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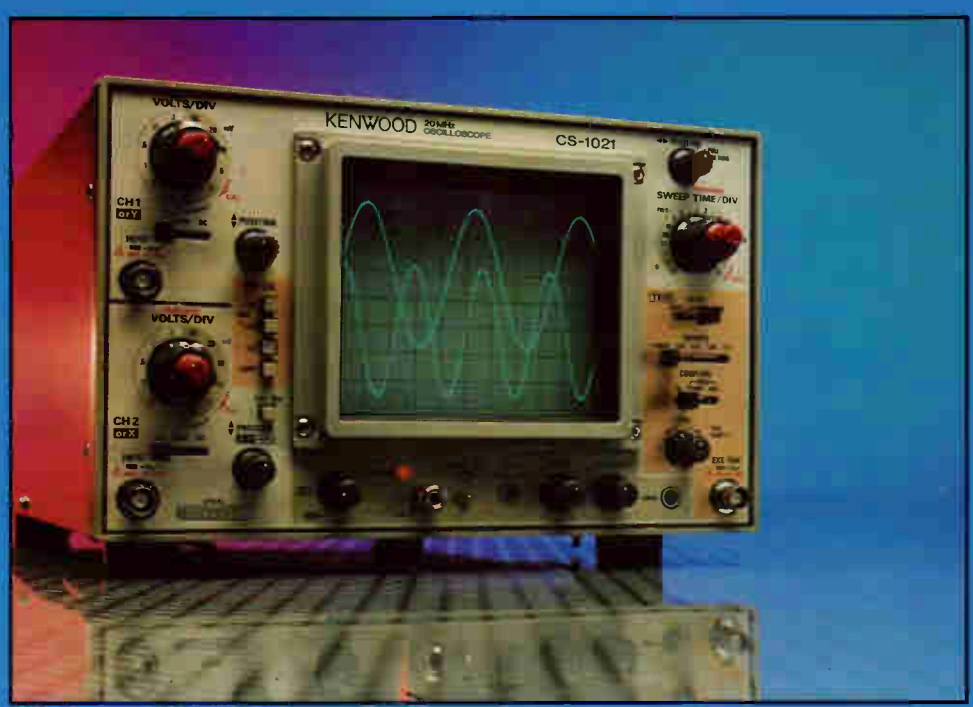

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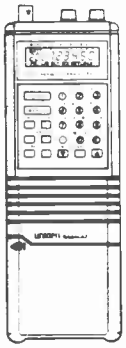

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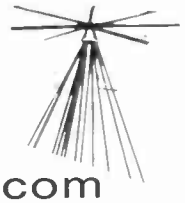

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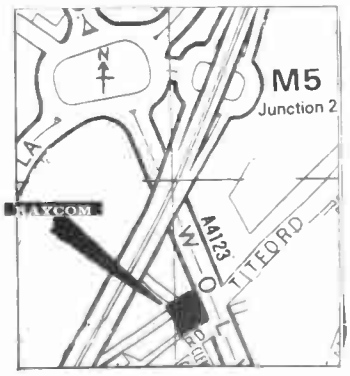

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ON THE COVER

This month's cover shows: **top** the Kenwood CS1100A 100MHz dual channel, four trace oscilloscope with delayed timebase. **Bottom:** the Kenwood CS1021 20MHz two-channel oscilloscope. Both items are available from: Thurlby Electronics Ltd, New Road, St Ives, Huntingdon, Cambridgeshire PE17 4B9. Tel: (0480) 63570

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Iain Mackenzie
Penny Phillips

Advertisement Manager
Marian Vidler

Advertisement Executive
Maria Smith

Publisher
Peter Williams

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Safety in the shack

Some of the constructional projects featured refer to additions or modifications to equipment; please note that such alterations may prevent the item from being used in its intended role, and also that its guarantee may be invalidated.

When building any constructional project, bear in mind that sometimes high voltages are involved. Avoid even the slightest risk – safety in the shack please, at all times.

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CA1352E	1.75	MC3357	2.75	STK463	11.50	TBA550Q	1.95	TDA2151	1.95		1.50
CA3086	0.45	MC3401L	2.50	STK0015	7.95	TBA560C	1.45	TDA2160	2.50	UPC1185H	
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AC141K	0.34	BC207B	0.25	BD410	0.65	BFR81	0.25	OC16W	2.50	2N1711	0.30
AC142K	0.45	BC208B	0.20	BD434	0.65	BFR88	0.30	OC23	9.50	2N2219	0.28
AC176	0.22	BC212	0.09	BD436	0.60	BFR90	1.50	OC25	1.50	2N2626	0.55
AC176K	0.31	BC212L	0.09	BD437	0.60	BFR91	1.75	OC26	1.50	2N2905	0.40
AC187	0.25	BC213	0.09	BD438	0.75	BFT42	0.35	OC28	5.50	2N3053	0.40
AC187K	0.28	BC213L	0.09	BD510	0.95	BFT43	0.35	OC29	4.50	2N3054	0.59
AC188	0.25	BC214	0.09	BD518	0.75	BFW10	0.55	OC32	5.50	2N3055	0.52
AC188K	0.37	BC214C	0.09	BD520	0.65	BFW11	0.75	OC42	1.50	2N2702	0.12
AD142	2.50	BC214L	0.09	BD534	0.45	BFW16A	1.15	OC44	1.25	2N3703	0.12
AD149	0.70	BC237B	0.15	BD535	0.45	BFW61	0.60	OC45	1.00	2N3704	0.12
AD161	0.50	BC238	0.15	BD575	0.95	BFW92	0.85	OC70	1.00	2N3705	0.20
AD162	0.50	BC239	0.15	BD587	0.95	BFX29	0.30	OC71	0.75	2N3706	0.12
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AF114	1.95	BC252A	0.15	BD698	1.50	BFX85	0.32	OC75	1.50	2N3733	9.50
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AF125	0.65	BC284	0.30	BD707	0.90	BFY18	1.35	OC139	12.50	2N4427	1.95
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AF127	0.65	BC301	0.30	BDX53B	1.65	BFY51	0.32	OC200	4.50	2N5294	0.42
AF139	0.40	BC303	0.26	BF115	0.35	BFY90	0.77	OC201	5.50	2N5296	0.48
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BC125	0.25	BD124P	0.59	BF198	0.16	BU125	1.25	T6036V	0.55	2SC1173	1.15
BC139BC	0.20	BD131	0.42	BF199	0.14	BU126	1.60	T9002V	0.55	2SC1364	0.50
BC140	0.31	BD132	0.42	BF200	0.40	BU204	1.55	T9011V	0.75	2SC1413A	2.50
BC141	0.25	BD133	0.50	BC240	0.20	BU205	1.30	T9015V	2.15	2SC1449	0.50
BC142	0.21	BD135	0.30	BF241	0.15	BU208	0.95	T9034V	2.15	2SC1628	0.75
BC143	0.24	BD136	0.30	BF245	0.30	BU208A	1.15	T9038V	3.95	2SC1678	1.50
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BC148A	0.09	BD138	0.30	BF257	0.28	BU326	1.20	THY15/65	2.25	2SC1953	0.95
BC149	0.09	BD139	0.32	BF259	0.28	BU326S	1.50	TIP25	0.40	2SC1957	0.80
BC153	0.30	BD140	0.30	BF271	0.28	BU407	1.24	TIP29C	0.42	2SC1969	2.95
BC157	0.12	BD144	1.10	BF271	0.26	BU408	1.50	TIP30C	0.43	2SC1985	1.50
BC159	0.09	BD150C	0.29	BF273	0.18	BU500	2.25	TIP31C	0.55	2SC2028	1.15
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BC171B	0.10	BD182	0.70	BF355	0.37	BUY69B	1.70	TIP41C	0.45	2SC2371	0.36
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BC173B	0.10	BD204	0.70	BF394	0.19	MJE340	0.40	TIP50	0.65	2SK33	0.55
BC174A	0.09	BD222	0.48	BF422	0.32	MJE350	0.75	TIP120	0.60	2SK105H	1.50
BC177	0.15	BD223	0.59	BF423	0.25	MJE520	0.48	TIP125	0.65	3SK88	0.95
BC178	0.15	BD225	0.48	BF457	0.32	MJE2955	0.95	TIP142	1.75		
BC182	0.10	BD232	0.35	BF458	0.36	MPSA13	0.29	TIP146	2.75		
		BD233	0.35	BF467	0.68	MPSA92	0.30	TIP161	2.95		
		BD236	0.49			MRF237	4.95	TIP2955	0.80		
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DESIGNING PCBs

R A Penfold explores the most practical methods of designing and building custom printed circuit boards

Like most things, the nature of electronic project construction has changed over the years. These changes have not been minor ones either. When I first started building projects in the 1960s, the choice was limited to either valve projects with everything hard-wired, or transistor based projects built on a plain SRBP board. Printed circuit boards (PCBs) were still relatively new and were rarely used by amateur constructors.

There are very few projects published today that do not use a custom PCB, and many have virtually all the required components on the board (including such things as controls, sockets, transformers and even batteries). The construction of a project is relatively easy when a board design is provided, and the likelihood of the completed unit working first time is quite good provided reasonable care is taken when building the unit.

The situation is different if you are working from a published design which only consists of a circuit diagram without detailed constructional information. The same is true when designing your own circuits. The basic choice is then between a proprietary PCB such as stripboard or a PCB of your own design. In either case, skill and knowledge are required in order to successfully complete the project, although (in my opinion at any rate) this kind of building from scratch is a far more rewarding hobby than simply copying a published design.

Some are of the opinion that proprietary PCBs are inappropriate for modern electronic devices, but this is not necessarily an opinion I would adhere to. There are many projects that can be constructed on stripboard and the like and which can be very neat and functional when finished. The time taken to complete the project can also be relatively short. On the other hand, a good custom printed circuit design will always give a neater and more professional result. It is worth remembering that some projects do not lend themselves particularly well to any other form of construction. In particular, many digital circuits are unsuited to other types of construction. The best choice is a matter of personal preference, depending to a large extent on the particular project concerned.

In this article we will only consider the design of custom PCBs, although some of the information also applies to proprietary boards. This is not intended to be a complete course on the design of commercial quality boards, but as a source of helpful advice for home constructors who wish to try their hand at designing and drawing up their own board layouts.

Circuit layout

Articles of this general type have, in the past, often recommended a board layout that is closely modelled on the circuit diagram. This seems reasonable enough, since the person drawing up the circuit diagram will have spent a fair amount of time organising the layout of the components into one that gives neat results with a minimum of wire crossing. This would seem to make the circuit diagram the ideal basis for the PCB, with the circuit draftsman having done a lot of the initially hard work for us.

In practice things are not necessarily that simple. This approach works best with uncomplicated circuits that are based on discrete semiconductors, or on relatively simple integrated circuits such as single operational amplifiers. The two-transistor amplifier circuit shown in **Fig 1** is a good example of when it is likely to work well. The printed circuit layout shown in **Fig 2** is derived from the circuit diagram, and the similarity between the two is so obvious that further clarification is unnecessary. The two layouts are virtually identical, with wires in the circuit being replaced by copper tracks in the board layout.

You may have already noticed that the board in **Fig 2** is shown as a component-side view. The copper track pattern of the real board would therefore be a mirror-image of the pattern in **Fig 2.** Most people find it much easier to design boards from a component-side view rather than as seen looking onto the copper tracks. Provided you draw up the board in the conventional manner, there should be no difficulty in making the transition from one view to the other.

Master drawing

The accepted method of drawing up PCBs is to use a drawing board fitted with a precision grid. The latter is a sheet of translucent plastic marked with horizontal and vertical lines at a certain pitch, just like graph paper. Various pitches are available, but for drawing boards using a scale of 1 to 1, a 0.05in grid is probably the most suitable. Incidentally, the drawing board does not have to be a proper type, as a piece of chipboard covered with white melamine will suffice. However, it is advisable to fit the board with wedges of wood or chipboard which brings it to an angle and makes the drawing work less of a strain on your back. One or two electronic component retailers supply portable drawing boards that are reasonably inexpensive and well suited to printed circuit design work.

The drawing should be produced on good quality tracing paper or drafting film. Tracing paper is much cheaper, but the additional cost of drafting film is unlikely to be significant unless you produce a large number of board designs. Drafting film is superior for this application as it is tougher and what the manufacturers call 'dimensionally stable'. This simply means that changes in temperature and humidity do not cause the film to expand or shrink significantly. It is also resistant to stretching and tearing. Although it looks very much like tracing paper it is actually made of a plastic material (usually polyester). Stability of the paper or film is obviously crucial when the accuracy of the finished board is largely dependent on the accuracy of the track pattern drawing.

The tracing paper or film is taped in place over the grid and the latter aids accurate placement of pads on the drawing. It is a good idea to keep all of the pads on the grid crossover points if possible. Some components have the pin spacing in metric units which might make it necessary to position a pad slightly off the grid. There are usually few problems with components such as polyester capacitors which have a narrow pin spacing of 2.5, 5, or 7.5mm. With 25.4mm to the inch these are close enough to 0.1, 0.2 and 0.3in for there to be no need for any slight manipulation of the pad positions. It is with the larger components which have wide pin spacings that problems can arise.

With components which have leadout wires rather than pins, that is, most resistors, transistors, diodes, inductors and capacitors, there is considerable latitude with pad spacing. However, it is the accepted practice to use a standard pitch for each type of component, and this is not simply to make the finished board look prettier!

The **Fig 2** layout shows that the resistors have their pads 0.4in apart. This is a convenient pitch for miniature ¼W resistors as it can be regarded as their natural mounting pitch. In other words, if you take a ¼W resistor and bend the leadout wires through right angles close to the body so that the component is ready for mounting on a PCB, the distance between the leads should be about 0.4in. With sensible and consistent

pad spacing for each type of component, construction of the board is made easier and can be completed much faster.

Axial lead components can be mounted vertically, but this is not something to be recommended. The problem with this method of mounting is that it is unstable, and components can easily be knocked out of position. This can lead to circuits shorting unless exposed leadout wires are insulated (it can also result in pads becoming ripped away from the board). Consequently, this is something that should be avoided as far as reasonably possible. In the case of electrolytic capacitors there is a full range of printed circuit mounting types (usually described as 'radial' electrolytics in component catalogues) which should obviously be used when a vertically mounted electrolytic is needed. Unfortunately, radial resistors seem to be absent from the components catalogues.

In **Fig 2** I have shown the components' physical representations rather than just simply using electrical symbols. When initially sketching out a design many designers find it easier to use circuit symbols, although this is a quick and simple method there is a slight risk that the area occupied by the circuit symbol is not necessarily occupied by the component it represents. It is therefore important to think in terms of the physical size and shape of the components when positioning them, and making plenty of measurements if necessary. One advantage of drawing a board design to a scale of 1 to 1 is that you can place the components on to the drawing even when the space which has been left for them is uncertain.

You may find the drawing easier to follow if different colours are used for the tracks and the component outlines. Alternatively, the tracks can simply be drawn as heavier lines.

Getting it taped

Having completed the pencil sketch and checked the design for errors, it is then a matter of turning this into a taped master. The drawing is removed from the board, turned over, and taped into position again. Great care should be taken to realign the drawing with the grid prior to taping it in place. The pencil design should clearly show through the tracing paper or drafting film, allowing it to be copied in order to give the required mirror-image of the original (component-side view) design.

Assuming that this drawing is going to be used as a photographic master from which the board will be produced, it is

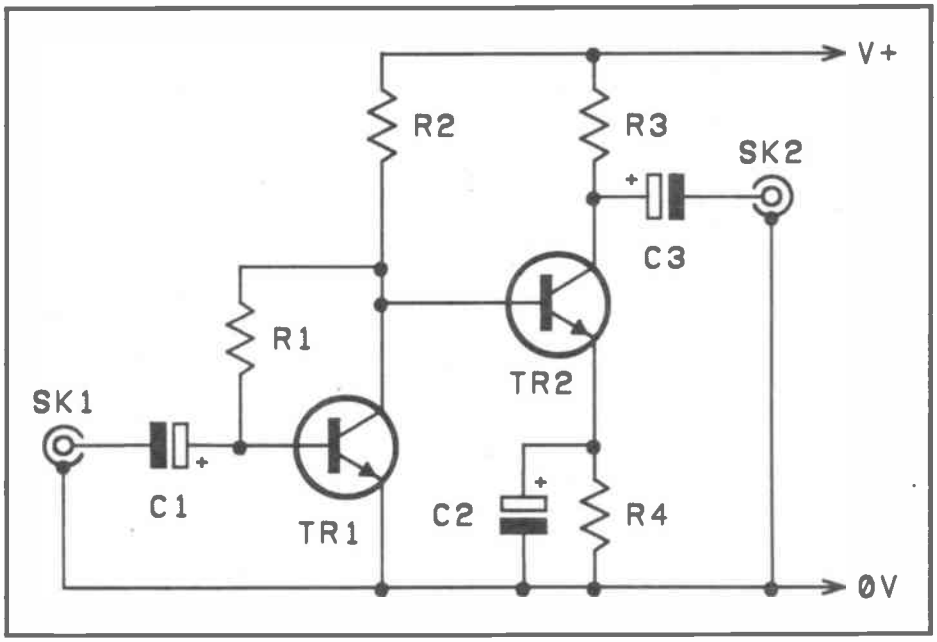

Fig 1: *The two-transistor amplifier circuit*

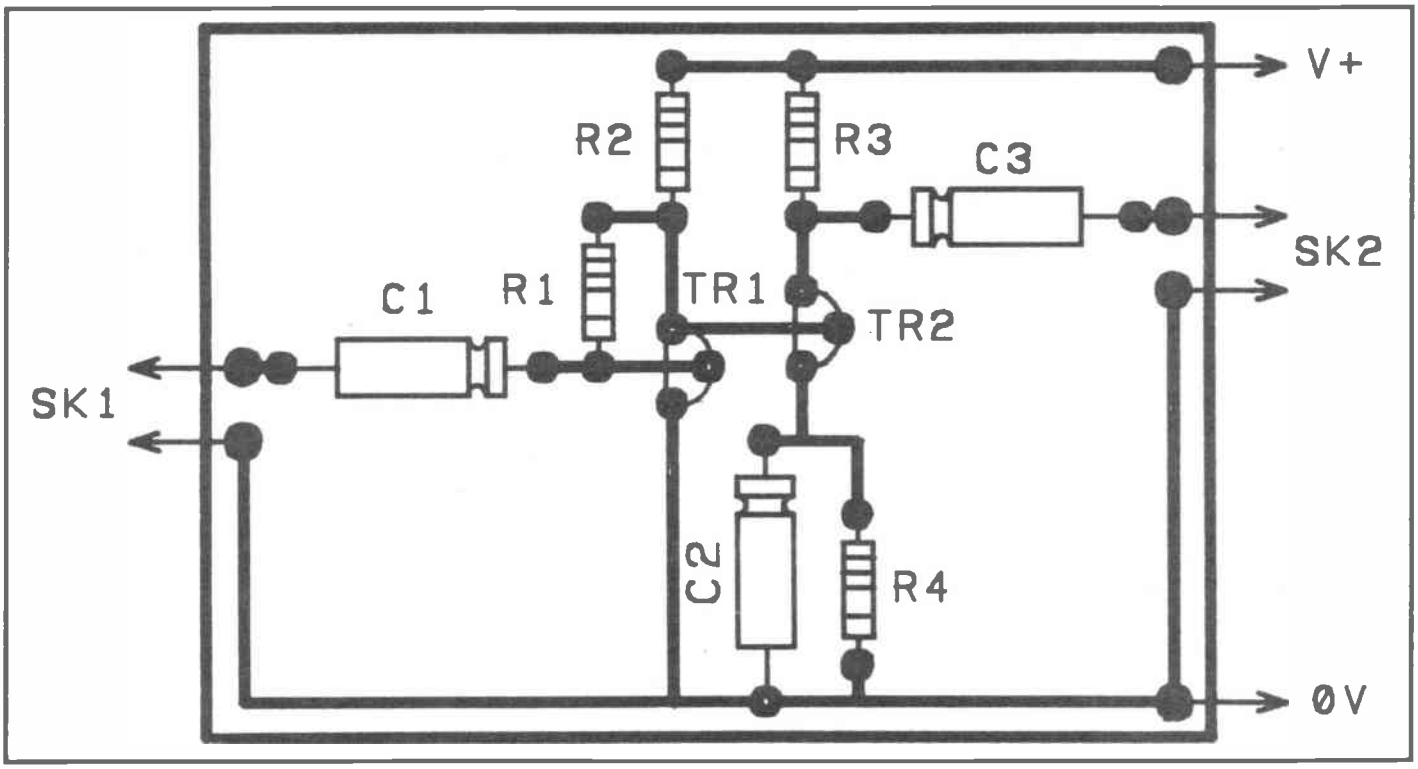

Fig 2: *The circuit-based printed circuit board design*

important that the design is marked with something that is suitably opaque. A technical pen can be used for this purpose, although neater results can be obtained using rub-on transfers. Probably the easiest method for obtaining very good results is to use die-cast pads and track tapes. The pads are made from a self-adhesive plastic material which is generally supplied on rolls of backing paper. The track tapes are made from a crêpe material, similar to very narrow rolls of the old cloth-type of insulation tape. Whereas rub-on transfer tracks are either straight or curved, these tapes can be laid in straight lines or taken through any curve (within reason). This tends to make them easier to use.

