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PRACTICAL ELECTRONICS

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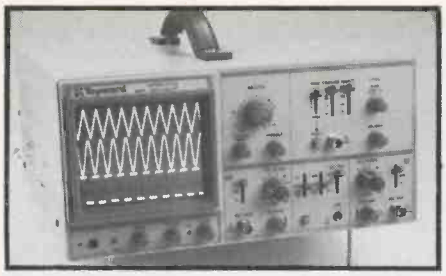

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NEXT MONTH

Designed for telescope monitoring, our computer controlled interface can track the heavens or be used for more down-to-earth functions. Are the days numbered for snap-shot films? - Barry Fox examines the emerging electronic technology that could revolutionise the still-photography scene. Transputers already revolutionise significant areas of digital processing, for an elite minority, but anyone with computing experience can learn to use them, as Robert Penfold found when reviewing a new transputer training system. All these features and many more are in an advanced state of preparation - we're already shaping the future for you :

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★ YOU CAN'T BEAT OUR VALUE

★ OR OUR HI-TECH GOOD LOOKS!

NEWS

TANDY PHONES

Representing the latest in active telephone technology the two new Tandy cordless phones offer the facility to receive or make telephone calls anywhere in the office, home, or outside, up to 100 metres from the base unit.

Both the ET1100 and ET1200 telephones offer the following features: The handset will operate up to approximately 100 metres from the base station. A security system which prevents unauthorised use of the telephone line. The handset is powered by nickel cadmium batteries which are automatically recharged by the base station.

Other features include a low charge indicator; base station may be wall and desk mounted; pushbutton dialling; last number redial facility; easy plug in connection to British Telecom socket; and headset earpiece volume control.

The ET1200 has a memory recall facility and can store up to 16 digits in each of nine memory locations. These numbers can be erased whenever required by storing a new number in the same memory location.

Both cordless telephones are styled in white and grey. The ET1100 (catalogue no 43-7302) is priced at £69.95, and the ET1200 (catalogue no 43-7303) is priced at £79.95. The telephones are on sale at all 258 Tandy stores and also through selected authorised Tandy dealers.

LOOK NO HANDS!

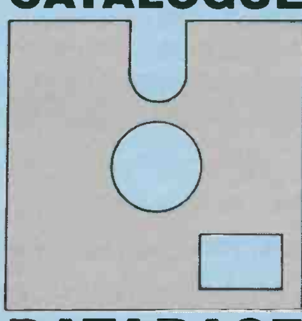
Conducting a telephone conversation when occupied in domestic pursuits has never been easy. Trying to do both usually results in burning the sauce, dripping paint all over the carpet, ruining the flower arrangement or at the very least creating a crick in the neck!

The 'hands-free' operated telephone has been available to the business sector for some time but now Audioline is introducing a hands free telephone, MODEL TEL 38, which is ideal for active telephone users. The TEL 38 allows the user to conduct a conversation without picking up the receiver and is operated simply by pressing a 'speaker' button when the telephone is ringing.

This stylish phone is also suitable for the design-conscious business as it features tone/pulse switching and compatibility with professional switchboards. Other features include a ten number memory and speaker and ringer volume control.

So whether at home or in the office the Audioline TEL 38 is the telephone you can use with your hands tied! It is available in white, grey and beige at approximately £49.95 from all good telephone stockists. **For further information** please contact Liz Bolton and Associates on 01-328-4992/4729.

CATALOGUE



DATABASE

Continuing our alphabetical browse through advertisers' liturature.

Cirkit have sent their biggest catalogue I have yet seen. It has over 300 A4 pages which reflect the company's growth in their **specialised field of electronic component distribution**. Many new names and products have been added, and there's a new and easy to use index which allows component selection by manufacturer, part number or description. With 25 main sections covering alarms to wound components, **this catalogue belongs in the workshop** of anyone seriously interested in electronic components. **Cirkit Holdings plc**, Park Lane, Broxbourne, Herts, EN10 7NQ. 0992 444111.

Compstock have sent a massive computer printout of their **semiconductor product ranges**, 40 pages of them. In addition to listing the products by type, description and price, they quote the quantity held in stock. A glance down the lists suggests that you are **likely to find nearly any semiconductor** for which you are searching. This a list you should not miss. **Compstock (Hobby) Electronics Ltd**, Compstock House, London Road, Stanford le Hope, Essex, SS17 0JU. 0375 360062.

Cricklewood's 1989 component catalogue I gave publicity to a few months back, but as they have been kind enough to send me another, I am only too pleased to mention it again. It has a cover price of £1, but it's an **extremely worthwhile cat to have around**, with 100 pages, liberally illustrated, full of components and hardware essential to any constructor. They also have quantity price structuring for many items, so you can save money on bulk purchases. **Cricklewood Electronics Ltd**, 40 Cricklewood Broadway, London NW2 3ET. 01-450 0995.

Display Electronics have sent a News Flyer of several pages highlighting a few of their goods. The flyer lists a variety of products, including acoustic couplers, computer joysticks, computer mains filters, disc drives, motors and pumps, and much more. **One interesting product** is the Telebox, which they say **turns most computer monitors into a quality colour tv**, from around £30. Their **bundle packs look appetising** as well, mixes of components at remarkable prices. **Display Electronics**, 32 Biggin Way, Upper Norwood, London SE19 3XF. 01-679 4414.

