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- Manual or Autoranging Facility
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* ON SALE FROM FRIDAY MAY 5TH
* AND STILL AT ONLY £1.25
* YOU CAN'T BEAT OUR VALUE
* OR OUR NEW GOOD LOOKS!
Viglen's Vigorous PCs

Viglen have sent us details of the five IBM compatible PCs in their Vig range, all of which have been designed to provide fast, flexible and reliable desk top processing.

The range commences with the Vig I, which is the fastest IBM XT compatible currently on the market. Two versions are available with 12 MHz and 15 MHz switchable speeds, each in various configurations. Both versions offer 640 KB of ram as standard and can house up to 1 MB on the motherboard.

The Vig II Elite is an IBM AT compatible, and is based upon the very latest NEAT (new enhanced AT) technology chip. It is available at 12 MHz and 16MHz switchable speeds and has the flexibility for further expansion. The memory can be set up as extended or expanded using the very latest EMS LIM Version 4. The motherboard allows up to 8MB of ram, thus making it an ideal computer for OS/2.

At the top of the range is the Vig III Cache, which is one of the highest performance 386 machines on the market. It offers 2 MB of memory as standard, and this may be expanded to 16 MB by the addition of a memory expansion card. This 386 features 64K of fast access static ram giving it a wait state. This makes the 20 MHz speed equivalent to 30 MHz Landmark speed.

A recent addition to the range is the Vig I portable. It may be switched from 8 MHz to 12 MHz and is supplied with 1MB of ram as standard, and, like the Vig II Elite, the motherboard can be expanded to 8MB, and benefits from the same advanced features. A Vig Laptop will soon be available.

The range of Viglen computers can be supplied with both 5.25” and 3.5” disk drives as an optional extra. The PCs are able to run all the best known software packages and are fully compatible with the equivalent IBM PC/XT/AT models. As standard, each computer comes complete with MS-DOS 3.30 and GW Basic. Viglen, however, are one of the few UK companies now supplying MS DOS version 4.

For further information, please contact Diran Kazandjian at Viglen, Unit 7, Trumppers Way, Hanwell, London W7 2Ql. Tel: 01-574 5126.

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3½-DIGIT, HANDHELD MULTIMETER

A handheld digital multimeter which costs only £39.95, is now available from Global Specialities. The meter features a 3½-digit liquid crystal display, and has six functions. The ranges are 200mV to 1000V dc, 200mV to 750V ac, 200µA to 20A dc and ac, 20 ohm to 20Mohm, and finally, pnp/npn transistor testing, measuring hfe from 0 to 1000 at an lb of INA, plus diode test. The Model 6022A is powered by a 9V alkaline battery providing in excess of 150 hours continuous use. The meter is supplied with test leads, and a carrying case is available as an option.

Contact: Global Specialities, 2nd Floor, 2-10 St. Johns Street, Bedford, MK42 0DH. Tel: 0234 217856.

KITTING-UP SATELLITES

You may recall that a Connexions satellite tv receiver was one of our competition prizes last year. The company have now introduced a satellite tv installation kit, principally aimed at professional installers. The installation kit comprises: antenna setting meter, inclinometer, compass, crimp tool, multimeter, inline amplifier, insertion tool, 2 way splitter, F type connectors, F type coupler, weather boots, F to N adaptor, N to F adaptor.

Of special interest is the insertion tool, exclusive to Connexions - for quick and easy application of F type connectors to RG6 coaxial cable. All components are available separately and can be purchased from all Connexions distributors. The kit comes in an attractive durable polypropylene case and is available at a trade price of £199.95 plus vat.

For further information: Connexions (UK) Plc, Unit 5, South Mimms Distribution Centre, Haggins Lane, Welham Green, Herts, AL9 7LE. Tel: 07072 72091.

If you are organising any event to do with electronics, big or small, drop us a line - we shall be glad to include it here.

Please note: Some events listed here may be trade or restricted category only. Also, we cannot guarantee information accuracy, so check details with the organisers before setting out.

Apr. 11-13 Portable Computing and Data Capture ’89. Conference and exhibition. Rivermead, Reading. RMDP. 0273 722687.


May 8-10. Eurobus ’89 - German Conference. Munich Sheraton Hotel, Munich. 01-940 4625.


Jun. 5-9. Lasers, Optoelectronics, Microwaves. 9th International Trade Fair and Congress. Munich Fair Centre. 01-948 5166.


Nov. 7-11. Productronica. 8th International Trade Fair for Electronics Production. Munich Trade Fair Centre. 01-948 5166.

BTEC CONTINUING EDUCATION CERTIFICATE COURSES. Starting dates Jan 11 and Apr 26 - each course 2 days per week. Wed/Fri for 13 weeks. London Electronics College, 20 Penywern Road, London SW5 9SU. 01-373 8721.
British Telecom's Skyphone, the world's first satellite telephone communications system for airline passengers, started trial operations in mid-February on an intercontinental British Airways Boeing 747.

Skyphone will allow passengers to make in-flight calls to anywhere in the world.

Anthony Booth, Managing Director of BT International said, Skyphone is another excellent addition to BT's wide range of international services, and its successful development illustrates our intention to provide customers, wherever they may be, with rapid and reliable communications.

Calls are transmitted via the Inmarsat satellite system and then routed into BT's worldwide network. In conjunction with partners in Norway and Singapore, BT is due to complete the worldwide Skyphone network by the end of 1989. The system has been developed and tested under a collaborative agreement between British Telecom, Racal and British Airways.

The pioneering technique developed by scientists at British Telecom's Research Laboratories for converting telephone speech to digital form has been adopted as the world standard by the Airlines Electrical Engineering Committee. It will be used by pilots when they talk to air traffic controllers as well as by passengers.

BT's speech coder was adjudged the best in an international competition, in which more than 20 different designs from all over the world were considered. The four best - from the USA and Japan as well as the UK - were comprehensively tested under simulated operating conditions.

Tests were carried out by telecommunications network operators in the three countries. In addition, the Civil Aviation Authority conducted extensive tests with pilots from international airlines. The BT design emerged as the clear winner in both types of tests.

The coder converts the analogue waves of telephone speech into a series of digital impulses. These are generated at a rate of 9,600 per second, the lowest rate so far used in public civil telecommunications. It compares to the 64 kbit/s used as standard for speech encoding in modern digital networks.

Operation at these low rates reduces the size and weight of the airborne encoding equipment, while at the same time maintaining high speech quality.

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POWER CONDITIONER
FEATURED IN ETI
JANUARY 1988
The Delta line was developed in the USA and portrays the high quality electronics which go into the building of quality audio amplifiers.

THE DREAM MACHINE
FEATURED IN ETI
DECEMBER 1987
About the control of your mind and the dreamer waking up with you. After all night, you will have no trouble falling asleep with the Delta line. The Delta line gives you the best of your dreams.

THE MISTRAL AIR IONISER
FEATURED IN ETI JUNE 1988
The MISTRAL ioniser is one of the most powerful and efficient ionisers on the market today. The ioniser produces high concentrations of negative ions to clean the air and improve the breathing quality.

READY-BUILT MISTRAL IONISER
The MISTRAL ioniser is one of the most powerful and efficient ionisers on the market today. The ioniser produces high concentrations of negative ions to clean the air and improve the breathing quality.

ROUGHLANDER PROJECTS
All can be built in an afternoon!
Japanese electronics companies are now ready to launch a compact disc that records music and computer data, for replay on a conventional cd player. A twin deck machine, which pairs a recorder with a player, so that commercially pressed cds can be copied onto blank discs, will cost only £80 or £100 more than a conventional cd player. The blank discs will cost under £5. A modified system will be in future be able to record video.

Although the new generation of technology will change the face of the consumer electronics industry, by ousting tape as the most convenient recording medium, Philips of the Netherlands has taken a surprising policy decision not to get involved in the new market until the copyright issues which it raises have been resolved. The chances of resolution are slim, because any cd which records cds inevitably infringes copyright. So although Philips' stance wins the company high moral ground, it may well number Philips' days as a manufacturer of consumer electronics.

BEHAVIOURAL MORALITY

All the major electronics companies, including Philips, have developed optical discs which can either record once, (cd-r) or erase and record several times (cd-e). But the technology has been seen as too expensive to compete with dat, a digital audio tape cassette the size of a credit card, which records several hours of hifi stereo in digital code. Although dat is the ideal medium for releasing 'long form' pre-recorded musical works, such as operas and concerts, the record companies worried about home taping and killed dat by refusing to make programme material available for release.

This cleared the way for cd-r and cd-e which the record companies' trade body the IFPI, (International Federation of Phonogram and Videogram Producers) now describes as "an even greater potential threat than dat". Because the record companies already release their music on cd, a recordable cd offers no new advantages to the record industry.

The IFPI says it learned about the new threat from an internal memo provided by Philips. The memo was written by Anneli Hoogakker, a lawyer who worked for the IFPI before joining Philips in Eindhoven. The Hoogakker memo tells how cheaply cd recorders and blank discs can be made. The Philips memo was triggered by an announcement from Japanese chemical company Taiyo Yuden that it is now ready to manufacture a recordable cd system.

The Taiyo disc is a blank pressed from polycarbonate, superficially similar to a cd, but with a coating of softer plastics and a spiral groove moulded in the surface. This groove guides the laser during recording. A laser of around 7-9mW is used to record music or data pits by modifying a layer of dye, with a 2mW used for play back. Once made, the recording cannot be erased.

BY BARRY FOX
Winner of the UK Technology Press Award

Tapes and cds - capable of digital recording in your own home - cause the recording industry so much anxiety that one major manufacturer may choose to miss the boat rather than be embroiled.

Taiyo claims that shelf life of a blank disc, before recording, is at least ten years, and archival life after recording is at least another ten years. The only proviso is that the discs should not be left in direct sunlight for long periods.

Philips gamely confirms that it will not launch cd-r or cd-e technology until the hardware and software industries have agreed on a copyright strategy. This could take many years because the software industry is in a weak position to bargain and fight the new technology. As most music is already available on cd, there is no permission to refuse.

If Far Eastern firms make cd-e and cd-r the dominant recording media of the future, Philips could be squeezed out of the consumer electronics business altogether.

SWEET SATELFAK

We have previously commented in PE's pages of the probability of news texts being distributed by electronic methods rather than on newspaper form. I had expected that this subject would have been one of those discussed at the Home Automation conference on which we reported in PE Apr-May 89. Although this turned out not to be the case, it appears that another of PE's entrepreneurial heroes, Alan Sugar of Amstrad fame, appears to be regarding the 'electron-news' scene with an eagle eye.

Normally reliable sources inform us that Alan Sugar may well enter into the Satfax market, combining the technologies of satellite transmission, computers and fax into a news text distribution facility. And of course the options for such a service don't end with news texts; books and magazines represent some of the other possible candidates for satfax dissemination, and on a worldwide basis. As long as there is power available to run a computer terminal and receive, the service can be received virtually anywhere around the surface of the globe.

Of course worldwide fax transmission is nothing new, Inmarsat, to whom we refer in the forthcoming Leisure Marine Electronics series of Jun-Jul 89, is one of those companies who already offer the facility for trans-satellite faxing. The implementation of satellite newspaper transmission, though, is one that could reap fortunes for the operating companies. That is, of course, on the assumption that readers will accept the limited convenience of having to read from a vdu screen, however portable it may be.

I know that commuting business men use portable computers while travelling by train, and so have the hardware for news browsing already under their arm, so to speak. But will they really carry a satfax in place of a paper, even though perhaps the computer might hold all of the day's papers in its memory? I suspect not. Or am I overlooking the undoubted possibility that advances in technology will eventually make satfax terminals as small and convenient as a newspaper? Could be.

Indeed, on this score, I may have an answer to one reader who recently asked what feature and constructional articles he would be interested in reading. We have previously commented in PE our view of the Golden Anniversary, perhaps we may be publishing a single-chip satfax project that can receive the news, not only from around the globe, but from one or two of the colonised planets as well. If that's the case, then PE itself will be the only paper, not only available, but as a multi-megabyte burst of electronic signals from our own satellite channel.
“The time has come,” your Ed has said, “To talk of many things: Of whose - and which - and crucial facts - Of theories - and computerings - and appearance. We think we have been making improvements, but I'm not going to get pious about that. We could blow our own trumpets until we are blue in the face, announcing how brilliant each change is and how irresistible you should find it. Codswallop! You know it, and we know it, that at the end of the day, however good we may think our publication is, if you don't like it, you won't buy it.

Well, this issue we've taken further steps along the path of what we believe is the right direction. The cover change is the first thing that should strike you. Ever since Issue One, the relative sizes and styles of the two words “Practical Electronics” have remained constant. We've now upped the size of “Practical”, enhanced the lettering, and increased the descriptive captions. Inside, we have reappraised the layout style and many of the type faces have been changed. This, we feel, gives the contents more visual appeal.

So how right are you? You are the final arbiters on that. We recognise that the changes in this issue are largely cosmetic. The structure remains similar to that found in other recent issues. The balance of constructional projects, technology features, informative theory and product news is largely unaltered, though the new Quick Chip series is one of which we hope you will approve.

What we want to know is, do you think that the structural content of PE should be changed? And we want to know now! We ran a survey in 1981 and another in 1986, but the world continues to change, and possibly, you the readers have changed too. During the 80s there has been an upheaval in society; employment patterns have altered drastically; new leisure activities are being catered for; many consumer goods are available which, in some areas, make less of an appealing activity; and the trend for instant access to condensed information seems to be increasing, placing question marks over detailed examinations of specific aspects of technology.

My belief is that there will always be a significant core of people who want the pleasure of building things themselves and who enjoy learning by doing. That core, I further believe, includes those who want to be more deeply informed about technology but without having to wade through scores of academic text books, which in any case can seldom be as topical as a monthly magazine.

But, I can only assess the truth of my beliefs by checking my source material. In other words, by asking you, the ones who matter, what you want. Hence the survey questionnaire on pages 35 and 36. Don't ignore it, tell me some answers!

THE EDITOR
PRINTER ACCESSORIES

We hold a wide range of printer accessories (sheet feeders, tractor feeds etc) in stock. Serial, parallel, IEEE and other interfaces also available. Ribbons We hold a wide range of printer attachments (sheet feeders, tractor feeds etc) in stock. Serial, parallel, IEEE and other interfaces also available. Ribbons

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PB BUFFER Internal buffer for most Epson printers Easely to install in your Epson printer
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20 Way D type

Make to Male £10

Female to Female £10

MALE

21 pin Scan Connector £20

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RIBBON CABLE

IBM XT/PC/RS232 360p £25

10 way

5 way

DIAGNOSTIC CONNECTORS

DIL HEADERS

SPD HEADERS

7 pin £10

20 pin £10

14 pin £10

5 way £10

10 way £10

20 pin £10

6 pin £10

8 pin £10

SOFTP VS

SOFTPL BIOS version 2.9.1

Uses 8K BIOS and 2.8M Memory

IBM XT/PC/RS232 360p £25

10 way

5 way

DIAGNOSTIC CONNECTORS

DIL HEADERS

SPD HEADERS

7 pin £10

20 pin £10

14 pin £10

5 way £10

10 way £10

20 pin £10

6 pin £10

8 pin £10

ATTENTION

All prices in this double page advertisement are subject to change without notice. No ALL PRICES EXC VAT Please and carfare £50 indicated as (a) £3.20 (b) £5.50 (c) £1.50 (d) £1.00

Using "Prestel" type protocols. For information and orders get the 24 hour service, 7 days a week
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Claims that all living things have an aura or resonating bio-energy field are frequently made by psychic-sensitive people. In general, until about 25 years ago most other people considered the concept as mere speculation or the crazy delusion of credulous table-rapping mediums.

Then an accidental discovery was made in the USSR by Semyon and Valentina Kirlian. They found that when certain biological specimens were placed in an ac ionising field of around 200kHz strange patterns were to be seen around them. The Kirlians claimed that these patterns proved the existence of bio-energy fields and represented scientific evidence of auras.

Following this discovery, researchers in the West, particularly in America, have built their own photographic equipment to verify these claims. They have found that the same sort of patterns can be produced in ionising fields at frequencies as low as 20Hz. Many American researchers, such as Johnson and Moss, have used low frequency cameras on a wide variety of animate and inanimate objects, and even on human volunteers. They have satisfied themselves that the images produced cannot be explained in terms of the normal effects produced by high voltages, chemicals from the photographic process, perspiration or other moisture, and that other conventional explanations are unsatisfactory.