When drawing up a board with these materials a scalpel is the only tool that is required. Start by laying down all the pads (using the scalpel to peel them from the backing) and position them accurately on the drawing. If necessary, take away the layer of clear tape covering the pads before trying to remove them.

A wide range of pad sizes is available, but for most 1 to 1 work, 0.1in pads (2.5mm) are best. If the pads are positioned very close to each other but must not connect, then a smaller size will be needed (about 0.07 or 0.08in will do). Some components such as preset resistors and relays, will require larger pads in order to provide a secure mounting (0.15 or 0.2in pads are suitable for these components).

Accuracy

Clusters of pads are available in DIL and TO-99 arrangements and offer far more accuracy than most of us can achieve using individual pads when making groups for integrated circuits.

Once all the pads are in place, the tracks are ready to be laid down using the tape. Start with the shorter pieces and gradually progress to the more intricate tracks. Make sure that the tracks do not fall short of the pads and try to avoid blocking the holes in the centre of the pads. Try to avoid cutting through the pad as well, and angle the blade slightly so that it undercuts the end of the tape. Should the pad be cut accidentally it is likely that the damage will be unnoticeable.

There is an enormous range of tape widths to choose from, and there is usually a lot of latitude when it comes to selecting a track width. In some cases a thinner tape will have to be used, because the track will have to pass through narrow gaps (about 0.025in or about 0.65mm). The methods of printed circuit construction by amateur builders often result in the undercutting of tracks and pads, rather than the slight spreading which occurs with some commercial production methods. Where possible it is better to use wider tracks of around 0.05in. A heavier gauge is often used for the power rails, but there is no real need to do this unless the circuit is drawing high supply currents. The heaviest possible tracks should be used for the power rails to avoid serious drops of voltage and any risk of the tracks burning out. In fact, all tracks that carry high supply currents (more than about 1 amp) should be as wide as possible.

Once the drawing has been completed it is just a matter of removing it from the board and erasing the pencil marks from

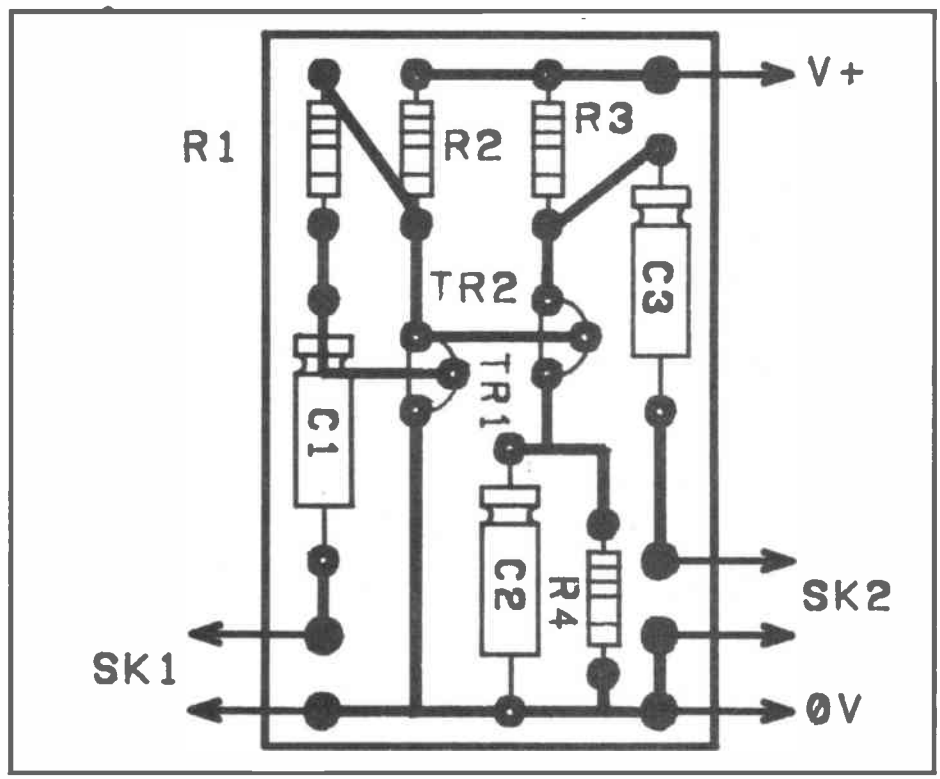

Fig 3: *The compact version of the circuit-based design*

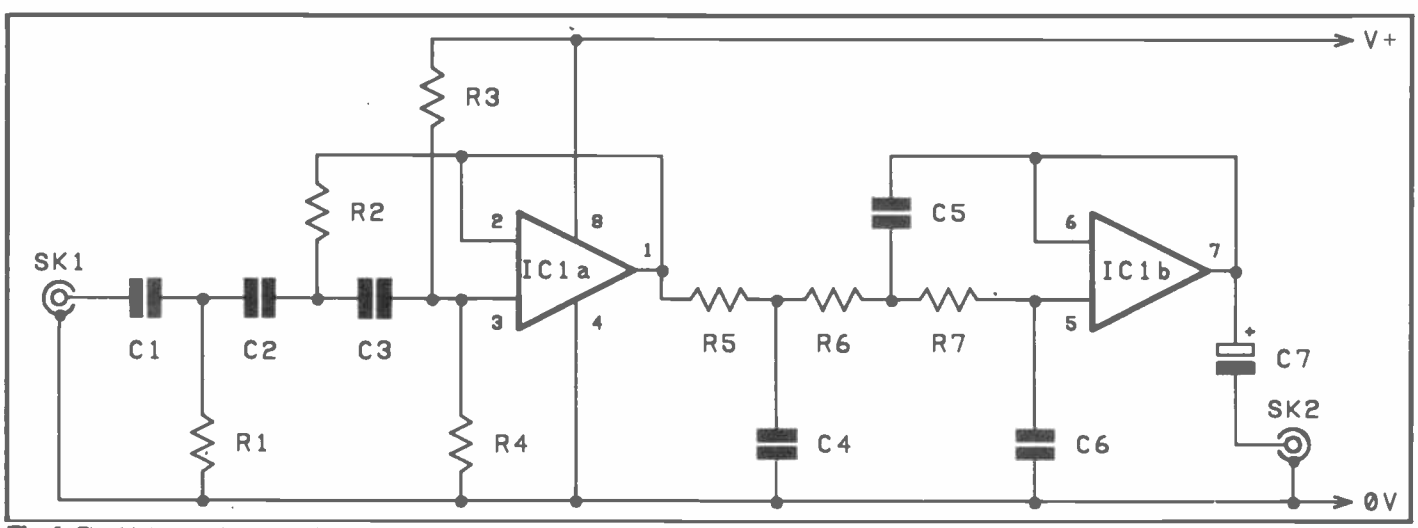

Fig 4: *The high-pass/low-pass filter circuit*

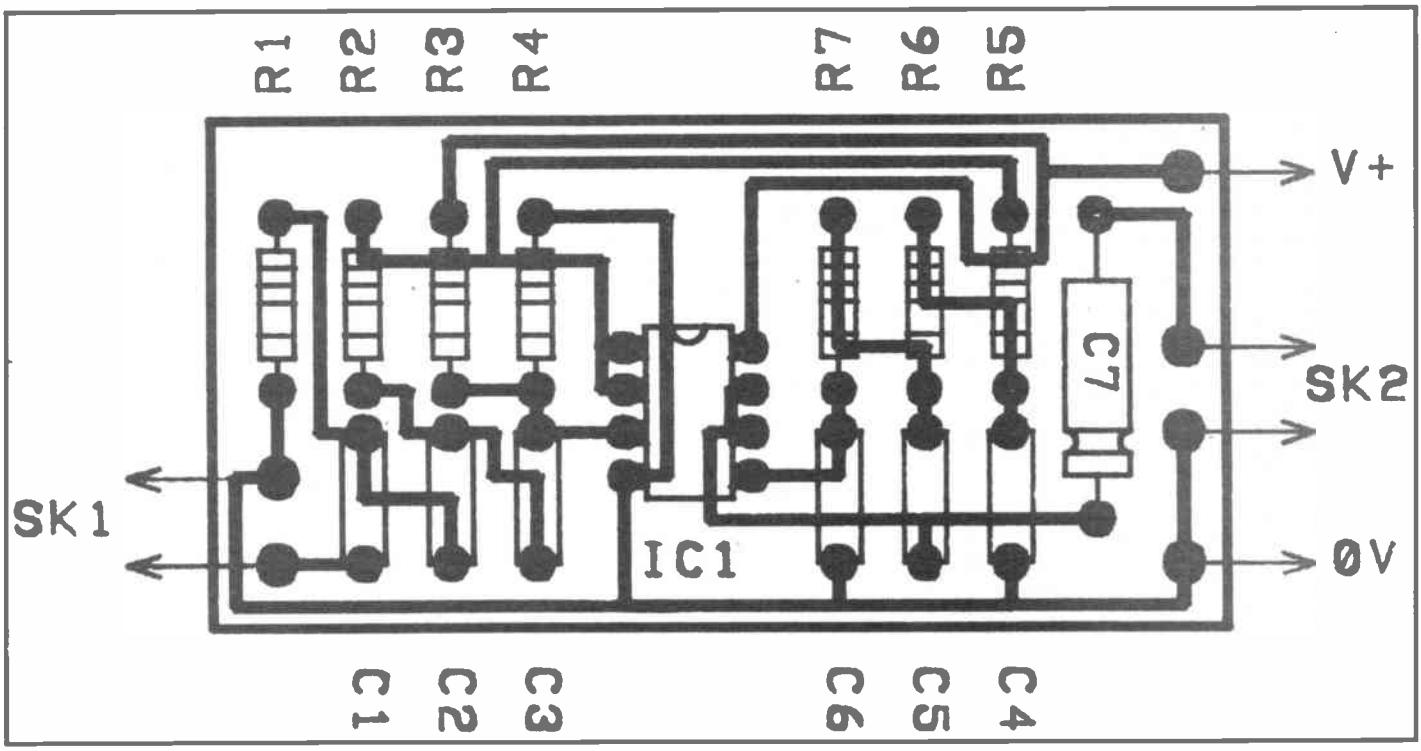

Fig 5: *The commercially produced PCB layout*

the underside. However, you should make a rough pencil sketch of the component overlay first, otherwise it can take quite a while to accurately work out where each component should fit when building the board. The corners of the board should also be accurately marked on the drawing.

If the board is not going to be produced using a photographic method, there is no need to draw a high quality artwork master. Just trace the pencil design on to the copper side of the board.

Compact layouts

The layout for a two-transistor amplifier circuit which is shown in **Fig 2** is reasonably practical, but unsuitable for most modern circuits. There are two main problems. Firstly, the component layout is far from compact and in the **Fig 2** layout the area of board that is actually occupied by components is less than 50%. For a simple circuit with less than a dozen components there is no real problem, since the size of the board is not very large – even with an inefficient layout. It is not unusual for contemporary projects to have more than a hundred components, but an inefficient layout could produce a board that would literally be around half a square metre in area!

The second problem is that a circuit diagram is theoretical in that the component symbols do not necessarily resemble the components in use. Although this does not present a problem with two and three lead components such as resistors, capacitors and transistors, it can produce many difficulties with multi-pin components. In particular, integrated circuits are often shown as rectangles with the pins scattered around in any order. They rarely show the pins in something that even approximates the true layout.

The easiest way of achieving a moderately compact layout is to use a slightly refined version of the technique described previously. **Fig 3** shows how the original layout can be modified slightly to give a substantially more compact design. This involves only minor modifications, with the main changes being to turn C1 and C3 through 90°. Also, R1 has been moved upwards slightly so that there is room for C1 to fit beneath it.

Although this is only a minor rearrangement of the board, the saving in space is quite considerable. The new version covers only half the area of the original and has a clearer appearance. In other words, the design takes into account the physical size and shape of the components far more than in the original.

Professionally produced boards are mostly designed in a very different way, the component layout often has little in common with the circuit layout. **Fig 4** shows the circuit diagram for a high-pass/low-pass filter, and **Fig 5** is the commercial board layout I produced for it.

The main advantage of this type of board layout is not that it is very neat and tidy, but that it is extremely compact. Fifteen components plus six off-board connection points have been accommodated within a few square inches. Furthermore, this has been achieved without having to closely cram the components together. By closing up the gaps between components it would probably be possible to reduce the board to little more than a single square inch.

While this type of board has its advantages, it is not without its drawbacks for the home constructor as it is less simple than producing a circuit-based layout. Some thought needs to be given to the grouping of the components before putting anything down on paper, and a fair amount of re-routing can be required before a satisfactory layout is produced.

I always find it easier to position the groups of resistors and capacitors first, and then decide which component is which as I put in the tracks. Things generally fall into place in a logical manner with a minimum of re-routing being required. In this case, as with most layouts these days, it is a matter of having an integrated circuit at the heart of the layout and a number of passive components fitted around it. Designing is often easier when starting at the integrated circuit and working outwards. In this example things are mainly straightforward, but the only difficulty arises when looping the output from IC1a around to R5. To make this possible, the positive supply rail track has to be looped around R5.

The components are then placed to allow a reasonably simple track pattern to be used, but it is very much a matter of having a neat component layout and designing the track pattern to suit. With the layout shown in **Fig 3** there is some compromise in the positioning of the

components to simplify to track pattern. A commercial layout will normally have a substantially more intricate track pattern than its amateur equivalent. The point to bear in mind here is that it would be virtually impossible to draw and construct a board layout while using normal amateur equipment and techniques!

Consequently, I would advocate a realistic approach to constructing home-made designs and avoiding excessively convoluted track designs. Taking tracks between pads of integrated circuits is certainly possible in home constructed boards, but constructing a board consisting of this type of thing tends not to be a great deal of fun to build and increases the risk of broken tracks, etc.

Missing link

Most commercially produced electronic equipment use double-sided boards these days, but the vast majority of electronic projects are based on single-sided boards. A double-sided board is undoubtedly suited to many modern circuits, being routinely produced in professional electronics, but is none the less very difficult for the amateur to build at home. This is mainly because it can be difficult to get the two sides of the board accurately aligned. It is something that few constructors would wish to undertake very often.

A single-sided board plus the link wires on the component side would be a more practical solution. These boards are normally designed to have as few link wires as possible, although if there was a choice between weaving a track halfway around the board or using a link wire, the latter would be a better option. When track routing the board you will often find that an unconnected pad has been surrounded by track. You may find that a little re-routing will provide a path into this pad, but this will not always be possible. A link wire will then become necessary, and getting tracks into pads that have become surrounded is the only reason for using links or double-sided boards.

When a pad (or a group of interconnected pads) has been cut off from the rest of the board, some pre-planning can make things a lot easier later on. At the very least make sure that there is sufficient space for an extra pad to take the link wire, and preferably give some thought to the route the link wire and subsequent track will take so that space can be reserved for them.

When you have finished checking the design see if it can be simplified, as I often find that I have something like three or four tracks crossing over two tracks via link wires. This should be re-drawn so that the two tracks cross over the three or four, thus saving one or two link wires. Sometimes you may find that a track has travelled halfway around the board to a connection point, but that subsequent tracking has provided a much closer connection point. Some quick re-routing may then simplify the layout slightly.

Complex boards

Designing a board for a complex circuit is usually similar to designing a simple one. The vast majority of circuits are built up from a number of stages, allowing the board to be designed stage-by-stage. Having designed the first stage, it can be difficult to accurately assess where to put the next stage in relation to this one. It is very easy to find that there is either a large gap between them and a lot of wasted space, or that insufficient room has been left and, consequently, there is difficulty in fitting the second stage.

A lot of boards are drawn up using a computer these days, thereby allowing the operator to design the second stage anywhere on the board and then slide it into place alongside the first stage. With conventional drawing methods the nearest equivalent is to draw the second stage separately. There should be no difficulty in deciding the best position for this stage on the main drawing and copying it into place.

Another technique which some designers use is to initially sketch the entire board leaving plenty of space between stages. I find this method rather slow, but it does enable very neat board layouts to be produced.

Many modern circuits do not have a signal which is taken in at one end and passed through various processing stages, appearing at the other end as an output. Often there are various feedback loops and side chains, with practically every stage connecting to virtually every other stage. Some designs are even reminiscent of diagrams showing how brain cells interconnect! Working out the layout for individual stages is quick and easy, but the interconnections between stages can be more difficult and time consuming.

This is a matter of taking tracks round and across the board and looking for the shortest and easiest route for each one. When a lot of tracking is needed it is not a good idea to cram the stages too closely together, because reasonable paths for these tracks will be required. These connections usually account for the vast majority of the link wires on a board (the link wires should be as short as possible). If necessary, do some minor re-routing to bring groups of tracks close together so that they can be bridged by a single link wire of moderate length. Rather than using a single 2in link wire, you will find using two or three short links plus some copper tracks will improve the board's reliability. Long link wires can easily cause short circuits and are very easy to break.

When dealing with boards of greater complexity it is important to avoid earth loops. These are not a problem with many projects, but they are all too easy to produce when designing boards for high gain and (or) high current circuits. In general the earth rail should run to the output of the circuit first, then run through to the other stages in reverse order until the input stage is reached. When interconnecting stages of a complex board, it is easy to end up with the earth rail running in a continuous loop around all or part of the board. If the circuit is prone to earthing problems then this is virtually guaranteed to produce one.

