10 W valve amplifier
TV receiver as monitor
mini printer
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<td>Full range of 74S &amp; 74HC series in stock.</td>
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<td>Ask for full list.</td>
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<tr>
<td><strong>ATTENTION</strong> All prices are subject to change without notice.</td>
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Please, add 50p p&p & 15% VAT.

Orders from Government Dept. & Colleges etc., welcome.

Detailed price list on request.

Stock items are normally by return of post. 

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A selection from next month's issue

- function generator
- NiCad charger timer
- soldering iron controller
- musical greeting cards
- model slot-car controller
- electronic candle
Back numbers of Elektor currently available are detailed below, with a brief description of their contents.

Send for your copies now, using the pre-paid Order Card inside the back cover of this issue.

Prices as follows: any one issue (except July/August) additional issues, each

July/August (Summer Circuits)  
Prices include postage and packing. Overseas orders requiring airmail postage add £ 1.50 per issue (£ 2.00 for July/August issue)  
Prices subject to change without notice.
FREE: This utility provides a disk usage analysis.

**MDUMP**: Enables you to display and modify any part of the disk.

**FREE**: This utility provides a disk usage analysis.

**VERIFY**: Verifies every sector on a disk.

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Telephone of the future

Management efficiency in countries throughout the world could be increased considerably if market evaluations of the STC Executel telephone currently underway in Europe, the USA, and Australia are successful.

Designed by STC Telecommunications at Harlow, Essex, and manufactured at Brighton, the Executel is an intelligent display telephone (IDT) with a screen and keyboard, powered by a microprocessor and with a memory to hold an executive’s diary, address book, and electronic “notepad”.

A manager with an Executel no longer needs a separate diary, calculator, notepad, address book, or clock. The unit combines all these, including a 20-year electronic diary, a directory for up to 256 individual entries and also gives the user access to Prestel and other viewdata services, and can send and receive electronic mail and telexes via the appropriate telephone services.

Chiefly, the Executel is a sophisticated telephone. In support of the normal telephone facility, it has push-button dialling, “hands-free” or handset operation, repeat dialling of the last number called, autodialling, and rapid dialling. It can work from a direct line or a private automatic branch exchange (PABX).

Well met by satellite . . .

Every working day, Ford engineers and executives in Germany and England “meet” for face-to-face talks without ever leaving their own plants.

They are able to see and talk with colleagues, discuss pictures and graphics, and evaluate vehicle components in detail, by using Europe’s first commercial application of international videoconferencing provided by British Telecom International’s (BTI) Business Communications Service.

The system links, by satellite, two fully-equipped studios at Dunton in Essex and Cologne, West Germany. The service is one of the first videoconferencing uses of transmission capacity on the European Communications Satellite (ECS1). Full audio and videoconferencing is available for one hour in the morning and one in the afternoon, five days a week.

More power for small computers

By this time next year, desktop computers with the power of some room-size mainframe machines may be on the market as chip manufacturers rush to get the latest microprocessors into production.

Last July, Motorola joined the ranks of the National Semiconductor Corporation, NCR Corporation, and American Telephone and Telegraph by announcing its first ‘true’ 32-bit microprocessor, the 68020. These companies are all trying to increase their share of a market expected to be worth £2.5 thousand million in 1988 by packing more and more on to a fingernail-size slice of silicon.

OED to be computerized

The Oxford English Dictionary, that ultimate work of reference for scholars and etymologists, is about to enter the computer age.

With the help of the British Government, its publishers, The Oxford University Press, are to transfer all 12 volumes onto computer and integrate into the main body of the dictionary the words contained in the four supplements which have been issued to update the original entries. The OUP, currently celebrating its centenary year, has announced a £7 million deal to undertake the computerization programme — involving researchers in the UK, Canada, and the United States.

The first task will be to transcribe the 21 000 pages of words and definitions contained within the total of 16 volumes onto computer and to produce the very first multi-volume, integrated Oxford English Dictionary. This alone will take 120 people up to 18 months — a lengthy process, but nothing compared to the 50 years it took to produce the dictionary initially and the 38 years over which the supplements have been added.

An end to radio piracy?

The Telecommunications Act, 1984, gives the Department of Trade and Industry the means of putting an end to unauthorized and illegal use of transmitters of all kinds. It is now an offence to manufacture, including assembly of component parts, sell, offer for hire, or import illicit transmitting equipment. The Act empowers the DTI to seize such apparatus summarily if there is doubt about its identity.

The Act also transfers the operational responsibility of the Radio Interference Service from British Telecom to the DTI. Licensing authorities have increased powers and may now, for instance, revoke or vary the terms of any transmitting licence in the light of the national interest or relations with a foreign government.

New radios for emergency services

What is believed to be the largest single order ever placed with a British company has been received by Marconi Communication Systems of Chelmsford from the Home Office Directorate of Telecommunications. Worth nearly £11 million, the order is for 20 000 type RC690 mobile radios and associated spares for police and fire vehicles in England and Wales. It brings the total of Home Office orders to Marconi to over £14 million for equipment to meet the new WARC (World Administrative Radio Conference) programme.

Simultaneously, it was announced by Burndred Electronics that they have been awarded a £6 million contract from the Home Office for the supply of mobile radiotelephones intended for the emergency services in England and Wales. Further orders for base stations and ancillaries are expected soon.

The Home Office took the opportunity to re-equip the emergency services with the most up-to-date mobile radios following the new frequency allocations decided by the World Administrative Radio Conference in 1979. New frequency assignments in the 100...108 MHz band (which is being vacated by the emergency services) will be decided for the European region by the second session of the ITU Regional Administrative Conference now being held at Geneva.

Clearer for radio amateurs

A new schedule to the amateur radio licence was introduced in September as a result of discussions between the Department of Trade and Industry and the Radio Society of Great Britain.

The schedule (which is a supplement
The combined company will retain the recent tour of U.S. military the name CEIS ANTENNAS LTD.

Commercial users, the merger will provide bigger volume of CSA with better commercial activity in France, the opening of an increased activity in the United States of America, and a prestigious order from The Vatican.

Following their agreement announced earlier this year, they have an- nounced their merging with R.T. MASTS LTD (RTM), increased activity in the United States of America, and a prestigious order from The Vatican.

Two forms of amateur radio licence are available. Those who have passed the Radio Amateur Examination (RAE), which tests technical and operational knowledge, may apply for the class B; this gives access only to frequencies above 144 MHz. The Class A licence, which gives access to all amateur bands, is available to those who have passed both the RAE and a morse test. There are currently about 55,000 amateur licences in force.

Merging and expanding CEIS ANTENNAS (CSA) of Rochester have had a busy period recently. Following their agreement with Allgon Antenn AB of Sweden reported earlier, they have an- nounced their merging with R.T. MASTS LTD (RTM), increased activity in France, the opening of an American based company, and a prestigious order from The Vatican. Because of RTM's strength in supplying private mobile radio equip- ment both to public utilities and to commercial users, the merger will provide CSA with bigger volume outlets at the smaller end of its range, and give them better competitiveness.

The combined company will retain the name CEIS ANTENNAS LTD. The decision to open an American based company was taken after a recent tour of U.S. military establishments by a CSA top management team. The enthusiastic reception everywhere on their 4000 mile round trip and the interest shown in CSA's military products, particularly those items which served the British Forces in the Falklands conflict, encouraged the establish- ment of the U.S. company.

The order from The Vatican is for the installation of a new broadcasting antenna system for the local radio station which transmits religious broadcasts. This system uses a v.h.f. transmitting panel similar to those supplied by CSA to the BBC and the IBA.

After the 1973 Sale of Goods Act the cry used to be 'caveat emptor!' ('let the buyer beware!'), but a court rul- ing earlier this year (McKenzie Patten v Olivetti) has tipped the scales slightly towards 'caveat vendor!' ('let the seller beware!'). The ruling has clearly worried dealers, but should give buyers some renewed peace of mind.

The case arose because the plaintiff wanted to computerize his offices and asked an Olivetti representative if the competence of their staff and the state of their books would allow the use of the system, and also whether the equipment ordered was up to date and suitable for their requirements. Although the Olivetti representative gave affirmative answers, the equipment that was delivered was obsolete, the nature of McKenzie Patten's books made transfer to the computer impossible, and, moreover, the plaint-iff's bookkeeper could not work the equipment. McKenzie Patten then sued and earlier this year were awarded substantial damages and costs in the High Court.

...and further dealers' worries Many dealers are concerned about the growing dissatisfaction of users with computers that can do little beyond playing simple-minded games. These users want to do something more worthwhile with their machines, which are often too limited to allow expansion and are usually provided with programs that do not meet the user's needs and wants. In a country with the highest computer density in the world that is a bad trend. And as there is not much that can be done about it quickly, it is probably mean that sales will begin to slide, but perhaps not until after Christmas.

Protecting your privacy Did you know that you can now claim compensation for damages or distress suffered as a result of misuse of personal information kept on you or your family by computer? Under the new Data Protection Act, any organization that keeps computerized information about people, is liable for loss, damage, or destruction of personal data or their unauthorized disclosure.

Under the new act organizations must, in twelve months' time, register with the Data Protection Registrar who has the power to refuse registration or to enforce requirements of the act. A useful booklet, recommended by the Home Office, is the National Computing Centre's *Guide to the Data Protection Act*, 32 pages, which sells at £1.50.

The changing face of Scotland More than ten years ago the Heriot-Watt University set up a small science park on its campus on the outskirts of Edinburgh and pioneered the development of science parks in Western Europe. By the end of this year science park developments will be in progress near all eight Scottish universities. This represents spending com- mitments by the universities and the Scottish Development Agency more than £25 million. More importantly, it forms a key element in a development programme that is fund-amentally changing the industrial structure of Scotland. Essentially, the growth of the science park concept in Scotland is a logical extension of the strategy for the regeneration of Scotland's economy, a strategy launched with the found- ing of the Scottish Development Agency in 1975. The long decline of Scotland's traditional industries of shipbuilding, heavy engineering, steelmaking, and coal mining, which were the mainstay of the economy as recently as a quarter of a century ago, has meant a loss of a quarter of a million jobs over that period. Restructuring after World War II, Scottish economic planners, with remarkable foresight, chose electronics as one key target to replace traditional heavy industries. The central belt of Scotland now has the highest concentration of elec- tronics companies in Western Europe, which are responsible for over 20 per cent of West European microchip production. The industry employs around 45,000 directly and is predicted to reach 100,000 by the middle of the next decade. Eight of the top 20 electronics companies in the United States of America, including IBM, DEC, Honeywell, Motorola, National Semiconductor, and Wang have major plants in Scotland. (LPS)
Bell those copycats!
Software writers and publishers on both sides of the Atlantic have been complaining for some time that illicit copying of their programs is affecting profits. In a market that is estimated to be worth some £3000 million worldwide, pirates must be making a lot of money. The software industry is therefore campaigning for changes in the law to make things more difficult for the pirates. But that is not the whole answer. There are voices proclaiming that software publishers are themselves to blame for nearly cent per cent of the illegal copies of software that exist. Nearly all publishers, it is suggested, ignore simple, inexpensive copy protection devices that are available to prevent unchecked copying. It is true that protection devices can all be cracked eventually, but probably ninety per cent of the users would either not have the know-how or be prepared to spend a lot of time on cracking the codes. Experienced programmers would find it difficult enough, let alone users who hardly know BASIC...
It seems clear that the industry and the law should get together quickly to combat this grand-scale theft. Make it clear that software is subject to copyright protection (in the UK the law is still confused) and increase the penalties for copyright infringement, as was done in the case of video tapes last year.

Heathrow goes digital
British Telecom is modernizing British Airways entire internal communications system at Heathrow Airport in the largest single exchange order it has ever received from a private company. The contract is worth up to £5 million and is expected to be completed by the end of 1985. It involves replacing six electromechanical exchanges, some of which have been in use for more than 30 years, with fully digital equipment. A completely new exchange is also being provided to serve the new Heathrow Terminal Four.
British Telecom is installing new BtEx exchanges, which take up only one fifth of their Stromger predecessors and provide a total communications package for both voice and data. The system also includes the world's largest Auto Call Distributor. This equipment automatically distributes incoming calls to British Airways' new reservations set-up. It will handle 500 lines, serving 380 operator positions. A total of 7000 extensions will eventually be connected, with a potential for up to 10,000. The system will involve the installation of 13,000 kilometres of wiring.

The system uses digital links to the airline's main centres in Bristol, Cardiff, Birmingham, and Manchester over British Telecom's Megastream network.

Düsseldorf hifi-video show
A two-day visit to the hifi-video show in Düsseldorf gave us the distinct impression that while the consumer electronics markets in the US and Japan are thriving, those in Europe remain depressed. Among the many new things that caught our eye were:
- compact disc players for cars;
- hi-fi stereo sound for video recorders;
- picture information on the sub-code lines of the compact disc;
- MSX computers — mainly of Japanese or Far Eastern origin, but surprisingly Philips also showed models and, together with Sony, appears to be the first manufacturer to market this new equipment in (so far only) Germany and Italy. Many people feel that the big problem with the MSX will be the software; isn't it always?
- the Schneider CPC464 home computer — better known in Britain as the Amstrad CPC464!
- a self-adjusting equalizer — a combination of an analyser, equalizer, and built-in microcomputer;
- a computer controlled video disc with merging of computer graphics and a 'real' picture (e.g. movie scene from the disc) on one TV screen.

A farewell...
The Gold Lion KT88 audio valve has reached the end of the line. After 28 years continuous production, the M-O Valve Company has decided to cease manufacture of this famous tetrode to free resources and production capacity for new product lines including integrated circuit packages. The Gold Lion KT77 will also be phased out.
As many of you will know, these valves have been extensively used for many years in music and hifi stereo amplifiers including those of such well-known names as Marshall, Burman, Hi-Watt, Roost, White, (Little White Rock), Radford, Beard, TVA, Grant Lumley, and Grant.

A landmark...
Philips, the world's largest TV manufacturer, has reached a unique landmark in the history of television: production of the company's 100 millionth set. On 6 September, Dr. W. Dekker, Philips' worldwide president, pulled the 100 millionth set off the production line in the company's headquarters at Eindhoven, the Netherlands. To mark the event, one hundred Philips sets were presented to Princess Margriet of the Netherlands for use by the Red Cross.

In Britain, Philips' UK chairman, Mr. Anton Post, presented 100 sets to the National Society for the Prevention of Cruelty to Children, this year celebrating its Centenary. They were received on the Society's behalf by TV and radio star Terry Wogan, just voted top male TV personality of all time in a specially commissioned poll conducted by Philips among 2500 viewers. Philips sells a television set somewhere in the world once every three seconds. The company, which has a large TV factory in Croydon, is the first TV maker ever to reach the landmark of 100 million sets produced. The first hundred million took Philips thirty-five years; the second will take less than ten!
United Kingdom secure a significant position in the world market for digital telephone exchange equipment. Developed jointly by British Telecom, Plessey Telecommunications, and GEC Telecommunications, it has already proved its effectiveness with several pre-production installations in Britain.

The rate of introducing System X is already being stepped up, and as it moves into full production, it becomes a strong contender for selection by telephone administrations in other countries.

A nostalgic moment...

On 6th September last the BBC commemorated the 50th anniversary of the start of broadcasts from its Droitwich long-wave transmitter. In the 1930s Droitwich was a name on the listeners' radio dial. The name Droitwich was known not only for its spa, but also for its radio service, and it continues as an honoured name in the transmitter world. Right now, only the second replacement transmitter since 1934 is being installed; all three transmitters have been supplied by Marconi, indicating the long term association the BBC has had with the British industry.

Technology has not stood still and the latest transmitter will use a new modulation system and has a conversion efficiency of some 70 per cent. This compares with 30 per cent for the old transmitter — a significant saving in power costs.

In 1934 the long-wave transmitter was three times more powerful than any previous BBC transmitter. Its aerial system was suspended between two 700-foot stayed lattice masts still in service today.

Before it was connected to the public electricity supply in mid-1940, the station provided its own power supply. To do this, it had four six-cylinder diesel engines, each driving an alternator with an output of 470 kilowatts at 415 volts, 3-phase 50 Hz. The generators were mounted on a 900-ton reinforced concrete block, floating on cork to stop noise from vibration!

Satellite monitored from Britain

The performance of the newly-launched European communications satellite, ECS2, in providing data is being monitored from a British Telecom International earth station. ECS2 went into orbit, launched by the Ariane space rocket, last August. Eutelsat, the body which administers the European satellite system, has awarded a one million pounds sterling contract to British Telecom.

