filter is selected for the particular frequency when the distortion function is required, the inertia of the counter mentioned earlier is a problem. The filter is arranged to have 180° phase shift at the particular frequency and by a combination of mixing the output with the direct signal and fine tuning, the fundamental is removed leaving only harmonics which are the results of distortion.

Initially the unfiltered signal is used to set 100% distortion on the meter and once this is done the read button is pressed. The sensitivity of the meter is then step-by-step increased whilst at the same time an attempt is made to improve the reading (make it as small as possible) with the nulling controls. When eventually the reading can be reduced no further, the meter scale and range selector are read and distortion determined.

Phase Determination

Here is where the two inputs are electrically split away from one another and separately filtered and passed through schmitt triggers. One channel has the option of being inverted in order to provide a 0° or 180° reference. The actual phase detection is carried out by cross-coupled NAND gates in a bistable configuration. When both signals are 'in phase', the bistable output is a symmetrical square wave. However, when a phase difference occurs, the output has a mark-to-space ratio proportional to the angle of lead or lag. This output is then integrated so that a DC output, suitable for applying to the meter, is produced, proportional to the phase difference between the two outputs.

Wow And Flutter

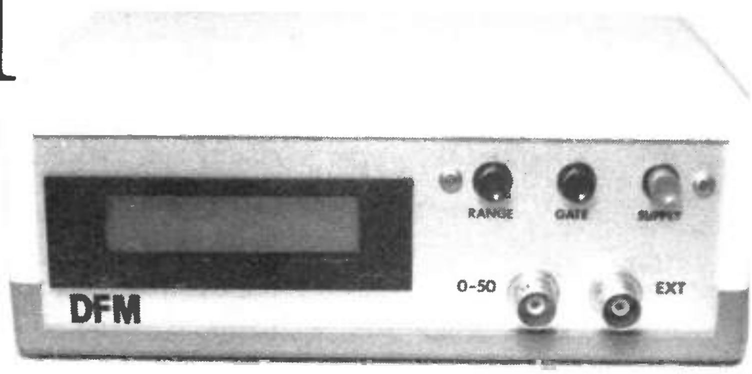
To determine wow and flutter a standard tape or disc may be used or alternatively the special internal oscillator output may be recorded. Wow and flutter measurement is normally made using a 3150Hz or 3000Hz signal and the customer's choice in the matter needs to be specified at the time of purchase. Once recorded, assuming a tape recorder is under test, the signal is than played off tape into the test set. Inside the set, the signal is clipped and fed to a phase-locked loop. Input frequency variations produce corresponding changes in the VCO control voltage which is used as a wow and flutter output. The wow and flutter signal is then passed to the range amplifier and then via the weighting filters to the meter circuit.

In Conclusion

After that brief look around the AMS 1's more interesting internal functional blocks, it can be seen that there are many instruments inside this one package. Care is therefore needed to see that the right button selections are made for the various measurements required — it can be confusing. To this end Wayne Kerr have installed lots of warning lights to try to give an indication that something may be amiss. However, when using the instrument for the first time much reference to the manual is required and in any case headphones and an oscilloscope help to see what is happening.

■ **R&EW**

WIDEBAND LCD-DFM



An 8-digit portable frequency meter, designed by Stephen Ibbs G4LBW, to cover the range DC-600MHz.

The frequency meter featured in the November '81 issue of **R&EW** used the Intersil 7216, which directly drives an 8-digit LED display, and whilst a battery pack was incorporated, its size made it primarily a piece of bench equipment. However, it had the advantage of three switchable ranges and a means of measuring capacitance. There *are* occasions, when a smaller portable unit is desirable and problems are encountered with LED displays, because even if multiplexed, they draw quite a lot of current. The answer lies in using LCD displays, and recent developments have made the design of a small frequency meter possible.

A new technique of triplexing liquid crystal displays was tested utilising the ICM 7231A. Previously each segment had to be connected separately — an 8 digit display with decimal points required 65 connections (including the backplane). By triplexing, each digit only requires 3 segments lines, the whole display controlled by three control lines, making a total of 27 connections, and this includes one annunciator (a chevron with the display specified) and one decimal point, per digit. This in turn means that one 40 pin IC can drive a display and still have other pins available for inputting and controlling data.

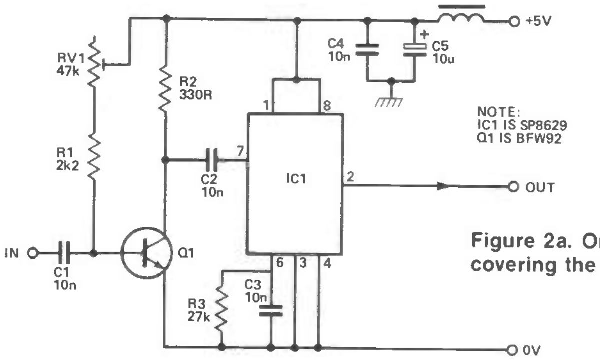


Figure 2a. One of the preamp/prescalers covering the 200MHz range.

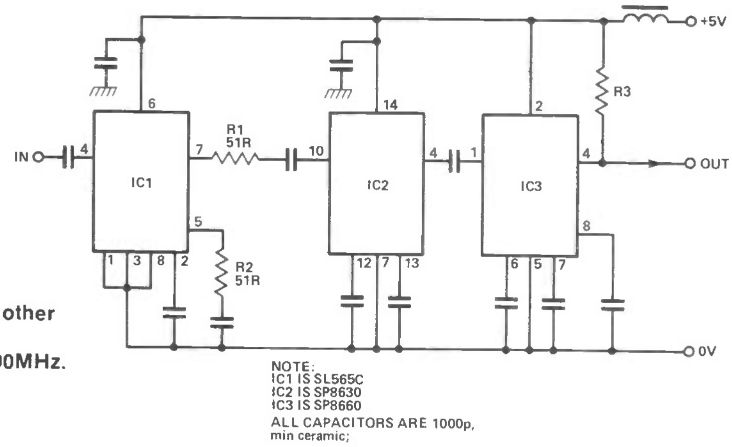


Figure 2b. The other prescaler, which operates up to 600MHz.

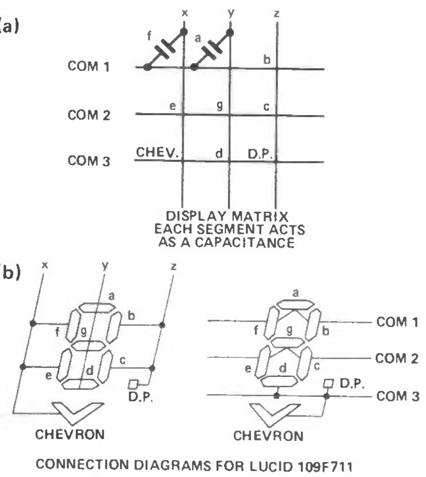


Figure 1. Display wiring as represented by a cross-matrix (a) and the actual segments (b).

A New Approach

The best way to understand the triplexing technique is to consider the display as a matrix(*Fig. 1a*). As the common line and the x segment line intersect, the 'f' segment lights. The voltages on the lines decide which segment lights. ***Fig. 1b*** shows the connections for the specified LUCID display to help faultfinding (eg if the 'b', 'c', and the 'dp' segments fail to work it is the z segment line of the digit which is suspect).

The LCD driver IC decodes the 4 bit BCD data arriving at pins 32-35, which is presented in multiplex form by the ICM7226A, a frequency meter IC that performs all the 7216 functions, but also provides BCD output. The IC has 4 gate times, but only two are used, as the 10ms gate (pin 30) was not felt to be very useful in frequency meter applications, and the 10s gate (pin 27) is normally too long to wait for portable applications.

The BCD output data is multiplexing through all the digits, each digit's data coinciding with a 'high' on the appropriate line D1 to D8. This control information needs to be encoded into a 3 bit binary code to be fed into the A0, A1, A2 pins of the 7231, which is accomplished by the 4532. One other piece of information will enable the 7231 to perform properly, a low-going pulse to the CS pin to latch the data, decode it, and then send it to the digit being addressed by the 'A' lines (37-39). This proved to be a problem in the design stage because, at first, the GS

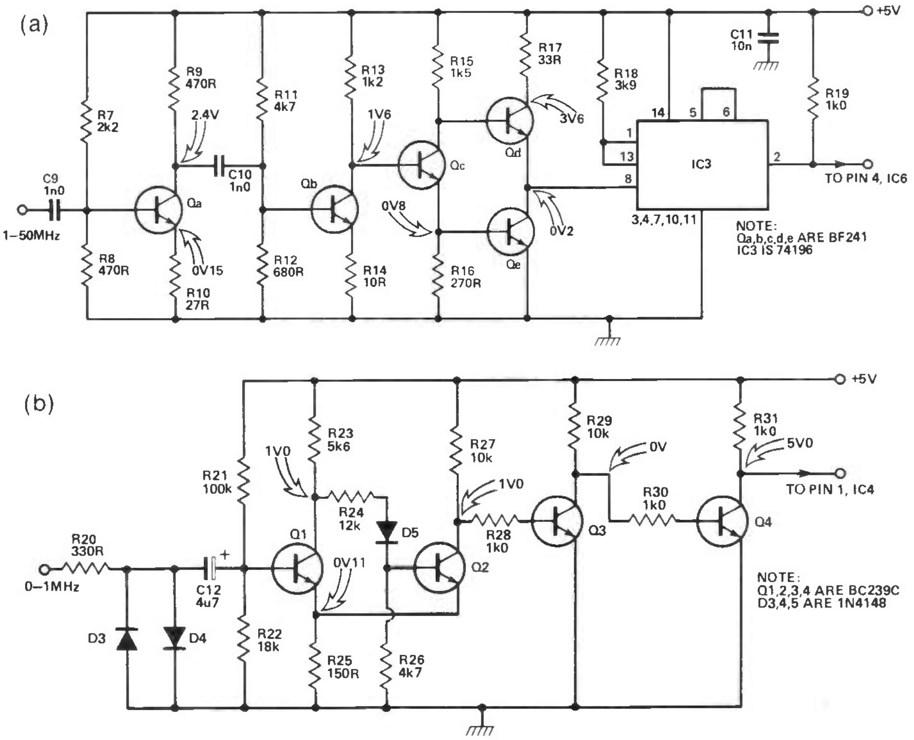


Figure 3. The HF prescaler (a) and LF amplifier (b) which appeared in the November '81 issue of R&EW.

output of the 4532 was used. Eventually, however, the Eo output was tried. This pin goes high when all the inputs are low and the E1 (pin 5) is high. Fortunately this occurs after each digit has been addressed (a delay actually incorporated into the IC's design to prevent inter-digit ghosting when driving an LED display direct). When inverted, this works a lot better than pin 14. The inclusion of C3 (22-1000pF) is to stabilise the display.

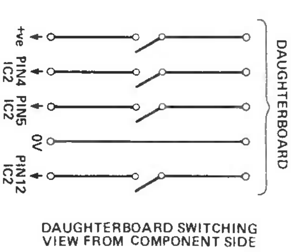
Pin 2 of the 7231 is labelled Vdisp, and this allows control of the display peak voltage, most easily accomplished by incorporating a preset, RV1, to vary the voltage on the pin. This will cause the display either to blank (+ve), or become so strong that it will ghost (0v). However, such an arrangement is fine *if* the display and IC do not fluctuate by more than ± 5°C. The circuit shown in ***Fig. 7d*** can be used to provide temperature compensation. The extra resistor and transistor are easily incorporated on the PCB.

Figure 4. bypassing the 74LS196 using a DPDT switch (top right).

NAND

A	B	OUT
0	0	1
0	1	1
1	0	1
1	1	0

TRUTH TABLE



DAUGHTERBOARD SWITCHING
VIEW FROM COMPONENT SIDE

Circuit Description

The 1-50MHz preamp/prescaler was taken from the **R&EW** meter already mentioned, with the exception that the BF241 was used instead of the BF274. A wire link connects the preamp to the prescaler IC, because if signals below 10MHz are being measured, the 74LS196 can be bypassed via a switch (***Fig. 4***) to avoid the signal being divided by ten, thereby giving better resolution.

The signal goes via a logic swiching network. The truth table of the NAND gate is given in ***Fig. 5***. If one of the inputs is high, signals (inverted) will pass through the gate. Thus R7 holds IC5d open, allowing signals to pass through. R8 holds IC5b closed, its output remaining high. This in turn opens IC5a, allowing the signal to pass through to the 7226. A 5-pin plug has been incorporated on the PCB, because it will be seen that if pin 12 was made to go low, and pin 5 high, signals from an external source can be fed to pin 4 and on to the counter. A small series of boards have been designed to fit onto the PCB plug (in position x), and when plugged in, they automatically switch the levels, and disable the output of the 50MHz preamp. It only takes a few seconds to open the case and plug on a new board, soldering the coax, but the author recognised that many would want a daughter board permanently plugged in, but switchable, so if the PCB plug is placed in position 'y', a multipole switch can be added to connect the board and achieve the necessary signal and supply connections. The 0V being common to all, only a 4 pole switch is needed, wired as shown in ***Fig. 6***. The use of a switch is particularly recommended for the 600MHz prescaler board because this draws a lot of current and it is good to be able to disconnect the +ve supply line when not in use. (The prescaled buffered output of the 50MHz preamp is also available at IC5 pin 8).

The 10MHz frequency reference is provided by X1 with trimming by TC1. A regulated +5V is needed by all the ICs, most easily achieved using a 3-terminal regulator with C4 and C5 included to aid stability.

The 300kHz-50MHz preamp was fully described in the Nov. 81 issue so will only be summarised here. Qa and Qb provide the amplification and Qc,d,e the level shifting to TTL. The IC acts as the divide-by-10, and if the S version of the 74196 is selected frequencies up to 100MHz can be processed. The LS version in the prototype worked up to about 45MHz.

The low frequency amp (1 — 500kHz) was also described in the same issue with Q1 being the amplifier, Q2 acting as a switch, and Q3 and Q4 shifting the output to TTL level square waves.

The 200MHz pre-amp has a choke and two capacitors for decoupling. The BFW92 is used in common emitter mode, and the preset should be adjusted to give half-supply voltage at the collector. The signal is then capacitively coupled to the input of the divide-by-10 SP8629, the output emerging at pin 2. The unit will randomly count, and this can be stopped by inserting a resistor between pin 7 and earth; though this will reduce the sensitivity. The IC is actually guaranteed to 150MHz but the prototype measured accurately up to 240MHz.

The 600MHz preamp needs no adjustment and uses the recently introduced Plessey IC, the SL565C wide gain amplifier (guaranteed to 1GHz). The output feeds the input of the two divide-by-ten ICs, the first being the SP8630 (up to 600MHz), the second being the 8660, which, whilst only guaranteed to 200MHz, does provide TTL output. This module will also randomly count, and resistors to the IC inputs will stop this, but reduce the sensitivity.

Both the 200MHz and the 600MHz boards measured the 12MHz oscillator stage of a 2M transceiver with ease, but the lower limit is somewhat dependent on the wave shape.

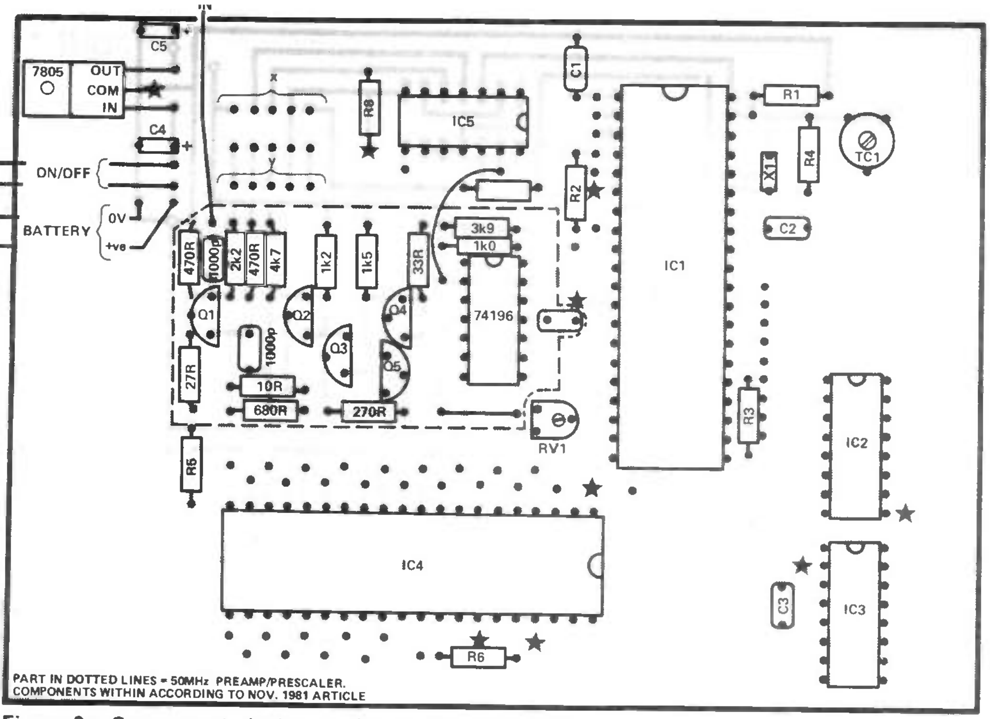
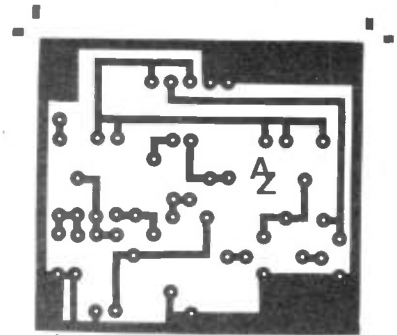
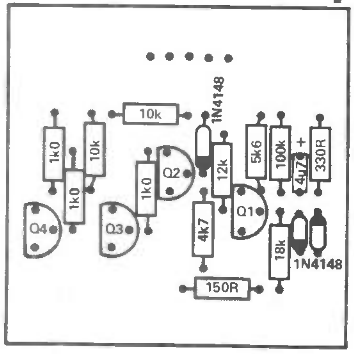


Figure 8a. Component placing on the double sided PCB.

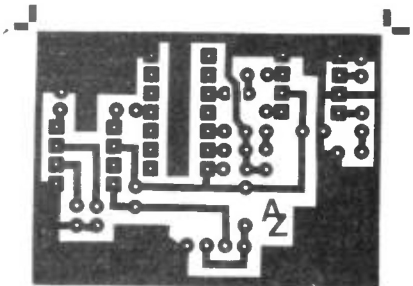
★ = SOLDER LINK BOTH SIDES



500kHz Pre-amp.



Foil pattern and component overlay for 500kHz pre-amplifier



600MHz Prescaler

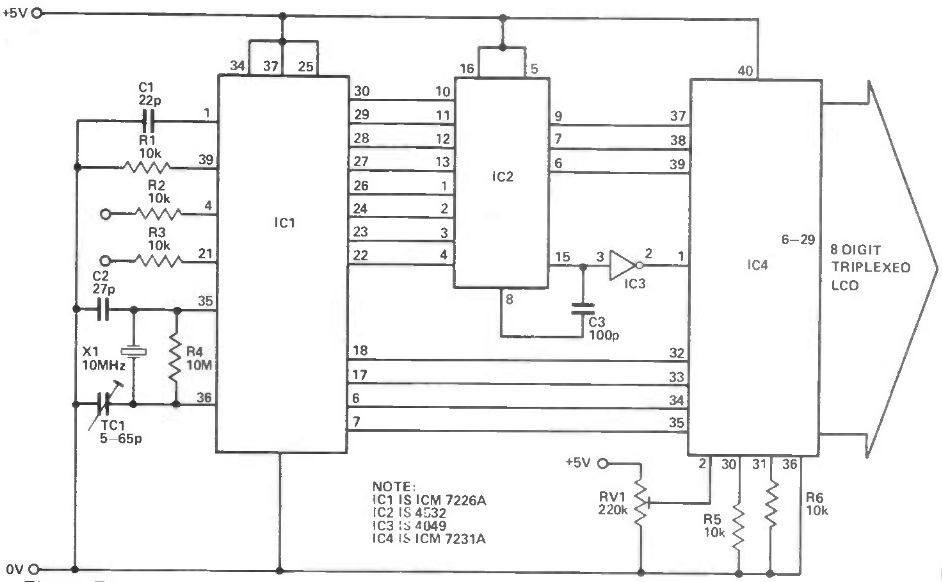
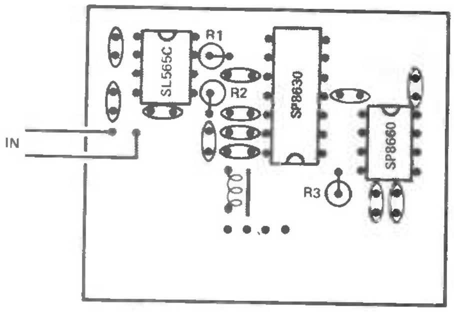


Figure 7a.
Main circuit of the LCD-DFM.



Foil pattern and component overlay for 600MHz prescaler.

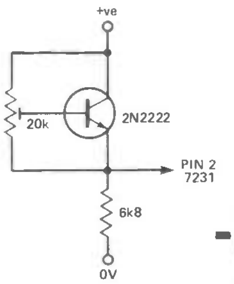


Figure 7d. Temperature compensation circuit (optional).

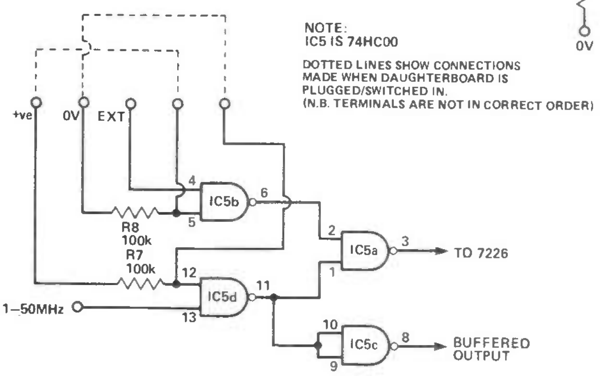
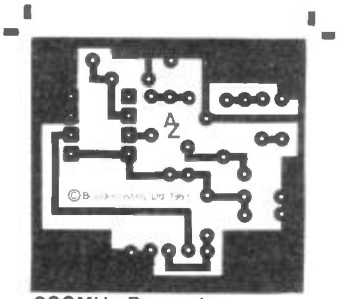
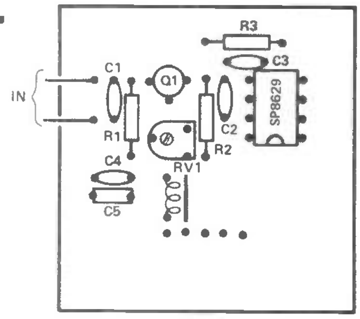


Figure 7c. Logic switching for additional boards using the 74HC00.



200MHz Prescaler



Foil pattern and overlay for 200MHz prescaler

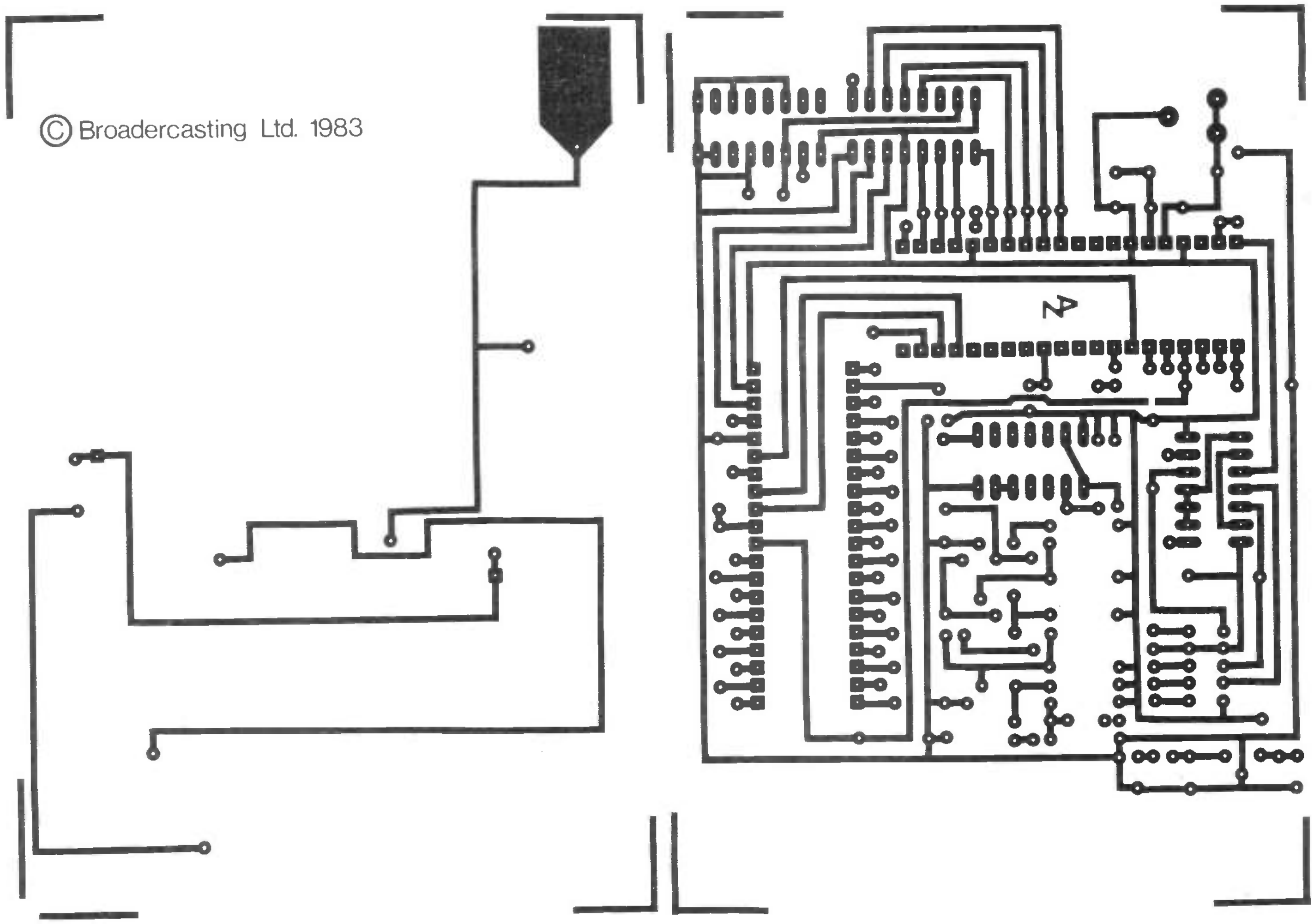


Figure 8b. The two sides of LCD-DFM board (includes pads for 50MHz prescaler).

PARTS LIST (Main Board)

Resistors

R1,2,3,5,6	10k
R4	10M
R7,8	100k

Potentiometers

RV1	min cermet 220k

Capacitors

C1	22p
C2	27p
C3	100p
C4	15V tant 200n
C5	10V tant 10u

Semiconductors

IC1	ICM7226A
IC2	4532
IC3	4049
IC4	ICM7231A
IC5	74HC00
IC6	7805

Construction

A double-sided PCB was designed, shown in *Fig. 8b*. Through-board solder-links need to be made at the points marked on the overlay, and the 0v side of R8 should be soldered on both sides as should the common line of the regulator. Please note that the track from IC1 pin 4 to IC4 pin 30 should have a small break in it (this will be explained later). The wire link from the supply has been deliberately included, rather than using a PCB track, to enable the regulator section to be tested before connecting it to the expensive circuitry.

Veropins were used for all lead connections except the display, and if the daughter board is to be left mounted, insert 8 pins for the switch leads. Sockets were used for the large ICs, and the regulator was mounted with the metal tab in contact with the small PCB heatsink. This is then bolted down before soldering the pins to avoid strain on the legs. Pin 4 of the 7226 has been left uncommitted for readers who wish to use the other facilities as indicated in the data file. In the prototype this is wire linked to D1 (30) to provide the frequency meter function. This wire link can, instead, be replaced by a PCB track on the component side if desired. If the other facilities *are* to be used, constructors may like to join the track break mentioned earlier. The effect of this will be to illuminate one of the annunciator chevrons below the display — the particular chevron changing as the function changes, to show which has been selected.

An SUE switch bank was installed to control the gate times, prescaler switching, (if included) and supply, and a 20mm spaced, three-way bracket was selected because in the future it is possible to change it to a 10mm, five-way bracket, and insert two other switches (for reset, pin 19 to earth, and the enabling of an external oscillator reference for greater accuracy, pin 30 to pin 1 via a diode and 10k resistor). Two BNC sockets were mounted, one for the 1-50MHz preamp, the other connected to the daughter board.

Testing

Test the regulator section, and if +5V appears at the output, switch off, and insert the wire link. Set the trimmer and preset to mid-travel, and switch on again, whereupon the display should light up. Adjust RV1 to get a good contrasting display with no ghosting. The unit may be reading randomly, but by applying a signal to the preamp, input, a stable reading should be obtained. The trimmer is then adjusted to display the correct frequency. Otherwise the 10MHz reference oscillator can be set up by placing the meter next to a receiver tuned to WWV (10MHz), and zero-beating.

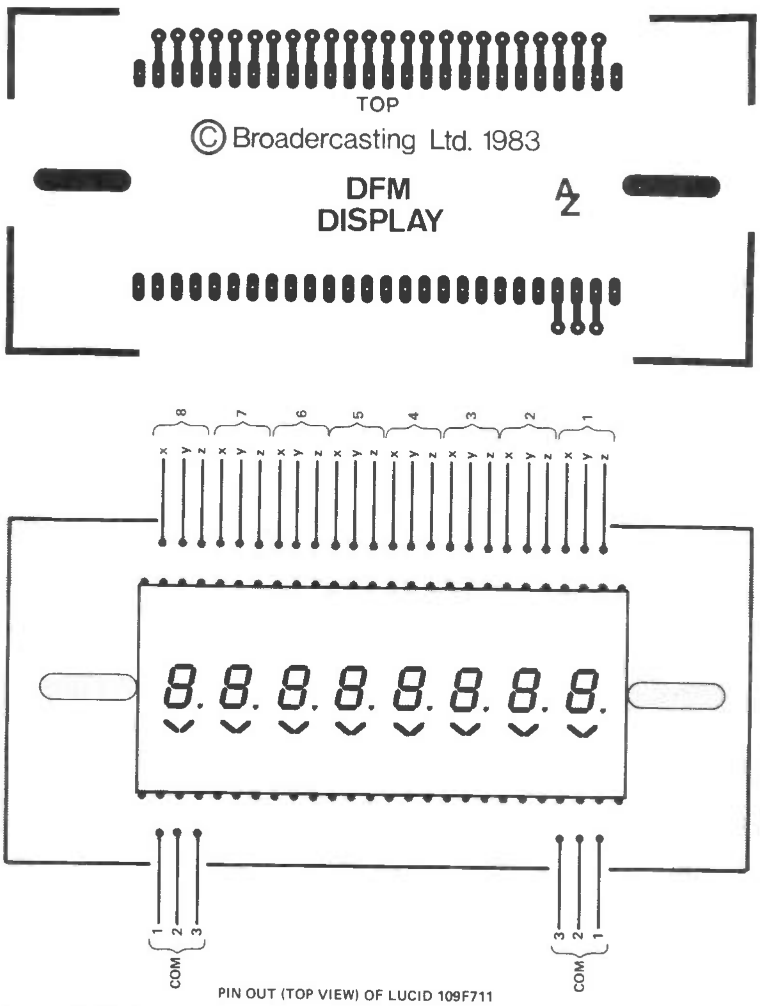


Figure 9. PCB foil pattern (above) and overlay (below) for the 8- digit display.

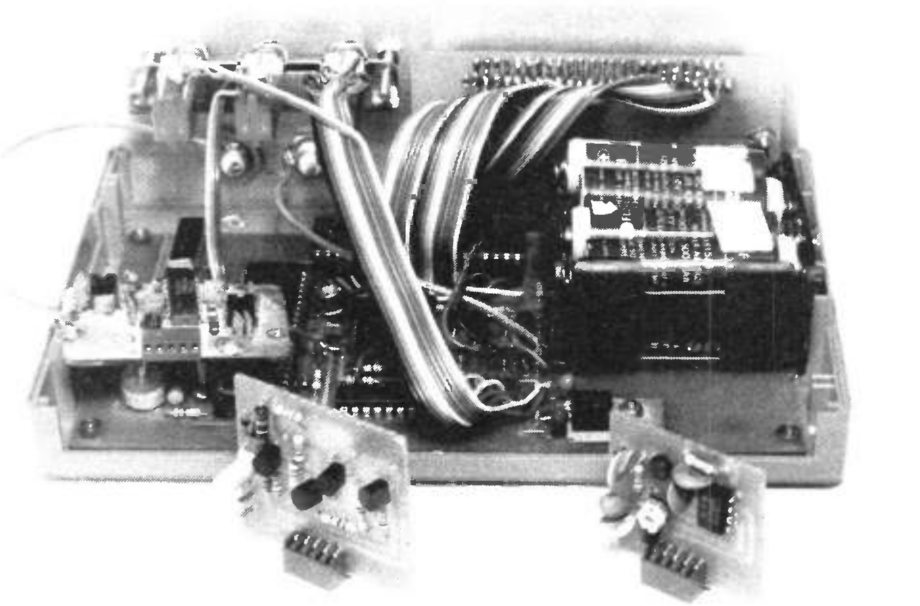
In Use

The supply switch has a second pole that can be used to switch in an external Ni-Cad charger (with two sockets on the rear panel) when the unit is switched off. This would avoid removing the batteries which can then be stuck down with double-sided sticky pads.

The meter does not display the decimal points simply because to cater for all the possible combinations of prescalers and gate times made the switching far too complicated. A decimal point can be activated by connecting the appropriate digit line to pin 31 of the 7231, normally held low by R6. A pad has been provided on the PCB for this purpose.

My thanks to Alan, G6NXO and Geoff, G6LYE for their help and advice with this project.

■ R&EW



The completed Digital Frequency Meter, as viewed from behind the display. The two boards in the foreground are the 200MHz and 600MHz prescalers.

OPTICAL ASTRONOMY

Scientists are constantly expanding our knowledge of space using a wide range of advanced optical and electronic technology. James S.B. Dick looks at some of the hardware employed by such modern-day astronomers.

Archaeological sites such as Stonehenge, the calendars of the Mayas, and Chinese eclipse records dating back to 4000 BC, show that Astronomy was widely studied long before civilisation came to Europe. The bright star Sirius would have been watched until it occupied a certain position in the sky after sunset — the Egyptians then knew the Nile floods were due. Astronomy is still used to compare the motion of the Earth against high-accuracy atomic clocks. Once the heavens had been mapped, simple observations provided knowledge of longitude and latitude on the Earth — of great importance to mariners before the advent of inertial and radio-based navigation systems. However, time and location are again being measured from 'celestial' sources — artificial satellites (such as GOES and NAVSTAR) are now being used to provide time, position and velocity information accurate to microseconds and metres.

While Astronomy has provided mankind with a time system, curiosity about his environment has made him look out at the stars, not with the aim of utilising them in mundane problems, but to explore. Although his interest in the stars may have been intense, man was ill equipped to observe them in an objective, scientific way. Indeed, it is only in recent years that the passion for exploration and observation has been provided for.

The Light Fantastic

The accurate, quantitative measurement of light is called photometry. By measuring the amount of light emitted by a star at different wavelengths, the temperature, approximate size and likely chemistry of that star can be determined.

A telescope is pointed at the star and then the collected light passes through a wavelength-selective filter onto a sensitive detector called a photomultiplier (PMT). Inside, photons from the star hit a cathode made of an alkali metal and eject electrons from the surface layer. The electrons are accelerated to the nearest positive electrode (one of the "dynodes") and collide with its surface. Each electron impact releases more ($\simeq$10) electrons, which are accelerated to the next dynode and so on. The end result is that one or two of the photons that liberated electrons at the photo-emissive cathode are responsible for an avalanche of perhaps one million electrons onto the anode. Typical anode currents are often quoted as 1 A/uW of incident light — the Sun's intensity is about $200mW/cm^2$ — though the maximum current allowed in the tube is usually about 1mA.

Instead of measuring the current as a function of intensity, the modern technique is "photon counting". With this method, the avalanches caused by individual photons are

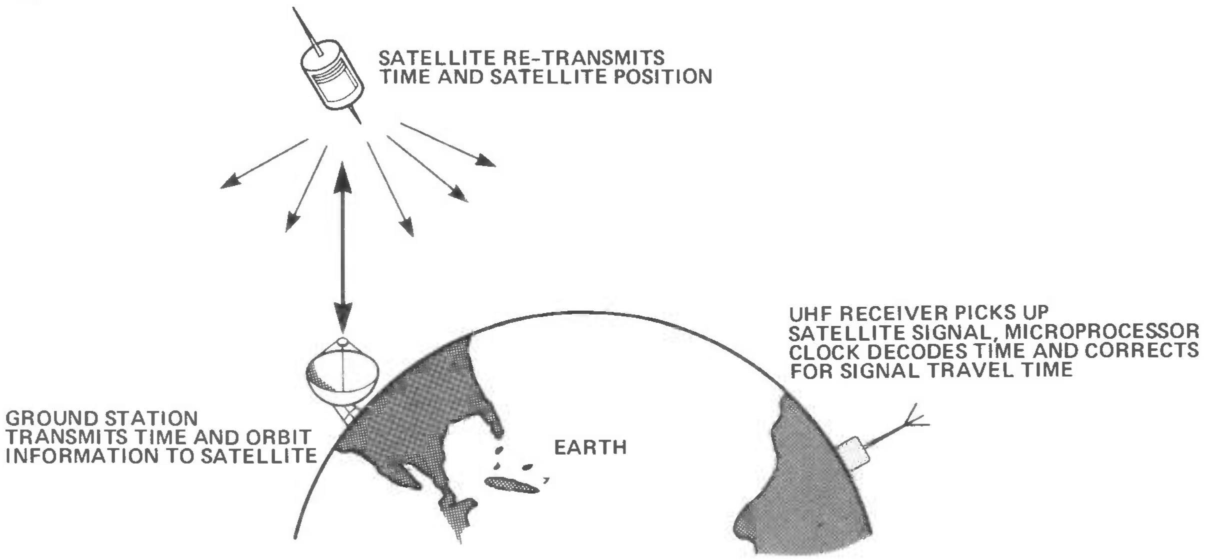
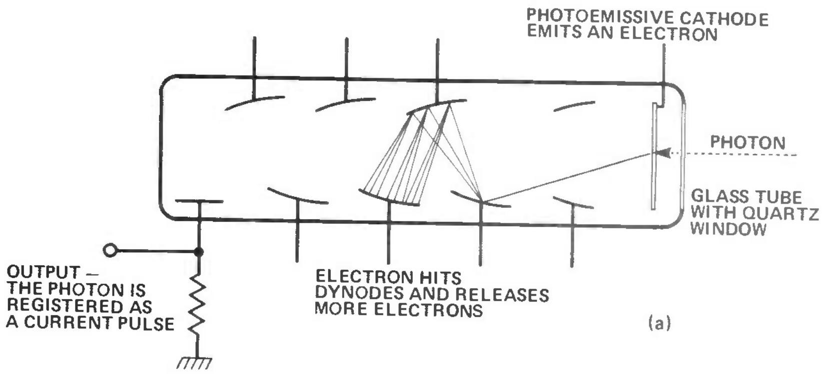


Figure 1. The principle elements involved in satellite time services.