The layout should be designed to avoid excessive stray pick-up at sensitive inputs as well as stray feedback which could cause instability. Tracks at the input of a sensitive amplifier should be kept as short as possible, and inputs should be isolated from the output circuitry and power supplies, etc.

Checking

The most important part of printed circuit design is checking the finished layout. Examine the design very thoroughly against the circuit diagram to make sure that every interconnection is present and correct. Also make sure that there are no additional tracks and pads which have been added by mistake when turning the pencil sketch into an artwork master. The tracks are easily cut from the finished board and any superfluous pads can be ignored, but this does not give particularly professional results.

It is worth giving the component's pin spacing a final check. When producing 2 to 1 artwork it is very easy to miscalculate the pin spacing, but with 1 to 1 artwork that is less of a problem. With 1 to 1 artwork it is very easy to check that the components will fit on to the board and that they are not crowded too close together. Simply check the groups of the components' positions on the drawing and make sure that the layout and components are correct. It is easier than you would think to be faced with a finished board fitted with a 16 pin DIL integrated circuit holder into which a 14 pin device must fit. Even experienced professional designers have been known to fall into this trap.

Conclusion

Hopefully, this article has provided some useful advice that will encourage prospective designers to take the plunge. For something of this nature there is no real substitute for experience, and you will only become a really competent designer if you study and work on many different designs. Start with simple circuits and work up to larger and more complex designs. Printed circuit design can be interesting and rewarding, and should not be regarded as a chore.

SPECTRUM WATCH

by John Andrews

In this column we try to avoid the stories other magazines tend to cover, or at least find new angles. So you won't be surprised to read about a drug-hunting radar which the US customs service has just ordered. In fact the radar does not detect drug substances but rather low-flying drug-smuggling aircraft. A contract worth $51 million has been awarded to RCA/GE Government Systems to make and install four systems in Texas and Puerto Rico, with an option on five more.

The intention is to place an electronic surveillance 'fence' around the south-western United States to detect and track drug smugglers. Each new radar will be built as part of a huge barrage balloon-like aerostat tethered to a ground support on a 15,000 feet line and will cover up to 300 miles in all directions. Two of these devices already operate in Florida and Arizona. In addition, thirty-four new aircraft, belonging to the US Coast Guard, will back up America's war on drug traffickers.

Wireless cable systems

Although the pace of cable TV in Britain appears to be hotting up, with American and Canadian groups starting to invest hard cash here, it is clear that the sheer size of the task of cabling cities will take a long time. Smaller towns and rural areas will have to wait even longer for cable TV to reach them, if it ever does.

Low-power microwave distribution is now seen as a feasible alternative to cabling the outer areas, using either low microwave or even millimetric wave frequencies. There are several attractions. A broad range of channels can be transmitted simultaneously, possibly using the new digital techniques. The initial costs are far lower than for cable and the home receiving devices can make use of some modules already developed for satellite TV. The receiving aerials will be compact, perhaps as small as 6in diameter.

Two systems are proposed. Marconi Communication Systems is proposing transmitters operating at 2.5GHz (a similar band is used in the USA) and a 50W transmitter could cover up to 25km radius. This would be easy to engineer but in an area of that size a large number of people would inevitably live in radio 'shadows' and would not be able to receive the new transmissions. Moreover, these frequencies are currently allocated for outside broadcast links and the broadcasters will not release these without a keen fight.

British Telecom's sights are on higher things, specifically a 10mW transmitter working at 30GHz. They consider this would be economic in small towns and could cover 5,000 to 10,000 households in a 2km diameter circle. Master antenna installations could serve blocks of flats and other shared housing which happen to lie in a 'shadow'. A trial of this equipment is currently taking place in Saxmundham, Suffolk. We should watch both developments with great interest!

The miracle of wireless

Radio enthusiasts are probably better informed than most people about the mysteries of radio transmission but even I stand back amazed now and again. A case in point was reported in the **East Anglian Daily Times** during October when 'radio ham' Daphne White of Colkirk near Fakenham, was disputing her higher than normal telephone bill. Her argument was that she could not have made the number of calls claimed by British Telecom. She pointed out she hardly ever needed to ring anybody because she could use her citizens' band radio to talk to people throughout the country and abroad. Fascinating – I am selling my Telecom shares and expect the sales of CB radios to rise dramatically!

Chaos on 23cm averted!

The Civil Aviation Authority has announced major plans to meet the needs of growing air traffic over Britain between now and the end of the century. Their 'Operational Strategy Plan' explains how this will be achieved, with a new pattern of air lanes over south-east England, new electronic equipment, new radars and eventually a new air traffic control centre.

The good news, for radio amateurs at least, is that although the number of primary radars is to increase, the new ones will be on the 10cm band. This will take the heat off 23cm where existing high-power stations cause considerable interference to some amateurs who share this band. It should also mean the retirement of the 50cm radars which cause little white lines on TVs tuned to video recorders on channel 36 in the vicinity of airports.

Submarine communication systems

Investigations are under way into the communications for the Royal Navy's next generation of nuclear-powered submarines, designated SSN20. A consortium of GEC-Marconi, British Aerospace and STC will investigate and define the communication systems needed for the new craft. Marconi will be the prime contractor and has considerable experience in the field. The company was a pioneer in naval communication and has supplied the Royal Navy and others with communication systems for decades. All current British submarines employ a Marconi HF communication and control system.

Why are these people talking into the lids of their calculators? I don't know either but they are promoting BT's proposed Phonepoint service which will enable your home cordless phone to work for outgoing calls in stations, airports and shopping malls equipped with Phonepoint base stations. The new generation cordless phones, CT2, work on 864-868MHz, the second harmonic of the 70cm amateur band. I wonder how immune they are to interference?

ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

Time flies if you're busy and here is a run-down of the activity in the world of amateur television during the past three months.

Good old 70

That's what a lot of people are saying, so why isn't there more activity on this band? I don't know, but Roy G6OKB (Isle of Thanet) says things are starting to look up again after a very quiet period. More news next time if the progress is sustained. He also thanks David Wilson, who managed to turn out a manual for a colour TV camera which the manufacturers could not provide. This reminds me that finding data can be quite a problem these days; many manufacturers are no longer prepared to keep stocks of old literature. You want a manual for a Pye Lynx? Well, Philips can't help you. Sometimes the BATC's reference library can assist, which is one of the benefits of joining a club.

Clive G8EQZ left his native Kent for the attractions of Hull a few years back and has set himself up for both 70 and 24cm TV there. The only problem is that no one comes back to his calls; is nobody else QRV up there?

News from Ireland now, where it is hoped that normal fast-scan ATV will be made legal during 1989. Applications are being considered on 70cm and 10GHz; operation on 24cm will not be permitted because of fears of interference with airport radar systems. Two keen ATVers who intend to be among the first to exploit any new opportunities are Rod EI3CZ and Bob EI7GM, both in Dublin.

SSTV

The Danish SSTV Group has sent us details of its Danish SSTV Contest for 1989. This starts at 0000UTC on 6 May and finishes at 2400 on 7 May. The SSTV frequencies recommended by the IARU for Region 1 must be used, on the following bands: 80, 40, 20, 15, 10 and 2 metres. I have full details and a logging form, which I am happy to copy and send to anyone who sends me an SAE care of the editor.

In Ireland Michael North EI7CL is having trouble with a Wraase SC-422 scan converter. If anyone can send him a circuit diagram and description he'd appreciate it – his address is 135 Downpatrick Road, Dublin 12.

One of the pioneers of SSTV in Britain, Grant Dixon G8CGK, is very active receiving video from weather satellites, both NOAA and the more difficult to predict Russian Metsats. He says they have a slow-scan TV net in the Herefordshire/Severn Valley/Malvern/Worcester area every Friday. And Monday evening is given over to what they call Spec-Com night, when Spectrum computer screen images and programs are exchanged over the air.

Grant has devised a program which loads in a picture from the weather satellite scan converter to the Spectrum. This represents pixels by 4 × 4 dot blocks and thus shows just a portion of a weather picture on the TV screen, but the viewer can scroll up, down and across to explore the whole picture. Alternatively you can reduce picture definition to make it an inset inside the full screen; this still gives a complete picture. You can also make screen dumps on a dot-matrix printer.

To achieve all this you need an interface board between the scan converter and the computer's I/O port. Grant has prepared a printed circuit board for this. You can get it, together with the program SCRL-TV for just £7.00. Write to Grant at Kyrles Cross, Peterstow, Ross on Wye, Herefordshire HR9 6LD.

Last time round, G1AIB was asking if anyone had a transmit/receive SSTV program for the Commodore 64 micro. Well, Brian G3KJX has! If you want one, though, you will have to get it from the author, I2CAB, who has written non-interface programs on disk for the 64 covering SSTV, Meteosat and RTTY. These give quite reasonable results, according to Brian, and I2CAB also provides similar programs for the IBM PC.

Brian resides in Northallerton and has been involved in ATV since the 405-line days. Together with G3ILD/T he received his first ATV pictures in the late 1950s (remember /T licences? I got into ATV just too late for one of those). Anyway, Brian hasn't become bored with it yet and is now thinking of moving to 23cm.

News from further afield

BATC member Michael Sheffield ZL1ABS attended last year's Dayton convention and appreciated the report in this magazine. He says he is looking forward to his next visit and to attending a BATC convention someday (surely the latter takes priority?). He is promoting the BATC down under and has lots of the club's books to sell there. The national radio club's magazine **Break-In** had an all ATV issue last August and this has stimulated more interest in the subject. Michael says the next all ATV issue will have more about 24cm and wonders if the RSGB would agree to something similar. Pigs will probably sprout wings first, but the RSGB does now promote ATV with Mike G8LES's excellent column in **RadCom**.

Television repeaters in New Zealand are making slow progress, Michael tells us. Airport radar is due to QSY from 602 to 1300MHz, relieving the QRM felt by the ZL 610-622MHz ATV band.

A couple of years ago the Youth Electronics Centre in Basel, Switzerland, joined the BATC and has enjoyed reading CQ-TV since then. Some of the material has been useful to the students there and the founder HB9DO sent the BATC a very nice letter of appreciation. The club has a 5 watt ATV transmitter and all the necessary materials for transmitting TV but activity is somewhat rare. The students seem to prefer building new electronic projects (a Meteosat receiver) to making video films and transmitting ATV.

A further problem is a new city regulation banning external radio and TV antennas; they want all existing aerials removed and people to watch cable TV. This is a bit much to swallow in a country that calls itself the oldest democracy in the world, so we must keep our fingers crossed that amateur transmitting antennas are exempted from this legislation. Otherwise plenty of money will be needed to fight this violation of human rights.

Higher things. . .

Of the 23/24cm repeaters, GB3UD is temporarily off the air, while GB3RT is moving to Corley (a superb location overlooking Coventry and Birmingham).

Things are starting to move on Britain's first ATV gateway, GB3TG (10GHz). Dave G4NJU, who conceived the project and is the manager of it, says that it now has the RSGB Microwave Committee's blessing and a licence application has been submitted to the DTI. The aim of this gateway, you will recall, is to provide an alternative input on 10GHz to an existing ATV repeater, in this case GB3TV on Dunstable Downs. The proposed location, at Bow Brickhill, would serve the Bletchley, Fenny Stratford and central Milton Keynes areas, which are in the hill-shadow of Dunstable.

The channel RT4 has been allocated provisionally, with input to the gateway on 10.250GHz (retransmitted on 1249MHz) and output on 10.150GHz (relaying the 1318MHz output of GB3TV). Obviously we await the result of the licence application with great interest; if it goes ahead, will it reach Northampton? If so, I think I shall be tempted to try 3cm ATV!

Incidentally, interference, albeit directional, from Mercury broad-band telephony transmissions has been noted in the Midlands between 10.30 and 10.35GHz. While ATVers should not cause deliberate QRM in return, we must

assert our right to remain on this (shared) band! Unattended beacons with an output of up to 14dBW become legal in 1989, so who will be first with an amateur television one?

. . .and back to base

We shouldn't forget that not all ATVers go on the air; quite a few use the hobby for recording amateur dramatics, local history and the like or just for the fun of playing with TV and making things work. This can be designing new video accessories or renovating older equipment. Recently I have heard from several people interested in the latter, specifically keeping old 405-line receivers and cameras in working order.

BATC member Jeffrey Borin had a couple of articles published recently in **Television** magazine (November and December 1988 issues) on 'How to Run Your Vintage TV Sets'. At first I was worried because I thought it said 'How to Ruin Your Vintage TV Sets', but no, the advice is very practical. A couple of people even have 625 to 405-line standard converters, so there is still some material to display on these receivers. We hope to have a display of 405-line technology at this year's amateur television convention (remember, it's at Coventry, not Crick now!).

NETWORK 934

Andy Emmerson G9BUP

Legalities

The latest issue of the UK 934 Club's magazine (essential reading for 934MHz enthusiasts) makes a fascinating claim that the three most popular beam antennas on the market don't meet the licence specifications. I am not sure I am qualified to judge, especially as I do not have to hand the details of all of these, but it's an interesting thought. It is certainly appropriate that we do keep within the terms of our licences, and I'll return to this point in a moment.

The reason the types of antennas used came up was because of the National Field Day report, written by John Levesley. Apparently some murmurs were heard from a number of contestants on the use of 'big beams' and the unfair advantage these gave over those folk who stuck to the law. As John says, 'These things do exist, and if reality upsets you, switch off now'. Two proposals have been put forward to solve the problem, at least as far as contests are concerned.

The first one is that we restrict valid contest entries to those using beams with no more than twelve elements, maybe even only beams meeting the licence requirements. The second one is that we have another category for people using collinears. The latter is dubious since collinears are an inefficient aerial for point-to-point and thus for contest working, so why should we make allowances for people who are not prepared to help themselves? In any case there are also illegal collinear antennas on the market.

Given that some operators are not too fussed about strict adherence to licence conditions, what likelihood is there of them owning up to using 'big beams'? Actually I was going to say large aerials are unlikely to harm anyone, so why worry, but it's not the attitude I should be promoting here. There *is* a small risk when long beams are used close to the ground (eg when working portable or mobile) and someone gets their head directly in the beam of RF. I cannot quantify the risk but I wouldn't take any chances either!

Keep it legal!

What are the rules then? The Department of Trade and Industry (DTI), which governs these kinds of things, issues information sheets but if you took out your licence some time ago you have probably never seen them. In the public interest some of the points are made here.

What is legal CB? Legal CB refers to CB equipment that meets the DTI specifications for the frequencies used. A legal CB station will also use an antenna (aerial) that conforms to the restrictions contained in the CB licence and repeated here. The use of all other equipment is prohibited.

How can I recognise legal CB equipment? All radios legal for use on 934MHz CB carry the mark CB 934/81 in a circle. But accessories do not have to carry this marking.

Can I use equipment designed for more than one CB service or converted equipment? No, and this also appears to rule out transverters (not that anyone still uses these – or do they?). Converted (or modified) equipment cannot be guaranteed to meet the DTI specification and might cause interference.

What is the maximum power level allowed? For 934MHz equipment, which must conform to specification MPT1321, the maximum RF power output allowed is 8 watts. Since most rigs put out only 5W this is no hardship, but it does rule out power amplifiers, even if they only compensate for losses in the coaxial feeder.

Can I use any ancillary equipment? The use of power microphones, echo boxes and speech processors is not illegal but neither is it recommended. According to the DTI these offer no advantages and can cause interference; I cannot prove or disprove the latter but some people certainly make good use of speech processors. If you have a quiet or 'fuzzy' voice, a *good quality* speech processor will give your signal more punch. I don't hold with echo mikes, nor tweety noises or Dalek voices though! You are permitted to use receive preamplifiers (on 934MHz, not on 27), also antenna switches. The use of power amplifiers (for example, 'burners', 'boots', etc) is strictly banned.

Can I use a VSWR or power meter? Yes, you can use a VSWR meter and an output power meter to set up a station, but they must be removed before the station is used since they can cause interference if left in place. (Someone please tell me how this can happen on 934MHz)!

Antennas for 934MHz. Any antenna with not more than twelve elements may be used. Each element may not exceed 17cm in length. (Does this mean a 12ft parabolic reflector used with a single element dipole is legal? There used to be a limit of 25 watts effective radiated power but this is not mentioned in the DTI's information sheet. I'll let you know when I have heard from the DTI).

Are there any height restrictions for CB antennas? No, apart from local planning restrictions and a requirement that within 1km of airfields the overall height of the antenna plus mast must be less than 15 metres.

Any further queries? Please write to the Department of Trade and Industry's CB licensing section (enclose an SAE) at Room 613, Waterloo Bridge House, London SE1 8UA.

Feedback

Paul Ewers read the review of the Selectronic base station adapter for the Cybernet Delta-1 transceiver and points out that you can get the 'Merit' base station cabinet for 27MHz radios from the dealer Truck-King. I haven't seen one of these so I am not sure about their facilities or whether the finish matches the Delta-1. As the price is lower you might wish to investigate. I actually bought the Selectronic one and find it ideal.

Short Wave News for DX Listeners

by Frank A Baldwin All titles in UTC, **bold** figures indicate the frequency in kHz

CHINA

Continuing our update and review of Far Eastern transmitters currently operating on frequencies ranging from **2560** to **4735**kHz, we begin with the Chinese station on **3950**. Qinghai PBS, Xining, transmits the Home Service 1 in Chinese from 2155 to 0030, from 0340 to 0630 and from 0955 to 1535, also featuring English language lessons from 0000 to 0030 and from 1400 to 1430. The power is 10kW and parallel frequencies are **4940** and **6260**. This one is regularly heard on **3950** by UK DXers during our winter periods, usually around 2230UTC.

The Foreign Service in Korean is radiated by Radio Beijing, China, on **4020** from 1100 to 1500, in Chinese from 1500 to 1600 and from 1730 to 1830, in Swahili from 1600 to 1730 and in French from 1830 to 2230, this latter transmission also being in parallel on **5295**. The power is 50kW.

It is sometimes possible, utility interference permitting, to hear the signals of Xinjiang PBS, China, on **4035**. At 50kW, Xinjiang PBS carries the Home Service in Tibetan from 2230 to 0130, from 0330 to 0545 and from 1000 to 1545, this schedule including relays of the Radio Beijing Minority Language Service in Tibetan from 1300 to 1326 and from 0000 to 0025.

Voice of the Strait, Fuzhou, China, on **4045** is on the air from 0955 to 1200 with the Haixia 1 programme at 10kW. Obviously, with that schedule timing, there is little chance of us UK DXers logging this one.

Radio Beijing, China, appears again on **4130** where it operates the Foreign Service in Cantonese from 1200 to 1300, in Tamil from 1400 to 1500, in Pushtu from 1500 to 1600, in English from 1600 to 1800 and from 1900 to 2000 and in German from 1800 to 1900 and from 2000 to 2100. The parallel frequency is **5250**.

CPBS Beijing, China, on **4190** transmits the Beijing Minority Language Service in Korean from 2130 to 2156, from 1000 to 1026 and from 1200 to 1226. The Mongolian programme is timed from 2200 to 2226 and from 1230 to 1256. The power is 50kW and its signals are sometimes audible here in our winter periods during the 2130 to 2156 Korean language transmission. I have logged it on several recent occasions.

