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Have you ever wanted a circuit which had lots of gain, rejects noise, and had a choice of single or balanced outputs? Perhaps even one which worked into the low megahertz region? Well, look no further. It's called the long-tailed pair, it's easy to design and make, and is one of the fundamental building blocks of electronics.

The first question about the circuit is why is it called the long-tailed pair? There is a simple answer to that — just look at Figure 1. It can be seen that the circuit consists of two transistors (the pair) with a high-valued resistor connected in common with the emitters of the transistors; this resistor gives the circuit its long tail.

The long-tailed pair is a differential amplifier. Indeed, it is probably the most commonly used configuration for this type of amplifier. Differential amplifiers are very important in electronics because they allow us to take in two signals at the same time and then to amplify the difference between the two signals.

The main reason why differential amplifiers are important is that they can reject noise. Take, for example, the case of two electrodes placed on the chest of a patient in hospital to pick up the faint electrical signals which come from the heart. These signals are in the microvolt region and the wires which carry the signal, although shielded, have to pass several items of mains powered equipment. The wires will pick up noise in the form of electrical signals from this and other electrically powered equipment in the room — eg the fluorescent lighting. The saving feature of this unwanted noise is that both wires will pick up the identical amount of noise (at least, in an ideal case) but will pick up the positive and negative signals from the patient.

So while we want the very small (differential) signals from the patient to be amplified we do not want the huge noise signals (in common to both inputs) to be registered at all. Enter the differential amplifier. The noise which appears as identical signals on both inputs to the amplifier will be rejected while the gain of the amplifier will be used to magnify the wanted signal. Of course, medical electronics is only one field where these devices are useful.

Another common use of the long-tailed pair is in audio equipment where a long line may be used to take the signal from a microphone on stage, say, to a power amplifier some metres away. They are also at the heart of every operational amplifier — even the humble 741. Differential amplifiers also have a very common use in digital circuits. Just as noise corrupts faint analogue signals it can also play havoc with the digital levels used by computers. So, again, the differential amplifier is used to reject the unwanted signal to pass, suitably amplified, to the computer. This function is so important that there are many chips devoted to the task of transmitting and receiving differential signals. For example, the 75110 and 75107 driver/receiver combination or the 75115 chip which can be driven by open-collector drivers.

Of course, the unwanted signal which the long-tailed pair is so good at rejecting need not be noise, it might be a steady state signal such as a dc level. For example, the configuration will allow any thermal drift in the two transistors to be nulled out. There will, of course, be some drift because the two transistors will not have exactly the same. If a dual transistor is used the drift will be very well matched; dual transistors are fabricated close to each other on the same minute piece of silicon and this allows their parameters to be matched. They both experience the same temperature too.

Looking at Figure 1, it can be seen that there are two output points from the long-tailed pair. Both do not have to be used. If a single output is needed then only one will be used while if a balanced output is required (perhaps for driving a balanced or differential line) then both can be used because the output from one is opposite in phase to the other.

Later, more applications of the long-tailed pair are considered — its use in radio frequency amplifiers is of particular interest.

Some jargon and calculations

Figure 1 shows the circuit to be

[Diagram of Fig 1: Symmetric circuit of the long-tailed pair]

Figure 2: Example of calculations
THE LONG-TAILED PAIR

set to be 600mV higher than the emitter voltage using a simple potential divider.

Variations on a theme

Now that we have seen how the basic circuit fits together, there are a number of interesting variations which broaden the range of applications where the long-tailed pair may be used.

Figure 3 shows the first variant. Here, a constant current arrangement is put into the tail instead of the resistor. Since constant current sources have a very high impedance, the common mode gain becomes very small which means that the circuit is good at rejecting noise. The differential gain, which depends on \( r_e \) and hence the collector current, can be altered by changing the current passing through the tail. This makes a neat gain-controlled amplifier and Figure 3 shows how the gain varies with the current.

While on the subject of current controlled configurations, a current mirror can be used as the load 'resistor' for the transistors. While a full explanation of current mirrors is outside the scope of this article, it is sufficient to say that the current drawn by \( T_1 \) is mirrored into \( T_2 \), because the current mirror tries to maintain the same current on both its outputs. The result of this configuration is that the differential gain of the circuit is very high – several thousand – and so the circuit makes an ideal comparator. In a comparator, the output voltage is either high or low; it operates like a

---

THE LONG-TAILED PAIR

completely symmetric. As mentioned before, the name comes from the fact that the resistor, \( R_e \), which is connected to the emitters of both transistors is much larger than the two resistors, \( R_1 \) and \( R_2 \), which are connected to the collectors and so \( R_e \) has a large voltage across it – the long tail.

When the two inputs have identical voltages applied to them these are known as common-mode inputs; inputs to the two transistors which are different are known as normal or differential. One of the great strengths of the long-tailed pair is its ability to reject common-mode inputs. The measure of this ability is the common mode rejection ratio or CMRR.

This is calculated as follows. Suppose that the same signal, \( V_{in} \), is applied to both inputs. Because of imperfections, a small output voltage, \( V_o \), will be generated. If another signal, \( V_{in} \), was applied to one input only and it resulted in an output voltage, \( V_2 \), being generated, then the CMRR is the ratio of \( V_{in} \) to \( V_o \) when \( V_1 \) equals \( V_2 \).

The differential gain is \( R_e/(r_e+R_C) \). Now \( R_e \) and \( R_C \) are both shown in Figure 1 but \( r_e \) is a resistance which is internal to the transistor and has a value which is roughly 25/\( I_C \) in ohms where \( I_C \) is the collector current measured in milliamps.

The gain for common-mode signals is \( -R_e/(2R_e+R_C+r_e) \). Remember that the common-mode gain should be small!

Let us design a simple long-tailed pair. Figure 2 shows the results. The collectors of both transistors are set at voltages which will allow a good variation without clipping caused by the collector trying to exceed the supply voltage; the voltage across \( R_e \) is quite large because this resistor needs to act like a constant current sink – ie, it will have roughly the same current passing through it regardless of the voltage variations at the emitters of the transistors. The constant current action of this resistor is central to the way the long-tailed pair works; a drop in current through one transistor is balanced by an increase in the current through the other. So when the voltage level on one output rises, the other output drops.

Therefore, \( R_e \) has quite a large value. If we choose the current through each transistor to be 1mA then \( R_e \) has 2mA passing through it. For a 12 volt supply, we'll make \( R_e \) have about 6 volts across it and choose the collector voltages to be at the halfway point between this voltage and the supply – ie about 9 volts. This means that \( R_e \) is 3.3kohms and \( R_C \) is 2.7kohms. With \( R_e \) set at 56 ohms, the differential gain will be 20, the common mode gain 0.6 and the CMRR will be 33: not a very ambitious amplifier!

The base voltage of the transistors is always set to be 600mV higher than the emitter voltage using a simple potential divider.

Variations on a theme

Now that we have seen how the basic circuit fits together, there are a number of interesting variations which broaden the range of applications where the long-tailed pair may be used.

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**Fig 3:** Diagram showing a constant current tail

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**Fig 4:** Current mirror load

**Fig 5:** Showing a phase splitter circuit
digital circuit. Which state the output is in depends on the difference between two input voltages. So, by having a very high gain amplifier using these voltages as its inputs, the output of the amplifier will saturate to either the high or low level with a very small relative change in the input signals (see Figure 4).

Figure 5 shows the long-tailed pair in its single-ended mode. By using a capacitor to bypass all ac signals at the base of one of the transistors to ground, only one input is used. However, both outputs can be used. Since the outputs are opposite in phase, the circuit may be used as a phase splitter; balanced loads may be driven from a single input.

The final variant described is shown in Figure 6. The long-tailed pair has a rather special property which makes it suitable for use as a radio-frequency amplifier. This property is the circuit's ability to beat the Miller effect.

The Miller effect is explained as follows. Between the collector and the base of any transistor there is a small capacitance called $C_{cb}$. Assuming that we are taking the output of the transistor from its collector, a small input voltage at the transistor base will create an output voltage at the collector which is bigger by the gain of the transistor. This larger signal is directed back to the base through $C_{cb}$ and makes the capacitor appear to be of higher value than it actually is – so a large value capacitor appears to be connected to the base. The (high frequency) signals applied to the base use the capacitor as a path to ground and so are partly lost.

By using the long-tailed pair with no collector resistor on the first transistor there is no multiplying factor and the Miller effect disappears. Hence the circuit is suited to RF applications. The circuit shown in Figure 6 has useful gain up to a few megahertz despite using common transistors.

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As anticipated, August showed a steady fall in Sporadic-E activity, especially during the second half of the month. Most of the signals originated within the European area, except for one instance when Morocco showed during the early evening on test card and later programmes. Other forms of propagation provided some worthwhile DX reception during the month. For example, at least three countries were identified in Band III via meteor scatter (MS) DX during the Perseids which peaked on the 12th.

Tropospheric reception was impressive too, especially during the first half of August with 525-line pictures from AFN-TV Soesterberg on the 5th and Switzerland in colour on the 12th.

Early morning goodies

While checking the UHF band for DX reception at 0430 on the 6th, a rather odd-looking test pattern was discovered amid the usual all night screenings from the various UK stations. The signal was extremely strong and clear but without sound. At first it was assumed to have originated from the local Sutton Coldfield transmitter – the BBC might have been carrying out field tests. Further investigations revealed a 5.5MHz sound and vision difference. The test pattern resembled the FuBK, but had part of the cross-hatch showing through a central window. There was no identification present on the pattern, which disappeared at 0450 when the transmitter was switched off.

Another mystery occurred in Band I when the Swiss ‘+PTT’ test pattern was noted via meteor scatter on channels E2 and E4 at 0440! In addition, at 0746 on the 6th, two Dutch stations were seen radiating colour bars with the identification ‘PTT-NL-AVVC’ superimposed over a black block in the upper portion of the pattern.

Reception reports

Chris Howles of Lichfield experienced what appeared to be tropospheric ducting during the morning of the 12th when the Swiss FuBK test pattern was resolved on channel E3. The signal was strong enough to lock colour. All other channels were inactive and only the Swiss signal was logged. Chris also tells us that Belgium switched over to a new colour test pattern immediately after station sign-off one evening. From his description, it sounds very much like the one received at UHF early on the 5th.

On that day, Chris located a PM5544 test pattern on channel E4 shortly after 1900. As the signal emerged the initials RTM, and their Arabic equivalent, could be clearly seen, confirming the reception of Morocco from the Younne transmitter which is located south of the country. The station eventually opened up and the Koran was shown. This is the first report of Morocco being received this season.

Vigilance from Simon Hamer (New Radnor, in Powys) rewarded him with meteor scatter reception in Band III on the 12th. This was the most productive day for this type of DX reception and his effort brought him YLE-1 from Finland on channel E9, possibly from the Lahti transmitter. The ‘YLE-TV1’ test pattern was being shown at the time so there was no mistake on channel E9 with the appearance of the same test pattern from the E3 (Tervola) and E4 (Vuokatti) outlets in Band I. Other Band III signals that day, which he managed to positively identify, were Sweden on channel E8 and Denmark on channel E5. Band II TV reception was possible on several days. For instance, Russian signals were noted on channel R4 on the 15th.