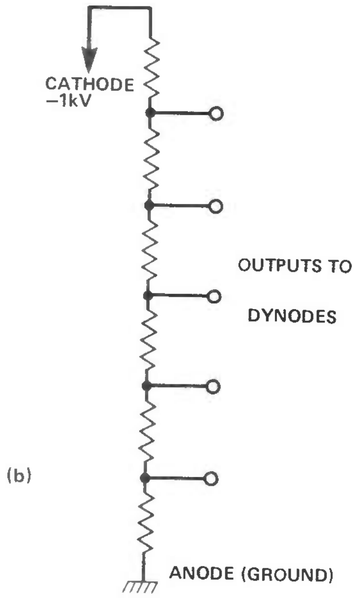


Figure 2. Diagram of a photomultipler (a) and the voltage divider to dynode chain (b) used with it.

amplified and counted as bursts of current representing photons. The amplifiers have rise times of a few nanoseconds and differentiate between current pulses of 10^6 electrons (caused by a photon) and 10^3 electrons (produced by thermal emission from one of the dynodes). Most systems can deal with a count rate of 1MHz, corresponding to a star on the 'naked-eye limit', seen through a filter (optical passband 200 nm) with a telescope of 1.5m aperture. The pulses are counted by hardware (TTL "HS" series) counters which are read and cleared under computer control. The computer then supplies the astronomer with real-time feedback and stores the data on, perhaps, magnetic diskette and paper "hard-copy" for later analysis. To measure one star in five colours may take twenty minutes — each measurement on the star is normally done twice and the intensity from the sky is measured so that it may be subtracted from that of the star.

Worth A Thousand Words

The photometry system just described provides information concerning the luminosity of a point of light. However, galaxies and other "extended objects" are best viewed as a picture. Early observers had to be accurate artists — sketches were made with pencil and paper — until photography took over and became one of astronomy's workhorses. Modern plates may be 30cm x 30cm and show a 6^0 square of sky, recording objects a million times fainter than the eye can see.

While Astronomers can digitise the vast amount of data held on photographic plates, by using a scanning densitometer, it is more convenient to use a two-dimensional electronic detector. The state-of-the-art utility here is the charge coupled device (CCD). These were first invented in 1970 and took only four years to go into production. Although they may be used as analogue delay lines and signal processors, only their optical processes will be discussed.

Essentially, within the CCD, a slab of p-type semiconductor has a matrix of electrodes placed on its top surface. When these electrodes are positively charged, a potential well forms beneath them and free electrons collect as a "charge packet" in the well. If the CCD is exposed to light, electrons freed by the incident photons gradually fill the wells. If a picture is focussed onto the CCD substrate, each well may be thought of as a picture element — the CCD is then an array of such elements. To read out the picture, a process known as charge coupling is used. Looking at ***Fig. 6***. the well under the 10 volt electrode is deeper than the others and will be the site of charge storage. Increasing the voltage on the third electrode to 10 volts will create another well and charge will be shared. If the potential on the second electrode is decreased, the charge packet will be totally transferred. Hence, correctly phased voltages applied to the electrodes cause a movement of the charge packet just beneath the

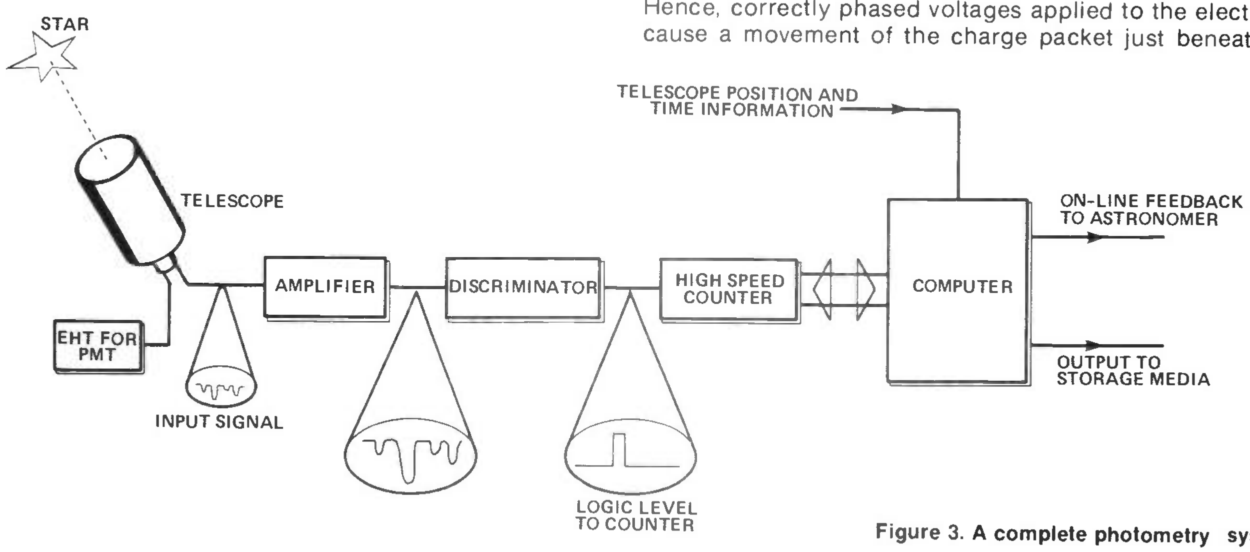


Figure 3. A complete photometry system.

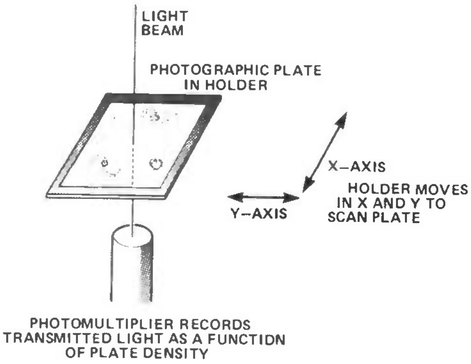


Figure 4. Representation of a scanning densitometer.

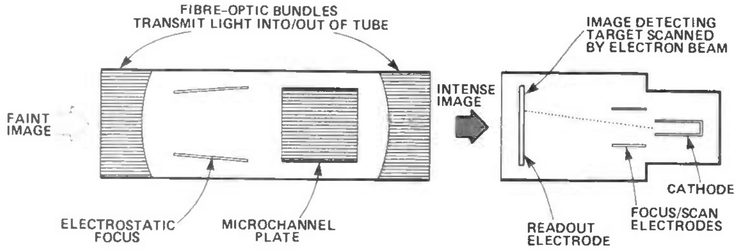


Figure 5. Microchannel plate and Vidicon for focussing and detecting images.

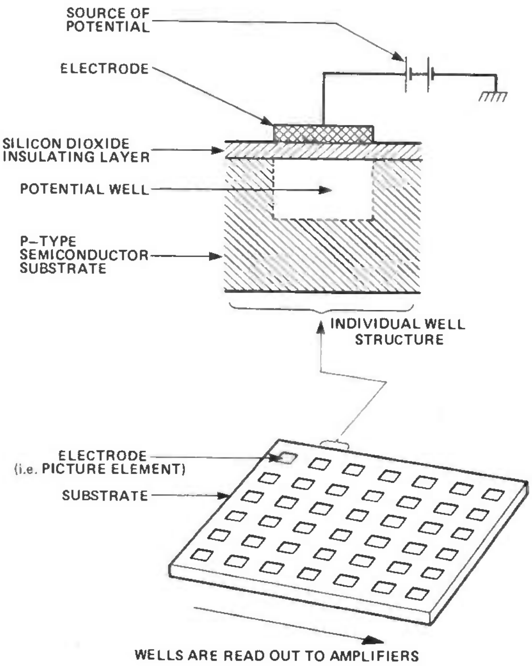


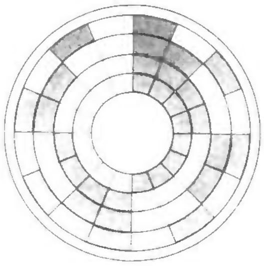
Figure 6. The CCD imaging array, with one cell enlarged to show electrode connections.

surface of the semiconductor, towards the readout gate. To transfer the picture from the CCD to a computer for analysis, successive rows of electrodes are clocked and their charge packets read out.

CCDs have some faults, however. Thermal emission of electrons is reduced by cooling the chip and irregularities in electrode spacing (typ ± 3%) are reduced by electron-beam techniques during manufacture. If a well is over-illuminated, more charges are created than can be held in the well. The surplus charges spill into nearby wells (ie, adjacent picture elements) — "blooming" causes a "white out" over a portion of the picture. Front face imaging of the CCD creates problems because of interference and absorption effects caused by the polysilicon surface layer. An alternative is to illumiate the device through the substrate which is chemically thinned to around 10um (spectral coverage from 300 nm to 700 nm is obtained, although manufacturing yield is significantly decreased). Due to the CCD's high efficiency (about 50%) in detecting photons, compared with a photomultiplier, they are an effective tool.

In order to guide the telescope onto a faint object, intensified TV systems are commonly used. A single stage microchannel plate intensifier is placed in front of a vidicon. Here, the image falls onto a fibre-optic bundle, whose other end is a photosensitive cathode. An electrostatic lens focusses the emitted electrons from the cathode onto a bundle of hollow glass tubes (a few microns in diameter), whose insides have a dynode-type effect. The accelerated electrons exit from the microchannel plate and hit a phosphor where they generate light. This is carried down another fibre optic bundle to the front surface of the camera tube. The image, intensified typically by a factor of 10,000 is then televised in the normal way and fed to a monitor in the telescope control room.

(a)



(b) (c)

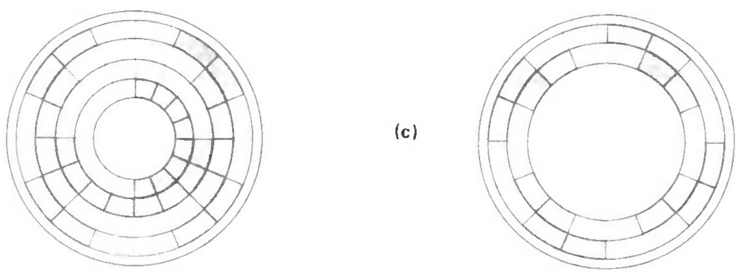


Figure 7. Digitising reference discs, absolute encoders for Binary (a) and Gray codes (b) and an incremental system (c) encoder disc.

Drives, Encoders And Trackers

In addition to detecting objects, it is necessary to access and track them. The position of stars in the sky is defined in terms of "right ascension" and "declination" — the celestial equivalent of longitude and latitude on the Earth. The telescope is moveable in the two axes of right ascension and declination. One method of determining the telescope position is to mount absolute encoders on the drive shafts. These are circular discs, optically encoded with information (usually in Gray code). Gray code is similar to binary except that one bit changes at each increment or decrement. While absolute encoders are large and expensive, the telescope's position is defined mechanically and is therefore non-volatile. ▶

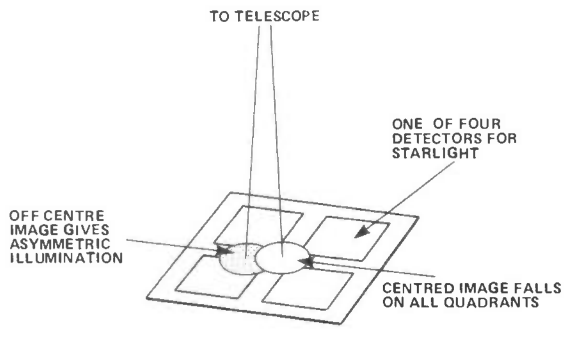


Figure 8. A quadrant star tracker.

Incremental encoders, with a resolution of 48,000 steps per resolution, — an accuracy of ± 0.0075 degrees — can be obtained at less cost and are physically smaller (15cm diam x 10cm deep). The position of the telescope is initially determined from a datum point and the subsequent pulses from the encoder's detector are used to alter that position.

Noise is a frequent cause of problems — encoder pulses are missed by the counters or spurious spikes add phantom pulses. The encoder system has to be kept on continuously if minor movements of the telescope, while parked, are to be counted. Once the telescope has been 'sighted' on a star, the drive system has to be capable of keeping the star in the centre of the field-of-view. While an accurate drive rate helps, the effect of telescope flexure and atmospheric refraction tend to decentre the star. The cure is to use an electronic eye as direct feedback — the Star Tracker. Light from a star (frequently a nearby star) is taken to a crude two dimensional detector; the simplest case may only have four picture elements. If the star is centred, equal quantities of light will fall into the quadrants — any asymmetry is monitored by the telescope control computer which then corrects the drive rate accordingly.

Earlier trackers used a single detector (photomultiplier, perhaps) with a chopping vane to segment the image into halves — the amplitude of the resultant AC signal being the feedback mechanism. More sophisticated trackers use the video output from the aforementioned acquisition camera. The video lines, corresponding to the centre of the field, display the star's profile in two dimensions.

Telescope drives were originally clockwork — a falling weight and governor linked to gears. Later, electric motors were used and their rotation monitored by a tachometer, whose output controlled the supply to the motor in a servo-loop. Even some small (0.5m aperture) telescopes are driven in declination — speed is not critical here because motion is only involved when moving between stars or for minor tracking adjustments. Continuous tracking is not required because the stars "move" only in right ascension axis.

Modern telescopes depend upon stepper motors, which move through a fixed angle each time a pulse is applied. The rate is simple to control via digital electronics, as it is directly proportional to the applied pulse rate. Step motors are expensive however, so synchronous motors are often used, particularly by amateur Astronomers. These are similar to stepping motors except that they are designed to run at a fixed frequency — typically ± 10% variation is allowed. A standard, small synchronous motor may run at 250 RPM for 50 Hz input and 300 RPM for 60 Hz. However, the necessity of a mains supply often prevents the amateur from taking his telescope into the country in search of dark skies. One solution is to run an invertor from a 12 volt battery. The frequency of the invertor is derived from a crystal oscillator and long-term tracking can be excellent. A variable track speed is provided by a frequency synthesiser — a multiple of a fixed frequency being derived from a voltage controlled oscillator. The output frequency is given by n x $f_{clk}/10^4$. An alternative to the synthesiser is the pre-settable down-counter. A counter is made to count down from an all-zero condition to a value, m, which is selected by thumbwheel switches. The output is given by

$$f_{OUT} = f_{CLK}/M\text{-}m),$$

where M is the maximum counting value plus one. This is fed to a flip-flop to produce a symmetric signal to the inverter transformer. ***Table 1*** shows that reasonable linearity between m, the dialled frequency, and f, the actual frequency, is obtained over a ± 20% range centred on 50Hz.

Switch-selected value	Output frequency (Hz)
2500	33
3000	35
4000	42
5000	50
6000	62
7500	100

Table 1. Comparison of dialled frequency, m. and actual frequency, f.

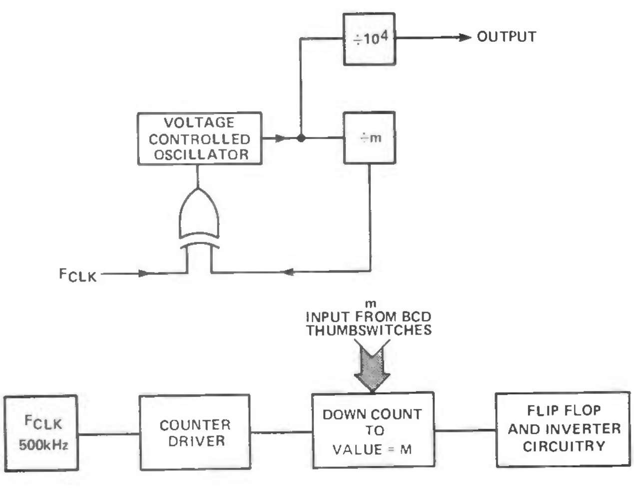


Figure 9. Basic frequency synthesiser and down-counter block.

A Brighter Future

The technological future for astronomy is bright. Improvements in CCD technology will provide better photon detection efficiency and reduce the flaws. Multiple mirror telescopes — their many surfaces accurately controlled by multiprocessor servo-loops — will let astronomers view fainter and therefore more distant objects. The increased use of accurate telescope control systems on all sizes of telescopes ensures quicker object - acquisition and eliminates the many minutes often spent searching for stars. Once the telescope, and the instrument it carries, are computer controlled, the observer may sit in a control room — perhaps several thousand kilometres away — and run his experiment. No more will there be the need for long journeys to observation sites. The increased output from Earth-bound telescopes and space-borne instruments is rapidly expanding mankind's knowledge of the universe.

■ R&EW

UPDATE: 2m TRANSVERTER

Howard Roberts describes some modifications to the design.

In lieu of the popularity of our 28-144MHz transverter, the author instituted some rigorous testing to make sure the project functioned over extended periods. As a direct result of this, a few improvements to the original design were revealed.

To increase stability on the power lines, three extra decoupling capacitors are placed around the board (C62,63 and 64 — 10n). Another improvement to stability, this time in the transmit circuit, can be achieved by replacing the BF960 stage with a bipolar stage as shown in ***Fig. 1***. To implement this change, remove C14 and C57 altogether and replace R7,R3, R38 and C65 with the following respective values: 10k, 3k9, 100R and 10u. The transistor used, Q5, is a standard 2N2369A.

Finally, the revised tapping points for coils L5 to L8 are listed in ***Table 1***; component placing for all these modifications being shown in the sectioned overlay.

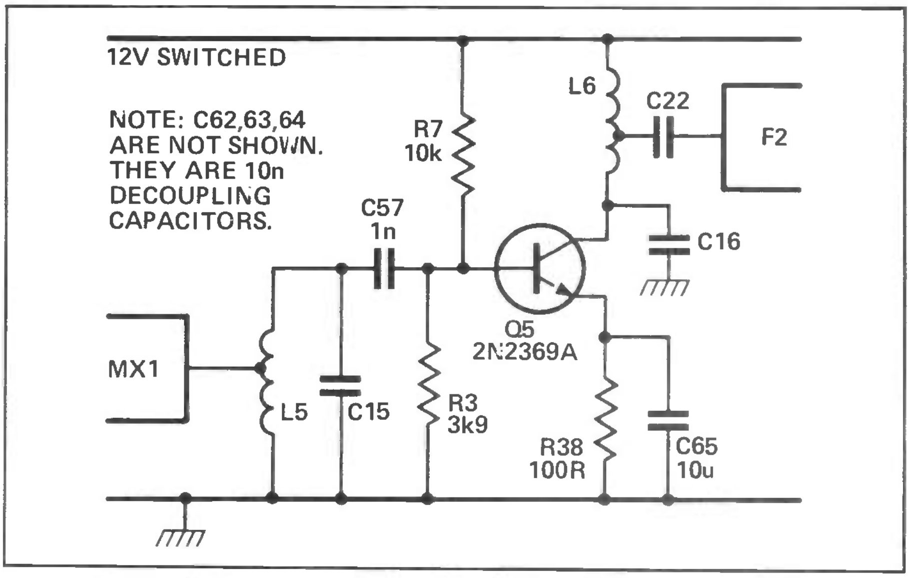


Figure 1: The revised transmit circuit using a bipolar transistor.

L5 Tapped 1 turns from cold end	L7 Tapped 2 turns from cold end
L6 Tapped 3 turns from cold end	L8 Tapped 2 turns from cold end

Table 1: Tapping points for coils L5 - 8.

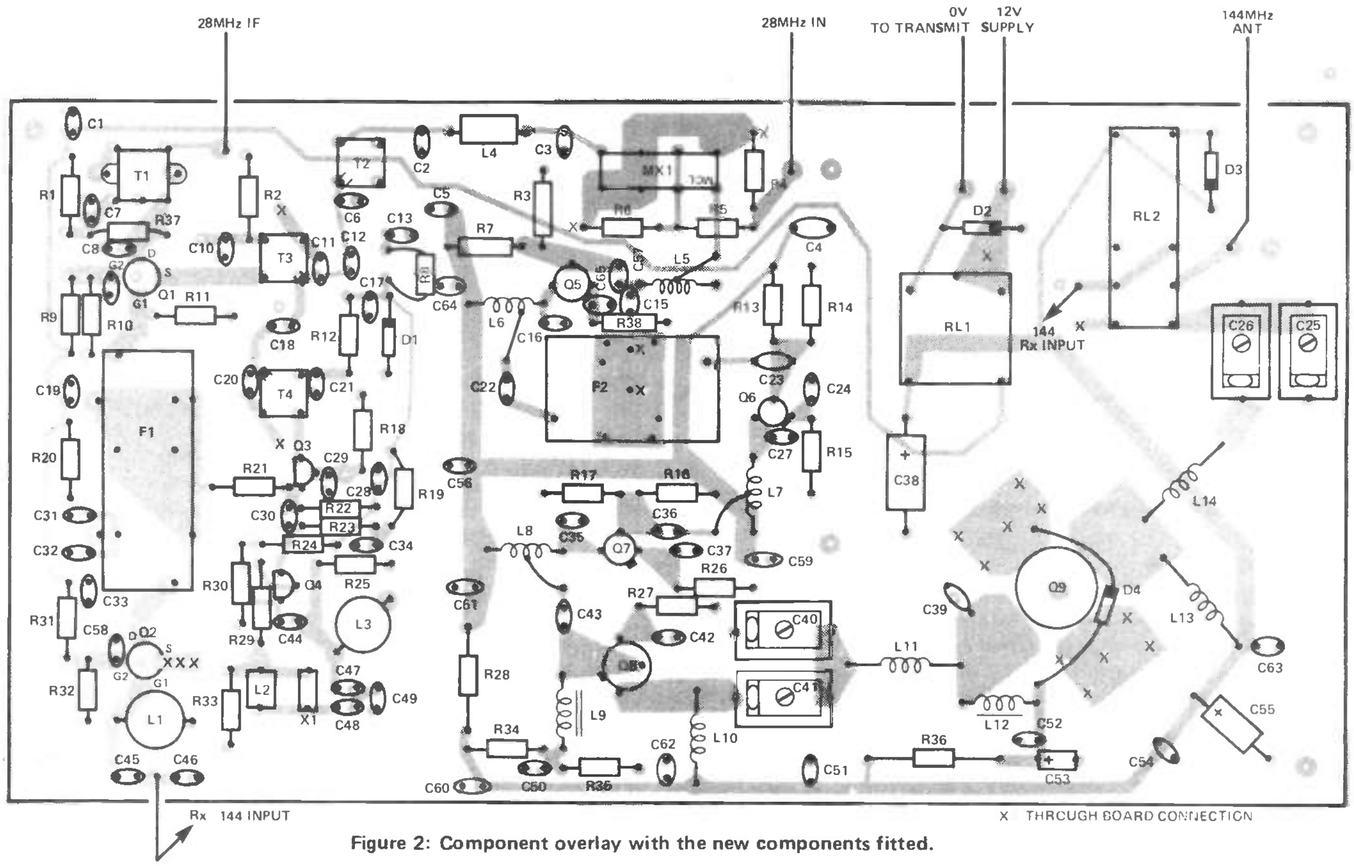


Figure 2: Component overlay with the new components fitted.

FRG7700 MEMORY EXPANSION

John Mills describes a modificaton to considerably increase the RG7700's memory facilities

Many users of the FRG7700 receiver from Yaesu must have at some time thought of buying the optional memory unit, but may have been dissuaded by the high cost of the Yaesu version. Owners with the unit already fitted will probably have wished for more than the present 12 memory channels. For both of these reasons the author decided to look more closely at the workings of the 'black box' to find a suitable solution.

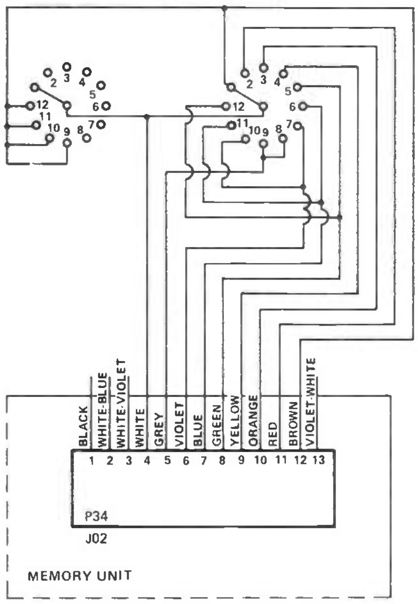


Figure 1: Existing memory switch wiring.

Rx Operations

The FRG7700 is not computer controlled — and this explains the relative complexity of the memory unit. It is not the intention of this article to go into complex electronic descriptions (see the feature published back in December 81/January 82 for more specific details of both the FRG7700 and the Trio R1000), but in essence however operation is as follows:

1. The manually set VFO frequency and bandswitch positions are 'read' and converted into digital data.

2. When the 'memory write' button is selected this data is stored in ICs Q30-35.

3. When 'memory read' is selected, the unit examines the stored data, and using its own internal PLL VFO, it generates the same VFO and frequency band information as was originally manually selected. At the same time, the settings preset on the main VFO and bandswitch are disabled.

The memory ICs used in the unit are 256 x 4 static random access units. Up to 256 data locations are available via the address inputs A10 to A17(J02). As will be seen from diagram 2, the memory switch S5A/B selects various address combinations up to a max of only 12.

Herein lies the key to this article, replace S5A/B with a 40 way CB type switch and you have instant access to 40 memory channels. Although this does not change the initial purchase cost of the unit, it does reduce the cost/memory channel from around £7.50 to £2.25.

At this stage the following points should be considered before proceeding further:

1. Extensive dismantling of the Rx is required and

2. Any warranty claims may be invalidated.

Step By Step

To fit the new switch follow the steps carefully and do not miss out any:

1. Disconnect the Rx totally from the AC mains.

2. If a memory unit is fitted remove from the Rx. Take care when removing the plugs, they are all numbered but pull on the body not the wires to remove them.

3. Remove the top/bottom covers. (Disconnect the plug to the backup battery holder).

4. Disconnect all connections to the main PCB — PB2169. Again take care

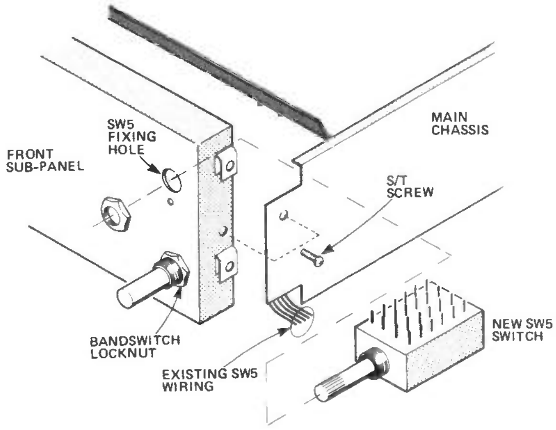


Figure 2: Exploded view of receiver chassis.

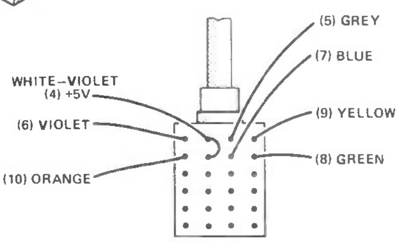


Figure 3: Wiring of new memory switch.

NUMBERS REFER TO J02 ON MEMORY UNIT

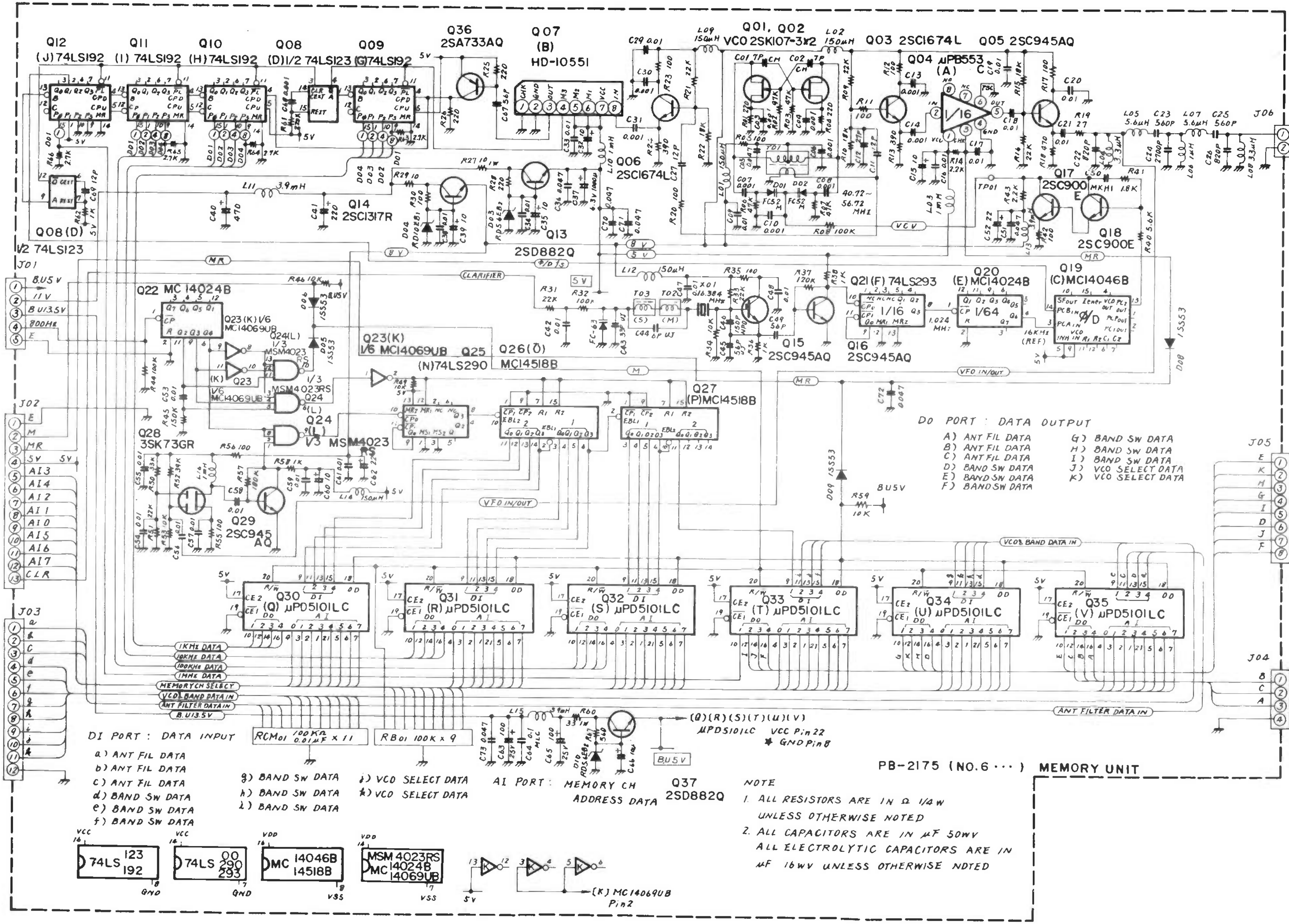


Figure 4: FRG7700 memory expansion unit circuitry.

to pull the plug bodies not the wires. Two wires from the backup battery must be unsoldered from the main PCB — note carefully the polarity and location of these connections.

5. The frequency display is supported by a foam backed metal plate secured by two screws, remove this panel and screws carefully. Remove the small PCB with the AM/PM LEDs held by a S/T screw to the left of the display.

6. Remove all front panel knobs. These simply pull off except for the VFO tuning knob and band select knob which are held by small grub screws. Note the position of the band selector knob as this is not indexed on the shaft. After removing the VFO knob, remove the small X-head screws exposed underneath to remove the plasti-chrome skirt.

7. Remove the main PCB, take extra care not to damage the vacuum fluorescent frequency display, easing the main PCB gently back and upwards.

8. Remove the front panel by removing the two top and two bottom CSK screws.

Now it gets trickier.

9. Refer to ***Fig. 2*** and remove the locknuts on the band select switch. Remove the S/T screw holding the R/H side of the front sub-panel to the main chassis.

10. Undo the locknut on S5 (diagram 3).

11. Carefully push S5 back out of the front sub panel as far as it will go. S5 will probably be restricted by a cable harness strap which is fitted to the bush of S5. If S5 cannot be removed easily, carefully unwrap the harness to release the wiring loom. At this point it may help if the front sub panel is carefully separated from the main chassis by one or two inches max. (See ***Fig. 2***).

12. As the wiring to S5 runs up from below the chassis, ease the switch and wiring out and through the gap between front and main chassis panels.

13. Refer to ***Fig. 1*** and check the colours shown against P34 (pins 4 to 12) from the memory unit appear on S5. If your Rx has different coding to that shown then write in your own colours to correspond with ***Fig. 1***. Remove all wires to S5. The wires from A16 and A17 are not used and should be stored within the main cable harness.

14. Enlarge the hole previously occupied by S5 to 9MM. Be careful not to allow metal drillings to fall in the Rx.

15. Wire the switch as shown in ***Fig. 3***.

16. Carefully fit the switch into S5 position ensuring the pins are upwards and that the lug on the switch locates into the exisiting location. Fit the washer and locknut provided and tighten carefully.

17. Re-assemble the Rx in reverse order to the previous steps.

18. Check correct operation before fitting any existing memory unit.

19. Refit memory unit and check operation is as before.

The receiver now provides 40 switch selected memory channels. Some of the new switch positions may line up with the existing front panel markings

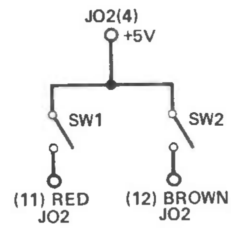


Figure 5: Switch wiring for 120 channel expansion.

but with frequency readout available the lack of 40 marked positions should not prove a problem. For the more adventurous reader, the memory can be expanded by a further 120 (3 x 40) channels if required. Refer to ***Fig. 5*** for wiring details. In this requirement the two unused address lines A16 and A17 are connected to ±5V by switches to select further memory locations. Some mental ability is required, with S1,2 'off' 40 frequencies are selected by S5. Switch on S1 to select a further 40, S2 a further 40 and lastly both S1 and S2 together to provide the last 40. Taking the full 160 channel capability this reduces the cost/chan down to 56P.

The author would like to thank Alec from Amcomm Services, Harrow, for the loan of a memory unit to aid this article. Amcomm also state that they will honour any warranty claims on Rx's bought from them that have the above mods fitted.

Note: The only part required for this conversion is S5, the SRS 303UCB switch.

■ R&EW

Zilog **Lesson 2** **Z8000 Course** PART 2

MEMORY AND PERIPHERAL INTERFACING

Continuing the second lesson of the Zilog Z8000 course, we introduce aspects of hardware design and timing circuits. The lesson concludes with some questions on all the material covered.

HARDWARE DESIGN CONSIDERATIONS

Memory Refresh

In the case of dynamic devices, memory interfacing requires correct setting of the refresh register: enable bit on and rate large enough. The LDCTL instruction, executable in system mode, allows refresh to be loaded from one of the Z8000's 16-bit registers. A hexadecimal value of 9E00 will produce refresh each 60 clock periods which, at 4MHz, will satisfy the worst-case needs of typical 16K dynamic RAMs. The table below lists the delay in clock cycles between refreshes for other possible refresh register values. Recall that bits one through eight hold the row value, and nine through fourteen hold the rate.

LOWER NIBBLE OF UPPER BYTE

UPPER NIBBLE OF UPPER BYTE	0 1	2 3	4 5	6 7	8 9	A B	C D	E F
0								
1								
2								
3								
4			NO REFRESH					
5								
6								
7								
8	256	4	8	12	16	20	24	28
9	32	36	40	44	48	52	56	60
A	64	68	72	76	80	84	88	92
B	96	100	104	108	112	116	120	124
C	128	132	136	140	144	148	152	156
D	160	164	168	172	176	180	184	188
E	192	196	200	204	208	212	216	220
F	224	228	232	236	240	244	248	252

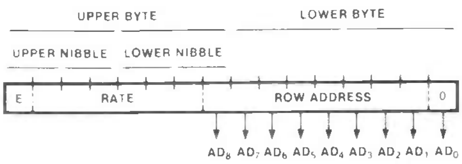


Figure 15
Refresh Control Register

Memory and I/O Spaces

In order to segregate memory and/or I/O spaces, the *ST3:0* lines must be *decoded*. The simplest needs can be satisfied by decoding the first ten ST combinations. This precludes distinguishing program stack and data stack memory or running slave operations unless further decoding is added.

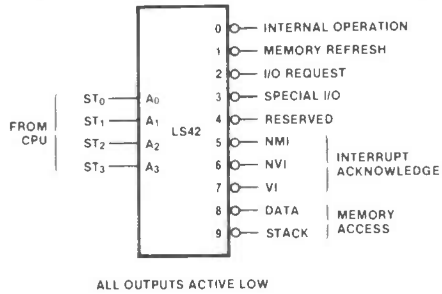


Figure 16
ST 3:0 Decoding

Address/Data Bus Design

Another system requirement is proper *buffer design* between the Z8000 and external memory, peripherals, or other Z-Bus devices. It is sufficient to point the data bus toward the processor *only* during read operations and to float it during acknowledged bus requests.

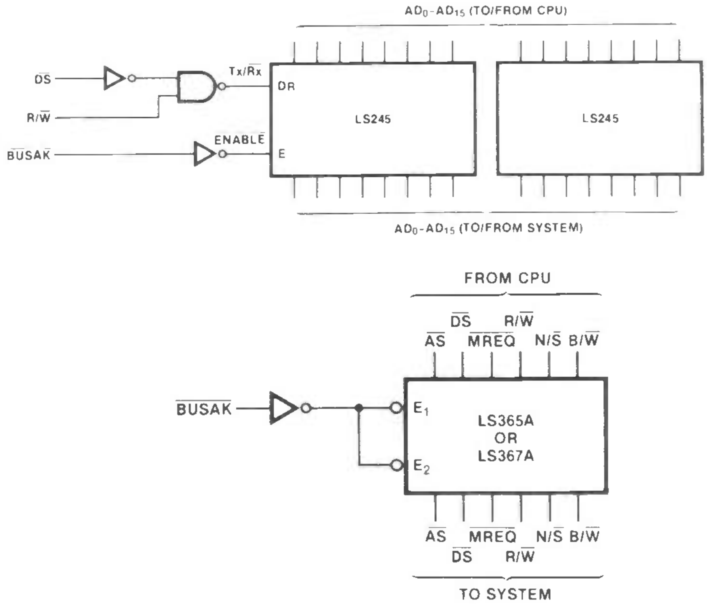


Figure 17
Buffering Address/Data
and Status Signals

The status buffer shown will need pull-up resistors on both sides.

Demultiplexing addresses from the AD15:O lines can best be accomplished with transparent latches when designing with standard memories. $\overline{AS}$, as intended, provides the latching signal and $\overline{BUSAK}$ must be observed.