The Home Service in Mongolian via Xinjiang PBS in Urumqi can sometimes be logged on **4220** where it is aired from 2300 to 0230, from 0530 to 0730 and from 1300 to 1700. This one is more often reported by DXers when heard on the parallel frequency of **5060**.

Not so often heard, largely by virtue of co-channel utility interference, is Radio Beijing on **4250** where it features the Home Service 2 in Chinese, on which frequency it radiates the Foreign Service in English from 2058 to 2330 and from 1100 to 1600 at 50kW.

Rarely heard far from signal source are the signals emanating from the 10kW Voice of the Strait, Fuzhou, on **4330**. At 10kW, the Haixia 2 programme is timed from 0353 to 1400.

Also on **4330** is Xinjiang PBS, Urumqi, which is on the air with the Home Service in Kazakh from 0000 to 0230, from 0530 to 0730 and from 1200 to 1700. This schedule includes relays of the Beijing Minority Language Service from 0100 to 0126 and from 1400 to 1426. The power is 50kW.

The Home Service 1 in Chinese from CPBS Beijing is on the air from 1958 to 2400 and from 0855 to 1730. The frequency is **4460** and the power 10/15kW.

An often reported channel of Xinjiang PBS, Urumqi, is that of **4500** where the Home Service 1 in Chinese is radiated from 2300 to 0200, from 0330 to 0730 and from 1030 to 1700. English language lessons are broadcast from 2330 to 2400 and from 1100 to 1130. The power is 50kW. Radio Beijing on **4620** carries the Foreign Service in Russian from 1000 to 1100 and from 1500 to 1600, and in Korean from 1100 to 1500 at 10kW. The parallel frequency is **4020**.

The widely heard and reported channel of Xinjiang PBS is **4735** on which it radiates the Home Service in Uigher from 2300 to 0200, from 0330 to 0730 and from 1030 to 1700. This schedule includes relays of the Beijing Minorities Language Service from 0030 to 0056, from 1100 to 1126 and from 1330 to 1356. The power is 50kW.

MONGOLIA

I have heard Ulan Bator on several occasions lately. The listed frequency is **4080** but in fact was received on an actual **4080.4**kHz on one occasion at 2148, when a talk in Mongolian was heard, followed by three descending chimes repeated, some orchestral music, six pips, an announcement (identification?) then more talk (news?).

VIETNAM

The rarely heard Vietnamese station in Hanoi transmits the Home Service in Korean from 2145 to 0200 (Sunday until 0400) and from 0900 (Sunday from 0800) to 1630 but sometimes closes earlier, around 1530 in fact. The power is 30kW and the frequency **3999**kHz. There is some doubt amongst DXers at the time of writing as to whether this one is currently active.

CLANDESTINE

The Clandestine Voice of National Salvation, thought to be operating from North Korea, is in Korean from 1000 to 1630 on **4119.9**, power unknown. To avoid jamming, the frequency is subject to slight variation sometimes. This one was logged on several occasions during 1987 and twice during 1988.

AFRICA

Angola

Radio Nacional, Luanda, on **3354.7** at 1815, YL with a talk in Portuguese. This rarely heard station, largely due to co-channel utility interference, operates from 1600 to sign-off at some time around 0600. The frequency can vary from the above to **3355.6**, the power being 10kW.

Burkina Faso

Ouagadougou on **4815** at 0540, with songs, African xylophone music, chants in vernacular, OM with an announcement and the station identification in French, *Bonjour* followed by more announcements. Radiodiffusion TV Burkina is on the air in French and local vernaculars from 0530 (Saturday and Sunday from 0700) to 0800 and from 1700 to 2400 at 50kW.

Djibouti

Radiodiffusion TV de Djibouti on **4780** at 1859, chants, OM announcements in Somali followed by an orchestral rendition of the National Anthem and off at 1900. With a power of 20kW, Djibouti is scheduled with the National Service in Somali, Afar and Arabic from 0300 to 0800 (Friday 0500 to 0900) and from 0900 to 1900.

Ghana

Accra on **3366** at 2032, a discussion in French until 2059, African drums, the station identification and a newscast in English. GBC2 is scheduled from 0525 to 0905 and from 1705 to 2305 at 50kW entirely in English, it being surprising then to hear them using French.

Nigeria

Kaduna on **4770** at 0502, OM with a news bulletin in English. Radiating the Home Service 2 in vernaculars and English, Kaduna operates from 0430 (sometimes from 0530) to 2305, the power being 50kW.

Mozambique

Maputo on a measured **3338.5** at 1740, a talk in Portuguese with several mentions of Tanzania, this being followed from 1750 to 1759 by a series of xylophone notes interspersed with many station identifications. The signal was lost at the sign-on of a co-channel utility transmitter at 1759. Emissao Interprovincial de Maputo e Gaza carries programmes in Portuguese and Tsonga from 0255 to 0530 and from 1500 to 2210, except for a relay of the Foreign Service in English at 1830. The power is 10kW.

Uganda

Kampala on **4976** at 1935 with a drama in English. This comparatively easily

received station is on the air with the Home Service in vernaculars and English from 0300 (Saturday and Sunday from 0345) to 0600 and from 1300 (Saturday and Sunday from 1400) to 2100 at 50kW. It sometimes operates in parallel on **5026**, occasionally with a different programme.

Zambia

Lusaka on **4910** at 0349, OM with a talk followed by a discussion in vernacular, then the station identification in English and a newscast from 0400 to 0411. At 50kW, Lusaka radiates the Home Service in vernaculars from 0335 to 0530 and from 1530 to 2105 (Saturday and Sunday until 2205). English news bulletins are at 0400 and at 1800.

CENTRAL AMERICA

Costa Rica

Faro del Caribe, San Jose, on **5055.2** at 0312, a religious talk then hymns in English. This 5kW transmitter programmes in English from 0300 to 0400, the schedule otherwise being in Spanish from 1030 to 2000 and from 2300 to 0600.

SOUTH AMERICA

Brazil

Radio Ribeirao Preto on **3205** at 0035, an interview in Portuguese. On the air from 0700 to 0400, the power is 1kW.

Radio Difusora do Amazonas, Manaus, on **4805** at 0158, folk music and songs, ann, id in Portuguese then off without the National Anthem at 0203. With a power of 5kW, the schedule is from 0900 to 1800 and from 2030 to 0200, all times being variable.

Colombia

La Voz del Cinaruco, Arauca, on **4865** at 0400, OM with the station and Caracol Network identification in Spanish, then into a programme of local pops. The schedule is from 0900 to 0400, the sign-off time being variable (Sunday at 0200). The power is 1kW.

Radio Nueva Vida, Cucuta on a measured **5567.3** at 0044, OM ann, folk mx and songs in Spanish, the channel being unusually clear of utility interference. This 0.1kW transmitter is on the air from 2300 to around 0230.

Ecuador

Radio Catolica Nacional, Quito, on **5055** at 0055, a religious talk, choir with hymns, the station identification and address in Spanish. With a power of 9kW, this Latin American station is on the air in Spanish and Quechua from 1000 (sometimes 1030) to 1400 and from 2200 to 0300.

Venezuela

La Voz de Carabobo, Valencia, on **4780** at 0046, OM with an excited sports commentary in Spanish. LV de Carabobo operates in Spanish from 0900 (Sunday from 1000) to 0400 (Sunday until 0300) with a power of 1kW.

ASIA

Bangladesh

Dhaka on **4890** at 0052, plucked string music and songs in Bangla. Dhaka carries the Home Service on this frequency from 0000 (sometimes from 0030) to 0330 and from 1250 to 1600. There are news bulletins in English at 0110 and at 1530, the latter during the English programme timed from 1530 to 1600. The power is 100kW.

China

Voice of the Strait, Fuzhou, on **2490** at 1547, songs followed by a talk in Chinese. Haixia 1 is radiated on this channel from 2055 to 0031 and from 0955 to 1751, the power being 10kW.

CPBS Beijing on **5075** at 2248, an English language lesson ending with 'Goodbye everyone', some announcements in Chinese, six pips and then the station identification.

India

AIR Gahauti on **3235** at 1540, a newscast in English then into a Hindi programme at 1545. The schedule is from 1230 to 1741 (Saturday until 1730) with an English news bulletin at 1530. The power is 10kW.

AIR Madras on **4990** at 0025, featuring a drama in Tamil. Madras has a power of 100kW and radiates the Foreign Service in Tamil from 0000 to 0045.

Iran

Kalamabad on a measured **3778.8** at 1530, announcements, some local style orchestral music followed by a newscast in Russian with mentions of Baku. At 100kW, Kalamabad transmits the Foreign Service in Russian from 1515 to 1600, in Farsi (Persian) from 1600 to 1700 and from 2030 to 2230, in Arabic from 1700 to 1830, in Turkish from 1830 to 1930 and in English from 1930 to 2030, also in parallel on **9022** and **15084**.

Pakistan

Quetta on **4878** at 0138, Urdu songs, OM with a talk, pips and a newscast at 0200. The Regional Service is radiated on this channel from 0045 to 0403 (Friday until 0345), from 1200 to 1600 and from 1745 to 1803. The power is 10kW.

North Yemen

San'a on **4853** at 0345, mx with songs in Arabic. With a power of 20kW, San'a broadcasts in Arabic from 0300 to 0700 (Friday until 2115) and from 1000 to 2115. The frequency varies slightly on some occasions.

SOUTH EAST ASIA

Indonesia

RRI Yogyakarta, Java, on **5046.4** at 1543, play theatre, announcements, interval signal theme 'Love Ambon' repeated, then a relay of the Jakarta news bulletin in Indonesian. This Indonesian station is on the air from 0800 to 2200 at 20kW, the frequency being variable.

North Korea

Pyongyang on **9325** at 1502, the station identification followed by a news bulletin in the English programme for Europe, timed from 1500 to 1550.

CLANDESTINE

Voice of Khmer on **6325** at 2350, plaintive songs Khmer, plucked string music, announcements, orchestral anthem and off at 2359. The schedule is from 2300 to 2359 to South East Asia.

NOW HEAR THESE

Kuching, Sarawak, on **4835** at 0040, local xylophone music, OM announcement with mention of Malaysia followed by some organ music. The Home Service in Bahasa, Malaysia and Melanau is scheduled from 2100 to 1600, the power being 10kW.

Ulan Bator, Mongolia, on **4850** at 0046,, duet in Mongolian. The Home Service 1 in Mongolian is radiated from 2200 to 1600, this schedule including relays of the Moscow Foreign Service in Mongolian. The power is 50kW.

Rangoon, Burma, on **4725** at 1356, YL talking in Burmese and still talking at 1418! Reception in the USB mode to avoid sidesplash from 4722 Volmet. At 50kW, Rangoon is scheduled from 1030 to 1445 (Saturday and Sunday until 1545) in January, February, March, June, September and October. From 1030 to 1545 in March, April, July, August, November and December.

NOW LOG THESE

Radio Tezulutlan, Coban, Guatemala, on **4835** at 0223, OM with the station identification in Spanish, some marimba music, announcements, then off at 0235 without the National Anthem. Operating Quechua and Spanish, Radio Tezulutlan is on the air from 1100 (sometimes 1200) to 1830 and from 2100 to around 0230. The power is 1kW.

Nei Menggu PBS, Hailar, China, on **4750** at 0020, orchestral music with some folk songs in Mongolian. The Home Service in Mongolian is radiated from 2130 to 2400, from 0330 to 0600 and from 0930 to 1500, this schedule including relays of the Radio Beijing Minorities Language Service timed from 2200 to 2226. English language lessons are from 2130 to 2200 and from 1100 to 1130. The power is 15kW.

Shinuiju, North Pyongyang Province, North Korea on a measured **3919.6** at 2344, sombre orchestral music, OM with a talk in Korean followed by some music and songs. The Home Service 1 is scheduled from 1958 to 1800 and includes some locally originated regional programmes. The power is 10kW.

Pyongson, South Pyongyang Province, North Korea, on **3350** at 2138, OM tirade in Korean. The Home Service 1 in Korean on this frequency has the same schedule as above.

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

The last issue of the Region 1 International Amateur Radio Union 'journal' has a very interesting report from the RSGB's Propagation Studies Committee on proposals for the future broadcasting of propagation conditions on the HF bands. It begins by pointing out that the selection of operational frequencies for radio communication in the HF bands, as well as the study of the propagation of radio waves generally, requires a knowledge of factors such as sunspot count, solar flux and magnetic index.

For many years such data was available from Meudon Observatory in France, and was broadcast in Morse code. This was intended for professional use, but was used quite extensively by amateur radio operators. With the development of landline and satellite communications, the need for these radio Morse code broadcasts declined, and as the transmitters used for the service required replacing, a review was carried out which resulted in the service being closed down.

This closure has left many radio observers without access to such data. The problem has been discussed in committee by IARU Region 1 and it was agreed that a need existed, which should if possible be covered.

The matter has been considered by the RSGB's Propagation Studies Committee and planning for the establishment of such a service has been under way for some time. The basic plan is to cover Great Britain and Ireland and as much of Europe as possible, probably with a transmission in the 3.5MHz band. However, with the amount of use and consequent QRM on this band, it would be useful if a 'fixed-service' assignment on a frequency just outside the 80m band could be granted.

The project has the favourable consideration of the radio propagation staff at the DTI, which is encouraging. Marconi Communications Ltd has donated a 1kW HF transmitter for the service, and negotiations for the siting of the equipment on a University of Sheffield field site at Buxton, Derbyshire, are well advanced. This would give good coverage of the UK, Eire and north-west Europe.

Support for the project has already been received from the Head of the Propagation Dept, Rutherford Appleton Laboratory. It would be most helpful if support from other professional organisations, especially those of neighbouring countries could be obtained. Organisations interested in this project should write to the RSGB Propagation Studies Committee at RSGB HQ.

Amateur radio activity from MIR

As mentioned in this column last month, amateur radio is now operational from the Russian spacecraft MIR. A number of QSOs have been reported and signals are said to be very strong. Operation has been reported on 145.000, 145.400 and 145.500MHz. Callsigns being used are U1MIR, U2MIR and U3MIR. It is pointed out that the astronauts concerned have had little experience of amateur radio QSOs and are not familiar with the English language. Hence, use the simplest of English phrases if you have the luck to contact them! Do not attempt to call them, wait for them to call CQ. Their time on the air is limited by their other routine duties and they are most likely to be heard on Saturdays and Sundays. QSLs should be sent via UW3AX.

Derby ARS 144-146MHz Contest

We are often asked to include details of club activities, contests, etc, in this feature, but invariably these requests arrive too late for the copy date. Therefore we were pleased to receive from the Derby and District Amateur Radio Society, details of their third National 144-146MHz Contest in plenty of time. The contest takes place on Sunday 12 March. A copy of the rules can be obtained from the club address, upon receipt of an SAE: DADARS National 2m Contest, 119 Green Lane, Derby DE1 1RZ.

Expedition to Ward Hunt Island

From the 'VHF/UHF Newsletter' we learn that accompanying Sir Ranulph Fiennes on the latest of his expeditions to the North Polar regions will be GM4DMA and GM1ILL. Lawrence Howell GM4DMA is an old campaigner, he was on last year's expeditions to Ward Hunt Island and has been on several antarctic expeditions. During the International Geophysical Year in 1957-8, he succeeded in receiving British and French Band 1 TV on South Georgia Island and in 1980 he set up the VP8ADE 28MHz beacon which is still performing very well. His wife Morag GM1ILL is also a qualified marine radio operator.

The expedition is due to leave Britain on 20 February and should arrive around 3 March. They will be taking 50MHz equipment with them and will operate on 50.110MHz with 25 watts to a 4 element yagi. Their equipment has been donated by Microwave Modules, South Midlands Communications and J Beams, with special coax cable to cope with the low temperatures supplied by Raychem Cables. They will also operate on 144.123MHz and will generally use the callsign GM4DMA/VE8 although GM1ILL/VE8 may also be used. The source of power will be a wind generator charging 500 amp/hr batteries.

Ward Hunt Island is at 83°05'N, 74°06'W. It is only a few miles across but is dominated by a 1300ft peak called Walker Hill. The station will be located 100ft above ice level, so the hill will obstruct low angle propagation from WSW to SE, but the azimuth of 97° to Britain will be clear. The station will operate until at least May. Possible modes of propagation at 50MHz are by F layer and auroral E propagation.

18 and 24MHz activity

Recently, during the period when 10 metres was widely open, I wondered if activity on the band indicated that 18 and 24MHz were also open. Tuning across the amateur allocation for the 24MHz amateur band, it was good to hear quite a bit of activity from DX stations such as W5 in Florida and KA in Miami, and an almost complete absence of commercial stations, harmonics, etc. 18MHz, however, was a completely different picture. Commercial activity and harmonics were as loud as usual and very little amateur activity could be heard at all. What there was, was being badly QRMd as usual. So when 10 metres is open, have a listen to 24MHz, particularly if you are after DX.

There has been a beacon on 24MHz operating from Italy. The frequency is 24.915MHz, with mode A1A emission. It sends: 'VV de IK6BAK. Beacon QTH locator JN6KR'. Power is 10 watts to a groundplane quarter-wave antenna. Reports are welcome to: Eliseo Chiarucci, via Sterpeti 50, I-61030 Montefelcino, (PS) Italy.

BARTG name change

At the recent BARTG AGM it was decided to change its name from the British Amateur Radio Teleprinter Group to the British Amateur Radio Teledata Group. The decision to do this was not taken without considerable discussion. The proposal for a change was made at the previous year's AGM, when it was decided to give the membership a year to discuss it. Some members were initially unhappy about the proposed change as they felt that to drop the word 'Teleprinter' might suggest that the Group was no longer interested in mechanical printers, which are quite popular still with a number of RTTY enthusiasts. However, this is certainly not the case and the majority opinion was that the Group would benefit from a wider title to indicate that it catered for all modes of data communication: AMTOR, fax, packet, RTTY and so on.

I was a founder member of BARTG and it is of interest to record that the original title of the Group was 'The British Amateur Radio *Teletype* Group'. A few months after we started, we received a communication from the Teletype Corporation of America, saying that they held a copyright on the word 'Teletype' so would we please cease using it! So we then changed it to 'Teleprinter', which was retained up to the present decision.

UoSAT's experimental role

When the UoSAT spacecraft project was first conceived, the main purpose was to provide small, inexpensive satellites which could be used to provide technical colleges and similar establishments with facilities for teaching space technology. In addition to this it was proposed to use them for experimental projects aimed at furthering space techniques of a type which more professional space organisations may not consider in keeping with their interests.

The educational aspects of the UoSAT project have been well publicised and are well used. The experimental aspects are not so well-known and deserve more attention than they receive. One such experiment has recently been recorded in the 'UoSAT Bulletin' No 145. Research data, which may enable VHF transatlantic openings to be more accurately forecast, has been obtained from particle-wave surveys carried out by UoSAT 2. Using the multi-channel electron spectrometer which is carried on this satellite, electron energy levels could be measured at eight nominal levels: 30, 300, 800, 1600, 3,200, 8,100 and 13,000 electron volts (eV). Each survey, which took up 96K of memory and lasted about twelve minutes, could be initiated at any point on the orbit as the satellite passed over the North Atlantic. The surveys were carried out to assist the RSGB's Propagation Studies Committee in analysing the propagation of 50MHz signals across the Atlantic.