Simon did well with tropospheric DX, especially the reception of the 525-line AFN-TV station at Soesterberg in the Netherlands. Most RTE transmitters were present during an opening to Eire on the 7th, including a mystery RTE-1 signal on channel E in Band III– there are no high-power outlets listed on this channel.

DX-TV log for August

The reception log for August comes from Simon Hamer. The names of transmitters are included where these are known.

04/08/88: YLE-1 (Finland) on channel E3 (Tervola) via meteor scatter DX, identified from the ‘YLE-TV1’ FuBK test pattern.

5/08/88: All tropospheric DX reception consisting of NED-1 (Netherlands) on channels E4 and E5; Smilde, E7 (Markelo) and E9 (Wieringermeer); NED-2 E45 (Wieringermeer) and E47 (Smilde); NED-3 E60 (Lopik); E5 (Roermond), E6 (Smilde), E7 (Markelo) and E9 (Wieringermeer); NED-2 E45 (Wieringermeir) and E47 (Smilde); NED-3 E30 (Lopik), E34 (Roermond), E35 (Goes) and E42 (Wieringermeir); AFN-TV (American Forces TV) on channel A80 from Soesterberg (Netherlands); RTBF-1 (Belgian French-language service) E3 (Liège), E8 (Vawre) and E11 (Légère); RTBF-2 E42 (Liège); BRT-1 (Belgian Flemish language network), E60 (Vawre) and E43 (Egem); BRT-2 E46 (Egem) and E62 (Schoten); RTL PLUS (Luxembourg) E7 (Dudelange); WDR-1 (West Germany-Westdeutsches Fernsehen) E9 (Langenberg) and E32 (Münster); NDR-1 (Norddeutscher Rundfunk) E10 (Harz-West); ZDF (Zweites Deutsches Fernsehen) E27 (Hochsauerland), E34 (Niebüll), E35 (Kiel or Buderich/Wesel) and E37 (Ludenscheid); DDR-F1 (East Germany) channel E6 (Brocken); DDR-F2 E34 (Brocken), DR (Denmark) E5 (Aalborg) and E8 (Aarhus); NRK (Norway) E6 (Bjerkeirim).

06/08/88: Similar reception to the 5th but with the following additions: DDR-F1 E5 (Inselberg), E11 (Schwerin) and E12 (Sonneberg); DR E7; NRK E8 (Sokn), Sporadic-E reception included RTE-1 E2 and E4; RTP (Portugal) E3 (Lousa); RTS (Albania) channel IC (Tirana); RAI UNO (Italy) IA and IB; ORF-1 (Austria) E2a (Jauerling) and E4 (Patscherkofel); TSS (Russia) R1 and R2.

07/08/88: Tropospheric reception from RTE-1 (Eire) on channels B (Maghera), D (Cork), E (unknown origin), F (Kilkenny), I (Sligo), 29 (Three Rocks – Dublin), 40 (Cairnhill) and 52 (Clhmont Cairn – vertical polarisation); RTE-2 on channels G (Sligo or Cork), H (Maghera), I (Kilkenny), J (Dublin), 33 (Three Rocks – Dublin), 43 (Cairnhill) and 56 (Clhmont Cairn – vertical polarisation), Sporadic-E reception included RUV (Iceland) on E3 (Stykkisholmur) and E4; MTV-1 R1 (Budapest) and R2 (Pecs).

08/08/88: DR E3 (Fyn) and E4 (Copenhagen); NDR-1 E4 (Flensberg); BR-1 (West Germany – Bayerischer Rundfunk) E2 (Grünten); SVT-1 (Sweden) E2; NRK E2 (Gulen); CST (Czechoslovakia) R1; TVP-1 (Poland) R1 and R2; TSS R1, R2 and R3; RAI UNO IA and IB; TV-1 E2, E3 and E4; +PTT SRG 1 (Switzerland, German-language network) E2 (Bantiger).

12/08/88: Canal Plus sightings

It seems the French Canal Plus network in Band I has expanded with at least two new high-power outlets in service. During the 1986 season, Canal Plus was often received on channel L3 (just above R2) from the south during Spanish openings, presumably from the Carcassonne outlet. Already this season, the remaining two French Band I allocations, channels L2 (slightly above E3) and L4 (above E4), have been evident,
particularlly during openings to the south-east. We assume the proposed Bastia L2 outlet and Ajaccio L4 outlet have now entered service, or increased their power. Both transmitters are located in Corsica, which explains why they often accompany Italian signals.

**Scrambled pictures**

Vision and sound are encrypted which means the picture vertically appears ragged with almost inaudible sound. The French TV system is unusual. Even in the early days of television, they opted for an odd TV standard composed of 409 lines. Fair enough, it was a high-definition system with a vision bandwidth of about 11MHz, compared with a modest 3MHz or so in the UK. To cram a sufficient number of channels into the VHF bands, the French used a method of interleaving whereby some sound carriers would be above the vision and some below. Goodness knows what the IF circuitry looked like in their TV receivers!

After re-engineering, the 625-line system was chosen for the VHF bands. Positive-going video modulation is employed, as opposed to negative-going used in every other country. The sound is strange too — amplitude modulation is used rather than the intercarrier system. For UHF and Band III broadcasting, the sound carrier is located 6.5MHz above the vision frequency but in Band I the sound carrier is situated 6.5MHz (AM) below the vision frequency. When encrypted, it can produce confusing-looking carriers at various points throughout the band. In fact, it resembles an FM carrier. For instance, the L2 sound carrier is on 49.25MHz and when received during such transmissions it produces a blank raster, not unlike cordless phone interference over channel R1! The vision signal is easy to recognise as it appears negative (white looks black) because of the inverted video modulation used for the French system. The SECAM colour system is used for both normal and encrypted broadcasts.

**DX-TV on Video**

A new thirty-minute video with commentary is now available from HS Publications which provides an interesting insight into the TV DXing hobby. Following on from the first cassette in the series, in Part 2 a typical DX-TV installation is explored showing receiving aerials and the various pieces of equipment in action. Needless to say, the effects of Sporadic-E and tropospheric openings are also illustrated.

The video retails at £14.50 (including postage and packing at £0.50 by airmail). The required video format (VHS or Beta) should be stated when ordering. The cassette is available from: HS Publications, 7 Epping Close, Derby DE3 4HR. Tel: (0332) 381699.

**Service Information**

**New Zealand:** The TV3 network should commence in April 1989 with stereo sound using the NICAM system. It will be divided into four regions but there are a few snags. Due to New Zealand's mountainous topography, especially in the Wellington area, so many translators are required for the existing services that channels 1 — 9 are in full use. This means that any further transmitters will have to use the new New Zealand channels 10 and 11 (or UHF) and neither company wants to do this since so many sets won't receive them!

**United Kingdom:** Recently, some dramatic developments have taken place in satellite broadcasting. Firstly, there was the announcement of plans for at least three English language services on Astra, to be transmitted in PAL. Then the government announced its plan to discuss with the IBA, BSF (British Satellite Broadcasting) and the BBC, the possibility of transmitting BBC-2 and Channel 4 by satellite only — a rather strange move.

The idea is to use the two spare high-power DBS channels from the five allocated to the UK. BSF will use three, but the other two have not yet been allocated. One option is to put BBC-2 and Channel 4 broadcasts on the high-power satellite which BSF plans to launch next autumn.

This would enable viewers to receive all five channels on one small dish; BBC-2 and Channel 4 would continue to be transmitted terrestrially for a number of years. If, and when, the terrestrial transmissions ceased, the UHF channels could then be released for a number of additional services, which might be regional or national. However, this idea has now been dropped.

The government's future policy on satellite and terrestrial broadcasting is showing a trend towards deregulation and subscription TV can have whatever they want at a price. Subscription television implies that scrambling techniques will be used — this being one of the great benefits of the MAC transmission system. The existing PAL signal is not suited to scrambling, so it comes as no surprise that Rupert Murdoch's recently announced channels on the Astra satellite will have to be funded from advertising. The high-power DBS channels from BSF next year, will all be scrambled, though only the feature film channels will require an actual subscription.

The MAC/packet 'family' of transmission formats was specifically thrashed out in Europe to pave the way for a common receiver for satellite television. The UK was prepared to compromise on its use of the MAC/packet system, C-MAC (developed by the IBA), and decided on D-MAC for DBS, which is suitable for most cable systems. D-MAC also retains the maximum data rate to make the most of multi-channel digital audio and data services. For older European cable systems, D2-MAC, with its half-speed digital element is easily derived but ideally should not be transmitted via satellite.

The full data-rate D-MAC system also has great possibilities for the future. Some services, such as standard-definition picture quality viewing in the home. All this can be achieved compatibly, so that standard equipment can remain in use for those not wishing to pay for extra features.

**Denmark:** Since the end of June, TV2 test transmissions ceased, the UHF channels would cause harm to the Aabenraa and Hedensted (Vejle) outlets. The PM5534 is used with an individual transmitter identification at the bottom.

**West Germany:** The channel E46 RTL+Television 5 outlet at Hamburg is now allocated. One option is to put BBC-2 and Channel 4 broadcasts on the high-power satellite which BSF plans to launch next autumn.

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NIKOLA TESLA’S RADIO MYSTERIES
by David Lazell

Today, there is a revived interest in Nikola Tesla’s radio related ideas. A new biography was recently published in the USA, whilst specialist books dealing with Tesla’s patents and publications. When, for example, a daily newspaper invited readers to imagine aspects of life in the next century, one of the predictions subsequently published could have come straight from the notebooks of Tesla, eighty or ninety years ago. This suggested that a portable radio transmitting device would be available for personal security. Pointed at any potential attacker, the device would effect an immediate, transient paralysis. Though the writer did not add further possibilities, one could assume accompanying use of an inaudible frequency to alert the nearest police mobile.

Such devices would be possible today and Nikola Tesla, though primarily interested in the civilian uses of radio and energy transmission, proposed various defence possibilities. Unfortunately for Tesla, and perhaps for Western democracy, he could not persuade the US military authorities to take his pioneering ideas seriously (at least not until the advent of the First World War). He was an immigrant in a nation of immigrants and, as far as the authorities were concerned, just another inventor in a land of gadget-makers and ideas men. His ideas in robotics certainly anticipated the industrial boom of the 1970s allied to radio control technology.

Little appreciation for his work

Tesla was only one of many aspiring creators of ‘artificial life’ but he was so advanced in his scientific ideas that his robotic principles were sound. He was keenly interested in the interaction of light energy and human or robotic mechanisms. Though primarily absorbed in radio developments at the time, by 1893 he had proceeded so far with a robot ‘obeying orders’ by the transmission of oscillating energy, that he was able to arrange a public demonstration in his adopted city, New York.

Tesla’s work was little appreciated at first by the US Patents Office in Washington DC. However, Tesla was already sufficiently well known as a scientist to receive a personal call from the head of the US Patents Office. An outline patent was soon granted.