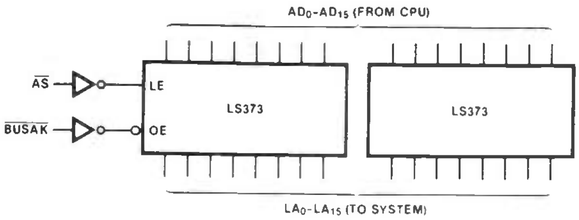


Figure 18
Address Latches

Multiplexing Latched Addresses into 16K x 1 RAMs can be accomplished by synchronizing $\overline{MREQ}$ to the CPU clock and then feeding the address bits alternately to the seven chip-address inputs during row (RAS) and column (CAS) address times defined by the circuitry shown below. The 16th address bit is used to select alternate banks of 16K words, if needed, while the lowest bit controls CAS to byte banks within each word bank.

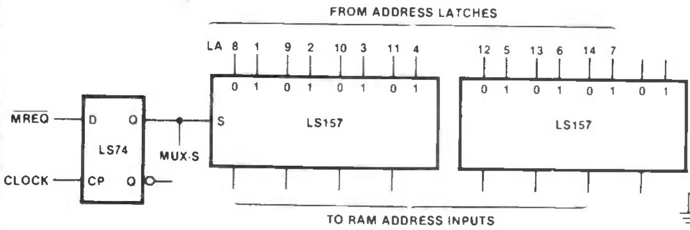


Figure 19
Address Multiplier

RAS and CAS generation can be achieved in several ways. The scheme below continues the logic given above to generate row and column selects compatible even with slow 16K RAMs. It also produces an optional $\overline{WAIT}$ output and properly utilizes A0 only for byte writes.

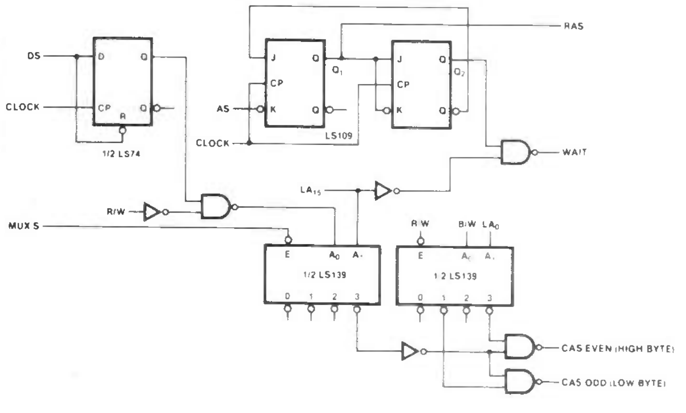


Figure 20
RAS and CAS Generation

There is another, more natural alternative, using Zilog 6132, 4K x 8 pseudo-static RAMs **(See Fig. 21).**

Any attempt to segregate memory spaces using the ST oututs must carefully consider the particular setup, access and other times crucial to proper operation of the memory devices selected. It may, for instance, be necessary to delay $\overline{AS}$ to these devices so that control circuitry has adequate time to enable and disable appropriate memory areas, according to the desired partitioning.

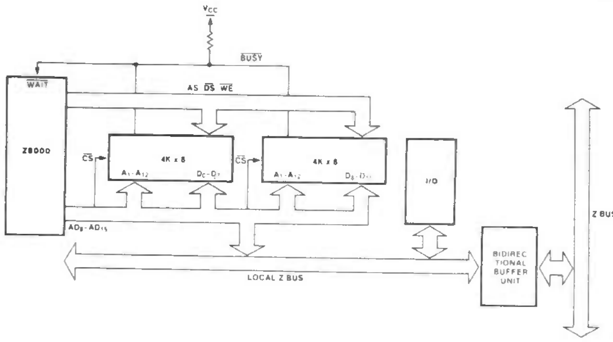


Figure 21
Z8000 - 6132 Interface

The $\overline{STOP}$ Input

The $\overline{STOP}$ input is a useful feature of the Z8000 apart from slave processing. A single-step circuit can, for instance, be designed.

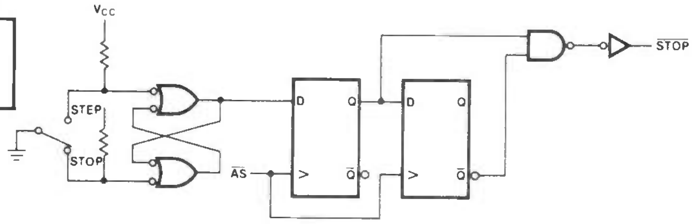


Figure 22
Single-Step Circuit

$\overline{STOP}$ currently puts the processor into a continual (rate insensitive) series of memory-refresh cycles. This increases heat dissipation in memory devices for the duration of the $\overline{STOP}$. The debounced input is latched in the first flipflop by $\overline{AS}$ while the second flipflop remembers the complement of the last switch position. This guarantees a low on $\overline{STOP}$ during T3 of each instruction's final machine cycle, as required by the Z8000's $\overline{STOP}$ timing **(See Fig. 24).**

The Clock

Finally, the clock circuitry shown in the previous lesson can be filled out to include both Z8000 and TTL drive capability.

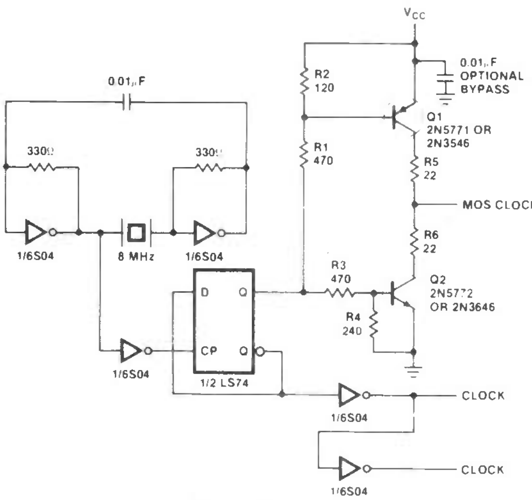


Figure 23
Clock Driver Circuitry

It is worth noting that the Z8000, like most MOS processors, will accept higher than nominal clock rates at higher supply voltages. This can be useful in critical applications where the speed advantage at a higher voltage outweighs the power dissipation penalty.

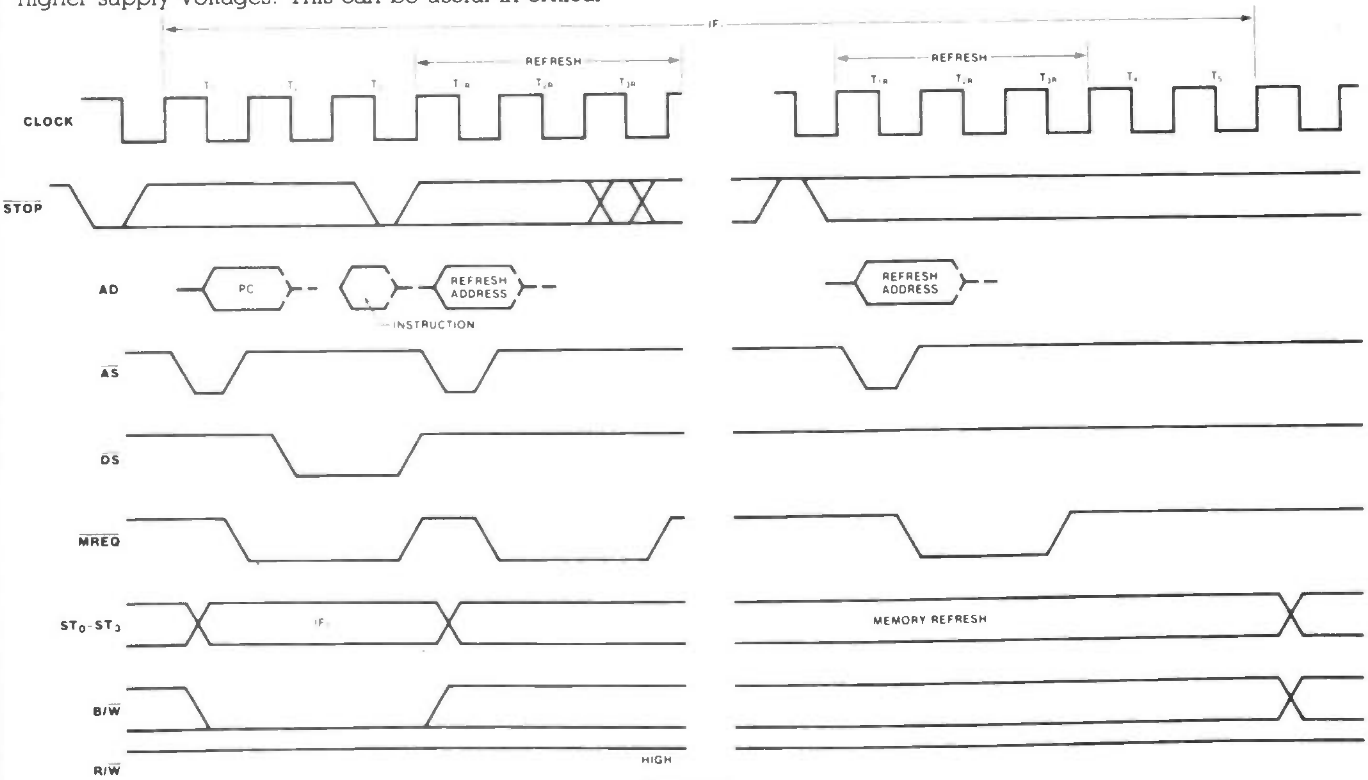


Figure 24
$\overline{\text{STOP}}$ Timing

QUESTIONS

1. The CPU clock is not one of the primary Z-Bus signals because:
   ____ A. Memory and I/O transfers are not synchronous to system clock.
   ____ B. Address strobe synchronizes address emission and latching during memory and I/O accesses.
   ____ C. Data strobe synchronizes data transfer and latching.
   ____ D. All of the above.

2. Proper memory access demands that a memory controller look at least at which of these signals?
   ____ A. $\overline{AS}$ and $\overline{DS}$
   ____ B. $\overline{AS}$, $\overline{DS}$ and $R/\overline{W}$
   ____ C. $\overline{AS}$, $\overline{DS}$, $R/\overline{W}$ and $B/\overline{W}$
   ____ D. $\overline{AS}$, $\overline{DS}$, $R/\overline{W}$, $B/\overline{W}$ and A0.

3. Bus direction in Z8000 systems should be determined with $R/\overline{W}$ and $\overline{DS}$ so that the bus normally points:
   ____ A. Toward the Z8000 except during read cycles.
   ____ B. Toward the Z8000 except during write cycles.
   ____ C. Away from the Z8000 except during write cycles.
   ____ D. Away from the Z8000 except during read cycles.

4. The ST lines by themselves can be used to create as many as:
   ____ A. Six memory spaces
   ____ B. Three memory spaces
   ____ C. Five memory spaces
   ____ D. Four memory spaces.

5. Which one of the following statements is *true*?
   ____ A. In order to work on a Z-Bus system, peripherals *must be* word organized.
   ____ B. Peripherals used on a Z-Bus system *must be* byte organized.
   ____ C. On a Z-Bus system peripherals *may be* byte organized if they read from and write to the appropriate half of the bus according to A0.
   ____ D. On a Z-Bus system peripherals *may be* byte organized if they read from and write to the appropriate half of the bus according to $\overline{AS}$.

6. Which of the following is *not* one of the basic cycles of which all Z8000 instructions are composed?
   ____ A. Memory
   ____ B. I/O
   ____ C. Execution
   ____ D. Internal

7. The time that memory and peripherals have to respond before data strobe goes away can be extended by pulling the:
   ____ A. $\overline{WAIT}$ line low
   ____ B. $\overline{STOP}$ line low
   ____ C. $\overline{BUSRQ}$ line low
   ____ D. ST3:0 lines low

8. By using the $N/\overline{S}$ and ST lines, as many as six memory spaces may sensibly be distinguished by a Z8000 system. How many I/O spaces can be distinguished?
   ____ A. Six
   ____ B. Four
   ____ C. Three
   ____ D. Two

GSC recently launched a hand-held DFM/Timer to complement their bench-top range. Robert Aldy reports on its capabilities as a field instrument.

5000 COUNTER/TIMER

One of the most useful pieces of test equipment, in addition to an oscilloscope, is a frequency meter/counter-timer. There are many DFM's on the market, but they are mostly designed for lab use only. Even the so-called 'portables' are usually bench types with the addition of a battery pack. Not so the latest model from Global Specialities corporation — the hand-held 5000. Its small size and battery power pack (Nicad or alkaline), make it ideally suited to general purpose field applications as well as for lab use (an AC adaptor/nicad charger is available as an option).

Functions And Displays

The 5000 provides for measurement of frequency, period and pulse width. All the controls are slide switches, with the exception of the trigger level control, which is a slide pot (more of this later). These switches select input attenuation, AC/DC coupling, trigger polarity, normal display or hold, mode and gate time.

The centre position of the power switch selects a self test function. This tests the internal logic against the meter's crystal reference and a table included in the manual shows the reading the meter should indicate when self testing. The manual also goes into some detail to describe how to calibrate the meter against an external reference.

The display is an eight digit 0.43" LCD type. The contrast between figures and background is good and easy to read. In addition, the display also includes annunciators to indicate over-

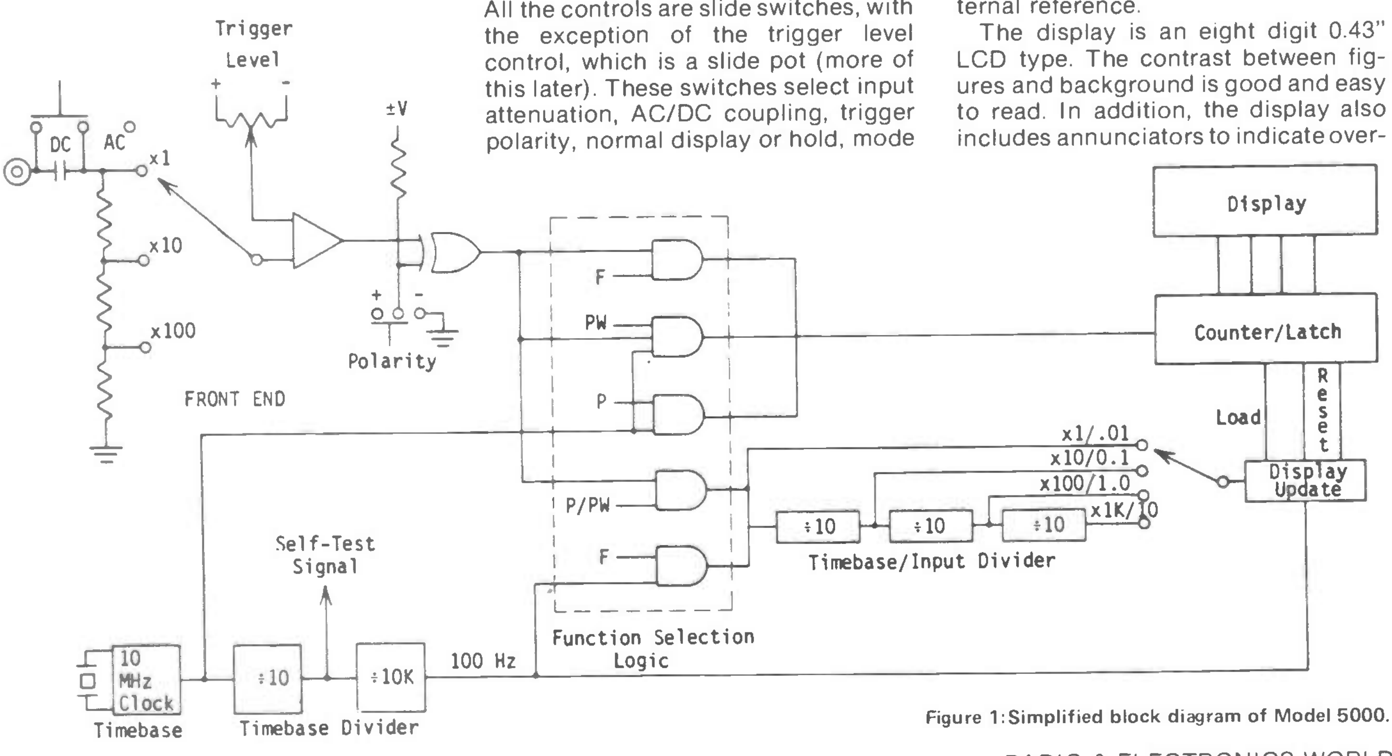


Figure 1: Simplified block diagram of Model 5000.

flow (OFL), low battery (BATT) and GATE. In frequency mode, 'GATE' indicates that the instrument is in the process of counting, whereas in period and pulse width mode it comes on when the signal has crossed the trigger threshold and goes off after the selected number of cycles have been completed. A pulse stretcher circuit on the GATE annunciator allows it to be used to set up the trigger level even on narrow pulses.

Frequency measurements are quoted at 0.1Hz to 40MHz, but typically extend to 50MHz. The resolution permits displays from 100Hz to 0.1Hz depending on the selected gate period (0.01, 0.1, 1 or 10 seconds). Irrespective of the gate setting, the frequency is always displayed in kHz. For fast, accurate measurement of low frequencies it is far better to use the period mode, and converting the result to frequency by invoking the reciprocal (ie, f=1/T).

Measurement Modes

In the period mode the 5000 measures the time over which the signal is above the trigger threshold of the input. This period measurement can be averaged over 1,10,100 or 1000 cycles depending on the setting of the gate switch. Periods from 50ns to 10 seconds are possible, but the time is always displayed in microseconds, making it a little inconvenient to read when measuring long periods. The pulse width mode measures the mark time or space time of the input signal depending on the position of the polarity (slope select) switch. Measure-ments range from 25ns to 10 seconds and as in the period mode the average can be taken over 1,10,100 or 1000 cycles. Again, time is displayed in microseconds. In all modes, resetting the meter can be achieved at a given time by switching over and back any of what the manual calls 'the Master Reset functions', namely gate, mode or polarity.

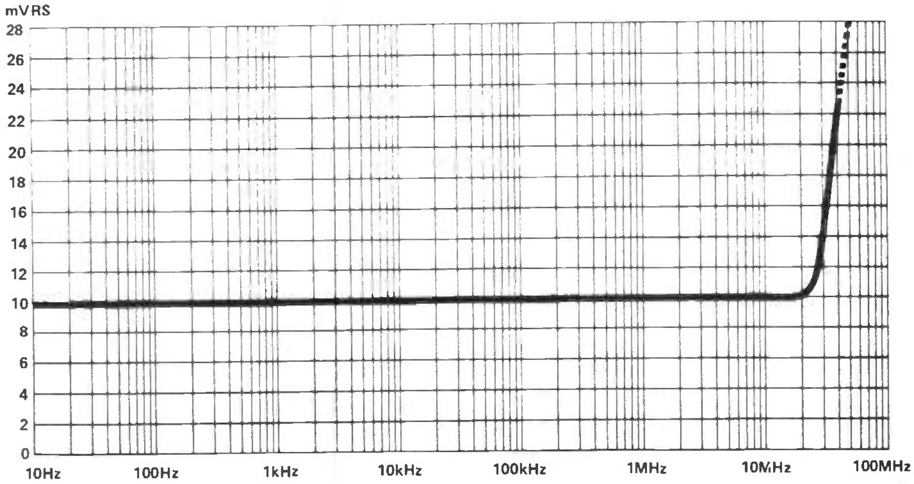
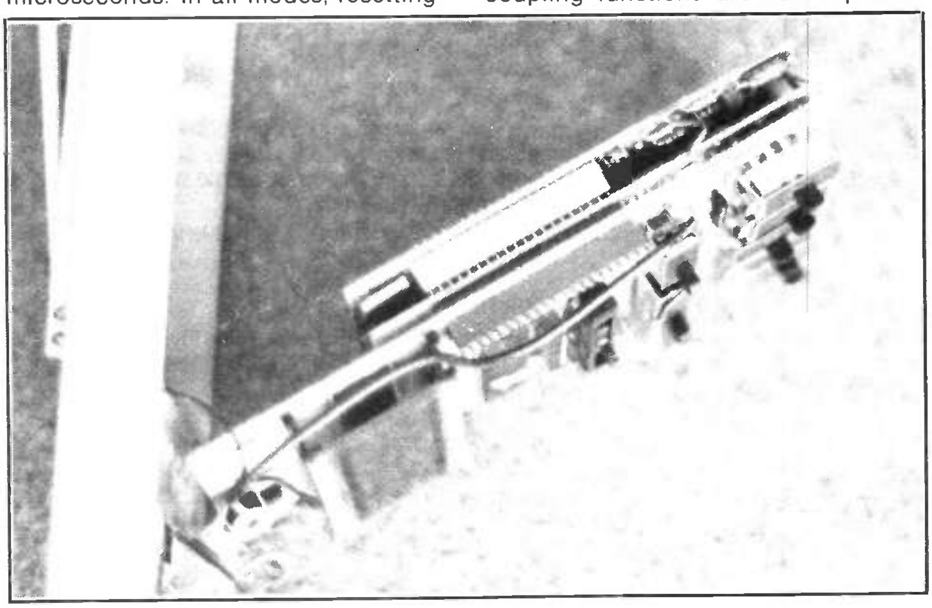


Figure 2: Sensitivity versus frequency—sinusoidal input.

In addition to the three primary modes, the display can be set to "NORMAL" or "HOLD". Generally, the 'Normal' position will be used and in this case the display is updated continuously. The time between the end of one count and the start of the next being a constant 230mS whichever range is used.

The 'Hold' position provides a useful addition to the basic functions. It allows for the measurement of a signal over a single gate period; the display is then held indefinitely until a reset is applied. This means measurements can be made of random or infrequent signals and, in fact, the meter can be left unattended to record the next event.

The trigger polarity and AC/DC coupling functions are self explanatory. Input attenuation can be switched between x1, x10 and x100 and is used to prevent the 5000 from being overdriven. It also effectively expands the range of the trigger level control. The input is overdriven when the attenuated signal is greater than ±0.5V (DC plus AC peak). Thus the maximum input signal that can be applied before overdriving is ±50V, achieved with the attenuator set to x100. If the instrument *is* overdriven, the signal is clipped but may still give an accurate reading of frequency and period. For pulse width, the trigger threshold is particularly



Input

Impedance	- 1M + 25p
Sinewave sensitivity	- 30mV RMS- 1kHz to 30MHz
	50mV RMS- DC to 50MHz
Coupling	- AC or DC
Attenuator	- x1, x10, x100
Trigger Polarity	+ve or -ve edge.

Reference

10MHz crystal oscillator

Modes

Frequency	- 0.1Hz to 40MHz
	- 4 gate times 0.01/0.1/1/10s (Display in kHz)
Period	- 50ns to 10s
	- 4 ranges 1/10/100/1000 cycle (Display in us)
Pulse width	- 25ns to 10s
4 ranges	1/10/100/1000 (Display in us)

Display

8 digit 0.43" LCD

Annunciators	- indicate overflow (OFL)
	- low battery (BATT)
	- 'GATE'
Battery life	- 7 hours continuous with alkaline batteries

important and this measurement is likely to become inaccurate.

Logical Operations

The simplified block diagram of the model 5000 (***Fig. 1***), shows the implementation of the main functions, and in particular, how the gate switch is used to switch in different parts of the timebase divider chain to perform the averaging facility. Note also how the trigger polarity is effected using an Exclusive-OR gate, which incidentally is one of the logic functions implemented with the new 74HC series high speed CMOS to save power.

The instruction manual for the instrument is very explicit and comes complete with a full circuit diagram. There is a useful section on applications and it is refreshing to see a full description on how to re-calibrate the meter, rather than the usual negative attitude of 'return to the manufacturers for re-calibration'. There is even a section describing how to change the voltage level at which the low battery warning comes on. This can be used to give a longer advance warning that battery voltage is dropping. To give this extra warning time, a resistor has to be removed from the circuit board, but it is not until the case is removed that it becomes apparent that this is not as easy as first thought. The circuitry is mounted on three closely stacked circuit boards and the only way to identify the required component is to compare each board with a diagram showing part of the track layout. Since the diagram is not very clear, a mistake could easily be made. Another criticism which may be levelled at the manual, is that there seems to be some confusion about the meter's specifications. Depending on which page you read, battery life under continuous use can be either 7 or 11 hours — a considerable discrepancy. Similarly, for period measurement, the specification reads ' .. from 50ns' as well as, '40ns'. The statement of input sensitivity is also confused. ***Fig. 2*** shows input sensitivity versus frequency, with the graph clearly indicating a sensitivity of 10mV RMS upto 20MHz, rising steeply thereafter. The specifications at the front of the manual state a figure of 30mV RMS. Under test, the result indicated the former figure to be more likely, at least with the review meter. It could be said that there is nothing like hedging your bets, but its still pity, since these small points spoil on otherwise well written manual.

In The Field

Using the meter is made easy by the simple 'no fills' approach to the design. The input is connected via a BNC socket. A 0.8m coax lead, fitted with BNC plug and miniature quick-clip probes, is supplied. When measuring large signals there is no problem using the controls, but when the signal amplitude is near the limit of the meter's capabilities, the trigger level needs very careful adjustment to achieve a correct reading. This is where the slide pot trigger adjustment was found to be sadly lacking. Slide pots may be justified from an aesthetic point of view on hi-fi gear, but when used to make fine adjustments in measurement and control they are an unmitigated disaster. Perhaps the manufacturers will heed this point and put a rotary trigger adjustment on their next model.

Overall, the 5000 functions well and is a likeable instrument, despite a few minor irritations. The robust construction, both internal and external, should ensure it will stand up to a good deal of rough treatment, making it ideal for field work.

■ R&EW

R&EW BOOK SERVICE

ZX81 BASIC BOOK
By Robin Norman
1982; 168pp; 215 x 130; Paperback.
Stock No: 02-11785 **Price: 5.95**
If you have a ZX81, or are thinking of buying one, this book will tell you all you need to know to get the best from it.
This book covers the basic 1K version, the additional facilities offered by the 16K expansion RAM, and how to use the ZX Printer. There are 14 original programs for you to run on the machine (for 1K and 16K versions), and for those confused by computer jargon (and who isn't?) there is a glossary of technical terms.
Robin Norman assumes no initial computing know-how, and his undemanding writing style is a perfect beginner's introduction.

THE SPECTRUM BOOK OF GAMES
By M James, S M Gee, & K Ewband
1983; 146pp; 155 235mm; Paperback
Stock No: 02-20479 **Price: 6.50**
Here is a selection of twenty-one exciting, high quality games written specially for the ZX Spectrum. These games make full use of the Spectrum's facilities, and are fully tested and crash-proofed.
Among those included are variant of popular arcade games such as Spectrum Invaders, Rainbow Squash and Mighty Missile; board games such as Capture the Quark; a compelling adventure game Treasure Island; a conversational game in which the Spectrum answers you back; and a commando game for you to test your skill. Each program is presented to appeal to all Spectrum owners, no matter how old or young, whether you are completely new to computing or fairly experienced.
Each program is accompanied by an explanation of how to play the game and how the program works, including tips on how to modify or 'personalize' it for your own special use.
Normally games of this quality are only available individually on cassette. This book therefore gives you remarkable value.

THE SPECTRUM PROGRAMMER
By S M Gee
1983; 142pp; 155 x 235mm; Paperback
Stock No: 02-20258 **Price: 6.50**
The appearance of the Sinclair ZX Spectrum in 1982 was a major event in personal computing. This book takes the Spectrum user in easy stages from his first steps in programming to a good level of competence.
Early chapters give a brief history of the ZX range, and give advice on how to set up the machine and use the keyboard. Subsequent chapters describe one's first steps in BASIC, looping and choice, handling text and numbers, and functions and subroutines. There are three chapters on graphics and sound while the final chapters is devoted to logic and other advanced topics.
The book includes many programming examples, and most chapters contain at least one complete program listing, mainly for games applications. It is clearly and logically written, and will be invaluable to all spectrum users, in the home, education and small business.

INTRODUCING SPECTRUM MACHINE CODE
By Ian Sinclair
1983; 152pp; 230 x 155mm; Paperback.
Stock No: 02-20827 **Price: 8.50**
GET MORE SPEED AND POWER FROM YOUR ZX SPECTRUM! Many of the things you want, like fast moving graphics for games, cannot be achieved with slow-acting, high level languages such as BASIC. Also, actions which have not already been provided for by your Spectrum's in-built BASIC interpreter are just impossible. For instance, you won't be able to use ZX81 cassettes, you cannot renumber a whole set of lines quickly you cannot send serial printer signals to the cassette output, etc. All these, however, and many others can be accomplished by programming the Spectrum directly in machine code. Sooner or later, all microcomputer users feel the need to get to grips with machine code.
Unlike most books on machine code, this has been written specially for the beginner who is carefully shown what to do in easy stages, step by step. A knowledge of machine code will enable you to really master your Spectrum and open up a fascinating range of extra facilities you would hardly have thought possible!

THE ZX SPECTRUM AND HOW TO GET THE MOST FROM IT
By Ian Sinclair
1982; 130pp; 155 x 235mm; Paperback
Stock No: 02-20185 **Price 6.50**
This book is written for the Sinclair SPECTRUM user who is a beginner or has used other machines, particularly the ZX81. It covers the setting up and operation of the machine in detail but from the viewpoint of the beginner, highlighting the difficulties and illustrating how the machine responds to incorrect commands. The beginner is guided through the difficult early stages until he or she feels confident enough to start designing and entering BASIC programs. The book has also been designed to be used as a reference guide for the more experienced user.

ZX81 USER'S HANDBOOK
By T J Terrell & R J Simpson
1982; 138pp; 215 x 135mm; Paperback.
Stock No: 02-12234 **Price: 5.95**
The ZX81 is a fascinating machine that has brought the power of the computer within everyone's reach. But the user is often bewildered by the many facilities offered by the ZX81, and after mastering some simple BASIC programming, finds himself asking questions about the machine:
What is a string and how is it used?
How can I create moving graphics?
How can I interface external hardware?
Why use machine code?
The ZX81 User's Handbook sets out to answer these and many more questions, covering the structure of the ZX81, binary and hexadecimal arithmetic, flow charts, logic, graphics, the Z80A microprocessor work and machine code.
Original programs illustrate these topics (all running on the standard 1K version), and a glossary of over 100 terms is included.

PROGRAMMING WITH GRAPHICS
By Garry Marshall
1983; 120pp; 155 x 235mm; Paperback.
Stock No: 02-20215 **Price: 6.50**
Computer graphics is a fascinating field. It has also become highly topical, as so many of the new personal computers have high-resolution graphics.
This book provides an up-to-date treatment of the subject, covering the three major methods of graphics production. After introductory chapters describing the background to graphics and the principles of its production, there are three chapters devoted to block, pixel and line graphics. The final chapter considers topics such as colour, movement and three-dimensional drawing, and the Appendix summarises the graphics facilities of various micros.
The book is readily understandable by the non-mathematical user, and has the great advantage over most books on this subject of being machine independent. It will therefore be of great interest to all personal computer users who use or wish to use graphics, whether in the home, in education or in business.

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ICR70/R2000
RECEIVERS REVIEWED

William Poel tells you what's going on inside the latest communications receivers.

Loyal readers of **R&EW** will remember the comparative review of the R1000/FRG7700 we published back in 1981. In the short space of time since that review, advances made in the general receiver art have been substantial. Not so much in the areas of signal handling (there are some who grumble that anything since an HRO has been a retrograde step as far as the ability to handle large signals and keep the unwanted products to a minimum is concerned) but in the areas of control and 'function' management. In other words, the invasion of the microprocessor, which means that radio engineering will never be quite the same again — traditionalists might like to muse upon the concept of using servo motors to drive the knobs on their favourite AR88.

The R70 is a significant product for ICOM, who for some reason best known to themselves have wilfully managed to keep out of the HF receiver business until now. Mind you, they've had a fair bit of practice, so it's not surprising that the essence of this receiver is a distillation of their existing HF designs used in transceivers such as the IC720. The R2000 is a very different kettle of fish, setting out to be a general coverage and broadcast receiver. It is a very worthy successor to the R1000, although on first impression it must be said that the R70 has more 'communications' appeal. And so it should, bearing in mind the cost differential.

We shall be very cautious about direct comparisons here. The last time we were forthright and suggested that the FRG7700 could be favourably compared with an NRD515, we failed to include the comment that the comparison was similar to that between a Ford and a Jaguar. So, in the present comparison, the R2000 is the GTXLR 'go faster' model, and the R70 is the laid back 10 litre job. Neither should cause undue distress to the owner of an NRD515, which remains in a league of its own.

Synthesize Or Bust

It's a brave receiver designer that tries to stand firm in the march of progress by insisting that non-synthesized local oscillators are where it's at. Redoubtable characters at Plessey still fly the flag for air spaced tuning capacitors and direct generation of the LO, whilst you could just as easily use the output of the phase detector (adjusting the filter time constants!) to drive a servo on the tuning capacitor — we have yet to hear of anyone doing this seriously enough to want to tell **R&EW** about it.

Both receivers provide fully synthesised steps without interpolation VFOs. The R2000 provides 50Hz, 500Hz and 5kHz, with 200 steps per revolution, but the R70 provides 10Hz, 100Hz and 1kHz with 100 steps per revolution. Purists will warm to the promise of vernier precision on the R70, although the R2000 isn't actually any more tricky to handle — except perhaps if you use a razor sharp CW filter system. The R70 provides only one 'memory', in the shape of the now conventional system of a second VFO. The R2000 grasps the opportunity of the MPU control and goes to town with 10 memories plus a full memory/band scan feature. The full versatility of this feature is best illustrated in conjunction with VHF converters and satellite watching.

Naughty, But Nice

Such things may well have AR88/HRO fans snorting in disgust, but these features need not degrade any other aspect of the performance, so why not just enjoy them? The memories store both the frequency and the mode, and when scanning, the mute operates to hold the scan on busy channels in the FM mode. It's all good fun, and whilst the signal handling may not be of the best, these extras are common enough to persuade owners of older receivers to trade up — or add on an R2000 to help keep as many ears open at once as possible. By careful choice of memory frequency, it's an ideal means of keeping track of HF conditions with the minimum of fuss.

The R70 has more immediately identifiable possibilities for the computer person, since ICOM have been good enough to provide a bigger I/O socket, plus enough of a description of the connections to enable those so inclined to control the whole receiver using an external computer, as we'll shall be exploring shortly. The R70 offers pass-band tuning, and this is one thing that even communications purists cannot deny has great utility in the confusion of modern HF communications. It's worth taking a closer look at PBT, since this is something that can be retrofitted (by the brave) to most dual conversion receivers, and the results really will be immediately detectable.

Any meaningful description of the circuit of either of these receivers requires reference to the detailed circuit diagrams, and whilst we just managed to squeeze in the R1000, FRG7000 and even the NRD515, both of the present receivers have advanced the art of complexity past the point at which it is possible to absorb the manufacturer's block diagrams, let alone the detailed circuit diagrams. The Japanese passion for illustrating block diagrams using every semiconductor as an excuse for another box has now gone too far, so we've simplified that of the R70 to help understand the way these receivers work (***Fig. 1***).

Once Around The Block

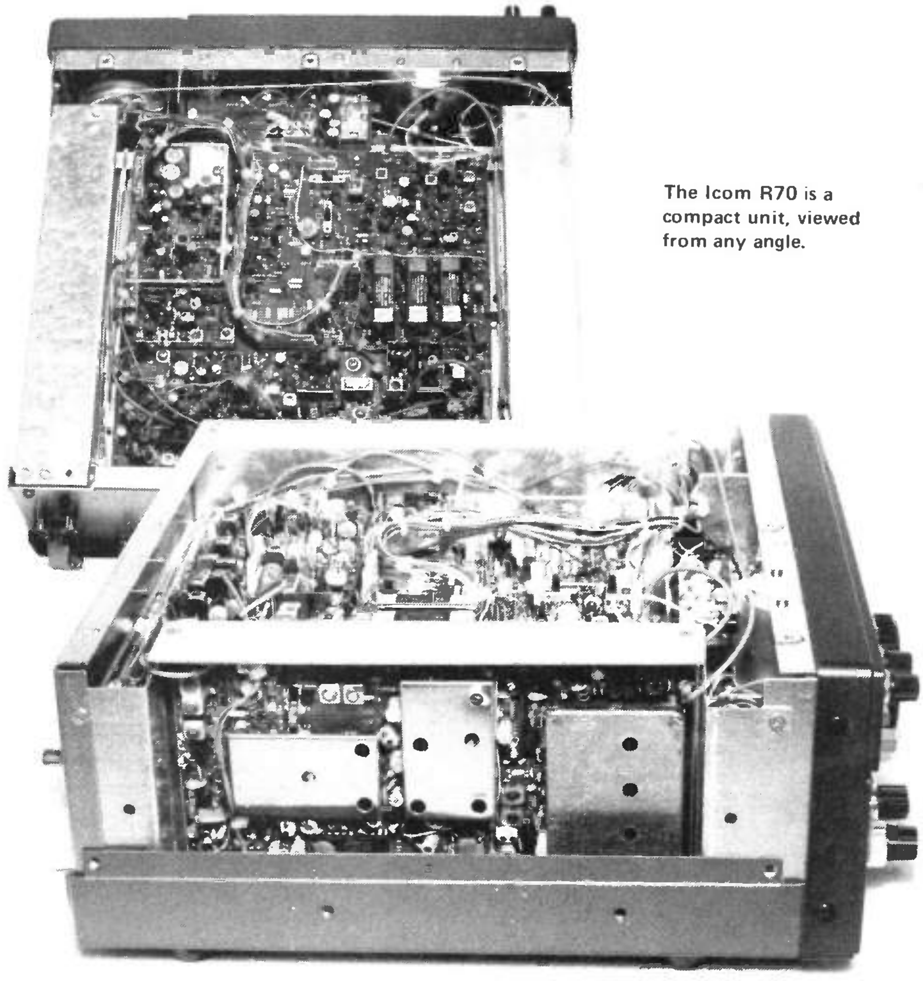
As usual, Trio have a more concise and readable approach which doesn't need much additional comment from us. One of the several noteworthy parts of the R2000 circuit is the use of the CMOS 8049 MPU, since quite apart from power consumption considerations, it's essential to keep the RF noise to a minimum. It's a shame that most non-Japanese micro manufacturers have not yet fully grasped the enormous significance of CMOS MPUs in the real mass marketplaces.

Both receivers employ essentially the same overall configurations, except for the items already noted. The R2000 uses a different set of numbers in VCOs and IFs — but herein lies the major difference from the communications standpoint, since the R2000 doesn't put all its selectivity up front, but keeps the first and second IFs wide enough to account for the fact that the first LO steps in 25kHz increments, the 2nd LO is fixed, and the 50Hz interpolation occurs at a ratherly gingerly 400kHz'ish, resulting from the division of the VCO in the IC2 PLL loop by 100 in IC3. This means, if there's a strong signal less than 25kHz away from the weak one you want to hear, then they all get to the last IF filter before meaningful filtration occurs. The 3rd mixer may well decide that it's had enough before that can occur.