The Digital Communications Experiment (DCE) is another experimental system which has proved very successful. This is a packet type system by means of which messages recorded in a memory module can be transferred from selected ground stations around the world by VHF radio. One of these, VK5AGR, in Australia and another, GB2UP, at the UoSAT Command Station, are now passing dozens of messages each week between each other. Other world-wide DCE stations now in operation are ZS6SAT in Johannesburg, N6IIU operating into the USA WestNet, K1KSY on the US east coast, DB20S into central Europe, ZL1AOX in Auckland, ZL5BA on Ross Island (Antarctica), AP2SUP and AP2PUL in Pakistan and the latest of all, UA3CR in Moscow.

UoSAT 1 celebrated its seventh birthday last October and UoSAT 2 celebrates its fifth birthday next March. UoSAT 1 continues to perform very well, supporting daily experiments on a schedule upload every week from the Mission Control Groundstation at Surrey University. It was the first satellite to be built at the university and the experience gained from it led to the construction of UoSAT 2. This was designed and built within the remarkably short period of six months. Throughout its five years of operation in low earth orbit, it has supported many wide-ranging experiments in digital store-and-forward communications, spacecraft attitude determination, stabilisation and control, auroral particle-wave measurements and on-board computer operations.

ICOM

VHF/UHF FM Handhelds

If you want a handheld with exceptional features, quality built to last, and a wide variety of interchangeable accessories, take a look at the ICOM range of FM transceivers.

All ICOM Amateur handhelds are supplied with a flexible antenna, rechargeable nicad battery pack and an AC wall charger.

IC-2E 2 Metre Thumbwheel Handheld

This popular transceiver from ICOM is still available after eight years of production. If you're looking for a straightforward but effective handheld the IC-2E takes some beating. Frequency selection is by means of thumbwheel switches (with 5KHz up switch), with simplex and repeater operation possible. Power output is 1.5 watts or LOW 150 milliwatts (2.5 watts possible with BP5A battery pack).

MICRO 2E/4E

These micro sized 2 metre and 70 centimetre handhelds give the performance and reliability you expect from ICOM. Measuring only 148 x 50 x 30 the micro fits in your pocket as easily as a cassette tape. The micro features up/down tuning switches for quick frequency changing, 10 programmable memories, LCD readout and 1.5 watts output (2.5 watts possible with BP24 battery pack).

IC-02E/04E Keypad Handheld

These direct frequency entry handhelds utilise a 16 button keypad allowing easy access to frequencies, memories and scan functions. Ten memories store frequency and offset, a front panel LCD readout indicates frequency, signal strength and transmitter output. Power output is 2.5 watts or LOW 0.5 watt. (5 watt is possible with the BP7 battery pack or external 13.8v D.C.)

IC-2GE/4GE

The 'G' series of handhelds fulfills the most important criteria for a handheld transceiver, it is small, rugged and easy to operate. The 20 memory channels can store simplex and repeater frequencies and with the several scan functions there is no need to manually search for activity. The 3 watt output and power saver circuit ensures low battery drain. (7 watts is possible with the BP7 battery pack or external 13.8v D.C.)

IC-12E 23 Centimetres

Similar in style to the 02E/04E this 1296MHz handheld utilizes ICOM's experience in GHz technology, gained by the excellent IC-1271E base station. With the growing number of repeaters on 23cm the IC-12E makes it an ideal band for rag chew contacts. Power output is 1 watt from the standard BP3 battery.

IC-32E Dual Bander

This exciting new handheld offers 2 metres and 70 centimetres in one compact unit. Tough and splash resistant it offers many features including crossband duplex operation, 20 dual band memories and power saver circuit. The IC-32E utilises most existing ICOM accessories, ideal if you are upgrading from an existing ICOM handheld.

Also available for ICOM handhelds are a large range of optional extras including rechargeable nicad battery packs, dry cell battery cases, desk chargers, headset and boom microphones, leatherette cases and mobile mounting brackets. New products just released:- HM46 miniature speaker/microphone and HS51 lightweight headset/microphone complete with PTT and Vox unit.

Icom (UK) Ltd.
Dept REW, Sea Street, Herne Bay, Kent CT6 8LD. Tel: 0227 363859. 24 Hour.

Seasons Greetings to you all

Into '89 with Icom

IC-751A HF All-Band Transceiver

- **Amateur Bands 160m - 10m.**
- **General Coverage Receiver.**
- **105db Dynamic Range.**
- **100W Output (40w A.M.)**
- **32 Memories.**
- **Electronic Keyer.**
- **CW Semi/Full Break-in.**
- **HM36 Microphone.**

The ICOM IC-751A was created for the ham operator who demands high performance whether entering contests, chasing DX or just simply enjoying the shortwave bands. It is an all mode solid state transceiver with a host of features designed for the crowded HF bands of today.

Additional features include passband tuning, 9MHz notch filter, adjustable AGC, noise blanker, RIT and XIT. A receiver pre-amp and attentuator provides additional control when required. The FL32 9MHz/500Hz CW filter is fitted as standard with CW sidetone on Rx and TX modes. On SSB the new FL80 2.4Khz high shape factor filter is fitted.

The transmitter is rated for full 100% duty cycle with a high performance compressor for better audio clarity. With 32 memory channels and twin VFO's, scanning of frequency and memories is possible from the transceiver or the HM36 microphone supplied.

The IC-751A is supplied for 12v operation but can be used with either internal or external A.C. power supply. It is fully compatible with ICOM auto units such as the IC-2KL linear amplifier and the AT500/100 antenna tuners.

Options available:- PS35 internal AC power supply, PS15 external AC power supply, EX310 voice synthesizer, SM8 and SM10 desk microphones and SP3 external loudspeaker.

Helpline: Telephone us free-of-charge on 0800 521145, Mon-Fri 09.00-13.00 and 14.00-17.30. This service is strictly for obtaining information about or ordering Icom equipment. We regret this cannot be used by dealers or for repair enquiries and parts orders, thank you.
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DATA FILE

This month Ray Marston looks at six useful ac power controller circuits and outlines dc power control principles

In the last five editions of 'Data File' we have looked at basic electrical/electronic power control principles and devices, and at a variety of practical ac power switching circuits. This month we conclude our look at ac power control circuits by presenting six useful lamp dimmer and motor speed controller designs, and then go on to take another look at dc power control principles.

Note that each of the ac power control designs shown here use either a Triac or an SCR as its power switching element and can be used on either 115V or 230V ac power lines. In each case the user must select the Triac/SCR rating to suit his own particular application; where applicable, component values for use on 115V power lines are shown in parentheses in the circuit diagrams.

Ac lamp dimmer circuits

Triacs can be used to make very efficient lamp dimmers (which vary the brilliance of filament lamps) by using the phase-triggered power control principles (described in the first part of this mini-series), in which the Triac is turned on and off once in each mains half-cycle. Its M/S ratio controls the mean power that is fed to the lamp. All of these circuits require a simple L-C filter in the lamp's feed line to minimise RFI problems.

The three most popular methods of obtaining variable phase-delay Triac triggering are: a Diac plus R-C phase delay network, a line-synchronised variable-delay UJT trigger, or a special-purpose IC as the Triac trigger. **Figs 1** to **4** show practical examples of lamp dimmers using each of these different methods.

Fig 1 shows the practical circuit of a Diac-triggered lamp dimmer, in which R1-RV1-C1 provide the variable phase-delay. This circuit is similar to the basic lamp dimmer circuit described in the first part of this mini-series, except for the addition of the on/off switch SW1, which is ganged to RV1 and enables the lamp to be fully turned off.

A weakness of the simple **Fig 1** design is that it suffers from a considerable amount of control hysteresis or backlash. If the lamp is dimmed off by increasing the RV1 value to 470k, it will not come on again until RV1 is reduced to about 400k, and will then burn at a fairly high brightness level. This backlash is caused by the Diac partially discharging C1 each time the Triac fires. The backlash effect of the above circuit can be reduced by wiring a 47R resistor in series with the Diac to reduce its discharge effect on C1. An even better solution is to use the gate slaving circuit of **Fig 2** in which the Diac is triggered

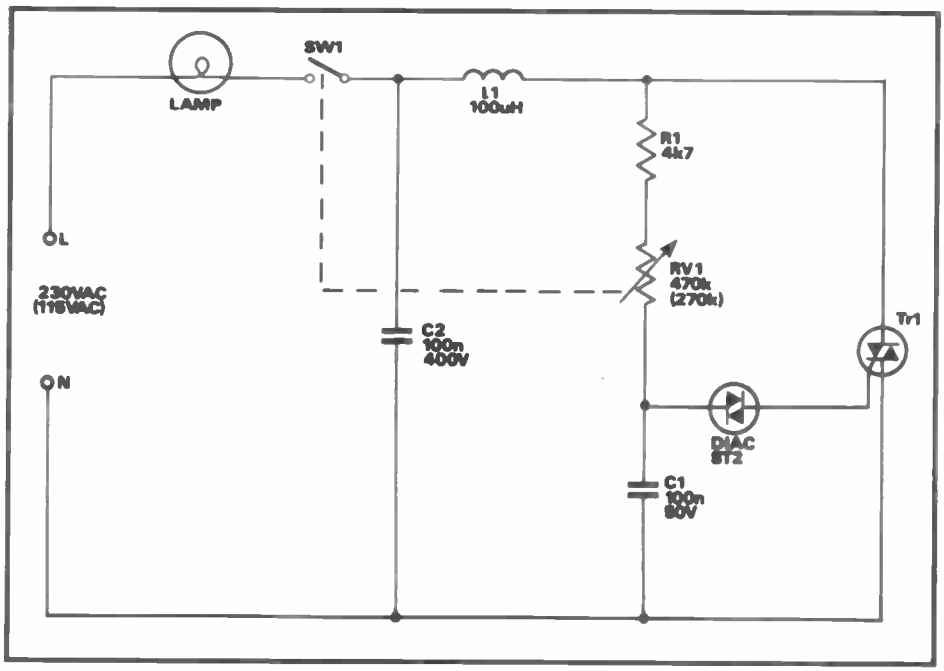


Fig 1: *Practical circuit of a simple lamp dimmer*

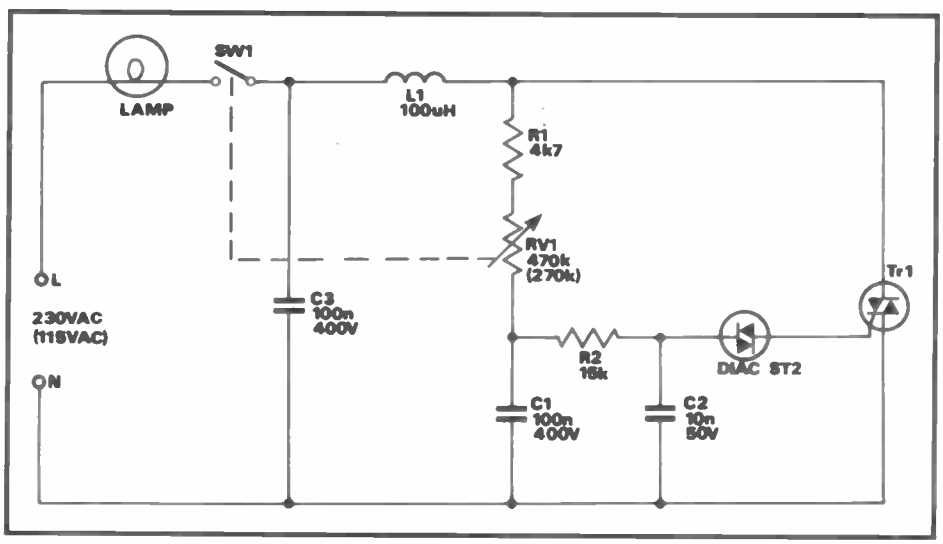


Fig 2: *Improved lamp dimmer with gate slaving*

from C2 which 'follows' the C1 phase-delay voltage but protects C1 from discharging when the Diac fires.

If absolutely zero backlash is needed, the UJT-triggered circuit of **Fig 3** can be used. The UJT is powered from a 12V dc supply which is derived from the ac line via R1-D1-ZD1-C1. The UJT is synchronised to the mains via the Q2-Q3-Q4 zero-crossing detector network, causing Q4 to be turned on (applying power to the UJT) at all times, except when the ac mains voltage is close to the zero crossover point at the end and start of each ac half-cycle. Thus, shortly after the start of each half-cycle, power is applied to the UJT circuit via Q4, and some time later (determined by R5-RV1-C2) a trigger pulse is applied to the Triac gate via Q5. The UJT resets at the end of each half-cycle and a new sequence then begins.

A 'smart' lamp dimmer

To complete this brief look at ac lamp dimmer circuits, **Fig 4** shows how a dedicated IC such as the Seimens S566B 'touch dimmer' chip can be used as a smart lamp dimmer which can be controlled via touch pads, push button switches, or via an infra-red link. The action of this IC, which gives a phase-delayed trigger output to the Triac, alternately ramps up (increases brilliance) or ramps down (decreases bril-

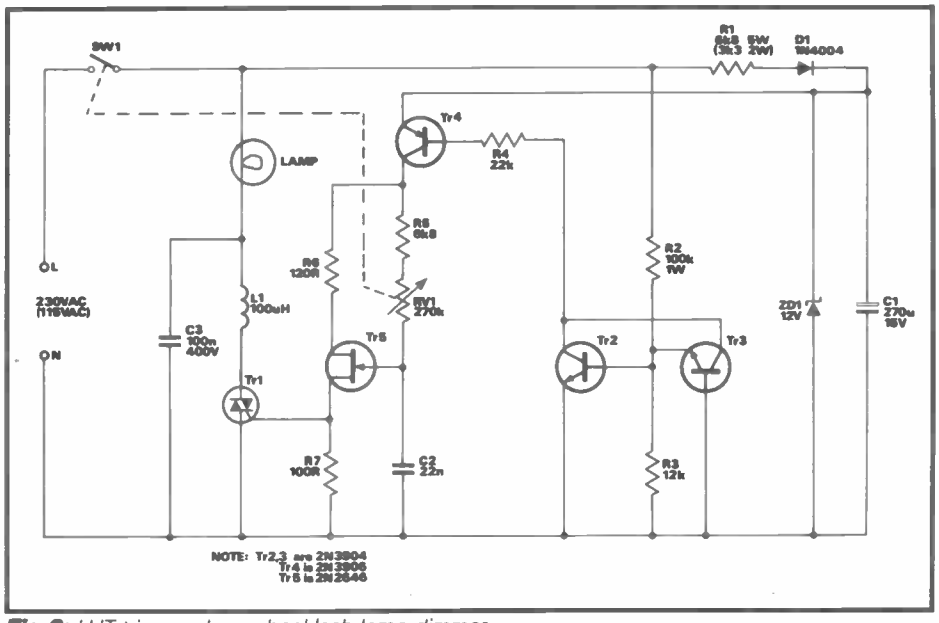


Fig 3: *UJT-triggered zero-backlash lamp dimmer*

Universal motor controllers

Domestic appliances such as electric drills and sanders, sewing machines and food mixers, etc, are almost invariably powered by series-wound 'universal' electric motors (so-called because they can operate from either ac or dc supplies). When operating, these motors produce a back emf that is proportional to the motor speed. The *effective* voltage applied is equal to the true applied voltage minus the motor's back emf which is directly proportional to the motor speed. This fact results in a degree of self-regulation of universal motor speed, since any increase in motor loading tends to reduce the speed and back emf, thereby increasing the effective applied voltage and causing the motor speed to rise towards its original value.

Most universal motors are designed to give single speed operation. Triac phase-controlled circuits can easily be

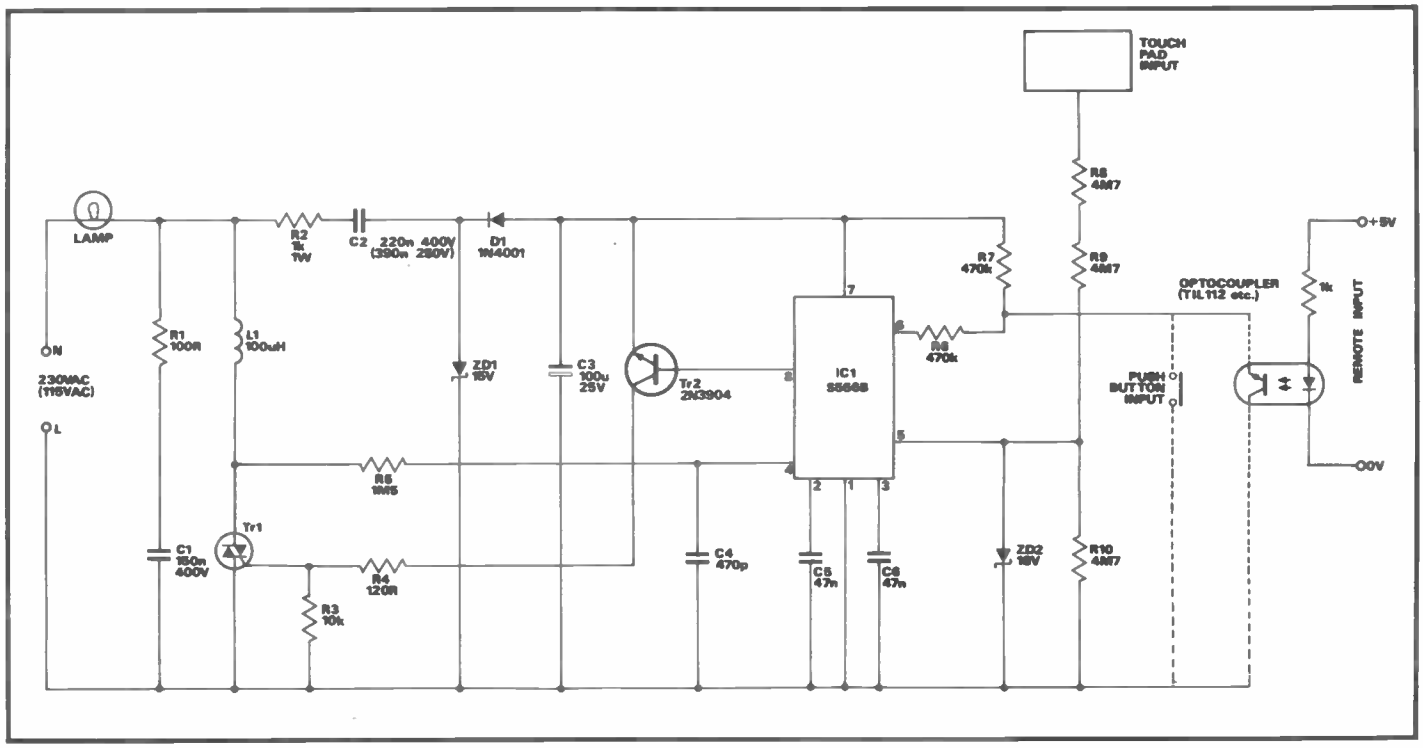


Fig 4: *Smart lamp dimmer, controlled by a dedicated IC*

liance) on alternate operations of the touch or push-button inputs, but 'memorises' and holds brilliance levels when the inputs are released.

'Touch conditioning'

The S566B IC incorporates 'touch conditioning' circuitry. This is a very brief touch or push input which causes the lamp to simply change state (from off to its previously set on value, or vice versa). A sustained (greater than 400mS) input causes the IC to go into the ramping mode, in which the lamp's power slowly ramps up from 3% to 97% of maximum and then down to 3% again and so on until the input is released. At this point the brilliance level is latched into the dimmer's memory and used as its 'on' brilliance value.