From the satellite earth station at Madeley (West Midlands), a new dish aerial is sending pilot signals to ECS2 to enable European business users to aim their aerials accurately at the satellite.

The Madeley aerial then monitors transmissions on the satellite's business services transponder — a reflecting device which receives, transmits, and translates commercial data onto correct frequencies.

Eutelsat was set up in 1977 and comprises all twenty western European countries collaborating in the communications satellite venture. (LPS)

Video disc — a success?

Austin Rover is using the recently introduced Thorn-EMI VHD Videodisc system to support the launch of its new Rover 200 series motor car. In this, the first commercial application of the Thorn-EMI VHD unit, a specially designed keypad containing a preprogrammed EPROM is the brain of the system, and dispenses with the need for a separate computer to control the disc.

The discs used in this system provide sixty minutes playing time on each side, and any part of the disc can be accessed within seconds. Two discs have been prepared with details on the new range of cars for point-of-sale use by dealers to permit interactive perusal by potential customers. Further discs are being used to aid the training of dealers' sales and service staff.

This system was chosen in preference to a conventional video tape player because it has some important advantages, such as rapid and precise access to any part of the disc; distortion-free frame hold, excellent picture quality, and long wear rate which allows prolonged use.

Austin Rover claims to be the first company to have developed and applied the videodisc technology in a way that directly benefits the consumer. In the sales room, it will to a large extent replace the function of the conventional sales brochure. (LPS)

...or a failure?

After Philips' Laservision videodisc system had previously failed to excite the public, RCA and Hitachi have also admitted defeat by stopping production of their CED videodisc system.

There appear to be several reasons for this collapse of what was thought to be a market winner only about a year ago.

First, the videodisc system offers no recording facility unlike the video cassette machines, and this has turned away tens of thousands of potential buyers who use this type of equipment mainly for "time shifting" of TV programmes.

Secondly, there are nowhere near enough disc titles available. As this is almost certainly the major reason that the Philips V2000 VCR has not fulfilled its early promises, it seems a remarkable oversight on the part of RCA/Hitachi. (The V2000 system lost the rich consumer market to the VHS system because the latter had an immensely wider choice of prerecorded popular films. Sony's Betamix is now in a similar catastrophic situation as Philips some years ago).

Thirdly, whatever disc titles were available (a few hundred at most) could not be hired from the large majority of High Street music and bookstores which continue to concentrate on prerecorded video cassettes.

Satellite firms

The Home Secretary, Mr Brittan, recently announced the five companies which will comprise the 'third party' with the BBC and ITV in the £400 million satellite television service.

The five companies are: Consolidated Satellite Broadcasting (linked to Radio Tele Luxembourg), Granada TV Rental, Rea'son's (who own Goldcrest Films and Television), Thorn-EMI, and the Virgin records, video, and air travel Group.

It is envisaged that the BBC will have a fifty per cent share, the ITV companies thirty per cent, and the 'third party' a twenty per cent share, but these figures have not been finally decided.
New materials for optical memories

Optical recording for information-processing systems

The storage of information by optical methods has many advantages over the conventional method of magnetic recording. Philips research laboratories are currently studying tellurium-selenium alloys, organic compounds, and magneto-optical materials that can function as optical memories. Depending on the material used, digital data (alphanumeric data and digital audio) and video information can be stored. The advantages are rapid access to the information and a very large storage capacity. It is becoming apparent that the scope for the application of optical recording is very varied. It will be possible to meet the specific requirements of new categories of users. Magnetic materials for use as a memory for storing information have been studied for many years at Philips research laboratories. One result of the fundamental studies of iron oxides is magnetic tape for many applications, including storage of large quantities of alphanumeric data and audio and video recording. As the use of magnetic tape increases and user requirements become more specific, various failings of this medium become apparent. The storage capacity is limited and the information is only reliable for a certain time owing to demagnetization. But sometimes the law requires that information should be stored for a long time. It then becomes necessary to copy the information every few years to guarantee its reliability. A further disadvantage of magnetic tape is that it may take a long time to locate a particular item. Philips research have long been seeking new methods of storage. The electro-optical techniques originally developed for LaserVision and the Compact Disc have provided a good starting point, since they are used for the storage of images and sound and are centrally produced. However, it is also possible for the user himself to store and retrieve information. In some cases, this information stored locally can be erased and replaced by new information. The major advantages of the new optical techniques are the larger storage capacity and more rapid access to the information. In brief, an electro-optical recording system consists of a disc the size of an LP covered with a sensitive layer in which a laser makes microscopically small pits. Depending on the basic material, a particular physical effect occurs during read-out by the laser so that the information becomes available in coded form. The nature of the material determines whether digital data (alphabetic information and digital audio) or video information can be stored. This depends on the required signal-to-noise ratio. The requirements for video in this respect are more difficult because of the large number of grey levels. For digital data (only two levels) things are much easier. The material also determines whether the information can be erased.

As optical recording obviously had much to offer, an intensive search began for materials on which information could be stored with the aid of a laser. Philips research laboratories are currently studying three classes of material that seem suitable for the optical recording of information: tellurium-selenium alloys, organic compounds, and magneto-optical materials. The last two groups are still almost completely at the research stage. Much more is known about tellurium alloys and, indeed, these have already been used in, for instance, the data disc for the digital optical recorder used in the Megadoc system introduced earlier this year. Despite great differences between the new media, there are a number of characteristic similarities in the recording and reproduction systems. Whichever disc is used, the system works best with a diode laser that operates in the infrared (about 800 nm) region. This laser creates a physical change in the storage material (hole formation or a phase change in a tellurium-selenium alloy, pit formation in an organic compound, and magnetization direction in a magneto-optical material). All such areas have a cross-section of about 1 micron, as the photographs show. The power of the laser for writing in information is about 10 mW at a pulse length of 50 ns. The read-out power is about 0.5 mW for all materials.

Tellurium-selenium alloys

One of the new materials for the storage of information is a polycrystalline tellurium-selenium alloy to which small quantities of other elements have been added, e.g. arsenic to give better control of the melting point and the stability of the material. A thin layer of the alloy is applied to a substrate. A narrow laser beam is used to melt this material locally so that holes are created with the same depth as the layer. During the read-out process, with a less intense laser beam, the presence or absence of holes produces differences in the reflection of the laser light. These differences in reflection represent the information in coded form.

Photo 1. The surface of a disc for Digital Optical Recording on a tellurium-selenium alloy. The horizontal grooves are the pre-printed tracks for the 1 μm-diameter pits used for recording digital data. Local widening of the pre-printed tracks gives the addresses that permit rapid retrieval of the recorded information.
Research has been concentrated on determining the composition of the alloy and on finding an efficient technique for applying a very thin layer of the alloy to a disc. The 'shelf life' of the discs is extremely good. Life tests have shown that the stored information can be guaranteed for at least ten years without any need for special environmental conditions. Shelf life will be greatly increased in a controlled environment.

The signal-to-noise ratio that can be achieved is so high that the disc with a tellurium-selenium alloy is ideally suitable for use as a storage medium for both digital data (alphanumeric information or digital audio) and video recording. The data disc for the digital optical recorder uses this technology. A compatible player is made by Van der Heem Electronics to a design by Philips Research Laboratories in Eindhoven (the Netherlands). Disc and player form one section of the Megadoc electronic data-storage system made by Philips Data Systems. A second type of player is currently being developed by Optical Peripherals Laboratory (U.S.A.), a joint venture of Control Data Corporation and Philips.

The use of tellurium alloys also makes it possible to record information on a disc, erase it, and then use the disc again to record new information. By choosing the energy output of the laser appropriately (compared with the level necessary for the 'hole' disc) the polycrystalline material is melted locally, but no holes are formed. After the laser pulse the molten areas cool down so quickly that they solidify in a metastable amorphous phase. These amorphous domains reflect differently from the crystalline surroundings on read-out. Erasure takes place when a laser with a sufficiently high energy level transforms the amorphous domains into the crystalline phase.

In most applications the disc can be used and erased many times. In principle, storage of both digital data and video recording is possible because of the high signal-to-noise ratio. These materials for erasable storage are now at the transition stage between research and development.

Organic compounds

Organic dyes exist that absorb a great deal of light and have a high reflectance even when applied in very thin layers. These thin layers of organic compounds seem to be a promising alternative to tellurium-selenium alloys. The memory effect is again obtained by melting the material locally with a laser to create small pits. The difference from the tellurium-selenium alloy is that these pits do not normally penetrate through to the substrate. The reflectance varies with the depth of the pit. The difference in reflection created by the pattern of pits is used when the information is being read. This melting process is irreversible, so the disc can only be written once. The shelf life is good: it has been found that these organic compounds retain the information just as well as the 'hole' discs with tellurium-selenium alloys. A great deal of research has been done on the 'light-fastness' of the material, which ensures that its characteristic properties remain unchanged. These compounds have also been found to be very resistant to heat and moisture. One attractive feature is the simple spin-coating process for applying the organic compound to the disc.

This type of disc has many applications. The signal-to-noise ratio obtained experimentally is high enough for the storage of both digital and video information.

Magneto-optical materials

Amorphous magnetic gadolinium-iron-cobalt compounds have been known for a long time. A laser can be used to heat the material locally, reverse the polarity of small areas and freeze it in this state. This technique makes it possible to 'write' on a magnetised layer in a pattern of areas of opposite magnetization directions. This type of pattern can then be read out with polarized laser light. The direction of polarization of the reflected light is rotated slightly with respect to the polarization of the original laser beam as a result of the Kerr effect. The 'written' areas on the disc can therefore be distinguished from the unwritten ones, and information can be read out. The information can be erased just as easily as it is written. The areas to be erased are heated by the laser, while an external magnetic field is applied with the same direction as the original magnetization of the layer; the magnetization of the heated area reverts to its original direction after cooling. The information can be written, erased, and rewritten as often as required.

The present research is much concerned with the operational life of the stored information. The stability of the material is very important here.

At present the signal-to-noise ratio is only moderate, so this storage method is suitable for digital data only (alphanumeric information and digital audio signals). It could very well be possible to improve the signal-to-noise ratio sufficiently for the recording of video signals.

Photo 2. Pattern of pits on the surface of an information-storage disc with organic dyes in the coating.
Once upon a time...

the story of valves

Before the arrival of the transistor all amplifiers, transmitters, receivers, etc., were made with valves. In the eyes of many 'modern' people valves were (and are) fragile and unreliable and had a short lifespan. Not all that long ago, however, there was no alternative. Before the valve there were simply no amplifiers, and the transistor was only invented in 1948. But think about this: without FM transmitters (which contain valves) would there be any point in having a compact transistorised FM receiver?

What exactly is a valve? Many of our more mature readers know, of course, but some of the youngsters may think something along the lines of: "Oh yes, one of those old-fashioned fragile glass things with all sorts of complicated-looking bits and pieces inside". This definition is not strictly wrong but it leaves out rather a lot. True, a valve is made of glass but, in spite of its appearance, it is not all that fragile, nor is it necessarily 'old-fashioned'. Valves are actually indispensable for certain applications (even today) and in others — such as hi-fi for example — they are on the way back 'in'. (To see this you need look no further than the valve amplifier elsewhere in this issue).

What, then, is a better definition for a valve? The transistor's predecessor is seen as a device in which electrons are fed into one side and come out on the other side. Between the two electrodes is a control electrode that can pass or inhibit the flow of electrons as desired. A major difference between this and the transistor is that no current flows through the control electrode. In this respect valves are more similar to (MOS)FETs than to bipolar transistors.

Are there other notable differences between valves and transistors? Plenty! It is quite normal for a valve to become warm even in its quiescent state: its innards must glow, actually, in order to generate the
cloud of electrons needed. Although mechanically it is vulnerable, the valve is very robust in an electrical sense: it is almost indestructible! If something does go wrong then the impending failure can almost always be predicted beforehand simply by looking carefully at the tube. It does not just suddenly kick the bucket like a transistor!

That, basically, is a sum-up of the most important points about valves. Up to now Elektor has had very little to do with valves but none the less some of our old hands are very knowledgeable on the subject. When we picked their brains this is the story that came to light.

Under the magnifying glass

An essential part in the operation of any valve is the movement of charge carriers (electrons) in a virtual vacuum. A valve consists of a glass tube containing a simple or complex electrode system. The electrodes must include at least a cathode and an anode.

The cathode often has the shape of a nickel tube covered with a layer of barium strontium oxide. It is warmed to a temperature of about 700...800°C by a filament in the tube. The surface then attains a dark red colour. The filament is electrically isolated from the cathode by heat conduction is very good.

The heat increases the motion of the electrons in the cathode. As a result of this some of the electrons will reach a speed greater than the so-called 'emission velocity' and will leave the surface (this is known as the Edison effect). An electron cloud (known as the space charge) then forms around the cathode. This cloud has a negative charge so the cathode is positively charged. A balance between cathode and electron cloud is reached, depending on the cathode temperature and material.

If a metal plate which has a positive potential with respect to the cathode (an anode in other words) is now placed at a certain distance from the cathode it attracts some of the electrons. The cathode then redresses the balance by releasing more electrons into the space charge. (From now on we will forget the interaction between cathode and electron cloud and simply refer to 'the cathode').

From the previous paragraph we see that electrons flow from cathode to anode (this is the anode current). Even if the anode is negative with respect to the cathode a (small) current will still flow because the electron cloud is negative with respect to the anode. This valve, called a diode, has no threshold voltage. As the anode is not heated no current will flow in the vacuum if the anode is negative with respect to the cathode. Current flows in one direction only so this diode can act as a rectifier.

Triode, pentode, and other valves

A three-electrode valve (triode) is made by placing a third electrode at a certain position between cathode and anode. This third electrode is normally in the form of a spiral with a fairly large pitch and is called the grid or control grid. If the voltage presented to this control grid is negative with respect to the cathode then the electric field between cathode and control grid will oppose and possibly even completely suppress the field between cathode and anode. The voltage between cathode and anode is the anode voltage. This voltage must be slightly negative in order to suppress the anode current completely. At zero volts there is already a small anode current flowing. This sort of valve was perfect for a diode voltmeter, to name but one application.

Figure 1a. In a diode the anode voltage must be slightly negative in order to suppress the anode current completely. At zero volts there is already a small anode current flowing. This sort of valve was perfect for a diode voltmeter, to name but one application.

Figure 1b. The triode characteristic clearly shows that for a small change in grid voltage (e.g., 2 V) a much larger anode voltage change (50 V) is needed in order to keep the anode current constant.

Figure 1c. This tetrode characteristic displays a marked dip where the anode voltage is lower than the screen grid voltage. The dip is caused by secondary electrons that flow from the anode to the screen grid.

Figure 1d. The pentode characteristic is notably flatter than the previous ones. It displays a certain similarity to a transistor's Ic/|Uc| characteristic.
on the control grid thus affects the anode current. If the magnitude of the negative control grid voltage is increased it can shut off the valve completely. By applying an alternating voltage to the control grid, the anode current is made to vary in time with the alternating signal.

The grid is much closer to the cathode than the anode so the anode voltage (which gives an attractive force) must change more than the grid voltage (repulsive force) in order to compensate for any fluctuations in the grid voltage and thus keep the anode current, $I_a$, constant. The ratio between these two changes is called the amplification factor and is given by the letters $A$ or $g$. The ratio between a small change in grid voltage and the resultant change in anode current (if the anode voltage remains constant) is called the mutual conductance or slope ($S$) of the valve. The valve can be used as an amplifier if a d.c. or a.c. resistance is connected in series with the anode line.

The anode and control grid of a triode form a capacitor. The anode circuit and control grid circuit are therefore capacitively coupled. The capacitive reactance decreases as the frequency increases. At high frequencies this can result in transfer from the anode circuit to the grid circuit so the whole circuit may oscillate. An extra grid, whose voltage remains constant with respect to the cathode, can be included between the anode and the control grid. This fourth electrode, called the screen grid, reduces the transfer characteristic drastically. The screen grid must not inhibit the anode current so it is fed a suitably high positive voltage.

Electrons that manage to pass the screen grid are speeded up by the attraction to the anode. In some cases the speed may become so great that the impact energy is too much for the anode. The impact of a single electron can then cause the anode to release a number of electrons. The electrons thus released (secondary electrons) can either return to the anode or go to the screen grid. In the latter case the anode current characteristic displays a marked ‘dip’, at which point the circuit displays negative resistance properties and a tendency to oscillate.