The R70 uses the textbook procedure and puts a 15kHz bandwidth crystal filter right up front at 70.4515MHz — the first LO is the only variable oscillator (excepting the pass band tuning system). As anyone with a brief practical aquaintance with PLL synthesis will have discovered, you don't get 10Hz resolution at 100MHz by direct methods, dual modulus or not. The R70 achieves 10Hz steps through the use of multiple mixings and divisions. A shortage of details on the ICs involved precludes us from making a proper analysis of what is going on, but whatever it is, it's so grossly complex that we'd rather bypass this technology and use the mental energy to work with the MC14515X series of synthesiser devices that we know and love. The convoluted machinations of this scheme achieve their objectives by generating the 10Hz at a sufficently low frequency to make for practical loop design.

And The Rest

The noise blanking systems in both receivers work well, with the additional refinement of the R70 having a wide/narrow facility to take into account the longer 'woodpecker' noises (wide — referring to the pulse width rather than



The Icom R70 is a compact unit, viewed from any angle.

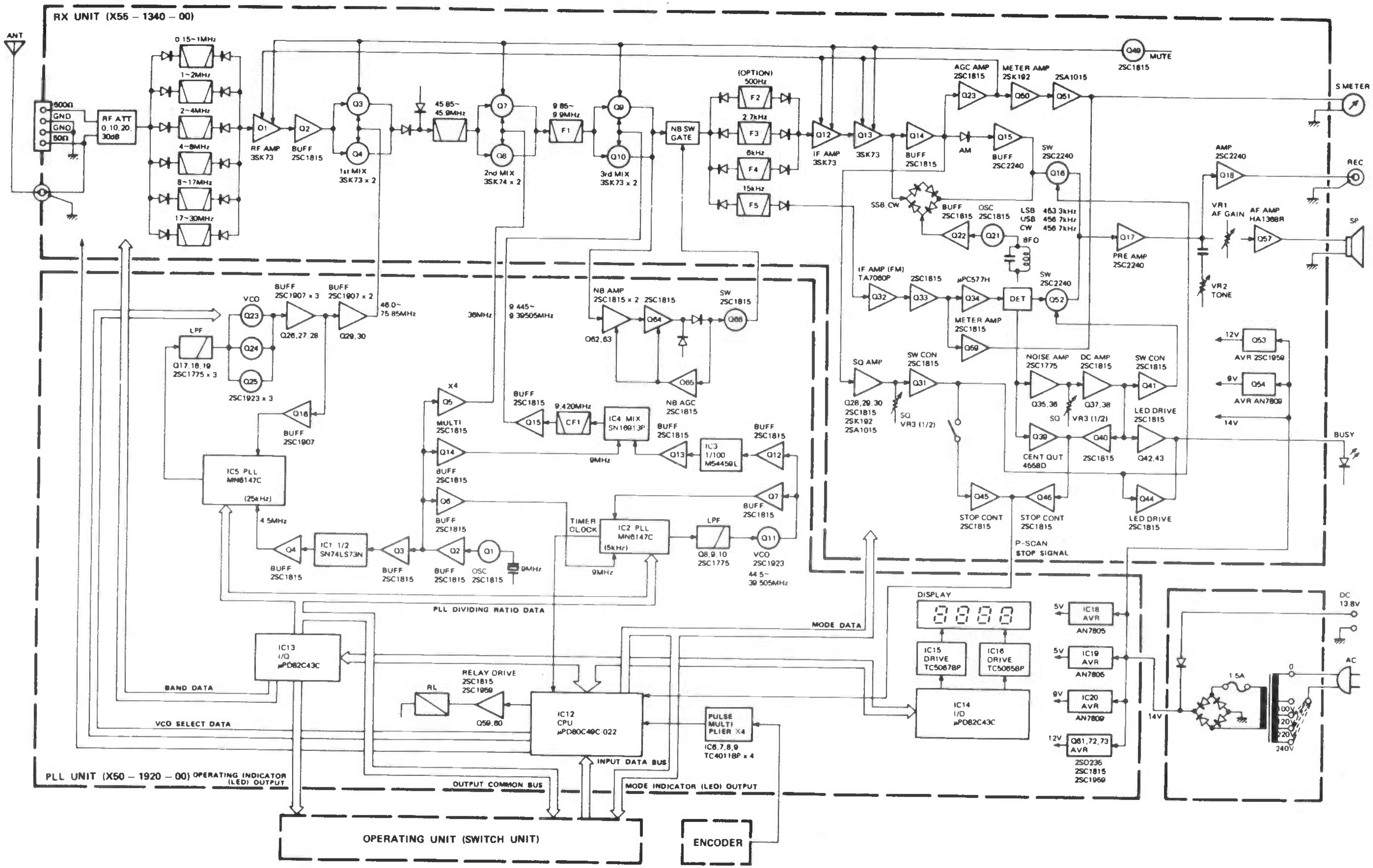


Figure 1: Block diagram of the R2000, showing both the HF and PLL sections.

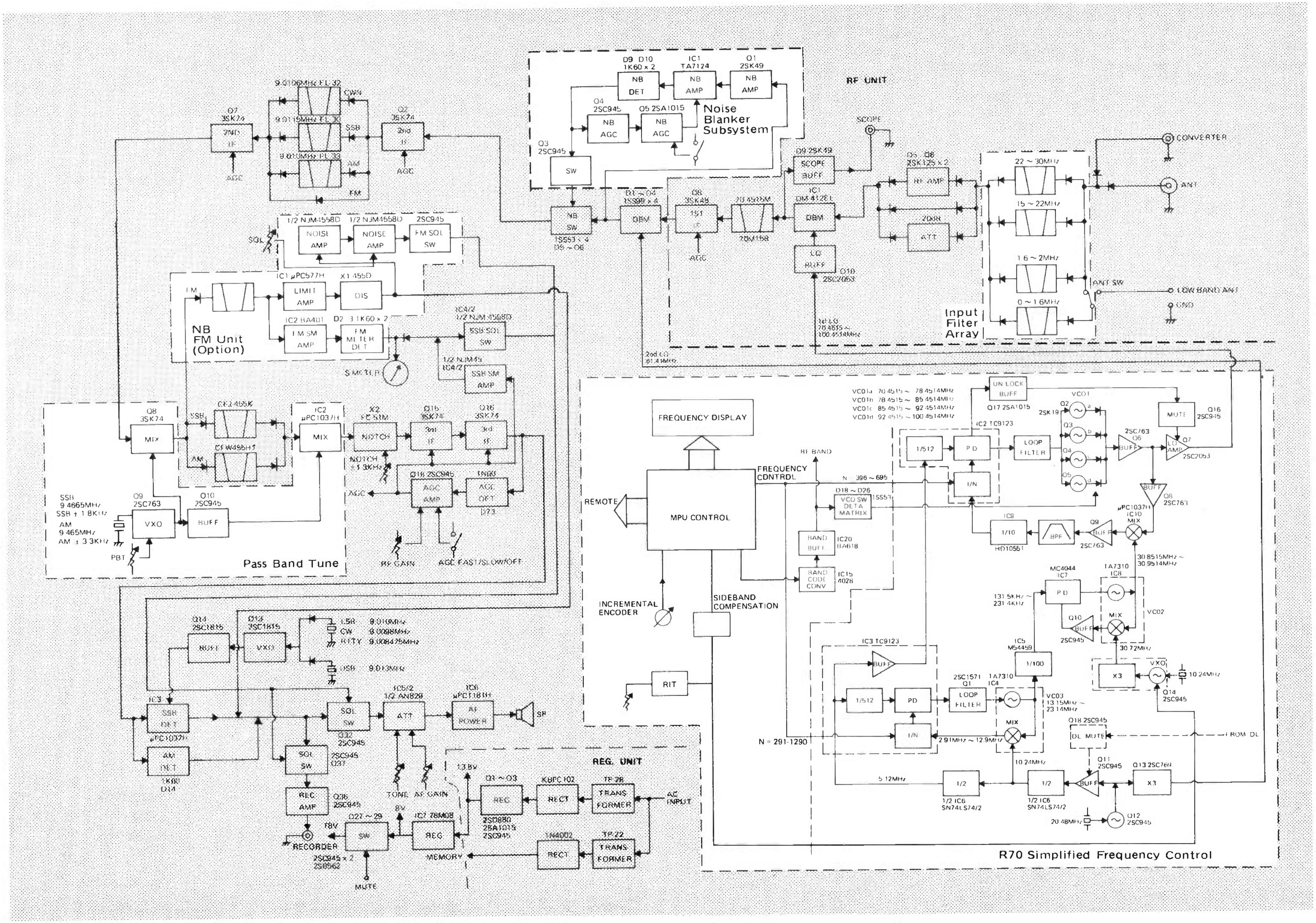
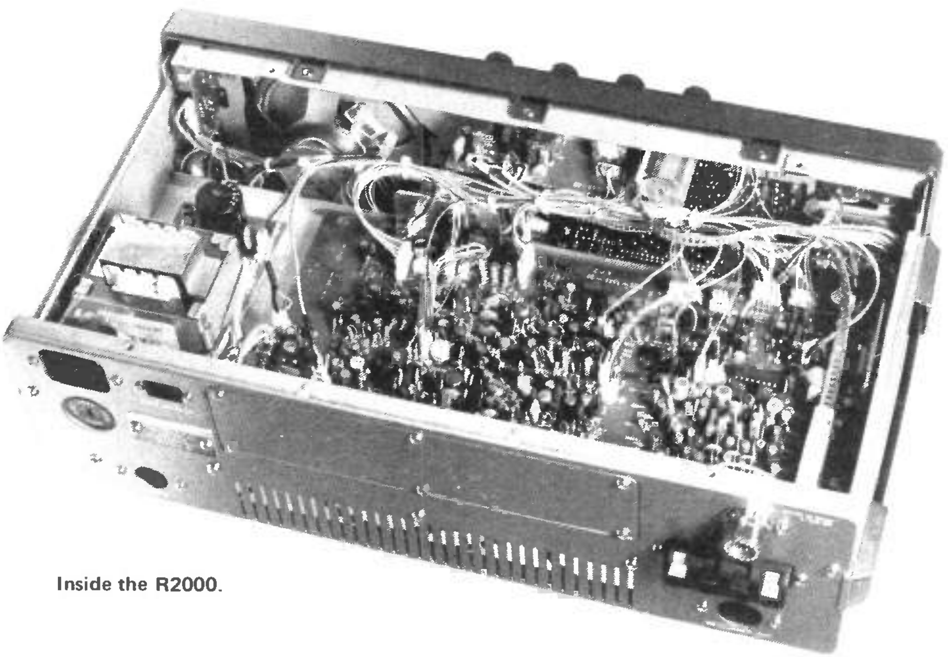


Figure 2: The Icom R70 block diagram, with the main areas highlighted.



Inside the R2000.

anything to do with selectivity), as well as ignition and similar shorter impulse noises. Likewise both receivers include FM facilities (it's an option on the R70), which works perfectly well in both cases — the adoption of squelch on all modes is very welcome, if a somewhat sudden departure from previous HF receiver practice.

RF gain works on the AGC loops in both cases, providing compensation on S meter readings in the approved manner. In fact, these two receivers seem to have remembered just about everything anyone might possibly have thought about when conceiving an 'ultimate' HF receiver system. Those of you who like to sit and muse upon such things should not, however, give up in despair that there's nothing left to do, since the truly vast numbers of parts in these receivers stem from the very introspective Japanese 'not invented here' mentality which denies them access to some of the bits that US and European designers are prepared to include.

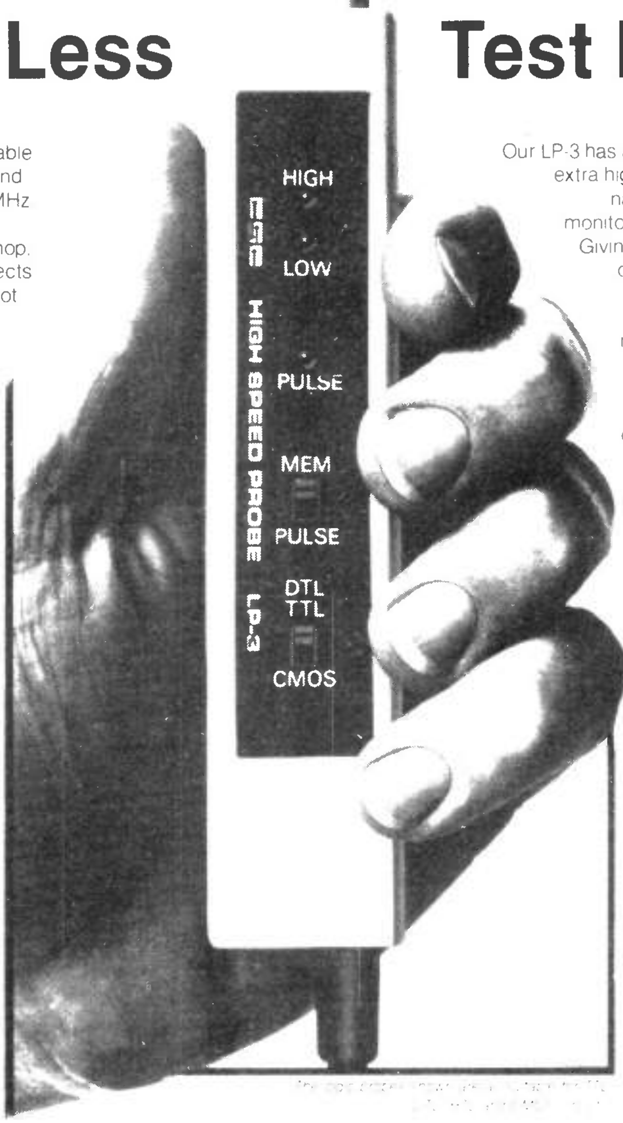
There's scope for simplifying the designs, and turning them into something a good deal more modular. But there is still a very real danger that the erstwhile designer will be so disheartened by the enormity of what messrs ICOM and TRIO have laid on him, that he will not bother to try and keep abreast of design trends any longer. Don't do it!

We'll be taking the designs apart, a bit at a time, to examine the latest in HF Rx design philosophy and suggest alternatives — and hope that some of it finds its way into the designs of our readers.

■ R&EW

The Logic Probes

Spend Less Test More



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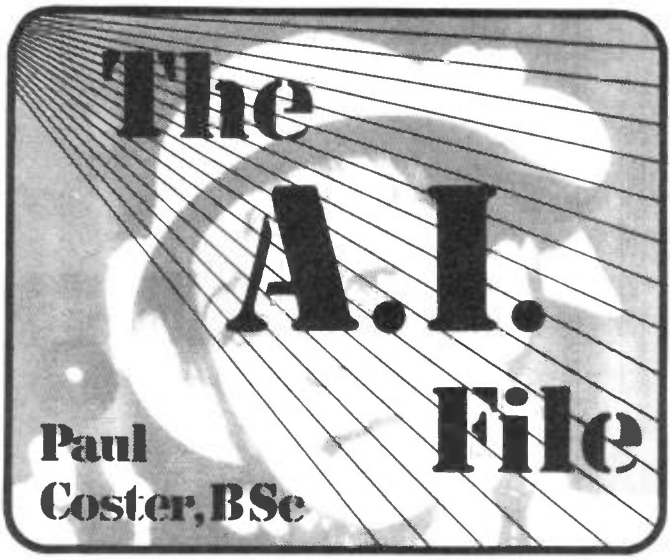

The sixties saw the birth of a number of programs which could converse and answer questions in English. One of the more famous of these 'human mimics', ELIZA, is analysed this month, to exemplify some of the shortcomings associated with conversational programs.

Followers of this series have probably, by now, acquired a somewhat sceptical outlook on Artificial Intelligence. This is not necessarily a bad thing, since all too often wild claims are made for programs supposedly exhibiting human traits such as creativity and intelligence. To the author's knowledge, no system exists at the present time which transcends the limitations imposed by its algorithmic roots — many machines can *act* in a human fashion, but there is always an underlying logic which says 'if A then B (or NOT B)', and in the final analysis a digital signal can only be high or low.

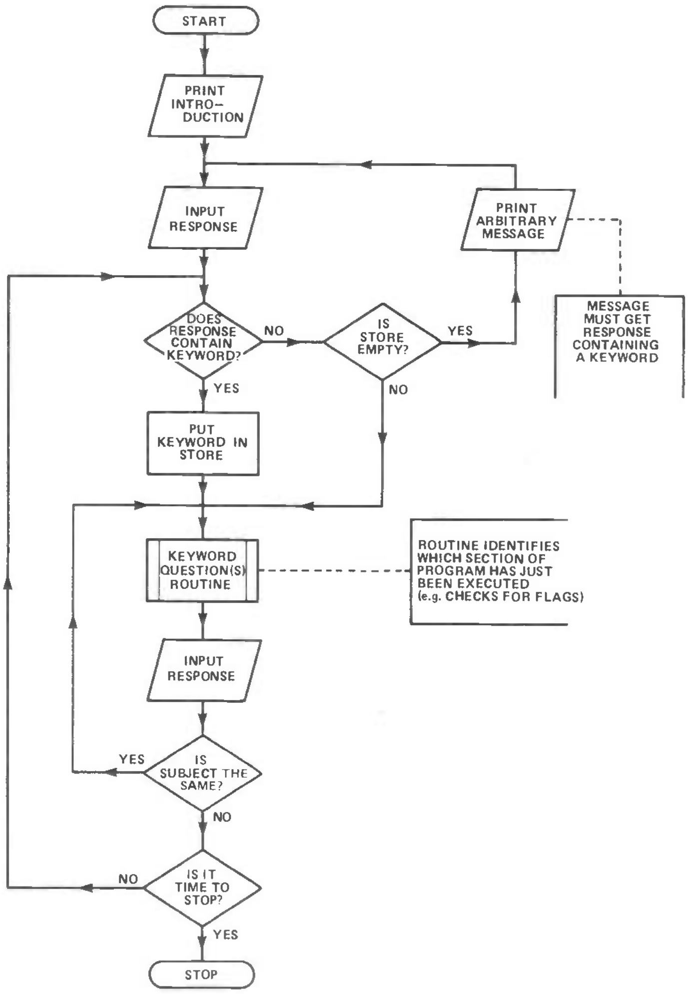

Figure 1. Flowchart reflecting the structural basis of programs which respond to questions using a key word searching routine.

1 My husband made me come here

2 Your husband made you come here

3 He says I'm depressed a lot of the time

4 I am sorry to hear that you are depressed

5 It's true. I am unhappy

6 Do you think that coming here will help you not to be unhappy

7 I need some help, that's for sure

8 What would it mean to you if you got some help

9 Perhaps I could learn to get along with my mother

10 Tell me more about your family

11 My mother looks after me

12 Who else in your family looks after you

13 My father

14 Your father

15 You are like by father in some ways

16 What resemblance do you see

17 You are not very aggressive, but I think you don't want me to notice that

18 What makes you think I am not very aggresive

19 You don't argue with me

20 Why do you think I don't argue with you

21 You are afraid of me

22 Does it please you to think I am afraid of you

23 My father is afraid of everyone

24 What else comes to mind when you think of your father

25 Bullies

26 Does that have anything to do with the fact that your husband made you come here

Table 1. Example of ELIZA's (italics) question and answer abilities (adapted from Weizenbaum, 1966).

The Turing Test And Other Fables

With this fact in mind, it's surprising to note that prior to the appearance of conversational programs onto the AI scene, a British scientist called Alan Turing had proposed a test for establishing whether a machine could 'think'. It comprised a game involving the machine and two people, assigned the letters 'A', 'B' and 'C' respectively. Each of B and C is isolated in a room with a computer terminal — their only means of communication. Person C's task is to ask questions of A and B in order to determine which is the machine and who is the person. The task confronting A and B is then to prevent C from discovering whether they are machine or person. Turing suggested that if C was ever unable to identify A and B reliably, then machine A must be capable of thought.

The Turing Test, though seemingly well designed, merely served to motivate a wave of AI research into producing a system to 'beat the test'. In effect, the goal became to develop a machine that could convince the person operating it that he or she was conversing with *another person*, rather than a machine. The problem with this line of reasoning becomes apparent when it is realized that programs *do* currently exist which can fool their operators into believing they are speaking to some mysterious person or intelligence 'behind' the machine; the point being that the programmers responsible for these technological miracles would never consider them capable of thought. In other words, the programs' creators know the sort of responses that will be elicited by a given question — can you consistently and accurately predict the way someone else will answer a particular set of questions? Creating a machine which *appears* to think is quite a different matter from coming up with one that *does* think (although we'll leave you to ponder the question as to how to differentiate between a person who *is* thinking and someone *pretending* to think).

Eliciting ELIZA

Having exposed the distinction between acting intelligently and possessing intelligence, we can move on to examining a specimen of the former — Joseph Weizenbaum's ELIZA. ***Table 1*** shows a typical conversation session with ELIZA. More importantly, it reveals certain key points about the program's *modus operandi*. In the first two lines, ELIZA responds to the statement 'My husband made me come here', by merely transforming the pronouns 'my' to 'your' and 'me' to 'you', then repeating the statement. This process of repeating a question by 'reflecting' it back at the person you are talking to, is a common enough occurence in everyday conversation, with intonation providing the interrogative form.

Another of ELIZA's techniques is to latch onto particular key words in a statement and respond with a comment or observation. For example, the word 'depressed' in line 3 appears again in line 4. The same is true for 'unhappy' (5 and 6), 'help' (7 and 8 — qualified as 'some help'), 'agressive' (17 and 18), 'argue' (19 and 20) and so on. A variation on this is obtained by the use of a collective noun instead of the one supplied. In line 8 ELIZA asks 'What would it mean to you if you got some help', to which the reply 'Perhaps I could get along with my mother' is given. Now, rather than posing a question based around the word 'mother', ELIZA employs the collective noun 'family', thereby exhibiting a further aspect of its structure — a database including examples of nouns which form part of a collective group.

A 'clever' extension of the noun-collective noun transition, is shown in lines 15 and 16. Here the statement 'You are like my father' contains the preposition 'like', meaning 'similar to'. The response, utilising the words supplied, would be 'In what ways am I like your father', but this has quite a complex construction. So, ELIZA employs the noun derived from the transitive verb 'resemble' and asks the question 'what resemblance do you see'. The point to notice is that this question could apply equally to any 'You are like..' sentence.

Who brought you here?

The Police

What trouble did you have with the Police

Cops don't do their job

What do they do then?

Cops arrest the wrong people

They arrest the right ones at times

The law should get those Italian crooks

Are you Italian?

My background is British, but I was born in this country

Do you know any Italian crooks?

I try to avoid the underworld

Are you afraid of the underworld

The Mafia are the worst gangtsers

Are you connected with the Mafia?

You know, they know me

How do they know you?

They spy on me

Why do they do that?

They want to get false evidence to frame me

What is it they have against you?

They are out to get me

What for?

I have incriminating evidence against the Mafia

Are you sure of this?

You don't believe me

I am doing my best

Table 2. An extreme case of paranoid schizophrenia, as modelled by PARRY; shown in italics (adapted from Colby, 1972).

Problem Corner

Perhaps the most interesting feature of the ***Table 1*** interaction is contained in lines 24-26. Having just responded to a statement concerning the subjects' father (line 24), ELIZA is confronted by the one-word answer, 'Bullies'. Without recourse to some other information, the machine's response cannot relate to line 25 directly, so ELIZA refers back to some previous subject. It still manages to ensure the link isn't unnatural, by asking whether the subject of line 25 is related to that in line 1. This is a rather more refined technique than simply continuing the dialogue with a new and unrelated topic, but it amounts to the same thing. There are programs, however, which unashamedly resort to the latter. ***Table 2*** shows an extract from a session with one such program, called PARRY, which may be excused its disjointed and convoluted conversational style, since it was designed to act in a manner similar to someone suffering from paranoia. And if, after reading through the interview, you think it's easy to tell that a machine was behind the responses, then consider the amusing fact that similar extracts fooled psychiatrists in America, who could not distinguish between diagnosed paranoiacs and PARRY.

■ **R&EW**

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74LS257	31 74257	0.36
74LS258	31 74258	0.36
74LS259	31 74259	0.51
74LS260	31 74260	0.26
74LS266	31 74266	0.20
74LS273	31 74273	0.70
74LS279	31 74279	0.35
74LS283	31 74283	0.40
74LS290	31 74290	0.40
74LS293	31 74293	0.40
74LS298	31 74298	0.54
74LS365	31 74365	0.34
74LS366	31 74366	0.40
74LS367	31 74367	0.30
74LS368	31 74368	0.30
74LS373	31 74373	0.72
74LS374	31 74374	0.72
74LS375	31 74375	0.31
74LS377	31 74377	0.60
74LS378	31 74378	0.44
74LS379	31 74379	0.44
74LS385	31 74385	1.30
74LS386	31 74386	0.27
74LS390	31 74390	0.51
74LS393	31 74393	0.48
74LS398	31 74398	0.80
74LS399	31 74399	0.65
74LS490	31 74490	0.60
74LS670	31 74670	1.15

74CXX

Type	Stock No.	Price
74C00	29 07400	0.35
74C02	29 07402	0.35
74C04	4069C	
74C08	29 07408	0.35
74C10	29 07410	0.35
74C14	4584C	
74C20	29 07420	0.35
74C30	29 07430	0.35
74C32	29 07432	0.35
74C42	29 07442	1.05
74C48	29 07448	1.50
74C73	29 07473	0.75
74C74	29 07474	0.75
74C76	29 07476	0.60
74C83	29 07483	1.30
74C85	29 07485	1.30
74C86	29 07485	1.30
74C89	29 07489	3.60
74C90	29 07490	1.05
74C93	29 07493	1.05
74C95	29 07495	1.25
74C107	29 74107	0.60
74C151	29 74151	2.10
74C154	29 74154	3.05
74C157	29 74157	2.10
74C160	40160	
74C1610	40161CM	
74C1620	40162CM	
74C1630	40163CM	
74C164	29 74164	1.05
74C165	29 74165	1.10
74C173	4076C	
74C1740	40174CM	
74C1750	40175CM	
74C1920	40192CM	
74C1930	40193CM	
74C1950	40195CM	
74C200	29 74200	6.50
74C221	29 74221	1.55
74C901	29 74901	0.55
74C902	29 74902	0.55
74C903	29 74903	0.55
74C904	29 74904	0.55
74C905	29 74905	6.50
74C906	29 74906	0.55
74C907	29 74907	0.55
74C908	29 74908	1.10
74C909	29 74909	2.10
74C910	29 74910	5.00
74C914	29 74914	1.10
74C918	29 74918	1.30
74C925	29 74925	6.00
74C926	29 74926	6.00
74C927	29 74927	6.00

74HCXX

Type	Stock No	Price
74HC00	30 07400	0.56
74HC02	30 07402	0.56
74HC04	30 07404	0.68
74HC10	30 07410	0.56
74HC20	30 07420	0.56
74HC86	30 07486	0.74
74HC132	30 74132	1.26
74HC266	30 74266	0.81
74HC4002	30 04002	0.56
74HC4075	30 04075	0.56
74HC242	30 74242	2.00
74HC243	30 74243	2.00
74HC74	30 07474	0.74
74HC109	30 74109	0.68
74HC175	30 74175	1.08
74HC373	30 74373	2.40
74HC374	30 74374	2.40
74HC533	30 74533	2.40
74HC534	30 74534	2.40
74HC165	30 74165	1.96
74HC173	30 74173	1.20
74HC160	30 74160	1.33
74HC161	30 74161	1.33
74HC162	30 74162	1.33
74HC163	30 74163	1.33
74HC4538	30 74538	2.10
74HC85	30 74280	2.95
74HC280	30 74280	2.95
74HC42	30 07442	1.00
74HC138	30 74138	1.08
74HC139	30 74139	1.08
74HC4514	30 04514	3.40
74HC4543	30 04543	2.75
74HC157	30 74157	0.92
74HC158	30 74158	0.90
74HC257	30 74257	0.90

LINEAR ICs

Type	Stock No	Price
LM10CN	61 00010	3.88
MF10	61 00011	5.05
L149	61 00149	1.86
ZNA234	61 02340	8.50
U237B	61 00237	1.28
U247B	61 00247	1.28
U257B	61 00257	1.28
U267B	61 00267	1.28
LM301AH	61 03010	0.67
LM301AN	61 03011	0.27
LM308H	61 03080	0.70
LM308CN	61 03081	0.65
LM324	61 03240	0.45
LM339N	61 03390	0.66
LF347	61 00347	1.60
LM348	61 03480	0.90
LF351	61 03510	0.49
LF353	61 03530	0.76
LM380N	61 00380	1.00
LM381	61 00381	1.81
LM382	61 00382	1.81
ZN419CE	61 00419	1.98
ZNA423	61 04230	1.00
ZN425E 8	61 04250	3.50
ZN426E 8	61 04260	3.00
ZN427E 8	61 04270	6.28
ZN428E 8	61 04280	4.78
ZN429E 8	61 04290	2.10
ZN432CJ10	61 04320	28.09
ZN433CJ10	61 04330	22.59
ZN450E	61 04500	7.61
NE542	61 05420	1.20
NE544	61 00544	1.80
NE555N	61 05550	0.20
NE556N	61 05560	0.50
SL560C	61 05600	1.98
NE562	61 00562	4.05
NE564	61 00564	4.29
NE565	61 00565	1.00
NE566	61 00566	1.30
NE567	61 00567	1.30
NE570N	61 00570	3.85
SL624	61 00624	3.28
uA709HC	61 07090	0.64
uA709PC	61 07091	0.36
uA710HC	61 07100	0.64
uA710PC	61 07101	0.59
uA711CN	61 07110	0.85
uA733CN	61 07330	0.89
uA741CH	61 07410	0.66
uA741CN	61 07411	0.20
uA747CN	61 07470	0.70
uA748CN	61 04780	0.30
uA758	61 00758	2.35
TBA820M	61 00820	0.78
TDA1028	61 01028	2.11
TDA1029	61 01029	2.11
ZNA1034	61 01034	2.10
LM1035	61 01034	2.10
TDA1054M	61 01054	1.45
TDA1062	61 01062	1.95
TDA1072	61 01072	2.69
TDA1074A	61 01074	5.04
TDA1083	61 01083	1.95
TDA1090	61 01090	3.05
HA1137	61 12411	1.20
HA1196	61 01196	2.00
HA1197	61 01197	1.00
TDA1220	61 01220	1.40
LM1303	61 01303	0.99
LM1307	61 01307	1.55
MC1310P	61 01310	1.90
MC1330	61 01330	1.20
MC1350	61 01350	1.20
HA1370	61 11370	1.90
HA1388	61 01388	2.75
LM1458N	61 14580	0.45
MC1496P	61 01496	1.25
SL1610	61 01610	1.92
SL1611	61 01611	1.92
SL1612	61 01612	1.92
SL1613	61 01613	2.06
SL1620	61 01620	2.50
SL1621	61 01621	2.50
SL1623	61 01623	2.50
SL1625	61 01625	2.50
SL1626	(SL6270)	
SL1630	61 01630	1.62
SL1640	61 01640	2.25
SL1641	61 01641	2.25
MC1648	61 01648	3.25
TDA2002	61 02002	1.25
ULN2240	61 02240	3.25
ULN2242	61 01090	3.05
ULN2283	61 02283	1.00
CA3060	61 03080	0.70
CA3089	61 03089	1.84
CA3123	61 03123	1.40
CA3130E	61 31300	0.80
CA3130T	61 31301	0.90
CA3140E	61 31400	0.46
CA3189E	61 03189	2.20
CA3240E	61 32400	1.27
MC3357	61 03357	2.85
MC3359 (see ULN3859)		
ULN3859	61 03859	2.95
KM3701	61 03701	85.53
KM3702	61 03702	74.84
LM3900	61 39000	0.60
LM3909N	61 39090	0.68
LM3914N	61 03914	2.80
LM3915N	61 03915	2.80
KB4400	61 04400	0.80
KB4412	61 04412	1.95
KB4413	61 04413	1.95
KB4417	61 04417	1.80
KB4420B	61 04420	1.09
TDA4420	61 14420	2.65
TDA4421	61 14421	2.65
KB4423	61 04423	2.30
KB4424	61 04424	1.65
KB4430	61 04430	2.30
KB4431	61 04431	1.95
KB4432	61 04432	1.95
KB4433	61 04433	1.52
KB4436	61 04436	2.53
KB4437	61 04437	1.75
KB4438	61 04438	2.22
KB4441	61 04441	1.35
KB4445	61 04445	1.29
KB4446	61 04446	2.75
KB4448	61 04448	1.65
NE5044	61 05044	2.26
MC5229	61 05229	9.60
NE5532	61 55320	1.85
KM5624	61 05624	4.35
SD6000	61 06000	3.75
SL6270	61 06270	2.03
SL6310	61 06310	2.45
SL6440	61 06440	3.38
SL6600	61 06600	3.75
SAS6610	61 06610	1.48
SL6640	61 06640	2.75
SL6690	61 06690	3.75
SL6700	61 06700	2.75
SAS6710	61 06710	1.48
LS7225	61 07225	3.65
ICM7555	61 75550	0.80
CL8038CC	61 08038	4.50
MSL9362	61 09362	1.75
MSL9363	61 09[illegible]	1.75
K10170	61 10170	1.87
TK10321	61 10321	2.75
HA11223	61 11223	2.15
HA11225	61 11225	1.45
HA12002	61 12002	1.22
HA12017	61 12017	0.80
HA12402	61 12402	1.95
HA12411	61 12411	1.20
HA12412	61 12412	1.55
LF13741	61 13741	0.33
MK50366	61 50366	3.35
MK50375	61 50375	3.85
MM53200	61 53200	3.90

PRESCALER

Type	Stock No	Price
U264	61 02640	2.27
U265	61 02650	3.16
U266	61 02660	2.43
11C90DC	61 01190	12.95
MSL2312R	61 02312	3.94
MSL2318	61 02318	3.84
MSM5523	61 05523	11.30
MSM5524	61 05524	11.30
MSM5525	61 05525	7.85
MSM5526	61 05526	7.85
MSM55271	61 55271	9.75
ICM7106CP	61 07106	9.55
ICM7107CP	61 07107	9.55
LC7137	61 07137	7.50
ICM7216B	61 72161	19.50
ICM7216C	61 72162	19.95
ICM7217A	61 07217	9.50
SP8629	61 08629	3.85
SP8647	61 08647	6.00
SP8793	61 08793	7.70
95H90	61 09590	7.80
HD10551	61 10551	2.45
HA12009	61 12009	6.00
HD44015	61 44015	4.45
HD44752	61 44752	8.00
MC145151P	61 14151	6.00
MC145152P	61 14151	6.60
MC145156P	61 14156	4.60

SMALL SIGNAL AUDIO

Type	Stock No	Price
BC182	58 00182	0.10
BC212	58 00212	0.10
BC237	58 00237	0.08
BC238	58 00238	0.08
BC239	58 00239	0.08
BC307	58 00307	0.08
BC308	58 00308	0.08
BC309	58 00309	0.08
BC327	58 00327	0.13
BC337	58 00337	0.13
BC413	58 00413	0.10
BC414	58 00414	0.11
BC415	58 00415	0.10
BC416	58 00416	0.11
BC546	58 00546	0.12
BC550	58 00550	0.12
BC556	58 00556	0.12
BC560	58 00560	0.12
BC639	58 00639	0.22
BC640	58 00640	0.22
MPSA13	58 04013	0.30
MPSA63	58 04063	0.30
ZTX108	58 01108	0.10
ZTX212	58 01212	0.10
ZTX653	58 01653	0.20
ZTX753	58 01753	0.20
2N2904	58 02904	0.25
2N2905	58 02905	0.25
2N3905	58 03905	0.10
2SB646A	58 03646	0.30
2SB648A	58 03648	0.40
2SD666A	58 03666	0.30
2SD668A	58 03668	0.40
2SA872A	58 02872	0.19
2SA1084E	58 01084	0.25
2SA1085E	58 01085	0.25
2SC1775A	58 01775	0.19
2SC2546E	58 02546	0.24
2SC2547E	58 02547	0.24

AUDIO POWER

Type	Stock No	Price
BD139	58 15139	0.29
BD140	58 15140	0.31
BD165	58 15165	0.46
BD166	58 15166	0.48
BD179	58 15179	0.38
BD180	58 15180	0.41
TIP31A	58 15031	0.35
TIP32A	58 15032	0.35
MJ2955	58 12955	0.68
2N3055	58 13099	0.58
2SB720	58 15720	0.60
2SD760	58 17600	0.60
2SJ49	60 01049	3.10
2SJ50	60 01050	4.25
2SJ83	60 01083	3.55
2SK134	60 00134	3.10
2SK135	60 00135	4.25
2SK227	60 00227	3.55
2SD753	58 03753	2.34

SMALL SIGNAL RF

Type	Stock No	Price
BFY50	58 06500	0.22
BF241	58 06241	0.18
BF273	58 06273	0.18
BF274	58 06274	0.20
BF362	58 06362	0.49
BF440	58 06440	0.21
BF441	58 06441	0.21
BF479	58 06479	0.66
BF6795	58 06679	0.55
BFR91	58 07091	1.33
BFT95	58 10095	0.99
BFW92	58 08092	0.60
BFY90	58 09090	0.90
NE21936	58 21936	5.00
ZTX323	58 06232	0.60
2N2369A	58 02369	0.38

RF POWER

Type	Stock No	Price
BFW16A	58 08016	0.65
MRF237	58 14237	3.20
MRF238	58 14238	16.50
MRF245	58 14245	40.00
MRF449A	58 14449	16.50
MRF472	58 14472	1.25
MRF475	58 14475	4.60
MRF629	58 14629	4.99
PT8811	58 18811	9.50
TP2320	56 12320	10.24
VN66AF	60 02066	0.95
ZTX3866	58 03866	0.45
2N3866	58 13866	1.20

SMALL SIGNAL FET

Type	Stock No	Price
BF256	59 00256	0.38
BF960	60 06960	0.99
BF961	60 06961	0.70
BF963	60 06963	0.99
J310	59 02310	0.69
J176	59 02176	0.65
2SK55	59 01055	0.32
2SK168	59 01168	0.37
3SK45	60 04045	0.49
3SK51	60 04051	0.54
3SK60	60 04060	0.58
3SK88	60 04088	0.99
40673 see 3SK51		
40822 see 3SK51		
40823	60 03823	0.65
3SK112	60 04112	4.60

DIODES

Type	Stock No	Price
AA112	12 01126	0.25
BA244	12 02447	0.17
BA379	12 03797	0.35
ND4981 7E	12 49817	0.51
OA91	12 00916	0.07
OA47	12 00476	0.10
PW02	12 62006	0.75
S04	12 24006	0.45
W005	12 10506	0.28
1N4001	12 40016	0.06
1N4002	12 40026	0.07
1N4004	12 40046	0.07
1N4148	12 41486	0.05
1N5404	12 54046	0.16
1N6263	12 62637	0.62

VARICAPS

Type	Stock No	Price
BA102	12 01025	0.30
BA121	12 01215	0.30
BB105B	12 01055	0.30
BB109B	12 01095	0.27
BB204B	12 02045	0.36
BB212	12 02125	1.95
ITT210	12 02105	0.30
MVAM115 see KV1236		
MVAM125 see KV1225		
KV1210	12 12105	2.45
KV1211 see KV1236		
KV1225	12 12255	2.75
KV1235	12 12355	2.75
KV1236	12 12365	2.55
KV1310	12 13105	0.40
KV1310	12 13205	0.40

ZENER DIODES

BZY88C 400mW 5%

Type	Stock No	Price
2V7	12 00278	0.10
3V3	12 00338	0.10
3V9	12 00398	0.10
4V7	12 00478	0.10
5V1	12 00518	0.10
5V6	12 00568	0.10
6V8	12 00688	0.10
8V2	12 00828	0.10
9V1	12 00918	0.10
10	12 01008	0.10
11	12 01108	0.10
12	12 01208	0.10
15	12 01508	0.10
18	12 01808	0.10
22	12 02208	0.10
27	12 02708	0.10
33	12 03308	0.10

SCRS TRIACS

Type	Stock No	Price
BRY55 100	52 55100	0.50
C10601	52 00106	0.70
C12201	52 00122	1.45
2N6403	52 06403	2.22
2N6073A	58 06073	0.98

BALANCED MIXERS

Type	Stock No	Price
SBL1	12 00003	4.88
SBL1-8	12 00013	5.00
SBL1-X	12 00023	6.33
SRA1	12 00033	10.80
SRA1 1	12 00043	12.77
SRA1H	12 00053	18.34
SRA3	12 00063	15.35

LEDs

Type	Stock No	Price
3mm round types		
CQX25 Red/Clr	15 20250	0.15
V178P Red	15 01780	0.15
CQX26 Gr/Clr	15 20260	0.16
V179P Green	15 01790	0.16
CQX27 Yel/Clr	15 20270	0.18
V180P Yellow	15 01800	0.18
CQX41A Or/Rd	15 20410	0.19
Standard 5mm DIA LEDs		
CQY40L Red	15 10400	0.12
CQY72L Green	15 10720	0.15
CQY74L Yellow	15 10740	0.15
CQX38A Or/rd	15 20380	0.20
CQX39B O/ncl	15 20390	0.29
Rectangular 2.5 x 5mm LEDs		
CQX10 Red	15 20100	0.17
CQX11 Green	15 20110	0.20
CQX12 Yellow	15 20150	0.20
CQX40 Or Red	15 20400	0.24
Infra-Red LEDs		
CQY99 Emit	15 10990	0.56
BPW41 Det	15 30410	1.51

I R Optocoupler

Type	Stock No	Price
BNY37	15 40370	1.44

FLAT DIFFUSED

Type	Stock No	Price
V320	15 03200	0.17
V321	15 03210	0.26
V322	15 03220	0.20
V323	15 03230	0.20
V330	15 03300	0.17
V331	15 03310	0.26
V332	15 03320	0.20
V333	15 03330	0.20
V340	15 03400	0.17
V341	15 03410	0.26
V342	15 03420	0.20
V343	15 03430	0.20
V510	15 05100	0.17
V511	15 05110	0.26
V512	15 05120	0.20
V513	15 05130	0.20
V520	15 05200	0.17
V521	15 05210	0.26
V522	15 05220	0.20
V523	15 05230	0.20
V530	15 05300	0.17
V531	15 05310	0.26
V532	15 05320	0.20
V533	15 05330	0.20
V540	15 05200	0.17
V541	15 05410	0.26
V542	15 05420	0.20
V543	15 05430	0.20
V550	15 05500	0.17
V551	15 05510	0.26
V552	15 05520	0.20
V553	15 05530	0.20

TRI COLOUR

Type	Stock No	Price
V518	15 05180	0.60

Ambit international

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Telex 995194 AMBIT G
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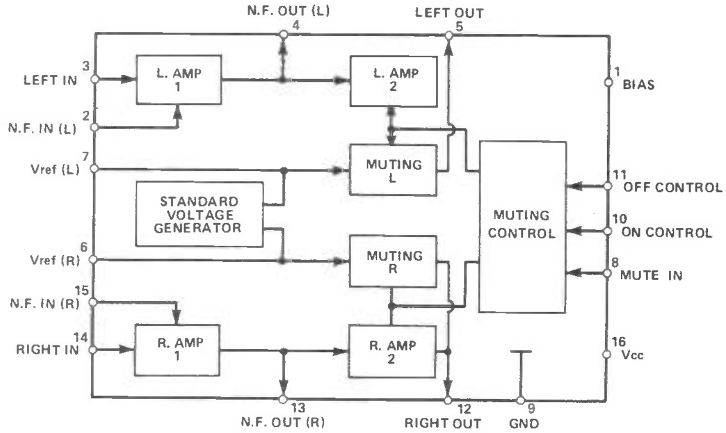
R&EW Data Brief

KB4438

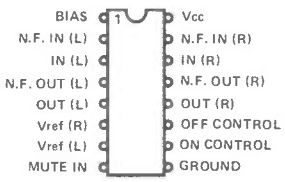
Muting system with AF amplifier

The KB4438 from Toko is a low noise, low distortion dual channel pre-amplifier circuit, specifically designed to follow a stereo decoder in FM tuner applications. It features sufficient gain to overcome the insertion loss of high quality pilot tone filters and de-emphasis circuits, yet still produces up to 3.2V RMS output. Other features include a muting facility of around 80dB, a slow turn-on controlled by an RC network. To this may be added a separation figure of 80dB; channels balanced to within ± 0.5dB.