SOLARPHONICS

When Alan Amos, MP for Hexham, and the Greenhead Parish Council asked for lights in the village payphone kiosks at Greenhead in Northumberland, British Telecom stepped in with space-age power, using a solar panel to harness the energy required.

The solar panel charges a battery during the daytime. At night the light operates for around four minutes each time the door is opened, which is usually long enough for most calls. Battery life is extended by using timed lighting periods in this way. The panel is almost maintenance-free, except for the occasional wipe over with a damp cloth by British Telecom technician Michael Algeo.

Two designs of solar panels are now to be tested in 40 payphones around the country over the next three months.

British Telecom's Payphone maintenance manager in Cumbria, Dave Randall, said "We try to provide lights wherever possible in public payphones. In this case laying on mains electricity was out of the question, so I am very pleased that we have been able to get both of Greenhead's kiosks included in the trial.

"We were looking for sites throughout the UK where a broad range of daylight conditions existed, and Greenhead was considered ideal."

EVENTS DIARY

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.

Aug. 25-Sep 3. International Audio and Video Fair. Berlin. 01-408 0111.

Sep. 4-6. Eurobus 89 – UK Conference. Novotel Hotel, London. 01-940 4625.

Sep. 12-14. Optical Systems. Ramada Inn, London.

Sep. 12-15. EPOS 89. The World's largest exhibition of retail information systems. Alexandra Palace, London. RMDP. 0273 722687.

Sep. 26-28. British Laboratory Week 89. Incorporating Computer Aided Sciences. Olympia, London.

Oct. 16-20. Systems, Computers and Communications. 11th International Trade Fair and Congress. Munich Trade Fair Centre. 01-948 5166.

Oct. 24-26. Sensors and Systems – International Transducer Exhibition and Conference. Wembley Conference Centre. 0822 614671.

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

CALL MINDER

The solution to the £6,000 domestic telephone bill could be finally with us, thanks to Britain's leading telephone accessories manufacturer Commtel Consumer Electronics plc. It has just announced the availability of the all British call-barring unit – the Callminder.

Callminder locks into the master telephone socket and can only be removed by a special key. It gives total control of all outgoing calls from the socket, with the exception of emergency (999), freephone (0800) and operator faults (151) calls which can still be dialled.

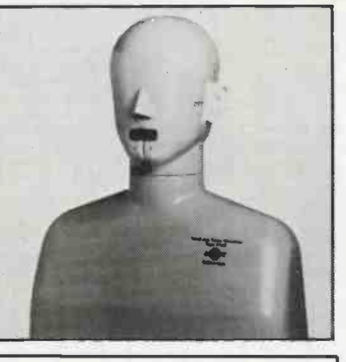
In addition, the unique unit enables the worried parent to programme up to seven different call-barring permutations. These range, for example, from local calls permitted at cheap rate only, to restricting STD calls to three minutes. The programming is done from the telephone handset and any calls outside the set programme can only be made via the owners special secret pin number.

Families can regulate the amount of time people spend on the telephone and more importantly, control the numbers that they dial. With Callminder, parents can automatically stop their children spending hours on the phone to their friends, listening to fantasy games and playing interactive video games.

Other than Star Services, which is an on-going rental facility, there is nothing available which offers the same total protection.

Callminder retails at £49.95 and is available from stock.

For further information contact: Steve Harper, Sales Director, Commtel Consumer Electronics plc, Fengate, Peterborough PE1 5XB. Tel: 0733 313444.



BODYTALK!

Available from Bruel & Kjaer is a Head and Torso Simulator (HATS) with a wide range of applications including simulated in-situ and insertion performance measurements on telephones, headsets and hearing aids, evaluation of hearing protectors and close-talking or noise-cancelling microphones, investigation of room acoustics and speech intelligibility, and stereo sound-field evaluation.

The manikin accurately simulates the acoustic field around a human head and torso. It also features a built-in low-distortion mouth simulator which closely replicates the sound field generated by the human mouth, including the frequency-dependent motion of the acoustic centre in the frequency-range which is important for testing noise-cancelling microphones.

For further information on this marvellous manikin, contact: Les Minnikin, Bruel & Kjaer (UK) Ltd, 92 Uxbridge Road, Harrow HA3 6BZ. Tel: 01-954 2366.

BENCH MARK

Now available from Alpha Electronics is a high accuracy 4½ digit multimeter primarily for bench use. Gold Star model DM 7241 had a basic dc voltage accuracy of 0.05%, with all ranges having full overload protection.

Laid out for clear and easy operation the manual ranges and functions are via front panel push buttons. Readings on the large clear 19999 count liquid crystal display can be held by a switchable measured value hold control.

Both dc and ac voltage have five ranges, a 10 microvolt resolution and maximum readings of 1000V and 750V respectively. Alternating and direct current is to 20A in five ranges with a best resolution on the 1.9999mA range of 0.1microA.

Resistance, with its own front panel adjust control for the 199.99 ohms range, goes from 10m ohms to 20M ohms in six very useful ranges. Continuity indication with an audible tone is a separate function.