A further electrode may be introduced between anode and screen grid to oppose the flow of electrons from the former to the latter. This so-called suppressor grid is generally connected to the cathode. Its purpose is to reduce the speed of secondary electrons so that they reverse direction and return to the anode. This sort of valve, with five electrodes, is called a pentode.

Other types of valves were also common, such as: the hexode (6 electrodes), the heptode (7 electrodes) and the octode (8 electrodes, six of which were grids). Numerous combinations were also made, producing the duodiode pentode, triode hexode, triode heptode, and so on.

**Pros and cons**

Normal radio valves were, of course, inferior to transistors in some respects. Transistors, for example, require no power.
to drive a filament but valves can handle much higher voltages and temperatures. Breakability of valves was not really such a problem as transistors cannot survive too much rough handling either. Just as with filament lamps, the anticipated lifespan was a compromise. Where long life was necessary (and more important than low cost) special types of valves could be specified, such as SQ (Special Quality), LL (Long Life), and telephony valves, all of which had an expected lifespan of at least 10,000 hours. Apart from the ability to handle more power, the most important difference between transistors and valves is size. Valves are much larger so the case housing a valve amplifier, for instance, must be larger than its transistorised counterpart and it must have plenty of holes or slits to allow cooling air to enter. For the most part valves have been replaced by transistors. They are generally only used now in high-power transmitters and for high frequency heating in industry. Valves still appear in other forms as magnetrons in radar transmitters and microwave ovens, as klystrons in TV transmitters and, of course, as cathode ray tubes in TV receivers.

Practical tips

Compared to transistors, some problems in equipment containing valves are fairly easy to track down. After power is applied it is easy to look at all valves and see if they are glowing. If so this means that the filament is intact and that it is being fed a voltage. In a tetrode or pentode the screen grid (the second out from the middle) must never glow. A red glow from inside, which may only be visible from some viewpoint underneath, signifies an overload of the screen grid. The power must be switched off and on or the grid must be adjusted. If the anode also starts to glow the power must be removed instantly because something is really wrong. The anode is heated by the filament and provides the electron cloud. The set-up shown here (figure 4) was sometimes used when studying the operation of a valve. It consisted of a fairly taut sheet of rubber, in which the changes of potential at the different electrodes are represented by rises and falls in the surface. As the middle was higher than the outside rim the effect of gravity helped simulate the various forces on the electrons. Steel balls were released from the middle (the cathode) and rolled outwards. The braking effect of a grid was mirrored using metal rings to raise the rubber surface at places. A ball that had to roll up an incline was slowed down, only to speed up again when rolling down the other side of this 'grid'.

The story of valves

Elektor November 1984
Light dimmers are available in all sorts of different forms. This circuit, however, is unlike any we have seen before. Its most important feature is the fact that at the push of a button it starts to dim the light automatically. The time taken to dim completely is about thirty minutes. This makes it ideal for a child's bedroom, where it can be used instead of a night-light. As you leave the room after putting the child to bed the button on the dimmer should be pressed. The dimming process is then so gradual that the child does not notice it and can sleep peacefully.

A dedicated IC

The heart of the circuit is the Plessey SL440. This IC is intended for applications in which a.c. power is varied by using phase control. Elsewhere in this issue we dedicate an 'Applicator' to the SL440. For this reason we will only deal here with how the IC is used in the autodim.

Moving straight to the circuit diagram, figure 1, we see that mains power is fed to IC1 via D1 and R2 (pin 2) and also via RF filter R1, R11, C1, D2 and D3 (pin 3). This diode pump circuit is used because of its low power loss and because it is simple. The 220 Ω resistor (R1) serves to protect the SL440 from any surges that might occur when the power is switched on. Strictly speaking, C3 is also part of the...
power supply circuit as it is a smoothing capacitor. The second pole of the mains is fed straight to the common terminal (pin 11) of IC1.

Within the IC, pin 3 is connected to a d.c. stabiliser that provides a supply for the internal circuits. This pin is therefore kept at a constant 11.3 V, which makes it an ideal source of voltage for external circuitry.

The zero-crossing detector in the SL440 is fed a 50 Hz signal via pin 2. When the crossover point is detected the trigger pulse generator is inhibited and the delay timing circuit is reset. An external capacitor (C4) connected to pin 14 then starts to charge. The rate of charge depends on the d.c. potential applied to pin 13. It is clear from figure 1 that this voltage is determined by the setting of P1. When the charge on C4 reaches a certain level a trigger pulse is output at pin 1. This negative gate drive pulse is fed through C2 and R4 to Tril which then conducts. The capacitor connected between pins 12 and 13 of IC1 (i.e. C5) acts in conjunction with the internal circuitry to form an integrator with a very shallow slope. This is used by the circuit in its automatic dimming procedure. When push button S1 is pressed capacitor C5 charges slowly and the lamp gradually dims to the level set with P1. The time taken for this depends on the values of C5 and R6. With the components indicated it is about 30 minutes.

Construction and calibration

The photograph at the start of this article will serve as an aid to assembling the printed circuit board. (Note that we have made a 39 k resistor for R2 by mounting 47 k on top of, and in parallel with, 220 k. The only reason for this is that we did not have a 39 k, 1 W resistor to hand when this prototype was being constructed.)

For the purposes of calibration, capacitor C5 is left out of the circuit. Power is applied to the autodim with a lamp connected to the output. By turning P1 from one extreme to the other it should be possible to vary the brightness of the lamp from fully off to fully on. If this is not possible the value of resistor R9 must be changed. This can be done by trial and error, but it is also possible to calculate the correct value using the formula given in the margin here. If a 22 n capacitor C5 is used (i.e. C4 as we have done) the d.c. voltage present at pin 13 of IC1 must be between about 3 and 8 volts. Component tolerances could mean that this requirement is not met. Note that when measuring this voltage the meter used must have an impedance of at least 1 MΩ.

When the correct value of R9 has been found and the circuit is working properly C5 should be fitted onto the printed circuit board. The autodim is then tested to check the complete operation. Even if the circuit has worked correctly so far it may now start to act up. As soon as the lamp is dimmed it may begin to become brighter again even if you do nothing to it.

This is, once again, solved by changing (in this case increasing) the value of R9.

Final points

When working on this circuit it is wise to remember that there are 240 V at various points so be careful about where you stick your multimeter probes (or fingers!). The printed circuit board, which is shown in figure 2, measures only about 70 mm square so it may be possible to fit it into the recess behind a normal light switch. Alternatively, it may be mounted in a small case and used with standard or table lamps, for example. As we have already said this is a very special dimmer, intended for a specific application. The power handling capabilities (1A at 100 W) are therefore quite sufficient. In use, this circuit will soon prove its worth. Not only will your child sleep easily thinking the light will remain on, but you can relax knowing that electricity is not being wasted by having a lamp burning all night.

Bibliography:

Phase control of a.c. power with the SL440 — Plessey Semiconductors.
Applicator (elsewhere in this issue)
Many home computer enthusiasts dream of the day they will be able to get themselves a printer. Programming and editing on the monitor can be very tiring — to say the least. In many cases the Centronics interface is already available or, as in the Commodore 64, programmable. All that is needed, therefore, is a printer. Unfortunately, printers are still pretty expensive: a look at recent advertisements indicates a price range from about £200 to £500 (incl. VAT). So how would you like one for considerably less than £100? That's all it costs to build our Mini Printer.

As the article describes the principle of a dot matrix printer in some detail, it is also of interest to those who have no intention of building the printer.
For most listings, the eighty or even 126 characters per line as provided on most dot matrix printers are not really necessary. For disassemblers listings, forty characters per line are ample. And therefore, the only real limitation of our Mini Printer compared with its bigger, commercial brothers is that it prints only forty characters per line. This is adequate for most BASIC programs, too, but if you want to print a BASIC program from a commercial cassette or diskette that has more than forty characters per line, simply format it by adding line numbers. Table 1 gives an example of how this is done.

Price and specification
We obviously do not want to compare the Mini Printer with an Epson or NEC printer which may cost up to eight or ten times as much. What is important is the performance of the Mini Printer, and, as can be seen from the technical data in table 2, that stands up very well.

At this stage, some of you will ask: "That's all well and good, but what about the mechanism and the processor? Are they included in the price, or where do I get them from?" Not to worry — both are catered for. Actually, they caused this project to take off, for some time ago we were provided by Seiko with one of their basic, low-cost mini printers. Once our designers had assessed and modified it, and Seiko had expressed their willingness to supply the processor and hardware on a one-off basis, we had the nucleus of the design presented in this article.

Hardware and chemistry
As shown in the photograph in figure 2, the mechanism of the printer is an ingenious piece of precision engineering. The motor drives not only the spiral guide roller for the print head but also the paper feed, which is made possible by the special construction of the guide roller.

The motor speed is monitored constantly by a tacho-generator built into the motor housing. The print head contains seven thermo needles (miniature heating elements) one above the other. During printing those needles that are to place a dot onto the paper are actuated simultaneously. The thermo paper is continually pressed against the print head by the paper guide.

A thermo-chemical reaction, which discolors the paper, takes place at the position of those needles that are heated. As the paper is white with a dark background, dark dots are caused on the paper. Note that this thermo-active paper may be obtained from stationers and department stores: it is not metallized paper!

Block schematic
The print mechanism must be driven so that an ASCII unit at the input of the Centronics interface is converted into a character on the paper. This cannot be achieved by a simple conversion, because there are also intervals of various lengths between the characters to be considered, as well as the control of the return mechanism and the shifting of the paper feed once a line has been completed. All this is taken care of by the single-chip central processing unit (CPU) type 8049: when this is programmed for our purposes it is type-coded 8049C289.

As can be seen from the block schematic in figure 3, the CPU is at the centre of a number of additional stages which are actually contained in only a few components. The Centronics interface matches the CPU input to the Centronics standard. The 'print format' determines the number of characters per line. 'Control' enables the manual control of the paper feed and reset. The clock for the printer is generated separate from that for the CPU.

Table 1.

<table>
<thead>
<tr>
<th>Character</th>
<th>ASCII Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>65</td>
</tr>
<tr>
<td>B</td>
<td>66</td>
</tr>
<tr>
<td>C</td>
<td>67</td>
</tr>
<tr>
<td>D</td>
<td>68</td>
</tr>
</tbody>
</table>

Table 2.

<table>
<thead>
<tr>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centronics interface with STB, READY, ACK, D0...D7</td>
</tr>
<tr>
<td>CPU: single-chip microcomputer 8049C289</td>
</tr>
<tr>
<td>dot matrix print head, 7 needles (styli)</td>
</tr>
<tr>
<td>5 x 7 dot matrix</td>
</tr>
<tr>
<td>characters separated by two spaces</td>
</tr>
<tr>
<td>contents: 150 characters</td>
</tr>
<tr>
<td>speed: 80 characters per second (c.p.s.)</td>
</tr>
<tr>
<td>13, 16, 17, 20, 24, 25, 32, or 40 characters per line (presettable or programmable)</td>
</tr>
<tr>
<td>printing direction: left to right</td>
</tr>
<tr>
<td>width of thermo paper: 79 mm</td>
</tr>
<tr>
<td>switches for paper feed and reset</td>
</tr>
<tr>
<td>power supply requirements: 5 V ± 5%, current consumption 3 A maximum during printing, 130 mA on standby, power supply on printed circuit</td>
</tr>
</tbody>
</table>

Figure 2. It is clear from this photograph that the printing mechanism is a fine piece of precision engineering that you could not hope to build yourself.
Figure 3. The block schematic shows to what extent the printer is centred on the CPU.

Table 3. How to set the number of characters per line with the appropriate wire bridge(s).

<table>
<thead>
<tr>
<th>Characters per line</th>
<th>P20</th>
<th>P21</th>
<th>P22</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>16</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>17</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>20</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>24</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>25</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>32</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>40</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

By adjusting the printer clock, the contrast, that is, the darkness with which the dot is printed on the paper, is changed. Moreover, the supply voltage and the ambient temperature also affect the circuit, so that the contrast ensures an even print quality.

The 'power down reset' stage will be discussed in detail in the circuit description. The 'power supply' is shown connected to the print head interface, the thermo print head, and the motor only, because these elements between them consume by far the larger part of the current, but it powers the other parts of the circuit as well, of course. The 'print head interface' transforms the logic level of the CPU output into a sufficiently large current for the individual thermo needles, and also controls the motor and the print head. Finally, the 'pulse shaper' converts the sinusoidal output of the tachogenerator into rectangular signals at TTL level.

Circuit description

The various blocks of figure 3 are easily recognized in the circuit diagram in figure 4 which again is dominated by the CPU. The Centronics interface consists of pull-up resistors R24...R31 and R37, as well as the two monostable multivibrators, MMV1 and MMV2. The strobe signals provided by different computers vary between a half and several microseconds. As the 8049 requires a signal of about 50 milliseconds, the strobe signal, STB, is stretched appropriately in MMV1. In the Centronics standard, at the READY signal the level of the signal is determinant, whereas at the ACK signal, the trailing edge of the pulse is. Most computers, including the Junior, and interface elements such as the PIA8255, need the trailing edge and therefore use the ACK signal for acknowledgment. Here, it is derived by MMV2 from the READY signal generated by the CPU.

The print format, that is, the number of characters per line, is determined by wire bridges P20...P22 as shown in table 3. If you want, a DIL switch may be used instead of the bridges, or the port lines may be controlled by TTL levels so that the number of characters can be changed every line. The fewer characters per line are chosen, the wider and bolder they become.

The reset and paper feed signals, controlled by push button switches S3 and S1 respectively, are actuated on negative logic levels. Both these networks need a current limiting resistor, R4 and R5, but
the paper feed circuit also needs a
decoupling capacitor, C3. The decoupling
is not necessary for the CPU but as a
'kindness' to the motor and print
mechanism. Port P23 of the CPU is not
scanned during the printing process so
that switch S2 is then inoperative.
The clock oscillator for the printer con-
sists of gates N1, N2, N4, resistor R9, and
capacitor C9. A presettable current source
comprising transistor T3, resistors R6...R9,
and preset P1 loads the oscillator circuit
and can therefore affect the frequency.
This arrangement makes diode D1
necessary. The output of the oscillator is
buffered by N3. The frequency of the
clock is nominally 16 kHz but can swing
over quite a wide range. It should be
noted here that the current source is
affected not only by the setting of P1 but
also by the supply voltage and the
ambient temperature. In this way the
effects of voltage and temperature vari-
ations are kept within tight limits to ensure
even quality of print.
To understand this, you have to take the
print head drive bus and the print head
interface into consideration as well. The
head drive bus consists of the data bus of
the CPU, DB0...DB7, and port line P27.
The dot information, which the CPU has
built up from the ASCII units, is available
at DB0...DB6. The motor is controlled
from DB7. Integrated circuit IC2 is an
8-transistor array which is used here as a
non-inverting line driver. The common
connection of the heating elements, as
well as the positive terminal of the motor,
is at +5 V. The motor and the appropriate
heating elements are actuated by connec-

Figure 4. The dominant
position of the CPU is
also evident in the circuit
diagram.
Figure 5. Construction of the electronics part of the printer becomes fairly simple on this PC board.

The pulse width of the needle point outputs is determined by the frequency of the printer clock and the CPU. The processor checks whether the corresponding heating element has been in operation recently. If so, the element is still warm and should not be supplied with heating current for too long, otherwise it may burn out. Therefore, the CPU holds the relevant output active (i.e. at logic 0) for only sixteen clock pulses, starting with the fifth of the dot cycle. If the element has not been heated recently, the CPU output remains at logic 0 for twenty clock pulses, starting with the first of the dot cycle.

When the data bus is in the high-impedance state, pull-up resistors R16...R23 are connected to it via port P27 and T2. This is essential as the 8049 does not have internal pull-up resistors. Always make sure that the inputs of IC2 are unambiguously at logic 1 when the data bus of the CPU is inactive.

Terminal R of the print head interface controls the print head in position 'home'. Capacitor C13 is necessary to decouple the motor power line from that to the heating elements, which has the added benefit of contributing to even quality of printing.

The pulse shaper for the tacho signal is formed by D2, T1, R12, R13, and C8. Ignoring the threshold voltage of the diode, the shaper functions as follows. During the positive half cycle, D2 blocks, whereupon T1 gets a sufficiently high base current via R13 to start conducting. During the negative half cycle, D2 conducts, so that the base of T1 is negative, and the transistor is cut off. A rectangular signal at TTL level, the frequency of which is equal to that of the sine wave at pin 1 of the 8049, therefore exists at the collector of T1.