BY DON PHILLIPS

**Life force or dark horse? A mysterious 'energy corona' - is detected around objects in an ionising field. Is this the psychic aura of old? If so, why do nuts and bolts too? Try it for yourself.**

Although some researchers in the West believe that the explanation will ultimately be due to a purely physical effect, those in the USSR have put forward the suggestion that it may be due to a "bioplasmic" field. For example, there have been reports that a Kirlian photograph of a leaf section will show the full outline of the original leaf before being cut. There have been suggestions that there is an invisible matrix underlying all matter and that maybe this is what many mediums have called the 'etheric' effect.

Following on from this is the suggestion that the Kirlian effect might validate the existence of the 'Chi' and 'Ki' energy as used in acupuncture. If this is the case, perhaps the imaging might be due to a heterodyning effect between the applied frequency and the inherent frequency of the imaged field. In this event it should be possible to image different parts of the surrounding held by altering the frequency of the applied ionisation.

---

Photo 1. Pattern produced around a 2p coin
POLYGRAPHY

In support of this, Johnson and Moss have found that different frequencies can reveal different aspects of the field surrounding objects. In particular they have found that the 'phantom leaf' effect only occurs at specific frequencies, evidence which tends to support the heterodyning effect. Many researchers are now investigating the effects produced by very high frequencies, even into the radio frequency ranges.

I have been researching into this fascinating field since 1981 but though I originally experimented with existing circuits for Kirlian cameras, I found they had limited parameters and were unreliable. Consequently, I designed and built my own cameras, and have had some startling results.

Experimentation showed that Kirlian photography could be achieved not only in the presence of ac fields, but also with a pulsed dc field. The latter produced some very strange and at present inexplicable patterns. How this effect ties in with the heterodyning principle is as yet unclear.

However, certain facts became obvious when using both ac and dc cameras. One of the differences is the way in which the cameras and specimens mutually interact. For example, the dc pulse cameras tend to throw the corona away from the specimen and leave the internal structure less defined.

This effect may not be entirely due to the separate applications of either dc or ac in the pure sense, but rather may be due to the initial loading surge through iron cored eht transformers. Further data on this should become available once we have developed an efficient air cored eht transformer for experiments in the rf range. So far, though, certain tests that have been carried out support this idea, including the fact that short ac exposures also divert the energy away from the specimen. It is pertinent to remember that a dc pulse is simply a special case of an ac waveform and that additionally it may cause 'ringing' at certain harmonics due to the inductive nature of the transformer.

PRACTICAL CAMERA

During my research I have had to build many types of camera. In addition to the pulsed dc version, I built an ac one that was powered from a 12V car battery, then a more ambitious one combining the ac and dc into one unit, and am currently working on an rf camera.

Photo 2. Bronze sprocket.

The circuit I shall describe here, though, is a somewhat simpler one of the ac type. It is powered from the normal 240Vac supply, and is capable of operating at 20Hz to 700Hz. It has the same circuit as one camera I have been using throughout much of my research and has proved to be very reliable. It is of a similar type to those seen at various Mind and Body festivals, but I believe it to be more reliable, and it certainly has wider parameters. The main circuit is shown in Fig.1 and its power supply is in Fig.2.

You may wonder why I have used transistors instead of integrated circuits. The reason is due to the transients generated by the high voltage generator and which are difficult to suppress simply and cheaply. Many Ics died in my early days of experimenting! The robustness of the transistors I have used has saved them from the same fate.

Photos 1 to 4 were taken on a dc camera, but photos 5 to 8 were all taken on this ac camera and give an idea of the type of results than can be expected. What the photos actually show still needs to be interpreted. However, I am satisfied that the normal explanations offered by critics do not hold water - you must judge for yourself once you have built the camera!

The unit basically comprises a mains operated power supply producing a smoothed but unregulated 37Vdc power rail, a high voltage generator operating at variable frequencies, and a timing circuit.

TIMED EHT GENERATOR

The eht voltage generator consists of a variable rate multivibrator formed around TR3, TR4, T1, and the associated capacitors C16 to C25 selectable by S3. The frequency range is selectable in ten steps between 20Hz and 700Hz, with an additional position for 'off'. Since T1 actively affects the frequency, a high performance coil of the type recommended in the parts list should be used. During frequency generation, the voltage across the primary of T1 swings between +37V and about -37V. The secondary winding then steps up the ac voltage to between about -40kV to -50kV with irregular damped oscillations occurring at 3kHz to 10kHz.

The duration of eht generation is controlled by the gated timing circuit around TR1 and TR2, and is dependent on the charging rate of C4 to C15 as selected by S2. With S1 open, the timing circuit is in its standby state, the relay coil is inactive, and the relay contacts are open, so inhibiting the eht oscillator. On closing S1, the pulse generated across C1 causes TR2 to switch on, so drawing current through the relay coil. The relay contacts close, so allowing

Fig.1. Circuit diagram of the Kirlian Camera.
the eht generator to function. The coil remains active until the capacitor selected by S2 has recharged, so turning off TR2.

The timing range is selectable between about 0.003 sec to 8 secs in twelve steps. VR1 is used to preset the maximum charge rate. Note that C1 and C2 should be high quality tantalum capacitors otherwise the circuit triggering may be inconsistent. C3 is used to damp stray transients that may be radiated by the eht generator so disrupting the timing period. Additional transient suppression is performed by TS1, TS2, C27 and the neon across the primary of T1. The neon has the additional function of providing visual indication that the frequency generator is functioning.

CONSTRUCTION

IT IS IMPORTANT TO NOTE THAT THE UNIT GENERATES VERY HIGH VOLTAGES. EXTREME CARE MUST BE TAKEN DURING TESTING AND USE. KEEP HANDS AWAY FROM THE EHT COIL AND THE ELECTRODE PLATE.

There are three PCBs, as shown in Fig.3. PCB 1 should be mounted as shown in Photo 9; the other two boards are mounted behind the control panel. The mounting platforms should be made from a non-conductive material - I used plywood and chipboard, though srbp board would be equally suitable. When wiring the PCBs together and to the control panel, care should be taken to keep the leads clear of the assembly and box edges to prevent possible chafing. The connections to be made are obvious from the circuit and PCB diagrams - just follow them logically.

Although not used on the prototype, D3 should be soldered across the relay coil, with its positive end on the positive supply tag. Ed.

The unit housing is shown in Photo 10, and it too should be made from a non-metallic material. The prototype box size was 21 x 11 x 5.5 inches, plus a 2.5 inch high lid. Take care when planning the box layout. On my unit, after allowing enough room for an 8 x 10 inch electrode plate, I had just 7 x 10 x 4 inches in which to mount the electronics assembly - a bit of a tight fit. The ignition coil T1 is mounted under the electrode plate, as shown in Photos 10 and 11.

To prevent tracking between the primary and secondary windings, a tight fitting rubber tube some 12 inches long should be pushed over the coil nozzle after connecting the eht lead. Then connect the lead to the electrode plate and fill the space between the coil and the plate with layers of rubber foam.

Fig.4 shows the construction of the electrode plate and its mountings. As seen in Photo 11, it is essential to leave a space of at least one inch all around the edges of the plate to prevent field breakdown when large specimens are photographed.

Plate glass of at least 2mm thick is placed over the electrode to insulate it; this too should extend around the plate by at least one inch. It should be secured in place by quarter inch hardwood battens screwed to the sides of the box. Acrylic sheeting could be used as an alternative, but plate glass is preferable since acrylic tends to become etched with markings caused by the ionising field.

Photo 12 shows the completed unit and a guide to the control legends, though note that this is a photo of the prototype and the final legends will differ slightly.

TESTING

Timer setting is best done with the frequency control in the off position. VR1 is used to adjust the timing range, using the one second position as the reference. While observing the neon and preferably using a digital stop watch, repeatedly trigger the circuit and adjust VR1 until a delay of precisely one second is obtained. Within the normal tolerances of the other capacitors, the other ranges should follow proportionately. Though a nominal value of 2µF is quoted for C3, it is best to select its
ideal value on test. With the timing switch set for one second, switch the frequency control from setting to setting, each time triggering the circuit and timing its delay on a stop watch. If the timing terminates before one second has lapsed, C3 may be increased in value up to a maximum of 10μF. Increasing it beyond 10μF could affect the triggering.

PHOTOGRAPHY

Photographs are taken by first laying a sheet of photographic bromide film on the electrode plate cover, emulsion side up, (Fig.5). The specimen is placed on the film, the ionising frequency selected and the unit triggered for the desired time. The exposure is then developed in a normal bromide developer. Naturally, the exposing and developing must be done under suitable safelight conditions. Panchromatic sheet film may be used instead if more detailed imaging is desired, but exposing and developing must done under total darkroom conditions. Though film is more expensive than photographic paper it has the advantage of allowing enlargement prints to be made of selected areas.

When photographing inanimate objects, such as leaves, metallic specimens, chemical compounds, etc, the ground lead (marked as the negative electrode on the panel) may be connected to the upper surface of the specimen to enhance the discharge path.

ON NO ACCOUNT MUST THE GROUND CONNECTION BE USED IF PHOTOGRAPHING ANY PART OF THE HUMAN BODY.

(I feel obliged to warn against using the unit to photograph any living creature. Ed).

Providing you do not earth yourself in any way, finger tips may be photographed by lightly touching them to the paper or film (Fig. 6) - the body's natural capacitance allows for completion of the ionising path.

PHOTO 3. Panadol tablet

PHOTO 4. Rennie tablet

PHOTO 5. Geranium leaf

PHOTO 6. House key

PHOTO 7. Finger tips

SUGGESTED EXPERIMENTS

Your Ed suggests that some of the questions you might care to seek answers to when using your camera are:

1. How different are the images produced by the same object at different frequencies and timing periods?
2. Are the images different when different photographic materials are used, eg, bromide or pan film?
3. Does humidity or temperature have an effect on the images? Don says this may be difficult to arrange but is essential, if only to rule out that moisture makes no valid difference.
4. Do the images change if the object is placed in different positions on the electrode plate? "A waste of time", says Don, "it will make no difference". Do you agree?
5. In the finger experiment, does the state of mind or physical well-being of the subject have any effect on the images? Don comments that this is the best test of all but is difficult to assess unless carried out.

Your Ed will be pleased to hear about interesting results produced by readers using this Kirlian camera. He can be contacted at Aldon Para-physical Research, 147 Butchers Road, Canning Town, London E16 1NE. Ed.
WOOD BASEPLATE VIEWED FROM UNDERSIDE TO ENVIRONMENTAL NOISE LEVEL OUTPUT PLYWOOD BASE PLATE

Thin rubber insulation strips 1 in wide all around electrode plate in this case. These strips must not prevent the glass from resting on the aluminum Plywood base plate.

Fig. 4. Showing electrode plate construction and method of fitting glass to electrode area

PHOTOGRAPHIC FILM EMULSION SIDE UP

Fig. 5. Technique for examining inanimate objects

FINGER NOT EARTHED

Fig. 6. Technique for examining finger-tips

under medical supervision and performed on numerous occasions to establish a statistically significant data base.

FURTHER READING

The Dark Side of the Brain (major discoveries in the use of Kirlian Photography and electrocrystal therapy), Harry Oldfield and Roger Coghill. Element Books. (Harry Oldfield is reputedly the leading researcher in Britain on Kirlian photography.)


COMPONENTS

RESISTORS

R1 47k
R2, R11 10k (2 off)
R3 6k
R4, R6 4k7 (2 off)
R5 200k
R7, R8 56R (2 off)
R9, R10 100k (2 off)
R12 16k
R13 30k
All resistors 0.5W 5% carbon.

POTENTIOMETER

VR1 47k horiz preset

CAPACITORS

C1, C2, C13 220nF 35V tantalum (3 off)
C3 2µF to 10µF 35V tantalum
(see text)
C4 220nF 63V
C5 10µF 63V
C6 47µF 63V
C7 22µF 63V
C8 10µF 63V
C9 4.7µF 63V
C10 2.2µF 63V
C11 1µF 63V
C12 470nF 63V
C14, C19 100n polyester (2 off)
C15 47n polyester
C16 2.2µF polyester

Photo 8. More finger tips

Photo 9. Mounting of power supply
EXPERIMENTAL PROJECT

Photo 10. Interior box showing coil mounting

C17  470n polyester
C18  220n polyester
C20  82n polyester (or 47n + 33n in parallel)
C21  68n polyester
C22  47n polyester
C23  33n polyester
C24  22n polyester
C25  10n polyester
C26  1µF 63V metal film
C27  22 1500V polypropylene
C28  10,000µF 40V elect
All 63V caps are single ended electrolytics unless marked.
Polyester capacitors shown have a 250V rating.

SEMICONDUCATORS
D1,D3  1N4148 (2 off)
D2          1N4005
TS1,TS2  BZX61C47 transient suppressors (2 off)
TR1,TR2  2N3904 (2 off)
TR3          TIP32A
TR4          BU208
REC1        50V 6A bridge rectifier

SWITCHES
S1          sp push make, or microswitch
S2,S3  1p12w rotary (2 off)
S4          dpst rotary mains
RL1        24V 650R dpdt relay

TRANSFORMERS
T1  12V ignition coil
     (Lucas super energy)
T2  25V + 25V 80VA toroidal,
     1.6A per winding (ILP
     Electronics 3X016)

SOCKETS
SK1        IEC mains connectors
SK2          BNC 50 ohm socket (and plug)
SK3        4mm banana socket and plug
            (NEG electrode)

ELECTRODE ASSEMBLY
Electrode plate 204 x 254 x 1.2mm
aluminium sheet (see text)
Electrode insulation 300 x 252 x 2mm plate
glass (see text)

MISCELLANEOUS
FS1        2.5A antisurge fuse and holder
            (20mm)
FS2        1A antisurge fuse and holder
            (20mm)
LP1        mains neon (red)
LP2        mains neon (orange)
Capacitor clip for C28. Heatsink TO3 7.2
°C vained for TR4 (eg. Maplin FL59P).
Heat sink 17 °C vained for TR3 (eg. Maplin
FL58N). Knobs (3 off). EHT lead 30kV
300mm length. Case materials to suit.
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KODAK TANDEM TM105-60B IBM compatible 30 inch flat. High definition monitor. Price £650.00 (D).

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HOME AUTOMATION

BY JOHN BECKER
PART TWO
THE LINE, THE SWITCH AND THE AUTOMATED WARDROBE.

Continuing our report on how leading experts regard the future for home automation.

Peter Forster has worked for Philips Electronics for the past 24 years, occupying his present position as Strategic Planning Manager since 1984. During this time he has been an active member of NEDO Interactive Home Systems Task Force.

Displays are now an integral part of the home and 97 per cent of the 20 million homes in the UK have a tv, and many have more than one. This has implications for the family unit for the tendency is for the family to split into separate cells for discrete viewing.

In the simplest situation, ie, with entertainment, transmission is basically one way. Teletext represented an important step forward in that users can interactively search for external data when required. The integrated home systems concept takes us another stage further as the tv can now display their status or images on the screen. It

the term "smart". The microprocessor is used to control the various card functions as well as provide a variety of services, such as calculations, which can be programmed according to the particular needs of the application.

Applications to which the card can be put in the automated home are likely to be initiated by the building industry. The smart card industry itself is unlikely to take the initiative in this area, though many possible applications are foreseen. For example, it is likely that "smart homes" will be designed in which the various functions may be controlled via an active smart card. This would provide a set of easily comprehended prompts to guide the householder through a routine of keyboard entries to produce a master control program for the house, protected by the householder's PIN. Smart cards could be used for gaining access to the house and garage, for operating the alarm system, and for activating high value consumer items such as tv, video, hifi, etc. With the cooperation of equipment manufacturers this would be a major deterrent to burglars. Using a suitable home-based terminal, the enhanced security also allows for fund transfers in both telebanking and teleshopping, as the French are already discovering.

These innovations are unlikely to occur overnight, though an increasingly rapid proliferation of smart card technology is expected.

PRACTICAL ELECTRONICS MAY 1989

19
We can go on from that stage and build in other options allowing the user to remotely take action in respect of the displayed status.