From the 1890s onwards, Tesla offered his ideas to the US military establishment but without apparent success. His ‘tele-automaton’, a radio controlled seacraft with submarine possibilities, worked well in Tesla’s own trials in 1898. Had the authorities developed such a device, it could have lessened the effect of U-Boats on allied shipping. Alas, the powers that be on both sides of the Atlantic were still living in the spurs and horseshoe era. When war in Europe was declared in August 1914, only the British Royal Navy had attempted on-going use of radio.

Tesla’s work in ‘electronic resonance’ was so advanced, that robots were highly sensitive to pre-selected frequencies whilst able to ignore others. Of some importance to Tesla was his original work on the high frequency oscillator, ie a singularly effective generator of high frequency oscillations. Having developed this instrument combining his dynamo with a condenser, Tesla spent much of his time exploring the possibilities of resonance. Transatlantic magazines, published simultaneously with minor variations in Britain and the USA, treated Tesla with respect.

From these technology immersed 1980s, one feels that Tesla (like Edison) entertained the press when the publicity would be useful. It may come as a shock for today’s readers to read an article from the 1910s, showing an artist’s impression of Tesla seated at what looks like a satellite dish antenna. Like Edison, who all but invented the thermionic valve whilst working on artificial lighting systems, Tesla was interested in expanding the experience of ‘ordinary mortals’.

It was left to Tesla to indicate a likely 20th century development: world-wide personal radio communication. The ‘wrist-watch two-way radio’ beloved of detectives in the strips was, among many other things, anticipated by Tesla. Probably his best known idea, and still one offering intriguing possibilities, had to do with wireless transmission of electricity. In London during a lecture to the Royal Institute, and in the USA while attending an academic conference in Philadelphia, Tesla argued that high voltage (10 to 20 million volts) transmission was possible, using receiving and transmission stations several hundred miles apart and operating on an international basis. Here, we have yet to catch up with Tesla’s ideas which (as in his ideas on regenerating the growing potential of the soil) could bring famine relief to our hungry world.

Tesla was anticipating a world-wide co-operative order, similar to President Wilson’s ‘League of Nations’. Ironically, Tesla’s great experiment at Long Island where a massive oscillation generator of ten million horsepower was to have been installed, was scrapped at the onset of the First World War. In the 1940s, when Tesla’s original biographer, Slavko Boksan, published his absorbing study, it was still possible to find local people who remembered Tesla’s ‘folly’: the wireless power tower equipped with its immense spherical antenna. When the USA entered the war in 1917, the tower was demolished. However, Tesla did not give up the idea and the plan is referred to in a book published in the year of his death (see On the Way to Electro-War by Kurt Doberer, 1943).

Weapon against armies

It was perhaps the collapse of those into which Tesla’s ideas were cast, the League of Nations, that revived interest in the use of radio as a weapon against armies. Among research that was considered in the mid 1930s, was the use of ultra short waves (3 to 8m) which would affect phosphorous based compounds in the body. Work on so-called death rays involved the use of ultra short wave frequencies to inhibit blood flow or actually coagulate the blood.

Another idea to disarm armies was to use radiated transmission to cause panic and/or apathy among military or even civilian populations. The perfect victory for any aggressor would be keeping property and resources in good condition, whilst killing human beings. In any case, any future thermo-nuclear attack would be preceded by an electro-magnetic pulse which would render useless communications based on transistorised and/or integrated circuits.

Yet Tesla, who was so often associated with military applications, thought that defence of democratic nations was vital. Andrew Carnegie, the steel maker and philanthropist, thought, as early as 1912, that a League of Nations could prevent war. Not so, responded Tesla, ‘peace can only come as a natural consequence of universal enlightenment and the coming together of races, and we are still far from this happy state of affairs’.

Nikola Tesla’s greatest invention was a polyphase system of alternating current. The patents were made in 1888 and within weeks, George Westinghouse (1846-1914) had secured exclusive rights to the patents and invited Tesla to join his Electric Company based in Pittsburgh. It took a further four years to perfect the system, making it ready for marketing on a US standard of sixty cycles per second.

There followed what might politely be called a friendly rivalry between Edison and Tesla. The great American inventor believed that the high voltages used in the Westinghouse alternating current system, meant that the proposed underground cables would prove a health hazard. Even Edison could be wrong sometimes. An odd by-product of the controversy was the development of the electric chair for convicted murderers. Using alternating current, the ‘hot seat’ was presented in the more flamboyant newspapers as proof that electricity was dangerous. As indeed it is.

Nikola Tesla anticipated most of today’s radio mysteries some that haven’t arrived in the shops yet. Despite his genius, he was a ham at heart.
The technology of amateur television has a rich history but even careful research in old issues of CQ-TV won't tell you a great deal about the equipment in the average TV amateur's shack at any given time. Recording history is not something that most ATV people are prone to, we are too busy trying out new techniques. Since I have more than a passing affection for 'the old stuff', I thought I would jot down a few lines to get established enthusiasts' memories going again, and perhaps interest some more recent recruits to our hobby.

Of course, when I first got involved with ATV a little over ten years ago, I never set out to acquire 'old junk'. I wanted modern equipment but since I could not afford it, I had to make do with cast-offs. In the process, I developed a feel for the outdated technology I have now preserved. It is easy to forget how rapidly things have changed in the television industry, and in our amateur television hobby, during the last decade. (Some people might not think so, looking at the composition of the club's committee!)

Joking apart, it is easy to forget how very different things were then. There was no home video market of course, and even surplus gear was difficult to come by unless you had connections. Video tape recorders were open reel affairs and out of the reach of most amateurs. Cameras were also a problem, at least for a cash hungry beginner. The choice lay between buying a second-hand surveill- ance camera or building something DIY. None of these but Clive, G8EQZ, was pleased with the composition of the club's committee!)

Another adjustable 405/625-line camera is the Pye Lynx, so well known that it doesn't need further description. The Pye Lynx is very common at rallies for around £20.00 and comes in several versions. I have one with a four-lens turret on the front. Beware of HT on the remote control socket below - cover this with several layers of insulation tape!

Incidentally, industrial TV used 625 lines from the early 1960s, even before BBC-2 started. The 405-line options were mainly for educational establishments that could not afford to ditch their existing receivers.

A very compact (and heavy) camera is made by Epsylon Industries. This particular model has a nuvistor head-amp, and the reason is so compact that the power supply and camera control unit are in a separate box! Much of Epsylon's early output seems to have been badged for EMI Ltd. The same organisation later redesigned the camera into a much better machine with the Aztec badge. This was a high performance version, with an alleged 800 lines horizontal definition and was sold by Dixons Technical (remember them?) as the Mirage HD800. I always wanted to find one of these but never succeeded! On the other hand, I did track down the designer, Dennis Beesley, who confessed some doubt as to whether the camera could manage 800 lines! The Aztec was generously built, with conveniently situated back panel test points, together with an ingenious system enabling the camera to genlock to another video source looped through it.

A very stylish little camera is the Beulah D805, with a wrap-around case and silver script metal badges on the sides. It gives quite a good picture and I was delighted to pick one up for just £7.50 at the Cranfield boot sale last September. This one has two nuvistors in the head-amp, plus a whole bunch of 'flowerpower' geranium transistors. Checking up in Practical Television, I was amazed to find that in 1962 this camera cost £220.00, albeit with a small monitor. Yes, that's £220.00 at a time when the magazine it was reviewed in, cost a mere two shillings (10p). The price of the magazine has gone up fifteen-fold, yet a CCTV camera and monitor (of much better quality) can be bought for well under £220.00 now. How times (and values) change.

As well as making industrial cameras, the company also sold a kit for construction by amateurs. The Beukit was advertised in Practical Television during 1963 for £48.00 (or sixty-nine guineas assembled and tested). A gallon of petrol cost five shillings (25p) then, and you'll rapidly gather that this was pretty expensive for hobbyists, though ideal as a technical college project. I did once have one of these and its performance was very poor, even after it had been rebuilt with npn (instead of pnp) transistors; the D805 is definitely a much better animal.

George Hammond's Beulah Electrons was a member of the DTV (Direct TV Components) group of companies and had a connection with Derek Pattinson's Crofton Electronics, who also prepared kits of parts for cameras (to their own designs and by Mullard). The company was an early supporter of the BATC and advertised these kits on the back of CQ-TV around issue 100. I never owned one of these but Clive, G8EQZ, was pleased with his (it cost enough, so he had to be!).

Probably some of the strangest types of camera were the separate head models made by EMI and Marconi. Looking very similar, these were not unlike a piece of drainpipe 9 inches long with a lens one end and a cable on the other! This camera head contained a vidicon or staticon tube and a head amplifier, plus a small motor for controlling the lens. The remaining electronics were in a camera control unit (CCU) which was the size of a suitcase, and could be installed remotely.

Monitors

Old monitors tend to be very heavy for their size and less desirable to collectors. I would make a couple of exceptions, though. Sony made an interesting transistorised 9in monitor (in moulded
plastic case) to go with their 2100 VTR outfit. Another attractive monitor (in a weird way) is the PM8 8in valve monitor outfit. Another attractive monitor (in a screen across the picture tube and little made by Epsylon. This has a round anodised aluminium labels, all very hammer finish paint, a glass implosion to other collectors. The only monoscope and Pye, but I have since passed these on owned every model of studio and mobile transceiver. None of these have come Delta base station... For several years now there have been rumours of a base station to complement the highly successful Delta-1 mobile transceiver. None of these have come true and in fact there has been no base station made for 934MHz since the original offering from Reftec. This, by the way, was a rather tasty piece of work: expensive but elegant and highly prized by owners. It was made in rather small numbers and though I don’t know why, the examples I have seen work rather better than the corresponding mobile rigs. Enough of the Reftec base station; if you don’t possess one now, you are not very likely to in future!

Getting hold of a Delta-1 is not difficult at present, although it may be soon, and many folk use them as base stations as well as mobiles. They perform equally well as home bases, of course, but some people feel they look a bit bare. The built-in loudspeaker sounds a bit inadequate, and not everyone is happy with the utility of the loudspeaker, and a spaghetti junction of red and black power leads, coax feeders and possibly more wires for preamps, power meters and so on. What would be nice is a console which tidies all this up and does everything in one box...

The SEL-2PE from Selectronic (203 High Street, Canvey Island, Essex SS8 7RN. Tel: 0268-691481) is therefore the answer to a maiden’s prayer. It comes as a silver grey box (measuring 12x3x8in WHD) into which you drop your transceiver. The console contains a hefty power supply and a loudspeaker, which takes over from the unit built in to the Delta-1. The only wires from the back of the console are the coax feeder and a mains lead for power.

Easy Installation

After you have installed your transceiver in the base unit it certainly looks a lot smarter and neater. The cabinet work is in steel, with no sharp corners, covered in a textured silver grey epoxy paint which feels a bit like sand. The front panel is finished in a smooth pearl grey, closely matching the Delta-1’s own finish, and carries the Selectronic logo and simple, but tough legends, together with a slotted grille for the loudspeaker. It will not win any prizes for aesthetic design but at least it is plain and workmanlike. The power supply itself is massive and professionally built, using a toroidal transformer to avoid background interference from the transceiver. It is fused internally at 6 amps, so it will have ample power to drive your transceiver and any accessories. Voltage was measured at 13.5V and after extended use the heatsink on the back of the unit only became lukewarm — a reassuring sign. The whole thing (apart from the loudspeaker) is made from British components, by BNOS Ltd, who have an excellent reputation for their power supplies and amateur band power amplifiers. All in all, a very acceptable piece of work.