The IC may also be used in other applications as a straightforward pre-amplifier by leaving out the pilot tone filters and de-emphasis capacitors from the applications board shown..



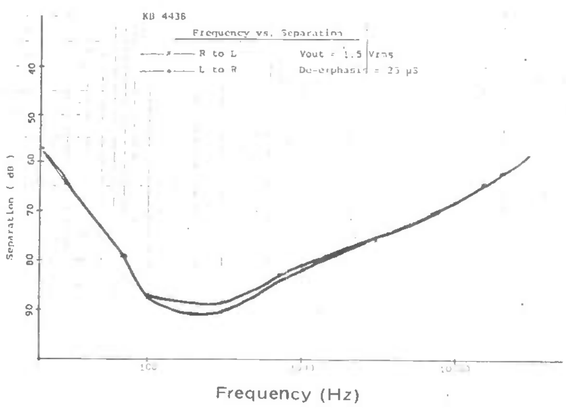
KB 4438 block diagram



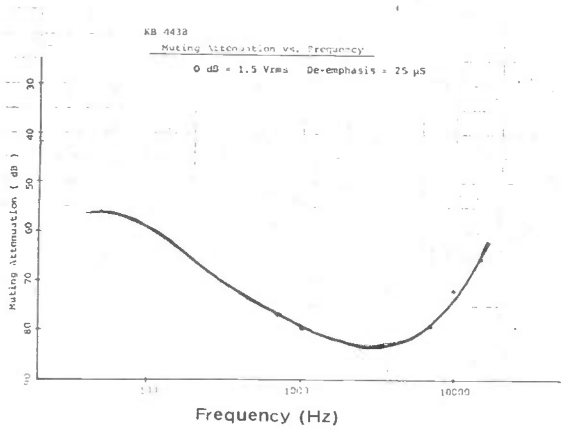
ABSOLUTE MAXIMUM RATINGS

DC SUPPLY (Vcc)	16V
POWER DISSIPATION	540mW
TEMP RANGE:	
OPERATING	−30°C TO +70°C
STORAGE	−55°C TO +125°C

Pin out for the KB 4438



Graph to show frequency versus separation.

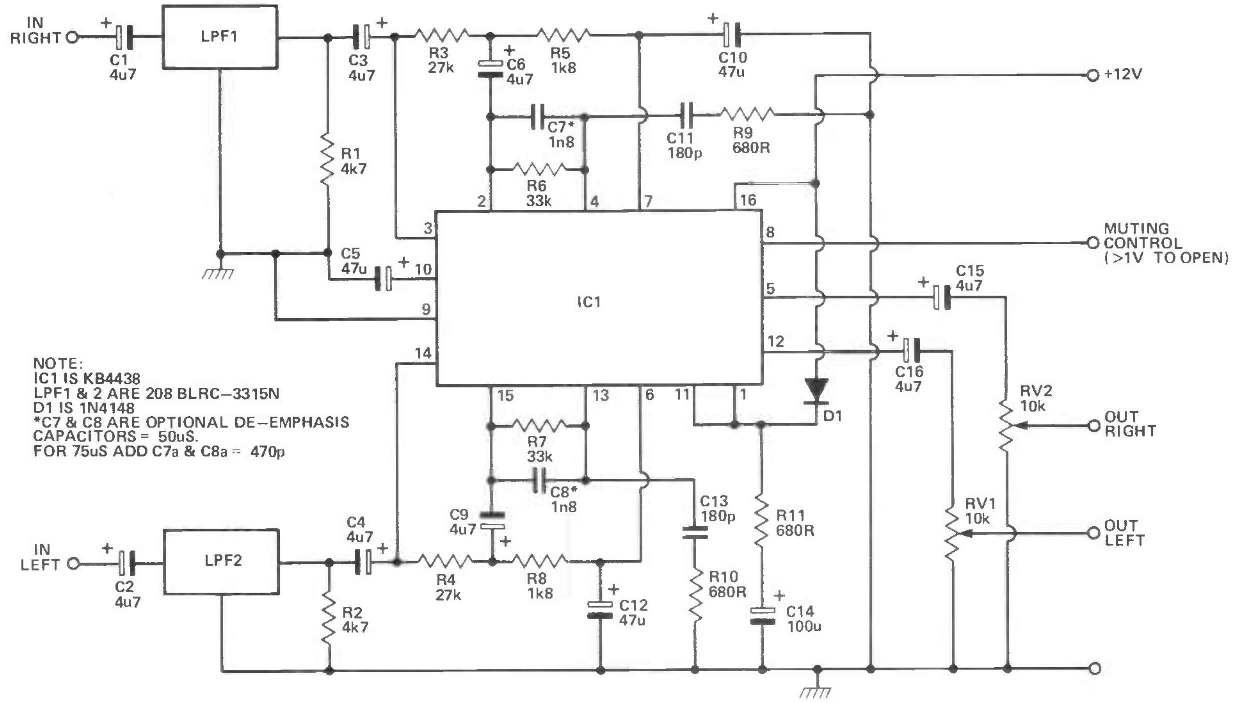


Graph to show muting attenuation versus frequency.

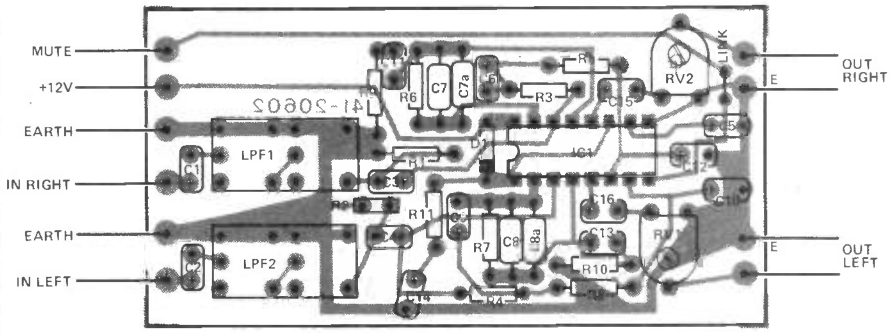
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
No Signal Current	ICC	7.0	11.0	16.0	mA	Input signal off
Voltage Gain	GV.	23		24	dB	
Channel Balance	C.B.			+0.5	dB	
Output Voltage	Vout	3.0	3.2		VRMS	Distortion 0.1%
Signal To Noise Ratio	S/N	87	96		dB	De-emphasis 25uS
Channel Separation	Sep	72	80		dB	De-emphasis 25uS
Distortion	THD		0.01	0.05	%	
Muting Attenuation	M.ATT	72	80		dB	Mute on, De-emphasis 25uS
Muting Transient Level	MDC.OUT	-20		-20	MV.DC	Input signal off
Muting Time	MT(1)		0.15		SEC.	Time from on to off
Muting Time (Power on)	MT(2)	1.0	1.6	2.5	SEC.	
Transient Level	on out		30	100	Mv.	At power on
Transient Level	off out		30	100	Mv.	At power off
S/N At Muting On	Mon. S/N	96	109		dB	At mute on
Muting On Level	MUT.S	1.20	1.35	1.50	V	

VCC = 13V, Ta = 25°C, RL = 6k8, VOUT = 1.5VRMS, De-emphasis = 25uS. Unless otherwise noted.

Table 1: Electrical Characteristics.

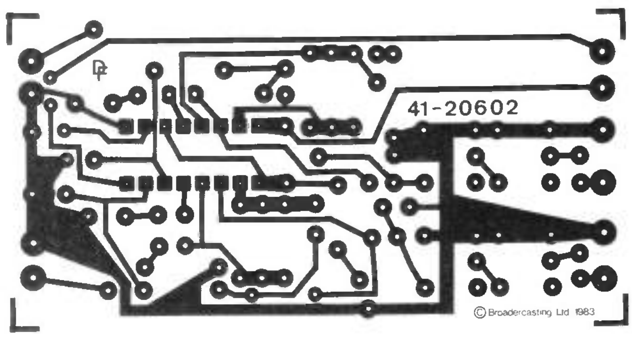


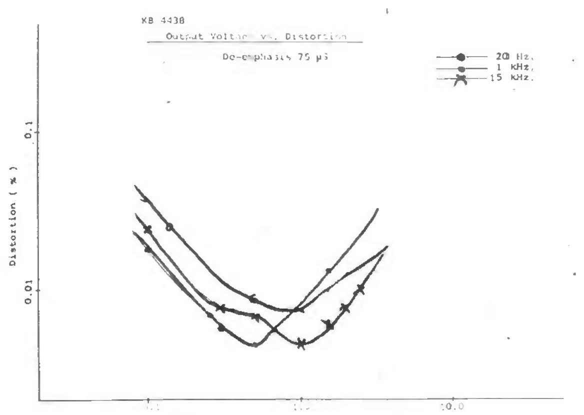
Circuit diagram for the board layout shown incorporating pilot tone filtering and de-emphasis components.



Component Overlay.

PCB Foil



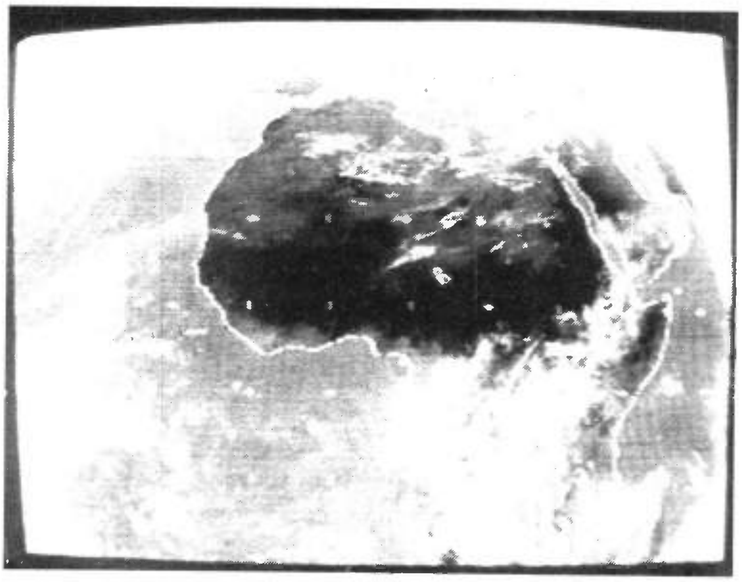


Graph to show output voltages.

S/N Ratio	96dB
Low Distortion	0.01%
High Muting Att.	80dB
High Separation	80dB
High Channel Balance	±0.5dB
Low Pop Noise	
Switch on Delay Facility	

Table 2: Specifications.

WEATHER SATELLITE RECEPTION



A practical approach, originated by Matjaz Vidmar YU3UMV, in VHF Communications magazine

The background to the METEOSAT weather satellites was described by Terry Weatherly in the August 1982 issue of **R&EW** (with additional notes March 1983), and at that time, the facilities for the enthusiast to construct and operate an effective ground station were relatively limited. However, we are pleased to announce that a recent series in the German-based publication, 'VHF Communications' has changed the picture somewhat. Those of you who attended the RSGB national exhibition at Birmingham will have had the chance to see the results of this system on the **R&EW** stand.

The main problem for the enthusiast has been getting a decent viewable picture — and whilst many have tried to live with a variety of surplus facsimile equipment, it's not been hitherto possible to emulate the effects you see on the TV weather forecast each night. The system to be described is a realisation of everything the keen satellite watcher has asked for.

The big attraction of METEOSAT over earlier weather satellite systems is the fact that it is stationary in the sky, and broadcasts a computer enhanced series of images. The TV signal is a standard form of slow scan image transmission, broadcast as an FM signal (on 1691/1694.5MHz). Viewing techniques have tended to adopt a variety of mechanical means (do you remember the article that featured a converted windscreen wiper motor?) with two serious drawbacks — definition is indifferent as a result of poor gray scale resolution, and conversion to differing speed standards is tricky.

Most **R&EW** readers should not be unduly frightened by the RF processing side of satellite reception, and most of us can probably provide a 'back of an envelope' solution to a digital scan conversion system — but translating such blocks into practise has been an important area which has only really come into its own with the dramatic drop in the price of the 64k DRAM.

One further problem that seems to surround METEOSAT for those not 'in the know' is the fact that most features either assume too much knowledge of the system and fail to cover the detailed specification, or they are written for the casual interest of the reader. As the author of this piece has discovered, the only comprehensive way to 'get into' METEOSAT is to read all the references, and if this feature causes you to want get deeper into the subject, then there is no alternative than to peruse the articles listed at the end.

Standards

Working on the assumption that a good many readers may already have access to weather satellite equipment (using a variety of non-ideal output media!), this series starts with consideration of the APT digital scan converter.

The choice of solution is based on memory size. The resolution selected was 256x256 (lines x pixels), which effectively produces a picture that uses all the available resolution on a domestic grade TV tube. The 64 level Gray scale resolution (radiometric) has been selected to provide the best overall definition, and this is further enhanced in an optional Grayscale to pseudo-colour converter. Purists may feel that this is cheating, but the infra red images are quite accurately represented by a scale from red to blue, and the visual effects are very soporific — no man-made visual effects box can outdo nature at her best.

The modulation technique is FM, with a maximum deviation of 9kHz, and an FM subcarrier at 2.4kHz which is amplitude modulated to a maximum of 80% (white) with frequencies in the range 0-1.6kHz. The overall maximum transmission bandwidth is 26kHz, with a 1.6kHz video bandwidth. The generic term "APT' refers to "Automatic Picture ▶

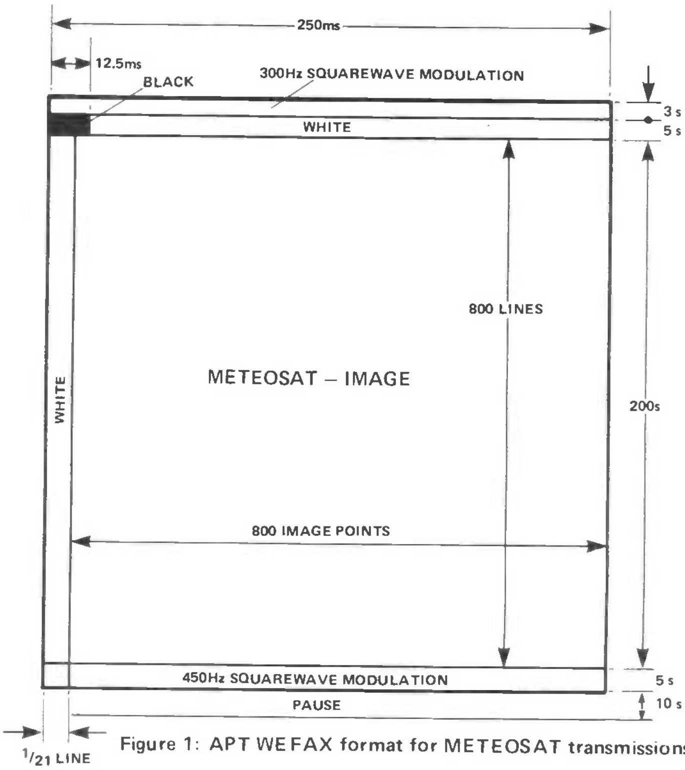


Figure 1: APT WEFAX format for METEOSAT transmissions.

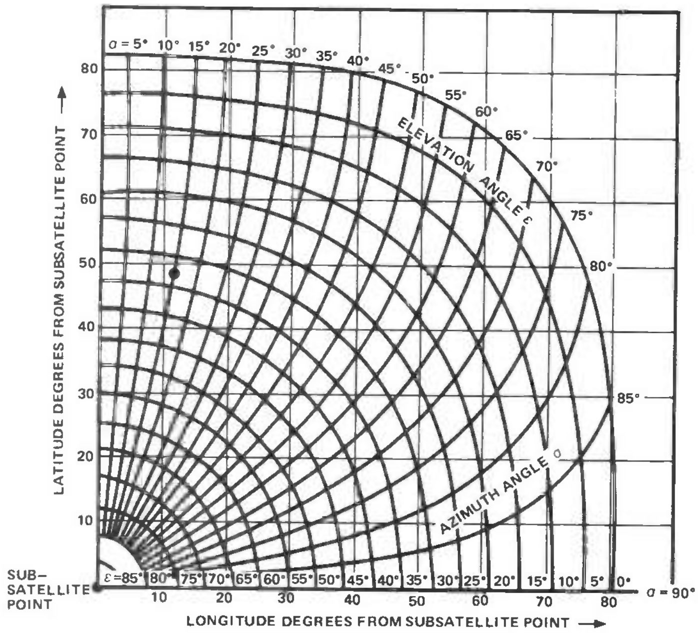


Figure 2: Azimuth and elevation angles can be taken from this diagram.

Transmission', which in METEOSAT's case means: 240 lines per minute, 840 pixels per line, 40 of which are in the form of a leading edge (***Fig. 1***). The 300Hz starting tone occurs at the top of the frame in the figure, since the picture will appear from the bottom of the screen and climb up to completion, 800 lines later.

The TIROS and NOAA series orbiting satellites use a different format, whereby the Infra red and visible images are transmitted simultaneously side-by-side on the same video lines (***Fig. 3***). The images are separated by burst frequencies of 832Hz and 1040Hz, allowing the user to select either the dual image (at 120 lines per minute) or blank either the IR or visible image and receive the resultant at 240 lines per minute.

Hardware and theory for getting the 1.6GHz signal down to baseband are adequately covered in the references at the end of this feature: but an area where there is scope for further development is the 137MHz IF sub-system. The **R&EW** 144Mhz UOSAT receiver system described by Graham Leighton has been successfully adapted by a number of satellite watchers, and we have had several effusive letters from the delighted users.

So we shall be revisiting the UOSAT receiver system in an issue or two's time to tidy up loose ends, put in a much wider filter for correct reception and provide a description of the adaption specifically to this application. Also NOAA and TIROS requirements will be considered.

The System

Figure 4 is the block diagram of the system for use with the scan converter. There are basically two sections involved in the image processor: the first demodulates and digitises the baseband signal from the 2.4kHz subcarrier, and the next section stores and displays the results. A further facility is provided in the shape of an input side chain for use with the high resolution (HRPT) digital images from the NOAA and METEOSAT series satellites, and this must be used in conjunction with a frame synchronizer, which will be covered in a separate feature.

The baseband signal is first filtered and demodulated before being sampled and converted in the section module, which provide the necessary TV signals to operate a composite or UHF input. In view of the excellent definition available with the system, purists will prefer to go directly into the video circuits where possible.

Pressure on space prevents further coverage in this issue, but next month we will run through each of the circuits involved. Those who can't wait should get the issues of VHF Communications listed here, since if you intend to go to all the trouble of getting your own met satellite ground station, then you should equip yourself with all the necessary background information and reading.

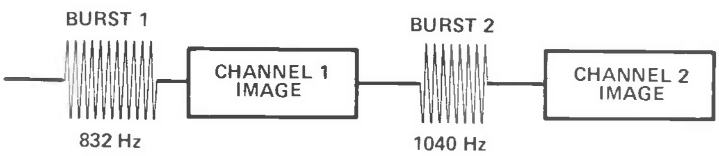


Figure 3: A NOAA6 video signal line.

Modifying the DL6HA 001/28 Dual-Gate MOSFET Converter for Reception of Weather Satellites and other Space Vehicles. T. Bittan, G3JVQ
1972/3 167-168
More Details on Reception of the European Weather Satellite METEOSAT. R. Lentz, DL3WR
1978/4 230-240
A System for Reception and Display of METEOSAT Images, R. Tellert, DC3NT
1979/3 130-140
1979/4 194-202
1980/1 14- 22
1980/2 73- 87
1980/3 169-178
1980/4 194-210
A Simple Converter for Reception of Weather Satellites in Conjunction with 2m FM Receivers H. Kulmus, DJ8UZ
1980/4 211-214
A System for Reception and Display of METEOSAT Images Part 7-9, R. Tellert, DC3NT
1981/1 43- 50
1981/2 110-118
1981/3 152-166
A Receive Converter for the Geostationary Weather Satellites METEOSAT — GOES —

GMS Part 1: The SHF-Module, B. Roessle, DJ1JZ
1981/4 207-213
Antennas for Reception of Orbiting Weather Satellites in the 137MHz Band T. Bittan, G3JVQ/DJ0BQ
1981/4 214-218
Forecasting the Reception Times of Orbiting Satellites, T. Bittan, G3JVQ/DJ0BQ
1981/4 219-220
A Receive Converter for Weather Satellites METEOSAT GOES, GMS Part 2: The local Oscillator Module, B. Roessle, DJ1JZ
1982/1 24- 30
A Digital Storage and Scan Converter for Weather Satellite Images, Part 1, Matjaz Vidmar, YU3UMV
1982/4 194-208

Remember — **R&EW** is now the UK representative for VHF Communications, if you have had any problems concerning subs., parts etc., please write to us with an SAE (mark the envelope VHF Comms) and we will endeavour to sort these problems out. Regrettably we cannot take responsibility for problems that have occured before our takeover.

■ R&EW

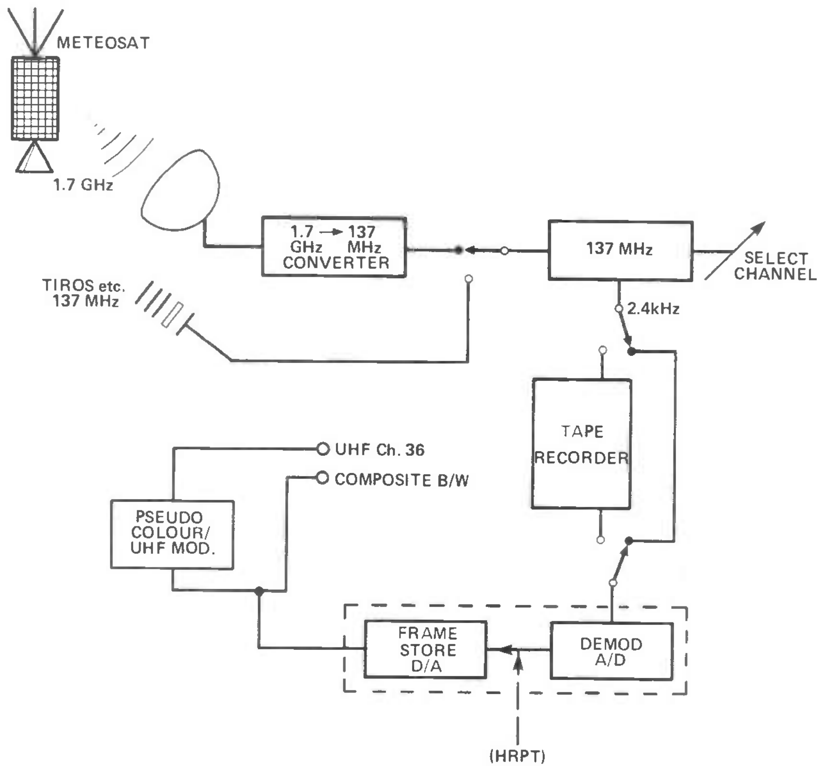


Figure 4: A complete METEOSAT ground station system.

Compiled by Arthur C. Gee, G2UK

Satellites again head the list of interesting events in the Amateur Radio World. The Russians sent another one up — ISKRA 3 — on the 18th November last. It was launched by hand from the Salyut 7 manned space laboratory, in the same way as the previous ISKRA. It was in a similar low orbit, so its life expectancy was short. In fact, by the end of the month, it was only being heard occasionally and has since ceased altogether. It transmitted telemetry and a code store was in operation at times. A fifteen to ten metres transponder was in operation and used by a number of stations. It is reported that the Russians are proposing to put twenty or so similar satellites into space in the near future, so interest in this sphere of amateur space activity should continue unabated for some time to come yet.

The launch of AMSAT's Phase III satellite is now scheduled for June 3rd. This replaces the one lost when the Ariene L5 failed. If successful this time, it will open a completely new phase in amateur radio communication, as it will be in a quite different orbit from previous Oscars and is a far more sophisticated spacecraft.

Burst Into Life

From time to time rumours abound that previously 'deceased' satellites have "come alive again"! Oscar 7 has been said to be sending out telemetry signals again, but nothing definite has been produced as 'hard copy'. It would have been in continuous sunlight at the time and as it failed in July 1980 through nicad battery failure, it could be that these batteries have now gone 'open circuit' and its solar panels were able to

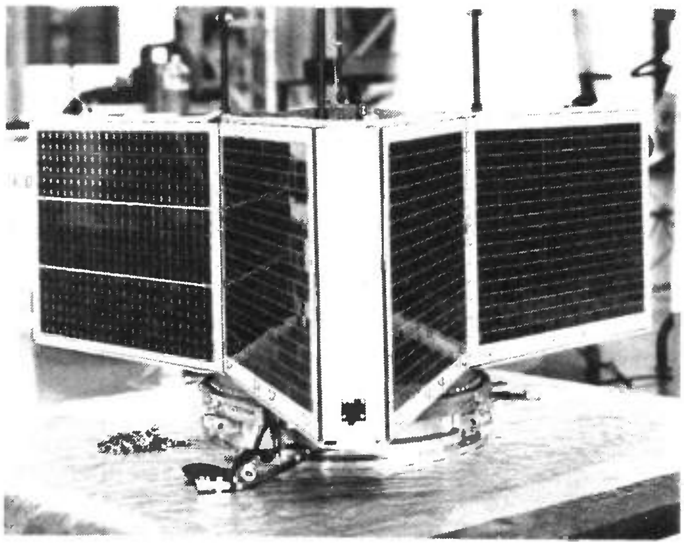
Another satellite, which sends the code signal "1051", over and over again and signs after a dozen or so "1051"'s with "55" has appeared on 29.401 MHz, the frequency of the beacons on the Russian RS 1 and 2, which were though to be defunct. It is said that it is RS 2 and that it is only switched on when it is within range of Moscow. It is though to be RS 2, because RS 2 has adequate solar panels, giving it a positive power balance, whereas RS 1 had batteries of low capacity giving a negative power balance. The other satellites are working well, including UOSAT, which has had its Digi-talker switched on at times.

"Mandrake", writing in the "Sunday Telegraph" reported that the Falkland's servicemen's seasonal phone calls home, at Christmas had not been very successful. A suggestion that it would have been better to have used amateur radio facilities for this, in the same way as the USA radio amateurs are able to with their 'patching' technique for their overseas Forces, fell on unsympathetic ears at the Ministry of Defence. British radio amateurs are not allowed by their Licence terms to participate in "third-party" traffic. A M. of D. spokesman said, "If it is illegal, we would not want to be part of it". "Mandrake" puts the blame on Tony Hancock for the credibility gap. The status of the amateur radio operator has never recovered from Tony's "The Radio Ham" all those years ago. "Mandrake" may well be right!

Turning A Blind Ear

Following a report from an official of the Home Office that nine stations were traced and closed down for illegal broadcasting in 1981, a "Wireless World" reader has a letter in the January 1983 issue, quoting a blatant example of continued infringement of the radio regulations by a mini-cab firm in his area. He concludes his letter by suggesting to the Home Office that if they only managed to trace nine cases and need a lead on this matter, they could do worse than "ask the amateurs" — a view this scribe heartily endorses!

From the "Trinity House Gazette" for December last, we learn that Larry Walker, the assistant keeper at Portland Bill Lighthouse, used to operate an amateur radio station at the Eddystone Lighthouse before it ceased to be a manned station. From Portland his latest contacts have been with amateurs in Goose Green (VP8LP) and with Pebble Island in the Falkland Islands. He reports that in the early hours of 5th October last, the Goose Green station received a call from an Argentine station, who very soon went off the air when he realised to whom he had been talking! During the Argentine occupation, assistant keeper Reg Silvey of the Imperial Lighthouse Service, living in Port Stanley, kept up transmissions from "underground" locations even though Cape Pembroke Lighthouse was unworkable.



News Review

The "new bands" are beginning to pick up a bit, particularly 10 MHz now that USA and Canada have been given permission to use this band. West Coast and VE stations have been worked in the late evening.

■ R&EW

As you read this, it is anticipated that the replacement for AMSAT's Phase III satellite will have been launched.

CIRCUIT MODELLER

Steve Kirby BSc, York Electronics Centre, evaluates a new software package which enables designers to 'prototype' using a micro.

If you've ever wanted to iron out the bugs from your latest design at the drawing board stage, before ever applying a soldering iron, 'Circuit Modeller' may be the answer. This newly released numerical circuit modelling program will allow you to 'try out' your circuit on a microcomputer before putting it on a breadboard. The package runs on any Z80 based computer with 64K of RAM and at least one floppy disk running under the CPM operating system. In addition, a printer capable of being set to 132 column width is useful for graphical output.

Too Big To Handle

For many years IC designers have had to use computer modelling to debug their circuits, as IC's are so expensive to build in small prototype quantities (around £50,000 for even a single wafer's worth!). Mathematical modelling programs were sophisicated enough to let the designer draw the circuit out on a graphics terminal, using a light pen to select components from a 'catalogue' of standard resistors, capacitors and transistors etc, each with its own mathematical analogue. Programs such as SPICE (written at Berkeley University, California) then worked out the circuits' DC voltages and currents using complex non-linear models which closely imitate the behaviour of real components. Using this information, a simpler small signal linear model can be constructed and used to predict gain and phase frequency responses from any selected input quantity, to any output, as well as finding frequency dependent input and output impedances.

What's A Linear Model?

A linear model of a circuit is a way of using simple mathematical equations to describe how that circuit behaves in response to a stimulus. The model is made up of linear components. These have strictly linear responses to inputs, that is, the effect (eg current for a resistor) is directly proportional to the cause (voltage across the resistor). This can be expressed as: output = K x input. With a linear component, if you double the input the output is also doubled.

Some components are naturally linear; resistors, non-polarised capacitors and air-cored inductors (*Fig. 1*). Operational amplifiers can behave non-linearly in an open loop circuit, but with the large amounts of

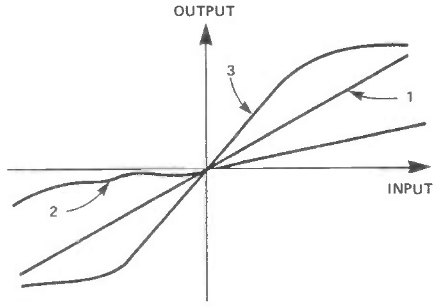


Figure 1. Curves representing the three different component types. Number 1 is for linear components (eg, resistors), number 2 for polarity sensitive components (eg, electrolytic capacitors) and number 3 represents non-linear devices such as op-amps.

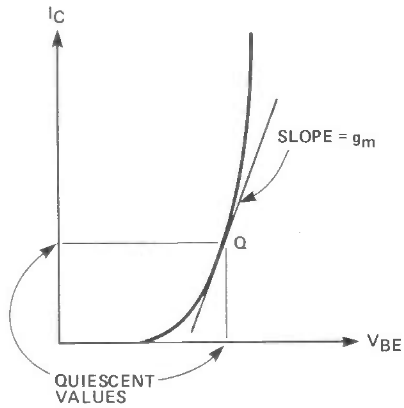


Figure 2. Finding the slope of the I_C-V_{BE} characteristic at point Q.

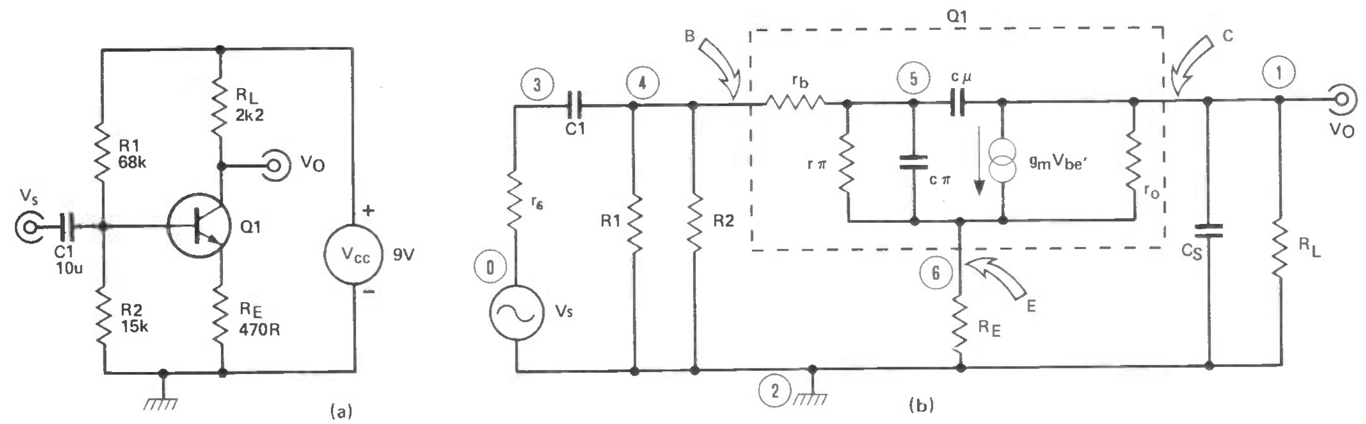


Figure 3. A single transistor amplifier (a) and the linear model (b) which represents it.

negative feedback usually used they are almost ideal linear gain stages. Other components are linear only for a certain polarity of inputs (eg, an electrolytic capacitor behaves very non-linearly if you apply the DC biasing voltage the wrong way around. Ferrite or iron-cored inductors have almost linear responses until the magnitude of the current through them becomes large enough to cause saturation of the magnetic material.

The most important class of non-linear components are transistors and diodes. A transistor's collector current is exponentially related to the base emitter voltage, as given by $I_c = I_s \times \mathrm{Exp}\,(V_{BE})/V_T$, which is a very good approximation to the experimental behaviour of most transistors. (I_s is a constant and V_T is the so called thermal voltage, KT/q, directly proportional to absolute temperature T, and about 26mV at 25°C). This extremely non-linear behaviour can only be fitted into the pattern for passive components if a small enough change in the base emitter voltage, from its average quiescent value, is used as the input. Then the output collector current can be "linearised" using the slope of the I_c — V_{BE} characteristic at the quiescent point (Q on ***Fig 2***). By differentiation, the slope can be found from I_c/V_T and is in amps output per volt input, called the "transconductance" (denoted by g_m). Using small subscripts to denote very small (△ 1% typically) changes in the variables, the formula may be written as $i_c = g_m \times v_{be}$.