Ladders could be dotted around the house at easily accessibly points, such as at each light switch. Each room has at least one light switch and represents a convenient access point to a home data bus via existing or additional wires. It is technically possible to install sensors which determine the whereabouts of any person and activate an audio or video message according to locality.

HDTV is important in the context of automating the home. Pilot transmissions should start this year, and services start in 1992. The number of lines will double from 625 to 1250, the pixels will increase from 180,000 to more than 700,000 and further improvements will give strikingly detailed, clearer, crisper pictures. These improvements will only be beneficial if the consumer accepts their desirability. It is likely that consumers will be encouraged in this by the falling real costs of electrical goods, accompanied by an increase in functionality – a form of efficiency, since the equipment can do more. It has been calculated that had the same results been achieved in the automobile industry, the price of a Rolls Royce would be £3.75 and it would travel three million miles to the gallon!

"Give freedom to consumers to compose individual system solutions" is Bang and Olufsen's view. The Beolink system represents this philosophy, being a totally integrated audio/video system with distributed sound, picture and operation. (Photos).

It comprises a central audio/video system with which consistent high quality picture and sound equipment can be available in, and controlled from, every room in the house. The concept is an integration of data, control, sound and picture. Video signals are distributed through a coax cable, and data and sound are distributed via a shared 7-conductor cable. In order to ensure the consumers's simple use of the system, however complex, the number of buttons has been reduced to a minimum and made readily accessible. The user can also communicate with the system via infrared remote controls. The system is not restricted to entertainment purposes and it additionally allows control and monitoring of security and other home automation functions, plus a connection to the telecommunications network.

To ensure the widest possible perspective for Beolink, B&O entered into cooperation with several Danish companies, including one of the telephone companies. The collaboration has two objectives – to ensure that the products of individual firms are adapted to the home automation market, and to coordinate product developments so that they collectively form a total system comprising entertainment, information, telecommunications, teleoperation, energy control and security. With the additional cooperation of the Danish Ministry of Industry considerable finance has been invested in the "Handbook Project". This will contain guidelines on the design and implementation of home information networks so encouraging Danish industry to meet the requirements for complete automated homes.

**INTERACTIVE VIDEO**

Bryan Quilter is Chairman of National Interactive Video Centre Ltd, a government-funded industry supported organisation for the encouragement and development of interactive video in the UK. He presented a video in which several key points were made...

Interactive video brings together the power of the computer combined with the highest quality motion pictures. This unique combination has to date been expensive and more suitable for industry, education and institutions rather than the home consumer market.

Technical innovations can find early markets in one section and migrate to another. Computers reached the consumer in micro form after decades of development in industrial, scientific and similar...
applications. Video travelled from consumer to industry. Technology is being transferred more widely and more quickly than previously. USA, Japan and Europe follow in quick succession. Standards battles may well be resolved at pre-competitive stages.

The key to the use of interactive video will be software. This could be entertainment, information or knowledge led and could reach the home from school or work. CDI is about to be launched and could be the first interactive visual medium for the home, if the performance and price expectations are realised. In any event the demand for IV software is very large and growing, and there is an immense opportunity for the UK.

At the training level, managers and government can solve many problems and potential problems by a bold and vigorous use of IV now. The benefits in the home will follow logically as the various elements fit into the market place.

**HOME BANKING**

Jonathan Reynolds is currently Research Fellow in Retailing at Templeton College, Oxford. He believes that the future of home banking in the long term can be said to be tied in with the future of consumer interactive services more generally.

According to a recent pronouncements by all the leading UK clearing bank retail banking directors, the future is not technology-led: "The nature of branches many well change. In the long term, there will be greater emphasis on self-service of all kinds and we will certainly see unmanned branches. But you cannot ignore the fact that the branch network is a very important sales force."

The future of home banking services using new technologies such as videotex, voice synthesis and voice recognition has demonstrated two key advantages to those involved: greater accessibility and speed of control for consumers over their financial affairs; for the financial institutions a potentially drastic fall in the cost of paper-based processing. But the cost to the institutions and customers is still questionable - home banking using any of the newer technologies is an extraordinarily expensive capital investment.

Banks have been progressively moving towards automation since the 1960s, and "like old age, home banking is inevitable, but nobody wants to get there first". Using the home for banking affairs appears intuitively more attractive in the US than perhaps anywhere else in the world. In reality, the experience has been rather different. The estimate is that there are fewer than 80,000 subscribers to bespoke home banking services at present. The results are as yet inconclusive, and it might be said that the jury is still out.

In France it appears that the jury has been rigged! As a result of considerable state subsidisation of videotex terminal distribution, one of the major cost barriers to the banks, the provision of terminal equipment in the home, has been largely overcome. At the end of 1987 there were some 850,000 customers of home banking services in France - one customer in 25 households.

Home banking in the UK has been characterised by early pioneering developments, followed by a disparate range of schemes and technologies advanced by banks and building societies. The lack of a large terminal population working to a common standard has prevented the kinds of scale economies and exponential growth of home banking services experienced in France - as it has prevented growth in other home-based teleservices.

Currently, home banking services in the UK are offered by the Bank of Scotland, Barclays Bank (pilot scheme for staff only), Clydesdale Bank, Lloyds Bank, Midland Bank (pilot scheme for selected customers only), Nationwide Building Society, Nottingham Building Society, Royal Bank of Scotland, and TSB/Speedlink.

When asked by Gallup in 1987 "which are you most likely to use computer shopping for?", 28 percent of UK respondents quoted banking affairs, second only to groceries. Popular support exists in principle for home banking, but a series of paradoxes dominate consumer issues in this area: consumers require the assurance of a secure system, but without the attendant complexity; they demand speed of access and interrogation of account information, but without the loss of the "float"; they demand a service at a low (or at no) cost, but one which is of high quality. These conflicts are not irresolveable, but may be costly and complex for suppliers to introduce.

Despite some negative aspects, there are genuine opportunities for growth in home banking services, but as part of a broader strategy. It was never envisaged that home banking would ever replace conventional retail banking activities, but that it might enhance and complement it.
HOME SHOPPING

Richard Poynder is Managing Director of Keyline Shopping Ltd. He described a unique concept in home service, which is being launched in the UK by Keyline in Autumn 1989. The company's product is an electronic communication system linking domestic consumers to wide variety of retail and financial services. The system comprises home terminals, an electronic delivery network accessed by a local telephone line, and a main computer system installed within the service provider's premises. Keyline was founded in November 1978 by Christopher Curry, co-founder of Acorn Computers and inventor of the BBC microcomputer.

Keyline consider that a home service should be seen as complementary to more traditional forms of shopping, and that three types of service are needed: shopping for and purchase of retailed products - home shopping; acquisition of financial services - home banking; obtaining of useful information - home information. These services are needed 24 hours a day, seven days a week, and in the case of tangible goods, there needs to be an efficient delivery or collection service.

The objective is to distribute 2.5 million terminals to consumers and, through the participation of major retailers and financial institutions, to enable the consumers to shop for, compare prices of, order and pay for a large variety of products and services. The terminals are inexpensive to manufacture, portable, intelligent and able to be used by inexperienced operators - ordinary people in their own homes. The range of uses for the terminal when connected through the normal modern BT wall socket is almost unlimited - bounded only by the range offered by the service providers. The process of obtaining goods and services is intended to be simple, fast, convenient and cheap.

The terminal is battery-powered and enables requests to be entered in simple English. At the right moment, the terminal will automatically connect the consumer, through the telephone line at local call rates, to one or more appropriate participating service providers. The customer is then prompted through the acquisition process for the required product, following information displayed on the terminal and entering simple English responses. Then, under password control, products can be ordered through the terminal, and paid for by any method agreed between the consumer and the supplier, eg, credit card, store account or current account. The method of goods delivery will also be by any mutually agreeable method.

Other facilities are offered by the terminal, both for local off-line use as a calculator, alarm clock, list storage, telephone number look-up, and for use connected to other domestic systems such as intruder or smoke detection devices.

Consumers may acquire the terminals at no capital cost, simply on application and payment of a small returnable deposit (around £35). They will then only need to pay for batteries (say 4 x AA batteries twice a year), and local telephone call charges for the time during which the terminal is on-line. Optional printers will also be offered to consumers, at a price of about £50.

The system has been designed specifically to protect consumers, retailers and financial institutions from fraudulent misuse. Features include both hardware and software tamper-resistance, as well as three levels of encryption depending upon the type of transaction being undertaken. User authentication will be by passwords issued secretly to users.

Fig.10. Comparison of building regulation standards in ten European countries using the Milton Keynes Energy Cost Indicator (MKECI)

DOMESTIC ENERGY CONTROL

Brenda Boardman is an independent energy consultant who has researched into energy use in the home for the last six years and is a member of many related organisations.

The best known method of auditing energy is the Milton Keynes Energy Cost Indicator (MKECI), which is an index based on cost. Fig.4 shows the MKECIs for identical three bedroom, five person, end of terrace houses, if built in Britain to the standards of the present building regulations of ten European countries. The lower the MKECI the less energy is used - so Britain is the worst of the countries illustrated, and Finland the best.

In a typical house about 12 per cent of the energy comes from electricity, but this represents 40 per cent of the costs. Fig.5 shows the way in which electricity is used by appliances in an average house in north-west England, excluding heating and cooking. Fig.6 shows the electricity demand over a 24-hour period in England and Wales.

Fig.11. Electrical appliance consumption in an average house (excluding space/water heating and cooking)

Because of increasing energy awareness consumers will expect that their appliances are easy to use efficiently, and that they have clear information on how to obtain that efficiency in practice. With electricity privatisation, it is expected that consumers will be offered a greater range of tariff bands. It is also predictable that domestic appliances may start appearing with add-on
HOME AUTOMATION

AUTOMATION FOR THE DISABLED

Elizabeth Fanshawe OBE DipCOT has been Director of the Disabled Living Foundation since 1983, and is a member of many organisations to do with improving the quality of life for disabled people. The Foundation is a national information resource on the non-medical resolution of the daily living problems facing the disabled.

The bulk of her remarks were addressed to the problems of disability as whole rather than to how automation might help the disabled. They were a chastening reminder that society has still not made adequate provision for the disabled in many areas. She made the point that due to the aging process alone nearly all of us may become disabled in some way. A DoH survey shows that six million adults in Britain have disabilities. This is a large market to explore, even though the disabilities do not conform to a designer's ideal requirement for standardisation.

Initially, she pointed out, the mass market appliance manufacturers can help the disabled by ensuring that control knobs are of a size suitable to those with impaired grasp; that control legends and instruction documents have letters large enough for those with restricted vision to read and that they contrast well with their background.

She declined to give "a list of wizzy automated items that disabled people need because if such items are designed with the needs of ALL in mind they will be of just as much use to (the majority of) able bodied. Careful thought must be given to products intended for achieving energy efficiency.

AUTOMATION FOR THE ELDERLY

Nigel Appleton is the Projects Director for the Anchor Housing Trust. His comments were largely related to defining old age and examining the economic situation for older people. He acknowledged that there is an undoubted role for automation and information systems in the field of specialised housing for the elderly.

To date the greatest penetration has been in communication and security systems. A major area of concern is the need to cope with increasing levels of frailty and confusion. Applications include supervision of residents, monitoring of self-administered medication, and control of mobility equipment. Many older people live alone or with one other elderly person, and are often at a distance from supportive family or friends. For the future their capacity to cope may depend upon a mix of human and technological support systems.

The problems are relatively basic. The need to control their environment, ie, heating and ventilation control and monitoring. The need for security and safety - alarm systems, smoke detectors and low temperature monitors. The need for communication - telephone and intercom systems, emergency call systems, computer banking and shopping. The need for low level support in personal care - activity monitoring, "vital signs" self-monitoring, and medication prompting. In all four areas the technology is already available and much of it is unsophisticated. The immediate future in this market lies not with new frontier technology but in the answers to two crucial problems: acceptability and affordability.

The resistance of older people to the acceptance of the new is probably no greater than for other age groups. But it may be that the way forward is to build on two pieces of equipment with which most older people are already familiar - the tv displays showing the price of the present band to enable more precise energy management and establish which appliances could be switched off to save consumption during peak periods.

It is known that consumers value immediate control in central heating systems and gas central heating, the most responsive of systems, has continued to increase in popularity in all income groups (Fig.7).

Another force for change may come from increasing concern for the environment, both globally and within buildings. Such factors as depletion of the ozone layer and the greenhouse effect will have an impact on the techniques used to insulate homes and reduce energy consumption.

However, there are two other social factors that influence successful home automation. There can be considerable difficulties and expense involved in getting appliances repaired, consequently products must be reliable. Secondly, for products to be acceptable they must be as much designed for use by people with disabilities as for the able-bodied. Careful thought must be given to products intended for achieving energy efficiency.
and the telephone. On affordability, there is the question of whether the market will be exploited solely for profit or whether there would be some intention of meeting need. The telephone is vital to the independence of elderly people, but many cannot afford it. Other systems and equipment which the majority of those who need them cannot afford will be seen as no more than rich geriatrics toys. Products and services must be affordable by a substantial number of those who actually need them.

There is a defined market for information and automation technology in specialised housing for older people. The greater challenge is in meeting the needs of the 95 per cent of elderly people who remain in their own homes. The need is for systems which will supplement or replace human support systems. Some needs and products are already identified but further product development is required and the future depends upon industry’s ability to respond to the challenge of acceptance and affordability.

### CONSUMER VIEWS

Dr Liz Mandeville joined RMDP’s research department in 1985 and has been closely involved with the field of home automation. She has just completed a second programme of research on the same subject among consumers to establish their interests, attitudes, expectations, fears and concerns.

#### TABLE 1 IMAGES OF THE AUTOMATED HOME

<table>
<thead>
<tr>
<th>Image</th>
<th>Attractive</th>
<th>Unattractive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home-accessed facilities</td>
<td>58.5%</td>
<td>14%</td>
</tr>
<tr>
<td>Remote control</td>
<td>57</td>
<td>15%</td>
</tr>
<tr>
<td>Armchair control</td>
<td>52</td>
<td>18%</td>
</tr>
<tr>
<td>Programmable home</td>
<td>75</td>
<td>7%</td>
</tr>
<tr>
<td>Robot aids</td>
<td>17</td>
<td>55%</td>
</tr>
<tr>
<td>Automated furniture</td>
<td>24</td>
<td>52%</td>
</tr>
<tr>
<td>Talking appliances</td>
<td>40</td>
<td>39%</td>
</tr>
</tbody>
</table>

Table 1 shows the percentages of all participants who found the listed images attractive or unattractive. From the table it is apparent that the more “science fiction” images of robots and automated furniture are generally disliked, though opinion is divided on the merits of appliances capable of conversing with the household.

This suggests that people like the idea of exerting greater control over their home, but don’t like “gadgets”. Fear was also expressed of a Sorcerer’s Apprentice situation with unstoppable machines forever turning the tv on and off, pumping water, opening and shutting windows, and even answering back when told to desist. As it emerged in discussions, programmability is a double-edged concept: control is good in human hands, but extremely threatening when handed over to a machine.

### TABLE 2 APPLICATION AREAS: LEVEL OF INTEREST

<table>
<thead>
<tr>
<th>Area</th>
<th>Average Number of Mentions for Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household security</td>
<td>74.5</td>
</tr>
<tr>
<td>Energy management</td>
<td>67.5</td>
</tr>
<tr>
<td>Working from home</td>
<td>60</td>
</tr>
<tr>
<td>Financial services</td>
<td>54.5</td>
</tr>
<tr>
<td>Household management</td>
<td>53.5</td>
</tr>
<tr>
<td>Entertainment, education and culture</td>
<td>44.5</td>
</tr>
<tr>
<td>Health monitoring</td>
<td>41</td>
</tr>
</tbody>
</table>

Interestingly, the concept of home automation evoked certain initial responses, but attitudes changed when people began to consider some of the areas where home automation can be expected to have an influence. This is probably partly because it takes the subject out of science fiction or hobbyist atmosphere which tends to surround it – people began to think in detail how it might really affect their lives. Table 2 shows the levels of interest in particular areas as revealed by the number of mentions made during the discussions. The limited nature of this information is recognised.