Housed in a sturdy and robust abs case with an adjustable tilt stand/carrying handle model 7241 measures 210 x 76 x 260mm and weighs 1.5kg. Fully guaranteed by Alpha for 12 months, this latest high accuracy, low cost instrument is supplied with a mains lead for switchable 110V or 240V mains use, test leads, spare fuse and operating instructions. The price quoted is £169 plus vat.

For further information contact: Alpha Electronics Ltd, Unit 5, Linstock Trading Estate, Wigan Road, Atherton, Manchester M29 0QA. Tel: 0942 873434.

PHASE POWER

Newly available from the IR Group is the Kenwood PD Series of benchtop regulated dc power supplies, which employ a novel phase-control technique with a built-in pre-regulator to ensure fast response and efficient high-stability supply of high currents.

Eight models are available in the range: two versions of the PD18 with 0–10A and 0–30A; four versions of the PD35 with 0–36V output at 0–10A or 0–20A and a choice of analogue or digital readouts; the PD56 with an output of 0–110V at 0–5V.

All the units feature high-accuracy voltage setting and excellent temperature characteristics and thermal response. Remote sensing and protection against overvoltage, overcurrent and overheating are provided as standard, and voltage and current limits are indicated by leds.

The PD Series is available from the IR Group on a sales, rental or leasing basis.

Contact: IR Group, Doran House, Meadfield Road, Langley, Slough SL3 8AL. Tel: 0753 44878.

SOARING VALUE

SOAR's newest series of cost-saving, value rated, digital multimeters feature 3200 counts, 3½ digit readout, full scale analog bar graph displays and lsi circuit technology for enhanced accuracy, high sampling speed and operating ease.

Available from Solex International, the SOAR hand held multimeters, models 3210/3220/3230, incorporate manual and auto ranging circuits; high speed sampling for the 32 segment analog bar graph display, which is many times faster than numerical displays; and resolutions far better than conventional 3½ digit dmms. An important added benefit is the longer battery life – 2500 hours of operation or more from normal alkaline "AA" battery cells. This is directly attributed to use of the special lsi circuit design. Audible continuity and diode testing functions are also included.

Durable and built for easy, long term use, the new models are rated as follows: Model 3210 – 0.7% basic accuracy with high speed auto ranging and 10 amp current measurements, ac/dc; Model 3220 – 0.5% basic accuracy with 30mA to 10A ac/dc current measurements with auto ranging function; Model 3230 – 0.35% basic accuracy, auto or manual ranging with measurements of 300 micro A to 10A, ac/dc current ranges.

All models are supplied with one set of test leads, two AA 1.5V batteries, a spare fuse and an instructional manual.

Solex International are sole UK agents for SOAR products.

For further details, together with a free copy of their full test and measurement catalogue, contact **Solex International,** 95 Main Street, Broughton Astley, Leics LE9 6RE. Tel: 0455 283486.

DELTA LIGHT

The new HD8366 from Delta Ohm is a digital light meter that may be used for measuring lighting levels outside and inside buildings for scientific or industrial purposes, accident prevention, aesthetics and agriculture.

Electricians and lighting experts, accident prevention officers (checking against glare or insufficient lighting), architects, designers of stands for exhibitions and fairs, decorators and horticulturists have all found that this portable lightmeter is a reliable measuring instrument.

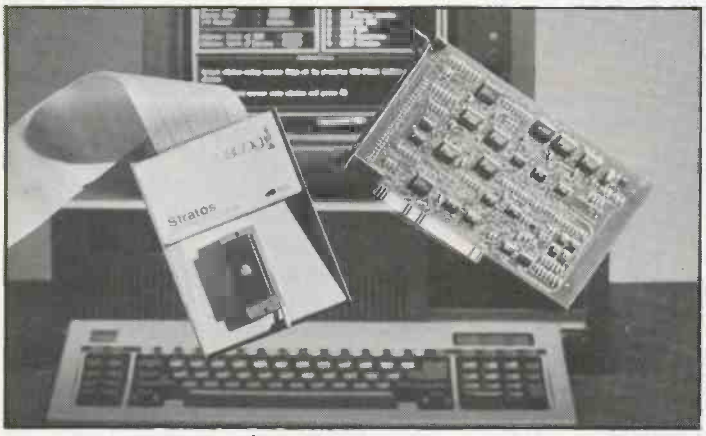
Being a digital instrument, there is no risk of possible damage due to intense lighting, a fault commonly found in instruments using a traditional analogue meter. A self-zeroing circuit allows the measurement of a very low lighting levels with excellent stability.

Most commercial light meters use a selenium cell as the sensor, as its spectral response is very similar to that of the human eye. Selenium cells, however, have the disadvantage of the so-called "memory effect" (the value indicated may be influenced by the previous readings, particularly

readings taken with a high degree of lighting). For this reason the HD8366 uses a silicon sensor, which does not possess this disadvantage.

The spectral response has been adapted to that of the human eye by means of a filter fitted onto the sensor, with an integral error of less than 4%. The linearity of the sensor is better than +1% in the field from 0 to 100,000 lux and +1.4% in the field from 100,000 to 200,000 lux.

For further information contact: Delta Ohm, PO Box 81, Worthing, Sussex BN14 3PW. Tel: 0903- 214335.