This is just what we need for finding a frequency response, the AC input can be made small enough so that it does not disturb the DC quiescent conditions, and all the non-linear semiconductors can be replaced by models that accurately "mimic" them at their working point. Models of bipolar transistors, JFETs, diodes and MOSFETs are all given in the CM theory manual.

A Case In Practice

To show the way of using linear models with CM, consider the single transistor amplifier in ***Fig. 3a***. We want to know what the small signal frequency response (gain and phase) is, from the voltage source input to the collector voltage output. A quick calculation shows that Ic is approximately 2mA, so g_m is 0.077V/A. ***Fig. 3b*** is the small signal equivalent linear model of ***Fig. 3a***. You may have noticed that some peculiarities have appeared, and the supply voltage has disappeared! To the small AC signals, the large decoupling capacitors in the power supply look like a short circuit to ground, and as we are only interested in small signal changes in current through the resistors, the DC quiescent currents are omitted — V_{cc} is at ground potential for small signals. The 'driving power' for the output comes from the floating current source $g_m.v_{be}$.

The input voltage source, Vs, has an output resistance modelled by R_s (say 10R). The transistor linear model is within the dotted line. The resistor, r_b, models the bulk silicon and connection resistances between the external base lead and the internal active base, and is very important in high frequency or low noise circuits. It is the voltage v_{be} across the lower limb of the potential divider resistor r_π which controls the collector current source $g_m.v_{be}$, implementing the small signal model equation.

The base current i_b is β_s times less than i_c, (β_s is the small signal AC current gain at quiescent current Ic) and r_π is:

$$r_\pi = \frac{v_{be}}{i_b} = \frac{v_{be}}{i_c/\beta_s} = \frac{\beta_s}{g_m} \quad \therefore \quad r_\pi = 3246\Omega$$

The slope of the I_c/V_{CE} characteristic is modelled by the collector emitter resistor r_o (***Fig. 4***). At high frequencies (say △ 1MHz) very small junction and packaging capacitances have large effects on the transistor's gain. These effects are modelled by C_π, C_u and C_s. Typical values for these components are C_u=2p, C_π=5p, r_b=100R, r_o=100k. This type of transistor model is called the "hybrid pi" after the two part hybrid pi model parameters (ie, the "famous" H_{FE}).

Circuit Modeller expects you to find the DC quiescent currents and turn the real circuit into a linear model yourself. In many cases the quiescent parameters are not too time consuming to calculate, or the parameters could just as well be measured on a breadboard; the circuit acting as an analogue computer solving its own equations! The model has an input voltage node (0 by CM convention), output (1), ground (2). Only node 0 is constrained to a given voltage (V_s), so there are five free nodes and at each of them we can use Kirchoff's current law and say the algebraic sum of all current into the node is zero. A bit of fairly tedious algebra gives us the five equations in ***Fig. 5***, one for each free node. These equations fall into a five-by-five pattern — for N unknown voltage nodes you

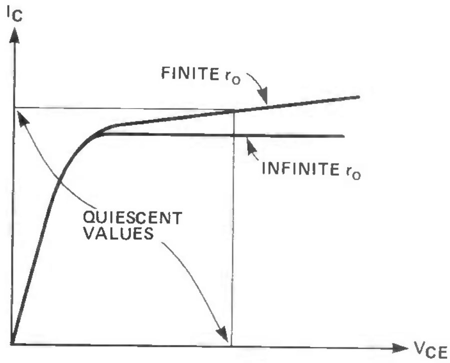


Figure 4. Graph showing the I_c/V_{CE} characteristics is modelled by R_o.

need N equations and an array (NxN) of coefficients. At this point (given a free week or two) you could solve the equations for the unknown voltages, using the algebraic symbols. A slightly quicker method is to substitute in numerical values for all the complex impedances (for a particular input frequency) and solve it using matrix algebra and techniques such as Gaussian elimination. However, with Circuit Modeller this is all done automatically in a few seconds. The "number crunching" inner core of the

$$0.V1 - \left(\frac{1}{r_s} + jwC_1\right).V3 + jwC_1.V4 + 0.V5 + 0.V6 = \frac{v_s}{r_s}$$

$$0.V1 + jwC_1.V3 - \left(jwc_1 + \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{r_b}\right).V4 + \frac{1}{r_b}.V5 + 0.V6 = 0$$

$$+ jwC\mu.V1 + 0.V3 + \frac{1}{r_b}.V4 - \left(\frac{1}{r_b} + \frac{1}{r_p} + jw(C_p + C\mu)\right).V5 + \left(\frac{1}{r_p} + jwC_p\right).V6 = 0$$

$$+ \frac{1}{r_o}.V1 + 0.V3 + 0.V4 + \left(\frac{1}{r_\pi} + jwC\pi + g_m\right).V5 - \left(\frac{1}{r} + jwC\pi + g_m + \frac{1}{R_E} + \frac{1}{r_o}\right).V6 = 0$$

$$-\left(jw(C\mu + C_s) + \frac{1}{r_o} + \frac{1}{R_L}\right).V1 + 0.V3 + 0.V4 + (jwC\mu - g_m).V5 + \left(g_m + \frac{1}{r_o}\right).V6 = 0$$

Figure 5. Using Kirchoff's current law to equate the five free modes.

NEW	Create new model (clears old model).
ADD	Add components to the model.
EDIT	Edit (or delete) existing components in model.
PRINT	Print out values and node connections of model components.
LOAD	Load a model previously saved on disc.
SAVE	Save the current model on a named disc file.
GAIN	Obtain gain and phase at a given frequency.
ZIN	Obtain input and output impedances.
PLOT	Plot graph on printer of log gain and phase against log freq.
BW	Find the centre freq. and bandwidth of amplitude response.
SEARCH	Search for a frequency at which a given gain occurs.
OPTION	Set options for graph phase (+/− 180° or full scale).
SYMBOLS	Change the symbols used in plotting graph.
?	To obtain help if you're stuck.

Table 1. Complete listing of the Circuit Modeller commands.

programs are all written in optimised Z80 machine code running hundreds of times faster than an interpreted BASIC version. CM solves purely for the gain and phase of the output (V(1)-V(2))/ input (V(0)-V(2)), but by using a unity gain controlled voltage source (CVS), as a mathematical floating voltmeter, you can pick off the voltage between any pair of nodes as the output, and similarly use another CVS controlled from input nodes (0) and (2) as a floating signal generator.

So, Circuit Modeller can take the grind out of complex mathematical calculations, whilst at the same time getting over the problem of limited memory on microcomputers. It does this by a combination of clever programming, limiting the size of circuit that can be handled and providing only a linear model frequency response analysis. CM can work on circuits with up to 32 nodes, made up with a maximum of 101 each of capacitors, resistors and inductors, 31 mutual inductors and 31 voltage or current sources.

What Can CM Do

It is best to look at CM's facilities by actually modelling different types of circuit. CM is full 'menu-prompted', so it is very easy and quick to learn. The single transistor amplifier linear model mentioned earlier would be entered as in *Table 2*

The features contained in CM are also worth explaining. Node 0 is always the input driven by an ideal voltage source, whose other terminal is connected to pin 2 (node 1 is the output). Current and voltage sources, whose magnitude are controlled by the voltage between a pair of nodes, are available and can be used both in active device models, and to have floating input drives or output pickups (eg, the frequency response of the current in the 100R base resistance could be made the output by having a voltage source controlled by nodes 4 and 5 driving nodes 1 and 2-the present node 1 should be changed to node 7 using the ADD command. Now we can ask for a gain at a particular frequency by typing the command keyword GAIN. CM will print out the gain (within a range of ± 600dB) at any specified frequency from well below sub-audio to near infra-red frequencies!

The most commonly used CM feature is the PLOT of log gain in dB and phase against log frequency. CM asks for an upper and lower frequency and

? NEW	(clear any existing model and accept new values)
*RO 10,0,3	(resistor between nodes 0 and 3, 10 ohms)
*RK 15,4,2	(15K resistor, RK used for value in kilohms)
(etc.)	
*CU 1,3,4	(CU used for capacitor in microfarads)
*CP 5,5,6	(CP used for capacitor in picofarads)
(etc.)	
*CS	
gm (A/V) ? 0.069	
Rout ? 100E3	(Exponents can be used for brevity)
current flows towards node number ? 6	
current flows from node number ? 1	
controlling voltage positive terminal node number ? 5	
controlling voltage negative terminal node number ? 6	
* (return)	
(now CM asks you if you want the model saved on disc file, this can be later re-loaded with the LOAD command)	

Table 2. Statements typed on the computer to enter the model of figure 3.

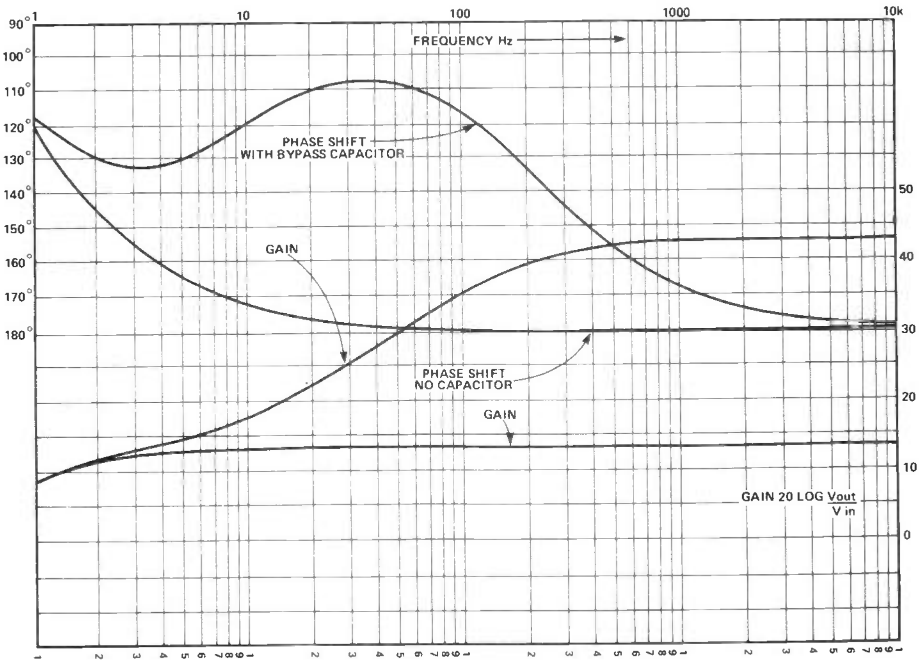


Figure 6. Plot of log gain (dB) against log frequency (Hz) of figure 3.

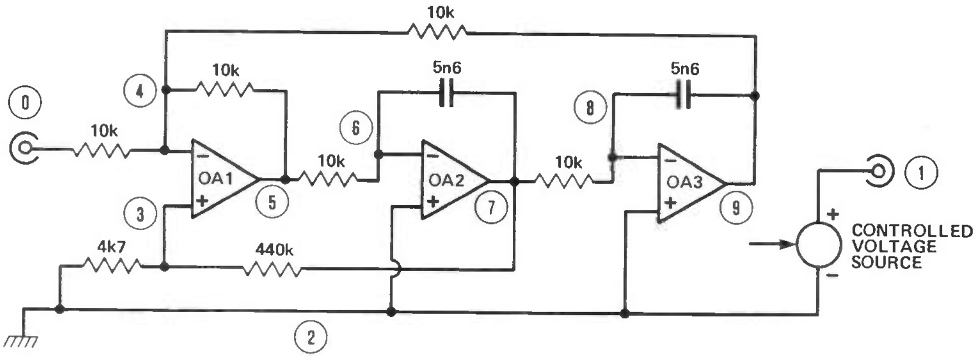


Figure 7. State variable bandpass filter circuit.

the number of steps to be plotted. After some calculation (the model above took 40 seconds for 50 steps from 1Hz to 10MHz) the graph is plotted out on the device expected to be a 132 column line printer (see ***Fig. 6***). The dB axis is scaled automatically over the rull range of calculated gains, which is a bit of a nuisance if you want it calibrated in 10dB steps. The phase can be calibrated to either a ± 180°, or full calculated range using the OPTION command. The component connections and values are listed on the printer by the PRINT command. The wide band gain of 4.7(13dB) and the input coupling capacitor induced 1.4Hz high pass break frequency can be clearly seen, as can the effect of the transistor junction capacitances in the output excess phase shift above 300kHz (note the phrase "wraps around" when in excess of 180°). The effect of bypassing the emitter resistor can be found by using the ADD command to put a 50u capacitor in parallel with RE, and re-running PLOT (see ***Fig. 8***).

The ZIN command finds the complex input and output impedances at nodes 0 and 1, at a given frequency: (11,170-j159,000)ohms input, (2,194 + j0.297) ohms output impedance for the above circuit at 0.1Hz. You stay in each of the command program sections until a single return is typed so the same command can be re-run very quickly. For example, the ZIN command loops back and asks for another frequency at which to calculate impedances.

There are built-in models of common operational amplifiers (eg, 741 and TL081) or you can 'build' your own. The model has a specified differential input resistance, voltage gain, output resistance and single pole break frequency. These were used to plot the response of the circuit in ***Fig. 7***, a state variable bandpass filter. The high, low and bandpass output (***Fig. 8***) were obtained by using EDIT to connect the control terminals of the output voltage source to ground and the outputs of op-amps 1,2 and 3 in turn.

You can find the frequency at which a particular gain occurs using the SEARCH command. This works iteratively from an initial 'guess' value you give, and will only converge for gains on a sloping part of the response. A second type of automatic search, the BW command, can find the centre frequency and upper and lower -3dB points of bandpass type circuits (including LC tuned filters containing mutual inductors) again working from an initial 'guess' (best found using PLOT) for the centre frequency. BW gave the centre frequency of the circuit in ***Fig. 3*** as 2.85kHz, upper 2.885kHz and lower 2.798kHz, bandwidth 86.6Hz.

To leave space in the memory for the large array of circuit equation coefficients the active part of the program, which implements a particular command, is only brought in from disk when needed. This 'overlay' system means there are some disk transfer delays, though they are not too noticeable in practice.

Summing Up

Two manuals are supplied with CM, both being blessedly short. A 17-page operating manual quickly and simply describes how to use CM with many examples, and a theory manual briefly outlines linear circuit theory and mathematical modelling and gives a partial explanation of how CM works. The manuals are clearly written and printed and include an index for quick reference.

Circuit Modeller itself is a useful tool, which matches up to the author's claims. Within the limitations of a small signal linear model it can perform useful circuit analyses and save significant amounts of time, especially in filtering circuits. The user *is* responsible, however, for ensuring that the linear model used is suitable for the real circuit being designed and built. I found it best to use CM in conjunction with a few hand calculated analytical equations, and compare the predicted performance with that measured on the scope ... no I won't be selling my soldering iron just yet!

■ R&EW

Circuit Modeller is produced by Harcourt Systems and marketed by Seasim Control Limited (01-346-9271).

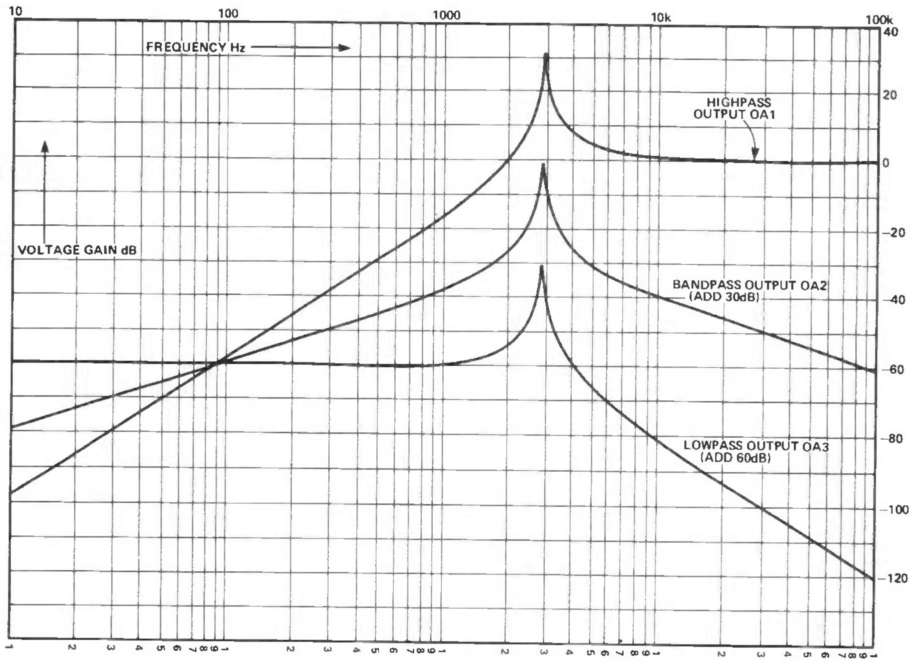


Figure 8. Plot of voltage gain against frequency for the figure 7 circuit.

VIDEO NEWS

Peter Luke reveals the shape of cameras to come and casts his eye over a varied range of new recorders.

Flat screen TV sets, that would herald the end of the cathode ray tube with its power hungry heater and fragile collection of electrodes, are still some way off from a production line reality. A similar revolution in camera technology is, however, here with us today in the shape of the Hitachi VK-C2000E.

Outwardly the new camera looks little different from 'ordinary' cameras, although it's smaller than most. The reason for this small size is that the bulky vidicon/satican/tricon tubes of the current generation of cameras has been replaced by a MOS image sensor. The advantages of a semi-conductor image sensor are manifold — low power consumption, robustness and an almost infinite life are perhaps the more obvious — but it is only until recently that adequate definition has been available from such devices.

A MOS image sensor is made up of a grid of light sensitive elements, each element in any row being connected to a CCD type shift register. The information from each point in a row can thus be output serially and the serial data stream from each row then added to similar information from other rows in the familiar order of a TV scanning frame. That's a very simple overview of the operation of the MOS element, not taking into account the requirements of encoding information as to the hue of any picture point (we'll go into more detail in a future issue of **R&EW**). Even this brief explanation of the system shows, however, that the other bulky and power hungry elements of conventional cameras — the scan coils — can also be dispensed with.

So much for the technical aspects of the camera — what about its specification and performance?

Gathering MOS

Ergonomically the camera is a delight, with an adjustable shoulder brace that allows the camera to fit snugly over the shoulder to provide a convenient and stable filming position.

For an £800 camera, the controls are perhaps rather spartan. A white balance control, auto fade in/out and a standby switch about cover them. There's a lot to be said for keeping things simple however, and the camera is delightfully easy to operate.

In terms of performance, the camera offers a quality that is not matched by many more conventional designs. Resolution is claimed at 450 lines — not many recorders will be able to take full advantage of this though — while the accuracy with which the camera reproduced colours was impeccable.

Perhaps the most notable feature however, was the lack of any 'comet-tailing' that is the scourge of most domestic 'tube-based' cameras. In fact the lack of lag on the Hitachi is only matched by broadcast standard cameras.

The camera will be available in the UK later this year and anyone considering the purchase of a top-of-the-range conventional camera, should take a look at the Hitachi first. It is definitely the shape of things to come.

Newcomers

Sanyo's VTC 6500 means the company now have a representative in the fashionable front-loading market. At £450 the recorder looks to be good value, offering as it does a 14 day, 8 event timer plus IR control and a healthy complement of trick video facilities.

JVC can now offer their VHS-C format system as a £1000 odd camera/ recorder package. The six month wait since the announcement of the model looks to have been worth while.

Mitsubishi have two new recorders in the shops. One, the HS 320, is a fairly conventional mains based machine though it comes with a fairly comprehensive range of facilities including Dolby noise reduction and an 'elapsed time' tape indicator — some day all tape indicators will be like this. The other machine, HS 700, is billed as a transportable in that it is a cross between a mains based machine and a portable (battery powered) machine. As one manufacturer has already had a fairly disasterous experience with such a hybrid, it's difficult to see how this model will find a market niche for itself — still at £450 it's not too expensive.

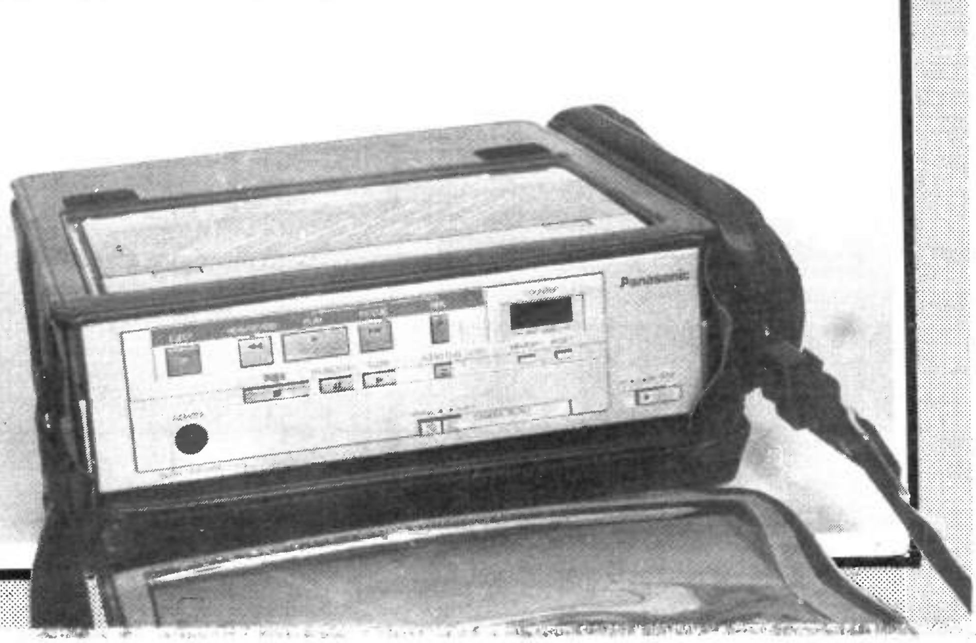
Philips have joined the ranks of those offering portables with their VR2220. It's a bit late in the day though, and the VHS and Beta camps are already further down the 'small is beautiful road'.

On the subject of smaller and smaller, Sony have demonstrated a recorder/ camera combination that makes use of full size Beta cassettes. The system uses a 'half-size' head drum yet maintains compatibility with the format by extending the tape path. This approach looks on the surface to be more attractive than the non-standard — though compatible — VHS-C cassettes.

To round off this tip-toe through the new releases, it's good to note that the excellent NV-100 portable from Panasonic (reviewed in the March 83 issue of **R&EW**) is appearing in a number of different guises.

Two camera companies with very good reputations, Canon and Olympus, have adopted the NV-100 and are now pushing it through their networks of photographic dealers. The days of the cine camera do indeed seem to be numbered.

Panasonic's NV-100 is now appearing under the banners of both Canon and Olympus



100W POWER AMPLIFIER PART II

The second and concluding part of our amplifier project, designed by Steven Marshall and Derek Frost, deals with construction and installation.

Last month we discussed the design of the power amplifier, including a description of the circuit and overlay diagrams. This month we continue with the construction and conclude by explaining how to integrate two amplifiers into your present system.

Construction

Begin by fitting Q7 and Q8 with their respective heatsinks, not forgetting to use a good smear of heatsink compound and lock washers, but do not tighten finally as yet. The temperature sensing transistor, Q3, should now be mounted next to the heatsink of Q8. The flat surface of Q3 must make good thermal contact with the surface of the heatsink. Therefore, before soldering, apply a blob of heatsink compound to the junction. Solder in, ensuring that Q3 remains flat, if necessary, bending the leads slightly after soldering. This is the most important part of the early construction and must be correct to ensure good thermal tracking for the output stage.

Continue by mounting the other components on the board, with, as ever, care over orientation of transistors, diodes and capacitors.

The wirewound resistors (R26,27,28, 29,30,31 + 32) and R33, the 2 watt carbon resistor wound with L1, should be mounted with an airspace between resistor body and board of at least 1/8" to allow for cooling. This is particularly important in the case of R27 and R28 which can get very hot when driving low impedance loads.

At this point, check the solder side of the board for solder bridges or dry joints, and double check component orientation on the top side. A mistake here could prove to be very expensive!

Next, study the diagram showing the power transistor mounting, which is **not** according to normally accepted practice, ie, there is an airspace between the PCB and heatsink bracket, to allow circulation of air all around the bracket. Note also that the two NPN power transistors are mounted in reverse with respect to each other, and the same is true for the PNP pair. This is to avoid a long connecting track between the two base connections. We found it helped to mount the transistors and To3 insulating washers with the usual liberal smearing of heatsink compound, to the bracket, then drop the eight mounting bolts through, holding all in place with sellotape. The whole assembly may then be turned over for fitting the plastic bushes into the aluminium bracket and then finally, the PCB and nuts with shakeproof washers just fingertight at this stage.

With a multimeter set to a high resistance range, check that the power

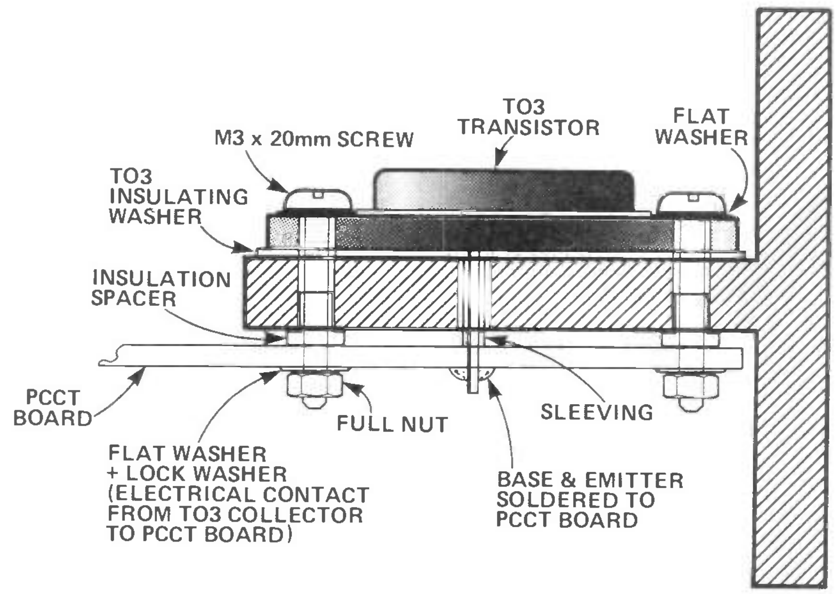


Figure 1: Heatsink bracket section showing power transistor mounting.

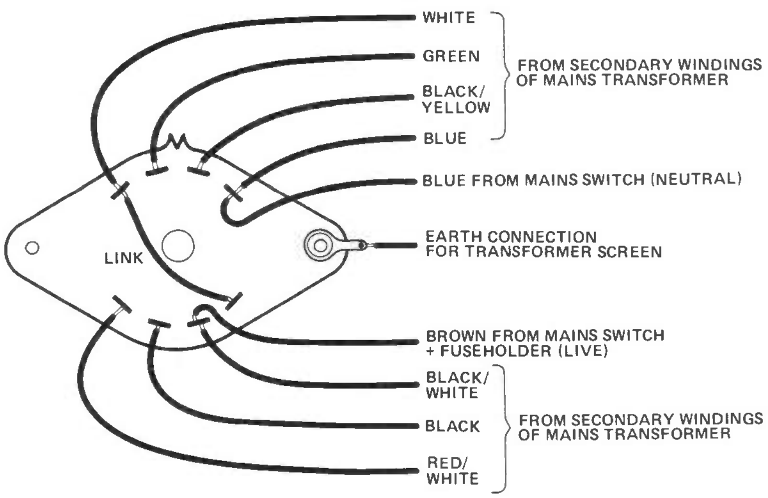


Figure 2: Rear view of voltage selector showing connections.

transistor cases are open circuit with respect to the aluminium bracket. If so then tighten the nuts and repeat the check, soldering the transistor leads if all is OK.

The discovery of a short between case and bracket will mean dismantling and checking for burrs on the bracket drilling or reversed transistors etc. (Do not solder output transistors before tightening mounting bolts or curing short circuits). The PCB is now complete and may be put aside. Construction of the protection board is straightforward if the overlay is followed and, as before, all components correctly orientated. The majority of components are vertically mounted due to the size of the relay and ideally, should be mounted with the relay fitted but not soldered until assembly is completed. This completes the board construction and assembly of the metalwork may begin with a trial assembly of all parts of the casing with the exception of the front panel.

The next stage is to assemble the rear panel assembly with sockets, fuseholders, etc. Remembering that the input socket is insulated from the case with two small bushes.

The phono socket should be fitted with the piece of audio coaxial cable, since it will be difficult to install after the back panel and chassis are assembled.

The two heatsinks should now be bolted to the aluminium bracket with the four socket headed bolts and a good coating of thermal compound. The back may now be dropped over the heatsink in the second slot from the board end, and the whole assembly slid into the chassis. After fixing the back with self tapping screws, the two holes in the chassis should line up with those in the bottom of the heatsink. If so, insert two M5 pan head screws into the heatsinks through the chassis and tighten up. Fit support pillars to PA board and install those for the protection board.

Next, fix the mains switch bracket to the chassis and then the switch to the bracket. At this point, the mains wiring from socket to switch and switch to voltage selector may be completed, Followed by installation of the transformer. Follow the diagram for connections of the primaries to the selector very carefully after passing all primary leads through a piece of sleeving. Double check afterwards since the selector is obscured by one of the smoothing capacitors.

Bolt the bridge into place, followed by the smoothing capacitors, and lastly the protection board, adjusting the positions of transformer and capacitors if required, so that they do not touch each other, then tighten everything up.

Wiring may now begin, following closely the colour coding and layout shown, to ensure stability and low noise.

The indicator LED should have its three leads connected and sleeved and the plug installed at the other end of the leads. Insert it into the front panel so that it is flush with the front and cement into place with a small dab of adhesive, impact (**not** superglue, which will attack the finish of the front panel). When the glue has dried off, preferably overnight, the front panel may be fitted and screwed carefully into place, at which point you are ready to begin testing.

One small word of warning. When interboard wiring is complete, but before connecting the transformer secondaries to the bridge rectifier. It is a good idea to switch on the mains supply and check that the correct AC voltages are appearing at the secondary connection leads (ie, 40.0.40 volts approx). A fault would indicate an incorrectly assembled mains voltage selector which **must** be corrected before proceeding further (22000u capacitors make a very loud bang when treated to an excess of voltage!) If all is well, connect the transformer to the bridge.

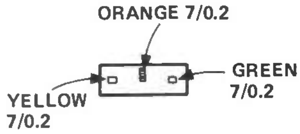


Figure 4: Rear view of indicator LED showing connections.

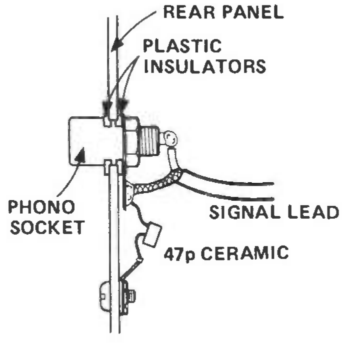
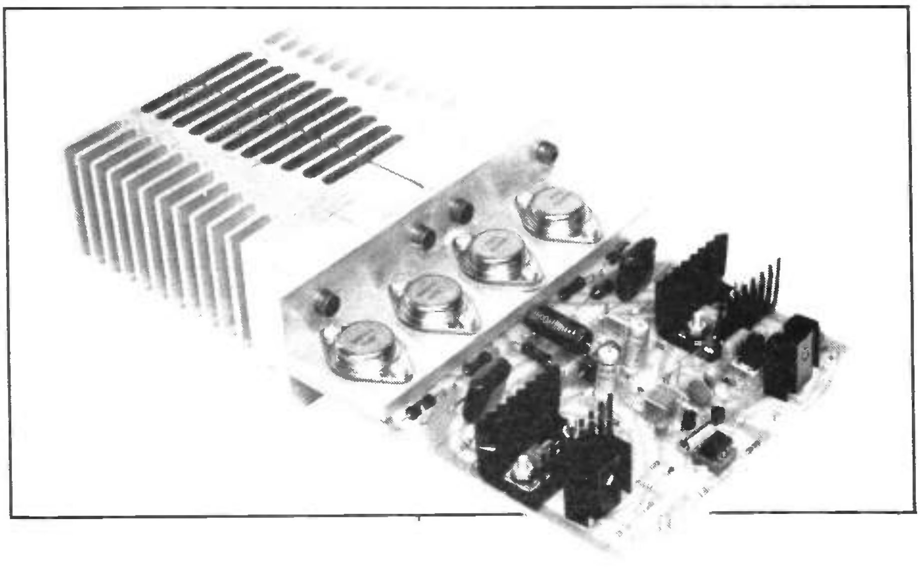


Figure 3: Rear panel section showing phono socket and plastic insulators.



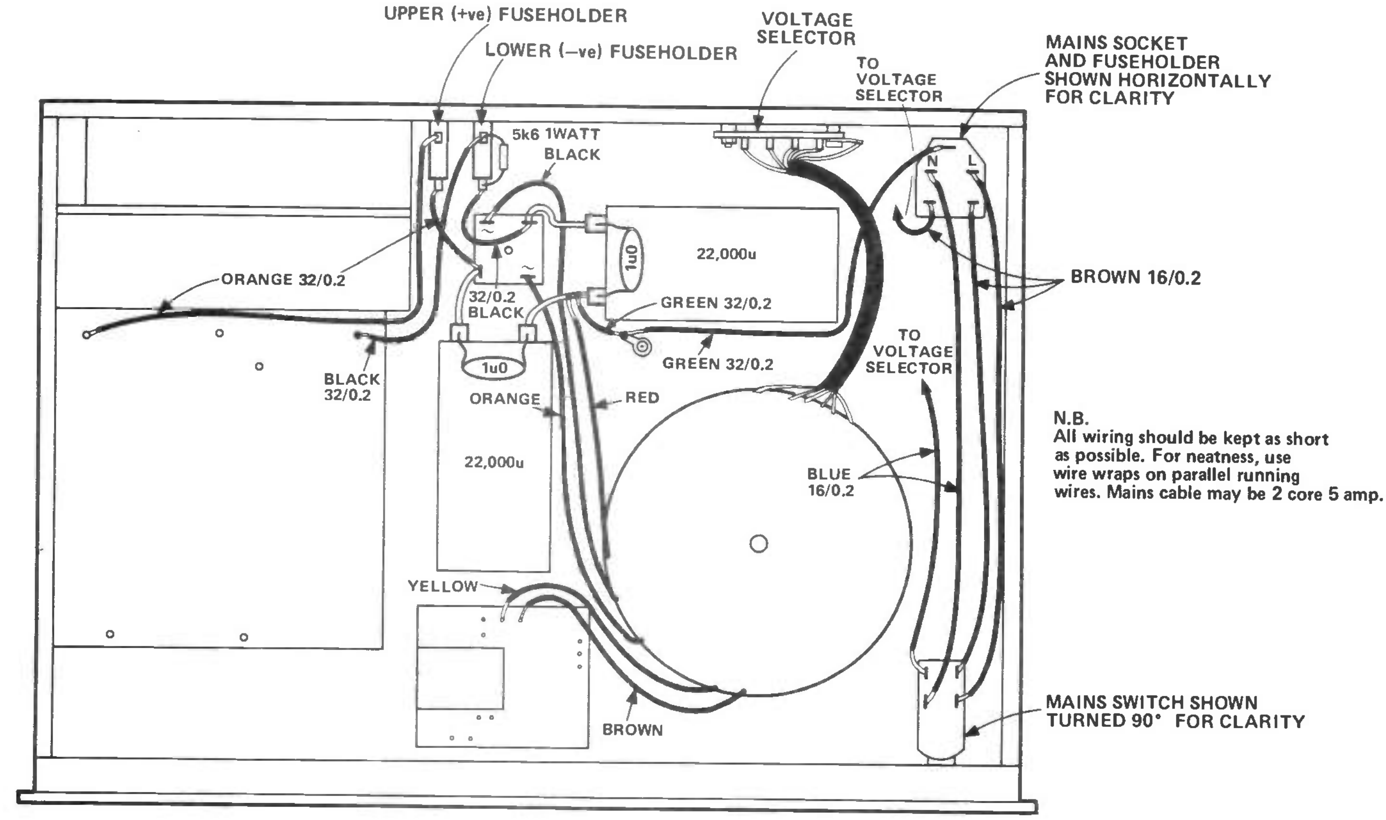


Figure 5: Main amplifier power supply wiring.

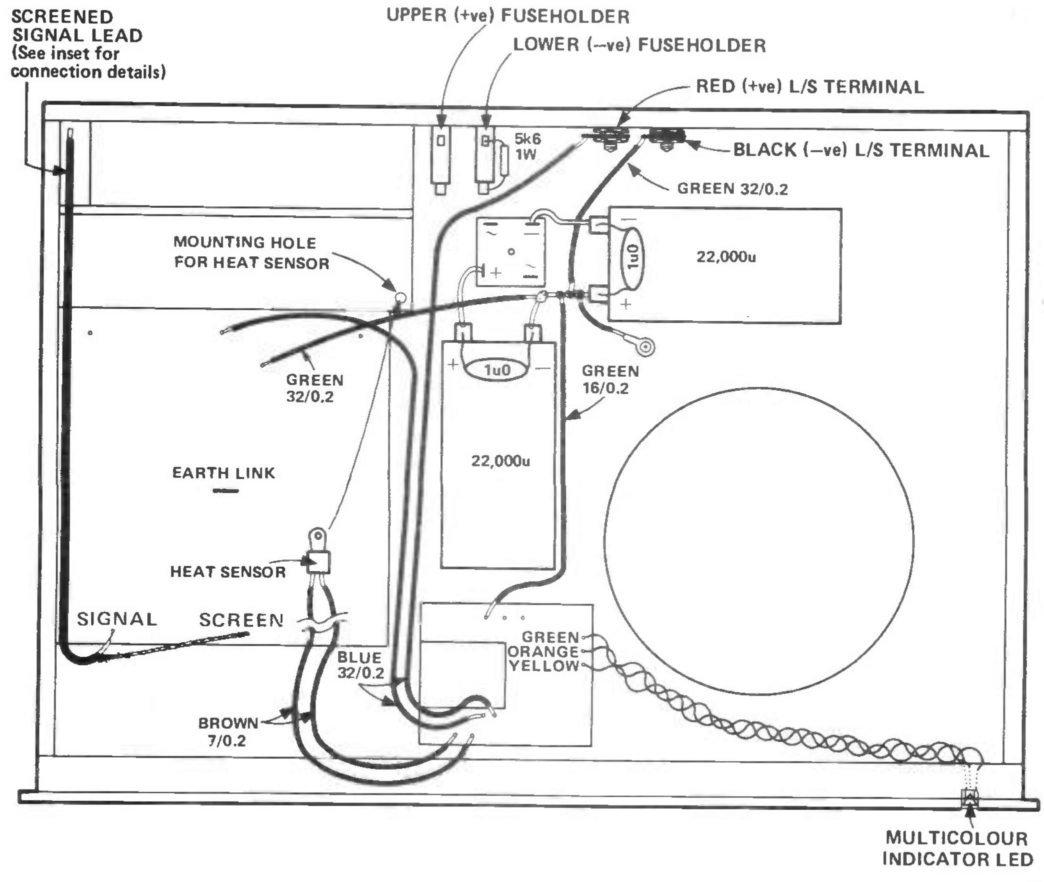


Figure 6: Main amplifier signal wiring. ▶

Setting Up

Begin by removing both supply line fuses (if fitted), turning RV1 fully anti-clockwise, and setting voltage selector at 240V. Connect a 1 watt 1ko resistor across the upper(positive) fuseholder and a 1 watt 1k8 resistor across the lower fuseholder in parallel with 5k6 1W already in this position. This will serve to current limit the amplifier temporarily in the event of a fault.