### TABLE 3 MOST AND LEAST POPULAR APPLICATION AREAS

<table>
<thead>
<tr>
<th>Area</th>
<th>% of ‘High’ Responses</th>
<th>% of Low Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entertainment, education &amp; culture</td>
<td>37</td>
<td>3</td>
</tr>
<tr>
<td>Household security</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>Energy management</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Financial services</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Household management</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Health monitoring</td>
<td>2</td>
<td>38</td>
</tr>
<tr>
<td>Working from home</td>
<td>1</td>
<td>34</td>
</tr>
</tbody>
</table>

Participants were asked to say which application areas they thought would prove most popular, and which the least. Table 3 shows the ranking order of the areas. The results indicate that there are clear winners and losers in the popularity stakes. Significantly, working from home, which has received a relatively large amount of publicity in discussions of home automation, fares very badly. (Strangely, considering the current media coverage relating to healthy living, so does health monitoring, Ed.)

Discussions about who will benefit most from specific areas of home automation revealed the information in Table 4.

To assess participant’s worries, the members of the groups were offered eight statements about home automation, each embodying a distinct attitude towards the subject, and asked which, if any, they agreed with. All except the last began “I think home automation…”

1. represents progress in life styles. I look forward to its introduction.
2... is the latest fad and will go the same way as other fads. I do not think it is something to take seriously.
3... has a lot to offer, but I am concerned about its implications for privacy and security of the home.
4... is likely to appeal only to technology enthusiasts.
5... is of great benefit to housebound and disabled people, but I am not convinced that it has much to offer the population in general.
6... will change people’s lives in ways we cannot yet foresee. I am concerned that many of the changes will be for the worse.
7... will make the task of running a home efficiently much easier and more cost effective. I welcome this development.
8... I regard the home as a private and relaxed place. I do not welcome the intrusion of high technology into the home.

Table 5 shows how participants responded to these statements.

### TABLE 4 WHO WILL BENEFIT MOST FROM HOME AUTOMATION?

<table>
<thead>
<tr>
<th>Area</th>
<th>Main Beneficiaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household security</td>
<td>Everyone - 30%</td>
</tr>
<tr>
<td>Energy management</td>
<td>Everyone - 48%</td>
</tr>
<tr>
<td>Financial services</td>
<td>The old - 26%</td>
</tr>
<tr>
<td>Household management</td>
<td>The rich - 26%</td>
</tr>
<tr>
<td>Entertainment, education &amp; culture</td>
<td>Everyone - 38%</td>
</tr>
<tr>
<td>Health monitoring</td>
<td>The old - 29%</td>
</tr>
</tbody>
</table>

Fewer than a third of participants think home automation is only for high tech enthusiasts or worry about its intrusion into the home, and fewer than one in twelve consider that it is a fad which will go away. The highest support is for those statements which reflect uncertainty and reservation. The task of companies entering this market will be to identify and address major areas of concern, so that their products may be received as helpful rather than threatening. This research is designed to help with that task.

Both as P.E.’s Editor and as an interested individual, I would have additionally liked to know the social and age groupings of the participants in relation to their answers.
The entertainment world has been prone to examples so much admired on the screen. The image must be reflected in the home and most of us regard as only suitable for factor - capability to control appliances that people to lead a more organised, secure and automated home owner! Like many PE readers, he loves inventing, making and activating standard bells, strobes or sirens.

Automation for controlling washing machines, toasters and other electro-mechanical devices. Such devices, such as contact or magnetic switches, pressure pads, thermometers, ultrasonics, infrared etc., will activate standard bells, strobes or sirens. It was soon apparent that each function needed separate controllers and that finding the appropriate one took longer than manually performing the same function. The implementation of a single master controller was the next objective.

Demobbing the home computer from the space-wars front, I built an interface, wrote software and converted the system to generate patterns of control sequences for lights and curtains. But it was limited - freedom of control was needed, a method of communicating with the computer that didn’t restrict access. The humble telephone - that was the answer, a means of communication from almost anywhere to the home. A second interface was built linking the phone to the computer via dtmf (dual tone multifrequency) across a conventional voice link. A dtmf tone pad placed over the handset would send coded data to the computer, which would reply with menus and prompts generated by digitally assembled human voice. In 1987 the next module was built, and control of a table lamp in the living room became telephone active!

Currently I have control of central heating, hot water, house lighting, curtains and what must be first - an underground plumbed sprinkler system to water the lawn. And all controllable at any time of day from anywhere in the world by the push of a button over the telephone. May that be inspiration to all PE readers!

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- Science Policy Research Unit, 0273 506758. David Gann.
- Smart Card International, 0689 78345. Roy Bright.
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Test gear is an important part of any engineer's toolkit and, like any other tool, having the right pieces of test gear can save a lot of time. The quality of gear is important, too. Ever tried using a soft-metal screwdriver?

One of the most fundamental items in the toolkit is the meter. A few years ago, the meter would almost certainly have been an analogue one. Now the most common type seems to be the digital multimeter. Originally, these were expensive and were only seen in professional use. However, they have dropped in price and are now easily afforded by the keen amateur.

Choosing which meter you want to buy might seem like a simple task — but as you delve into the jargon you might discover that meters, analogue and digital, have a lot more to them than meets the eye. Some modern digital meters can appear to be very complex — but is the complexity worth it?

Digital Multimeters

There are three quick reasons why, in most instances, a digital meter is better than an analogue meter. The first of these is accuracy. Accuracy is usually expressed as a percentage of the value read plus or minus one or two digits. For measuring dc voltages, a manufacturer might specify ±0.3% + 1 digit. This means that if we were measuring, say, 2Vdc the error would be (±0.3% + 1 digit) = 0.006V from the first part of the specification and to this 0.006V we would have to add 0.001V if we were using a “3½” digit meter on, say, a 4 volt scale.

WHY DIGITAL

By a 3½ digit meter, the manufacturer means that the meter will display three digits with 0 and 9 capability but there will be another digit which will only be able to display 0, 1, or 2 (typically). Hence, the meter will read from 0000 to 2999 but the exact range covered will depend on which range is selected by the user. So it might be 0.000 to 2.999V or 0.00 to 29.99 mA or 0.000 to 299.9 Ohms. The decimal point can move around to accommodate different ranges.

This level of accuracy is far above what analogue meters can manage — typically a few percent accuracy. But be careful. If you use a 0.000 to 2999.9 mA range to measure a current of only 3 mA then the digital meter's accuracy will fall. Using the same specified accuracy as above, 0.3% of 3mA is 0.009mA. Remember that we have to add the “1 digit” (which is always the least significant). The accuracy is now 0.009mA plus 0.1mA which represents 3.6% of the reading. So with a digital meter you have always to remember to use the most sensitive range which will cope with the quantity being measured.

The next advantage of a digital meter is the resolution. If you have to measure small fluctuations in a constant signal then the higher resolution will enable you to see the changes where small movements of a panel meter's needle would never be spotted.

The digital meter converts the analogue signal from the test-prods using an analogue-to-digital converter (adc). The output of the adc is then fed to the meter's display. With higher quality meters, better adc are used and so a higher accuracy and a 3½ digit resolution might be offered; a £300 meter might well have an accuracy of ±0.05% and 4½ digits.

Increasing cost will bring other advantages — more later.

The third ‘quick’ reason for buying a digital meter is that the adc will have a very high input impedance. Good digital meters have an input impedance of at least 10 megohms — some up to 10 gigohms! This high impedance means that the meter will not, under most circumstances, load the circuit which it is measuring. For accurate measures of voltages this can be very important: placing a low-impedance meter across a component can have the effect of shorting it out! Good analogue meters typically have an impedance of 20k ohms per volt — so on a 3V range a 60k resistor is placed across the circuit under test.

There are circumstances where this value of resistance in parallel with the circuit under test will seriously affect the reading being taken. Take, for example, a simple voltage divider consisting of two 100k resistors in series. The voltage at the mid-point will be half the supply voltage — except when you place the meter in the circuit. Then the voltage read will be just over a quarter of the supply voltage! With a good digital meter the error will only be 0.5%.

TRUE OR AVERAGE?

One major difference between analogue and digital meters is their ability to offer "true rms" or "average" readings — meters seem to come in the two types so it is an important point to get right. But what does it all mean?

The term “average” means that the meter measures the average value of the ac voltage or current. A “true root-mean-square” meter measures the effective heating value of the signal being measured. In many cases there is little difference. Since wave signals give the correct reading regardless of the type of meter used, slightly distorted sinewaves will give
readings which may be only a few percent in error. However, ac waveforms which are spiky — like current from a rectifier or a voltage controlled by an scr or triac (eg, a light dimmer circuit) — can be wrong by some tens of percent if measured with an averaging meter.

If you need a true-rms meter then there is another choice waiting for you. Because the meter has to respond to rapid spikes in signals, the meter’s adc unit has to be designed to cope — and it will only do so up to a certain frequency. Averaging meters and lower priced true-rms meters will give readings accurate to a few percent with signals having frequency components up to 1 or 2kHz. Medium-priced true-rms meters will respond accurately to, say, 30kHz; the better quality meters can be used up to a few hundred kilohertz with only a small percentage error.

This may seem exotic but if you are trying to measure noise in audio equipment or low frequency digital signals then a response up to 200kHz will ensure that you measure a significant number of the harmonics which the signal is likely to contain.

Using a shunt for low-current work. The shunt is just an accurate low-value resistance which is placed in parallel with the meter and takes most of the current. These can be used up to around 20 amps. If higher currents are to be measured, a clamp probe should be used. With these probes, you do not have to break the circuit whose current you want to determine; normally a meter has to be placed in series with the circuit under test and requires a break to be made somewhere — with the current off, of course!

A manufacturer will also state the crest factor with which the meter can cope. This factor is simply the ratio of the peak voltage to the root-mean-square voltage of the signal; typically a crest factor of three can be accommodated.

**MORE AND HIGHER**

All meters have their limitations. Perhaps the maximum ac current that can be measured is only 2 amps. This is not enough to test many domestic appliances and certainly not utility or commercial circuits where current up to a few thousand amps can be found. Current limitations can be overcome by using a shunt for low-current work. The shunt is just an accurate low-value resistance which is placed in parallel with the meter and takes most of the current. These can be used up to around 20 amps. If higher currents are to be measured, a clamp probe should be used. With these probes, you do not have to break the circuit whose current you want to determine; normally a meter has to be placed in series with the circuit under test and requires a break to be made somewhere — with the current off, of course!

With a clamp probe, the probe just snaps round a conductor — which might be a few centimeters in diameter — and uses the magnetic field generated by the current to couple into either a pick-up coil (for ac only use) or a Hall-effect device; Hall effect devices can be used on ac or dc circuits.

Measuring high-frequency circuits is a problem familiar to the amateur. While many amateur radio books have details of build-your-own hf probes, you can also obtain them ready-built with responses up to near 1GHz!

TV service engineers and valve enthusiasts will be aware of the dangers of taking measurements on high voltage circuits — special probes prevent the high voltage leaking up into the unwitting user. Normal meter probes would not be safe at these voltages.

**BITS AND PIECES**

Voltage and current measurements are the main uses to which meters are put. But there is also the need to measure resistance — and digital meters cope well here, too. They also offer a simple diode test facility and a continuity beeper. The extra accuracy can be useful when building audio filters. Often, filter designs call for 1% components — which tend to be expensive. By checking components in stock, items within the tolerance range required can sometimes be found.

If you find yourself testing cables or circuit continuity often then look in the manufacturer’s specification to see if a fast continuity check is offered — some digital meters can take well over a second to signal that continuity is okay.

One completely new field for meters is that of measuring frequency. This was a feature which was never incorporated into analogue meters — but since a lot of digital logic is inside a digital meter it was a little step to make frequency measurements possible. Typical handheld meters can measure up to around 200kHz — very useful if you are testing tone-generating circuits like modems or ask communications equipment.

Linked with frequency measurement as a new feature is capacitance measurement. This is a rare feature so remember that a resistor and capacitor voltage divider fed with an ac signal of known frequency can help you find the value of a capacitor.

Finally, one of the greatest time savers must be the ability to leave the meter watching for the minimum and maximum values that it measures in a circuit — saves waiting for that intermittent fault to happen!

So if this is a frequent task, get a meter with a min/max hold facility. Similarly, a touchhold feature which allows you to set-up the
METER PHOTOS
We had asked our regular advertisers if they would care to send photos of any meters they stocked. All agreed, but at the time of going to press only Cricklewood Electronics, 40 Cricklewood Broadway, London NW2 3ET, had obliged, to whom our thanks for the photo at top right (model 6010). The other photos show newly released meters and were received as part of publicity material detailing new products. In order of photo appearance further information can be obtained from:

Philips Test and Measurement, York Street, Cambridge, CB1 2PX (reference Fluke Models 83, 85, 87) and Alpha Electronics, Unit 5, Linstock Trading Estate, Wigan Road, Atherton, Manchester M29 OQA (reference Gold Star Model DM 6335).

Electronic Temperature Instruments, PO Box 81, Worthing, Sussex BN13 3PW (reference Model DM 4351) Instrument Rentals, Dorcan House, Meadowfield Road, Langley, Berks, SL3 8AL (reference Model PM 2525) Philips Test and Measurement, York Street, Cambridge, CB1 2PX (reference Fluke TL 20 Test lead set and meter model 27).

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PRACTICAL ELECTRONICS MAY 1989
Like the hydrogen maser, the rubidium vapour cell resonator depends on hyperfine energy changes for its operation. However, the levels of interest are the \([F = 1, m_F = 0]\) and \([F = 2, m_F = 0]\) states which can be abbreviated to \(F = 1\) and \(F = 2\). The component parts of the rubidium resonator are shown in Fig. 8; it employs two isotopes of rubidium, namely Rb85 and Rb87.

Excited atoms in the Rb87 lamp relax down to the \(F = 2\) and \(F = 1\) hyperfine levels, emitting light energy as they do so. This light is directed through a filter cell containing Rb85 vapour whose quantum energy levels are very similar to those of Rb87. However, there is just sufficient difference for the Rb85 vapour to act as a selective filter to the Rb87 light.

Consequently, the light energy emitted by transitions down to the \(F = 2\) level in Rb87 is strongly absorbed by the Rb85 gas, whereas that corresponding to transitions down to the \(F = 1\) level passes through unaffected.

Therefore, the light leaving the filter cell and entering the Rb87 absorption cell has the correct range of frequencies to pump atoms from the \(F = 1\) level up into excited states, but not atoms in the \(F = 2\) level (remember, energy is absorbed or emitted according to the formula \(E = hf\).)

Naturally, this process results in the \(F = 2\) level having far more atoms than \(F = 1\), i.e., we have a population inversion in the \(F = 2\) level.

Now, because all the atoms in the \(F = 1\) state have been pumped up to higher levels, the light energy responsible for this excitation is no longer absorbed and passes through with constant intensity.

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**Fig. 8. Rubidium cell resonator**

For most practical purposes, an output frequency much lower than the transition frequency is required, and this can be obtained from a secondary oscillator phase-locked to the vco.

To ensure the rubidium resonator has a high Q-factor, special 'buffer' gases must be added to the filter and absorption cells. However, these gases produce substantial frequency shifts, as does mistuning of the microwave cavity; consequently, the device cannot be used as a primary frequency standard, and must be carefully calibrated at manufacture. Once the cell is adjusted and sealed, however, the frequency remains highly stable and the drift rate is around a hundred times less than the highest quality quartz oscillators.

Another attractive feature of the rubidium oscillator is that, unlike the hydrogen maser and caesium resonator, it re-uses rather than depletes source atoms and so frequent renewal of exhausted parts is unnecessary.

Certain rubidium oscillators do not feature the light detector and vco, but instead take their output directly from the maser energy in the microwave cavity. However, the light source must have higher power, and the cavity tuning and Q-factor become much more critical parameters; thus, systems employing the closed-loop servo mechanism are often preferred, and are known as passive atomic standards.

**THE CAESIUM BEAM RESONATOR**

The caesium oscillator shown in Fig. 10 is also a passive standard, but in many ways is superior to other atomic references, and advantages such as its excellent long-term stability and relative...
insensitivity to magnetic fields make it an ideal choice for the international standard.

Like the hydrogen maser and the rubidium oscillator, the caesium resonator exploits quantum energy transitions to establish the required reference frequency; the transition used occurs between the \(|F = 4, m_F = 0\) and \(|F = 3, m_F = 0\) levels.

Caesium atoms of various energy levels are evaporated from the oven and directed as a beam towards magnet A which deflects each atom through an angle determined by its energy level. Consequently, those atoms in the \(F=4\) states are deflected through the microwave cavity towards magnet B, while those in the \(F=3\) states are deflected away.