PC BASED EPROM PROGRAMMER

Stag have introduced the first high quality programmer in their range specifically designed for use with any PC, (IBM PC, XT, AT or compatible), and catering for all the most common eprom device types. Known as Stratos, it is priced at a competitive £249.

Stratos has been completely designed by Stag in the UK and is manufactured, using the latest smd technology, in their own fully automated Welwyn Garden City factory. It consists of a PC-bus compatible interface card which fits inside the computer together with a cable connected to an external unit which is the programming site for the device. The interface card is less than half the length of a standard PC expansion card format, allowing it to be installed in any slot in a PC or compatible computer. The interface operates reliably in any system, independent of clock speed. Full protection is offered to the motherboard and bus loading is minimal.

At the remote programming site, a 32-pin, wide blade zif socket is used to accept the device to be programmed. This is housed in a robust metal casing and all connections are short circuit protected and current limited, preventing damage. A single led indicates when the unit is 'busy'. Like all Stag programmers, this PC based system performs a range of integrity tests in addition to simply programming the device. The hardware caters for all variants of Vpp and Vcc, including programming and verification at elevated voltages. All approved programming algorithms are used including Snap, Flashrite, and QuickPulse.

For further information contact: Stag Electronic Designs Limited, Stag House, Tewin Court, Welwyn Garden City, Herts AL7 1AU. Tel: 0707 332148.

BARCODE PC CARD

The special products division of Multiprobe Limited has launched the Multibar PC Card. By simply slotting the card into their computer, existing IBM PC or compatible users can now enjoy the benefits of barcode scanning, printing and verifying at a fraction of the usual cost.

At just £499 plus vat, the card is ideal for those companies wishing to take advantage of a flexible and competitively priced barcoding system on the factory floor, or in the shop or warehouse. With Multibar, say the makers, you can produce almost any type of barcode label from your existing PC terminal, using the printer you would normally use for wordprocessing.

Comprehensive print facilities are available and these include negative and mirror image printing, image rotation, serialised output (increment and decrement), and the reproduction of company and product logos on the barcode label itself. Label formatting is extremely flexible with Multibar and can be previewed on screen prior to printing.

Multibar will operate in conjunction with all the recognised input devices – ccd scanner, wand, laser – and a wide range of printers. For example, 9 and 24 pin dot matrix printers, ink jet and laser printers, thermal and thermal transfer printers.

For further details please contact: Kevin Cookson, Multiprobe Limited, Rock Bank, Clarence Road, Bollington, Macclesfield, Cheshire SK10 5JZ. Tel: 0625 74505.

CHIP COUNT

This month we highlight one of the industry's first fully integrated smart H-bridge power ics, jointly developed by National Semiconductor and International Rectifier.

LMD18200

The LMD18200 H-bridge driver, targeted at the smart-power market, can drive dc and stepper motors up to a quarter-horsepower. Integrated on the single chip are four power dmos transistors and control logic, which includes internal current sensing, output short-circuit protection and two-stage thermal shutdown capability.

The features, performance, reliability and size of the LMD18200 make it perfectly suited for use in many motor-control applications. They include computer peripherals, such as tape and disc drives, printers and plotters, office equipment like scanners, copiers and fax machines, and automation - ie robots.

Before the introduction of this chip, designers required separate power transistors and logic components in order to construct an H-bridge power ic. With the new device, they save time and enjoy the advantages that integrated intelligence brings to system designs. The 3-amp H-bridge is fabricated with a multiple-technology process that uses cmos and bipolar control technology at the front end and dmos fet power devices as the outputs. The circuit operates at supply voltages from 12 to 55 volts, with a continuous output of 3A (6A peak).

The on-resistance of each of the four output mosfets is 0.3 ohms, and turn-on/turn-off switching times are typically 100ns. Input voltage requirements provide high noise immunity and are cmos and ttl compatible. The device interfaces with pulse-width modulation input signals and is suitable for both locked antiphase (one-wire) or sign-magnitude (two-wire) forms.

The H-bridge uses Hexsense current sensing, introduced by IR and integrated with its Hexfet power mosfet discrete technology. Hexsense circuits are nearly lossless and eliminate the need for external low resistance, high thermal dissipation series sensing resistors.

Two stage thermal shutdown sends a warning flag to the host system at 135°C and the device shuts down at 170°C. This feature prevents equipment damage or human injury in motion systems, and allows orderly computer system shutdowns.

The LMD18200 H-bridge is offered in an 11-pin plastic power single-in-line package. Power dissipation at a case temperature of 75°C is 25 watts in free air at an ambient temperature of 25°C. Maximum junction temperature is 150°C, and the ambient operating temperature range is -40°C to +125°C.

Fig.1 shows the basic block diagram as published by National.

For further information contact: National Semiconductor (UK) Ltd, The Maple, Kembrey Park, Swindon, Wilts, SN2 6UT. 0793 614141.