Capacitors C6 and C7, and inductor L1, are the externally required components for the internal clock of the CPU. The
clock frequency is around 6 MHz: its exact value depends on the tolerances of the external components. The precise value is, however, not important as the 8049 is on 'hold' for most of the time.

The power down reset circuit is based on the precision voltage comparator ICL8211. The circuit ensures that during short breaks in the supply voltage the program of the CPU is not confused which might conceivably give rise to the heating elements being actuated inadvertently and so cause the print head to burn out.

To do so, the circuit generates a reset pulse during supply breaks: a printing error is better than a burnt-out print head! Strictly speaking, however, the circuit is not necessary because in most cases mains power failure is completely taken care of in the power supply. In any case, in the absence of mains voltage, the power on reset is activated when the printer is switched on. And if the worst comes to the worst, a print head costs only a few pounds. It is, however, important that if the power down reset circuit is not used, the RESET terminal, pin 4, of the CPU is taken to earth via C5: there should be no other connections to this pin!

The power supply is a conventional circuit with fixed voltage regulator, for which in this case a 78H05 (with aluminium TO-3 housing!) is used to cope with the current requirement of the printer.

Construction

Note: owing to space shortage on the printed circuit the designations of P20...P22 on the board in figure 5 are cramped together: the outer terminal is not for P22 but is the common one for the three bridges leading to R3.

IMPORTANT: Before soldering multturn preset P1 in position, set it to the centre of its travel, that is, to about 25 k measured with a multimeter. This setting should not be changed until calibration! It is there-

---

**parts list**

**Resistors:**

- R1, R2, R14 = 27 k
- R3, R4, R5, R11 = 1 k
- R6 = 150 k
- R7, R8 = 22 k
- R9, R32 = 2 k
- R10 = 100 k
- R12, R13 = 180 k
- R15...R31, R37 = 10 k
- R33 = 15 k
- R34 = 3 M
- R35 = 18 k
- R36 = 6.8

- P1 = 50 k multturn cermet preset rectangular
- P2 = 5 k multturn cermet preset rectangular

**Capacitors:**

- C1, C2 = 1 n
- C3, C4 = 10 n
- C5, C11 = 1 µ/16 V
- C6, C7 = 33 p
- C8 = 500 p
- C9 = 820 p
- C10 = 2200 µ/25 V
- C12, C14...C17 = 100 n
- C13 = 1000 µ/10 V

**Semiconductors:**

- D1, D2 = 1N4148
- T1, T3 = BC 5508
- T2 = BC 5606
- IC1 = 8049C289
- IC2 = LB1256
- IC3 = 78H05
- IC4 = 74LS221
- IC5 = 4006
- IC6 = ICL8211** (Intersil)

**Miscellaneous:**

- L1 = inductor, 270 µH
- S1, S2 = single-make push buttons
- B1 = rectifier bridge
- B40C5000 (40 V, 5 A)
- Thermal printer, Seiko type MTP401
- Heat sink, for TO-3
- 14-way DIL socket (for Centronics input: this component is optional as connection may be made, if desired, by soldering flat ribbon cable direct to the board)
- 8-way 25 pin ribbon cable connector (same comments as for 14-way DIL socket)
- Case, 205 x 155 x 65 mm
- Printed circuit board 54106

*Available from Roxburgh Electronics Ltd 22 Winchelsea Road Rye East Sussex TN31 7BR

---

*see text*
Table 4

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>STB</td>
</tr>
<tr>
<td>2</td>
<td>D1</td>
</tr>
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<td>D1</td>
</tr>
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<td>D2</td>
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<td>D4</td>
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<td>D6</td>
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<td>9</td>
<td>D7</td>
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<td>10</td>
<td>ACK</td>
</tr>
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<td>11</td>
<td>READY</td>
</tr>
<tr>
<td>12</td>
<td>14 earth</td>
</tr>
<tr>
<td>13</td>
<td>+5 V</td>
</tr>
</tbody>
</table>

Table 4. Pinout of the Centronics input socket on the PC board.

Figures 6 and 7. These photographs show how we have installed our prototypes into an appropriate case.

Before commencing work on the printed circuit, have a look at the photographs in figures 6 and 7 which show how we assembled our prototypes. The printing mechanism is fitted on a metal plate above the printed circuit and is fastened to the rear panel of the case. This arrangement saves a lot of space and the case can therefore be smaller and less expensive. The connection between the output terminals on the printed circuit and the socket on the side panel (for the flexible print head cable) is best made in flat ribbon cable.

We have designed a simple holder for the paper roll and this is fitted at the rear panel of the case behind the paper entry and exit slits. The position of these slits is shown in figure 10. If the holder is positioned accurately, the beginning of a new paper roll (cut straight beforehand) is simply inserted into the entry slit, the paper feed picks it up (press SI!), and it then emerges from the exit slit. It is thus not necessary for the case to be opened to change the paper roll.

Either touch-type or normal push button switches may be used for S1 and S2. In either case the relevant part of the PC board (clearly marked on figure 5) must be cut off and fitted behind an appropriate cut-out in the front panel. Cutting part off the board enables the use of a variety of mains transformers.

It is, of course, perfectly feasible to assemble the printer to your own design; the only thing you have to be careful with
is to ensure that the paper does not pass across the heat sink of the voltage regulator or the mains transformer.
Finally, it is recommended that in spite of the temperature-compensated oscillator circuit some air vents are provided in the case.
Table 4 shows the pinout of the Centronics socket on the printed circuit, while figure 8 shows the connectors to the printing mechanism and the print head.

Calibration

IMPORTANT: before the printer is connected to the mains, make certain that P1 has been preset as instructed under ‘construction’; failure to do so may result in a burnt-out print head! Also, before the calibration is commenced, the printer must be connected to the Centronics output of a computer. The computer is then programmed to give forty letter characters in a line. Switch on the printer and let the computer pass the line of characters to the printer: the print head should now move across the paper. In most cases there will also be a print-out on the paper, most probably too bold or too faint, and as likely as not there will not be forty characters across the paper width.
There will either be forty characters across part of the width of the paper, or there will be fewer than forty printed in too wide a fount. Careful adjustment of P1 and repeated test print-outs will result in optimum setting of the potentiometer and this is evidenced by the printing of forty clean characters in line across the width of the paper. During this calibration it will become quite clear how the printer clock affects both the number of characters per line (or rather, their width on the paper) and the contrast (i.e. how bold or faint the characters are printed).
If you have incorporated the power down reset circuit, this should next be calibrated. First, pull out the mains plug and that of the print head! Next, connect a regulated power supply across C11 and adjust P2 so that pin 6 of IC8 becomes logic 0 as soon as the output of the power supply drops below 4.5 V. Take care that the voltage does not exceed 5 V during the calibration.
Finally, test the paper feed switch, whereupon the lid can be closed onto the case: the printer is ready for use.
Every week the local papers carry tales of burglaries and break-ins, sometimes in our own street or neighbourhood. Most of these crimes are the work of the 'amateurs' or opportunists of the criminal world and they, unlike their 'professional' counterparts, should be quite susceptible to some sort of deterrent, even if it is very simple. A popular ploy has been to mount an empty burglar alarm box on the side of the house but as the number of affordable burglar alarms has increased recently most people are now more likely to fit the full system. The problem then is the large number of alarms falsely crying 'wolf', with the result that real burglaries often go unnoticed. The circuit proposed in this article does not give false alarms; in fact it gives no alarm at all. Instead it produces a light signal that will never call out the Police unnecessarily, which in itself is a distinct advantage.

The basic circuit

This circuit is a burglar deterrent unlike the run-of-the-mill alarms, as the block diagram of figure 1 shows. Connected directly to the mains is the power supply section, consisting of two parts: a voltage dropper and rectifier, and a regulator. This is directly followed by a clock, which feeds a noise generator formed from a shift register. The resultant noise signal is applied to the last stage, the 'display' via a control section.

A noisy LED

Unusually, for a mains-powered circuit, there is no transformer to be seen on the circuit diagram of figure 2. This means that certain tracks on the printed circuit board carry 240 V a.c. so be careful about working on the circuit, or trouble-shooting it, while the power is switched on. Whenever the mains power is removed capacitor C1 is discharged through resistor R8. If this were not done there would be a chance that the voltage across this capacitor could give somebody a
nasty shock if they touched the pins on
the plug-top.
A 10 V zener diode limits the amplitude of
the half-wave rectified power signal and
this is then buffered by smoothing ca-
pacitor C2 before being fed into voltage
regulator IC1. The output of this 78L05
provides the 5 V needed to supply the cir-
cuit. Two EXOR gates, N1 and N2, make
up the clock oscillator we mentioned
when describing the block diagram. The
frequency of oscillation, with the values
stated here for R2 and C7, is about 2 Hz
but this may vary depending on the
source of IC2. Changing the frequency is
quite simple as its magnitude is roughly
1/(2RC). The clock signal is applied to
pins 1 and 9 of a double four-bit static
shift register. These two registers are
cascaded to form a single eight-bit shift
register, with the eighth bit supplying the
control signal for the LED. The purpose of
this is to form a noise generator. Two bits
from the second shift register are fed
back to the D input of the first register via
an EXOR gate so that the final effect is
that the signal output at Q2 has the form
of a pseudo mains noise. When the power
is first applied to the circuit the section
based on N3 automatically resets the
second shift register to zero by taking its
D input high. Initially N3 functions as an
inverter but after a delay introduced by
the RC time of R3 and C5 it becomes a
non-inverting buffer. From then on the
information from IC3a's highest output
(Q3) is passed straight via pin 7 to the first
register of IC3b. With each successive ris-
ing edge of the clock signal the data is
shifted one place to the right. The same
effect is seen with the information trans-
mitted via N4 to pin 15 of IC3. Every 128
clock periods the pseudo mains noise
generation cycle repeats itself. This cycle

Figure 1. This circuit is
totally unlike any normal
burglar alarm, but this is
hardly surprising as it is
intended as a deterrent,
no more and no less.

Figure 2. Although we
hope this circuit will pro-
tect your valuables there
will be no need to hock
anything to pay for the
components. This low
cost means that several
of these deterrents can
be built and placed at
strategic points in your
home.
Figure 3. Building this circuit should cause no problems using the printed circuit board design given here. The photograph at the bottom of this page will also be of assistance.

Parts list

Resistors:
- R1 = 3M9
- R2, R8 = 1 M
- R3 = 100 k
- R4 = 2k2
- R5 = 47 k
- R6 = 470 Ω
- R7 = 1 k

Capacitors:
- C1 = 470 n/400 V
- C2, C6 = 100 μ/16 V
- C3 = 10 μ/16 V
- C4 = 100 n
- C5 = 22 μ/16 V
- C7 = 330 n

Semiconductors:
- D1 = zener diode, 10 V/1 W
- D2 = 1N4001
- D3 = LED, red
- T1 = BC547
- IC1 = 78L05
- IC2 = 4030
- IC3 = 4015

Using the burglar deterrent

The burglar deterrent is put into service by plugging it into the mains. Probably the most important point in this respect is where it is placed. A suitable location must be chosen so that any would-be housebreaker will see the LED flashing and assume that he has been detected. The impression can be heightened by making a suitable front panel for the case. Let your imagination run wild — that is what the burglar is supposed to do. If the LED does not seem to be striking enough it can also be replaced (together with resistor R5) by a small 6 V/50 mA bulb painted red. Possibly the idea of having 240 V present on the printed circuit board does not appeal to you. If this is the case the section consisting of R7, R6, C1, D1 and D2 may be replaced by a mains transformer rated at 6 V/100 mA and a bridge rectifier (or four 1N4001 diodes).
DANGER! Ultra-violet light is harmful to your eyes, so when working with a mercury vapour lamp, wear some form of effective eye protection.

How to make your own PCBs

You require an aerosol of ISOdraft transparentizer (distributors for the UK: Cannon & Wrin, 68 High St., Chislehurst, Kent, 01 467 0935, who will supply the name and address of your local stockist on request), a mercury vapour lamp, sodium hydroxide (caustic soda), ferric chloride, positive photo-sensitive board material (which can be either bought or home made by applying a film of photo-copying lacquer to normal board material).

Wet the photo-sensitive (track) side of the board thoroughly with the transparent spray.

Lay the layout cut from the relevant page of this magazine with its printed side onto the wet board. Remove any air bubbles by carefully ‘ironing’ the cut-out with some tissue paper.

The whole can now be exposed to ultra-violet light.

The exposure time is dependent upon the ultra-violet lamp used, the distance of the lamp from the board, and the photo-sensitive board. If you use a 300 watt UV lamp at a distance of about 40 cm from the board and a sheet of perspex, an exposure time of 4...8 minutes should normally be sufficient.

After exposure, remove the layout sheet (which can be used again), and rinse the board thoroughly under running water.

After the photo-sensitive film has been developed in a sodium hydroxide solution (about 9 grammes of caustic soda to one litre of water) for no more than 2½...3 mins at 20°C the board can be etched in ferric chloride (500 grammes of FeCl₃ to one litre of water). Then rinse the board (and your hands!) thoroughly under running water. It is advisable to wear rubber or plastic gloves when working with caustic soda or ferric chloride solutions.

Remove the photo-sensitive film from the copper tracks with wire wool and drill the holes.
VDU card
(September 1983, page 9-38)
Where is spoken of the possibility of using a 15 MHz crystal for optimum performance, please read 16 MHz crystal.

mating logic families
February 1984, page 2-48
The formula for $R_{(\text{min})}$ on page 2-51 should read:
$$R_{(\text{min})} = \frac{V_{\text{cc(max)}} - U_{\text{OL(min)}}}{I_{\text{OL}} - \Sigma I_{L}}$$

direct-coupled modem
(October 1984, page 10-48)
C15 should be a tantalum capacitor of 1 μF/16 V with its + terminal connected to R52. It happens occasionally that FF3 sets on switch-on; this may be prevented by connecting a 470 pF capacitor between pins 7 and 11 of IC7. On switch-on, FF3 must then be reset.

lamp saver
(September 1984, page 9-58)
Parts list, version 2: T1 should be BC 549C, BC 550C and T2 should be BC 559C, BC 560C.
The direct-coupled modem featured in last month’s issue of Elektor provides a new (for us) and very important application for the RS232/V24 norm. It is unlike any demands we have made of this protocol before as it makes use of a number of auxiliary control signals that have rarely been needed in Elektor circuits up to now. This means that they are less familiar to us than the normal signals. For that reason we decided to have a close look at the CCITT recommendation and along the way we will see why, when this is a serial ‘interface’, so many lines are needed.

The RS232/V24 standard is seen as the original serial interface. It was introduced to define a specific connection, namely that between terminals and modems. In the words of the CCITT (Consultative Committee for International Telegraph and Telephone) it is intended “for interchange between data-terminal equipment and data circuit-terminating equipment”. To avoid becoming too ‘wordy’ a number of abbreviations will be used. The most common are: DTE (Data Terminal Equipment) for the two interfaced ‘machines’ that produce and/or process the information (computer, terminal, etc.); DCE (Data Circuit-terminating Equipment) for the interfaced equipment that transmits or receives information but does not process it. This latter is the modem (MODulator/ DEModulator), which is sometimes referred to as the data set.

It is clear that using the RS232/V24 between two computers, or between a computer and a printer, if that is possible, is a departure from its original purpose. The specific signals needed for communication between a terminal and a modem will, of course, be completely different to those required when a computer wants to drive a printer.

The electrical characteristics of the RS232/V24 and the pin-out of its 25-pin connector are not repeated here. They have already been dealt with in detail in Elektor, most recently in the May 1984 issue (page 5-68), and on infocard 64.

RS232/V24 is a standard for interfacing a modem to data processing equipment

An RS232/V24 interface will be found at each end of a telephone line used for communication between two DTEs. At one side it is between the data transmitting computer (or terminal) and its modem and at the other end it is located between a second modem and the data receiving computer or terminal. Data connections to a modem are bidirectional and much more complex than the one way lines needed with printers or VDUs. Furthermore the data is fed into the telephone network so there is a whole battery of protocol signals with clearly defined functions. This makes it possible to automate the processes of accepting a call, making a call, replying to requests and even choosing a transmission rate. The format of the signals and the number used depends on the options chosen. Possible choices are: one-way or two-way communication, with or without verification, synchronous or asynchronous, automatic call or answer, and so on.