Note that the touch pads used with this circuit can be simple strips of conductive material, and that the operator is safely insulated from the ac mains voltage via high-value resistors R8 and R9. Also note that several touch pads or operating push buttons can be wired in parallel if desired, enabling the dimmer to be operated from several differently placed points.

used to provide these motors with fully-variable speed control, but give rather poor self-regulation under variable loading conditions (a suitable 'Diac plus phase-delay' circuit is shown in **Fig 5**). This circuit is particularly useful for controlling lightly loaded appliances such as food mixers and sewing machines, etc.

Electric drills and sanders, for example, are subject to very heavy load variations and are not suitable for control via the **Fig 5** circuit. Instead, the variable speed regulator circuit shown in **Fig 6** should be used. This circuit uses

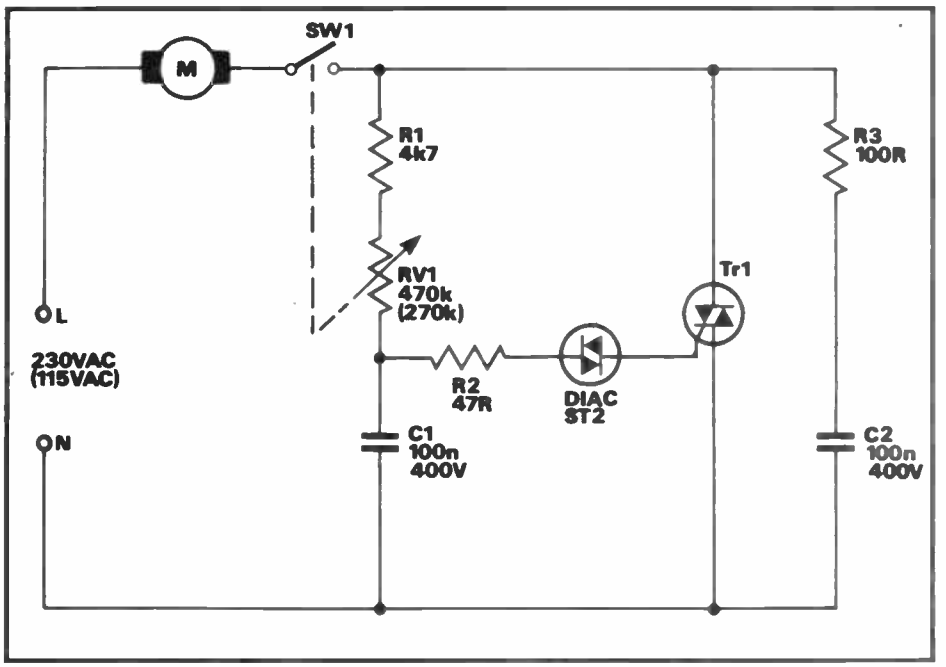


Fig 5: *Universal motor speed controller, for use with lightly loaded appliances, food mixers, sewing machines, etc*

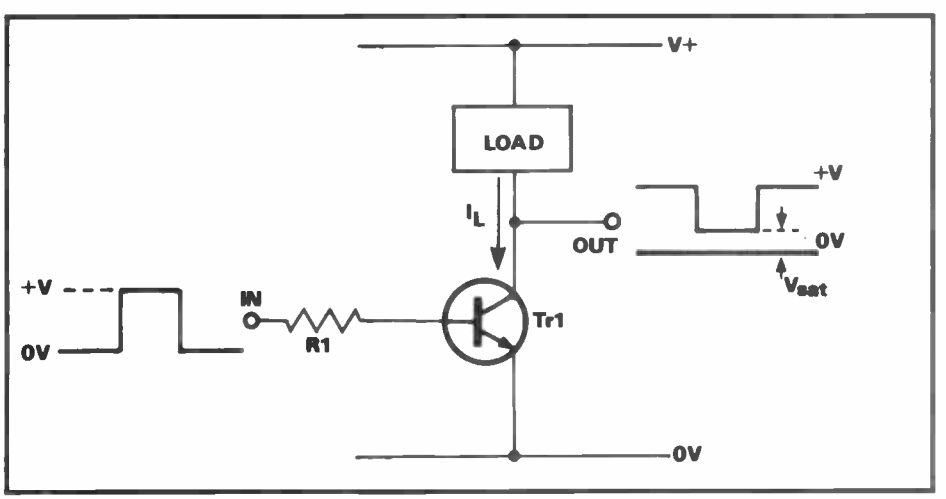


Fig 7: *The npn transistor switch acts as a load-current 'sink'*

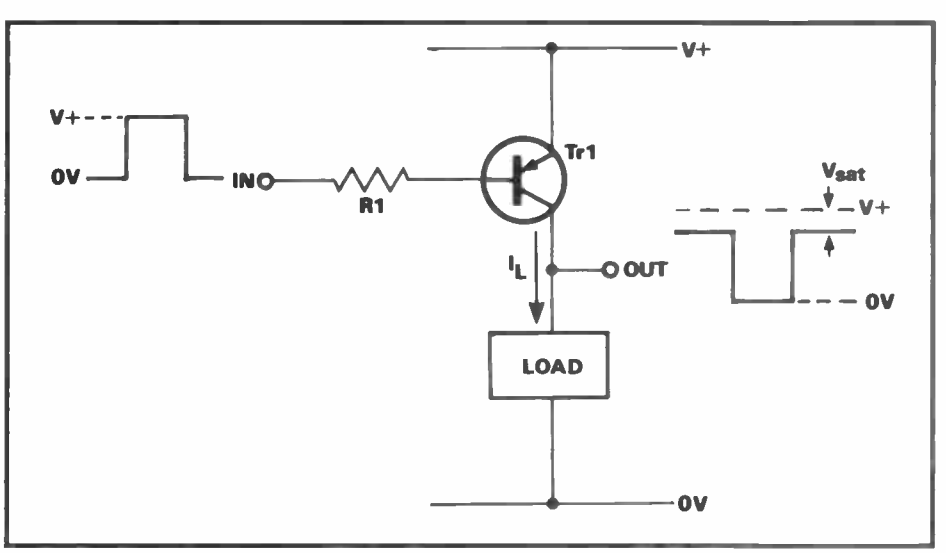


Fig 8: *The pnp transistor switch acts as a load-current 'source'*

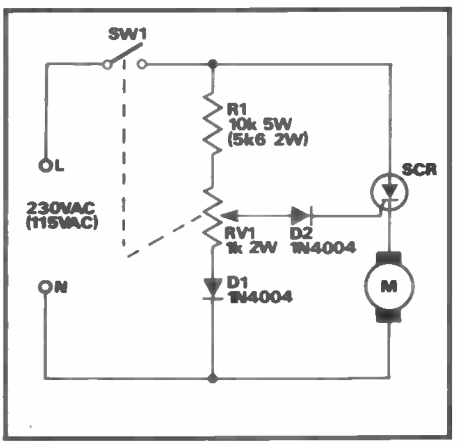


Fig 6: *Self-regulating universal motor speed controller, for use with electric drills and sanders, etc*

an SCR as the control element and feeds half-wave power to the motor (this results in only a 20% or so reduction in maximum available speed), but in the off half-cycles the back emf of the motor is sensed by the SCR which is used to obtain an automatic adjustment of the next gating pulse to give automatic speed regulation. The R1-RV1-D1 network provides only 90 degrees of phase adjustment, so all motor pulses have a minimum duration of 90 degrees and provide very high torque. At low speeds the circuit goes into a 'skip cycling' mode, in which power pulses are provided intermittently to suit motor loading conditions. The circuit provides particularly high torque under low-speed conditions.

Dc power control

So far in this 'power control' mini-series we have concentrated on ac designs; in the remaining parts, we will look at dc power control circuits only. The dc power feed to loads such as lamps, heaters, relays and electric motors, etc, can be controlled fairly easily via unidirectional solid-state devices such as bipolar transistors, power MOSFETs, or SCRs. They can be used in either the 'static' mode to give a simple on or off switch control action, or in the 'pulsed' mode to give a variable power control action. In the remainder of this episode, we will outline static dc power switching basics.

Dc power switching basics

Three basic types of solid-state devices are available (in either discrete or integrated-circuit form) for use in dc power control applications, these being the bipolar transistor, the power MOSFET and the SCR; each of these devices offers its own particular set of advantages and disadvantages. Let's look at the ordinary bipolar transistor first.

In most dc power switching applications the bipolar transistor is wired in the common emitter mode, as shown in **Figs**

7 and **8**. In the case of the npn device (see **Fig 7**) the load is wired between the Q1 collector and the positive supply rail, and the transistor acts as a current 'sink' (current flows *into* the collector via the load). In the case of the pnp device (see **Fig 8**) the load is wired between the Q1 collector and the negative supply rail, and the transistor acts as a current 'source' (current flows *from* the collector into the load).

The main advantage of the common emitter configuration is that it offers a very. low saturation or 'loss' voltage (typically 200mV to 400mV), the main disadvantage is that it offers fairly low overall current and power gains (typically 100:1). In practice, these gains can easily be increased to 10,000:1 (without increasing the saturation voltage) by cascading a couple of common emitter stages (see **Fig 9**) or by wiring a pair of transistors in the Super-Alpha mode, as shown in **Fig 10**.

Really high current/power gains can be obtained by using a power MOSFET as the dc power switch if required. These devices have a near-infinite dc input impedance and thus give near-infinite current and power gains. One of the most popular types of power MOSFET is the VFET family of enhancement mode devices from Siliconix. **Fig 11** shows one of these devices, the VN66AF (which incorporates a built-in input-protection zener diode) which is used in this mode.

Note that the VN66AF can pass maximum currents of about 2 amps and has a typical saturation resistance of about 2 ohms. Thus, if the device is used with a 12V supply, it will give a saturation voltage of about 80mV when used with a 300 ohm load, or 1,091V when used with a 20 ohm load, etc.

The SCR is the third type of solid-state power switching device and is of particular value in controlling self-interrupting dc loads such as bells, buzzers or sirens (**Fig 12** shows the basic circuit). These loads usually comprise a solenoid and an activating switch which is wired in series to give an auto-switching action. The solenoid first shoots forward via the closed switch (forcing the switch to open) thus making the solenoid fall back and re-close the switch, thereby restarting the action, and so on.

The basic **Fig 12** SCR circuit effectively gives a non-latching load-driving action, since the SCR automatically unlatches each time the load self-interrupts; the load and SCR are only active while gate current is applied to the SCR. The circuit can be made fully self-latching by shunting the load with resistor R3 (as shown) so that the SCR's anode current does not fall below the minimum holding value as the load self-interrupts. Note that SCRs offer typical gate-to-anode current gains of about 5,000:1, but give typical saturation voltage values in the range 800mV to 1.5V.

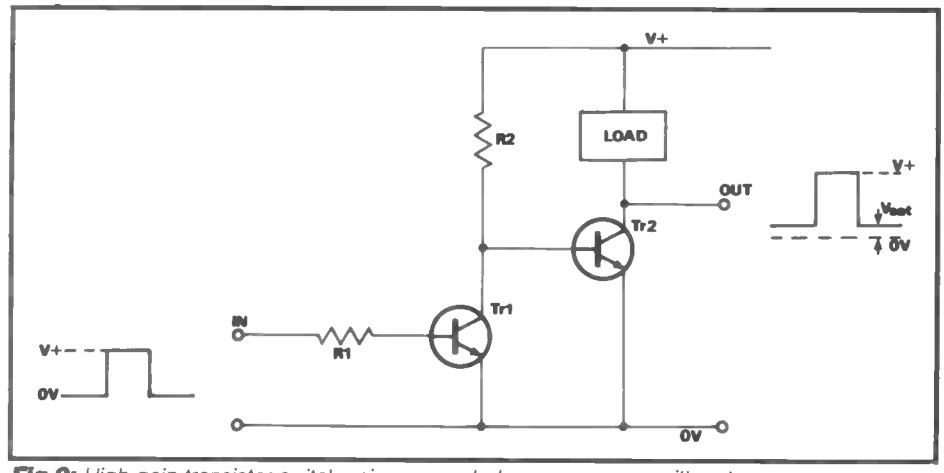


Fig 9: *High-gain transistor switch using cascaded npn common emitter stages*

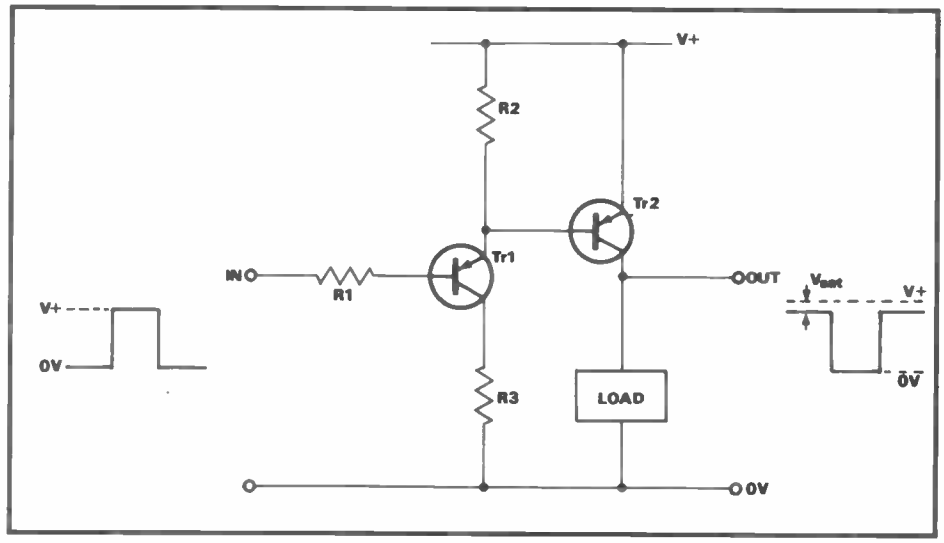


Fig 10: *High gain transistor switch using a Super-Alpha pnp pair*

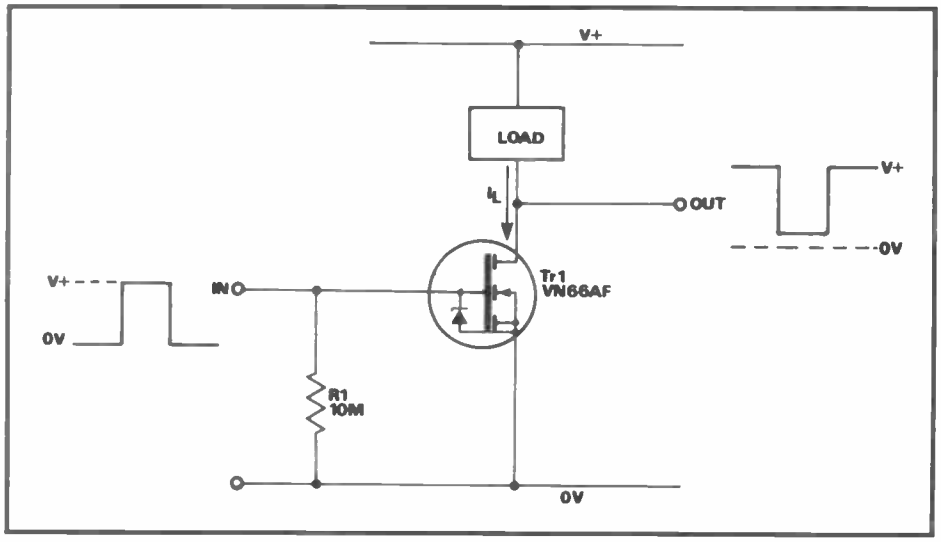


Fig 11: *VMOS FETs offer near-infinite current/power gain*

Load-type basics

When designing dc switching circuits, some thought must be given to the type of load to be controlled and to its possible harmful effects on the solid-state switching circuitry. The most important points to note here are as follows.

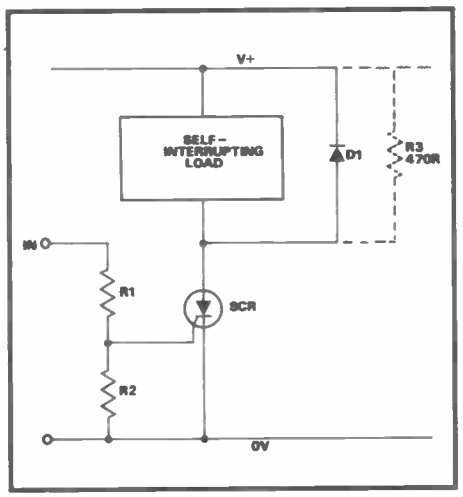
When driving filament lamps, note that these devices have a cold or 'switch-on' resistance that is typically a quarter of the normal hot or 'running' value and

thus pass switch-on currents that are four times greater than the normal running value. Thus, a solid-state switch used for controlling a 500mA lamp must have a surge rating of at least 2 amps.

When driving highly inductive loads such as relays, solenoids, bells, buzzers, speakers and electric motors, etc, these devices can generate very large back emfs at the moment of current switch-off. Also note that solid-state power switches need protecting against damage from this source. **Fig 13** shows how protection can be fully provided by using ordinary silicon diodes to 'damp' the back emf. Here, D1 stops the voltage from swinging more than a few hundred mV above the positive supply rail value, and D2 stops it from swinging significantly below the zero volts rail. In practice it is often adequate to provide partial protection by only using D1, as in the case of the SCR circuit shown in **Fig 12**.

Finally, when driving loads that are electrically very noisy the loads may require damping via small ceramic capacitors to minimise RFI generation, and the power supply to the switch-driving circuitry may need extensive ripple decoupling.

In next month's edition of 'The File' we will show how some of these dc power switching principles can be put to practical effect in LED and lamp control applications.



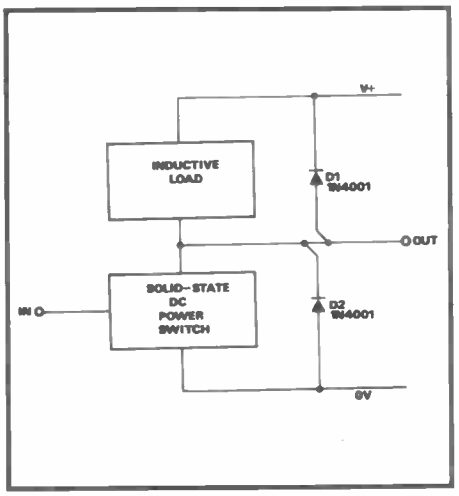


Fig 12 far left: *The SCR dc switch offers high power gain*

Fig 13 left: *When driving inductive loads, the solid-state switch must be protected via damping diodes*

DX-TV RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

October 1988 was outstanding for long-distance TV enthusiasts because reception via the F2 layer occurred. Although the peak in the forthcoming eleven-year solar cycle is approaching more rapidly than predicted earlier, enthusiasts anticipated that the first television signals would appear towards the end of 1989.

Sporadic E and tropospheric propagation played a less active role during the month. Tropospheric signals from several European countries penetrated the United Kingdom over the weekend of the 15th and 16th. Band III frequencies were more affected than those at UHF.