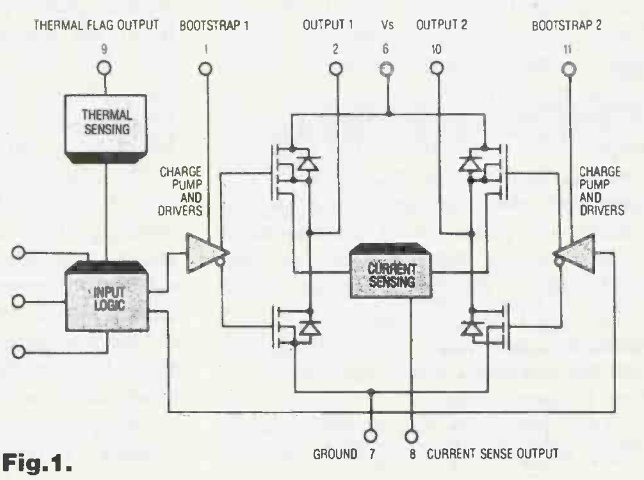
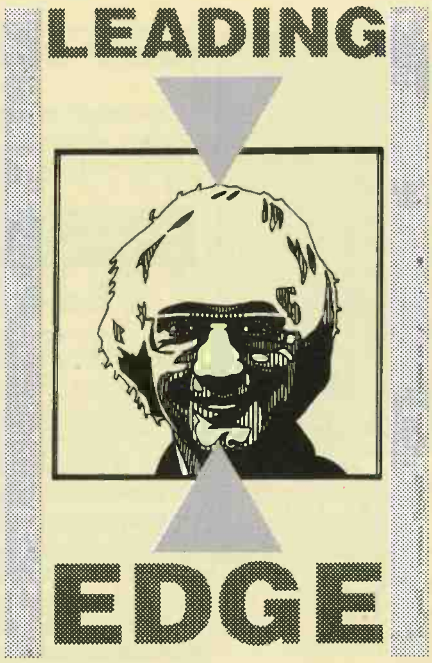


Fig.1.



BLOOMING PIANOS

BY BARRY FOX
Winner of the UK Technology Press Award

Hit a key, any key. The silence is deafening.

Anyone who works in an office, or uses a wordprocessor, will know that daisy wheel printers and typewriters make a truly horrid noise. It is the price you pay for letter quality text. But perhaps not any more.

Ten years after making the daisy wheel head a world standard of LQ printers, the Xerox Corporation has acknowledged that it creates a "cloud of noise". The company says its Palo Alto Research Centre has spent four years and $40 million developing Piano, a daisy wheel which sounds much quieter.

The design change is so radical that offices must buy new machines to benefit, starting at over £1000 each. Xerox says it has "no plans" to licence Piano technology to competitors.

Piano was developed by Dr Andrew Gabor whose company, Diablo, invented the original daisy wheel in 1972. Xerox bought Diablo, and licensed manufacturers round the world to use what Gabor describes as "the most valuable patents ever owned by Xerox". The new invention takes advantage of the fact that the ear is less sensitive to low frequency noise. It pushes the frequency of the impact noise from the wheel down in frequency.

It is surely no coincidence that Xerox is offering Piano at a time when the original daisy wheel patents are approaching the end of their life and the computer industry is turning to ink jet printers as a way of achieving letter quality text with almost no noise.

Although Piano uses clever tricks to make a daisy wheel sound much quieter, the demonstration machines used by Xerox for a grand launch at a London theatre recently showed potential flaws in the system. Also Xerox has offered confusing and contradictory technical data on the sound produced. The Health and Safety Executive says it would like to see more technical evidence before giving the system an official blessing.

Daisy wheel printers make a nasty impact noise when flexible leaf hammers, carrying the negative impression of text characters, slam into paper on a backing platen. The platen briefly deforms into a dimple which behaves like a tiny loudspeaker. Because the mass of the daisy wheel leaf is small, only 2 or 3 grammes, its resonant frequency is high and the percussive sound spreads over a high frequency band.

Gabor rejects the idea of using ink jet, which he refers to dismissively only as "other non-impact" technologies. While still culling royalties from daisy wheel impact technology, Xerox could not risk making it obsolete. So Xerox PARC researchers were stuck with the obligation to improve the daisy.

Gabor found it was impractical to kill the sound by changing the platen, because there was then incompatibility with existing papers and inks. So he tried to lower the resonant frequency, and thus push the sound down in frequency, to make it less intrusive. It was also impractical to increase the mass of the leaves, so he combined two tricks.

The physical mass of each daisy wheel leaf is increased to 1.2kg, by directly coupling it to a lever mechanism and heavy metal bale bar driven by a motor with heavy armature. The effective mass of the lever mechanism is also increased to 2.25kg by connecting the levers close to the axis of rotation of the bale arm. This increases the moment of inertia.

Gabor compares this to the difficulty of stopping a bicycle wheel by grabbing spokes near the centre, rather than the tyre at the edge. He stresses the lack of audibility of the sound produced and theorises that it would be impossible to cram enough Pianos into one room, however large, to produce sound as loud as from one conventional daisy wheel machine. Piano is undoubtedly very quiet but the machines demonstrated in London emitted a potentially disturbing low frequency drumming sound which could well prove irritating and fatiguing in an office, especially if several machines were in use at the same time. Xerox admits to the problem, but says it was caused because the tables used for the launch demonstration were "monstrosities". It does seem odd that a company the size of Xerox, launching a new concept as potentially important as Piano, should hire a theatre for the launch and put the prize exhibit on totally unsuitable tables.