Setting up the unit is easy and takes five minutes or less. First you remove eight screws to release the wrap-around lid of the case and drop in your transceiver. A little care is necessary here, since the protruding knobs and cables of the Delta-1 make this a fairly tight fit. More importantly, you will want to take care to avoid scratching your transceiver’s paintwork and this is quite tricky; be warned.

When fitted, the front of the transceiver protrudes slightly through the slot pierced in the base unit’s front panel. How you retain it in place is another matter. The base of the console is drilled to hold the mobile mounting bracket of the transceiver, into which you then screw the transceiver itself. You do have to drill the mounting bracket as well, though. As I lost my Delta’s mounting bracket ages ago (it must be somewhere in the loft!), I would opt for using double sided foam tape, which is quicker and simpler and just as effective.

After this, all you need do is connect the coaxial cable from the aerial and plug in the fly-leads for 13.5 volts power to the loudspeaker which already has the correct plugs fitted. The mains lead has a moulded-on 13amp plug supplied (a nice touch) but the cable is only two metres long. I found this too short for my shack; three metres would have been better.

Tucked inside the console there is a stand, but they have sold out of any all-weather and a loose matching plug which are not mentioned in the instructions (because there aren’t any!). I only noticed that the lead was live when the transceiver was actually connected. It is in fact used for feeding accessories, such as a preamp, aerial changeover switch or electronic power meter (or all three — the power supply is adequate). The loudspeaker is a straightforward 2.5in diameter job, but the sound quality is far better than the rig’s own one; it makes listening far more pleasant.

Pit for purpose

There is no doubt the SEL-2PE does its job very well. It looks smart and tidies up the shack. A nice touch are the fold down feet, so you can tilt it up if you wish. I’m not quite sure what you do with the microphone; Selectronic’s picture shows a stand, but they have sold out of these and cannot obtain any more. You could screw or tape a bracket to the side of the case. The console should satisfy
all those people who want a 934MHz base unit but are too busy (or not quite sure how) to make their own. The flat lid leaves you room for placing power and 5 meters on top, and it will be easy to power them with the white fly-lead provided. I also use a remote antenna changeover relay which needs switching. If I was feeling confident I might drill the console’s case to the right of the mains on/off switch to accommodate the changeover relay which needs switching. If I was feeling confident I might drill the console’s case to the right of the mains switch to accommodate the switch.

Value for money?

Judging this is difficult, though I am sure many people will be happy to order this accessory. Certainly, if you want a commercial unit you have little choice, it’s this product or nothing! A price tag of around £135.00 is not unreasonable for a well-made British product, for which around £135.00 is not unreasonable for a second-hand transceiver with adequate communications quality loudspeakers. Of course, you can buy a commercial unit you have little choice, there will inevitably be only a limited demand. Of course, you can buy a second-hand transceiver with adequate power supplies for £10.00 or £20.00, and communications quality loudspeakers are not that expensive either. But then you are stuck with spaghetti junction again and if you are one of those people who has the rig in the living room, I think you would get permission to buy one of these consoles. While it doesn’t look like a piece of fancy Hi-Fi, its appearance is a lot better than any box of plywood and silver foil you could make at home. Or prove me wrong!

Second-hand sales prospects

When Mike Machin rang me from Selectronic to tell me the SEL-2PE was on its way, I took the opportunity to ask him about trade. Having seen the odd 934MHz rig up for sale in the RAEd small ads, I wondered if people were leaving the band in any quantity. Apparently not, although some people were leaving the band (eg after passing the RA and migrating to 2 metres). They were replaced by newcomers who had been impressed by the civilised operating on 934. (Not like 2 metres!). In fact, there was a waiting list for second-hand Delta-1 transceivers at Mike’s Canvey Island shop and there are not so many new rigs still in stock. The specification runs out in December 1988, which means that sets can no longer be manufactured or imported after this time. There is nothing to stop you using them after this, nor to prevent shops from selling existing stocks, but there will be no more new sets made. The average price for a second-hand Delta is £250.00 and likely to go up from now on. Draw your own conclusion about what to do if you haven’t bought one yet!

See you next month ... And why weren’t you working the tropo DX last month?

The SEL-2PE transceiver
Hurricane Gilbert

The media has highlighted amateur radio's role in relief work for the Jamaican and Cayman Islands' hurricane. It appears radio amateurs were the first to alert the outside world about the disaster in the Cayman Islands. Their communications also enabled tour operators to arrange quick return flights for holidaymakers.

UoSAT-D and UoSAT-E

More details are available about the in-flight experiments on these spacecraft. The primary payload on UoSAT-D will be the PCE (Payload Communications Experiment). This advances the work done on UoSAT-2 with the Digital Communications Experiment. The PCE system is being developed under contract from VITA (Volunteers in Technical Assistance). This American organisation provides technical assistance to underprivileged countries which hope to use 'store and forward' communications as a link with development workers in remote areas. The flight of the PCE on UoSAT-D, and its use by radio amateurs, will be funded by the University of Surrey and AMSAT-UK.

UoSAT-E will be, primarily, a technology demonstration mission, flying the Transputer Data Processing Experiment (TDPE), Solar Cell Experiment (SCE) and CCD Imaging System, which should have flown on UoSAT-C.

SCE monitoring system

The UoSAT Solar Cell Experiment comprises an array of solar cell samples from several manufacturers. These will be constantly monitored for change in performance caused by radiation, temperature and other environmental effects. The cells under development will be covered by various cover slides designed to enhance panel efficiency and investigate panel degradation due to radiation. The Solar Cell Experiment will be mounted on a panel that will replace part of a solar panel on the side of the UoSAT-E spacecraft. The SCE monitoring system can be used when the sun is shining on the SCE, will make a series of current/voltage measurements on each cell. As well as the SCE, UoSAT-D will also carry the first gallium arsenide solar cells manufactured by the Italian FIAR/CISE organisation.

RSGB '75' Award

This follows the activities which took place to mark the 75th Anniversary of the Radio Society of Great Britain. To qualify, UK amateurs and SWLs must make one contact with GB75RS during 1988 and 75 different contacts with RSGB members. These may be made on any band using any mode, including satellite but not duplicate contacts or contacts via repeaters. Amateurs and SWLs overseas may also apply for the award, but different conditions apply. Details from: John Harvey, G4LJV, RSGB 75 Award Manager, 38 Bodenham Road, Northfield, Birmingham B31 5DS. Claims must be postmarked no later than 1 April 1989 and accompanied by a £1.50 cheque made payable to the RSGB to cover postage and packing.

AMSAT Oscar 13

This is gradually settling down to a regular schedule. Various engineering tests, measurements and operations, directed at getting it into its proper attitude, have produced alterations to its published schedule since its launch. The attitude control mechanism on AO-13 consists of a group of subsystems which can be used to steer the satellite with the help of sun and earth sensors. The In House Computer (IHC) computes the spacecraft's attitude from these measurements and the magnetorquers, responding to the computer commands, generate magnetic fields. These magnetic fields interact with the geomagnetic field to produce a torque to change the spacecraft's orientation in space.

The geomagnetic field intensity falls off rapidly with attitude and also varies with latitude. Since AO-13 is at a much higher perigee than originally planned, ie 2500km instead of 1500km, the geomagnetic field is much less. The field drops off as the cube of the distance. Therefore, by doubling the attitude, the field is reduced eightfold. Hence, the time required for "torquing" is much greater.

HEALTHSAT-1

Representatives from the Soviet Space Research Institute, the International Telecommunications Union, the League of Red Cross and Red Crescent Societies, the United Nations and AMSAT-NA, met recently at Annecy, France. They discussed the possible launch of a small Packet radio 'Store and Forward' satellite for the SatelLife Group, based in Boston, USA. Tentatively designated HEALTHSAT-1, the satellite would provide a prototype electronic mail service for physicians working in remote areas where communications are difficult or non-existent.

It is proposed that HEALTHSAT-1 would operate near but not actually in the amateur bands, if licensing on space research frequencies can be agreed with international authorities. If not, the satellite would be licensed for amateur radio frequencies and regulations, when it would revert to one of the OSCAR series and be used by the general amateur radio satellite community. In this case, it could be used by SatelLife for limited use to prove the feasibility of the idea.

This satellite is intended for launch from a space station such as the Soviet Mir. It would be transported to Mir by a Progress cargo rocket and launched into orbit by one of the cosmonauts aboard. As Mir is in a low orbit, its orbital time is not expected to be very long, possibly a year or less. Mode J operation is proposed, requiring only a low-powered ground station.

Brazil's Peaceltalker satellite

This proposed satellite differs from the established satellite concept, exploring new possibilities of using space. It will be the first satellite specifically designed to transmit spoken messages that promote peace between nations using space communications. It will be equipped with a phonetically-based programmable speech synthesizer. Initially, it will transmit in Portuguese, English and Russian. It will also transmit various telemetry parameters, therefore providing a source of study for satellite 'in-orbit' behaviour near the equator.

This project, which is also called DOVE (Digital Orbiting Voice Encoder) is sponsored by BRAMSAT, under the coordination of its President, Dr Junior de Castro, PY2BJO. For further information contact: BRAMSAT, Rua Maccaulay No 119, CEP 01256, Sao Paulo, Brazil.

Microwave beacon news

Just a reminder that following the installation of a new transmitter, the
callsign of the microwave beacon at Martlesham Heath, near Ipswich, has been changed from GB3BPO to GB3MHL. The frequency remains at 1296.830MHz. Reports are welcome and should be sent to: John Ouarmby, GB3MHL. The frequency remains at G3XDY, 12 Chestnut Close, Rushmere St Andrew, Ipswich IP5 7ED.

The microwave station GB3NKW, in northwest Kent, has returned to service. The 1296.810MHz transmitter failed towards the end of last year and a few weeks later, the aerial mast came down in the hurricane which swept across the south of England last October. This put the 13cm beacon on 2320.850MHz out of action as well. Repairs were rapidly carried out and both beacons were restored to full operation. The cost of the repairs seriously depleted the North Kent Beacon Group's finances. It should be remembered that the provision and running of beacons such as these, are the responsibility of the volunteers who establish them. They are not available from any 'central beacon funds'. Users should remember this and make a fair contribution to their upkeep.

10 metre band looking up

The 10 metre band has been giving good DX propagation again recently. The progress of the solar cycle, towards maximum activity, has reached the stage where the renowned DX possibilities of this band at times of great solar activity are being experienced again. Reports are widespread of JA and VK stations on 29.300 to 29.515MHz. Reports are widespread of JA and VK stations. And QSOs have been had through repeaters in the USA from 10 metre FM stations in this country.

Now that activity is increasing on the 10 metre band, it is well to remind users that the frequency band 29.300 to 29.515MHz is within the Amateur Radio Service band allocation and should, if possible, be kept free for this service.