Now, the field gradient of magnet B has the same direction as that of magnet A. Thus, if the atoms arriving at magnet B have not made a transition in the cavity, they are still in the \(F=4\) state and are deflected away from the detector; however, if they have made a transition from \(F=4\) to \(F=3\), they will be deflected so as to strike the detector.

The transitions are stimulated by supplying the cavity with microwave power: if the microwave frequency is close to the transition frequency \((9,192,631,770 \text{ Hz})\) many atoms will be induced to make the transition. However, if the frequency is not quite right, the transition probability will decrease; thus the detector output current will peak at the exact transition frequency (Fig.11).

By feeding the detector current to the vco, whose output is multiplied to provide the microwave signal, we have again established a closed-loop servo system - similar to that of the rubidium oscillator - such that the vco is locked to the atomic transition frequency. It is then a relatively simple matter to synthesise other output frequencies, also locked to the atomic transition, and having the same accuracy and stability.

From Fig.11, we see that the resonance curve is about 50Hz wide at half intensity, and so the caesium Q-factor is: \(Q = \frac{f_o}{\Delta f} = \frac{9,192,631,770}{50} = 183,000,000\) million!

The \([F = 4, m_F = 0]\) to \([F = 3, m_F = 0]\) transition is chosen because it is the one least affected by external magnetic fields. Nevertheless, some field dependence does exist, and the exact frequency is given by:

\[
 f = (9,192,631,770 + 427 \times 10^8 \times B^2) \text{ Hz}
\]

Although screening can reduce these effects, it is almost impossible to remove all magnetic influences, and so a small magnetic field - the \(C\) field is deliberately induced in the cavity. This field separates the Zeeman levels, and allows the correct transition to be 'picked out' from those which would otherwise produce unwanted resonant frequencies.

Various other factors can degrade performance. For example, any asymmetry in the microwave cavity will introduce unwanted phase shifts to the microwave field, and the accumulation of caesium deposits on the cavity ends can result in frequency errors as large as 1 part in 10^9.

A secure vacuum seal is also important; during development of one of the prototypes at the National Physical Laboratory, Essen and Parry found that the most convenient remedy for small leaks was to bung them with plasticine!

Fig.12 depicts the present caesium resonator at NPL: this formidable mechanism is a third generation machine which boasts an accuracy of 1 part in 10^9.

When we talk about the accuracy of, say, a tapemeasure, we are concerned with how closely its graduations correspond to those of an accepted standard of length.
However, when dealing with the caesium standard - which is itself the accepted frequency reference - it is difficult to conceive of its accuracy since we have no superior standard with which to compare it.

Nevertheless, one approach is to measure or estimate the uncertainties of all known parameters which affect the transition frequency, and to combine these figures in a statistical manner to determine theoretically how far the frequency deviates from the value laid down in the definition.

Alternatively, a more practical method regularly conducted by a collection of international laboratories, involves the comparison of scores of caesium resonators in order to determine the average transition frequency: this is then taken as the principal reference value, and each individual resonator can then be 'tweaked' to bring its frequency into line.

Many of these resonators are commercially available, and, indeed, the fundamental purpose in developing any standard is that it can be made available as a reference for accurate measurements.

Hewlett Packard, for example, market the HP5061B caesium beam standard, and the HP5065A rubidium oscillator, both of which can be supplied accurate to a few parts in $10^{-5}$. However, the price of such accuracy is considerable: the rubidium oscillator costs around £22,500, and the caesium model will set you back a cool £24,000!

Radiocode Clocks of Penryn, Cornwall, supply two rubidium oscillators: one is a compact module measuring just 4 x 4 x 4 inches and accurate to 5 parts in $10^{-6}$, whereas the RbS 10000 is a microprocessor-controlled instrument for high precision application. Although cheaper than the Hewlett Packard models, these oscillators are still only intended for specialised use, and prices start at around £6000.

Fortunately, for those of us with modest budgets, there is another way to make use of atomic accuracy. For many years now, various authorities throughout the world have broadcast special signals carrying time and frequency information which is locked to an atomic standard.

For example, in Britain, Radio 4 programmes are transmitted from Droitwich, Burghhead and Westerglen on a 198kHz carrier wave which is locked to the BBC's rubidium standards which are periodically checked by the NPL. A similar service is transmitted on 162kHz from Allouis, France.

Another popular British service is the MSF 60kHz signal transmitted from Rugby. MSF began experimentally in 1950 with a one-hour broadcast every day, and was extended in 1966 to provide 24-hour coverage.

The signal comprises a 60kHz carrier synchronised with the NPL caesium resonator, and modulated with a comprehensive code providing year, month, day of month, hour and minute information. For example, in Fig.13, the code represents 12:24 on September 28th.

At the transmitter, the accuracy of a broadcast standard like MSF is essentially equal to that of the controlling standard: thus, MSF has a transmitted accuracy of around 2 parts in $10^{-8}$.

However, the receiver accuracy will be compromised by the effects of noise and propagation errors. High frequency signals propagate in a complex manner as they reflect from the ionosphere back down to earth. Variations in the ionosphere's profile and height introduce a Doppler frequency shift to the signal, and errors as large as several parts in $10^{-6}$ can occur.

Low frequency signals, however, follow the earth's curvature, using the ionosphere more as a boundary than a reflector. Consequently, the Doppler effects are less troublesome to low-frequency transmissions like MSF, although the ionospheric component cannot be ignored, especially during the winter months when it causes maximum disturbance.

A typical arrangement for detecting and decoding the time and frequency information is shown in Fig.14.

The phase-locked-loop is used to lock the high stability crystal vco to the broadcast carrier: thus, the vco output is an exact multiple of the carrier frequency having the same accuracy and stability, and can be used to synthesise other frequencies if desired. In this way, the crystal vco behaves as a 'flywheel' oscillator whose output is constantly corrected by the incoming precision signal; in many cases, the loss of the broadcast signal (for example, due to a break in transmission), need not be catastrophic, since the crystal vco continues to run, albeit with reduced accuracy.

For broadcast signals like MSF which contain time information, suitable decoding logic is also required to generate a 24-hour time display.

Radiocode Clocks market the RFS 1000 which is a portable off-air frequency standard tuned to the 60kHz MSF broadcast, and has decade frequency outputs ranging from 1Hz to 1MHz. The basic model costs around £450 and provides long-term accuracy approaching 1 part in $10^{-9}$.

The IFS8000, on the other hand, is an 'intelligent' off-air standard which uses a microcomputer-based control system to improve performance and increase long-term precision to 1 part in $10^{-11}$.

Such off-air standards can be used as the reference oscillator of a universal counter timer (uct), allowing measurements to be made with accuracies far superior to those obtained with a quartz crystal timebase.

Nevertheless, we shall see in a future article that a variety of operational and systematic errors must be considered before the uct measurement accuracy can approach that of the external standard.
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1989 CREEEMOOD 100 PAGE COMPONENT CATALOGUE

PRACTICAL ELECTRONICS MAY 1989

Component Solutions Ltd. 0782 641884

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PERIPHERALS

| Z80ACTC| 1.20  | 1.20  | 1.20  | 1.20  | 74LS00      | 1.8432MHZ |
| Z80APIO| 1.20  | 1.20  | 1.20  | 1.20  | 74LS02      | 0.32      |
| Z80S6S| 1.20  | 1.20  | 1.20  | 1.20  | 74LS04      | 1.84      |
| 8155   | 1.80  | 1.80  | 1.80  | 1.80  | 74LS08      | 1.84      |
| 8156   | 1.80  | 1.80  | 1.80  | 1.80  | 74LS10      | 1.84      |
| 8243   | 1.40  | 1.40  | 1.40  | 1.40  | 74LS14      | 1.84      |
| 8251   | 1.20  | 1.20  | 1.20  | 1.20  | 74LS20      | 1.84      |
| 8253   | 1.20  | 1.20  | 1.20  | 1.20  | 74LS30      | 1.84      |
| 81C55  | 1.20  | 1.20  | 1.20  | 1.20  | 74LS32      | 1.84      |
| 8212   | 1.45  | 1.45  | 1.45  | 1.45  | 74LS34      | 1.84      |
| 82C55  | 1.80  | 1.80  | 1.80  | 1.80  | 74LS34      | 1.84      |
| 6522   | 2.40  | 2.40  | 2.40  | 2.40  | 74LS34      | 1.84      |

OPTO

| 3mm    | 0.10  | 0.10  | 0.10  | 0.10  | 74LS00      | 1.8432MHZ |
| 5mm    | 0.15  | 0.15  | 0.15  | 0.15  | 74LS02      | 0.32      |
| 74LS74 | 1.80  | 1.80  | 1.80  | 1.80  | 74LS04      | 1.84      |
| 74LS24 | 1.50  | 1.50  | 1.50  | 1.50  | 74LS08      | 1.84      |

MEMORIES

| 2716  | 3.20  | 3.20  | 3.20  | 3.20  | 74LS00      | 1.8432MHZ |
| 2732A | 3.50  | 3.50  | 3.50  | 3.50  | 74LS02      | 0.32      |

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R5 100 50p each
R10 500 50p each
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C04 4N7 4N7 50p each
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PLANNING FOR THE NEXT 25!
WE ASK FOR YOUR HELP.

PLEASE TICK THE APPROPRIATE BOX!

1. How long have you been interested in electronics?
Less than a year  
Between 1 and 5 years  
Between 6 and 10 years  
More than 10 years

2. What is your present involvement in electronics?
(you may tick more than one box)
As a hobby  
As a profession/trade  
Research and development  
Servicing and installation  
As a student  
As a teacher

3. Below is a list of topics which have been covered in various issues of PE. We should like to know how interested you are in reading constructional articles on each subject.

<table>
<thead>
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4. We'd also like to know how interested you are in each of the following articles in PE:

<table>
<thead>
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<td>Transport technology</td>
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5. How would you describe your expertise in electronics?
Beginner  
Average  
Advanced  
Very advanced

6. On the whole, do you find that the constructional projects in PE are:
Much too simple  
A little too simple  
Just about right  
A little too difficult  
Much too difficult

7. How would you rate the information given to you for constructing projects?
Excellent  
Good  
Adequate  
Poor

8. On the whole, how expensive do you find the constructional projects in PE?
Much too expensive to complete  
A little too expensive to complete  
Not too expensive to complete

The future Editorial policy of PE is in your hands - it will be determined by your replies to this questionnaire. The opinions of every single one of you are of great importance to us. Whether you read PE regularly, or this issue is the first one you've seen, we want to hear from you. Not only will you play a vital part, but each of you who replies will be sent A VOUCHER WORTH £2 off your next subscription.

Not only that, there are THREE CASH PRIZES to be won. The person who most closely estimates the number of questionnaires received back will be sent £100. The next nearest will be sent £50 and the third nearest will be sent £25. £5 each will go to the next five. The questionnaires must be received back by 31st May 1989.

PE TAKES YOU FURTHER ON THE HI-TECH ROAD - WITH YOUR HELP WE'LL TAKE YOU FURTHER STILL. BE PART OF US!

YOUR ANSWERS TO THE QUESTIONS WILL REMAIN TOTALLY CONFIDENTIAL

YOU MAY SEND A PHOTOCOPY OF THIS FORM

please turn over
9. When you build a constructional project published in PE, do you:
   - Always complete it
   - Nearly always complete it
   - Sometimes complete it
   - Never complete it

10. Are the constructional projects published in PE interesting because you want to:
   - Always
   - Usually
   - Sometimes
   - Never
   - Build the exact project shown
   - Modify the project to suit your own needs
   - Use parts of the circuit for other purposes
   - Just read how the circuit works

11. Which other topics, projects or articles, if any, would you like to see covered in PE?

12. How many electronics projects (from any source) have you constructed in the last year?
   - None
   - 1-2
   - 3-5
   - 6-10
   - over 10

13. Please list the projects (from any source) you have constructed in the last year (even if you didn't complete them).

14. How much money do you estimate that you have spent in the last 12 months on components, kits, materials, etc.

15. Do you have difficulty obtaining the components for the projects you construct?
   - Very
   - Quite
   - Rarely
   - Never

16. When obtaining components for the projects you build, do you prefer to:
   - Shop around for the best prices
   - Buy from a regular supplier you have come to know
   - Buy as a kit from a single source

17. How often do you use each of the following sources for obtaining the components you need?
   - Mail order through catalogues
   - Mail order through magazines
   - Personally through a retail outlet
   - Some other source (state which)

18. Do you make your own printed circuit boards?
   - Always
   - Sometimes
   - Never

19. How long have you been reading PE?
   - under 1 year
   - 1-2 years
   - 3-5 years
   - 6-10 years
   - over 10 years

20. How often, if at all, do you read each of the following magazines?
   - Practical Electronics
   - Electronics (Maplin)
   - Electronics and Wireless World
   - Electronics Today International
   - Elektor
   - Everyday Electronics
   - Practical Wireless
   - Television
   - Other magazines (say which)

21. How do you usually see the copies of PE that you read?
   - Buy my own copies
   - Read someone else's copy
   - Read copies taken by my school
   - Read copies taken by my firm/organisation

22. What do you usually do with the copies of PE that you see?
   - Throw them away after I have read them
   - Keep them for future reference
   - Pass them on to someone else

23. Which daily newspaper, if any, do you read?

24. Please tick which age group you are in:
   - Under 16
   - 16-24
   - 25-34
   - 35-44
   - 45-54
   - 55-64
   - 65+

25. Please say whether you are:
   - Studying
   - employed
   - Self-employed
   - Between jobs
   - Retired

26. If you are a student or teacher, how important is electronics on the school/college timetable?
   - Very
   - Quite a lot
   - Not very
   - Not at all

27. Please say in which hobbies or other leisure activities you are most active or interested:

NAME AND ADDRESS (IN BLOCK LETTERS):

MY ESTIMATE OF THE TOTAL NUMBER OF QUESTIONNAIRES RETURNED TO PE IS:

ALL YOUR ANSWERS WILL REMAIN TOTALLY CONFIDENTIAL!

SEND THIS FORM (OR A PHOTOCOPY) TO: Practical Electronics, Survey Dept, 193 Uxbridge Road, London W12 9RA

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K669 Reed Switch Pack – A selection of about 15 types of reed switches from sub 12mm long to 5A rated 50mgh long, mostly form A (new) (name of Circuit Change) over 30 £2.00

K540 Resistor Pack – mostly 1/4, 1/8 and 1/2W, also some 1/10W, 1/25W, 1k, 10k, 10 damn, mostly form A. (name of Circuit Change) over 300 £10.00

K501 Tube具有电阻 行星 switched - Rotating, side push, rotary, toggle microswitches - Amazing value at only £2.00

K569 Reed Switch Pack – A selection of about 15 types of reed switches from sub 12mm long to 5A rated 50mgh long, mostly form A (new) (name of Circuit Change) over 30 £2.00

K540 Resistor Pack – mostly 1/4, 1/8 and 1/2W, also some 1/10W, 1/25W, 1k, 10k, 10 damn, mostly form A. (name of Circuit Change) over 300 £10.00

K501 Wirewound Resistors – Range of values from 0.01 to 100kil, mostly form A (new) (name of Circuit Change) over 30 £1.00

K540 Resistors Pack – mostly 1/4, 1/8 and 1/2W, also some 1/10W, 1/25W, 1k, 10k, 10 damn, mostly form A. (name of Circuit Change) over 300 £10.00

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Investigation 4

The DIY memory

Breadboarding the memory circuit is a challenge for those who like finishing up with a bird's nest of connecting wires. This investigation is strictly for the enthusiastic. If you are feeling faint-hearted at the prospect, the next investigation is much less demanding!

The circuit requires more room than usual (Fig. 17). It is best to begin by wiring up the buffers and their control gates - the three ICs on the right of Fig. 17. Check that these operate properly before completing the circuit with the NOR gates and latch IC. This version of the circuit has two LEDs to indicate the state of data input or output.

To read and store data, follow the steps listed in the previous section. When you are reading data, do not have the D0 and D1 leads plugged in, as this over-rides the true data output.

Investigation 5

The 2114 memory chip

This IC (Fig. 18) contains all the circuit elements of Fig. 17 and a lot more beside. Instead of storing four bits, the 2114 stores 4096 bits. Its addressing system provides for 1024 words, of four bits each. It is a good example of the power of large scale integration.