F2 reception builds up

Towards the end of October, Chris Howles of Lichfield noted very smeary signals on channel E2 which he thought may have been F2 layer propagation. His suspicions were confirmed a few days later when similar signals were resolved here at Derby on channels E2 and R1, accompanied by various communication systems present between 40 and 48MHz. The latter signals were mainly distorted but occasionally Russian and American speech could be made out. On 31 October, Spanish accents were heard around noon – possibly from South America if reports of the 10m amateur band are anything to go by.

Multiple images

Vision reception occurred most days during the last week of October. Sometimes the signals were short-lived (ten to fifteen minutes) at P2-3 strength but they exhibited all the typical characteristics of F2 reception such as multiple images and smeary video. Chris comments that signals on E2 on the 29th were stronger from the north-east. At Derby, programmes with captions in the Roman alphabet were noted shortly after 0900, but these were unreadable.

Identifying reception via F2 layer propagation can be virtually impossible at times. The signals may be strong but multiple images and smeary video can make it difficult to decide whether stationary or moving pictures are present on the screen.

Strong signals

31 October was the best day with very high signal levels on channel R1 from late morning until 1255. At 1235GMT, E2 video was present. There appeared to be a dark rectangle in the centre of the screen, possibly part of a test pattern, but the poor definition made it impossible to be absolutely certain. The VITS (Vertical Interval Test Signal) in the frame bar was absent. A short time later, a programme could definitely be made out and this time the VITS was present. Between 1252 and 1255 reception gradually disappeared. The last report of F2 reception was on 6 November when Chris resolved signals on channel R1 around 0900GMT.

Latest F2 predictions

Despite earlier pessimistic reports about the current solar cycle (number 22), activity seems to be rapidly increasing and latest predictions suggest that the forthcoming peak will be significantly better than the last which occurred around 1979/1980.

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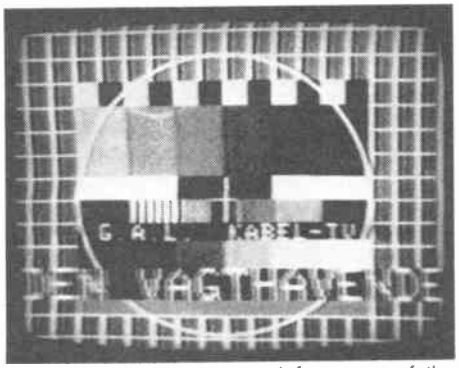

Fig 1: *Electronic test card from one of the Scandinavian cable TV networks*

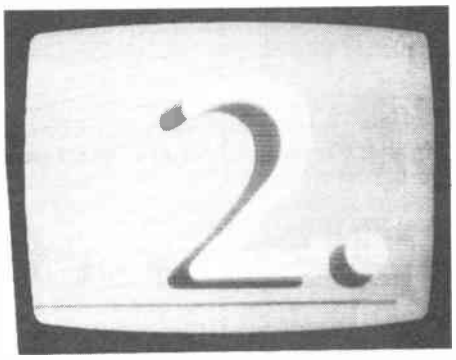

Fig 2: *Caption used by DDR:F2, the 2nd network in East Germany*

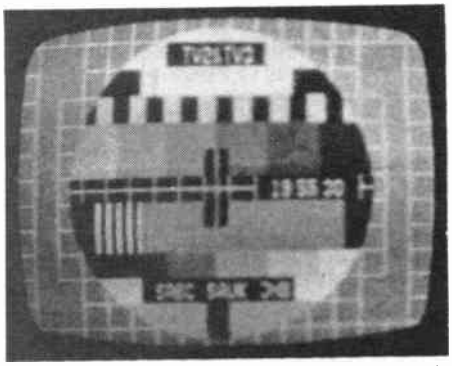

Fig 3: *The PM5534 test card transmitted by the South African TV service*

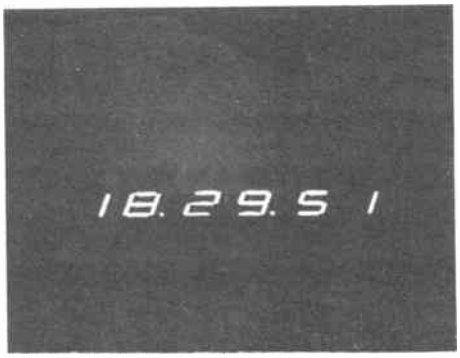

Fig 4: *Clock caption radiated by the Indian TV network based in Madras*

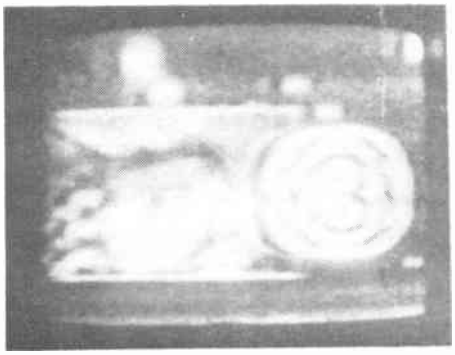

Fig 5: *Malaysian TV identification caption received via F2 propagation in India*

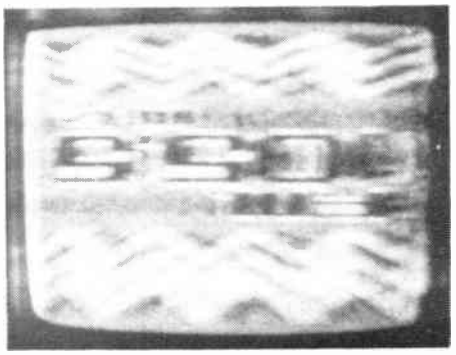

Fig 6: *Malaysian clock caption received 20/10/88 in India via the F2 layer on channel E2*

DX-TV RECEPTION REPORTS

TEP in the UK

Via Roger Bunney of Romsey comes the news of an African station being received in the south-west of the UK. On 9 October at 1650, Roger Fussel at Torpoint received a greyscale/colour-bar test pattern (channel not known) via TEP (Trans Equatorial Propagation), followed by an African singer, two men on drums, choir, etc, with fade-out at 1720. At times the signal was unwatchable due to severe flutter. A recent RSGB 'VHF/UHF Newsletter' indicated that an amateur in Leicestershire received channel E2 signals on many days during September and October but it is not known whether these were at 'scanner level' or were actual pictures.

Mystery test cards

On 7 September at 2325, Nick Brown of Rugby noticed a weak but stable signal on channel E36 during a trop opening. It comprised half-field colour bars with the wording 'EUTELSAT/F1 TRANSPONDER 3' underneath. At 2335 it switched to a test pattern with blocks and squares.

On 16 October at 1355 on channel E36, a mystery PM5544 test pattern was observed co-channelling with a programme. The test pattern eventually disappeared after thirty to sixty seconds.

DX-TV log for October

This month we are featuring the October 1988 DX-TV log from Garry Smith of Derby.

04/10/88: West Germany BR-1 (Bayerischer Rundfunk) on channel E2 with 'GRüNTEN' FuBK.

08/10/88: Unidentified channel E4/IB programme at 1415 via Sporadic E (SpE).

11/10/88: SVT-1 (Sweden) E2 'KANAL 1 SVERIGE' PM5534.

15/10/88: DDR:F1 (East Germany) on channel E12 via trop, also on channel E5 at times.

16/10/88: SWF-1 (Südwestfunk) E9 and E10 'SWF-1 BADN' FuBK (E10 later changed to 'SWF-1 DBG); unidentified channel E36 PM5544 floating with programme at 1355; RTBF-2 (Belgium) E42 'TELE 21' PM5544.

17/10/88: WDR-1 (Westdeutsches Fernsehen) on E11 'WDR-1 TW11' FuBK; HR-1 (Hessischer Rundfunk) E7 'hr1 FFTM' FuBK; RTL PLUS (Luxembourg) on channel E7.

25/10/88: Weak signal on E2 from the east via F2 at 0900GMT.

26/10/88: ORF (Austria) E2a 'ORF FS1' PM5544; CST (Czechoslovakia) on channels R1 and R2 with the 'RS-KH' EZO test card (a 'CST ODK3' FuBK was floating with the R2 EZO at times). Reception via SpE.

27/10/88: TSS (Russia) R1 UEIT test card via SpE; DR (Denmark) on E3 with the 'DR DANMARK' PM5534 via meteor shower propagation (MS); channel R1 programme via F2.

29/10/88: Unidentified E2 programme from the east/north-east at 0810 via weak F2 activity. Stronger signals present from 0850-1910 on E2 with very smeary video – captions seemed to be in Roman alphabet.

30/10/88: Very weak smeary video on E2 from the east shortly after 0800.

31/10/88: CST R2 EZO test card via MS; unidentified channel R3 programme via MS; very strong F2 signals on channel R1 until 1255; unidentified channel E2 black bar test pattern (no VITS) at 1235 – a programme on E2 with VITS was later resolved. All signals from the east.

Reception reports

Simon Hamer of New Radnor in Powys, noted Norway and Sweden in Band III via tropospheric DX on 16 October. He also saw the 'TV2 SVERIGE' PM5534 at UHF. Many West German stations were resolved. Even AFN-TV Soesterberg put in an appearance at the top end of the UHF band on channel A80. Simon's log for the 16th is as follows: NRK (Norway) on channels E5, E6, E7, E8 and E9; SVT-1 (Sweden) E8 and E9 with 'KANAL 1 SVERIGE' PM5534; SVT-2 E30 with 'TV2 SVERIGE' PM5534; DR (Denmark) E5, E6, E7, E8 and E10 with 'DR DANMARK' PM5534; DDR:F1 (East Germany) E5, E6, E11 and E12 with 'Aktuelle Kamera'; West Germany: NDR-1 E10; WDR-1 E9 and E32; HR-1 E5, E7 and E8; BR-1 E6; SWF-1 E8; ZDF E21, E27, E30, E34, E35 and E37 on 'heute' news programme; HR-3 E37 FuBK; WEST-3 (WDR-3) E30, E39 and E48 FuBK; NDR-3 E57 with 'NDR-3 HMBG' FuBK; NED-1 E4, E5, E6, E7, E29 and E39 on 'NOS JORNAAL'; NED-2 E27, E32, E47, E53 and E54 with PM5544; NED-3 E30, E34, E35 and E42; BRT-1 E10, E43 and E49 (vertically polarised); BRT-2 E46, E55 (vertically polarised) and E62; RTBF-1 (Belgium) E3, E8 and E11; RTBF-2 (TELE 21) E42 and E63; AFN-TV A80 (Soesterberg-Netherlands); RTL PLUS (Luxembourg) E7; TDF Canal Plus L5, L6, L7, L8 and L9; TDF tf1/A2/FR-3) L22, L25, L26, L34, L35, L37, L40, L52 and L63; RTE-1 (Eire) on channels B, D, F, H, 29, 40 and 52 (vertically polarised); RTE-2 G, I, J, 33, 43 and 56 (vertically polarised) – all via tropospheric reception.

Towards the end of the month, Sporadic E brought in Canal Plus on channel L3 on the 22nd, while on the 31st strong unidentified signals were present on channels E2 and R1 via F2!

David Glenday managed to pull in some spectacular DX using a single UHF grid! From the Arbroath location he identified Switzerland E34 on the 15th at a distance of some 800 miles. Even the new Danish TV-2 PM5534 was spotted just before midnight with its new logo on channel E30 from Vejle/Hedensted! The biggest surprise was the appearance of the 'RTL-PLUS KöLN' test pattern on channel E36. Could this be the new outlet at Lübeck/Berkenthin?

Veteran Tx DXer Bob Brooks (South Wirral) has reported Sporadic E DX from Spain on 7, 14 and 18 October. Some of the signals were in colour. Other Band I catches included West Germany E2 on the 22nd which he was able to identify from the programme, plus strong F2 signals on the 31st. These were present on channel E2 from 1055 until 1250 but despite captions appearing occasionally, it was impossible to decipher them because of the characteristic smeary video effect.

On the 16th, the French M6 (Metropole Television) network was logged at high levels from Rheims on channel L56 by Kevin Jackson in Leeds. The best reception on the 17th was from the Bayerischer Rundfunk BR-3 outlet at Hof, which is close to the border with Czechoslovakia. Kevin thinks that there were signs of the Czechoslovakian CST-2 network from Susice on channel R35 at the time. Unfortunately, definite identification was impossible because the channel was well occupied by a Dutch and a West German station.

Walter Gouder (Malta) has advised us that the Greek first network shows only the abbreviation 'EPT' at the top of the PM5534 test card but on channels E22, E43, E50 and E57 additional identification, 'ET 2', appears at the bottom, presumably indicating the second network. Early last summer, the Indian Head monoscope test card was in use on E42 and E50! Another old and familiar monochrome test card, the Philips PM5540, was seen on 29 and 30 June from the east on E8. Its origin still remains a mystery.

According to Duncan Fraser in New Zealand, 1988 produced the best winter Sporadic E openings for some years. Australia was received during ten days in July although signals were mainly weak and intermittent. On the 24th, the audio of KVZK-Samoa was received briefly on channel A2. This consisted of the tone accompanying the test card. Unfortunately, the video was lost under the New Zealand channel 2. The most interesting DX occurred on 21 July when another 525-line picture was received briefly on channel A2, but from the direction of Australia, almost at right angles to Samoa. Signals lasted for about three minutes before abruptly disappearing, although sync pulses were present for a further ten minutes but they were very weak. Duncan is convinced that it was ABS/CBN2 in the Philippines via TEP and Sporadic E – a distance of 5,200 miles.

Openings on the 6m amateur band between Japan and South America are becoming more frequent at distances in excess of 7,500km. Duncan writes: 'For several months now we've been hearing of all this long-distance 6 metre working, but New Zealand has been in isolation until late October. Since then there have been numerous reports of ZL/JA, also ZL/Hawaii and a number of ZL/Califor-

nia. At the beginning of November, New Zealand TV channel 1 audio at 50.75MHz (nominal) was received in California for thirty minutes at S9+ 30dBs! It is interesting to note that reports from California of the New Zealand TV sound channel have several times mentioned that only one, or sometimes two, of the three channel 1 frequencies (nominal, plus and minus 10kHz I think) were being received, ie reception was very selective at the New Zealand end'.

Best meteor showers

The meteor showers which produce good viewing for the TV DXer are the Quadrantids, Perseids and Geminids. During these showers, signals can be popping up every few seconds throughout Band I in periods of peak activity. Signals often appear in Band III on channels as high as E10 and E11. Pointing the aerials towards Scandinavia seems to produce more signals than any other direction. The results obtained in Bands I and III can vary tremendously from year to year because the showers may be more intense in different parts of the northern hemisphere.

Rosy future for UK TV?

The Government's new White Paper on the future of television broadcasting in the United Kingdom suggests that within a few years the present licence fee system will be abolished to make way for subscription TV. The expression 'pay as you view TV' sounds nice to the gullible viewing public but could subscription TV actually work like that? In France there is a monthly subscription payable to watch Canal Plus broadcasts (for those who want it) but that is not exactly a pay as you view system. The viewer pays in advance so it is more of a 'take it or leave it' system. And should the viewer wish to watch the programmes on the portable TV in the bedroom, would this mean having to pay an extra subscription?

Waste of energy

As many DXers will know, encrypted broadcasts already exist in the UK over the terrestrial network. Test transmissions by the BBC took place towards the end of 1987. At the moment the encrypted programmes are aimed at the medical profession to enable them to record the special programmes via a decoder during the night. Doesn't it seem rather odd that these have to be encrypted in the first place? Wouldn't it have been much easier to hire out a series of pre-recorded video tapes? It would have been less costly, although the news wouldn't be as hot. Just think of how much power the transmitters are wasting throughout the night. It's a far cry from the days of the early seventies when aerial riggers and technicians in the TV servicing trade were deprived of a test card when every BBC2 transmitter was switched off immediately after the morning showing of 'Play School' because of the energy crisis. The excuse at the time was that the expense of keeping the transmitters burning for the benefit of the TV trade wasn't justified!

Fifth channel

As for a fifth terrestrial channel in the UK (Channel 5 – such an imaginitive title), it will only provide limited coverage for around 70% of the population and we have it on good authority that transmitters could not be sited near the south-east coast because of interference to neighbouring countries. So what? The Government introduced a strange arrangement in Band III in the form of data/PMR transmissions which do not exactly fit in with anywhere else in Europe (or the world come to think of it). But why should that stop them introducing a non-conformist UHF network? There's also speculation that the fifth channel could be the UK's most popular one – strange when one considers its limited coverage!

Why not use satellite TV?

No doubt many people are suspicious as to why the Government has to tinker with the existing terrestrial broadcasting arrangement in the first place. After all, the BBC and IBA contract companies have a proven successful track record. Any new TV services, including the proposed fifth channel, would be technically 'more at home' if broadcast by satellite. Then the viewer could decide whether to invest in the necessary equipment and fund the additional services by subscription.

Service information

Belgium: Since early October, a new local television station has been operating in Brussels. It is called 'TeleBruxelles' and uses channel E36 with horizontal polarisation. The transmitter is located at 166 Avenue Louise, B-1050. The aerial is ten metres above the roof of the eight-storey building and the main beam is directed north, north-west. The signal is not obtainable in some parts of the city. At the moment a daily thirty-minute local news and magazine programme is repeated continuously from 1800 to midnight local time Monday to Friday, with an omnibus edition on Saturday and Sunday from midday. At other times an identification caption 'TeleBruxelles' is shown.

Austria: ORF has opened a regional TV programme for Vienna on channel E34 with 50kW ERP. The FuBK test pattern carries the identification 'WIEN KANAL 34' or 'WIENSTADT FS'.

Yugoslavia: A third network is now operating near Zagreb on channel E25. The transmitter is located at Sljeme and has an ERP of 10kW. Horizontal polarisation is used. Programmes are broadcast between 1630-2100GMT, Monday to Friday. The FuBK test pattern with 'JRT ZGRB3' identification is aired from 1545-1625 with an occasional morning showing.

Denmark: The following TV2 transmitters are now in operation:

E22 Tommerup 500kW
E27 Aabenraa 600kW
E30 Hedensted 500kW
E32 Svendborg 250kW
E40 Videbaek 600kW
E53 Copenhagen V 600kW

The new Viborg outlet on channel E56 is now testing. The planned opening date for Thisted (E28) and Viborg (E56) was 1 January 1989.

The regional programme 'TV SYD' is now aired via Aabenraa on channel E27.

TV-2 now has a new symbol/logo. It is also incorporated within the PM5534 test pattern at the top. Between the digits of the hours/minutes and minutes/seconds there are colons. The lower identifica-

MAIN 1989 METEOR SHOWER DATES

SHOWER	OVERALL PERIOD	EXPECTED PEAK	NOTES
Quadrantids	1-6 January	3 January at 1500hrs	1
Lyrids	19-25 April	22 April	
May Aquarids	24 April-20 May	5 May	
Delta Aquarids	15 July-20 August	28-30 July	
Perseids	23 July-20 August	12 August at 1400hrs	2
Orionids	16-27 October	20-23 October	3
Taurids	20 October-30 November	1-8 November	4
Leonids	15-20 November	17 November	
Geminids	7-16 December	13 December at 2100hrs	5
Ursids	17-25 December	22 December	

Notes:-
1: Short-lived shower. The peak is expected at 1500GMT (+ or – three hours)
2: Peak expected at 1400GMT (+ or – twelve hours)
3: Rather flat peak of activity over approximately three days
4: Weak, very flat peak
5: Expected peak 2100GMT (+ or – six hours)

Courtesy of Roger Bunney

tion band is white and now incorporates the Danish Royal Post crest to the left of the transmitter name. The crest and name are in black. The common identification on the new test pattern is 'TV-2' (top) and 'DANMARK' (bottom). The 'TV-2' identification at the top features the new stylised logo.