RS232/V24: the signals

A look at all the signals recommended by this standard

<table>
<thead>
<tr>
<th>CCITT</th>
<th>Function</th>
<th>DTE</th>
<th>DCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>Signal ground or common return</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>102a</td>
<td>DTE common return</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>102b</td>
<td>DCE common return</td>
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<td>-</td>
</tr>
<tr>
<td>103</td>
<td>Transmitted data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>104</td>
<td>Received data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>118</td>
<td>Transmitted backward channel data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>119</td>
<td>Received backward channel data</td>
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<td>105</td>
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<td>107</td>
<td>Data set ready</td>
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<td>108/1</td>
<td>Connect data set to line</td>
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<td>108/2</td>
<td>Data terminal ready</td>
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<tr>
<td>110</td>
<td>Data channel received line signal detector</td>
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<tr>
<td>111</td>
<td>Data signal quality detector</td>
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<td>112</td>
<td>Data signalling rate selector (DTE)</td>
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<tr>
<td>116</td>
<td>Select standby</td>
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<tr>
<td>117</td>
<td>Standby indicator</td>
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<td>120</td>
<td>Transmit backward channel line signal</td>
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<td>-</td>
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<td>121</td>
<td>Backward channel ready</td>
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<td>123</td>
<td>Backward channel signal quality detector</td>
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<td>124</td>
<td>Select frequency groups</td>
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<td>127</td>
<td>Select receive frequency</td>
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<td>129</td>
<td>Request to receive</td>
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<td>130</td>
<td>Transmit backward tone</td>
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<td>132</td>
<td>Return to non-data mode</td>
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<td>133</td>
<td>Ready for receiving</td>
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<td>Received data present</td>
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<td>140</td>
<td>Loopback/Maintenance Test</td>
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<td>141</td>
<td>Local loopback</td>
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<td>142</td>
<td>Test indicator</td>
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<td>-</td>
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<td>191</td>
<td>Transmitted voice answer</td>
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<td>192</td>
<td>Received voice answer</td>
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<td>Transmitter signal element timing (DTE)</td>
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<tr>
<td>114</td>
<td>Transmitter signal element timing (DCE)</td>
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</tr>
<tr>
<td>115</td>
<td>Receiver signal element timing (DTE)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>128</td>
<td>Receiver signal element timing (DTE)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>131</td>
<td>Received character timing</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
RS232/V24 signals

RSZ7Z21-1,1

DTE

MODEM

MODEM

"-us

Ewa.

L.

11

noon

gig

mi

MODEM

DTE

Silt

All the RS232/V24 signals are listed in table 1. The numbers indicated represent what the CCITT refers to as circuits (by which they mean lines or signals). Data and ground lines require no explanation so we will not deal with them here. Circuits 118 and 119 (back channel) are effectively dealt with by the two modem articles, in the last two months’ issues. The other signals (for control, state and clock) are regrouped here according to their functions.

Unit ON, incoming call, automatic answering ON

The signals used are:

DSR (Data Set Ready)

CDSL (Connect Data Set to Line)

DTR (Data Terminal Ready)

CIN (Calling Indicator)

In the case of communications via the telephone network the unit that makes the call must first get a line: this can be done manually (by the operator or user) or automatically (Automatic Calling Unit), as can the answer. If the call is not made automatically the modem must receive a CDSL signal. It then connects to the telephone line and indicates that it is ready to transmit by activating the DSR line. For its part the terminal must indicate that it is primed for action by activating DTR. The DTE + DCE unit that initiated the call is then ready and simply waits for an answer.

If the unit that is called has a bell detector its modem activates the CIN line and its DTE reacts with the CDSL signal. When the call is accepted this modem activates its DSR line to let its DTE know that the connection has been made. This procedure is summarised in figure 1. The automatic call unit (ACU) should conform to V25, which recommends a specific protocol. As that is a different norm we will not deal with it here.

When the physical connection between the two modems has been made the data transmission procedure can begin. No matter how the connection was made the DTR and DSR signals at both ends of the line should be active. One unit is then ready to transmit, the other to receive.

Transmitting the data

While data is being transferred, during which time we assume that CDSL, DTR and DSR are active, the following signals are the ones that interest us:

TMD (Transmitted Data)

RCD (Received Data)

RTS (Request To Send)

RFS (Ready For Sending)

DCD (Data Carrier Detector)

The actual serial data travels on RCD and TMD between DTE and DCE at each end of the line (see figure 2). Between the two units, on the actual telephone line in other words, data can only travel in one direction at a time. Two different modes of communication are possible: duplex and half-duplex (or simplex, as the CCITT call it). Half-duplex communication is strictly one-way. When a modem has finished transmitting data it must immediately remove its carrier from the line to give the second modem a chance to transmit its answer.

Transmission of data can start as soon as the RFS line is active. The data appears on the RCD line and is demodulated by the receiver modem.

In duplex mode the carrier is not removed after the data has been sent. The difference between duplex and half-
duplex modes is more than simply a matter of protocol between modems. The mode used must be agreed, either verbally or by means of a program, before transmission of data can start.

Synchronization and time bases
The signals mentioned up to now can only be used for communication between asynchronous modems. Each has its own clock and synchronization is achieved by means of start and stop bits that precede and follow each character. Synchronous modems, on the other hand, use the following signals:
- TSET (Transmitter Signal Element Timing)
- RSET (Receiver Signal Element Timing)
These signals allow the modulator and demodulator clocks to be synchronized. Also present is a circuit to change the baud rate (DSRS). This is generally used if the transmission is very noisy, whereby a lower baud rate may be temporarily selected.
- The STF (Select Transmission Frequency) and SRF (Select Reception Frequency) signals are used by duplex modems to decide the frequencies used by main and back channels. If one of these uses the upper frequency band the other automatically uses the lower band.

This leads us to the signals that relate to the back channel. Their functions are identical to those of their main channel counterparts. Apart from the data transmission and reception lines (Transmitted Backward Channel Data and Received Backward Channel Data) there is TBCS (Transmit Backward Channel line Signal) to start back channel transmission, the corresponding reply when the DCE is ready (BCR - Backward Channel Ready) and the carrier detector on the back channel, BCRS (Backward Channel Received Signal). These three signals are seen in figure 3.

The other circuits
In addition to the signals already mentioned there are some that are less frequently used. Both the main and the back channels have a signal to indicate the quality of the modem's transmission when no distortion is noted. There is a mode changer and indicator (standby), a selector for the frequency groups, a Request To Receive signal, a back carrier selector and some test signals whose use is obvious. These latter are circuits 140...142, which allow the quality of the transmission to be tested by looping together either the local unit (DTE + DCE) or the two units via the telephone line (DTE + transmitter DCE and receiver DCE). The three connection possibilities are indicated in figure 4.

Many of the signals we have been talking about are for control or indication of a condition so it is worth noting that a control circuit must have a voltage of at least 3 V if it is active (on). Anything less than this and the circuit is inactive. In the case of data lines, on the other hand, a logic 1 is indicated by a voltage lower than −3 V and a logic 0 by a voltage greater than +3 V. These are the V24 recommendations so it might be wise to check that all the equipment used conforms to these norms before placing too much trust in them.

Figure 3. The back channel is brought into operation by the TBCS and BCR signals. The modem in the receiving station signals the presence of the back channel carrier to its DTE and sends it the data received on this channel (RBCD).

Figure 4. Certain specific signals recommended by the V24 norm allow verification loops to be set up. Three possibilities are available, namely the local interface, the local line, and the telephone line and receiving modem.
use your TV receiver as a monitor...

If you have a modern television receiver that is not only suitable for remote control, but is also fitted with a video input, there is no need to read this article! However, if you want to convert a second or perhaps your portable TV receiver into a monitor, the versatile amplifier described here could be what you have been waiting for!

Most television receivers cannot be controlled by an external video signal: only those fitted with an A/V (audio/video) or SCART connector (see Elektor, September 1984, page 9-52) can.

Right from the outset we must tell you that if your television receiver is not fitted with an isolating mains transformer (the most likely case), it should be as a first priority. An isolating transformer can be installed in most sets immediately after the mains on/off switch (see figure 1).

A second prerequisite is a full circuit diagram of the TV receiver: without that you cannot proceed. Many sets are provided with one nowadays, but if you have none, you should be able to get it from your local dealer or the manufacturer's service/spares department.

Video output

Although monitors normally only have a video input, an output may prove very useful, as may be seen from figure 2. Here, the output of the demodulator in the TV receiver is taken via the video output to the video colour inverter featured in our October 1984 issue in an experimental set-up. If you use this set-up for your own experimental work, note that the 100-ohm preset is imperative to attenuate the signals into the video inverter; furthermore, it is advantageous to use an amplifier between the output of the inverter and the video input of the TV set. This amplifier may either be the present one, or that described on page 12-36 of our December 1983 issue.

Before you can start experimenting, it is necessary to make a small modification in the TV set as shown in figure 3. This consists of breaking the connection between...
the demodulator and the video amp/sync separator. The modular construction found in most modern TV receivers makes it easy to find this connection. The signal level at this point should be 2...3 Vpp. The break in the video signal path will affect the AGC (automatic gain control) setting in the u.h.f. tuner. This may be noticeable from either a deterioration in the picture quality or even a complete absence of signal. It is therefore necessary to establish for certain whether the AGC is affected or not. If it is not, the AGC connection to the u.h.f. tuner and i.f. amplifier can remain, but if it is, the AGC connection should be broken as shown and replaced by Manual Gain Control P1 via switch S. The gain must then be set separately for each transmitter owing to differences in field strength. Fortunately, this situation is likely to arise only in older black-and-white sets.

It is quite easy to fit the video output socket onto the inner back cover of the TV set. The d.c. voltage onto which the video signal is superimposed serves to set the operating point of emitter follower T1 (see figure 3). The video signal proper is applied to the BNC (or jack) socket via C3 and R5. If its amplitude is greater than 3 Vpp, it must be attenuated to that level by P4. This preset is normally so adjusted that the emitter of T1 is connected direct to C3. The signal at the base of T1 should be not greater than 6 Vpp. The power supply for T1 must be taken from somewhere inside the TV set: the u.h.f. tuner normally works from 12 V so that a suitable supply can almost certainly be taken from this unit.

**Video input**

We have now come to the heart of the matter. A TV receiver can only be used as a monitor if it is fitted with a video input. A basic circuit for this is given in figure 3: if this is adequate for your purposes, all well and good, but most of you will probably have set your sights a little higher. First, let's have a look at the basic circuit of the amplifier in figure 3. The transistor amplifier has two tasks: (a) to raise the video signal to the required level, (which is set with P3), and (b) to superimpose the video signal onto the appropriate d.c. signal.
use your TV-receiver as a monitor...
elektor november 1984

Figure 4. The circuit of the monitor amplifier may be built in so many ways that it is suitable for all possible situations. The various versions are explained in the text.

Figure 5. Examples of application of the monitor amplifier in black-and-white or colour television receivers. Explanations are given in the text.
voltage which determines the level of the line sync pulses and is also used to bias T1. The d.c. level is set by P2: in this amplifier to 12 V.

The requirements of a fairly sophisticated, universally usable video amplifier may be summarized as follows:

- Input impedance about 75 ohms;
- Suitable for use with video signals above and below 1 Vpp;
- Adjustable d.c. and a.c. levels;
- Output signal amplitude (normal and inverted) up to about 8 Vpp;
- Output stage should be usable with the multitude of video amplifiers found in TV sets.

All these requirements are met by the circuit given in figure 4. The parallel connected input resistors P1 and R1 ensure an input resistance of at least 75 ohms and not more than 100 ohms (with SI closed).
use your TV receiver as a monitor...
elektor november 1984

### Table 1

<table>
<thead>
<tr>
<th>version</th>
<th>normal</th>
<th>inverted</th>
<th>with collector resistor</th>
<th>without collector resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>x</td>
<td>x</td>
<td>0...8 V (emitter of T3) 2</td>
<td>0...10 V (emitter of T3) 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6...12 V (collector of T3)</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>x</td>
<td>x</td>
<td>5.5...10 V (emitter of T3)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2...10 V (emitter of T3)</td>
<td>2</td>
</tr>
</tbody>
</table>

**Table 1.** D.C. levels in the two versions of the monitor amplifier.

Preset P1 allows attenuation of too large input signals, while too small input signals are amplified by T1/T2 (gain presettable with P2). The maximum output level this amplifier can provide is about 8 Vpp. The amplitude of the a.c. output signal is determined by the setting of presets P1 and P2, while the level of the d.c. voltage depends on the setting of P3 and clamping diode D2. Values obtained in our prototype are given in Table 1: the setting limits are dependent upon the output signal.

Transistor T3 is a buffer which provides either a normal or an inverted signal to the output socket. This stage can also be connected as an emitter follower. The versatility of the circuit in Figure 4 may be demonstrated by a few examples.

**Figure 5** shows sections of circuit diagrams of a number of black-and-white and colour television receivers. Integrated circuit TBA900 is often found in mains-operated black-and-white receivers. The video signal is applied to pin 9 of this IC (see Figure 5a). The connection to this pin should be broken and taken to the pole of a change-over switch. One of the contacts of this switch is connected to the video signal line in the TV set (for instance, to "M8"), and the other to the output of the monitor amplifier. In this case, T3, R11, and R12 (Figure 4) may be omitted and the output signal taken from C5+. Set the a.c. level to 3 Vpp with P2, and the d.c. level to 2 V with P3.

**Figure 6.** A modified circuit of a video amplifier for type TX television sets. The BF869 (or equivalent) must be mounted on a heat sink.

**HAVE YOU REMEMBERED THE MAINS ISOLATING TRANSFORMER?**

A second example may be seen from Figure 5b which shows part of a portable B/W receiver fitted with a mains isolating transformer. The circuit of Figure 4 is connected as shown for version A (that is, T3 = BC547B, collector of T3 to the positive line, emitter of T3 to the negative supply line via R2). As the level of the video signal should not exceed 1.3 Vpp, preset P2 must be replaced by wire bridge D-E and the level of the output signal (for an input signal of 1 Vpp into 75 ohms) preset by P1. The d.c. level is set to 6.8 V with P3.

A third example concerns an older B/W set partly using valves (see Figure 5c). The video input here should be located somewhere in the vicinity of T412. Again, as in example 1, version A of Figure 4 should be used. The change-over switch is connected as in example 1 but with the first contact connected to terminal 6 in Figure 5c instead of to "M8". The d.c. level should be set to 2 V with P3.
Our fourth example concerns the quite common Philips type TX B/W portable, although the following considerations apply equally to the portable B/W sets of most other manufacturers. The relevant part of the circuit is shown in figure 5d. In this case, the circuit of figure 4 is connected in version B (that is, T3 = BC 557B, collector of T3 to earth or negative supply line, and emitter of T3 direct to output socket 2 because R350 (figure 5d) serves here as the emitter resistor. The pole of the change-over switch is connected to R350, and the two contacts to the emitter of T3 (that is, output 2 in figure 4) and TS550 (a test point in the TV set) respectively.

A further modification, to improve the picture quality in type TX sets, is shown in figure 6. As you will see, the TS550 stage in the original circuit has been replaced by a cascode stage which increases the bandwidth of the set up to 15 MHz. This will be especially appreciated by computer owners who want to read 24/25 lines with up to 80 characters. The modified circuit is easily built onto a small prototyping (Vero) board. Transistor BF869 (or equivalent) must be mounted on a heat sink.

A fifth example is given in figure 5e and this time it concerns a portable colour TV which needs special treatment! First, it needs an isolating transformer and, second, the video output is designed to figure 7. Again, the circuit is easily constructed on prototyping (Vero) board and then connected to point B on the monitor amplifier. Note here that the sync pulse for the line time base must be generated separately otherwise the picture quality will suffer.

Construction and calibration
If your desired setup is covered by one of the examples given, the completion of the printed circuit shown in figure 8 should be straightforward. It becomes a little more difficult when your equipment is dissimilar to any discussed so far. In such a case, it is best to start with the simple arrangement of example 3 and then attack the problem with the monitor amplifier.

DO NOT FORGET THE ISOLATING TRANSFORMER!
The completed printed circuit can in most sets be mounted onto the inside of the back cover together with the video input socket and change-over switch. All signal lines should be in coaxial cable, while simple stranded wire may be used for the supply lines. The wiring between the television receiver and the printed circuit may give rise to high-frequency (greater than 20 MHz) oscillations in some cases. These oscillations do not affect the picture but if they are present, a 470 ohm resistor may be put in series with the output line. It goes without saying, of course, that whenever a connection in the set is cut this should only be done once you are absolutely certain that it is the right one. Calibration and presetting instructions have already been given under the various examples. If your case falls outside these examples, follow the circuit diagram of your particular TV receiver.