In order to write or read to 1024 different addresses we need ten address bits. Addresses range from 00 0000 0000 to 11 1111 1111 (0 to 1027 in decimal or 0 to 3FF in hexadecimal). There are four data input/output terminals. The WE input has the same function as in our DIY memory. There is an extra control input, CS. This is, in effect, disconnected from system. When it is low, data may be written or read. Wire up Fig. 19 to see how the memory works. CS is connected permanently to 0V so that the chip is enabled. To write data:

- plug WE into the +5V line (read)
- set up an address by plugging A0 (lsb) to A9 into the +5V or 0V lines. You have 1024 addresses to choose from. To prevent yourself from becoming too tangled in a maze of wires, it is best to connect A3 to A9 permanently to 0V. Just work with A0 to A2. These give you eight addresses, which is ample.
- set up the data by plugging D0 to D3 into the +5V or 0V lines. You can set up any value from 0000 to 1111. The data you are writing is displayed on the LEDs. Make WR low. Then make it high again. The data is now written into the latches in the chip.
- You are now in read mode. Remove the data leads from the supply lines. The LEDs now show what data is being read.

Owen shows more practical ways in which you can learn the basics of computer hardware, concluding with simple circuits for a 2-bit adder, awd, frost alarm and weighted dice.

Fig. 17. Breadboard version of the DIY memory

Fig. 18. The 2114 memory chip

DIGITAL ELECTRONICS

PART 8 – MORE COMPUTER LOGIC

PRACTICAL ELECTRONICS MAY 1989
OTHER MEMORIES

The memory chip that we have just been working with is known as random access memory, or ram. There are two types of ram. The 2114 is one of the type known as static memory. Static memory, once written to, holds its contents until they are altered or the power is switched off. The other type of ram is known as dynamic memory. This does not hold the data indefinitely. This is because the data is not stored in flip-flops but in tiny capacitors. The capacitors are either charged or not charged, depending on whether the data has been written with 1 to 0. But, the charge leaks away from the capacitors in two or three milliseconds unless it is refreshed. This operation has to be done repeatedly by circuits in the computer. When the chip is refreshed, every capacitor is tested before the charge has had time to leak away completely. Uncharged capacitors are left uncharged. Capacitors that have some charge remaining on them are recharged. All this has to be done in between the times allocated to the microprocessor for writing and reading.

Obviously dynamic ram is more trouble to use. Its chief advantage is that, since capacitors are less complicated than flip-flops, it is possible to fit many more of them on to a chip. They cost less too. For about the same price as the 2114, storing 4096 bits, you can buy the 41256 dynamic ram which stores 262144 bits.

RAM is intended for temporary data storage such as programs loaded into the computer and later replaced by other programs, and data such as the results or calculations made while the program is running.

The other main type of memory is read only memory. This is intended for permanent data storage. It may store the programs of a computer's operating system, for example, or its built-in language. Or it may store frequently used programs such as a word-processors. The data in a ram is put into it when the computer is being manufactured. Or perhaps the owner buys a ram chip or a cartridge containing such a chip, and plugs it into a socket in the computer. There are several types of rom, differing in the way the data is stored.

Mask-programmed:

This type is manufactured with the data already part of the chip design. The data can not be changed once the chip is made. It has to be specially made and is therefore expensive, except in large quantities.

Fusible link:

This chip is manufactured with all the bits set '1'. To set a bit to '0' it is addressed and then a high current is passed through the chip. This 'fuses' the addressed circuit units, converting the bit to '0'. Once this has been done the only change you can make is to turn more '1's into '0's, but not '0's into '1's. This type of rom is cheap to make. The only extra cost is the original programming.

Eprom:

The Erasable Programmable ROM is the most frequently used type of rom. The data is held in small capacitors, charged by applying a high-voltage pulse. Unlike static ram, the charge does not leak away rapidly as the capacitors are not electrically connected to the outside world. They retain their charge (and therefore the data) for hundreds of years. The charge is detected by the effect of its electric field, but this does not remove any of the charge itself. These chips are cheap to make and easy to program. Their other advantage is that they can be altered. If you make a mistake when programming them, you can erase the program and start again. Erasing is easily done by shining strong ultra-violet radiation on the chip for about half an hour. This is why eproms have a quartz window (Fig. 20). The uv produces ions which discharge the capacitors.

E²rom or Eerom:

The Electrically Erasable rom, or Electrically Alterable rom (eeprom), like the eprom, can be erased and reprogrammed as required. E²roms are much quicker than eproms to erase but are much more expensive.
**Cd-rom:**
Digital recording techniques need not be restricted to audio. A cd disc can also store large quantities of data and programs in binary form. It takes longer to read the data, since it is not possible to pick out any particular byte instantly, simply by calling up its address. But a cd player does not take more than a few seconds to find the required track and, once it is in position, can read a continuous block of data quickly.

**MORE ELECTRONIC MATHS**

We have seen how multiplication can be done. Now let's look at addition. In binary arithmetic there are only four possible addition sums:

<table>
<thead>
<tr>
<th>Numbers to be added</th>
<th>Carry</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Two single-bit numbers, A and B are added to give a single-bit sum S. When A=1 and B=1, the sum is 10 or 0, carry 1. The table above looks like a truth table. What truth-table is it? It is really two truth tables in one. One is the truth table for A, B and S. S=0 when A and B are equal; S=1 when A and B are different. Those readers who were with us for Part 2 (PE Oct. 88) will recall that this operation is known as exclusive-OR. The other truth table is the table for A, B and C. This is the AND operation. The logic of binary addition can be done with just two gates, an EXOR and an AND. However, since we need the AND gate to get C, we can get the EXOR function from two NOR gates and the AND as in Fig. 21. (Work out the truth tables for yourself, to prove it!) This circuit adds two 1-bit numbers and produces the sum bit and the carry bit.

When we are adding numbers of 2 or more bits we need to allow for the carry-over from one stage to the next, as this example shows:

\[
\begin{align*}
0 & \quad 1 \\
+ & \quad 11 \\
00 & \\
\end{align*}
\]

**Step 1:**
Add the two least significant bits:

\[
1 + 1 = 0, \text{ carry } 1
\]

**Step 2:**
Add the next two bits:

\[
0 + 1 + 1 (\text{ carried over}) = 0, \text{ carry } 1
\]

Fig. 21 can do step 1, but not step 2. It has no input for a bit carried over from a previous step. Fig. 22 shows a circuit that accepts a carry-in bit. Fig. 22 is called a full-adder, while Fig. 21 is only a half-adder. The full adder consists of two half adders: the first adds A and B, producing a sum and a carry; the second adds C\text{IN} to the two half-adders are ORed to give C\text{OUT}.

If we connect the C\text{OUT} of Fig. 21 to the C\text{IN} of Fig. 22, we have a circuit that adds two 2-bit numbers.

**INVESTIGATION 6**

A 2-bit adder

Fig. 23 shows a breadboarded version of Figs. 21 and 22. Instead of the single OR gate we make use of two NOR gates, since these are to be spare in IC3. This circuit (with some of the gates swapped to simplify the wiring) is also featured as Module 11 this month. If you prefer, build the module and use it in this investigation.

The adder accepts two numbers A and B. A\text{0} and A\text{1} are the lsb and msb of a respectively, and similarly for B. The outputs appear as two sum digits, S\text{0} (lsr) and S\text{1} (msr), and a carry-out digit. Build the adder and try adding various pairs of numbers. What is the largest answer that it can produce? (Answer at end.)

You can extend the adder by connecting another full adder to it. The C\text{OUT} output of this circuit becomes the C\text{IN} of the extra adder. Now you can add two 3-bit numbers.

**MICROPROCESSORS**

Last, but no means least, we come to the logic device that is at the centre of all microcomputers, the microprocessor. Microprocessors are also to be found in many other pieces of equipment that perform complicated operations, such as washing machines, computer printers, robots, video players etc.

The key section of the microprocessor (Fig. 24) is the arithmetic and logical unit, the ALU. Here is the logic that performs arithmetic operations such as adding and subtracting, and logical operations such as ANDing, or ORing. The ALU operates on data stored in a special register called the accumulator. This is equivalent to a small pad of paper that you might use to jot down the various stages of a calculation that you are doing in your head. The alu corresponds to your head! You can think of the
accumulator as a register rather like the shift register of Fig. 7 last month but with parallel loading and unloading. Its shifting facility is used for operations such as multiplication – though this is not the only way multiplication can be done. The accumulator is often an 8-bit register, though many microprocessors may have 16 bits or more in the accumulator and in other registers. Data from the accumulator may be taken to the alu, operated on and then returned to the accumulator. Data from the accumulator may also be taken along the internal data bus to the other registers. There are usually several general-purpose registers used for holding numbers that will be needed later. Data is stored in these until it is needed again. The other registers are:

**Flag register:**
This is used not for storing an 8-bit byte, but for single bits, each of which has a special meaning. For example, one flag bit is set to 1 if the result of a multiplication is negative.

**Program counter:**
This tells the microprocessor at which address in memory the next instruction of the program is stored.

**Instruction register:**
The current instruction is stored here (more about instructions next month), and goes to a decoder to find out what has to be done.

The instruction decoder passes on the decoder instruction to the control logic. It is this section that sends data around inside the microprocessor from one register to another, tells the alu what to do with it, and calls up the next instruction when it is ready to proceed. It has connections to other parts of the microcomputer and a set of lines known as the control bus. Data is sent from one part of the microprocessor to another along an internal data bus.

At bottom left in Fig. 24 is the clock, an astable which produces pulses at a high rate (several megahertz). This times the operations of the microprocessor and ensures that its action is synchronised both internally and externally (for example, so that the microprocessor does not try to read or write to dynamic memory while it is being refreshed). The clock is usually a separate ic, not part of the microprocessor.

Data is sent to other parts of the computer along the data bus (more about this next month). There are tri-state buffers between the external data bus and the internal data bus. There is also a buffer for the address bus, another topic for next month’s discussion.

**SELF-TESTING**

1. Name three logical circuits that can be built up from D-type flip-flops.
2. What input is needed to make a D-type flip-flop change state?
3. What is the difference between a siso shift register and a sipo shift register?
4. What types of shift register would you use for sending data along a transmission line?
5. How many shifts are needed to multiply 7 by 16? What do the bits look like before and after shifting?
6. What is the difference between a register and a latch?
7. What are the three output states of a tri-state buffer?
8. What does WE mean?
9. What factors can alter the data stored at a memory address?
10. What is the difference between ram and rom?
11. How is data held in an eprom?
12. How is data erased from an eprom?
13. What logic gate is used to calculate the 1-bit sum (S) of two 1-bit binary numbers? What logic gate calculates the carry bit?
14. Why is a half-adder so-called?
15. Which part of a microprocessor does the arithmetic?
16. Which is the main register used for calculations?
17. What is the purpose of the internal data bus of a microprocessor?
18. Which register keeps a note of how far the microprocessor has got in its program?
19. Where in a microprocessor would you look to find the bit carried over from an addition?
20. What does the instruction register do? The answers are on the next page.

**A 2-bit adder**
This is based on Fig. 23, though the pin connections are different, so as to adapt the wiring for stripboard (Fig. 25). The two 2-bit numbers added are A1A0 and B1B0. Their sum (S) and carry (C) are indicated by three leds. There are three terminal pins on the right, for connecting to other circuits (see the second System of the Month). The module requires a maximum current of 30mA.

![Fig.25. Module 11. 2-bit adder](image)

![Fig.26. Module 12. Audible warning device](image)
Parts required:
- R1 1k carbon 5%
- R2-R4 180 ohm carbon 5% (3 off)
- ICl 74LS08 quadruple 2-input AND gates
- IC2,IC3 74LS02 quadruple 2-input NOR gate (2 off)
- D1-D3 74LS02 quadruple 2-input NAND gate
- T1 pc terminal 3-way
- TR1 ZTX300 npn transistor
- R1 47k carbon 5%

Parts required:
- High input activates the awd. The module drains on the logic to only a few microamps. 
- A transistor switch here. This reduces the operating voltage should be in the range 3-
- (Note: NOT the piezo transducers, which tone when a current is passed through them. 
- solid-state devices or buzzers that produce a malfunction etc. The awd is any of the alarm 
- systems, warning of circuit malfunction etc. The awd is any of the solid-state devices or buzzers that produce a tone when a current is passed through them (Note: NOT the piezo transducers, which require an astable to generate the tone). Operating voltage should be in the range 3-12V. Although many of these devices can be driven directly from a logic gate we use a transistor switch here. This reduces the drain on the logic to only a few microamps. High input activates the awd. The module requires 2mA when activated.

Audible Warning Device
A useful output interface (Fig. 26) for alarm systems, warning of circuit malfunction etc. The awd is any of the solid-state devices or buzzers that produce a tone when a current is passed through them (Note: NOT the piezo transducers, which require an astable to generate the tone). Operating voltage should be in the range 3-12V. Although many of these devices can be driven directly from a logic gate we use a transistor switch here. This reduces the drain on the logic to only a few microamps. High input activates the awd. The module requires 2mA when activated.

Parts required:
- R1 1k carbon 5%
- R2-R4 180 ohm carbon 5% (3 off)
- ICl 74LS08 quadruple 2-input AND gates
- IC2,IC3 74LS02 quadruple 2-input NOR gate (2 off)
- D1-D3 74LS02 quadruple 2-input NAND gate
- T1 pc terminal 3-way
- TR1 ZTX300 npn transistor
- R1 47k carbon 5%

Audible Warning Device
A useful output interface (Fig. 26) for alarm systems, warning of circuit malfunction etc. The awd is any of the solid-state devices or buzzers that produce a tone when a current is passed through them (Note: NOT the piezo transducers, which require an astable to generate the tone). Operating voltage should be in the range 3-12V. Although many of these devices can be driven directly from a logic gate we use a transistor switch here. This reduces the drain on the logic to only a few microamps. High input activates the awd. The module requires 2mA when activated.

Weighted Dice
This is an electronic dice system for use in games (Fig. 29). It is weighted, but that does not mean it is unfair. If you shake a pair of ordinary 6-sided dice, you will rarely score 2 (double 1) or 12 (double 6). Score 7 is the easiest to obtain because you can get it from 1+6, 2+5, 3+4, 4+3, 5+2 and 6+1. In this system the counter output is used as if it is a two 4-sided dice. It is hardest to score 0 (double 0) or 6 (double 3), and easiest to score 3 (0+3, 1+2, 2+1 and 3+0). This is what we mean by saying it is weighted. The astable runs fast, running the counter through from 0 to 15 too quickly for anyone to see the score. When you press the button, the stream of pulses from the astable is interrupted. The counter halts. Its upper two bits are taken to represent a score of 0 to 3 on one die. The lower two bits represent 0 to 3 on the other die. The adder totals these two scores and presents you with the answer – 0 to 6. An optional extension to the system sounds an awd if you score double-3.

Investigation 6:
The largest answer produced is 110, the sum of 11 and 11.

Self-testing
1. Counter, storage register, shift register.
2. A positive-going (rising) edge triggers the 7474 D-type flip-flop.
3. SISO has only serial input and output.
4. PISO has parallel output as well.
5. Four starts, as 00000111 ( =7), finishes as 01110000 ( =12).
6. The output of a register is fixed until the clock goes from low to high. Then the output changes to the new data. The output of a latch follows the input data (the latch is transparent) as long as the clock input is high. When the clock goes low, data present at the output is held latched until the clock goes high again.
7. High (1), low (0) and high-impedance (in effect, disconnected).
8. Write enable. Writing is enabled when this line is low.
9. New data being stored there; 'spikes' on the supply line; power being switched off.
10. RAM is temporary data storage that can be freely written to, and read. ROM has data stored in it before it is installed in the computer.
11. In capacitors that are charged or not charged.
12. By exposing the chip to strong ultra-violet radiation.
13. Exclusive-OR; AND.
15. The alu, arithmetic and logical unit.
16. The accumulator.
17. Carrying data from one register to another, or to the alu, or to the buffers.
18. Program counter.
19. In the carry bit of the flag register.
20. It holds the instruction that the microprocessor is currently performing.