France: FR-3 (France Regions 3) is transmitting encrypted programmes which are intended for the medical profession. The special programme is known as 'STV' and is transmitted between 0800 and 0900 local time on weekdays. The 'Discret 1' scrambling system is used (the same as Canal Plus). Incidentally, a new generation of Canal Plus decoders is planned for mid '89.

On 28 October, the high-power TDF-1 DBS satellite was successfully launched. Following the failure of the German TV-SAT earlier in the year, it would seem that the new French satellite will be the first high-power broadcasting satellite in Europe. The signals are strong enough to be received using small dishes over at least the southern half of the UK. The transmission format is expected to be one of the MAC/packet family, the European standard for satellite broadcasting.

This month's service information was kindly supplied by Gösta van der Linden (Rotterdam, Netherlands), the Benelux DX Club (Netherlands), Bertrand Prince (France), Dalibor Frkovic (Yugoslavia) and, last but not least, the Independent Broadcasting Authority (Winchester, United Kingdom).

MEDIUM WAVE DXING

by Steve Whitt

The festive season is behind us now and with the New Year upon us hopefully there is more time available for listening on the medium wave band. Despite the holiday period, developments in the radio world have not slackened off.

Offshore update

Throughout the chequered history of offshore radio, most events have been shrouded in mystery and rumour has often displaced fact. In order to bring you up to date with events surrounding Radio Caroline during the past year I have used a report prepared by the station itself. It is just over a year to the day since the 300ft aerial mast collapsed on the merchant vessel **Ross Revenge.**

The 300ft radio tower mounted midship on the Caroline vessel was one of the tallest structures of its kind ever used at sea. Nevertheless it had stood for six years and was well-known by seafarers as one of the most spectacular sights off the English coast. The mast allowed reliable high-power transmission on both 558kHz, home of the 24 hours-a-day English language service, and 819kHz where Dutch language and religious programming provided diversity of output and an additional source of income.

The storm which hit the **Ross Revenge** a year ago was particularly savage (ironically the ship had survived the October hurricane) and at 3am on 25 November it became clear that nature had proved the engineering feats of man to be merely transient. The tower collapsed. Fortunately no one was injured as it fell, though the ship became very unstable for a period until it was re-ballasted. In addition, the falling structure destroyed a vital and expensive diplexer that allowed two transmitters to simultaneously feed into one aerial. Many said that this must be the end of Caroline but, as before when tragedy struck, the station did not give up easily. Within eight days, Radio Caroline was transmitting with low power on 558kHz using a makeshift aerial. At this time the signal could just reach the Suffolk, Essex and Kent coasts. Manned by a skeleton crew of just four people, the **Ross Revenge** survived to the new year.

During January, often in rough weather and freezing temperatures, the crew managed to build two 90ft masts and complete a new temporary aerial system. This allowed power to be raised, thereby extending coverage to London and the Netherlands. However, the transmitters were not suited to low-power operation and this led to numerous technical breakdowns during spring and early summer '88. Additionally, it was still impossible to operate a second service on 819kHz, since tests with a new design of carbon fibre aerial failed in April due to flexing in the wind.

By July Radio Caroline decided to reactivate the Dutch service on a shared-time basis using the single channel of 558kHz during the daytime. This operation lasted several months, but it was necessary to raise funds for the purchase of important equipment. A new diplexer was bought and installed which allowed the 819kHz service to restart in late October. The Dutch service moved to this channel and the Viewpoint religious programmes also restarted there, thus allowing a full-time English service on 558kHz.

Even with the latest developments it will be some time before Radio Caroline has fully recovered from last year's trauma. The current power levels are still quite low and are limited by the aerial structure. The power on 558kHz is around 1kW which is down from 4kW during summer '88, and 8kW prior to the collapse of the 300ft mast. The power on 558kHz has been reduced to allow operation simultaneously on 819 (with about 4kW) since the antenna can only handle a limited total power.

Next Easter Radio Caroline will celebrate its twenty-fifth year on the air and perhaps by then the aerial repairs will be complete.

Local radio

Many DXers enthusiastically chase rare transatlantic DX while often overlooking the DX in their own backyard. Although many local radio stations can be very difficult or even impossible to hear, they are often regarded as not being real DX on account of their close proximity. However, they can present quite a challenge to the listener and certainly make a good target for the seasoned DXer and the newcomer to the band. Under this heading I would include all of the UK and Eire, where there are around 200 local stations on the air, as well as much of western Europe which roughly includes another thousand.

To hear rare local stations, the DXer need not rely on special ionospheric propagation conditions so much as skilled timing. Sometimes it is only possible to hear a rare local station when a stronger co-channel station has closed down (either for the night or perhaps for transmitter maintenance). In other cases

it may only be possible to uniquely identify a station when it opts out from its usual network programming to carry local material. In addition, if you tune the band during special events such as public holidays and government elections, etc, you may find that the stations have extended or modified their usual broadcasting schedules, thus possibly giving you reception of a rare signal.

Although I have made the distinction between local radio and transatlantic reception, it should be remembered that, unlike short wave, the MW band is primarily a local broadcasting medium no matter where in the world the signal comes from.

Newsdesk

Ireland: As many readers will appreciate, the radio scene in the Republic has been in a very volatile state for some years now, due to the absence of suitable broadcasting legislation or regulatory authority. Consequently, it has been difficult for listeners to find their way around the radio dial without a guide to Ireland's 150 or so independent stations. However, this is all due to change by the time you read this column. New legislation will have driven the majority of stations off the air to await their new licence issued by the newly formed Radio Commission. Stations that have overstayed their welcome beyond 31 December 1988 could face large fines and forced closure. The Radio Commission has been delayed in organising the local radio system which will replace the unlicensed stations and there will be a period of silence possibly extending to three months or more. So far only one station has declared that it will defy the law and not close down; look out for Radio Dublin on 1188kHz operating from 58 Inchcore Road, Dublin.

Spain: In the rugged north-eastern area of Spain there is an area centred on San Sebastian that is populated by the fiercely independent Basques. The Basque language is a peculiar anomaly in this part of Europe having little connection with either French or Spanish; indeed it has more in common with Celtic languages like Breton. It is possible to hear this unique language via a new local station that has been putting a good signal out around Europe. Look for Euzkadi Irratia on 1296kHz with 10kW. Its address is: Andia 13, E-20004 San Sebastian.

United Kingdom: From the end of December 1988 BBC Hereford & Worcester will be starting test transmissions on 819kHz from Hereford and 738kHz from Worcester. Official programmes will begin from 31 January '89 from 0600-1900hrs with regional material until midnight. Transmitter power may be less than the planned 150W, since it is likely that the MW service will only serve the main towns and not the entire county. In fact, it is quite possible that the MW service will only be a temporary feature of this station. BBC Hereford & Worcester has two offices at Hilton Road, Worcester WR2 5WW and 43 Broad Street, Hereford HR4 9HH. There are full studio facilities in both towns and split programmes at times during the day are quite likely. Footnote: BBC Wiltshire is now unlikely to have any MW service.

USA: The Federal Communication Commission (FCC), which licenses stations in the USA, reports that at the end of last July a total of 4914 AM (MW) stations were licensed to operate. Table 1 shows the most popular radio formats with listeners as measured by audience ratings.

USA audience ratings

Adult contemporary	21.7%
Contemporary hit radio	18.8%
Country	12.9%
Album orientated rock	11.8%
Beautiful music/easy listening	10.0%
Urban contemporary	8.2%
News/talk	5.7%
Gold/oldies	4.7%
Big band	1.7%
Spanish	1.4%
Religious	0.8%
Classical	0.7%

Table 1

The figures reflect US radio as a whole and music formats will be biased towards FM whilst talk will predominate on AM. It is however illuminating to observe the low placing of religious broadcasts which bears little relationship to the large number of religious programmes broadcast; obviously regardless of audience size they can still bring in the money.

Mystery solved!

On several occasions in the past I have noticed that a number of American stations were apparently operating on just one sideband + carrier rather than the normal two sidebands + carrier of conventional AM. This was most evident on WSSH 1510 but I did not follow up this mystery other than to comment on it in a reception report to WSSH. However, I recently came across the following explanation for this phenomenon.

'Power-Side is a new processing system invented and produced by Leonard Kahn of AM stereo fame. Simply this system is a hybrid of conventional AM and SSB, putting most of the modulation into one sideband and reducing the amount in the other proportionally. The idea is to improve reception of the station using Power-Side by increasing their range, like SSB, improving their coverage in adjacent channel situations, and as a halfway point between AM and the eventual adoption of superior SSB radios for the AM broadcast band of the future'. A number of well-known stations are using Power-Side, but there are others who wish to keep their secret advantage from their competitors.

Harmonics

Some purists argue that listening to the harmonic signals of MW stations isn't really MW DXing at all, but nevertheless it can still give an interesting insight into MW listening.

Normally equipment manufacturers and station engineers do their best to filter or suppress these harmonics but sometimes poor maintenance or lack of spares causes the signal to reach the aerial. This is when things become interesting to the MW DXer. Harmonics are generally quite low power but they can often be heard over great distances for two reasons. Firstly, they appear on frequencies uncongested by other broadcast stations (1600-3200kHz) and secondly, these higher frequencies can be subject to propagation conditions which are quite unlike those affecting the normal MW channels. In this way it is sometimes possible to hear a MW station that would otherwise be totally inaudible.

When looking for such signals remember that they come and go on an irregular basis, eg, after the transmitter has been serviced. The harmonics shown in table 2 have been reported recently.

Harmonic signals

1890	Donegal Community Radio 2×945	much better than fundamental
1962	Hometown R Castleblaney 2×981	better than fundamental
2349	DDR Burg 3×783	
2520	UNID Spain 2×1260	
6012	RCE Benaente 4×1503	

Table 2

On that note it is time to go for another month. See you next time. REW

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■ Exchange Tamiya ½ scale Midnight Pumkin car with radio control system, as new, for 27 multimode CB or a scanner. Mr C Powis, 28 Kington Gardens, Chelsmley Wood, Birmingham B37 5HS. Tel: 021-788 8447

■ Sony ICF-2001D, boxed, excellent condition, £250.00. AN1 active antenna, £30.00. Era 80 RTTY, CW reader, £50.00. Realistic PRO32A hand-held VHF/UHF scanner, boxed, including Ni-Cads, hardly used, £150.00. Selling to buy computer hardware. Paul. Tel: (0604) 413131 after 6pm weekdays (Northampton)

■ Altron CM35 slimline 3-section telescopic mast and accessories. Tiltable ground or wall mounted, extends 35ft. Cost new £344.00, will accept £250.00 including delivery UK mainland. Tel: (0256) 56524

■ Marconi service manuals: copies CR-100, CR-300, TF899, TF2103, TF144 series, TF1041C, TF2201, Atlanta 2207C, B-28, B-43. All at £6.00 each including post and packing. Mr Small, 10 Sibleys Rise, South Heath, Great Missenden, Bucks

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■ Racal RA121 single sideband adapter. Tel: (0730) 62049

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■ KW107 ATU. Tel: (0908) 313507 (Milton Keynes)

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VP21	10	Assorted Switched, slider, push, rocker etc	£1.50
VP22	4	Sheets Copper Clad Board, approx 14 x 12cm	£1
VP23	10	40mm track Slider Pots, 100K Lin	£1
VP36	100	Sq in total Copper Clad Fibreglass Board	£1.50
VP42	10	Black Heatsinks, fit TO3 and TO220, drilled	£1
VP43	4	Power-fin Heatsinks, 2 x TO3, 2 x TO66	£1
VP44	15	Assorted Heatsinks, TO1/3/5/18/220	£1
VP54	20	Assorted IC DIL Sockets, 8-40 pin	£2.50
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VP83	1	Electronic Buzzer 6V 25mA	£0.95
VP84	1	Electronic Buzzer 9V 25mA	£0.95
VP85	1	Electronic Buzzer 12V 25mA	£0.95
VP87	1	Telephone Pick-up Coil with 3.5mm jack plug	£1.25
VP88	1	Pillow Speaker with 3.5mm jack plug	£1.45
VP107	1	Piezo Buzzer miniature, 12V	£1.25
VP108	1	Piezo Buzzer miniature, 240V	£1.25
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VP115	1	High Pass Filter/Suppressor, CB/TV	£0.50
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VP236	1	BETA Video Head KCleaner Cassette, wet type	£2.50
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VP238	4	AA Ni-Cad Batteries, 1.25V 500mAh C/R MA	£4
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VP34	200	Silicon Diodes like OA200/BAX13-16, 40v	£1
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VP240A	1	Triac 10A 600v, isolated case TO220	£1.25
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Some of the many items described in our current list which you will receive if you request it

3½in FDD CHINON 80 track 500k. Shugart compatible interface. Standard connections, interchangeable with most other 3½in and 5¼in drives. Brand new. £28.50 plus £3 insured post.

CASE NOW AVAILABLE FOR THE CHINON F353 This is the 80 track, single sided one which we have been selling at £28.50. The case is sheet metal, finished in hammer-beige with ample ventilation and rubber feet. Overall size 4¼in x 7in x 1½in approx. Designed to take the ribbon cable and 3 core power lead. Price £8. Our ref 8P21.

3in FDD HITACHI HFD305SXA Shugart compatible interface. 500k on 3in disc. Recommended for many Amstrads but interchangeable with most drives. £29.50 plus £3 insured post.

FDD CASE AND POWER SUPPLY KIT for the 3in or 3½in. £11.00. Ref 11P2 for the Chinon, 11P3 for the Hitachi.

9in MONITOR made for ICL, uses Phillips black and white tube. Brand new and complete but uncased. £16.00 plus £5.00 post.

ACORN COMPUTER DATA RECORDER REF ALF03 Made for the Electron or BBC computers but suitable for most others. Complete with mains adaptor, leads and handbook. £10.00. Ref 10P44.

POWERFUL IONISER Uses mains transformer. Generates approx. 10 times more ions than the normal diode/cap ladder circuits. Complete kit £11.50 plus £3.00 post.

FREE POWER! Can be yours if you use our solar cells—sturdily made modules with new system bubble magnifiers to concentrate the light and so eliminate the need for actual sunshine—they work just as well in bright light. Voltage input is .45—you join in series to get desired voltage—and in parallel for more amps. **Module A** gives 100mA. Price £1, Our ref. BD631. **Module C** gives 400mA. Price £2, Our ref. 2P199. **Module D** gives 700mA. Price £3, Our ref. 3P42.

SOLAR POWERED NI-CAD CHARGER 4 Ni-Cad batteries AA (HP7) charged in eight hours or two in only 4 hours. It is a complete, boxed ready to use unit. Price £6. Our ref. 6P3.

50V 20A TRANSFORMER 'C' Core construction so quite easy to adapt for other outputs—tapped mains input. Only £25 but very heavy so please add £5 if not collecting. Order Ref. 25P4.

SWITCH AC LOADS WITH YOUR COMPUTER This is easy and reliable if you use our solid state relay. This has no moving parts, has high input resistance and acts as a noise barrier and provides 4kW isolation between logic terminals. The turn-on voltage is not critical, anything between 3 and 30V, internal resistance is about 1K ohm. AC loads up to 10A can be switched. Price is £2 each. Ref. 2P183.

METAL PROJECT BOX Ideal size for battery charger, power supply, etc.; sprayed grey, size 8in x 4¼in x 4in high, ends are louvred for ventilation other sides are flat and undrilled. Price £2. Order ref. 2P191

BIG SMOOTHING CAPACITOR. Sprague powerlytic 39,000uF at 50V. £3. Our ref. 3P41.

4-CORE FLEX CABLE. Cores separately insulated and grey PVC covered overall. Each copper core size 7/0.2mm. Ideal for long telephone runs or similar applications even at mains voltage. 20 metres £2. Our ref.2P196 or 100 metres coil £8 Order ref. 8P19.

6-CORE FLEX CABLE. Description same as the 4-core above. Price 15 metres for £2. Our ref. 2P197 or 100 metres £9. Our ref. 9P1

TWIN GANG TUNING CAPACITOR. Each section is .0005uF with trimmers and good length ¼in spindle. Old but unuse3d and in very good condition. £1 each. Our ref. BD630.

13A PLUGS Pins sleeved for extra safety, parcel of 5 for £2. Order ref. 2P185.

13A ADAPTERS Takes 2 13A plugs, packet of 3 for £2. Order ref. 2P187.
20V-0-20V Mains transformers 2½ amp (100 watt) loading, tapped primary. 200-245 upright mountings £4. Order ref. 4P24.

BURGLAR ALARM BELL—6" gong OK for outside use if protected from rain. 12V battery operated. Price £8. Ref. 8P2.

24 HOUR TIME SWITCH—16A changeover contacts, up to 6 on/offs per day. Nicely cased, intebnded for wall mounting. Price £8. Ref. 8P6.

CAPACITOR BARGAIN axial ended, 4700µF at 25V. Jap made, normally 50p each, you get 4 for £1. Our ref. 613.

PIEZO ELECTRIC FAN—An unusual fan, more like the one used by Madame Butterfly than the conventional type, it does not rotate. The air movement is caused by two vibrating arms. It is American made, mains operated, very economical and causes no interference, so is ideal for computer and instrument cooling. Price is only £1 each. Ref. BD598

SPRING LOADED TEST PRODS—Heavy duty, made by the famous Bulgin company, very good quality. Price 4 for £1. Ref. BD597.

ASTEC P.S.U.—Switch mode type. Input set for +230V. Output 3.5 amps at +5V, 1.5 amps at +12V, and 3 amps at +5V. Should be OK for floppy disc drives. Regular price £30. Our price only £10. Ref. 10T34. Brand new and unused.

APPLIANCE THERMOSTATS—Spindle adjust type suitable for convector heaters or similar. Price 2 for £1. Ref. BD582.

3-CORE FLEX BARGAIN No. 1—Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm for £2. ref. 2P189.

3-CORE FLEX BARGAIN No. 2—Core size 1.25mm so suitable for long extension leads carrying up to 13 amps, or short leads up to 25A. 10m for £2. Ref. 2P190.

ALPHA-NUMERIC KEYBOARD—This keyboard has 73 keys giving trouble free life and no contact bounce. The keys are arranged in two groups, the main area is a QWERTY array and on the right is a 15 key number pad. board size is approx. 13" x 4"—brand new but offered at only a fraction of its cost, namely £3. plus £1 post. Ref. 3P27.

WIRE BARGAIN—500 metres 0.7mm solid copper tinned and p.v.c. covered. Only £3 plus £1 post. Ref. 3P31—that's well under 1p per metre, and this wire is ideal for push on connections

INTERRUPTED BEAM KIT—This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components—relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. Price £2. Ref. 2P15.

1/8th HORSEPOWER 12 VOLT MOTOR Made by Smiths, the body length of this is approximately 3in, the diameter 3in and the spindle 5/16th of an inch diameter. It has a centre flange for fixing or can be fixed from the end by means of 2 nuts. A very powerful little motor which revs at 3,000rpm. We have a large quantity of them so if you have any projects in mind then you could rely on supplies for at least two years. Price £6. Our ref 6p1, discount for quantities of 10 or more.