Britannia rules the (air) waves

The September issue of RadCom reports, under the above heading, in the news bulletin feature, an amateur radio 'first', which took place on Thursday 21 July. At 1815GMT, the Plymouth Radio Club made direct contact with the Royal Yacht Britannia, while operating the Special Event station, GB400A, as part of the Armada celebrations. The Royal Yacht used its international callsign to receive a greetings message sent by the Club's Vice-President, Paul, G3VCN, as it approached Plymouth Hoe. Permission for this historic event was given by the DTI. The message sent was as follows: 'On the occasion of the Armada celebrations, the President and Member of the Plymouth Radio Club send, with humble duty, loyal greetings to Her Majesty from their special radio station on Plymouth Hoe. They also wish to convey to His Royal Highness Prince Philip, The Duke of Edinburgh, as Patron of the Radio Society of Great Britain, sincere greetings from the assembled radio amateurs in this, the 75th Anniversary of the Society.'

The following reply was received at GB400A: 'The Queen and Duke of Edinburgh have asked me to send you their warmest thanks for your message of greeting and their congratulations on your 75th Anniversary.' The message was signed by the Queen's Private Secretary.

RSGB's convention

The RSGB's 75th Anniversary convention, at the Birmingham National Exhibition Centre, was described officially as a 'stunning success'. Just under 7,500 people attended, and traders reported 'brisk business after a slow start'. Much of the success was due to the visit by HRH Prince Philip.
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Ray Marston looks at a selection of practical circuits in the fourth part of his series on power control circuits.

This month we continue the 'power control' theme by showing a further selection of practical on/off switching circuits. We start off by looking at simple Triac power switches that can be used on either 115V or 230V ac power lines. They can also be used to switch power to lamps, heaters, motors and many other domestic or industrial appliances. In these designs, the user must simply select the Triac 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.

Triac power switches

Triacs are solid state power switches that can be triggered (turned on and latched) either synchronously or nonsynchronously with the ac mains voltage. Triacs turn off automatically at the end of each mains half-cycle when their main terminal currents fall below the device's 'minimum holding' value.

Synchronous circuits always turn on at the same point in each ac half-cycle (usually just after the zero crossing point) and generate 'minimal radio frequency interference' (RFI). We will describe a variety of synchronous designs in the next two editions of 'Data File'.

The trigger points of non-synchronous circuits are not invariably synchronised to a fixed point of the ac cycle, and may generate significant RFI, particularly at the point of initial turn on. This month, we will only deal with non-synchronous power switching circuits. Figures 1 to 8 show a variety of non-synchronous Triac power switch circuits that can be used in basic on/off line switching applications.

The Triac shown in Figure 1 is off and acts like an open switch when SW1 is open, but it acts like a closed switch that is gated on from the mains via the load and R1 shortly after the start of each mains half-cycle when SW1 is closed. Note that the Triac's main terminal voltage drops to only a few hundred millivolts as soon as the Triac turns on, so R1 and SW1 consume very little mean power. Also note that the Triac's trigger point is not synchronised to the mains when SW1 is initially closed, but becomes synchronised on all subsequent half-cycles. Finally, the R2-C1 forms a 'snubber' network that provides rate effect suppression; similar networks are fitted to all of this month's Triac circuits.

Figure 2 shows how the Triac can be used as a power switch that can be triggered via a mains derived dc supply. C1 is charged to +10V on each positive mains half-cycle via R1-D1, and the C1

Fig 1: Simple ac power switch, ac line triggered

Fig 2: ac power switch with line-derived dc triggering

Fig 3: Isolated input (optocoupled) ac power switch, dc triggered

[Further diagrams and text as per the original document]
**Fig 4:** Isolated input ac power switch, ac triggered

The diagram shows an isolated input ac power switch with an ac trigger. The switch is powered by 230V AC (115V AC) and includes components such as R1, R2, R3, R4, C1, C2, and a Triac. The switch circuit is designed to be triggered by an ac signal, allowing for remote operation.

**Fig 5:** Isolated input ac power switch with transistor-aided dc triggering

This figure shows an alternative method of triggering the Triac using a transistor and an optocoupler. The transistor is driven by the 'photo-transistor' side of the optocoupler, which is fed from a 5V (or greater) dc supply via R4. The Triac turns on only when the external supply is connected via SW1.

Optocouplers have typical insulation potentials as high as several thousand volts, so the above external circuit is fully isolated from the mains driven Triac circuitry. This can easily be designed to give any desired form of automatic 'remote' operation of the Triac, by replacing SW1 with a suitable electronic switch.

**Fig 6:** Isolated input ac power switch with dc triggering

In this figure, the Triac is ac triggered on each mains half-cycle, via C1-R1 and back-to-back zeners ZD1-ZD2. Note that the mains impedance of C1 determines the magnitude of the Triac gate current but that C1 dissipates near zero power. Bridge rectifier D1 to D4 is wired across the ZD1-ZD2-R2 network and is loaded by Q2. When Q2 is off, the bridge is effectively open and the Triac turns on shortly after the start of each mains half-cycle. When Q2 is on, a near-short appears across ZD1-ZD2-R2, inhibiting the Triac gate circuit and the Triac is off. Q2 is actually driven via the optocoupler from the isolated external circuit, so the Triac is normally on but turns off when SW1 is closed.

**Dc triggering**

Figures 5 and 6 show a couple of ways of triggering a Triac power switch via a transformer derived dc supply and a transistor-aided switch. In the Figure 5 circuit, the transistor and the Triac are both driven on when SW1 is closed, and are off when SW1 is open.

In practice, of course, SW1 can easily be replaced by an electronic switch, enabling the Triac to be operated by heat, light, sound and time, etc. Note, however, that the whole of this circuit is 'live'. Figure 6 shows how the circuit can be modified for optocoupler operation, so that it can be activated via fully isolated external circuitry.

**UJT triggering**

Finally, to complete this look at basic non-synchronous Triac on/off power switching circuitry, Figures 7 and 8 show a couple of alternative ways of obtaining Triac triggering via a fully isolated external circuit. In these two circuits the triggering action is obtained from pulse generating the UJT (unijunction transistor) oscillator Q2. This operates at a frequency of several kHz and has its output pulses fed to the Triac gate via a pulse transformer T1, which provides the desired isolation. Because of the fairly high operating frequency of the UJT oscillator, the Triac is triggered on within a few degrees of the start of each mains half-cycle when the oscillator is on.

In the Figure 7 circuit, Q3 is wired in series with the UJT's main timing circuit, which triggers the Triac when SW1 is closed.

---

**Isolated input control**

Figure 3 shows how the Figure 2 circuit can be modified so that it can easily be interfaced to external control circuitry. Here, SW1 is simply replaced by a transistor Q2, which in turn is driven from the 'photo-transistor' side of an inexpensive optocoupler. The 'LED' side of the optocoupler is driven from a 5V (or greater) dc supply via R4. The Triac turns on only when the external supply is connected via SW1.
resistor, so the UJT and Triac turn on only when SW1 is closed. In the Figure 8 circuit, Q3 is wired in parallel with the UJT's main timing capacitor, so the UJT and Triac turn on only when SW1 is open. In both of these circuits, SW1 can easily be replaced by an electronic switch, thus giving some form of automatic power switching action.

**Automatic control**
The main advantage of the Figure 3 to 8 Triac circuits, when compared to ordinary electro-mechanical switching circuits, is that they can easily be modified to give an automatic switching action in response to variations in time, light, or heat, etc. This is achieved by simply using suitable circuitry in the input control position. An almost infinite variety of control circuits can easily be devised (Figures 9 to 13 show a few examples of these). All of these circuits are shown with relay outputs, enabling them to be used directly as ac or dc power switches. However, each circuit can easily be modified to give direct Triac activation.

**Time control**
The most popular type of automatic control circuit is that related to time and Figures 9 to 11 show circuits of this type. Figures 9 and 10 show a simple 'timer' type of action, in which the relay turns on as soon as the circuit is activated, but then turns off again automatically after a preset period. Figure 11 shows a pulser action, in which the relay repeatedly switches on and off at a preset rate.

The action of the Figure 9 automatic turn off relay switch is as follows. The 4001B CMOS gate is used as a digital inverter, with its output feeding to the relay coil via npn transistor Q1, and with its output taken from the junction of the time controlled potential divider which is formed by R2 and C1. When power is initially applied to the circuit, C1 is fully discharged, so the inverter input is grounded and its output is at its full positive rail potential; Q1 and the relay are thus driven on. As soon as power is applied, C1 starts to charge up via R2, and a rising exponential voltage is fed to the inverter input. After a delay determined by the C1-R2 values, this voltage rises to the threshold value of the CMOS inverter stage, and its output swings low and switches Q1 and the relay off, thus completing the action. D1 and R1 ensure that C1 discharges rapidly as soon as power is removed from the circuit, giving a rapid reset action.

The circuit gives a time delay of about 0.5sec/µF of C1 value, thus enabling delays of up to several minutes to be obtained. If required, the delay can be made variable by replacing R2 with a fixed and a variable resistor in series.

The circuit shown in Figure 9 offers only medium accuracy timing operation; far greater accuracy can be obtained by using a type-555 timer IC as the basic timing element, as in the case of the simple six to sixty seconds timer of Figure 10, in which the IC is wired in the monostable or one-shot mode. Here, the circuit starts a timing cycle when the 'start' switch S1 is briefly closed. The timing cycle is then complete.

Finally, the Figure 11 circuit shows a simple relay pulser, which repeatedly switches the relay on and off at a variable rate (via RV1) of 26 to 80 cycles per minute via Q1 between the astable multivibrator (designed around R1-RV1-C1) and the two CMOS 4001B NOR gates.
Heat/light control

To complete this edition of 'Data File,' Figures 12 and 13 show circuits that can be used to activate a relay in response to variations in light or temperature levels.

The Figure 12 circuit acts as a dark-activate switch that turns the relay on when the light intensity falls below a preset level. RV1 and LDR (a light dependent resistor) are wired as a light-sensitive potential divider which has its output filtered (to give transient suppression) via R1-C1 and is fed to the input of the 4001B digital inverter stage, thus driving the relay via Q1. Under bright conditions, both the LDR resistance and the inverter input are low. Their output is high and Q1 and the relay are off. Under dark conditions the LDR resistance is high, so the inverter input is high, its output is low and Q1 and the relay are on. The precise ‘trip’ level of the circuit is fully variable via RV1. Note that the LDR used here can be any cadmium sulphide photocell that gives a resistance in the 2kΩ to 2MΩ range at the desired ‘trip’ level, and that (when adjusted) the RV1 value should balance that of the LDR.

Finally, Figure 13 shows a precision over temperature switch that turns the relay on when the temperature exceeds a preset level. Here, the op-amp and Q1 are wired as a relay driving precision voltage comparator, with one input driven via the fixed R1-R2 voltage divider, and the other driven via the temperature sensitive divider formed by RV1 and thermistor TH1. This divider gives a low output at low temperatures (thus switching the relay off) and a high output at high temperatures (thus driving the relay on). The precise trip temperature of the circuit is fully variable via RV1 and is virtually indepen-
**Fig 13: Precision over-temperature relay switch**

dent of variations in the supply rail voltage.