NEXT MONTH:
Owen looks at computer systems, their architecture, input-output functions, and drives a bus!
Astronomy has been revolutionised by electronic devices, notably the ccd or charge-coupled device, developed largely by a British team at Herstmonceux led by Professor Alec Boksenberg. (We ran a report on them in PE Sep 88. Ed.) Using a ccd together with the 2.2-metre telescope at La Silla, the Chilean observatory run by the Europeans, three astronomers - H.E. Schwarz, C. Aspin and J.H. Lutz - have made important studies of a faint object which may be unique. It is too far south to be seen from Britain (it lies in the constellation of Centaurus) and has the unexciting designation of He 2-104. It may well be the first object to be observed in a state of transition from one state to another.

There are some pairs of stars, physically associated, which are known as symbiotic stars in which the two components are interacting. Some of these are surrounded by envelopes of gas, others by envelopes of dust. He 2-104 seems to be of the 'dusty' broken up - though the demise of Phobos is by no means imminent! (Deimos, the smaller and outer satellite, seems to be safe.)

Last July the Russians sent two probes to explore Phobos. One of these was lost when it was given a faulty command from the ground station - a case of human error; efforts to locate the probe from the La Silla Observatory failed, and the chances of finding it again now seems to be virtually nil. This leaves Phobos 2, which will - we hope - hover at a height of no more than 50 metres above the surface of the satellite, making analyses of the soil elements, rock structure and so on.

**PROBING SOLAR SYSTEMS**

**BY DR PATRICK MOORE CBE**

In Chile, astronomers are observing an event which is probably unique in our time - a star hatching into a solar system. And the Russians are looking for life on Mars.

The William Herschel Telescope at Las Palma. Photo by courtesy of R.G.O.

Phobos, the inner satellite of Mars, has come in for a great deal of attention lately. It is a curious little body, irregular in shape and with a longest diameter of less than 30 kilometres, so that it is quite unlike our massive Moon. It also seems to be in an unstable orbit, gradually spiralling down toward Mars, so that it will eventually crash on to the surface even if it is not previously
been to begin making a temperature map of the Martian surface, and study the materials present there; it seems that the Russians have not finally given up all hope of finding some sort of organic material ("life"), though it is clear that even if Mars is not completely sterile, any living organisms must be very lowly indeed.

However, Phobos is the main target for this particular probe, and one is bound to ask just why the concentration is upon the tiny satellite rather than on Mars itself. The reason is that so far as we can tell, Phobos is typical of the very small members of the Solar System. It may well be a captured asteroid; after all, Mars is much closer to the main asteroid zone than we are. But for the Challenger disaster, the Americans should have obtained the first close-range asteroid pictures by now (en route to Jupiter, the Galileo probe was to have imaged the asteroid Amphilthea), but as things are the Russians seem ready to be first in the field.

Small through Phobos is, it could well be of tremendous importance in the future. Manned missions to Mars are being planned, and Phobos seems to be a perfect natural space-station: it is close to Mars — only about as far above the Martian surface as we in Britain are from Aden — and its gravitational pull is so slight that a "landing" there will be more in the nature of a docking. So Phobos, and Deimos too, may have a major role to play in our exploration of the Red Planet.

THE SKY THIS MONTH

For planetary enthusiasts, the main target this month will be Mercury, which is in the evening sky and should be easily visible with the naked eye. For the second part of April it will set well after the Sun, so that this is the most favourable opportunity for some time to come. At maximum brightness, on the 14th, the magnitude is -1.4, just about the same as that of Sirius, though of course Mercury is never visible against a dark background. Telescopes will not show much — almost all our knowledge about Mercury has been derived from one space-probe, Mariner 10 — but it is always a source of satisfaction to locate this quick-moving, elusive little planet.

Venus is out of view (it passes through superior conjunction on April 4, so that it is on the far side of the Sun). Mars passes from Taurus into Gemini, and is in the evening sky, but has now faded to well below the first magnitude; Jupiter remains brilliant in the west for some time after dark, and Saturn, still in Sagittarius (the Archer) is coming into view well before dawn. The rings are wide open, so that even though the planet is low in the sky even a modest telescope will show the ring-system easily.

The Moon is new on April 6, and full on the 21st. There are no solar or lunar eclipses this month. There is, however, one meteor shower; the Eta Aquarids are active from about April 24 to May 20. They are associated with Halley's Comet, and may have a ZHR of as high as 35 (that is to say, a naked-eye observer with the radiant at the zenith could expect to see 35 Eta Aquarids per hour).

We have now lost the brilliant winter constellations, such as Orion; instead, the southern aspect of the sky is dominated by Leo (the Lion) and Virgo (the Virgin). The Great Bear is high, the "tail" points to the brilliant orange Arcturus, and the curved line joining the Bear with Arcturus will, if continued, lead on to Spica in Virgo. Lower in the south there is a rather blank area; this is filled by Hydra (the Watersnake) which has only one fairly bright star. The W of Cassiopeia is at its lowest, in the north, though over Britain it never sets: Capella is descending in the west, Vega gaining altitude in the east. Deneb, in Cygnus, has also risen, but we have yet to see Altair in Aquila (the Eagle), the third member of the unofficial "Summer Triangle".

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LOW ORBIT

A recent survey indicates that the public are likely to be slow in installing satellite tv receiving equipment for Sky and BSB transmissions. Whereas Sky forecast sales of 1 million aerials during 1989, and BSB expect 3 million by 1991, a report by Logica, a software and consultancy company, predicts that the total homes receiving satellite tv by the end of 1991 will only be between 1.6 and 2.2 million.

Looking on the brighter side, the survey suggests that by 1996 more than 7 million homes will be suitably satellite-equipped. Personally, I am waiting for tv manufacturers to produce sets and aerials capable of tuning to all satellite channels before I enter the viewing arena.
The January Winter Consumer Electronic Show (CES) in Las Vegas was a frost—not so much in temperature, but in content. The swarms of electronic press reporters were all asking each other if they had seen anything new. Four long days of blah.

To give you an idea of how dead the event was, the biggest news was the Nakamichi announcement that they were going to start selling a consumer $10,000 dat recorder in the US. Other than some smirks at the concept of the Record Industry Association of America (RIAA) carrying out their threat to haul any firm trying to sell a dat recorder into court, the ripple effect was small.

**CANNED LAUGHTER**

One wonders how much record company money the RIAA would be willing to spend on such a frivolous suit. Going into court and asserting that a $10,000 dat recorder is going to destroy the record industry might tend to make them even more of a laughing stock than they already are.

**STATE**

Several members of congress were assembled, where they repeated the message we've had from two previous CES congressional panels: the record industry needs to look to congress for any action until they can prove actual losses. No more yelling wolf.

The Nakamichi entry, in addition to its amusing price, had one other interesting aspect: it will record at the previously verboten 44.1kHz sampling rate, thereby enabling it to make direct digital copies from cds— the ultimate horror for RIAA. Heh, heh.

DAT hasn't made much headway in Europe or Japan, I suspect because the systems have been blocked from the 44.1kHz cd standard.

The early dat systems were priced for people who have to have the latest technology—and can afford to pay for it. But one hears rumours of $3000 dat being readied for manufacture, once things get moving.

**AUTO-DESTRUCT?**

There's a chicken-and-egg problem with prerecorded digital tapes. Without players, record stores won't stock the tapes. And, many industry insiders believe, without prerecorded dat, it's going to be very difficult to sell dat players— particularly for cars, where they are needed the most. Car cd players are okay, but they do skip on the bumps, and it's difficult to change discs while driving. Yes, I know about the cd car jukeboxes. I also know what they cost.

As I wandered around the enormous halls at CES, I was reduced to numbness by the endless recitations of "exciting" features which the "latest models of everything sported. The Pitchmen spluttered when I asked them what the benefits of these exciting new features were. Did all these new features mean that

**VAGUE GAMBLING AT VEGAS**

serious faults in their earlier products had been discovered and had now finally been surmounted? This confused them.

**BY WAYNE GREEN**

**THE WCES 89 RETORT!**

**Consumer electronic shows can be a bore. Or they can be a laugh. Or they can be so boring, you have to laugh. But no cheap cd? That's not funny.**

I was disappointed that the outfit which promised the laser arm for playing lps showed only a hand-made sample, and announced that they were not going to actually market the players. Darn. My life is so full of disappointments.

The biggest disappointment of the show was the lack of record companies exhibiting. Dozens of people stopped by my CD Review booth to lament records not being there, in years gone by Teharc had done a land office business selling thousands of their cds for $10. CES clamped down on selling at the show, so the record companies dropped out. Might CES go the route of NCC, National Computer Conference, once the biggest of all American computer shows and now defunct? Could be.

**Hi-D BOOMBOXING**

There were a few high definition tv demos. Yep, sure looks great! But with so much money at stake, the infighting over standards is going to be fierce and could possibly lead to the industry's self destruction. Would quad sound have lived if there had been one standard format? Would vcrs have been accepted several years sooner if we hadn't had the Beta/VHS war? Something akin to quad sound is sneaking back via surround-sound encoded movies on video tapes. The high end audio exhibitions were in the Riviera Hotel. There a hundred or so makers of almost identical, expensive, small speakers did their best to convince the attendees that their particular speaker was the best. They did prove that if you put good speakers into small boxes, they'll sound pretty good—as long as you don't have something right there in a larger speaker for comparison. As is obvious from boombox sales, the human ear can get used to almost anything.

**TWEKS RUMBLED**

The LP tweeks were there. Yes, there are still a few people who believe that lps sound better than cds. Any cds. Sigh, I twit them, saying, yes, they're probably right, but of course my lp player has a 100-pound turntable belt-drive that is independently sprung to avoid feedback— driven by belts to avoid rumbles—has a vacuum suction to hold the lp tight—a special cushion to reduce the needle bounce—the whole works in a special class 10 clean cabinet to avoid dust—and so on.

**TOP POPS**

VCRs and compact discs are still top selling consumer electronic products, so that's where most of the CES action was, even if the new products were comparatively boring.

Of course, in Vegas there's always the gambling. Casinos and slot machines are everywhere. The dream of something for nothing dies hard in man and is the secret of Vegas' success. It takes stern moral fibre not to succumb to the beckoning slots. You never win on the first play, which means that from then on you're working just in the hopes of breaking even. The machines are computer controlled to egg you on, always giving back less than you've spent. They will inexorably drain you, as they have millions before you.

You'll notice that no one working the slot machines is smiling. They have nothing to smile about. They are grimly trying to recoup the ever growing deficit their fadng hopes have triggered.

The next CES is in June at Chicago. After the excitement at Las Vegas, I can hardly wait.
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Fancy a quick dabble with the soldering iron? Your Ed’s got a new series of quick-chippy circuits that you can put together in little more than the batting of an eyelid. They’ll give you pleasure to build, and become useful little gadgets that you know you’ve always wanted, even if you didn’t realise it! Here’s this month’s offering: a legal telephone monitor. We’re sure it’s for yoo-hoo!

The problem with telephones is that you’re not allowed to connect anything to the lines unless you’ve obtained official approval. A real shame, this, since there are all sorts of things one can invent that could make direct use of Buzby’s wireful-world communications network. It’s not allowed though!

Even though British Telecom now have special sockets into which other gear can be plugged, that equipment has to have the approval of Those in Charge. BT have relinquished their authority on this, and it’s Oftel who are now responsible. But, try as I might, it seems an impossibility to find out precisely what the situation is about getting approval for home telephone accessories that plug into the lines. However, adding together various statements made by different sources, it appears that even if a particular circuit is in theory suitable for approval, unless it’s made by an approved manufacturer it may not qualify. “Too many possibilities for home constructors to get their assembly wrong”, is the opinion generally offered. “We don’t want poor unsuspecting telecom engineers knocked off their poles by a 250Vac overload if someone mistakes a mains socket for a 9V battery!” Point well taken.

BY JOHN BECKER

REMOTE-A-BELL

Still, all is not lost. There are other ways of doing things without direct connection. It’s possible to detect the voltage changes in a telephone without plugging anything in. All it needs is an inductor close to the phone line and an amplifier. Surely there’s no way that anyone’s going to regard this as an unofficial connection?

So what can we invent that’s useful? Speech detection is really out of the question for a simple circuit since the amount of amplification and consequent noise levels would be too high to accept. We can, though, remotely detect whether the phone line is swinging up and down by about 50 volts when you dial out, or someone is dialling out. So let’s take that as this month’s quicky theme.

We’ll build a circuit that will allow you to have an extension buzzer well away from the phone, out in the garden perhaps. It will also let you hear if someone is using the phone, out in the garden perhaps. It will also let you hear if someone is dialling out. So let’s take that as this month’s quicky theme.

**INDICATING INDUCTORS**

Fig.1. The Remote-A-Bell circuit diagram. Note that the pulse length can be extended by increasing C5 or R7

**CIRCUITOUSLY EXTENDED**

We’ll build a circuit that will allow you to have an extension buzzer well away from the phone, out in the garden perhaps. It will also let you hear if someone is using the phone while you’re off in another room somewhere. With all the recent fuss about Chat-lines, I can see that this might perhaps help cut down on phone bills! “I hear you dialling your friends again - make sure you put the money in the box…” Incredible as it may sound, you can detect whether the phone line is being pulsed simply by taking a single turn of its cable around a simple small inductor. The phone line swings up and down by about 50 volts when you dial out, or someone is ringing you. This change in voltage can induce a small current into the inductor. Looking at Fig.1, L1 represents the inductor and the single turn of cable around it.

The value of L1 has been found experimentally not to be at all critical. Values of between 1 milli-Henry and 100 milli-Henries all produce results. The signal level obtained, though, is extremely small. We need to amplify it. One end of L1 is taken to a mid-voltage reference level, as set by R8 and R9, and the other taken via C1 and R1 to the inverting high-gain amplifier IC1A. C1 is made fairly small so that mains hum from nearby electrical wiring is not unduly picked up and amplified. The gain at IC1A is set by the ratio of R1 to R2, about 1000 times. The output here is a very short pulse of a few millivolts, accompanied by diminishing harmonic peaks caused by the action of the inductor.

C2 isolates the dc output of IC1A so that only the pulse affects the next amplifier, IC1B. The amplification factor here too is around 1000 as set by R4 and R6. This is sufficient to raise the pulse to a respectable level, approaching the maximum allowed by the opamp characteristics. C4 just adds a little bit of damping to lower level noise signals. If on test the gain is found to be a bit high, and random noise still gets through, increase the value of R4, or decrease R6.

We now raise the pulse to full line level by using a comparator, IC1C. The comparator triggers from a low to high output state when incoming signals pass above the threshold level set by VR1, typically around 0.5V above half the battery level. Between them C4, D1, D2, C5 and R7 form a diode pump network. Pulses pass through C4 and D2 to charge up C5. When the charge on C5 exceeds the threshold level set by VR1, the comparator is triggered into a high output state. Once the pulses have ceased, R7 discharges C5, and IC1C reverts to its low output state.

**DETECTIVITY**

The output of IC1C is sufficiently powerful to allow a high impedance audible warning device to be connected directly to it. Alternatively, the output can be taken via the transistor TR1 to provide sufficient power for driving a small bell. The type of transistor used for TR1 is unimportant so long as it’s an npn type capable of carrying the current through the speaker.

You can use any dc power supply of between about 5V and 15V. A 9V battery will do just fine. If you use a 5V supply, you could use the output of IC1C to send pulses to a computer so that you can do a bit of programmed detection work on the signal. I’m not going to give information about this here since I have a more complex computer-controlled dialling and cost...

51
Fig. 2. Suggested Veroboard layout

monitoring circuit in mind for some time in the future. But I'll give the hint that both serial and parallel computer ports can be used to detect changes in logic levels, and that Basic is fast enough for monitoring the phone pulses. This should give you something to think about!

There's hardly anything to the assembly of this circuit, and a small piece of Veroboard or similar is quite acceptable. A suggested layout is shown in Fig.2.

Just make sure that you check all your joins for satisfactory connections without shorts across the tracks. Remember to cut all the track points where shown. Naturally, IC1, TR1, D1, D2 and the electrolytic capacitors must be inserted in the correct way round. There's no real setting up to be done - twiddle VR1 until the buzzer or bell remains silent until you dial out, or someone rings you.

One final point. The circuit, in its simplicity, can be subject to interference from spikes occurring on nearby mains wiring. Such things as fluorescent tubes, fridges and microwave ovens can create these spikes when they are turned on or off. Suppression techniques for such happenings are beyond the scope of this simple project. The occasional "ping" on the extension bell, though, is unlikely to be mistaken for a true phone call or dial-out.