The calibration is fairly simple and can be carried out with a good multimeter and by keeping a sharp eye on the screen. An oscilloscope with which the various waveforms can be checked is, of course, an advantage.

Parts list

<table>
<thead>
<tr>
<th>Parts list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistors:</td>
</tr>
<tr>
<td>R1* = 330 Ω or 68 kΩ</td>
</tr>
<tr>
<td>R2 = 680 Ω</td>
</tr>
<tr>
<td>R3,R4,R10 = 10 kΩ</td>
</tr>
<tr>
<td>R5 = 1 kΩ</td>
</tr>
<tr>
<td>R6,R8 = 180 Ω</td>
</tr>
<tr>
<td>R7 = 3 kΩ</td>
</tr>
<tr>
<td>R9,R11*,R12* = 470 Ω</td>
</tr>
<tr>
<td>P1* = 100 Ω preset</td>
</tr>
<tr>
<td>P2 = 2 kΩ preset</td>
</tr>
<tr>
<td>P3 = 10 kΩ preset</td>
</tr>
<tr>
<td>Capabilities:</td>
</tr>
<tr>
<td>C1,C7,C8 = 100 n</td>
</tr>
<tr>
<td>C2,C3 = 10 μF/16 V</td>
</tr>
<tr>
<td>C4,C5 = 100 μF/16 V</td>
</tr>
<tr>
<td>C6 = 47 μF/16 V</td>
</tr>
<tr>
<td>Semiconductors:</td>
</tr>
<tr>
<td>D1,D2 = 1N4148</td>
</tr>
<tr>
<td>T1,T3 = BC 557B</td>
</tr>
<tr>
<td>T2,T3* = BC 557B</td>
</tr>
<tr>
<td>Miscellaneous:</td>
</tr>
<tr>
<td>BNC sockets as required*</td>
</tr>
<tr>
<td>SPST switch*</td>
</tr>
<tr>
<td>Single-pole change-over switch*</td>
</tr>
<tr>
<td>Printed circuit board 84101</td>
</tr>
</tbody>
</table>

*See text

Figure 7. Video input circuit for the generation of line sync pulses. The circuit is required in example 5e.

Figure 8. Component layout and track side of the printed circuit board for the monitor amplifier. Before commencing work on this, check with figure 5 which version you need!
At last, here is a small unit that provides a quick, safe, and simple way of checking the presence or absence of a voltage in an electrical line without the necessity of physical access to the conductor. And, what's more, it's really cheap to build. Telephase will enable the detection of a break in any normal, non-shielded, 'live' electric cable or wire. It is suitable for use with a.c. voltages from about 60 V to 250 000 V. With a little practice, it should be possible to gauge the voltage level from the distance between the detector and the wire at which the indicator LED extinguishes.

**Circuit description**

The circuit is based on a type 4049UB hex inverter. The sensor is formed by a small piece of thin (about 0.2 mm) tin plate. The electro-magnetic field surrounding the live conductor or source induces a very small voltage in the sensor. This voltage is sufficient to start a low-frequency oscillator formed by inverters N1/N2 and associated components. The onset of oscillations may be preset, within a narrow range, by P1. The oscillator signal is applied to N4 . . . N6 via N3. Inverters N4 . . . N6 are connected in parallel to allow sufficient current for LED D1 to light. Power is provided by two 1.5 V size N batteries. Current consumption is determined primarily by the type of LED used. As the unit will normally not be used for long periods at a time, the batteries should last 6 . . . 12 months.

**Construction**

The unit is constructed on a printed circuit board: if our EPS84100 is used, no special problems should arise. Note that the sensor and the batteries are connected to soldering pins. The sensor is made simply from a piece of tin plate about 0.2 mm thick and 40 x 15 mm in area to make it fit neatly in the proposed case. The on/off switch is mounted in the side of the upper part of the case: make sure that it is clear of the battery and adjacent to the S1 terminals on the PC board after assembly.

The completed unit is then assembled in a case of 100 x 50 x 25 mm; a Vero case 202-21027E is ideal.

**Operation**

Switch the unit on when the LED should
light briefly to indicate that the Telephase is ready for use. Test the unit by pointing the sensor end at a known live source, such as a mains outlet socket or cable. Switch the Telephase on and bring it in close proximity of the outlet or cable: the LED should now remain lighted. The Telephase is now ready for checking whether a cable or appliance is live or not. Always point the sensor end of the unit at the source being checked. Approximate distances at which various voltages may be checked are given in Table 1.

Note that it may happen that the LED suddenly extinguishes, although the cable being checked is alive and well! This may be caused, for instance, by the live and neutral conductors being twisted which gives rise to zero nodes in the electromagnetic field. If the LED therefore suddenly goes out, check the immediate vicinity to make certain that the Telephase is not situated at such a node.

Table 1.

<table>
<thead>
<tr>
<th>a.c. voltage (V)</th>
<th>110</th>
<th>240</th>
<th>440</th>
<th>1000</th>
<th>5000</th>
<th>9000</th>
</tr>
</thead>
<tbody>
<tr>
<td>distance (cm)</td>
<td>1...2</td>
<td>3...4</td>
<td>6...8</td>
<td>10...15</td>
<td>20...30</td>
<td>30...45</td>
</tr>
</tbody>
</table>

Figure 2. Pinout and connection diagram of the 4049UB.

Table 1.

<table>
<thead>
<tr>
<th>a.c. voltage (V)</th>
<th>110</th>
<th>240</th>
<th>440</th>
<th>1000</th>
<th>5000</th>
<th>9000</th>
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<td>6...8</td>
<td>10...15</td>
<td>20...30</td>
<td>30...45</td>
</tr>
</tbody>
</table>

Figure 3. Component layout and track side of the printed circuit.
A 10 Watt hi-fi amplifier with just four valves

Of late there seems to be a renewed interest among audio enthusiasts for valves. Valve amplifiers are 'in'. Those in the know now say, as, indeed, they always have, that valves sound better than transistors. The fact that we have designed a valve amplifier does not necessarily mean that this is our opinion. Appreciation of sounds is, in any case, purely a personal matter so everybody simply has to decide what he personally prefers. That is now very easy, at least for anybody who builds this 'good-old-fashioned' amplifier it is.

With the invention of the transistor, valves lost their 'monopoly' as the active element in electronics. They have never completely disappeared, however, and for many applications, especially where a lot of power has to be handled, they are indispensable. Even in cases where where the transistor might seem to be the logical choice, however, valves are still to be found. Some audiophiles, as we have already mentioned, prefer tubes but ham radio users have also refused to let the 'new-fangled' transistor supercede their beloved valves. The HF people favour tubes for their indestructibility and power handling characteristics, the audio enthusiasts for other reasons. They consider that valves have a different (and better) sound than transistors. Whether this is so or not there is certainly a resurgence in interest for valves. Just one of the indications of this is seen in the increasing number of valve power stages in the high-end sector. We have also been bitten by the valve bug, as witnessed by this amplifier. The power output is quite small (10 watt) but this could be just the beginning. We may even come up with a heavier version at some stage in the future (but that is not a

Specifications
nominal output power: 10 watt into 4, 8 or 16 ohm
maximum output power: 12 watt
harmonic distortion: 0.5% (50 Hz...20 kHz)
signal/noise ratio: depends on individual circumstances
input sensitivity: 200 mVrms
input impedance: 1 MQ
damping factor: 25
frequency characteristic:
20 Hz...40 kHz ± 1 dB (at 1 watt)
feedback: about 26 dB
promise). The valves themselves are still readily available so that will not be a problem; the ones we use are actually advertised in this issue.

A classic circuit
Those who grew up with valves will recognise the 'classic' layout of the circuit diagram. It is shown in a modernised form in figure 1: this is how it would look if it could be built with semiconductors. Our showing it like this is, of course, a complete reversal of the situation of a quarter century ago when designers converted the new-fashioned transistor circuit diagrams back to valves in order to understand what was going on.

Compared to modern circuits, the layout of figure 1 looks extremely simple. All it has, basically, is a preamplifier stage (T1), a differential stage (T2) and two power transistors. Such a layout would be impossible to achieve with normal bipolar transistors; at very least a few drivers would have to be included. This is one obvious advantage that valves have. As far as modern semiconductors are concerned, only the MOSFET can be considered in any way comparable to tubes. Having seen how simple the circuit design is, we can now move on to the actual circuit diagram, as shown in figure 2. If we ignore compensation networks, decoupling capacitors and so on, we see that the circuit is essentially the same as that of figure 1. An EF86 pentode (V1) acts as a preamplifier, a double-triode ECC83 (V2) forms a differential amplifier, and finally two EL84 pentodes make up a push-pull stage, that drives the loudspeaker via an output amplifier. The EF86 is connected as a triode and has a gain of about twenty times. Filter R8/C3, which is in parallel with anode resistor R5, ensures that the gain is reduced at high frequencies. This is necessary in order to achieve stability. The phase shifting needed for driving the power elements (V3 and V4) is provided by the ECC83 double-triode with cathode coupling. This

Figure 1. If it were possible to make this amplifier with semiconductors this is how it would look. Clearly the design itself is very simple.

Figure 2. The circuit diagram for this amplifier is very unusual for Elektor. The reason for this is, of course, the fact that it contains four valves. Note that the values of C2 and R4 depend on the impedance of the loudspeaker used.
Figure 3. In common with many of our designs, all the components, except for the transformers, fit onto a single printed circuit board.

'differential stage' is used because it keeps distortion to a minimum and enables a direct coupling to be made to the preamplifier tube. The reasoning is easy to understand knowing that the grids in the double-triode must have a positive potential due to the large voltage drop across cathode resistor R7.

The power stage consists of a conventional push-pull circuit with two EL84s set to an anode voltage of 310 V. There is no need for V3 and V4 to be paired as each has its own cathode resistor (R17, R18). The improvement here would, in any case, be very small. The resistors in series with the grids (R15, R16) and the screen grids (R19, R20) improve the stability. Some output transformers have special screen grid tap-off points on the primary side. If these are available points A and C should be connected to them and the power stage will then be 'ultra-linear'. If the transformer used does not have this facility A and C should simply be connected to the positive supply at points B.

The signal from the secondary side of the output transformer is fed back to the non-decoupled part of the cathode resistor of V1. The values given to the feedback network (C2/R4) depend on the impedance of the loudspeaker used. The relevant values are given in the table at the top right-hand corner of figure 2.

The power supply is straightforward and follows the well-known transformer, bridge rectifier, electrolytic formula. In this case we have used a supply transformer intended for use with valves. This has two secondary windings to provide the anode voltage of 250 V at a minimum of 75 mA and the filament current of 2 A at 6.3 V.

Construction

Although this sort of project would have been constructed differently before, there is now no reason why it cannot be mounted, as a transistor amplifier would be, on a printed circuit board. The valve mounting sockets for insertion into printed
circuit boards have been available for a long time and the other components are the same as a modern amplifier would use. The printed circuit board that we have designed for this project is seen in figure 3. In spite of its compactness everything fits on the board, except for the two transformers and R21 (which is soldered across the loudspeaker terminals). In general, construction is just the same as for any other Elektor project but there are a few points to note. The board does not contain any tracks to feed the valve filaments so these must be wired by hand. Make sure the cable used for this is capable of handling the filament current of 2 A. It is also wise to twist these two wires together. The filament connections are pins 4 and 5 for V1, V3 and V4, but pins 4, 5 (already joined on the board) and 9 for V2. Plenty of room has been left on the board for mounting smoothing capacitors C11 and C12. We used a double capacitor here (2 x 50 μF/450 V in a single case) but a single 100 μF/450 V type may be used instead. When fitting the components to the printed circuit board simply follow the sequence normally used. The valves are delicate, of course, so fit them last. We have already mentioned the transformers briefly. The mains transformer must have at least two different secondary windings as we need 250 V at 75 mA and 6.3 V at 2 A. The output transformer must have an impedance of 2 x 4 kΩ at the primary side, preferably with screen-grid tap-off points. The impedance at the secondary side depends on the loudspeaker that is to be used. Well-informed suppliers will know what you want if you just ask for a 10 watt valve output transformer, or a transformer for a 2 x EL84 push-pull stage. If you were in the habit of 'salvaging' parts from radios when valves were in fashion there may be a suitable transformer lying at the bottom of your junkbox. Don't reject it simply because of its vintage; it may be just what is needed.

Parts list

Resistors:
R1, R8 = 1 M, ½ W
R2 = 1 kΩ, ½ W
R3 = 100 k, ½ W
R4 = see figure 2
R5, R11, R12 = 100 k, ½ W
R6 = 3.9 k, ½ W
R7 = 68 k, ½ W
R9 = 180 k, ½ W
R10 = 33 k, ½ W
R13, R14 = 820 k, ½ W
R15, R16 = 47 k, ½ W
R17, R18 = 270 Ω, 1 W (carbon)
R19, R20 = 47 k, 1 W (carbon)
R21 = 1 k, ½ W

Capacitors:
C1 = 10 μF/16 V
C2 = see figure 2
C3 = 330 μF (polyester)
C4, C7, C8 = 100 μF/400 V
C5, C6 = 10 μF/50 V
C9, C10 = 47 μF/25 V
C11, C12 = 50 μF/450 V (may be combined in a single package)

Semiconductors:
1N4007

Valves:
V1 = 868
V2 = 863
V3, V4 = EL84

Miscellaneous:
F1 = fuse, 1 A slow blow (with holder)
S1 = double pole mains switch
Tr1 = output transformer for 2 x EL84, secondary: 2 x 4 kΩ, preferably with screen grid tap-off points
Tr2 = mains transformer, 250 V at 75 mA and 6.3 V at 2 A
4 off socket for valve
1 off phono socket (for input)
2 off output sockets (e.g. wander plug type)
Case and wiring

In a mechanical sense it is very easy to 'finish' this amplifier and make it into a very attractive project. Unlike power transistors, valves do not have to be mounted on heatsinks. This makes the choice of a case easier. As long as everything fits inside, any sturdy metal case will be suitable. It is important to have enough ventilation slots in the case as the valves dissipate a lot of heat and this must be dispersed. If the case is just big enough to fit all the components it is a good idea to mount the printed circuit board on its side. The valves will then be horizontal and can pick up as much cooling air as possible.

A very important part of building any amplifier is the wiring. If this is not done carefully the chances are that a lot of hum will be generated and that can be very difficult to get rid of. In principle the same rules apply when wiring any amplifier, whether it has transistors or valves. The most important points are:

- Always use a single central ground point and wire all the amplifier's ground connections directly to this. The ground should be connected to the metal case either from the central point or directly at the input; try both and use whichever gives less hum. Lines from the input socket to the board must be made with screened cable. Finally, keep all the wiring as short as possible so as to minimise loss.
- Make sure that the correct polarity is used for the feedback connection from the output amplifier. If the loudspeaker connections are reversed the amplifier will be heard to oscillate.
- Before applying power check that the anodes of V3 and V4 are connected to '+' (via Tr1 if applicable). Failure to do this will mean that the screen grid will take on the job of the anode and this is something that is not recommended (not even by 'Murphy's handbook of self-destructive valves and other associated phenomena').

Final points

By now the printed circuit board should be completely assembled and all the appropriate 'bits and pieces' should be correctly wired up. It is time for the 'acid test'. When power is applied to the amplifier it should work properly. No calibration or adjustment is needed. Before use, however, check that the test voltages shown in figure 2 agree with those measured on the printed circuit board. If they do not, then recheck everything on the board and all the wiring because there is undoubtedly a mistake in it somewhere. If you want a stereo valve amplifier remember that all the components must be duplicated. This means that not only do you need two printed circuit boards but also two mains transformers and two output transformers.
Energy saving is rightly popular: it does not only save you money, it also makes our natural resources go further. The Government has for years been offering free advice to all and sundry on energy saving. And so have local authorities, and the regional gas and electricity boards. We felt that we, too, should contribute to these efforts and the result is described in these pages. The meter will make it possible for you to monitor the gas consumption of your central heating system, and the effects your saving measures have on this, from your armchair.