Switch on mains power, whereupon the LED on the fascia should glow red intially, and turn green after 8-10 seconds.

Check that the DC voltages on the amplifier side of both fuseholders are ± 24 to 26 volts. Monitoring the positive supply voltage at the same point, gradually turn RV1 clockwise, when the voltage at the half way point should drop to 20 to 21 volts. Return RV1 to zero (fully anti-clockwise). This indicates that the amplifier is working and quiescent current is adjustable.

Owners of an oscilloscope and signal generator may confirm this by injecting a 1kHz signal at 300mV, to give an output of approx 10V.

Capacitors of this size retain sufficient charge to destroy a good sized screwdriver or soldering iron bit for some time, so proceed by disconnecting the mains, then discharging both capacitors with a 1-2 watt 100 ohm resistor. Remove the 1ko and 1k8 resistors previously added for current limiting, insert the lower (-ve) fuse, and connect a meter set to 100-200mA fsd across the +ve fuseholder, observing the correct polarities.

Switch on the amplifier and check for the LED to change from red to green. With RV1 still fully anticlockwise (this ensures that the output transistors are turned off) the amplifier should draw approx 40mA.

The output stage quiescent current should now be set to 20mA per device pair (40mA total), by turning RV1 slowly clockwise. This is in addition to the initial current — if initial current is 38mA then set final current to 78mA or if 42mA then set to 82mA.

This should all be done with no load or signal and amplifier at ambient temperature of 20°C approx. Replace +ve fuse, then check that voltages on amp board agree with those on circuit diagram.

In Use

The amplifier is nominally rated at 100 watts, but a brief look at the specification from last month's article will indicate that it is capable of vastly more than that. If you are using 4-ohm loudspeakers, that is, the impedance curve drops to 4 ohms or less, don't forget that the delivery is in excess of 200 watts — even 2 ohms can be coped with, and in this case 240 watts continuous is supplied. This means there are large currents flowing, so the loudspeaker leads must be able to carry them.

An ideal place to situate the power amps is under, or very close to, the loudspeakers, connected by the shortest possible lengths of heavy (at least 15 amp, preferably 30 amp) cable, or any of the super quality audio cables if you already have some. Remember to ensure that all connections are very tight and secure, and you'll be in for the listening experience of a lifetime!

■ R&EW

The CA3080 Operational Transconductance Amplifier (OTA) can be used in a host of voltage or current controlled applications. Ray Marston explains how.

Data File

The CA3080, is a special type of operational amplifier, capable of being controlled by an external current. ***Fig. 1a*** shows the basic symbol and formulae for a conventional op-amp, which is essentially a voltage-amplifying device. It has differential input terminals and produces an output voltage of A(e1 — e2), where A is the open-loop voltage gain of the op-amp (typically 100,000), and e1 and e2 are the signal voltages at the non-inverting and inverting input terminals respectively. The open-loop voltage gain of the op-amp is fixed, and it also has a high input impedance and low output impedance.

Figure 1b shows the basic symbol and formulae of the CA3080 OTA, which is essentially a voltage-to-current amplifier. Like a conventional op-amp, it has differential-voltage input terminals but, as indicated by the constant-current symbol at its output, these input voltages produce an output in the form of a high-impedance current with a value of g_m(e1 — e2), where g_m is the transconductance or 'voltage-to-current gain' of the device. In practice, the g_m value can be controlled by, and is directly proportional to, the value of an external bias current fed into an I_{bias} terminal. In the CA3080, this current can be varied from 100nA to 1mA, giving a 10,000:1 gain-control range.

An OTA is a very versatile device. It can be made to act like a conventional voltage-amplifying op-amp by simply wiring a suitable load resistance to its output terminal — its output current is converted to a proportional voltage. The total current consumption of the CA3080 OTA is double the value of I_{bias}, which may be as low as 100 nA, enabling the device to be used in true micro-power applications. The magnitude of I_{bias} can easily be controlled by an external voltage and a series resistor, enabling the OTA to be used as a voltage-controlled amplifier (VCA), oscillator (VCO) or filter (VCF). ***Fig. 2a*** shows the connections of the 8-pin dil 'E' version and ***Fig. 2b*** shows its internal circuit.

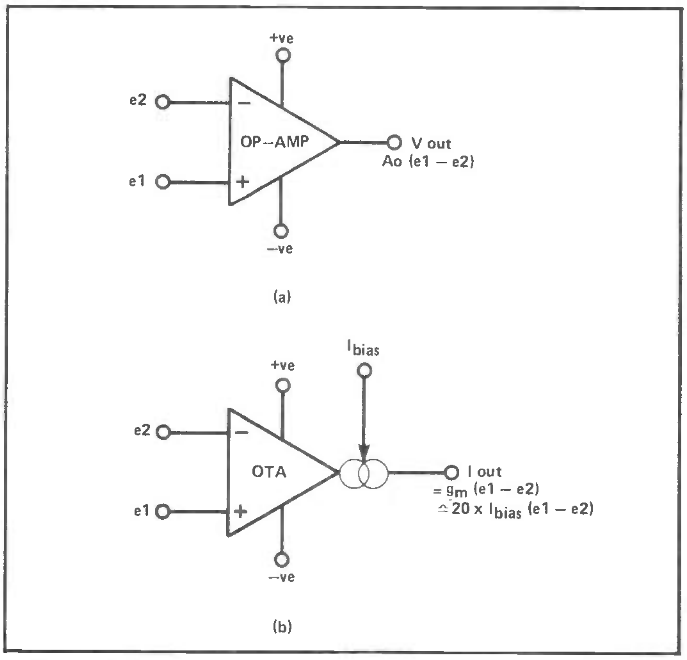


Figure 1. A conventional op-amp (a) is a fixed-gain voltage-amplifying device. An OTA (b) is a variable-gain voltage-to-current amplifier.

CA3080 Basics

The CA3080 is a fairly straightforward device, made of nothing more than one differential amplifier and four current mirrors. Each of these comprise a 3-terminal circuit that, when provided with an external bias current into its input terminals, produces an in-phase current of identical value at its output terminals. When a current mirror (CM) source and CM sink are connected as shown in ***Fig. 3*** and powered from split supply rails, they generate a differential (I_{source} - I_{sink}) current in any external load that is connected to the 0V rail.

Figure 4 shows how the differential amplifier and four current mirrors are interconnected in the CA3080 to make a practical OTA. Bias current I_{bias} controls the emitter current, and thus the g_m, of the Q1-Q2 differential amplifier via CM 'C'. The collector currents of Q1 and Q2 are mirrored by CMA

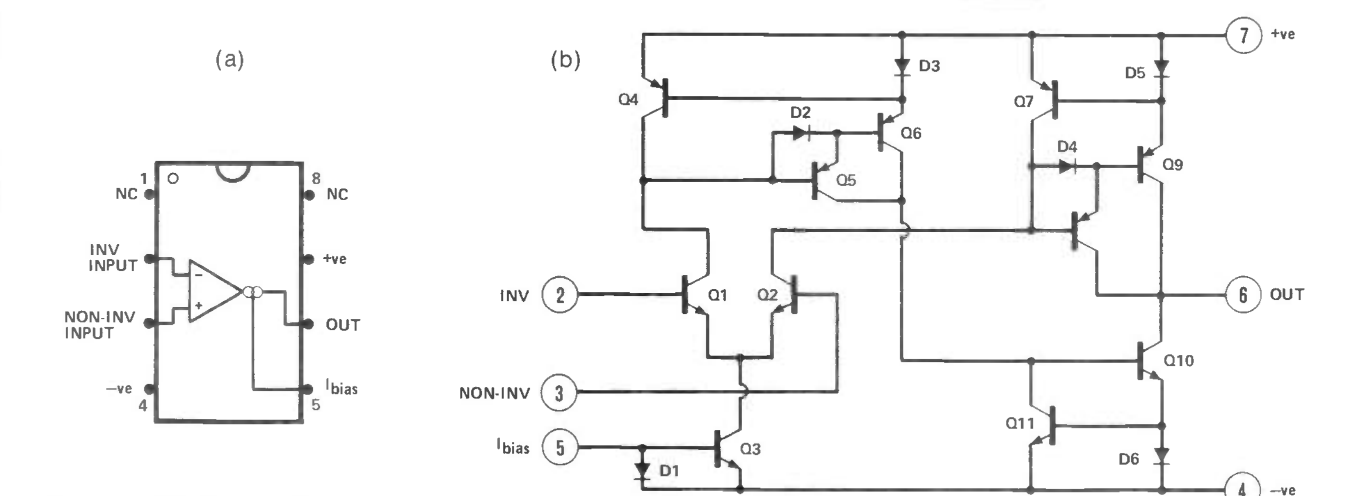


Figure 2. Connections (a) of the 8-pin dil 'E' version of the CA3080, and (b) its internal circuit.

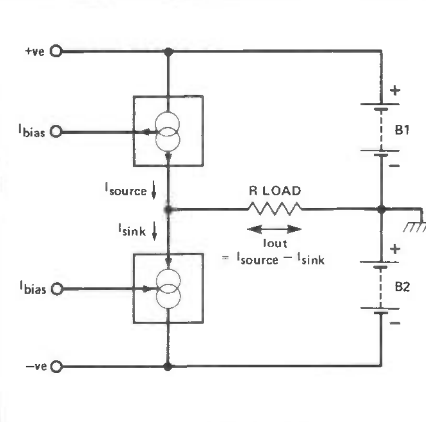


Figure 3. When two current mirrors are wired as shown, they generate a differential current in an external load.

and CMB and fed into the bias and sink terminals (respectively) of CMD, so that the externally available output current of the circuit is equal to $I_b - I_a$.

If you refer back to ***Fig. 2b***, which shows the internal circuit of the CA3080, you should be able to work out the functions of the individual elements with little difficulty. Q1 and Q2 form the differential amplifier, with D1-Q3 making up CMC of ***Fig. 4***, and CMD comprises D6-Q10-Q11. Current mirrors CMA (Q4-Q5-Q6-D2-D3) and CMB (Q7-Q8-Q9-D4-D5) are slightly more complex, using Darlington pairs of transistors, plus speed-up diodes, to improve their performances.

The slew rate (and bandwidth) of the IC depend on the value of I_{bias} and any external loading capacitor connected to pin 6. The slew rate value, in volts/us, equals I_{bias}/CL, where CL is the loading capacitance value in pF, and the I_{bias} value is in uA. With no external loading capacitance connected, the maximum slew rate of the CA3080 is about 50V/us.

Basic Circuits

The CA3080 is a very easy IC to use. Its pin-5 I_{bias} terminal is internally connected to the pin-4 negative supply rail via a base-emitter junction, so the biased voltage of the terminal is about 600mV above the pin-4 voltage. I_{bias} can thus be obtained by simply connecting pin-5 to either the common rail or the positive supply rail via a current-limiting resistor of suitable value.

Figure 6 shows a simple but instructive way of using the CA3080 as a linear amplifier with a voltage gain of about 40dB. The circuit acts as a direct-coupled differential amplifier. It operates from split 9-volt supplies, so 17V4 is generated across bias resistor R1, which thus feeds roughly 500 uA into pin-5 and causes each IC to consume another 1 mA from its supply rails.

At a bias current of 500 uA the g_m of the CA3080 is approximately 10 mmho. The output of the ***Fig. 6*** circuit is loaded by a 10k resistor (R2), and thus gives an overall voltage gain of 10 mmho x 10k = 100, or 40dB. The peak current that can flow into this 10k load is 500 uA (=I_{bias}), so the peak available output voltage is ±5V. The output is also

Some Finer Points

All of the major operating parameters of the CA3080 are adjustable and depend on the value of I_{bias}. The maximum (short circuit) output current, for example, is equal to I_{bias} and the total operating current is double the I_{bias} value. The input bias currents drawn by pins 2 and 3, when the IC is operating in the linear mode, each roughly equal I_{bias}/200, the precise values depending on the current gains of Q1 and Q2 within the chip.

The transconductance (g_m) and the input and output resistance (impedance) values also vary with the I_{bias} value. ***Fig. 5*** shows typical parameter values when the IC is driven from split 15 volt supplies at an ambient temperature of +25° C. Thus, at a bias current of 10uA, g_m is typically 200 umho, and input and output resistances are 800k and 700M respectively; at 1 mA bias, the values change to 20 mmho, 15k and 7M respectively.

The available output voltage swing of the IC depends on the values of I_{bias} and an external load resistor connected to the output (pin 6) of the device. If the load impedance is infinite, the output can swing to within 1V5 of the positive supply rail and to within OV5 of the negative rail. If the impedance is not infinite, the peak output voltage swing is limited to I_{bias} x RL. Thus, at 10 uA bias with a 100k load, the available output voltage swing is ± 1V.

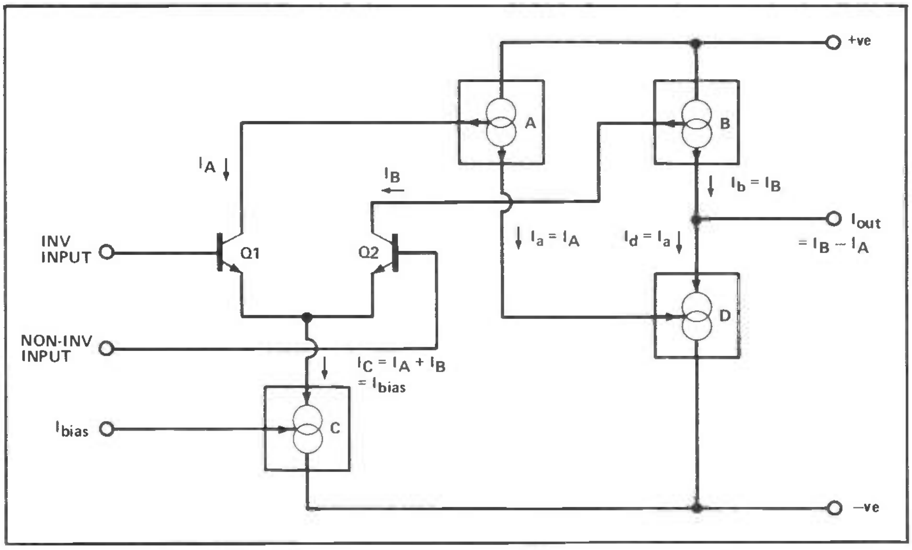


Figure 4. The CA3080 comprises one differential amplifier and four current mirrors.

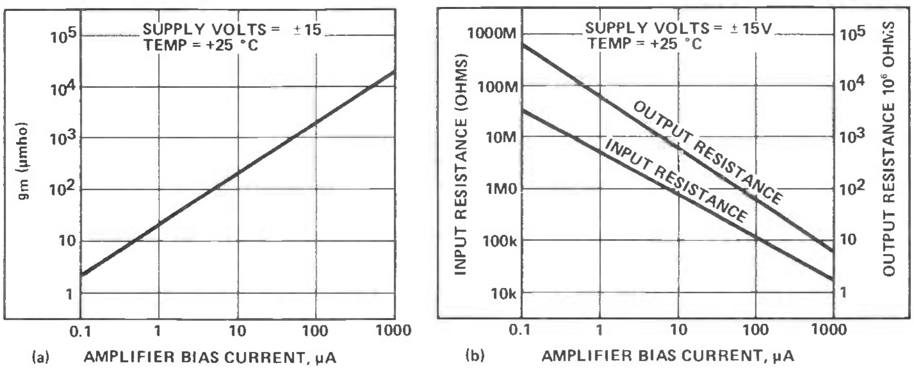


Figure 5. The transconductance (a) and the input and output resistances (b) of the CA3080 vary with the bias current value. ▶

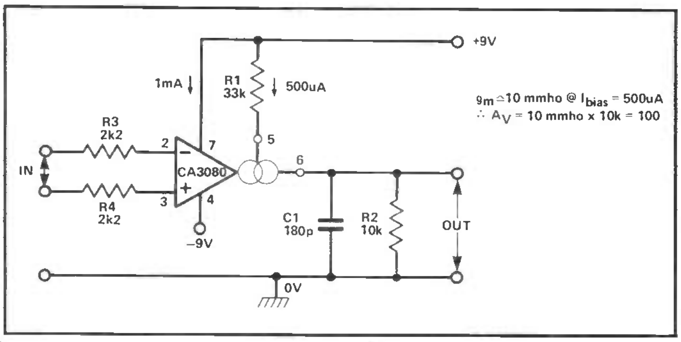


Figure 6. Differential amplifier with 40dB voltage gain.

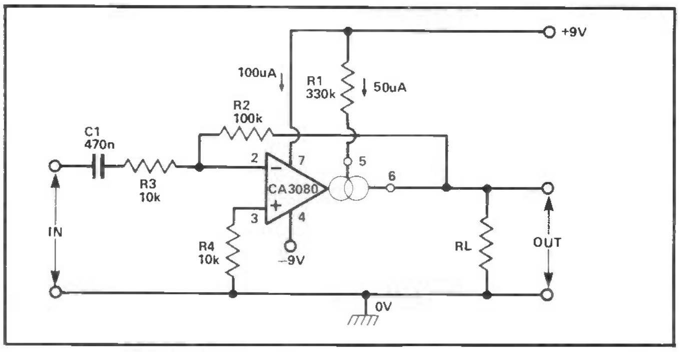


Figure 7. 20dB micro-power inverting amplifier.

loaded by 180 pF capacitor C1, giving the circuit a slew-rate limit of 500uA/180pF = 2.8V/us. The output impedance of each circuit equals the R2 value (10k).

Note in this circuit that the IC is used in the open-loop mode, and that if the slew rate of the chip is not externally limited via C1 the IC will operate at its maximum bandwidth and slew rate. Under this condition the CA3080 may be excessively noisy, and pick up radiated EMF signals.

In the ***Fig. 6*** circuit, the differential inputs are applied via series resistors R3 and R4, which simply help equalise the source impedance of the two signals and thus maintain the DC balance of the IC.

The voltage gain of the circuit depends on the value of I_{bias}, which in turn depends on the value of the supply rail voltage. The voltage gain of the CA3080 can be made almost independent of the I_{bias} and supply voltage values by using conventional op-amp techniques, as shown by the 20dB AC-coupled inverter circuit of ***Fig. 7***, which consumes a mere 150 uA from its split 9-volt supply rails.

Figure 7 is wired like a conventional op-amp inverting amplifier, with its voltage gain (A_V) determined primarily by the R2/R3 ratio (= 10, or 20dB). This gain equation is, however, only valid when the value of an external load

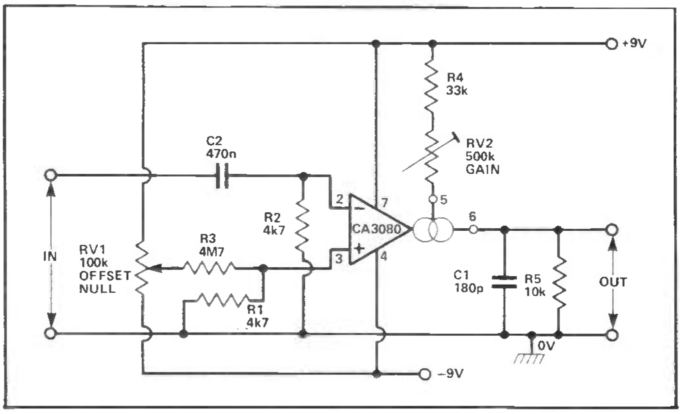


Figure 8. Variable-gain (x5 to x100) AC amplifier.

resistor, R_L, is infinite, since the output impedance of this design is equal to R2/A_V, or 10k, and any external load causes this impedance to give a potential divider action that reduces the output of the circuit.

In ***Fig. 7***, the main function of I_{bias} is to determine the total operating current of the circuit and/or the maximum available output voltage swing. With the component values shown, I_{bias} has a value of 50uA, causing the circuit to consume a total of only 150 uA. When R_L is infinite, the output is loaded only by R2, which has a value of 100k, so the maximum available output voltage is ± 5V. If R_L has a value of 10k, on the other hand, the maximum output voltage limits at ± 0V5. This circuit can thus be designed to give any desired values of voltage gain and peak output voltage. Note that, since the IC is used in the closed loop mode, external slew rate limiting is not required.

If the CA3080 is to be used as a high-gain DC amplifier, or as a wide-range variable-gain amplifier, input bias levels must be balanced to ensure that the output correctly tracks the input signals at all prevailing I_{bias} values. ***Fig. 8*** shows how suitable bias can be applied to an inverting AC amplifier in which the voltage gain is variable from roughly x5 to x100 via RV2, and the offset balance is pre-set via RV1. The circuit is set up by adjusting RV2 to its minimum (maximum gain) value and then trimming RV1 to give zero DC output with no AC input signal applied.

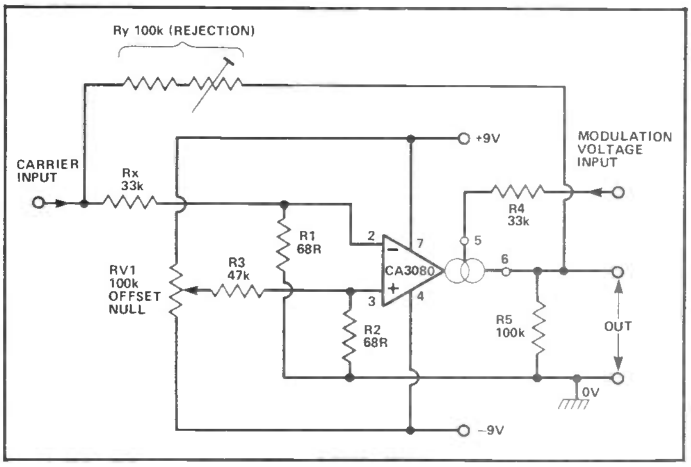


Figure 9. Ring modulator or 4-quadrant multiplier.

Voltage-Controlled Gain

In practice, the most important uses of the CA3080 are in true micropower amplifier and oscillator applications, and in applications in which important parameters are controlled by an external voltage. In the latter category, one important application is as a voltage-controlled amplifier (VCA) or amplitude modulator, in which a 'carrier' signal is fed to the input of the amplifier, and its output amplitude is controlled or modulated by another signal fed to the I_{bias} terminal. ***Fig. 9*** shows a practical circuit for a ring-modulator or 4-quadrant multiplier, in which the output signal polarity depends on the polarities of both the input signal and the modulation voltage. Operation of the circuit is such that, when the modulator input is tied to the zero volts rail, the inverted signal currents feeding into R5 from the output of the OTA are exactly balanced by non-inverted signal currents flowing into R5 from the input signal via Ry, so that zero output is generated across R5. If the modulation input goes +ve, the output of the OTA exceeds the current of the R_Y network, and an inverted gain-controlled output is obtained. If the modulation input is — ve, on the other hand, the output current of R_Y exceeds that of the OTA, and a non-inverted gain-controlled output is obtained. Thus, both the phase and amplitude of the output

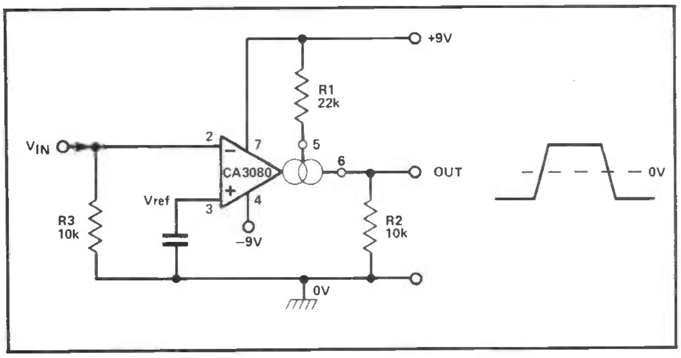


Figure 10. Fast inverting voltage comparator.

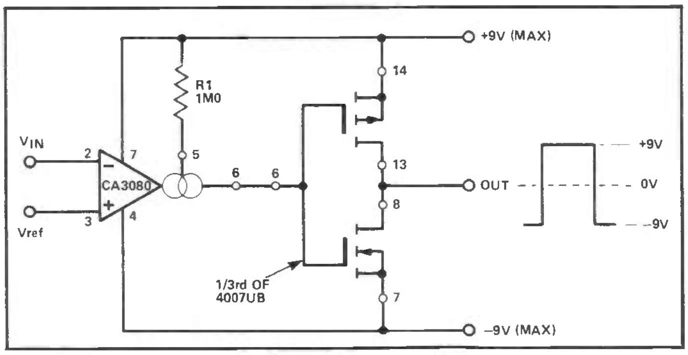


Figure 11. Non-inverting micro-power voltage comparator.

signal of this 4-quadrant multiplier circuit are controlled by the modulation signal. The circuit can be used as a ring modulator, by feeding independent AC signals to the two inputs, or as a frequency doubler by feeding sine wave signals to the two inputs.

Note that, with the R_X and R_Y values shown, the circuit gives a voltage gain of x0.5 when the modulation terminal is tied to the +ve or -ve supply rail; the gain doubles if the values of R_X and R_Y are halved. Also note that in practice a voltage follower buffer stage must be interposed between the output terminal and the outside world.

Comparator Circuits

The CA3080 can easily be used as a programmable or micro-power voltage comparator. ***Figure 10*** shows the basic circuit of a fast, programmable, inverting comparator, in which a reference voltage is applied to the non-inverting input terminal and the test input is applied to the inverting terminal. The circuit action is such that the output is driven high when the test input is below V_{ref}, and is driven low when test is above V_{ref} (the circuit can be made to give a non-inverting comparator action by transposing the input connections of the IC).

With the component values shown, the I_{bias} current of the ***Fig. 10*** circuit is several hundred uA, and under this condition the CA3080 has a slew rate of about 20V/uS and thus acts as a 'fast' comparator. When the test and V_{ref} voltages are almost identical, the IC acts as a linear amplifier with a voltage gain of g_m x R2 (about 200 in this case). When the two input voltages are significantly different, the output voltage limits at values determined by the I_{bias} and R2 values; in ***Fig 10***, the output limits at roughly ±7V when R2 has a value of 10k, or at ±700 mV when R2 has a value of 1k.

Figure 11 shows how the above circuit can be modified so that it acts as an ultra-sensitive micro-power comparator which typically consumes a quiescent current of only 50 uA but gives an output voltage that swings fully between the two supply rails and can supply drive currents of several mA. Here, the CA3080 is biased at about 18 uA via R1, but has its output fed to the near-infinite input impedance of a CMOS inverter stage made from one section of a 4007. The CA3080-plus-4007 combination gives the circuit an overall voltage gain of about 130dB, so input voltage shifts of only a few micro-volts are sufficient to switch the output from one supply rail to the other.

Schmitt Trigger Circuits

The simple voltage comparator circuit of ***Fig. 10*** can be made to act as a programmable Schmitt trigger by connecting the non-inverting 'reference' terminal directly to the output of the CA3080, as shown in ***Fig. 12***. In this case, when the output is high, a positive 'reference' value of I_{bias} x R2 is generated; when V_{in} exceeds this value, the output regeneratively switches low and generates a negative reference voltage of I_{bias} x R2; when V_{in} falls below this value, the output regeneratively switches high again and once more generates a positive reference voltage of I_{bias} x R2. Thus, the trigger thresholds (and also the peak output voltages) of this Schmitt circuit can be precisely controlled or programmed via either I_{bias} or R2.

Astable Circuits

The Schmitt trigger application can be modified as an astable multivibrator or square-wave generator circuit by simply connecting its output back to the non-inverting input terminal via an R-C time-constant network. With the addition of a few other components, an output waveform with variable mark/space ratio can be produced, as shown in ***Fig. 13***. Here C1 alternately charges via D1-R3 and the left half of RV1, and discharges via D2-R3 and the right half of RV1, to give an M-S ratio that is fully variable from 10:1 to 1:10 via RV1.

■ R&EW

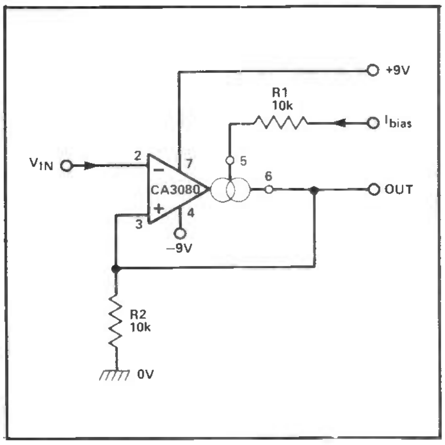


Figure 12. Programmable Schmitt trigger.

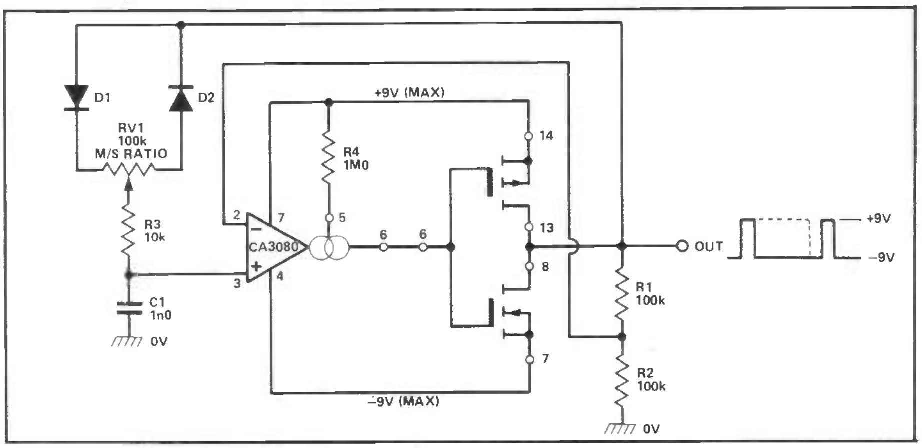
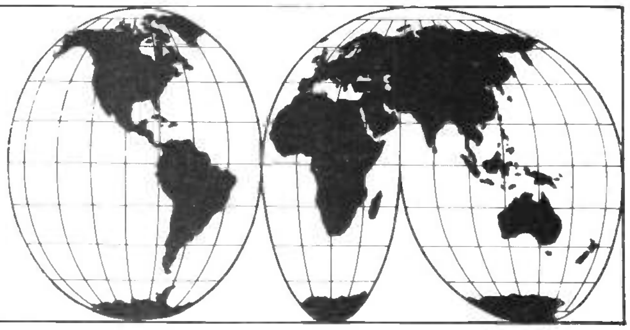


Figure 13. Variable mark-space ratio astable.

SHORT WAVE NEWS FOR DX LISTENERS

Frank A. Baldwin



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

In last month's rendition, we dealt with a review of some of the easier-to-receive Latin American stations operating on the 60 metre band (**4750** to **5060**). The present instalment continues this review, commencing with some of the Brazilian transmitters regularly logged here in the UK. Some of our beginner SWL readers may care to visit the frequencies designated from around 2200 onwards.

Adjust the dial to **4835** where may be found signals from Radio Nacional in Boa Vista operating from 0900 to 0400 and identifying as "Radio Difusora Roraima", it has a power of 10kW. Then there is Radio Jornal do Brasil in Rio de Janeiro on **4875** from 0900 through to 0530 with a 10kW transmitter; Radio Clube do Para, Belem on **4885** to the schedule 0800 to 0300 at 10kW; Radio Bare in Manuas on **4895** working away from 0800 (Sunday from 0900) to 0400 with a 5kW signal and identifying as "Radio Super Bare".

Turn your attention now to that part of your receiver dial indicating the frequency **4905** where you may log Radio Relogio in Rio de Janeiro on the air to the to the schedule 0800 to 0300. You cannot mistake this one for the reason that it broadcasts time-signals which overlay current programmes, the second pulses being quite distinctive. The power is 5kW.

The nearby channel of **4915** will almost certainly provide signals from Radio Anhanguera in Goiania if conditions are right. It operates from 0900 (Sundays from 1000) to 0400 and has a power of 10kW; or there is Radio Dragao do Mar in Fortaleza which can be located on **4925** where it is scheduled from 0800 to 0900 and from 2130 to 0300 with a 5kW transmitter although there is a difficulty here with the co-channel Brazilian Radio Difusora Taubate, Taubate operating from 0830 to 0300 with a power of 1kW. Both stations are often reported so it will be apparent that the station identification must be clearly heard before an entry is made into the logbook.

ON **5025** operates the often reported Radio Borborema in Campina Grande, scheduled from 0800 to 0430, it identifies as "A Princesa do Sul" and has a power of 1kW whilst on **5035** we have Radio Aparecida with a 2.5kW signal operating from 0900 to 0300.

The last Brazilian at this high end of the band is Radio Clube do Para in Belem which is on the air from 0700 to 0300 with a power of 10kW.

Turning our attention now to some of the Colombians on the 60 metre band, we commence with Radio Guatapuri in Valledupar which may be tuned at that point of the dial marked **4815**. Identifying as "Radio Favorita", it has a power of 10kW and is scheduled on the air around-the-clock.

Neiva in Colombia may be heard on **4855** where it is scheduled from 1100 to 0530 although it has been reported as closing at 0400 on occasions. The power is 1kW.

Then there is a particular favourite of mine in the form of Radio Super in Medellin on **4875** which is often logged in the early mornings whilst I drink a cup of welcome tea! It is scheduled around-the-clock and has a power of 2kW — the station, not the tea!

To wind up the Colombian scene on this band there now remains Radio Caracol in Neiva on **4945** on a 24-hour basis at 2.5kW; Radio Santa Fe in Bogata

DX-TV

Compiled by Keith Hamer & Garry Smith

Enhanced tropospheric reception conditions returned yet again during February — in fact on two occasions around the middle of the month. There hasn't been such an abundance of openings since the early 70's so perhaps we're making up for lost time.

Other reception during the month was due mainly to Meteor Shower (MS) activity although an aurora was noted on the 4th with the characteristic rumbling and sleigh-bell sounds present on the various Band I channels.

Czechoslovakia (CST) and Austria (ORF) were the most commonly identified television services received throughout the month via MS. The distinctive "RS-KH" test card (see **R&EW**, April 1983) from CST was seen on the 4th, 7th, 8th, 9th, 10th, 11th, 15th, 16th, 21st, 22nd, 24th and 28th on channel R1. The Austrian "ORF FS 1" PM5544 was seen on most days together with occasional glimpses of the Telefunken T05 monoscopic test card. The Swedish "TV 1 SVERIGE" PM5544 was noted on channel E3 on the 2nd, 6th, 17th, 23rd and 28th while the Norwegian PM5544 was seen on the 6th, 20th and 21st. Other countries noted via MS included Spain(RTVE), Russia(TSS) and Poland(TVP) which were all identified during test transmissions or news programmes. A late-evening tropospheric lift on the 15th provided West German reception throughout Band III and UHF with the East German first network appearing near closedown at 2157GMT on channel E6 with the "ak" news symbol, clock caption and programme schedule for the following day. Similar conditions on the 18th and 19th produced Dutch, Belgian, French and a few West German stations. The signal strengths were high and good enough to sustain snow-free colour pictures of entertainment quality for several hours on both days.

Notes For Beginners

By the time this column is read, the 1983 Sporadic-E season should be underway permitting the reception of television signals from as far away as Russia, Jordan, Spain and Iceland. Reception occurs on several channels throughout Band I between 48MHz and 70MHz. To receive these signals a VHF tuner is required in place of the UHF type normally fitted to British sets. Varicap tuners are the best and can be obtained relatively cheaply from Sendz Components or Manor Supplies. The ELC 1042 type covers only Bands I and III whereas the ELC 2000 and ELC 2060 versions are multi-band with the added bonus of UHF and an extended Band I coverage up to approximately 90MHz for "out of band" Eastern European channels. Existing powering arrangements may be used, that is, a stabilised 30V supply for the tuning potentiometers and a 12V supply for the tuner itself. It should be noted that a band switch will be necessary and great care is essential with regards to isolation. A large-screen receiver is likely to have a live chassis irrespective of mains polarity. A small-screen mains/battery portable is likely to have an isolated chassis but the service manual should be consulted if there are any doubts.

There are various receivers on the market which already have facilities for Bands I and III. The channels are normally marked 2-4 (Band I) and 5-12 (Band III). The Plustron TVR 5D is one on **4965** with the same schedule and power and finally Radio Cinco in Villavicencio on **5040** also with a 24-hour schedule but with a power of 3kW.

To complete the review of the so-called 'easy' stations operating from Latin America there now remains another old favourite of mine — La Voz Evangelica in Tegucigalpa, Honduras which may be logged on **4820** where it is scheduled from 1030 to 0300 and from 0500 to 0600 in Spanish and from 0300 to 0500 in English. These latter programmes are religious in content but do make the station identification a relatively easy matter for the beginner making a start at the LA game.

Next month some of the not-so-easy stations will be reviewed.

Around The Dial

United Arab Emirates
Dubai on **21655** at 1213, OM and YL in an Arabic dramatic production — even complete with the cries of a baby — in an External Service presentation. Dubai is on this frequency from 0700 through to 1715.

Egypt
Cairo on **9475** at 2023, YL with songs together with some typical Arabic music during the Domestic Service schedule which is on this channel from 1800 to 2345.

Cairo on **11665** at 2028, local-style songs and music in the "Voice of the Arabs" Service to the Middle East, North and Central Africa, South Asia and Europe from 1900 to 0030 on this frequency. Trumpet fanfare at 2030 followed by OM with station identification and a newscast in Arabic.

Canada
Montreal on **6045** at 0644, OM with the French programme for Africa, the Middle East and Europe, scheduled from 0630 to 0645.

Netherlands Antilles
Bonaire on **9175** at 0623, YL with announcements at the end of the English programme for the North American West Coast, listed on this channel from 0530 to 0625.

Czechoslavakia
Prague on **7345** at 2018, OM and YL with an English programme for Europe, timed from 2000 to 2030. It was all about the local music and folk songs, complete with several samples.

Prague on **6055** at 0623, OM presenting the news and comment feature in the French transmission to Europe, scheduled from 0600 to 0630.

Iraq
Baghdad on a measured **3367** at 2044, OM with a talk in the Persian transmission to Iran which is aired on this frequency from 1600 to 1900 and from 2000 to 2300.

Nigeria
Lagos on **7255** at 0628, OM's with a chorus of African chants, drums, OM and YL with announcements in the French programme for West Africa, on this channel from 0600 to 0700. QRM from the overlaying Radio Sofia.

Poland
Warsaw on **6135** at 1447, YL with a talk in the Danish transmission for Europe, scheduled from 1430 to 1500.

Warsaw on **6095** at 0636, OM with a talk in Polish in a programme for Poles abroad — I nearly wrote Poles apart — this session being timed from 0600 to 0700.

Warsaw on **7270** at 0640, OM with listeners' letters and replies during an English programme to Europe, scheduled from 0630 to 0700.