Also there is considerable confusion over the audio effect which Piano achieves. Xerox cites conventional daisies as generating between 60dB and 80dB, with Piano at 46dB. Xerox employed Dr Geoff Leventhal, head of the Institute of Environmental Engineering at the Southbank Polytechnic, as a consultant. Leventhal used techniques specified by the International Standards Organisation, ISO, to measure between 64dB and 68dB, from old machines and 54dB from Piano.

Dr Gabor says that dropping the sound by six octaves, halving the frequency six times, makes the pitch "so low it is hardly heard". Dr Leventhal says he found the peak energy to be at between 500 and 1000Hz but admits he is not so sure about the six octave drop, which would puts Piano's sound output into the infrasound band. Dr Gabor sticks to his six octave claim but quotes much higher frequencies of conventional daisies.

Xerox says the sound levels quoted are all on the "A" scale to match human heaving and differ widely because they were taken at different distances from the machines. Xerox says it is confident that there is no risk of long term fatigue from the low frequency noise.

The Health and Safety Executive is keeping an open mind.

"If low frequencies become dominant, the dull drumming sound could cause irritation after a while" says the HSE. "We need to see a frequency spectrum for old machines, and new machines. That is only to see exactly what Piano is doing".

So far Xerox has released no such quantifying data.

PRACTICAL ELECTRONICS

CONSUMER SCORING

In my editorial comment of PE July 89, I enthused over the excitements and benefits of Exhibitions. For me, they probably rate as the most potent source of information on how the technological world is developing. Coming not far behind in my ratings, are Reports - the busy person's guides to the universe without hitch hiker's leg-ache.

Ferguson have been so kind as to save me a lot of leg-ache, and telephonist's ear-ache, by sending me a report on the Consumer Electronics scene.

We all know that consumer electronics are now a vital part of our daily lives. Ferguson's report says that we spent £4500 million pounds on related products in 1988. An amazing sum, but all is not yet rosy for manufacturer's bank balances. In the last quarter of 1988 there was a reduction in growth, as a result of Government efforts to curb consumer spending. With this pressure likely to continue throughout 1989, Ferguson predict difficult times ahead for manufacturers.

One area likely to suffer is satellite tv. Ferguson's research indicates that whilst there is potential for a considerable satellite tv market, it is likely to develop more slowly than many people, particularly the broadcasters, had hoped. Despite the reasonable levels of consumer interest shown in satellite tv, apparently their current intention to purchase is at a relatively low level, with around only 14% of those interviewed interested in receiving the new channels on offer. Not surprisingly, many prospective purchasers seem unwilling to pay subscription fees for film channels, an obvious blow to the broadcasters to whom the fees are one of the main revenue sources.

Furthermore, the confusion over the two competing and incompatible systems of Sky and BSB is causing the majority of respondents to wait until they know what programmes are on offer. However, once Sky encrypts and BSB is in operation, the demand is likely to increase.

Those involved in tv generally can probably also take heart from the fact the tv viewing is reportedly the UK's favourite activity. (Odd - I thought reading PE and doing electronics would have been ...) In 1988 purchases of colour tvs grew by 9% to 4.4 million. With nearly 100% of the UK population already owning sets, over half the tvs were bought as additional sets. Only 4% of sales were first-time purchases. Interestingly, sales of small screen sets have overtaken those of large screen.

Video penetration grew from 50% in 1987 to 64% in 1988, though the market is forecast to decline in 1989. Long play video recorders, however, are likely to continue increasing their market share. I, for one, have been converted to regarding long play recorders as beneficial - there can be few aggravations worse than running out of tape because of programme mistiming! Sales of hifi stereo models are forecast to rise with increased consumer awareness, and the introduction of more Nicam models. At the top end of the market, Super VHS will continue to find popularity.

Surprisingly, although video photography is growing, only about 1.5% of the UK participates and we are well behind other Western countries in taking up this activity.

The audio market findings are also revealing - in brief, 82% of us have stereo systems and 12% have more than one, while 13% of us own compact disc players.

Although not covered by Ferguson's report, one consumer area that could soon make an enormous impact is electronic still photography. Barry Fox will be taking a look at this next month - a full length feature well worth reading.

THE EDITOR

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Publisher:
Angelo Zgorelec
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Tel: 01-743 8888
Telecom Gold: 87: SQQ567
Fax: 01-743 3062

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As part of the competition we held in PE Feb 89 we also ran a mini-survey on the types of test gear you rated as workshop f vourites. Regular readers will have seen th t from the results published in the June issue signal generators came fourth, and frequency counters came eighth. I commented at the time that I agreed with the fourth position but regarded a frequency counter as the fifth most important.

The Editor's completed unit

COUNTING IMPORTANCE

Confirmation of that importance was thoroughly brought home to me recently when I was experimenting with a complex set of circuits relating to precision analysis of certain long wave radio transmissions. All five principle categories of test gear were in use, two digital multimeters, a multi-trace scope, two power supplies, two signal generators and a frequency counter. As the circuit complexity and monitoring requirements grew, so too did my frustration. It became increasingly obvious that the signal generators and the frequency counter had seen better days and were showing acute signs of senile dementia.

The stabilities of the tuning controls and range switches were the main problems with the generators, though the XR2206

By counting time as a frequent function your Ed bridges the generation gap with his multipurpose workshop test aid.