**electronic gas meter**

The circuit is intended for systems with the usual control, that is, the boiler is on or off. When it is on, the gas consumption is constant and can be read off the gas board meter. It is, therefore, quite easy by measuring the cumulative time the boiler is on to calculate how many therms of gas have been burnt in that period. Since the price per therm is known (from your gas bill, for instance) it is possible to display the heating costs instead of the number of therms, which has psychological advantages.

The cumulative time mentioned above is measured by feeding 50 Hz pulses to a system of counters and dividers when the boiler is on. These pulses are generated by the 'central heating monitor' published in our 'summer circuits '84' issue (page 7-30).

Not only will the cumulative time the boiler has been on be known, but also the number of times it has been switched on. This figure will indicate whether it is worthwhile resetting the sensor which is present in virtually all room thermostats. Once the sensor has been reset, it is then possible to note whether it has made the desired difference.

**Circuit description**

The circuit in figure 1 consists of three distinct parts: at the left the central-heating monitor already mentioned, at the right the display, counters, and acoustic signal generators, and in the centre dividers IC5 and IC6.

The central heating monitor provides four optical and two electrical signals:
- D1 lights when the room thermostat switches on the pump (more heat required); if subsequently the boiler is also switched on (not enough hot water to meet the heat requirement), D2 lights. If there is enough hot water to meet the heat requirement, the boiler remains off and D3 lights. As soon as the room thermostat switches off the pump (room heat has reached required level), D13 lights.
- Schmitt trigger N4 supplies 50 Hz pulses to pin 11 of binary divider IC5 as soon as, and as long as, the central heater boiler is on.
- The four seven-segment displays, LD4...LD1, are driven by four decade counters (two in IC7 and two in IC8) via IC9...IC12. The latter ICs convert the BCD (binary coded decimal) information from the decade counters into seven-segment code which is used to drive the twenty-eight display segments via R39...R66. The drive is inhibited if S11 — BLANK — is switched on.
- When S13 is in position 1, the four decade counters in IC7 and IC8 are connected in cascade. Because the decimal point of LD2 is permanently on (via R36), the display reads 000.0...999.9. Each pulse at pin 9 of IC8 increases the display reading by 0.1, provided S10 is open. If S10 is closed, IC7 and IC8 still react to further pulses, but the information is only passed to the display after S10 has been opened again. The number of pulses at pin 9 of IC8 depends on the cumulative time that the boiler has been on and on how long it takes the boiler to burn, say, 10 cu.ft., or 10 pence worth, of gas, to your personal choice.
- When S13 is in position 2, IC8 again counts the amount of gas consumed, or the cost thereof (LD2 and LD1: 0.0...9.9), but IC7 now counts the number of times the boiler is switched off during the cumulative period. This is achieved by driving pin 10 of IC7 with the output signal of Schmitt trigger N1, that is, the signal which terminates the 50 Hz pulse trains at the output of N4. Segments LD4 and LD3 then display 00...99 'boiler on' periods. If the time during which this number has been counted is known, the 'boiler on' frequency is easily calculated. A reduction of this frequency is (a) useful because of energy saving, and (b) feasible by resetting the room thermostat.

monitors your central heating consumption

**Standard specification**

<table>
<thead>
<tr>
<th>LED indication of:</th>
<th>room thermostat closed (more heat required) (pump running)</th>
<th>boiler on (water not hot enough)</th>
<th>boiler thermostat off (water hot enough)</th>
<th>pump not running</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>room thermostat closed (more heat required) (pump running)</td>
<td>boiler on (water not hot enough)</td>
<td>boiler thermostat off (water hot enough)</td>
<td>pump not running</td>
</tr>
</tbody>
</table>

- Display choice of:
  - gas consumption: 000.0...999.9 units of 100 cu.ft.
  - heating costs: £ 000.0...999.9
  - "X.XX" with "Y.Y" = 0.0...9.9 (6 to 100 cu.ft.)
- and "X.X" = 00...99 "burner on" cycles

**BLANK: display "---" (energy saving)**

**LATCH: memory switch**

**RESET: setting afresh of counters and dividers**

Audible signal after each "burner on" cycle. Suitable for all 24-volt two-wire thermostat systems.

Boiler: on/off type Suitable for most domestic boilers Suitable for all 24-volt two-wire thermostat systems.

monitors your central heating consumption

...
Assuming that the system uses cubic feet of gas per minute, burning 10 cu.ft. would take 10/r minutes. Each minute, three thousand 50 Hz pulses are generated. If you want the gas consumption to be displayed, with LD1 — the decimal figure — increasing by 1 for every 10 cu.ft., 30 000 (50 Hz) pulses are needed for one count pulse at the clock input (pin 9) of IC8. This means that the number of 50 Hz pulses at the output of N4 must be divided by $3 \times 10^4/r$: the divisor is, therefore, inversely proportional to the gas consumption per minute. This is to be expected, of course, because the higher the consumption per minute, the faster 10 cu.ft. will be burnt, and the fewer 50 Hz pulses are required to increase the display by 0.001 or 0.1, as the case may be. If you want the heating costs rather than the gas consumption displayed, the divisor is additionally dependent on the price of gas. If 100 cu.ft. of gas cost q pence, for 10 pence (display increased by 0.001 or 0.1, as the case may be) you get 10/q x 100 cu.ft. The divisor for the heating costs is therefore 100/q times as large as that for the gas consumption and amounts to $3 \times 10^4/rq$.

The position of the DIL switches determines the binary value of data J0...J7 (switch closed = 1; switch open = 0), which is periodically loaded into down counter IC6. The position of switches SI...S8 (2 < n < 256). The divisor consists of a fixed and a variable part: IC5 provides the fixed part, 128, while the variable part, n, is determined by IC6 and the position of DIL switches SI...S8 ($2 \leq n, \leq 256$). The position of the DIL switches determines the binary value of data J0...J7 (switch closed = 1; switch open = 0) which is periodically loaded into down counter IC6. The splitting of the divisor into a fixed and a variable part enables accurate settings for a wide variety of domestic central heating boilers. Setting errors will almost certainly be smaller than the error in measuring the gas consumption per unit of time.

RESET push button SI2 resets the counters and dividers either after the electronic meter has just been switched on or at the beginning of a metering period. This switch is, of course, not provided on the gas board meter.

A buzzer, operated by oscillator N8, has been provided for acoustic warnings if required. The oscillator operates during the times monostable multivibrator N5/N6 is triggered. Trigger pulses are provided when the first decade counter in IC8 has completed one complete cycle. Putting it another way: every time 10 cu.ft. or 10 pence worth of gas, as the case may be, has been consumed, the buzzer sounds.

The meter is most conveniently constructed on the PC board shown in figure 2, but unfortunately and exceptionally, this board is not available through our PC service. Sorry! If you make it yourself to dimensions as shown (160 x 75 mm), it will fit neatly in a case of, say, 180 x 120 x 65 mm, and this will give sufficient space between the board and the front panel for LEDs, buzzer, switches S9...S13, as well as the heat sink for IC2. The displays may be mounted behind some red perspex fitted in a suitable cut-out in the front panel.

There are a few awkward wire bridges to be soldered in, particularly in the 'digital' corner. Check these carefully with figures 1 and 2.

Note that R3...R66, R36, and R23...R30 must be mounted upright; R39...R66 may be fitted at the track side which also benefits heat conduction.

The position of switches SI...S8 is also important: the ON positions (= 1) should be nearest IC8. Further note that in view of the compactness of the board, there is not all that much space for C3 and IC2 and its heat sink.

Connections X, Y, and Z were fully dealt with on page 7-31 of our July/August 1984 issue. Preset P1 should be adjusted to obtain a voltage of about 3 V d.c. at pin 2 of IC4 (junction R19/R20).

The current consumption of the circuit may be reduced by increasing the value of R36 and R39...R66 to 1.2 k or even 1.5 k, provided that the consequent reduced brightness of the display is acceptable. With SI1 on, the current consumption amounts to about 400 mA; when it's off, the consumption reduces to about 50 mA depending on how many LEDs are alight.

The buzzer circuit may be omitted, as you wish, or be used for other purposes as your own ingenuity may decide!

**Adjustment of room thermostat**

Any central heating system must compensate for heat loss from inside to outside. If on average the amount of heat produced is equal to that lost, there is thermal equilibrium: the mean inside temperature remains constant. In a situation of imbalance, there is either over-production of heat so that the inside temperature rises, or a deficiency of heat causing the inside temperature to decrease. If it is not exceptionally cold, the boiler will, on average, work below full capacity. The boiler is then on for part of the time and overproduces heat, and off for another part of the time when no heat at all is produced. Consequently, the temperature falls and rises alternately. It is, however, not at all necessary for the room thermostat to operate every time the temperature drops by ½ °C!

**Calibration**

First, the gas consumption per unit time has to be established by reading the mechanical gasmeter over a period of, say, 5 or 10 minutes. During that time, make sure that only the central heating system is using gas; pilot lights of other appliances may, however, be left on. Also make sure that the boiler is on all through the period by setting the boiler thermostat and the
Parts list

Resistors:
- R1, R15 = 220 k
- R2 = 470
- R3 = 1k5
- R4 = 560 k
- R5 = 18 k
- R6, R31, R33 = 10 k
- R7 = 2M2
- R8, R10, R12, R21, R22* = 22 k
- R9, R11, R13, R14, R16* = 820
- R17* = 69 k
- R18*, R20* = 6k8
- R19* = 15 k
- R23... R30 = 100 k
- R32, R35, R37, R38 = 47 k
- R34 = 4M7
- R36, R39... R66 = 1 k
- P1* = 50 k preset

Capacitors:
- C1 = 10 n
- C2, C7 = 220 n
- C3 = 2200 µ/25 V
- C4, C8, C9 = 100 n
- C5 = 330 n
- C6 = 10 µ (6 p8/13 polyester* (not on PCB)

Semiconductors:
- TI, T2, 74, T5, T6, T7 = BC 547B
- T3 = BC 5578
- D1 = LED yellow
- D2, D4 = LED green
- D3, 1313' = LED red
- 135, 06, D8, D9, 010, 011, D14... D17* = 1N4001
- D7, D12 = 1N4148
- LD1, LD2, LD3, LD4 = 7760
- IC1, IC13 = 4093
- IC2 = 7815
- IC3, IC4* = 3140
- IC5 = 4000
- IC6 = 40103
- IC7, IC8 = 4518
- IC9, IC10, IC11, IC12 = 4511

Miscellaneous:
- Tr1 = mains transformer, secondary 15 V, 0.5 A
- F1 = fuse, 315 mA
- complete with fuse carrier
- three-way spring-loaded terminal
- two-way spring-loaded terminal
- S1... S8 = eight-fold DIL switch
- S9 = DPST mains on/off switch
- S90... S11 = SPST switch
- S12 = spring-loaded push button switch, push to make
- S13 = single-pole change-over switch
- Bz = piezo buzzer, e.g. Toko PB720
- heat sink for IC2

room thermostat(s) at maximum. An ordinary watch may be used for the time measurement. Note the gasmeter reading at the beginning and at the end of the period. The difference between the two readings is the gas consumed in hundreds of cubic feet. The amount of gas consumed divided by the time it was consumed in gives the gas consumption per unit time = r cu.ft./min.

If you want the gas consumed displayed, calculate the variable part, n1, of the divisor from

\[ n_1 = \frac{30000}{128r} \]

where r is the gas consumption as defined above. Round off the quotient to the next integer (which should be not less than 2, nor more than 256), deduct 1 from it to give a figure n2. Then proceed to set S1... S8 as determined by the following procedure.

1. Is \( n_1 - 128 \) negative?
   - If yes, S1 = 0 and \( n_2 = n_1 \)
   - If no, S1 = 1 and \( n_2 = n_1 - 128 \)
2. Is \( n_2 - 64 \) negative?
   - If yes, S2 = 0 and \( n_3 = n_2 \)
   - If no, S2 = 1 and \( n_3 = n_2 - 64 \)
3. Is \( n_3 - 32 \) negative?
   - If yes, S3 = 0 and \( n_4 = n_3 \)
   - If no, S3 = 1 and \( n_4 = n_3 - 32 \)
4. Is \( n_4 - 16 \) negative?
   - If yes, S4 = 0 and \( n_5 = n_4 \)
   - If no, S4 = 1 and \( n_5 = n_4 - 16 \)
5. Is \( n_5 - 8 \) negative?
   - If yes, S5 = 0 and \( n_6 = n_5 \)
   - If no, S5 = 1 and \( n_6 = n_5 - 8 \)
6. Is \( n_6 - 4 \) negative?
   - If yes, S6 = 0 and \( n_7 = n_6 \)
   - If no, S6 = 1 and \( n_7 = n_6 - 4 \)
7. Is \( n_7 - 2 \) negative?
   - If yes, S7 = 0 and \( n_8 = n_7 \)
   - If no, S7 = 1 and \( n_8 = n_7 - 2 \)
8. Is \( n_8 - 1 \) negative?
   - If yes, S8 = 0 and \( n_9 = n_8 \)
   - If no, S8 = 1 and \( n_9 = 0 \)

Note that \( n \) should not be 0 before procedure 2 and should be 0 no later than procedure 8.

Check the positions of S1... S8 by temporarily short-circuiting C2 and measuring the time \( t \) between pressing RESET switch S12 and the display jumping from 000.0 to 11-62 000.0.
This time should be equal to that needed by the boiler to burn 10 cu.ft. of gas, or 10 pence worth of gas. The time \( t \) may be calculated from

\[
t = \frac{128n_r}{50} \text{ seconds}
\]

where \( n_r \) is an integer determined as above. Check the settings of S1...S8 again with the central heating in operation. Make sure that the boiler is on long enough for 10 cu.ft., or 10 pence worth, of gas to be burnt.

If you want the heating costs to be displayed, calculate the variable part, \( n_v \), of the divisor as follows. Assuming that the price of gas is \( q \) pence per 100 cu.ft., you get \( 10/q \times 100 \text{ cu.ft.} \) for 10 pence (which causes LD1 to increase by 1). The divisor for the heating costs is, therefore, \( 100/q \) as large as that calculated for the gas consumption, that is, \( 3 \times 10^6/rq \) (where \( r \) is the gas consumption per minute as before). The actual cost of 100 cu.ft. of gas is 1.032 times the price per therm stated on your last gas bill. When the relevant figures for \( r \) and \( q \) are inserted, variable part, \( n_v \), can be computed from \( n_v = 3 \times 10^6/128rq \). As before, round off the answer to the next higher integer (which should be not less than 2, nor higher than 256), and deduct 1 from it to give a figure \( n_v \).

Next proceed as indicated under points 1...8 for the setting of switches S1...S8 for consumption display.

If you find in the computation of \( n_v \) that the results are higher than 256 (owing to a small boiler or a different price structure from that used here), use output Q7 (or Q8, or Q9) of IC5. This increases the fixed part of the divisor to 256 (or 512, or 1024). Whichever you have chosen (but do not use one that is larger than necessary) must then be substituted for the figure of '128' in all formulas used in this article.

In Britain, gas has a calorific value of 38.5 MJ (= 38.5 MWs) per m³. A consumption of

\[
1 \text{ cu.ft./min.} \text{ is therefore equivalent to } \frac{1}{60} \times \frac{1}{35.3146} \times 38.5 = 18.17 \text{ kW}.
\]

**Notes on gas:**

1 m³ = 35.3146 cu ft.
1 cu ft. = 28.3168 cc
1 therm = 96.9 cu ft.
1 cu ft. = 0.00132 therm
1 kWh = 3400 Btu = 3.6 MJ
1 cu ft./min. = 18.2 kW
Calorific values of gas in UK = 38.5 MJ/m³ = 1032 Btu/ft³
1 Btu is amount of heat needed to raise the temperature of 1 lb of water by 1°F
1 Btu = 1.055 kJ

**Remarks:**

1. Components marked * are only needed if the standby state of the pump switch is to be indicated.
2. If LED indicators D1 and D3 are not required, apart from the components marked * the following should also be omitted: R1, R2, R7, R8...R11, R15, C4, T1, T3, D1, D3, D7, D12.
3. If decimal point of LD2 is used as 'on' indication, R4 and D4 should be omitted.
4. If acoustic signal is not required, R34, R35, C1, C7, IC13, and B2 should be omitted.
phase control of a.c. power

A.C. power can be controlled by arranging to trigger a triac with a variable delay pulse generator synchronized to the mains supply frequency. The delay control range needs to be from 1 to greater than 10 milliseconds. The SL440 contains all the electronics required to perform this method of phase control.