The thermistor used in this circuit can be any negative temperature coefficient (ntc) type that presents a resistance in the range 1k0 to 20k at the required trigger temperature. The RV1 resistance should equal this value at the same temperature. Note that this circuit can be made to act as an ‘ice’ or under temperature switch, by simply transposing TH1 and RV1.

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**DECEMBER 1988**
During this time of year signals from the Far East can be heard by listeners in the UK and Europe. From around mid-September to mid-March DXers turn their attention not only to the 60 and 90m frequency range is not often visited by many SWLs, which is not surprising considering the time involved and the usual lack of success.

Apart from the obvious necessity of a highly sensitive and selective communications receiver, a further prime requirement is that of an outdoor aerial array as long and as high as possible. Whilst it is perfectly possible to utilise a relatively short length, this will not be as successful. The recommended length is 132 feet. Unfortunately, not every enthusiast is able to erect such an array, garden dimensions these days tending to be somewhat smaller. However, don't give up, when the prevailing conditions for Far Eastern reception are at their best, usually mid-term, a successful logging may well be possible.

The times which usually provide the maximum opportunity for hearing such transmissions are from around 1500 to 1730 and from 2100 to 2330UTC.

CHINA
For the past few years, this country has provided us with the opportunity to log some Far Eastern signals on the 120m band. Chinese regional transmitters serving their various local communities are well in evidence on this band. I suggest that 120m band beginners focus their attention on the channels below. Should the receiver exhibit a memory facility, a selection of the frequencies should be entered and retained for some of the 'season', particularly to the mid-term period.

TRY THESE
The lowest in frequency is Yunnan PBS (People's Broadcasting Station) in Kunming on 2410. This transmitter carries Home Service 3 programme in the local vernaculars Dehong Dai and Jingpo from 2225 to 0030 and from 1025 to 1630. This schedule includes a relay of the Radio Beijing English language lesson timed from 1030 to 1100, the power being 15kW. A parallel channel is 8960.

Fujian PBS, Fuzhou, features programmes in Chinese on 2340 from 1020 to 1700 and from 2050 to 2400 carrying the Home Service 1, the power being 10kW. An English language lesson is timed from 1330 to 1400.

Zhejiang PBS, Wenzhou, with programmes in Chinese on 2415 from 2135 to 0005 (Sunday until 0205), from 0225 to 1445 (Sunday until 0715) and from 0805 to 1420. The schedule includes relays of the CPBS 1 programme from 2230 to 2300 and from 1200 to 1230. The present power is unknown.

Jiangxi PBS, Nanchang, is in irregular operation on 2445 from 1900 to 1420 in Chinese at 10kW. It is, therefore, a matter of luck whether one logs this station or not.

Yunnan PBS, Kunming, transmits again on 2460 where it is on the air with Home Service 1 programmes in Chinese from 2150 to 2400, from 0255 to 0600 and from 0855 to 1540. English language lessons are timed from 2230 to 2300, 0500 to 0530 and from 1400 to 1430. The power is 15kW.

Zhejiang PBS, Hangzhou, may be located on 2475 where it carries the Home Service 1 in Chinese from 2055 to 0510 and from 0755 (Tuesday from 0855) to 1500. English language lessons are featured from 2140 to 2210 and from 1330 to 1400. With a power of 10kW, it is in parallel on 4783.

Voice of the Strait, Fuzhou, on 2490 transmits Haixia 1 in Chinese from 2055 to 0031 and from 0955 to 1751, the frequency being an alternative to 4765. The power is 10kW.

Voice of the Strait transmitters carry either the First or Second Programme; in DXers' language known as Haixia 1 and Haixia 2. The former derives from the Chinese language identification Hai-xia-zhi-sheng guang-bo dian-tai. Broadcasting to Taiwan and other offshore islands, Voice of the Strait transmitters are also active on the 90m band (3200 to 3400).

NORTH KOREA
The following North Korean regional stations are rarely heard outside the immediate localities but reports do sometimes appear in the SWL press signifying success for a few fortunate DXers residing nearer to the respective signals. For those aspiring to supreme feats of DXing, these details should prove to be of some assistance.

The frequency of 2300 is occupied by Hyesan in Yanggang Province. This station transmits the Home Service 1 from 1958 through to 1800, the language being Korean. The following two transmitters have the same schedule and programme. Sarwon in North Hwanghae Province is on 2350. Hamhung in South Hamgyong Province was on 2400 but is now thought to be inactive.

These station schedules include locally originated programmes timed from 2230 to 2300, from 0430 to 0520 and from 1110 to 1800 and each have a power of just 1kW – hence the supreme DX rating.

ON THE AIR
Listed below are some of the stations logged during the month prior to publication. Tuning some of the frequencies specified at the times stated, should result in a successful outcome providing the prevailing conditions are good.

AFRICA
Equatorial Guinea
Radio Nacional, Bata, on 5003.7 at 2028, typical fast and rhythmic music, some songs in vernacular. The Home Service in Spanish and vernaculars is radiated from 0500 to 0700 and from 1700 to 2200, the power being 100kW.

Radio Nacional, Malabo, on 6250 at 2032, music and songs in Spanish. Malabo is on the air from 0500 to 2205 in Spanish and vernaculars at 10kW.

Angola
Radio Nacional, Luanda, on 4953 at 0417, OM with a talk in Portuguese followed by a song then more talk. This station can also often be heard from around 1830 onwards at this time of the year. At 10kW, Radio Nacional operates around the clock in Portuguese but the frequency is subject to slight variation.

Burundi
Bujumbura on 3300 at 2037, a discussion in vernacular than OM with a song. The Home Service in French. Kirundi and Swahili is radiated from 0300 to 0700 (Sunday from 1000) and from 1600 to 2100 with an English news-cast at 1645. The power is 25kW.

Ghana
GBC2 Accra on 3366 at 1802, local and African news in English during which the announcement 'This is coming to you from GBC Accra' was made. At 50kW, Accra on this frequency broadcasts entirely in English from 0525 to 0900 and from 1705 to 2305. Unfortunately, the channel is often subject to utility interference but on occasions the station is clearly audible here in the UK.

Kenya
Nairobi on 4934 at 1859, African drums and music then YL in English with the station identification and time check. The Voice of Kenya operates the General Service entirely in English on this channel from 0200 (Sunday from 0230) to 0630 and from 1300 to 2010 (Saturday and Sunday until 2110).

Niger
Niamey on 5020 at 0557, OM with a talk, YL with a song, four pips time check, the station identification in French then some pipe and drum music. The Home Service 2 programme on this channel is timed from 0530 to 0700 and from 1700 to 2200, and has been off since 1600. The power is 20kW. The Home Service 2 programme on this channel is timed from 0530 to 0700 and from 1700 to 2200, and has been off since 1600. The power is 20kW.
SHORT WAVE NEWS

30/200kW. Namey has also been heard on 3260 at 2136 in parallel with 5020, the power being 4kW.

South Africa
SABC Johannesburg on 4880 at 0403, OM with news in English of local sporting events and results. This Radio 5 programme is aired from 0300 to 0510 and from 1625 to 2200, our evening periods often providing a chance of logging this station. The power is 100kW.

Swaziland
Swazi Radio, Sandlane, on 4975.9 at 1830, OM with the station identification followed by a talk in Spanish about the return of Mrs Alliende to Chile and its implications. Broadcasting in Spanish to South America, the Voice of Chile is on the air from 1030 to 1300, from 1600 to 1900 and from 2200-0100.

Brazil
Radio Anhanguera, Gioana, on 4915 at 0331, announcements in Portuguese followed by the station identification with echo effect. The schedule is from 0800 through to 0400 with a power of 10kW.

Chile
Radio El Espectador (Voice of Chile) Santiago, on 18139.7 at 0021, a talk in Spanish about the national Anthem at 0258. The power is 10kW.

Indonesia
AIR Delhi on 3365 at 1745, Indian orchestral music. The schedule is from 0025 to 0229 and from 1230 to 1840 with English newscasts at 0035 and 1830. The power is 10kW.

AIR Hyderabad on 4800 at 1733, YL in English with the local and world news. Hyderabad radiates from 0025 to 0215 and from 1200 to 1741 or 1830. The power is 10kW.

Mongolia
Ulan Bator on 4080.4 at 2148, OM with a talk in Mongolian, three descending chimes repeated, more talk, some orchestral music, six pips at 2200 then more talk (news?). The Home Service 1 in Mongolian is timed from 2200 to 1600. Relays of the Moscow Foreign Service are broadcast in Mongolian from 0600 to 0850, 0930 to 1000 and 1200 to 1245, and in Russian on Tuesday and Friday from 1130 to 1200. The power is 50kW.

Sri Lanka
Colombo on 4902 at 1711, monchs with Buddhist chants. The National Service in Sinhala is broadcast on this channel from 2330 to 0230 and from 1000 to 1730 (to 2330 on full moon days). The power is 10kW.

Taiwan
The Voice of Free China, Taipei, on 9965 at 0900, the news in Arabic during a transmission to North Africa and the Middle East, timed from 2000 to 2100.

Indonesia
RRI Sibolga, Sumatra, on 5256.3 at 1603, a newscast in Indonesian until 1607, followed by some orchestral music. Sibolga is scheduled on the air from 0900 to 1900, the power being 1kW.

RRI Pekanbaru, Sumatra, on 5894 at 1542, Indonesian gamelan music, YL with some songs, ann and off at 1600. Pekanbaru radiates to the local population at 5kW from 2200 to 0200 and from 0830 to 1600, sometimes to 1700 or 1800.

Philippines
FEBC Manila on 11880 at 0920, OM with a religious talk in English to Central and South East Asia timed from 0830 to 0930, followed by theetrofit signal and then into Chinese (Hakka) at 0930.

CLANDESTINE
Radio Iran Toilers on 10870 at 1555, YL with a talk in Farsi (Persian), folk music and a song, also heard on 6330 in parallel. This clandestine is operated by the Iranian Tudeh (Communist) Party which is based in Kabul, transmissions being made via Radio Afghanistan facilities. The identification is Radio-ye Zahmatkesh-e Iran.

NOW HEAR THESE
La Voz Evangelica de la Mosquitia, Puerto Lempira, Honduras on 4914.4 at 0232, a US recorded religious talk in English until 0235 then a hymn and talk in Spanish. Off without the National Anthem at 0302 after some announcements, a talk and a song in Meskito. This one is on the air in Meskito and Spanish from 2300 to 0300 but includes an English transmission from 0215 to around 0235. The power is 0.5kW.

Radio Nueva Vida, Cucuta, Colombia on 5567.3 at 0106, OM with a talk in Spanish, a sad slow song (pasillo) with guitar. The schedule is from 2300 to around 0230 and the power is just 0.1kW.

Radio 2 de Febrero, Rurrenbaque, Bolivia on 5505.3 at 0120, folkloric music and songs with announcements in Spanish at 0131. This station operates irregularly from 1200 to 1500 and from 2130 to around 0300 with a power of 0.4kW.

NOW LOG THESE
Radio Ancash, Huaraz, Peru on 4990.7 at 0318, announcements in Spanish, folkloric music and songs, promotions and ann. Radio Ancash is active from sign-on between 0900 and 1200 until close around 0500, featuring a tourist programme in Spanish and English irregularly from 2300 to 2400. The power is 3kW.