8-DIGIT COUNTER

Browsing through the catalogues of many PE advertisers and other suppliers, I found that Cirkit sell a PCIM300 8-digit lcd up/down counter which appeared to meet my needs. It features 8mm display height, Schmitt trigger clock input, leading zero blanking, and store and reset inputs for operation as either a frequency or period counter. It has a power supply operating range of 3V to 6V, drawing only 1.7mA.

The internal circuit is based on two synchronously cascaded MM74C947 four-digit counter circuits which directly drive

FREQUENCY COUNTER AND DUAL-GENERATOR

BY JOHN BECKER

vco chip of one of them seemed to have developed an internal linearity problem as well. The accuracy of the frequency counter also became questionable. So too for a while did the scope accuracy, but after running a series of tests, it was confirmed that the scope was ok, but that it was the counter that had become inaccurate, by about 6%.

I had designed and built the counter and generators quite a few years ago and decided that rather than completely overhaul them I would replace them with a new combined design. At the same time the counter readout range would be increased from four digits to eight, taking advantage of one of the newer families of integrated counter and lcd display modules.

Dropping the experimental radio circuit for a while I got out paper, pencil and pcb pads, and came up with the design I now share with you.

It consists of an eight digit frequency counter capable of monitoring frequencies to around 4MHz, an audio sine/triangle wave generator with a range from nearly-dc to in excess of 20kHz, and a squarewave generator with a range from around 0.5Hz to about 1.4MHz. The complete block diagram is shown in Fig.1. Let's look at the counter first.

the built-in 8-digit lcd display. The manufacturer's quoted clock frequency is typically 3MHz, though in practice could be either side of this (my own sample appears to have a limit of about 1.5MHz).

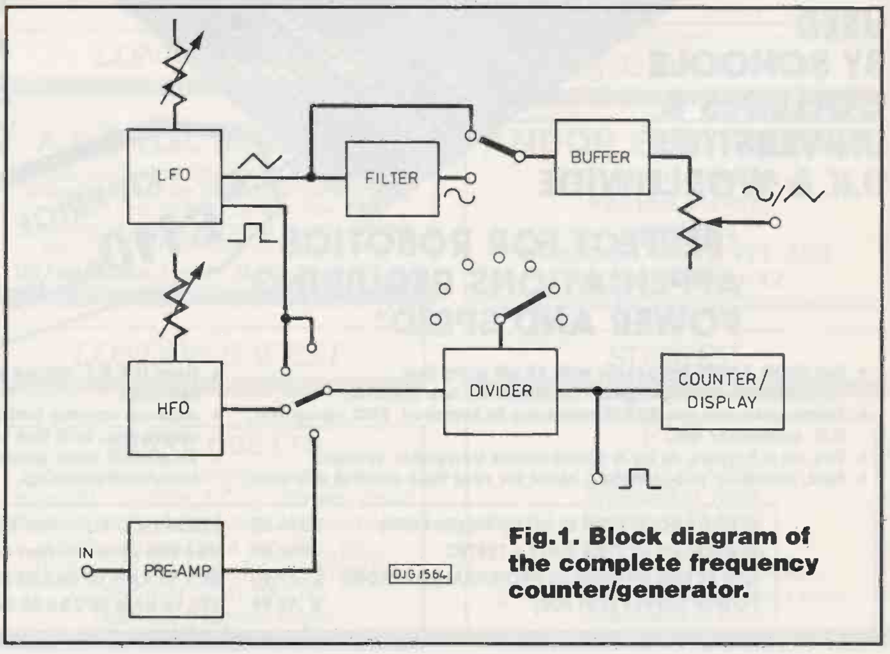


Fig.1. Block diagram of the complete frequency counter/generator.

Fig.2 shows the block diagram of the MM74C947 and Fig.3 shows the internal connections of the counter and display module, both as given in the *National Semiconductor CMOS Logic Databook.*

CONTROL CONDITIONS

For correct operation of the module as a frequency counter, there are five control conditions to be met. The Enable pin must be high to allow the chips to count. The Up/down pin should be high to allow the count to proceed upwards. With the Store pin high the results of the counting will not be displayed on the lcd readout; the count will proceed but will not be seen on the display until Store is taken low, whereupon the counter contents will be transferred to internal latches feeding the display. Normally, Reset is held high; taking it low will reset the counter to zero. The counter clock input is triggered by the trailing (negative) edge of the clock pulse (a fact that doesn't really concern us in this application).

The function of the two pins marked EL was quoted on the data sheet supplied with the counter module as being the backlight connections, but their use was not explained. So, purely out of academic interest, I rang the source company whose name was on the data sheet (not Cirkit) and asked how they should be connected. This appeared to cause a little consternation. Apparently their engineers had never used them! Later they rang me back and said that the module had no backlight built in and that a separate module was required for that function. As I don't really intend to use the counter in the dark I didn't pursue the matter further!