The basic elements contained in the SL440 are shown in the block diagram of Figure 2. A brief description of their function is as follows.

The d.c. stabilizer is a simple shunt stabilizer and is included primarily to supply 11.3 V to the internal circuitry. However, this supply can be accessed at pin 3 to provide a stabilized supply for external control networks.

The output of the crossover detector takes the form of a pulse generated during the crossover period (the zero voltage point) of the mains supply waveform. This pulse is used for internal purposes to inhibit the trigger pulse generator and reset the time delay circuit.

The pulse generator used in the SL440 is a relaxation type oscillator. An external capacitor connected to pin 14 is charged linearly from the zero voltage point of each mains cycle. When the charge on the capacitor reaches 6.8 V (11.3 V - 4.5 V) the threshold of the oscillator capacitor is exceeded and the capacitor is discharged rapidly. The output of the oscillator at pin 1 is a single current pulse rising in less than 500 ns to a peak value in excess of 100 mA and decaying to zero in approximately CR seconds (where R is 1.5 k). The time taken by the capacitor to acquire a 6.8 V charge therefore determines the time delay before the triac fires. The charge rate of the capacitor is dependent on the d.c. potential applied to the control terminal at pin 13. Note that a.c. power is increased as the voltage level at this terminal is reduced. Power is at a maximum when the control voltage is 2 V or less and totally cut off when the control voltage is greater than 9.5 V (CT = 15 n).

The servo amplifier is a high-impedance direct-coupled inverting amplifier with a gain of RL/2000. Its single input is at pin 12 and its output is connected to the control terminal at pin 13. The inverting characteristic of the servo amplifier enables a capacitor to be used for ramp control of lighting and can provide exceptionally long (30 minutes or more) fade rates. The servo amplifier can also be used in closed loop applications or can be bypassed for simple manual control by a potentiometer connected to pin 13. With power control systems it is frequently desirable to be able to shut down the power in the event of some load malfunction. This is achieved in the SL440 by grounding pin 4 which has the effect of returning the potential of the control terminal at pin 13 to that of the internal stabilized supply rail, irrespective of the control level supplied by the amplifier or any manual control setting. This facility can also be used to eliminate spurious firing or to provide a soft start to the load current by connecting pin 4 to ground for short periods of time at initial switch-on. An impedance of at least 100 k should be included in series with pin 13 to allow the inhibit circuit to exercise full control over the control terminal. Any level of 50 Hz a.c. power under control may be totally inhibited in less than 10 milliseconds with the use of these techniques.

The inhibit action occurs only when the voltage at pin 4 is more negative than the internally defined threshold level of 5 V. When the inhibit facility is not required, pin 4 should be connected directly to the internal 11.3 V stabilized rail at pin 3.

A feature of the SL440 is that of a.c. load current control. This facility is in the form of an a.c. current detector that can monitor the a.c. load current conditions via a transformer with its secondary winding connected across pins 5 and 10. The output of the detector is internally connected to the inhibit terminal at pin 4.

The internal control timing wave-
forms are shown in figure 3. The solid waveforms are those when a simple half-wave rectified supply is used. The broken lines result from a full-wave rectified supply. It is seen that the slope of the charge rate on the timing capacitor determines the delay of the pulse generator output.

Lighting control applications
Phase control is essential for the smooth control of lighting systems operating from 50 Hz supplies. An important consideration where filament lamps are concerned is the magnitude of the initial surge (or inrush) current. Owing to the difference between the hot and cold resistances of a filament a surge current of usually 10 times (and up to 25 times) the normal operating current is encountered for the first few cycles of supply. This may last as long as 20 cycles with a large lamp. The use of the soft start facility at pin 4 of the SL440 is therefore advisable for such loads. This will also extend the operating life of the lamp considerably. The circuit in figure 4 shows a suitable arrangement giving a 500 millisecond period of increasing conduction angle. Diode D resets the capacitor mode when the supply is removed. Filament lamps often fail in the short-circuit mode and it is therefore advisable to incorporate a fast acting fuse in the system.

A fairly sophisticated use of the SL440 is in the circuit diagram of figure 5 which shows an automatic fading circuit for filament lamps. With switches S1 and S2 both open, the level of brightness is controlled by potentiometer RV1. When S1 is closed, the positive voltage applied to pin 12 causes firing pulses to be produced at a conduction angle approaching 180° and lamp brightness is maximum. When S2 is closed and S1 is opened, the servo amplifier acts as an integrator and the lamp brightness fades progressively to the level previously set by RV1. The fade rate is determined by the value of capacitor C1 and can be selected as desired. A value of 250 µF will give a very slow fade rate of up to 30 minutes. A simple manually controlled lamp dimmer can be realised with minor modifications to this circuit. All components connected to pin 12 (including both capacitors) are removed and pin 12 is connected direct to pin 11. In this application the servo amplifier is not used and proportional control of the lamp brightness is effected by the voltage level applied to pin 13 by potentiometer RV1.

Motor control applications
Motor speed control is also possible with the SL440 and the methods and circuit configurations are numerous and of course depend on the type of motor in use. Some motors are not suitable for wide speed-range phase control. However, for many applications, open loop systems which control only the power to the motor are acceptable. For example, shunt wound motors can be made to have good speed/load characteristics and may produce acceptable regulation when controlled in an open loop system.

The SL440 can also be used in a closed loop motor control system and the example shown here is for the control of a servo motor and includes variable current limiting. The circuit diagram is shown in figure 6. The motor used is a d.c. servo motor with an integral tacho generator that provides a d.c. voltage level proportional to motor speed. The tacho generator is used in a velocity servo loop and the motor speed is linearly proportional to the setting of potentiometer RV1. The maximum motor current is determined by preset potentiometer RV2 in the range 1...10 A.

A practical point to be noted is that if the SL440 is to be used with an IC socket, the capacitor on pin 3 must be discharged before the IC is inserted or internal damage to the internal shunt stabilizer may result.

Literature:
'Fluorescent dimmer'
(Elektor E86: June 1982)
Phase control of a.c. power with the SL440
(Plessey Semiconductors)
SL440 power control circuit data
(Plessey Semiconductors)
Helping Hands

For those who often find themselves short-handed (and long-sighted) in the workshop, Light Soldering Developments Limited have brought out a very useful device called Helping Hands. Supported on a solid, cast base, the tool consists of a 115 mm long support bar, fitted with two crocodile clips and a 5 dioptre glass lens. The support bar, clips, and lens are all mounted on adjustable ball-joints, and can be set to any required position to hold parts and assemblies for cleaning, adjusting, soldering, and many other jobs, while affording a clear, magnified view. The Helping Hands is available direct from the manufacturers at £7.45, incl. VAT and p&p.

Light Soldering Developments Ltd
Spencer Place
97/99 Gloucester Road
Croydon CR2 1DN
Surrey
101 6891 0574

Programmable precision references

A range of linear programmable precision references manufactured by Motorola is now available from in-depth stocks held by specialist distributor Axiom Electronics Limited. Designated TL 431, these monolithic ICs operate as low temperature zeners which are programmable from Vref to 36 V with two external resistors, and exhibit a wide operating current range of 1.0 to 100 mA with a typical dynamic impedance of 0.22 ohms. Other features include an equivalent full-range temperature coefficient of 50 ppm per °C and low output noise voltage (Vn/Vns = -95 dB typical), which make the ICs suitable for use in instrumentation, medical, telephony, telecommunications, data acquisition, and control systems.

Axiom Electronics Limited
Cressex Industrial Estate
High Wycombe
Buckinghamshire HP12 3NR
(0494) 422181

New eurocard is electorbus compatible

Solascen Micro-Systems Ltd. of Southampton are now marketing a CPU card based on the Motorola 6809 microprocessor. The board offers a full RS 232 serial interface, a two port parallel interface with handshake and outputs to drive a standard CUTS type cassette interface. There are two 28-pin sockets that can house 2 K/8 K static RAM, 4 K/8 K EPROM, or a combination of them. A wide range of software is also available from Solascen, including Monitor, Disassembler, Editor/Assembler, and Forth Programming Language.

Solascen Micro-Systems Limited
91 Bryanston Road
Bitterne
Southampton SO2 7AL
(0703) 439224

Musical doorbell chips

The type UM3481/2/3/4 ICs which are used in the “musical doorbell” (see our summer circuits ‘84 issue page 7-861) are available ex-stock and complete with circuit diagrams at £1.60 each, inclusive of p&p and VAT from Midas Telecom
1 Oaklands Grove
LONDON W12 QJD
(01 763) 3382

Printed circuit track repair kit

This new printed circuit board repair kit, Model SRS 050, is an American product that is now available from the UK representative Nietronics Limited.

The three types of kit available are Deluxe, Standard and Economy. The Deluxe kit is complete and contains the following components. Master frames with tracks, fingers, pads, elbows and flatback pads. There are three sizes of eyeslets and three sizes of funnels. The setting tools, tweezers and all chemicals suitable for the maintenance and repair of most types of printed circuit boards are included. All consumable items can be purchased separately. Nietronics Limited, North End Road, Yatton, Avon BS19 4AU. Telephone: (0272) 832566

High quality audio transformers

Avel-Lindberg have developed a range of specialised toroidal power transformers for use in very high quality audio amplifiers. These transformers can provide power requirements of between 500 VA and 2 kVA, and dual outputs of up to 70 V r.m.s.

The radiated magnetic field (the cause of most unwanted hum in audio amplifiers) is maintained at a very low figure of less than seven gauss (7 x 10^-4 Tesla) measured at a distance of only 5 cm from any surface of the transformer. A flash proof test of 4.5 kV peak is applied to each transformer and primary to secondary insulation can be provided to standards required by the customer.

Avel-Lindberg Limited, South Ockendon, Essex RM15 5TD. Telephone: (0708) 853444

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RESI & TRANSI

A series of clear cut sections in book form in which two interpreting characters explore the head of electronics in their own intelli- gent world, this adventure is full of interest, because they often go against the grain - whereby they encounter much resistance - before they reach their goal. These two characters, one electronic and the other digital, come to grips with electronics in an unusual way: exciting, playful, but thorough. Part 1 comes complete with a printed circuit board and resistor pack.

Part 1: Boshon the Mysteries of Electronics £5.10
Part 2: Hands off my Bike £6.30

DIGIBOOK

Paves a simple step-by-step introduction to the basic theory and application of digital electronics and gives clear explanations of the fundamentals of digital circuitry. Brought to life by experiments designed to reinforce the newly absorbed knowledge. Supplied with an experimenter's PCE.

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For the home constructor - 300 projects ranging from the basic to the very sophisticated. A very useful and economical reference book!

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Here all is the book that designers have been waiting for: the Elektor Data Sheet Book. In 210 pages it gives you a CMOS. Here at last is the book that designers have been waiting for the Delmar Data Sheet. It contains all the information that the designer needs to make informed decisions. It is an indispensable aid to the Junior Computer, it is an excellent tool for the student, and it is a useful reference for anyone who has a system with one or more 8024. It affords a complete familiarisation with this flexible and effective component.

Price £9.90

JUNIOR COMPUTER BOOK 1

For anyone wishing to become familiar with microcomputers, this book gives the opportunity to build and program a personal computer at a very reasonable cost.

Price £6.60

JUNIOR COMPUTER BOOK 2

Follows the logical development of Book 1 and explains a detailed scheme of the software of the machine. To make programming fun, the machine is able to extend its language skills, for a special version of BASIC is now available on cassette.

Price: £8.60

JUNIOR COMPUTER BOOK 3

The next, transforming the basic single board Junior Computer into a complete personal computer system.

Price £6.90

JUNIOR COMPUTER BOOK 4

Book 4, the last in the series, describes all the software required to operate the complete system. A number of peripheral devices, such as a printer and a video terminal, may be "hooked up" to the computer. During the final stage in its "growth", the machine is able to extend its language skills, for a special version of BASIC is now available on cassette.

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The book is a continuation of our popular and very successful 300 circuits, expanded, and complete with all 301 additional circuits ranging from simple to more complex designs, described and explained in straightforward language.

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MICROPROCESSOR HARDWARE

This book describes a range of peripheral equipment that can be connected and used with an assembler of personal computers, such as the Z80, M6800, Z8000 or the 8080 CPU.

Price £7.90

JUNIOR COMPUTER VIA 6522

This book deals with the well-known Versatile Interface Adapter (VIA) type 6522. Although it is an indispensable addition to the Junior Computer, it is not aimed at junior users, but at anyone who has a system with one or more 8024. It affords a complete familiarisation with this flexible and effective component.

Price £9.90

SCYMPUTER (1)

Describes how to build and operate your own microprocessor system - the first book of a series - future books will show how the system may be extended and used in various ways.

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SCYMPUTER (2)

The second book in series. An updated version of the monitor program (e.g. Jump) is introduced together with a number of expansion possibilities. By adding the SCYMPUTER to the system described in Book 1 the microcomputer becomes even more versatile.

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Complete construction details of the Elektor Formant synthesizer - comes with a FREE cassette of sounds that the Formant is capable of producing together with advice on how to achieve them.

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A selection of circuits which give as much enjoyment in building them as actually playing the games. The circuits are fascinating, although the electronics involved are not complex and therefore anyone with a good understanding will find these book satisfying. These are electronic games which you can build and add to their collection.

Price £6.30

JUNIOR COMPUTER HARDWARE

Modifications of the PM/PME EPROM: Source listing. New dump of the Software minicruncher and puncher (Ed. B. Key, May 1982)

Price £8.40

JUNIOR COMPUTER SOFTWARE

Source listing of the bootstrap loader for Ohio Scientific Floppies: Hex dump of the EPROM with free cassette.

Price £2.10

EXTENDED PRESET UNIT FOR THE POLYPHONIC SYNTHESIZER

This book is the culmination of a project which was started in the October 1981 issue of Elector. It contains a full circuit of a VDU and a CPU card, and of course the terminal, work some software is also needed. Two new books are now available to meet this need. Paperware 3 not only includes all the necessary software, but also deals with all the ins and outs of the terminal. Paperware 4 provides all the software and other information for using the extended preset unit with the Junior Computer, either in expanded form or on the 8024.

Price: Paperware 3 £7.90
Price: Paperware 4 £8.20

ELEKTOR PAPERWARE

now with four volumes available!

Junior Paperware volumes 1 and 2 were published to provide the software needed for our floppy drive controler. The floppy drive is the disk controller and powerful storage medium the most significant. It combines large storage capacity with speed of access, however, large capacity, error-free. It is not enough, however, to simply connect a floppy drive to a microcomputer. A lot of software is needed to make it run, and this software is found in Junior Paperware 1 and 2.

Junior Paperware 1 (price £2.10) provides the modifications needed to the PM/PME EPROM and the source listings and hexdump of the sofware. Junior Paperware 2 (price £2.10) gives the source listings and hexdump of the software.

Universal Terminal Paperware 3 (price £2.70) provides detailed information of the terminal, such as could not be described in a magazine. It includes a description of the Cathode Ray Tube Controller (CRC) and how to program of this channel. It contains complete descriptions of Interfacer Interface Adaptation, Asynchronous Communication Interfaces, and Centronics Interfaces on the terminal, and the source listing of the video routines for the Universal Terminal.

Universal Terminal Paperware 4 (price £2.80) deals with using the Universal Terminal with the Junior Computer. It contains the source listings needed for both the Junior Computer and the Universal Terminal with the Junior Computer. It also includes the source listings needed for both the Junior Computer and the Universal Terminal with the Junior Computer. It also includes the source listings needed for both the Junior Computer and the Universal Terminal with the Junior Computer.

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UNIVERSAL TERMINAL

Paperware 3 (price £2.70) provides detailed information of the terminal, such as could not be described in a magazine. It includes a description of the Cathode Ray Tube Controller (CRC) and how to program of this channel. It contains complete descriptions of Interfacer Interface Adaptation, Asynchronous Communication Interfaces, and Centronics Interfaces on the terminal, and the source listing of the video routines for the Universal Terminal.

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ORDER INFORMATION

For Ohio Scientific Floppies: Hex dump of the EPROM with free cassette.

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PAPERWARE 3 & 4

The hardware for a Universal Terminal has already been described in Elektor. It contains basically a VDU and a CPU card, and of course the terminal, work some software is also needed. Two new books are now available to meet this need. Paperware 3 not only includes all the necessary software, but also deals with all the ins and outs of the terminal. Paperware 4 provides all the software and other information for using the extended preset unit with the Junior Computer, either in expanded form or on the 8024.

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