Radio Satelite, San Juan, Peru on 6726.3 at 0111, YL with a talk in Spanish. The schedule is from 2400 to 0400.

please mention RADIO & ELECTRONICS WORLD when replying to any advertisement
**DXing in your sleep**

The easiest way to identify an MW DXer is if they fall asleep during the day. Since the fundamental characteristics of the ionosphere favour long distance MW radio reception at night, this hobby will be the province of the shift worker, the insomniac or the outright fanatic. There is one solution and that is to DX in your sleep!

All you need apart from the standard aerial and receiver are a tape recorder, timer and a fairly methodical approach to listening. Neither the tape recorder nor timer should be expensive and, indeed, I don't know any serious DXers (SW or MW) who doesn't already use a recorder. Depending on your selection of equipment there are two ways of DXing in your sleep.

If you have an ordinary radio and a separate cassette recorder you'll need to buy a mains timer unit (get one with a digital display since these can be set precisely to the minute) which will cost about £15.00–£20.00. With such a timer connected in series with the mains lead of the recorder you are able to make a recording at any time of the day or night when you're not around. Just make sure that your radio is tuned to the frequency of the station you want to hear.

Unfortunately, such remote control is trickier for really tough DXing, since in these circumstances you might want to be making continuous adjustments to your receiver or aerials to improve reception. However, for less marginal conditions, this technique is very valuable, particularly for night after night monitoring of one frequency. I use it, for example, for monitoring 1440kHz after Radio Luxembourg closes down at 3am. It would be impossible for me to be awake at this time every night and I would soon be put off by the DX-less nights. Indeed, taping for an hour every night. Indeed, taping for an hour every night with an intermittent audio lead from radio to cassette and detecting when audio starts, ie, when the internal timer has turned on the radio. It then switches on the recorder for as long as sound is present. So if you have the equipment but have not tried this before, why not give it a go and let me know how you get on?

**Half a century on**

In the eighty-odd years that radio has 'existed', each decade has seen an ever increasing rate of change so it is sometimes worth standing still and having a look back in time. Going back fifty years takes us to 1938 which in retrospect was a very significant year for radio as the war clouds started to build over us.

In Europe, this year saw the first broadcasts from the newly formed Radio Sweden, this being the Swedes' first step into international broadcasting. In contrast, Swedish domestic radio provided by the Swedish Broadcasting Corporation had been operating since 1925.

Meanwhile, across the Atlantic, one of the most celebrated events in all of radio broadcasting took place on 30 October 1938. On this night before Hallow'en the Columbia Broadcasting System carried Orson Welles' adaptation of H G Wells' *War of the Worlds*, causing mass panic among several hundred thousand listeners in the Eastern USA who mistook the play for real life. Welles employed his mastery of the dramatic to present *War of the Worlds* in a news format style, adopting the emotion and trauma that had filled the real live coverage of the Hindenberg disaster. Today it is amazing to think that a one hour radio play could have had such impact. So, was it the play for real life? Orson Welles' adaptation of H G Wells' *The Story of Radio*, in which it appeared that the history of broadcasting centred solely around the BBC. There were no mentions of Lord Haw Haw, Radio Normandie, Radio Luxembourg, the offshore pirates or independent local radio, to name just a few gaps. Unfortunately, the casual visitor could be excused for thinking that Radio 1 was the be-all and end-all of radio.

Behind the glossy facade, the one glimmer of hope was the small stand manned by the European DX Council whose volunteers were working overtime introducing many a newcomer to the delights of international radio. Sadly, in the whole hall only seven world-band receivers could be found; four on the EDXC stand and three on the Grundig stand. BBC World Service should have had one on their stand to show visitors how to tune in a short wave radio to their programmes. In radio technology terms the centrepiece was the promotion of the VHF Radio Data System (RDS) though exactly what Joe Public made of this is anyone's guess.

**Newsdesk**

**International waters:** Radio Caroline

Radio has recently changed its address so all mail should go to PO Box 146, Playa d'Aro, Gerona, Spain. Programming hasn't altered so it is not clear if this indicates a change in management. Listeners who have had difficulty getting a QSL card confirming reception of the 558kHz signal could try writing directly to the religious broadcasters who buy airtime on Caroline transmitters. For instance, correct reports are verified by the priestlist Jose M. Ojaspebach whose programmes go out on 558kHz after the Dutch daytime programmes end.

**United Kingdom:** Some months back I discussed the topic of networking its Empire service, despite extensive propaganda from the powerful Zeesen transmitters operated by the Germans. In fact, the European service was preempted by the Arabic service to the Near East which was shortly to be joined by the Spanish and Portuguese languages of the Latin American service that started on 14 March. By the end of 1938 the BBC was producing programmes in nine languages.

**BBC Radio Show**

At seemingly considerable expense BBC Radio stations 1, 2, 3 and 4 celebrated their 21st birthday during the first week of October. The show was mounted at Earl's Court but only occupied a small fraction of this massive exhibition hall. I visited on Friday 7th, having missed the official press day a week earlier due to other commitments. Though I'm sure that the vast majority of visitors enjoyed themselves, I couldn't help feeling a bit disappointed, rather like wanting more food two hours after eating a Chinese meal.

Radio Show it was in name but in reality the hall was dominated by Hi-Fi and in-car entertainment. Even more unforgivable was the lack of coverage of *The Story of Radio*, in which it appeared that the history of broadcasting centred solely around the BBC. There were no mentions of Lord Haw Haw, Radio Normandie, Radio Luxembourg, the offshore pirates or independent local radio, to name just a few gaps. Unfortunately, the casual visitor could be excused for thinking that Radio 1 was the be-all and end-all of radio.

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While their respective FM outlets have GEM-AM in the East Midlands. This is a medium wave DXing amongst Independent Local Radio in the UK. Well, the phenomenon continues to be relevant. Radio Trent and Leicester Sound, 999 from Nottingham and 1260kHz from Leicester. It won’t be long before every I LR station on 945 from Derby, 999 from Nottingham and 1260kHz from Leicester.

predictable AM Gold format with hits for broadcasting but certain frequencies ever happened to individuality or creativity. Notwithstanding, the military is interested in these frequencies because of their ability to survive after nuclear war. Great distances via groundwaves and are less reliant on ionospheric refraction to reach their destination; one of the consequences of nuclear war is likely to be a highly disturbed ionosphere which may lead to effects similar to a prolonged short wave fade-out.

DX file
Recently MW DX has been a mixed bag with some good DX days and plenty of days afflicted by increased solar activity leading to ionospheric disturbance. On better days I’ve pulled in the following:

250kHz WWGT, Portland, ME, USA; heard as early as 2200hrs.
1010kHz WINS, New York, USA; heard as early as 2330hrs (despite Irish and Spanish stations on 1008kHz).
1060kHz WBIV, Boston, MA, USA; heard ‘DXing in my sleep’ with unusual identification as ‘Q-98’. This is the slogan based on call letters of the FM sister station which is just relayed on MW.

1510kHz WSSH, Boston, MA, USA; fairly regular with easy listening music from about 2330hrs.

Note all times are UTC/GMT. It is regrettable to note that this month two popular MW frequencies for transatlantic DX have become that much harder to DX on (do any ever get easier?). BBC R1, as part of their new FM stereo image, have extended broadcasting hours to 0200 from midnight, and this affects their MW frequencies as well. Thus, it may well now be late night DXers (for those listening in their sleep) who’ll hear much on either 1050kHz or 1090kHz.

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

** lightning return posting**
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TX-3 RTTY/CW/ASCII TRANSCEIVE
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Split-screen, type-ahead operation, 24 memories, clock, review store, callsign capture, RTTY auto CR/LF, CW software filtering and much more. Needs interface or TU. BBC-B and Master, CBM64 tape £20, disc £22. Spectrum tape £35, +3 disc £37 inc adapter board (needs interface/TU also). For VIC20 we have our RTTY/CW transceive program. Tape £20.

RX-4 RTTY/CW/SSTV/AMTOR RECEIVE
This is still a best-selling program and it’s easy to see why. Superb performance on all 4 modes, switch modes at a keypress to catch all the action. Text and picture store with dump to screen, printer or tape/disc. An essential piece of software for the SWL. Needs interface. BBC-B and Master, CBM64 tape £25, disc £27. VIC20 tape £25. Spectrum tape £40, +3 disc £42 inc adapter board (needs interface also). The SPECTRUM software-only version (input to EAR socket) is still available, tape £25, +3 disc £27.

TIF1 INTERFACE
Perfect for TX-3 and RX-4, RTTY/CW CW Fitters, computer noise isolation for excellent reception. Transmit outputs for MIC, PTT and KEY. Kit £20 (assembled PCB + cables, connectors) or ready-made £40, boxed. State rig. Available only with TX-3 or RX-4 software.

Also MORSF TUTOR £6, LOGBOOK £8, RAE MATHS £9 for BBC and CBM64 (disc £2 extra), SPECTRUM, ELECTRON, VIC20

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- AR88 communications receiver, 550kHz to 32MHz, super condition with CCT and details, £100. Barking WXR, 30 general coverage, portable, 0-30MHz in 30 bands, 1MHz wide, AM/SSB, complete with ac power adapter, £30. Fortro 70cm TX 20W TX, two channels fitted, £435.00, 437.00, up converter to channel 36 on a UHF TV, in-line demodulator for picture checking, all 12 channels, £30. Tel: (0703) 241697
- Matchbox size transmitters, plans 80 to 105 FM, £2. Etch resist tweezers, super quality, 25p per pair.
- 27MHz FM hand-held 5W, separate speaker mic, with ac PSU, spare batteries, suit conversion to 2m, £40.
- VHF high band Tx/Rx presently on 156MHz, boxed charger, spare batteries, like new, £950. Reftec £600. CDE AR-40 rotator, £30. 50MHz 2 element 5114, printer 5103 (requires service), load-DIR: will fit over wet suit boots, new, £9. All by post only.
- Spare tubes, suit PCB manufacture or similar, £40.
- Ultra violet unit comprising PSU, 7 tube lamp unit, etchjng circuit boards, and tape/radio. DIN socket, Sanyo motor BFJ6R, bass, balance, volume controls. Output: L-R spkrs reverse, used on bench, PWO, offers. TDK audio tape demagnetiser, original packing, offers, Silent keys: President AM/SSB. CB, TX, plus mic, never used, £30. bargain.
- 2m 8 element yagi, £60. Radcom magazines, April 1988.
- Barlow Wadley XCR, 30 general coverage, portable, DX300 7724 evenings. £30 please mention RADIO & ELECTRONICS WORLD when replying to any advertisement DECEMBER 1988

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Advertisements will be included free of charge in the next column only if they arrive by the deadline and conform to conditions stated. We reserve the right to edit and exclude any ad. Trade advertisements are not accepted.

Simply complete the order form at the end of these ads, feel free to use an extra sheet of paper if there is not enough space on the order form. We will accept ads not on our order form.