I hope to have another simple quicky for you next month.

Fig.3. Track view of Veroboard layout.

**ED-LINES**

SPEECH THERAPY

Nasa has introduced a computer controlled method whereby technicians can more accurately monitor the condition of each of the 31,000 heat resistant tiles on the Shuttle. Previously, one technician up a ladder would measure each of the tiles and shout down the results to a colleague on the floor - a system open to errors. Now a single technician speaks the number of each tile into a speech recognition unit and takes measurements with a laser tool, following instructions from a computer. The technique has cut down the total checking time from several months to just eleven days. Ed.
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pach track with an ultra-high frequency diode across a gap in the middle of the aerial. Two inductors were formed as part of the pcb track, coming from each side of the diode, with a small value capacitor across the two inductor ends. A 250pA meter, in series with a limiter resistor, was then connected across the capacitor. It needed no power supply since any microwave leakage would generate sufficient current to drive the meter directly.

C.P. Finn, Beverley

Thanks, I assume you mean something like this

Ed

Dear Ed,

Barry Fox’s article dealing with ‘electronic smog’ (PE Sept 88) is timely although the problem is not new. One might also include high voltage ac railway electrification as another offender.

I did, however, understand the comment that a motor or welder has zero resistance at the moment of switch-on. Surely resistance is a physical property of the conductors and is always present? The inrush current depends upon the source impedance of the supply and the resistance and reactance of the motor. The latter is complex but is low at standstill, hence the high current, and increases as the motor speed rises. In the case of welders I think the real problem arises from the electromagnetic energy associated with the welding arc.

Finally, let us not forget the effect of mains spikes on components leading to breakdown.

M.W. Burnby, Wirksworth, Derby

Mr Burnby is right of course. I was using shorthand. At the moment of switch-on there is an almost complete short circuit across the supply because resistance is almost zero - then reactance and inductance take over. I appreciate helpful comments like this - it keeps journalists like me on our toes.

Barry Fox

Dear Ed,

I am a retired electronics engineer and subscribe to PE because I want to stay in touch, mainly through Marketplace, Industry Notebook, Leading Edge, Editorial and Spacewatch.

I wrote in response to Mr Trice’s letter (PE Sept 88) about Astro Electronics and your reply and appeal to readers. I have misgivings about Mr Trice’s idea of using a stepper motor to drive a telescope. They are inherently very low torque devices and in view of telescope mass and power losses in the reduction gear wonder if their torque would be sufficient. Also, the fact that the speed must be variable might lead to a complicated and expensive clock control.

A small universal motor, such as a washing machine spinner, might be more appropriate. They have a high torque and are easily controlled by a dedicated chip, like one of the TLE370x series from Siemens, with a tachogenerator in the control loop. This would be less complicated and cheaper. However, before starting on a project like this I need a few questions answered:

What should be the mean tracking speed taking into account Earth’s movement round the Sun? Is it true that dedicated amateur astronomers have instruments up to six inches?

What speed variation is admissible when taking photographs? How does one calculate the exposure values?

D. Balet, Co Kerry, Eire

I share your misgivings about stepper motors and believe that synchronous motors will achieve more satisfactory results under adequate control.

The Sidereal Clock article in PE Feb 89 gives figures for calculating sidereal time which, compared to solar time, gains approximately 3 minutes 56 secs per solar day.

Patrick Moore’s opinion is that it is pointless to spend money on any refracting telescope with an aperture of less than three inches or a reflector with a main mirror less than six inches diameter. The subject of light intensity and camera exposure values is too complex for a published reply so I refer you to the Astrophotography article in Astronomy News Apr-Jun 1987, and to the book Astro Physical Quantities by Clayhorne Allain (available through a library). As a rough guide, with an f1.8 28mm lens, 30 seconds exposure on 10X80 ISO film will probably produce acceptable results without apparent star trailing.

Ed

Dear Ed,

I write in response to Mr Trice’s list of components which he quotes as saying 3,300,000 ohms. Or in other words has a resistance of 3.3 megohms. Later in the article he then states ‘...a suitable resistor’. Is this a resistance or an inductance? One would think the real problem arises from the electromagnetic energy associated with the welding arc.

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A number like R55 is the number given to a component in a circuit or pcb diagram. Each component will have a different number prefixed by, for example, R for resistor, C for capacitor, D for diode etc. The SM3 means that the value of R55 is 3M3, or in other words has a resistance of 3.3 Megohms, which is the same as saying 3,300,000 ohms.

Best wishes to you and your brother.

Ed

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Ed

Dear John

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I recall that some years ago I saw an article describing such a unit. It mentioned in a constructional parts list it said ‘a suitable resistor’. Is this a resistance or an inductance? One would think the real problem arises from the electromagnetic energy associated with the welding arc.

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Barry Fox, in Leading Edge of PE Jan 89, reported on the imminent arrival of the second generation of cordless telephones, the so-called CT2 generation. Keith Clarke of British Telecom Research Laboratories obliquely referred to CT2 in part one of Home Automation last month. "The expectation is", he said, "that in the future the customer will have a stylised personal communicator which will operate to any of a large number of receivers and transmitters". The concept of which he spoke, in fact encompasses personalised transceivers not only of the CT2 genus, but also those of CT3 and beyond. CT2, though, has now been officially announced and, by the time this report is published, should be at the mass production stage. It will shortly be available in the BBC tv series "Bread", and the cellular phone variety. As a quick recap, "Bread" phones have a low-power two-way radio in the handset and, using analogue techniques, communicate with a mains powered base station plugged into the user's own telephone line. The range varies from around 50 metres indoors, to at best 1km outside. Cellular phones also use a radio link, but communicate with commercial base stations at which computers handle the call routing to mobile targets throughout most of Britain.

This first generation technology, CT1, is subject to interference and suffers from low speech quality which gradually falls off even further as the user starts to move away from the base station. CT1 also has an inherent lack of security, through operating on a fixed frequency with only eight channels available, and being open to eavesdropping by unauthorised listeners.

CT2 is being implemented under the general name of telepoint and offers an inherently more secure mode of operation, using digitally coded techniques. The telepoint concept consists of a network of public base stations linked into the public switched telephone network. Subscribers will be able to access the network using personal pocket sized cordless phone handsets. The intention is to liberally scatter the base stations at strategic places around the country. Locations may be as diverse as railway stations, shopping centres, restaurants and service stations. It is also possible to purchase one's own station for domestic or office installation.

### TELEPOINTING THE FORUM WAY

By Michael Strassen

The British are scoring points with CT2, a lighter, simpler access-only version of the poserphone. There are five to win in the PE competition, too.

#### ROVING ACCESS

Although the system is intended for roving use, it is not a mobile phone as such. The user must remain within the locality of a base station, the public versions of which do not allow handsets to receive incoming calls. Besides which, unlike the cellular phone network, there is no central computing system which can search out the locality of a given receiver. However, because it is basically only an outgoing system, the circuit design is much simpler, and the handsets can be far lighter.
To dial into the national and international telephone network, the user simply stands within range of a telepoint, typically around 200 yards, switches on the handset, enters a personal identification number (PIN) and keys in the appropriate telephone number. The telepoint will check that each handset's unique code number corresponds to the user's PIN, so ensuring that no unauthorised use can be made of the system and that calls are correctly allocated for subsequent billing. As an additional safeguard, subscribers will receive fully itemised bills - similar to the use of credit cards in this respect. Calls will be charged at the normal telephone rates. Although there will be additional subscription charges, the tariffs will be considerably lower than those for cellular services.

The technology is totally British, and the UK is the first entrant to this communications field. There are four licence holders in the scheme, consisting of BT/STC, Mercury/Shaye, Ferranti, and a group including Philips, Barclays and Shell. Shaye Communications is the company who have designed and developed the first of the CT2 handsets and base stations for the telepoint network. Shaye grew out of a laboratory set up by Sir Clive Sinclair (whose entrepreneurial endeavours are much admired by PE).

**FORUM HANDSETS**

Known as the Forum, Shaye's handset weighs just 130 grams, around the same as popular calculators, and contains an integral aerial. It communicates via the telepoint network and complies with the common air interface (CAI) standard for CT2 systems. This standard defines the radio interface between equipment produced by different manufacturers and allows interworking of products.

Operating in the 864 to 868 MHz spectrum, the Forum phone offers excellent speech quality with no degradation as the caller moves toward the speech range extremity. Interference is further limited and security improved by the fact that the phone is frequency-agile and selects the best available channel out of a range of 40 each time a call is made.

The handset fits easily into the pocket and offers up to 50 hours of continuous speech from a replaceable long-life lithium cell. Alternatively, the user may opt for a rechargeable nickel-cadmium battery used in conjunction with the Shaye nicad battery recharger.

To make a call once you are within range of a telepoint station, switch on the handset by opening the flap which conceals the keypad when the phone is not in operation. Select an appropriate telepoint network (customers can subscribe to more than one network) which will ask for your PIN. Enter the number, then key in the telephone numbers, make the call, and on completion, close the flap.
If you have a Forum personal base unit plugged permanently into a standard telecom wall socket at home or the office, calls can be made or received in exactly the same way as existing cordless phones operate. In the office the personal base unit can be connected to either a direct line or pabx exchange line. For outgoing calls the handset is operated in the same way as if you were using a public telepoint station. With the Forum you can also receive incoming calls via the personal base station. If the handset rings, indicating an incoming call, pick up the handset, open the flap and respond as normal.

### STANDARD FORUM FEATURES

- Pushbutton digit dialling.
- Memory storage of 12 x 22 digit numbers.
- Last number redial.
- User selection of loop disconnect of dtmf signalling.
- User selection of telephone service provider (BT or Mercury).
- User selection of telepoint service provider.
- Call transfer.
- Intercom through suitably equipped base unit.
- Mute.
- Memory retention during battery change.
- Inbuilt protection against recharging a non-rechargeable battery.
- Reverse battery polarity protection.
- Low battery indicator.

### INFORUMATION

The Forum Personal Phone and the Forum domestic base unit will retail at £150 each, plus vat. Both will be available through multiple retailers and other outlets. For further information please contact Shaye Communications, Capital House, 48-52 Andover Road, Winchester, Hampshire SO23 7BH. Tel: 0962 55925, or Jonathan Simnett/Isabel Robertson, A Plus Public Relations on 0753 686655.

### FORUM FOR ALL

Shaye’s chief executive, Bill Jeffrey, comments, “For the first time the consumer will be able to have a single telephone that is personal to them, one which they will be able to take with them at all times and use in the home, in the office and when they are out and about.”

“The Forum personal phone is”, Bill Jeffrey continues, “the smallest, lightest, and most truly portable cordless telephone developed to date, one that will change the face of personal communication in the next decade.”

### WIN YOUR OWN FORUM

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Study these seven questions and put a circle around the answers you think are most appropriate (one circle for each question!).

1. When was the first communications satellite launched?
   1955  1962  1975

2. Was it called -
   Astra Buzbysat Telstar

3. Who is usually credited with inventing the telephone?
   Hans Fernsprecher Guglielmo Marconi
   Alexander Bell

4. When did he do so?
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5. How much do you like the new cover style?
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7. How much would you like more Easi-build circuits?
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The winners of the Astra satellite TV aerials will be announced next month!
by the time you read this the Monopolies and Mergers Commission may have made a decision on whether to allow a proposed takeover of Plessey to go ahead. The predators, as the newspapers call them, are GEC and Siemens of West Germany, who would set up a joint company for the purpose.

All this started to happen last November, and you may have been wondering why I haven't mentioned it before, considering that such a massive re-grouping would be highly significant to the whole UK electronics industry. Well, I was repeatedly frustrated by a whole series of new developments affecting GEC. Several times, as I was poised with fingers over the keyboard ready to write a report, something else would happen to change the whole picture.

Most important was a "phantom bid" for GEC itself. This came from a company called Metsun, specially formed for the

purpose by an international group of electronics/communications companies and bankers. Relying on certain rumblings of discontent from GEC shareholders, Metsun planned to acquire the group and dismember it into what it saw as a more efficient commercial deployment of operations.

As things turned out, GEC threw a defensive spanner into Metsun's works by announcing a tie-up with the American General Electric on several joint ventures to improve the two companies' competitiveness in European markets. Thus GEC became much less vulnerable, wedged supportively as it was between GE and Siemens, respectively the second and fourth biggest electrical/electronic companies in the world. Soon after this, a powerful member of the Metsun consortium, AT&T of America, withdrew from the takeover plan and the whole project collapsed.

You may remember that GEC once tried to take over Plessey on its own (see my report in the March 1986 issue). The main idea of GEC was to make itself bigger in the telecommunications equipment business and thereby achieve a better share of the world market. But this plan was vetoed by the Monopolies and Mergers Commission.

Subsequently, as I reported in February 1988, Plessey and GEC agreed to co-operate just on the manufacture and marketing of telecoms switching equipment, which is now largely electronic. This came from the formation of a joint-venture company called GEC-Plessey Telecommun-ications (GPT), which now has annual sales of over £1 billion and a foot in the US market through its subsidiary Stromberg-Carlson over there.

Well, GPT is now a major factor in the latest proposed takeover of Plessey. Siemens is already a big player in public telecommunications networks (third largest in the world), switching systems and components,

and believes that the British taxpayer should not be expected to support loss-making concerns. Thorn-EMI did some cost-cutting but was unable to get Inmos into a satisfactory state or profitability. It has now sold the vlsi company to the Thomson group, which is controlled by the French state.

To be more precise, the majority shareholding in Inmos will go to the holding company of SGS-Thomson Microelectronics NV based in the Netherlands. This was formed last year when the Italian chip firm SGS was merged with the semiconductor business of Thomson. It seems that Thorn-EMI will continue to have a shareholding in Inmos but probably a small one.

Obviously there's something of an entente cordiale going on between Thorn-EMI and Thomson. You'll recall that it was Thomson to whom the UK company sold its Ferguson radio and television set making business not long ago.

So what is the reason for all these bids, mergers, takeovers, joint ventures and so on in the electronics industry? Why can't all these firms just settle down and get on with the job of making and selling electronics products without so much fuss about ownership?

The mere facts as outlined above don't explain very much. From a financial viewpoint it's obviously something to do with firms needing to maintain or improve market share and profits, and thereby satisfy the shareholders in a very competitive environment. But saying this makes it sound like some autonomic process working on its own, a mere collection of blind reflexes. Nor does the financial explanation, which revolves around market value rather than use value, take account of the technology and its development. In a later report I hope to explore these questions more deeply, because conventional explanations only seem to deal with the "how" and not the "why".
PRACTICAL ELECTRONICS BOOK SERVICE

Here is your Editor's choice of books he thinks will be of interest to electronics and computer enthusiasts.

BEGINNERS AND EARLY STARTERS

NEW Mini-Matrix Board Projects.
R.A.Penfold. 112 pages. £2.50.
Order Code BP99
Shows a selection of 20 useful and interesting circuits that can be built on a mini-matrix board of 24 holes by 10 copper strips in size - an ideal book for early experimenters.

NEW From Atoms to Ampere.
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For the absolute beginner, clearly explaining the fundamentals behind the whole subject of electricity and electronics.

NEW Electronic Projects for Beginners.
F.G.Rayer. 128 pages. £1.95.
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Electronics Build and Learn R.A.Penfold. 128 Pages. £5.95.
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Combining theory and practice, the book describes a circuit demonstrator unit that is used in subsequent chapters to introduce common electronic components and circuit concepts, complete with practical experiments.

Practical Electronic Building Blocks R.A.Penfold. There are two books -
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Book 2 : 112 pages. £1.95.
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Book 1 is about oscillators and gives circuits for a wide range, including sine, triangle, square, sawtooth and pulse waveforms and numerous others from voltage controlled to customised ic types. Book 2 looks at amplifiers, ranging from low level discrete and opamp types to lc power amps. A selection of filters and regulators is included.

Each project is designed for building on a Verobloc breadboard and is accompanied by a description, circuit and layout diagrams and relevant constructional notes. Many of the components are common to several projects. Book 1 covers linear devices, and Book 2 covers more logic chips.

Shows the complete beginner how to tackle the practical side of electronics and includes simple constructional projects.

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Modern Electronic Test Equipment K. Brindley. £6.95.
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