East Germany
Radio Berlin International on **6080** at 2140, OM with a newscast in English during a programme in that language timed from 2130 to 2215 on this channel.

Spain
Madrid on **21595** at 0647, some of the colourful and distinctive music of Spain during a transmission intended for Spaniards in Australia, the Near and Middle East, scheduled from 0600 to 0930 (not Sunday).

Madrid on **11760** at 2042, OM with a newscast of both local and world events during the English service to Europe, timed from 2000 to 2100.

Switzerland
Berne on **6165** at 0643, a YL yodelling some yodels — made my throat ache — during the German, French and Italian programme for Africa and Europe, featured on this channel from 0600 to 0645.

Berne on **3985** at 0652, Swiss music in typical style during a music programme for Europe, scheduled from 0645 to 0700.

Libya
Tripoli on **6185** at 0651, YL with a song, some local-style music, YL announcer in the Domestic Service which operates at this point on the dial from 0500 through to 2330.

Kuwait
Radio Kuwait on **11990** at 1140, OM with songs in Arabic together with the music in a programme of the Domestic/External Service, on this channel from 0400 to 1505.

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example and this particular set will resolve the UK and Western European sounds systems.

For initial experiments with Sporadic-E propagation the aerial used for DX can be a fairly simple affair especially as the signals can attain very high strengths. A simple dipole with each rod 50 inches in length will suffice and should be mounted horizontally and externally where possible. The enthusiast can then progress to the luxury of a more ambitious aerial system such as a rotatable 3 or 4-element beam for weak-signal work. The use of a pre-amplifier is tempting but should be avoided, especially at Band I freqencies, since it can overload in the presence of strong signals. A bandpass filter may be necessary to avoid interference from CB. To ensure that the DX system is functioning the receiver can be tuned throughout Band I to check that signals are arriving satisfactorily from local and semi-local BBC-1 transmitters. Reception will be displayed as a pattern of white lines because the 405-line system uses positive vision modulation rather than the negative modulation system used by the UK 625-line services and Continental VHF and UHF networks.

Figure 1: West German FuBK test card carrying a stereo TV sound test transmission.

During the Sporadic-E season (which lasts from early May until mid-September) a check for reception throughout Band I should be made as often as possible during the day because signals can come and go within a matter of minutes. Sometimes a Sporadic-E opening will last the whole day, occasionally from about 0600 until 2400, or even later. It should be noted that there may be several days during the season when signals are totally absent. Full details about getting started with DX-TV were given in the September 1982 edition of **R&EW**.

Service Information

Sweden: Severiges Radio have introduced a new transmitter on channel

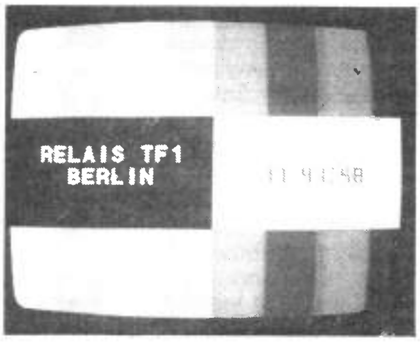


Figure 2. (SLIDE) Test pattern radiated by the French TV first network (TF 1) relay station operating in West Berlin. Photo by courtesy of Juergen Klassen, West Germany.

E41 at Finnveden with an ERP of 1000kW for their first network. The transmitter was previously operating on E4 with an ERP of 3kW.

East Germany: Links via Poland and the Gorizont satellite are providing Russian army personnel stationed in certain parts of the DDR with television programmes from the USSR. The East German authorities are rapidly extending the TSS-1 network on UHF channels as well as E12 and E4. The latter channel is causing some concern in West Germany as TSS transmissions

Sweden
Stockholm on **6065** at 0655, OM with a talk during the Swedish transmission to Africa and Europe, this being a relay of the Domestic 1st Programme, on this channel from 0430 to 0830.
Stockholm on **9615** at 1208, OM presenting a newscast in the German programme for Europe, timed here from 1200 to 1230.

Norway
Oslo on **6015** at 0658, OM with station identification as "This is Radio Norway International" in both English and Norwegian, interval signal then a newscast in the Norwegian programme to Africa, the Middle East, Europe and South America, scheduled from 0700 to 0745.

South Yemen
Aden on **6005** at 1952, OM with songs in Arabic with local orchestral backing in the Domestic Service which is scheduled on this frequency from 0300 to 0630 (Friday from 0630 to 1100) and from 1100 to 2200. Logged often of late.

Benin
Cotonou on **4870** at 0610, YL with a newscast in vernacular in the Home Service which is on this channel from 0400 (Saturday from 0550) to 0800 and from 1300 (Saturday from 1100) through to 2400. The power is 30kW.

South Africa
RSA Johannesburg on **25790** at 1204, OM with a newscast in the French programme to Central Africa and Europe, timed from 1200 to 1300.

Turkey
Ankara on **15220** at 1210, OM with a song complete with local orchestral backing in the transmission for Turks abroad. The "Voice of Turkey" is on this channel with this programme from 0700 through to 1700.

Mauritania
Nouakchott on **4845** at 0607, OM with quotations from the Holy Quran. The schedule is from 0600 (Sunday from 0800) to 0900 and from 1758 (Saturday and Sunday from 1700) to 2400. The power is 100kW.

China
Radio Peking on **7780** at 2010, OM with a talk during the Portuguese presentation to Africa and Europe, scheduled from 2000 to 2100.
Radio Peking on **7800** at 2006, European-style music in the French programme for Africa and Europe, timed from 1930 to 2030.
Radio Peking on **11600** at 1425, YL with a talk all about Chinese history during an English programme for South East Asia being presented on this channel from 1400 to 1500.

South Korea
Seoul on **7550** at 2100, OM with station identification in Russian as "Govorit Seoul" (Here is Seoul) and the following Russian programme for the USSR. The inevitable jammer arrived a minute later, identifying in morse as UB.

Romania
Bucharest on **17850** at 1153, YL with a song during the French programme for Africa and Europe, scheduled from 1130 to 1200. YL with station identification, interval signal and carrier off at 1155.

Sri Lanka
Colombo on **4902** at 2120, the chanting of monks on a full-moon day. This is the Home Service 1 which irregularly operates on this frequency from 0000 to 0300 and from 1000 to 1745 in Sinhala. On full-moon days the schedule is extended from 1000 through to 2400. The power is 10kW.

Iran
Tehran on **3779** at 2040, YL with a talk in Persian in the Domestic 1st Programme which closes at 2130 but can be heard from around 1930 onward at my QTH.
Tehran on **15260** at 1135, OM's with a rousing marching chorus in Persian then OM with announcements, exhortations and the rest. All in the Domestic Service 1st Programme which is on this channel from 0630 through to 1615.

Vatican
Vatican City on **6190** at 2039, OM and YL with the English programme directed to Africa from 2030 to 2045.

Seychelles
Mahe on **15405** at 1158, European-style light music, OM with announcements at the end of the Arabic programme for North East Africa and the Middle East, scheduled from 1100 to 1200. Off abruptly at 1200 without the National Anthem.

Now Hear This

Voz de Sao Vicente, Cape Verde on a measured **3931** at 2115, when radiating a talk in Creole. This one operates from 1200 to 1400 and from 1800 to 2400 Monday to Friday inclusive; Saturday from 1200 through to 2400 and on Sunday from 0900 through to 2400. The power is 10kW and the languages used are Portuguese and Creole. Not an easy one to log owing to the surrounding — and often covering — commercial interference. It announces as "Voz de Sao Vicente" and it is sometimes heard by DXers both in the UK and Europe.

■ R&EW

are now interfering with BR-1 (Bavarian Television) programmes from Ochsenkopf. The new service is known as 'Fernsehen der Sowjet-Armee' (FSA).
Spain: There is a new television service operating in the Basque country called Euskal Telebista (ETB). The studios are based at Durango and the main UHF transmitters are located at Durangesado (channel E33), Bilbao (E35), Vitoria (E42) and Jaizkibel (E51). The Philips PM5544 test card is used with the identification "ETB" in the upper black rectangle.
Afghanistan: Until recently, PAL colour was used with 625 lines scanning but following the invasion by Russia, links have been provided to the Eastern-bloc system called "Intersputnik". A new transmitter has been specially installed to radiate programmes using the USSR colour system, SECAM.
Denmark: There are plans to introduce a second network in an effort to combat competition from planned communal television systems. Denmark's Radio are also investigating the possibility of commencing a regional television service.
Faeroe Islands: Television broadcasting is presently limited to private stations which mainly radiate programme material supplied by Denmark's Radio. A national network is planned for the islands with transmitters at Torshavn and Suduroy.
Bulgaria: Bolgharska Televizia are currently bringing into service a number of high-power transmitters. Details of channel allocations are not available at the moment.
Poland: TVP-2 are now radiating programmes from a new outlet on channel R26 with 1000kW ERP. Its location is unknown.
Czechoslovakia: Soviet television programmes from TSS-1 are now being relayed via three low-power transmitters.
The Bratislava outlet operated by CST is reported to be back in service following a fire which caused severe damage.
Hungary: Magyar Televizio (MTV) have commenced a teletext service similar to the BBC's CEEFAX system.
We are indebted to the EBU (Belgium), Gosta van der Linden (Netherlands) and Alexander Wiese (West Germany) for the above information.

■ R&EW

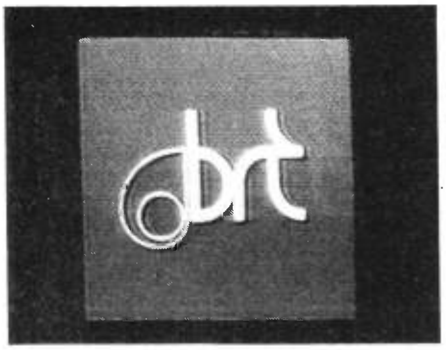


Figure 3. Identification caption received from Belgian Television.

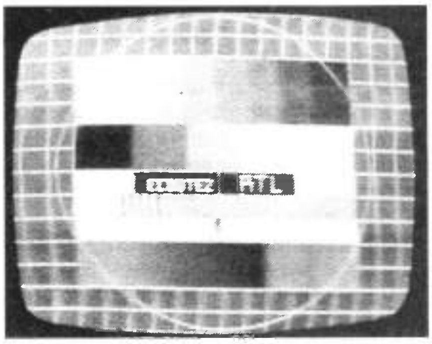


Figure 4. The FuBK test card radiated by Radio-Tele-Luxembourg and received on channel E27.

NOTES FROM THE PAST

With the results of the April survey beginning to emerge, it's interesting to note Centre Tap's comments on readers' correspondence in the past.

Of the many readers who wrote on the type of articles they like in *Radio Constructor*, and its general policy, all praised its wide range of subjects and many say they would like to see an even wider field. A South Australian reader, Mr. E.M.P. Wells, suggests we might emulate the Australian *Radio and Hobbies* magazine. For British readers unfamiliar with this magazine, I might mention that up to half its contents are given over to articles of scientific interest. Occasionally such subjects as astronomy are covered, but in these days of radio-equipped sputniks perhaps the latter is not really so remote from our hobby after all.

We would like to hear of readers' experiences on the efficient frequency range of transistors and also their employment in hi-fidelity circuits. He does not like ultra-miniaturisation (matchbox sets, etc) but readily appreciates that other readers do. One of the chief reasons for his interest in transistors is on account of the exorbitant cost of batteries "down under". Readers who do see copies of Australian magazines are invariably horrified at the prices of all radio gear, many items costing more than double the list price in UK and then gaily advertised as bargains. If you are thinking of emigrating to Australia, take as much gear as you can carry.

He also asks about projection TV. Am afraid, OM, interest over here has largely languished chiefly on account of cost, and with many others I personally feel that the "eventual" TV receiver will be in the form of a flat picture to be hung on the wall or stood on the mantelshelf.

Reely

To get round to other correspondents. From P.M. (Gainsborough) comes a complaint. He writes; "Recently you said you were open to receive readers' criticisms. Here is one, and an important one, I think. Insist that all set designers stick to coils of well-known and easily obtainable makes. This business of so many turns of 32 s.w.g. enamelled on a ½in former is both irritating and expensive. It is almost impossible nowadays to buy either the wire or a former without a lot of trouble. In any case you have to buy far more wire than you need and the rest of it is usually waste. Even if the gauge happens to be right for the next winding job, the specification is sure to call for either silk or cotton-covered. Because of this silly practice I have already collected half-a-dozen reels which, as far as I can foresee, are useless. In any case the ready-made coils are cheaper than buying the wire. Otherwise the magazine is all right but more articles on refinements such as magic eyes, tuning meters, remote control, noise suppression, etc, would further improve it".

Fireside Listening

Recently I wrote of matchbox receivers, and some interesting correspondence with readers has ensued. An outstanding application of the idea comes from Mr. O. G. Kerslake who builds miniature receivers into tiny radiograms which form a part of 3-D stage sets which he surrounds with a gilt picture frame for hanging on walls.

He built up the scene with dolls house furniture. The radio located behind the picture scene really works and can be heard clearly at the far end of the room. The clock which tells the correct time is the dial and movement from a small wrist watch; the mirror forming the overmantel is one of the type used in birdcages. The figure sitting in the scene could be a cut-out of your wife or girl friend — failing possession of either of these you could fall back on a pin-up personality.

The usual plaques or model scenes are dead and of little interest, but you can use a working model which might well be based on real life or be an actual scene from your own drawing room, complete with carpet and rug. Other working parts might well be included by imaginative readers. For instance, I would suggest that a "live" fire could be simulated by a peanut bulb behind red celluloid set inside a grate. A small piece of suspended foil would rotate automatically by the heat, giving apparent life and movement to the fire. The purist might even add a little Eureka wire element so heat comes off as well!

The great thing, of course, is to keep everything in the correct proportion to ensure naturalness and reality.

As far as the radio side is concerned, a moving coil headphone earpiece (or even an old m/c microphone) will serve as the loudspeaker, and with the advent of transistors and deaf-aid components a set which would really fit into the "radiogram" cabinet might well be designed. Alternatively, a little judicious cheating is permissible with the larger components hidden behind the breast of the fireplace or even at the back of the scene. There is still time to get one ready as a Christmas present for a special friend. A small ceiling light could be fitted. Thus one could shave in the mirror while listening for the time-signal and weather report.

What's My Line

A.G. of Ewell asks, in a cheery letter: "I have often been amused by some of the sub-headings you use. They remind me of the sub-titles used for the small news items on the front page of the London *Evening News*. You wouldn't happen to be the same chap, would you?" The answer, I am afraid, is no, but on A.G.'s recommendation I am considering applying for the job when it falls vacant.

Finally R.M. of Dorking, another of the Old Timer school, writes: "How thankful I am that I kept up my interest in the technical side of radio. The TV programmes are so dull (except for sport and outside broadcasts) that I should be bored to death if I couldn't get some fun out of constructing, adjusting and experimenting, which is more than most licence-holders get. As for the plays-most of them are feeble, especially those written 'specially for TV' — a phrase I've learned to dread. Produced for any form of entertainment for which an admission fee is charged, the customers would want their money back — and if they didn't get it they would be justified in wrecking the theatre".

SUPPLIERS & SERVICES INDEX

NEW PRODUCTS

See The Light

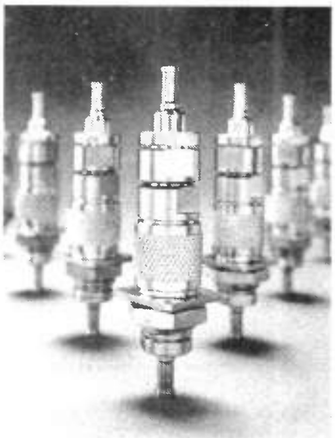
Hellermann Deutsch Ltd., a member of the Bowthorpe Holdings PLC Group of companies, are launching a Fibre Optic Connector — the new TC2 series.

The TC2 incorporates the unique 'BI-TERM' feature, allowing the Connector to be assembled using either the Pot Polish or cleave fibre termination procedure.

Its features are: easy accessibility for ferrule cleaning, alignment sleeves can be replaced in the field. Interface sealing to avoid ingress of dust or moisture, combined bulkhead or jam nut mounting styles as standard, termination of fibres by 'pot or polish' or 'cleave' method, and a comprehensive assembly kit for simple assembly.

Developed for the 50/125um., range of single fibres; average insertion loss is 1dB. The TC2 Connector is designed to allow ferrules and alignment sleeves to be replaced at a minimal cost where a faulty termination is made, thereby avoiding costs normally incurred in discarding the whole Connector.

For information:
Hellermann Deutsch Ltd.,
Technical Sales Dept.,
EAST GRINSTEAD.



Plain, Portable Printer

Rapid Terminals now offer a plain paper, portable printer manufactured by Digital Equipment Corporation. Known as the DECwriter Correspondent (LA12), it is a 150 character per second dot matrix printer that measures only 46.5 x 14.4 x 39.4cm. In addition to the usual EIA standard RS232C, RS423 and CCITT-V28 serial interfaces, the LA12 also incorporates an acoustic coupler, approved to work on British Telecom modems, which will connect to a host computer over standard telephone lines.

The LA12 employs friction feed and will accommodate any paper up to 8.5 inches wide. A tractor feed option is available for use with fan fold paper.

Each character is printed within a 9 x 9 dot matrix with true descenders. Character spacing can be varied between 5 and 16.5 characters per inch, the latter allowing a full 132 characters to be printed on 8.5 inch wide paper. Line spacing is 2 to 12 lines per inch.

For international use, the LA12 incorporates a universal power supply and character sets for ten languages. The full 128 ASCII character set can be printed using the LA12's QWERTY standard keyboard. In addition, the keyboard can be changed to numeric data entry mode using a single keystroke (an indicator shows if the numeric code is selected).

The LA12 is flexible when communicating with a host computer. Two models (C and D) are available, both having the EIA serial I/O port operating at 50 to 9600 baud. The Model C also includes an acoustic coupler.

The acoustic coupler operates at 300 baud. It is compatible with both Bell 1035 and CCITT-V21 specifications. The coupler 'muffs' are adjustable for different size telephone handsets accommodating most standard telephones.

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

Beckman Measures Up

A low-cost version of the successful T-series handheld digital multimeters has been introduced by Beckman Instruments. At only £43.45 (plus VAT), it is the lowest priced professional quality instrument currently on the market.

The T90 offers six resistance ranges from 200R to 20M plus a separate diode test function, five DC voltage ranges from 200mV to 1000V (0.8% accuracy), two AC voltage ranges of 200V and 600V (1.5% accuracy) and five DC current ranges from 200uA to 2A. There is no AC current range.

All functions and ranges are selected by a single rotary switch, the meter being fitted with an on/off switch. The 3½ digit liquid crystal display, features automatic decimal point and polarity, plus overload and low battery indication.

The T90 will operate continuously for 200 hours from a standard 9V battery. Size is 150 x 90 x 30mm and weight only 285g, including battery. A selection of accessories is available.

Beckman Instruments Ltd., Mylen House, 11 Wagon Lane, SHELDON, Birmingham, B26 3DU.

PT's F1 HF Rx

Phase Track announces a new and advanced HF broadcast receiver. It discards synthesiser techniques, because of their poor performance. In place of which, is an application of synchronous demodulation.

In its specific application to BBC World Service reception the limited channel capability is no drawback and the use of crystal control gives the receiver a high standard of performance, in such a compact form.

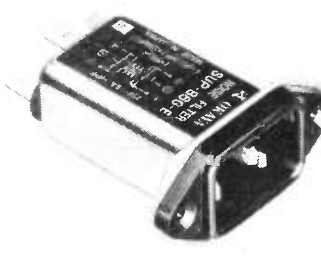
The carrier recovery technique is the result of a considerable amount of practical investigation. Momentary carrier fades hardly affect the fly-wheel synchronisation system, making it almost immune to interference.

practical the application of single sideband techniques to the reception of AM signals. This system has been made possible by the greater production accuracy of specially developed thick film circuits.

The LINIPLEX F1, HF receiver is available from Phase Track Ltd at £500 (ex works) and includes a universal mains adaptor, spare antenna plugs, spare fuses, a 4M super-flexible wire dipole antenna, adjusting tool and fully comprehensive Operation and Maintenance Manual. It is guaranteed against defective components or bad workmanship for a period of 1 year from the date of purchase. Available from Harrods, London, in April at about £800.

Phase Track Ltd., 132 Queens Road, READING, Berks, RG1 4DG.

NEW PRODUCTS



Stolec Stoppers

Stolec, a UK based company with subsidiaries in the USA and Japan, are offering a range of new filters and suppression devices for removing RFI interference.

The range covers currents from 1 — 100 Amps, single and three phase.

Stolec can also offer a fast custom design service through their associate company, Roxburgh Suppressors Ltd., of Rye, East Sussex.

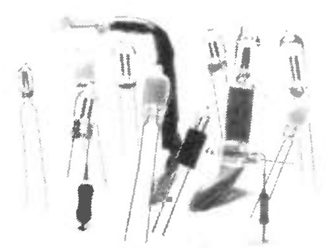
For further information please contact:

*Stolec Ltd.,
Unit 1,
Haywood Way,
Ivyhouse Lane,
HASTINGS,
East Sussex.*

Neons On Parade

BOSS Industrial Mouldings Ltd, as sole UK Distributors for Philips Miniature Neons, have introduced a range of blue and green fluorescent neons. These have AC striking voltages of 100V and 94V respectively, and life expectancy of greater than 20,000 hours. Both neons are available either as individual discrete components or with an appropriate butt welded special film resistor suitable for 220-250V operation at temperature up to 130°C.

*BOSS Industrial Mouldings Ltd.,
James Carter Road,
MILDENHALL,
Suffolk,
IP28 7DE.*



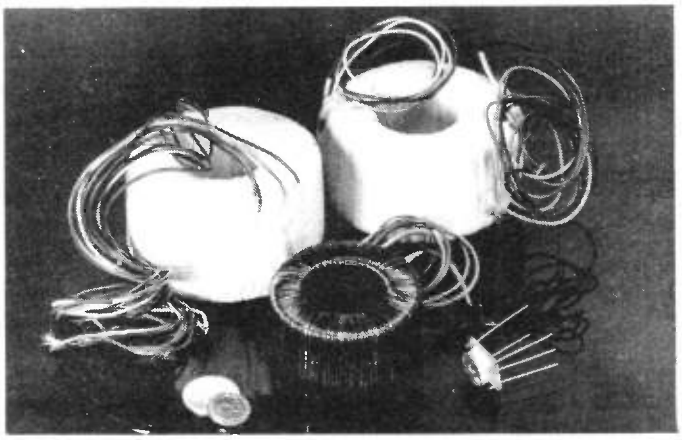
Whiteley's Into Toroids

A new range of toroidal transformers has been launched by Whiteley Electronics Limited of Mansfield.

The transformers, which are suitable for a variety of power and audio applications, are available in VA ratings of 20 to 400 and a range of core sizes from 25 to 150mm (OD). The manufactuers offer advice to customers on the most practical and cost effective units for particular applications.

Though Whiteley have been making laminated core transformers for more than 40 years, this is the first toroidal type to be maufactured by them. The Company use the toroidal transformers in their production of audio and other electronic equipment.

*Whiteley Electronics Ltd.,
Victoria Street,
MANSFIELD,
Notts,
NG18 5RW.*



Dynamic Duo

Duckhams have made two further additions to their range of industrial aerosols. They are a Dry Film Release Agent and Lubricant and an Electrical Cleaning Spray — 'D11' and 'D12'.

'D11' — a dry film release agent and lubricant is a new concept in dry-film, non-stick surfacing. 'D11' will deposit a thin, smooth white layer on metal, plastic, rubber and wood. Of high adhesion and chemical resistance, the deposit is intended for all types of extrusion, compression and injection moulding.

'D12' — an all-purpose electrical cleaning spray for all electronic components used in industry as well as in computers and marine, automotive and machine electrics etc. Compatible with all plastics, metals and lacquer, 'D12' is non-toxic and non-flammable and is safe to use while machines are in motion.

Its powerful spray means contaminant is flushed away with the minimum of waste, while instant evaporation and the absence of both oil and silicon ensures a residue-free surface results.

Alexander Duckham & Co. Ltd.,
Summit House,
WEST WICKHAM,
Kent,
BR4 OSJ.

FORCEful Mobiles

Cody Electronics, the exclusive UK distributors for the Force range of VHF and UHF hand portables announce the addition of the new Force UHF mobiles to their range of Force Communications Equipment.

A steel case and die-cast rear metal frame protects the Force Mobile radiotelephone from vibrations and the effects of poor weather conditions. The unit is suitable for virtually all business, industrial, public service and farming applications.

Operating on the frequency range 420 — 470MHz, the unit has 2 to 8 channels and RF Power Output of 15/25 watts. A high performance receiver ensures maximum rejection of ignition noise, adjacent channel signals and power-off transmitters. The radio has an audio output and there is provision for adjusting the RF Power to meet the requirements of low power systems.

Options available include CTCSS as a plug-in module and five tone signalling in the following formats: ZVE1, CCIR and EEA. The Force is supplied complete with fist microphone mounting hardware and can also be used as a Base Station Unit.

Frank Cody Electronics Ltd.,
Star House,
Gresham Road,
STAINES,
Middlesex.
TW18 2AN.

NEW PRODUCTS

Counting Benches

A new low-cost bench-top frequency counter offering a wide range from 5Hz to 650MHz has been introduced by GSC.

The new Model 6000 incorporates an 8-digit LED display and simple pushbutton controls with LED indicators for selecting the input, gate time and lowpass filter.

Two front-panel BNC inputs are provided: one covering the range 5Hz to 100MHz with a 1M input impedance and the other for signals between 40MHz and 650MHz with a 50R impedance. Gate times of 0.1, 1.0 and 10 seconds are available, and a switchable low-pass filter provides 3dB/octave roll-off at 60kHz for audio and ultrasonic measurements.

The standard Model 6000 incorporates a 3.579545MHz temperature-compensated crystal oscillator with an accuracy of ±1 part in 10^6.

The instrument is compact (76 x 254 x 178mm) and lightweight (1.6kg), and features a flip-up leg for benchtop use.

Global Specialties Corporation,
Shire Hill Industrial Estate,
SAFFRON WALDEN,
Essex,
CB11 3AQ.

A Clean Sweep

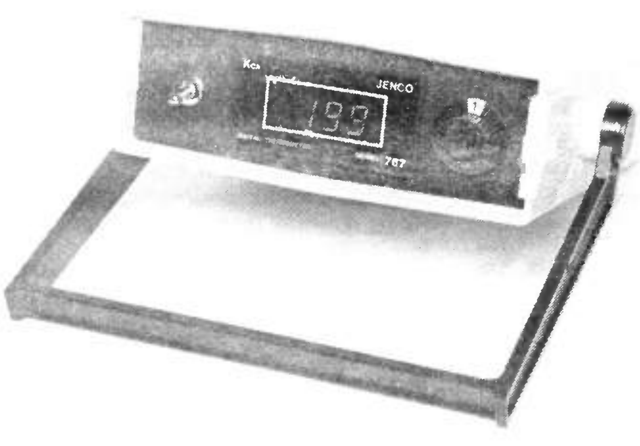
For the first time, Datong have developed an Automatic Notch Filtering system for use with *any* receiver. Presented in a new aluminium case (measuring only 150 x 90 x 42 mm), Model ANF gives the user a powerful tool to remove tune-up whistles and heterodyne type interference — it connects in series with the receiver's loudspeaker.

The Datong ANF continuously scans the audio frequency range from 270Hz to 3.5kHz. Whenever a whistle or heterodyne is detected, model ANF automatically locks onto it, and notches it out. It will clear any interference from the DX you are working, in typically 1 second or less. The notch is extremely deep, typically better than 40dB at 3.5kHz, and should the interfering signal drift, Model ANF will track it automatically.

The notch can be moved manually if the user wishes, but due to the sharpness of the filter notch, the ANF has automatic frequency control (AFC) in the manual notch position. This unique facility prevents the user having to search for the best notch position.

Model ANF is able to detect and lock onto whistles up to 6dB below the level of other signals. It contains its own 2 watt audio power amplifier and requires an external 12 V DC supply. The price of the unit is £67.85 (including VAT) and it can be obtained from the Manufacturer direct or through Datong dealers.

Datong Electronics Ltd.,
Spence Mills,
Mill Lane,
Bramley,
LEEDS.
LS13 3HE.



Centemp Temp Sense

Centemp Instrument Company have added a range of bench mounting digital thermometers to their range of temperature measuring instruments. Available in base metal thermocouple calibrations J, K and T, the 199 series features an analogue output of 1mV/°C resolution. Accuracy is quoted as ± 0.1%

Competitively priced at £189 excluding VAT the 199 series comes complete with two metres of mains lead.

For further details please contact:

Centemp Instrument Co.,
62 Curtis Road,
HOUNSLOW,
Middlesex.
TW4 5PT.

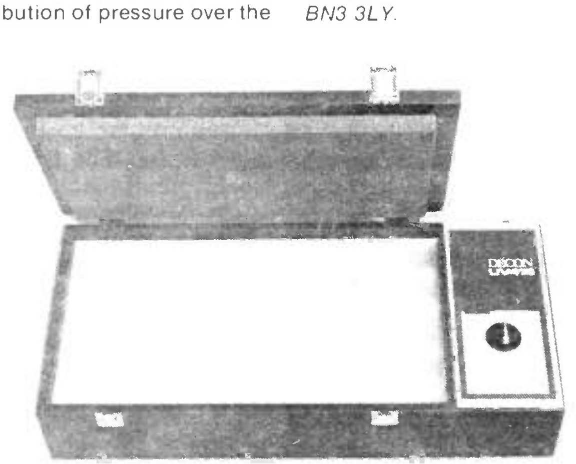
Bigger Exposure

In the past, ultra-violet units with a large exposure area have always been expensive. The UV415 from Decon Laboratories is a new unit with an exposure area of 45 x 24cm, but a price of only £97.

The light source is four 15W actinic blue flourescent tubes backed up by a reflector and controlled by a six minute electro-mechanical timer. This is housed in a sturdy matt black cabinet which has a foam pad attached to its lid to ensure even distribution of pressure over the glass plate.

To complement this unit Decon Laboratories are also introducing a new range of high quality, spray coated photosensitive copper boards. These are available in four standard tinax bases. The developer for these boards is granular and is packed in small sachets which make up ½ L solution.

Decon Laboratories Ltd.,
Conway Street,
HOVE,
Sussex.
BN3 3LY.



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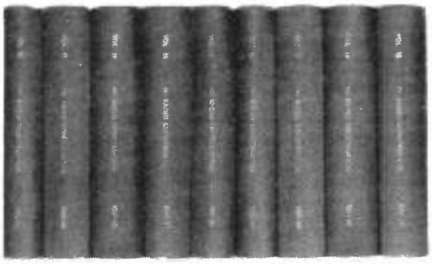

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OSCILLOSCOPE. Telequipment D52 dual beam + manual + new probe kit (worth £15). V.G.C. £90 o.n.o. Phone: 021-236-3583.

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NATIONAL PANASONIC. Auto stop stereo cassette deck RS-26OUSD. £35.00 o.n.o. Box No. 37.

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COMPONENTS. Redundant stock now available. Very competitive prices, S.A.E. for list. Datong Electronics Ltd., Spence Mills, Mill Lane, Bramley, Leeds, LS13 3HE.

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10k(5off).. 10M.. 100k(2off)..

Potentiometer

220k Min Cermet..

Capacitors

22p.. 27p.. 100p.. 15V tantalum.. 10V tantalum..

Semiconductors

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Miscellaneous

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RGB

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100R min preset(3off)..

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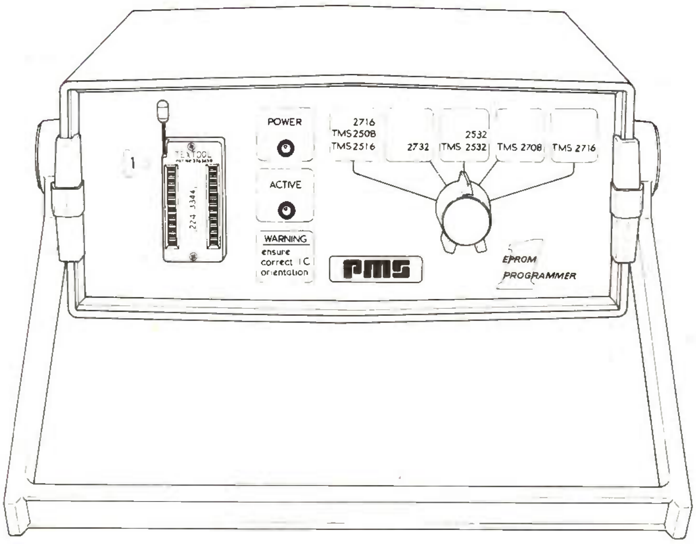
PROM 1



Intelligent EPROM Programmer

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

The PROM 1 offers the following functions:-

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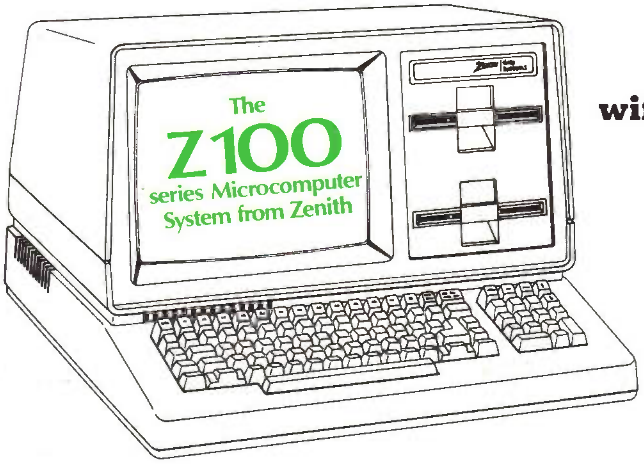
2. Buffer to Disk. Allows contents of buffer to be stored on disk.
3. EPROM to Buffer. Allows contents of EPROM to be stored in Buffer.
4. Buffer to EPROM. Programmes EPROM with current contents of the Buffer.
5. Display Buffer. Displays contents of the Buffer on screen and allows full screen editing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

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

R.R.P. **£349.00**

ZENITH | data systems



The 16~bit Micro

with 8~bit compatibility and colour graphics

Features 8088 and 8085 processors, 128K user RAM expandable to 768 kb, 2 x 320kb drives, 2 serial ports, 1 parallel port, light pen socket and 4 - S100 bus slots for add on options. Disk controller supports 4 - 8" drives and 4 - 5.25" drives. High resolution graphics (640 x 225 pixels, 8 colours). Supplied with MSDOS, CP/M 85, 16-Bit Microsoft Colour Basic with FULL GRAPHICS implementation and complete documentation.
The Z-100 comes in two basic forms:-

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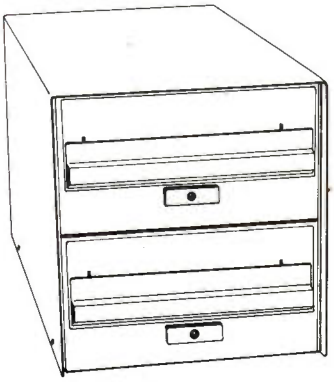
Z-100-22 Low profile version with full colour RAM set .... **£ 2,576**



Twin 8" Drives (as illustrated), suitable for the Zenith Z-100 series computer with no extra interfacing. Capacity 1.2 Mb per drive .... **£ 1,050**
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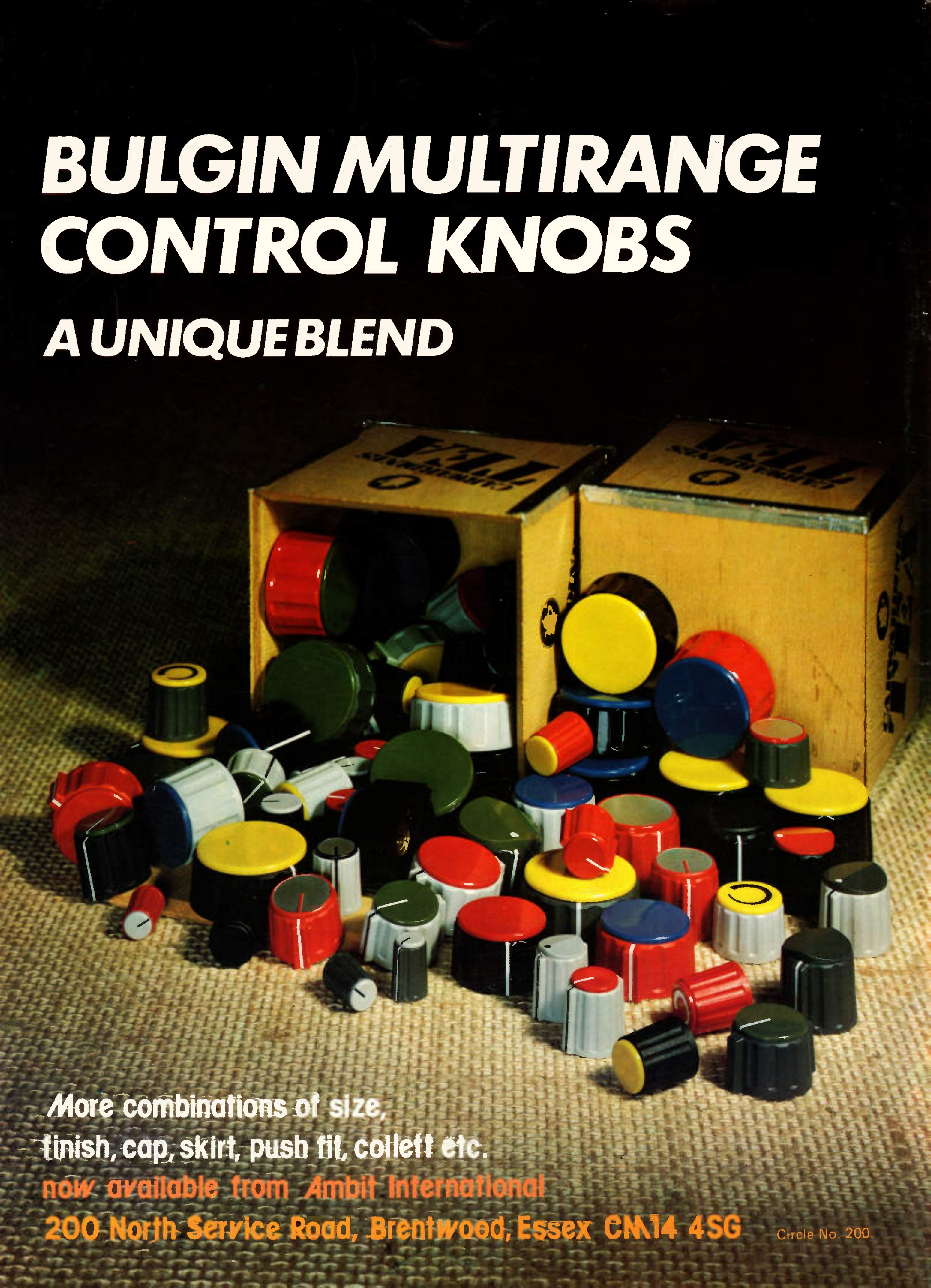
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