Send to: Radio & Electronics World, Sovereign House, Brentwood, Essex CM14 45E.
interface to allow computer to send CW on a Tx, program included, £165. Case to suit above keyboard, £3. Minolta underwater camera, 110 format, built in flash, good down to 5m, new, still boxed, £60. Part exchange any for 6m gear. WHY? Ben. Tel: (0562) 743253

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- AOR 2002, Lowe 1000 HC frequency counter, PSU (stabilised) and Discone aerial, £487. Tel: 061-748 7485

- Dimmer switches, almost new and unused, originally cost £9.00 each, will sell for £5.00 each. Also, single gang sets, £1.50 each. Double sockets, £3.00 each. Light switches £1.00. All unused and almost new. Pocket size LCD colour television, almost new, good condition. Originally cost £550 will sell for £300. Write to: D McDowell, 257 Linn Rd, Larne, Co. Antrim BT40 2AH

- Delcom 144MHz with built-in pre-amp, 144.100 to 144.350, Mic, RT, VVO, others. Also Alan K1300B 27MHz am Tx, mint condition, offers. Write to: S Martin, 24 Collingwood Close, Weston Super Mare, Avon BS22 9PQ

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- Telefunken music centre, must be in good working order. If anyone has one of these to sell, please write to: Dilyn Edwards, Berllan Glyd, Prestatyn, Clwyd LL16 4PA

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DECEMBER 1988
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Ex Government Geiger counter with 3 probes x-ray, alpha, beta ................. £45.00
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Type R210 receiver 2-15 MHz, complete with ATU £75.00
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**WORKSHOP SERVICE MANUALS**

Any Colour/Mono TV, Amateur Radio, Military Surplus, Music System, Vintage Valve Wireless etc, etc........ £5.00 plus LSAE
Any Video Recorder ........ £15.00 plus LSAE

FREE Catalogue Unique Repair and Data Guides for LSAE

MAURITRON (REW)
8 Cherry Tree Road, Chinnor
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**TURN YOUR SURPLUS**

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**COLES-HARDING & CO**
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Est Over 10 years

**Selectronic**
The UK's leading suppliers of 934 MHz personal radio equipment
203 High Street
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(Open Mon-Sat 9-5.30)

Amateur radio equipment also in stock

**2 METRE COLLINAR**
UVRAL X25%over 5%

An omni directional antenna giving low angle radiation. The ideal base station vertical. Ruggedly constructed for long life.

Technical Specification

- Gain: 6 dB
- Impedance: - 50 Ohms
- Max Power: - 100 Watts
- Length: - 3.14 metres
- SWR 144 to 145MHz: - Less than 1.5
- Wind Loading: - 4.8 Kgf at 100mph
- Weight: - 1.2 Kgs
- Mounting Diameter: - 25mm
- Termination: - Free 'N' Socket
- N Plug extra, costs £4.85 inc VAT

Send cheque or postal order for £33.95 inc VAT plus £2.50 postage to:

BUCKLEYS (UVRAL) LTD
Beta Works, Range Road
Hythe, Kent CT21 6HG
Tel: (0303) 50127/50128

Various Factors Available

--- World Radio History ---

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ELECTRO DISPOSALS

2000 sq ft of surplus equipment and components

UNIT 31, LONLAS WORKSHOPS
SKEWEN, NEATH
Tel: 0792 818451

PROFESSIONAL SURVEILLANCE EQUIPMENT

Crystal Controlled Micro Transmitters, Telephone Transmitters and Covert Body Transmitters

High Grade, Superb Stability

Countersurveillance

Portable and Pocket Bug Detectors and the Unique CS420 Tap Defeat System which will Nullify the Effect of ANY Telephone Interceptions

Includes all necessary accessories and manuals

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South Humberside DN35 8EU
Tel: 0472 690383

Pye M296 UHF mobiles
POA

Pye A200 linear amp, 148/174MHz
£35 each

Airlight 62 headset EM mic
£35

X-Band 20 inch dish and feed
EL/AZ mount inc motor drives and syncros
£50

Solid State indicator units ex.
"Red Steer" radar
£65

Marconi Apollo HF receiver
£295

All + 15% VAT
Cheque with order - carriage included

NEWMARKET TRANSFORMER LTD

Now manufacturing Toroidal transformers, 30va to 2.5kva. Competitive prices, prompt delivery, one-off to production runs. Phone M Durman on 0638 662989/660799 for quotations.

MRZ MICROWAVE MOBILE ANTENNA

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UK AND EXPORT

MRZ COMMUNICATIONS LTD

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7 DAY SERVICE

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EARLY CLOSING THURSDAY 1.00PM

(SUNDAYS BY APPOINTMENT)

SPECIALIST IN 904 MHz

SUPPLIERS OF ALL 27MHZ AND 934 MHZ EQUIPMENT

AMATEUR ACCESSORIES CATERED FOR

08053 20 01 53 (DAB)

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VISA

TEL: (0782) 619658
7 DAY SERVICE

COUNTY GUIDE

RATES

BOXES and sizes

20mm x 59mm single
40mm x 59mm double

Total
prepayment
rates

3 issues
£47.00
£47.00

6 issues
£88.00
£88.00

12 issues
£158.00
£158.00

RADIO & ELECTRONICS WORLD COUNTY GUIDE ORDER FORM

TO: Radio & Electronics World • Sovereign House • Brentwood • Essex
CM14 4SE • England • (0277) 219876

print your copy here

NUMBER OF INSERTIONS REQUIRED

Single County Guide 3
£47.00

6
£88.00

12
£158.00

Double County Guide 3
£94.00

6
£176.00

12
£316.00

PAYMENT ENCLOSED

£

Conditions — Payment must be sent with order form. No copy changes allowed. Ads accepted subject to our standard conditions, available on request.
DISPLAY AD RATES

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COLOUR AD RATES

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SPECIAL POSITIONS

Covers: Outside back cover 20% extra, inside covers 10% extra.
Bleed: 10% extra (Bleed area = 307 x 220)
Facing Matter: 15% extra.

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CONDITIONS & INFORMATION

If a series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

COPY

Except for County Guides copy may be changed monthly.

No additional charges for typesetting or illustrations except for colour separations.

For illustrations send photographs or artwork. Colour Ad rates do not include the cost of separations.

Published — web-offset.

PAYMENT

All single insertion ads are accepted on a pre-payment basis only unless an account is held.

Accounts will be opened for series rate advertisers subject to satisfactory credit references. Accounts are strictly net and must be settled by publication date.

OVERSEAS PAYMENTS: If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

CONDITIONS

10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only.

ADS ACCEPTED SUBJECT TO OUR STANDARD CONDITIONS.

FOR FURTHER INFORMATION CONTACT

Radio & Electronics World, Sovereign House, Brentwood, Essex CM14 4SE

(0277) 219876

ADVERTISERS INDEX

Bi-Pak ........................................... 8
J Bull ........................................... 35
P M Components ............................. 4, 5
Computer Appreciation ................. 16
Harrison Electronics ..................... 8
MCP Electronics Ltd ....................... 14
Icom ........................................... 18, 19
Interbooks Ltd .............................. 24
Keytronics ................................... 36
Lake Electronics ........................... 14

Marlow Marketing ......................... 28
No 1 Systems ............................... 29
Radio & Telecommunications Correspondence School .... 14
Softmachine Distribution Ltd ......... 28
Suma Designs ............................... 24
C R Supply Co ............................. 28
Technical Software ....................... 29
Telecomms .................................. 3
Webster Electronics ..................... 29
R Withers .................................. 2

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DECEMBER 1988
NEWLY ADVERTISED ITEMS

PET CAPACITOR MICROPHONE Eagle C120 200 Electric type microphone. An RT amplifier is built into the microphone, which is a class dynamic microphone while retaining the characteristics of a condenser microphone. External influence by magnetic and electrostatic noise is minimized since it is a free-standing sensor. The small size of this microphone and the low power supply needed for its operation makes it excellent for use in the home, portable, or mobile. Electrical specifications are as follows: Output impedance, 10 kilos; maximum sensitivity 80 dB. Frequency range 100 to 8000 Hz. Price £1 each. Order Ref: BD760.


Ex GDP MULTI-RANGE METER 12/0C Complete in real leather case with carrying handle. Complete with a choice of three ranges, including AC and DC volts, direct current 5mA, and DC up to 100 volts. The latter range is particularly useful, as you will be able to read right down to one ohm and below. This meter also has provision for reading direct current 9.5-amp and 0.5-amp. Meter size 8" 3" in 2 ½" deep. Lever operated. A very useful tool for the home or office. Price £11 each. Order Ref: BD401.

10 NEW TONE GENERATORS. These are tied for equal pins, two sets but tags, being spot welded, are easy to remove. Unused, tested and guaranteed. £20.00 each or 6 and we find the total for £10.00. Order Ref: BD507.

6 TRACK CASETTE DECK Complete with cassette holder. In fact, if you have any 8 track cassette then, with the addition of 2 speakers this unit would play them all. As black cassettes are no longer made the system should become more popular, therefore, the cost of useful parts: motor, tape head and drive, pick-up, etc. and an associated capacitor. Brand new. Brand new. Brand new in makers packing. Each £40. Order Ref: BD905.

FET CAPACITOR MICROPHONE Eagle C120 200 Electric type microphone. An RT amplifier is built into the microphone, which is a class dynamic microphone while retaining the characteristics of a condenser microphone. External influence by magnetic and electrostatic noise is minimized since it is a free-standing sensor. The small size of this microphone and the low power supply needed for its operation makes it excellent for use in the home, portable, or mobile. Electrical specifications are as follows: Output impedance, 10 kilos; maximum sensitivity 80 dB. Frequency range 100 to 8000 Hz. Price £1 each. Order Ref: BD760.


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LASER TUBE

Made by Philips Electric, totally new and unused. This helium-neon has and has a typical power rating of 1 cm. It emits red...
### Electronic Components

**ELMAS Instrument Case**
- 8741 Micro Ex equipment £1.30
- 2732-45 2716 USED £2..100+ £1.50
- 274-30 2176 USED £2
- ZN428E-8 £4.00
- ZN427E-8 £4.00
- 4416 RAM £3.50

**TRANSISTORS**
- 8 pin 10K Z2K 5/£1.00
- 1702 EPROM £5.00

**SURFACE MOUNTED**
- 2SC1520 sim BF259 3/£1.100/£2.2
- 2N3773 NPN 25A 160V £1.80 10/£18
- SE9302 100V 10A DARL SIM TIP121 2/£1
- POWER FET I RF9531 8A 60V P channel to 220 2J£1

**ZIF SOCKETS**
- b-220 Heat Sink sim RS 403-162 10/2.50

**MISCELLANEOUS**
- H1 12v 55w (car spot) £1.50
- Olivetti logos calculator keyboard £1.50
- FS22BW NTC Bead inside end of 1" glass probe res @ 20°C 1000/£80

**ELECTRONIC COMPONENTS BOUGHT FOR CASH**

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**RELAY 2 v 2 pole changeover looks like RS 35-741 marked**

**SCHEMATIC**

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**STC 47WB**

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**POLYESTER/POLYCARB CAPS**

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**ADD 15% VAT TO TOTAL**

**P&P AS SHOWN IN BRACKETS (HEAVY ITEMS)**

**P&P AS SHOWN IN BRACKETS (LIGHT ITEMS)**