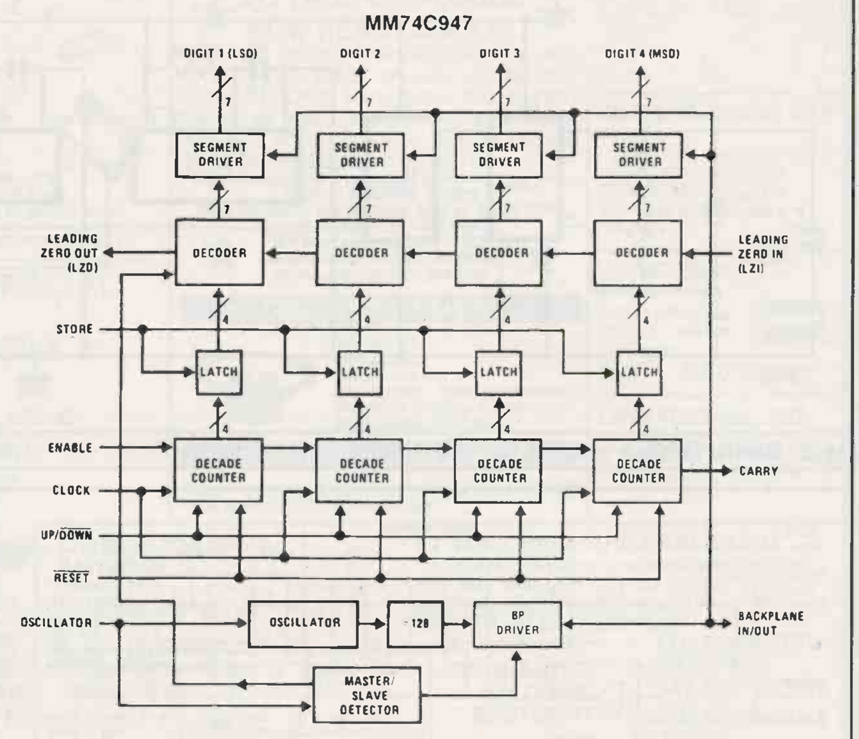
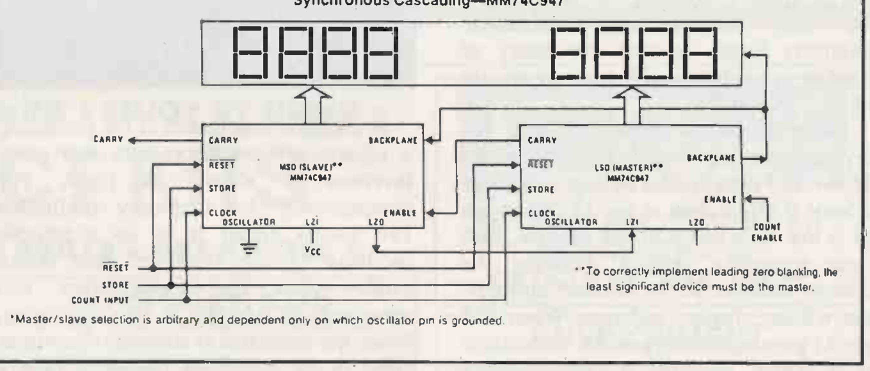


Fig.2. (above) Block diagram for the MM74C947, and Fig.3. (below) How two may be cascaded.



SAMPLING RATES

Much thought was given to the rate at which the counter should sample the input frequency. There is much to be said for having a high sampling update rate since short-term variations in clock frequency can be monitored. On my previous counter I used a sample rate of 10Hz which allowed for rapid updating when changing frequency generator rates. In reality I found this to be a bit too fast since the less significant digits tended to jitter in their readout. For this new circuit I have opted for a sampling period of precisely one second, so automatically ensuring that the readout is in Hertz on the normal range. It also simplifies the control circuit.

By using a 32768Hz crystal as the basic sample rate controller, it is only necessary to divide by 32768 in order to achieve a rate of 1Hz. Since 32768 is 2^{15}, all we need is a 15-stage binary divider after the crystal oscillator. However, a sampling rate of one second must take into account how you use the clocking pulse. A squarewave of 1Hz consists of a pulse having a high period of 0.5secs and a low period of 0.5secs. I felt it was easier to control the counter allowing it to count only during a low logic period of precisely one second. To achieve this, of course, all we do is to add a further binary division stage, making it 16 stages in all. Then, by using a very rapid store and reset cycle, the high period of what in theory has become a 0.5Hz sample rate can be terminated early. The result is a sampled read out at almost exactly once per second. Fig.4.

Fig.4. Timing waveforms

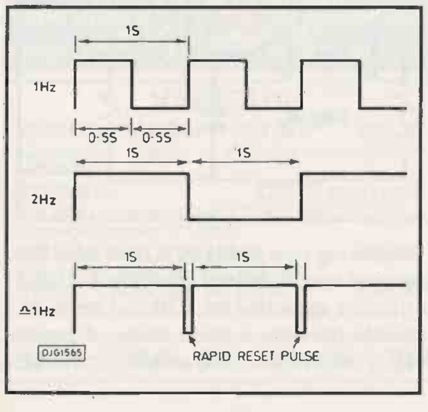


Fig.5 shows how we achieve the control sequence as a practical circuit.

TIMING CIRCUIT

The cmos 4060 chip used for IC3 is a combined oscillator and 14-stage binary divider. Its basic block diagram, as given by Motorola, is shown in Fig.6. There are several ways in which it can be made to oscillate; the method I've chosen consists of the configuration around the crystal, R16, R17, C6 and C7. Although the crystal would prefer to oscillate at the nominal frequency of 32768Hz, this rate

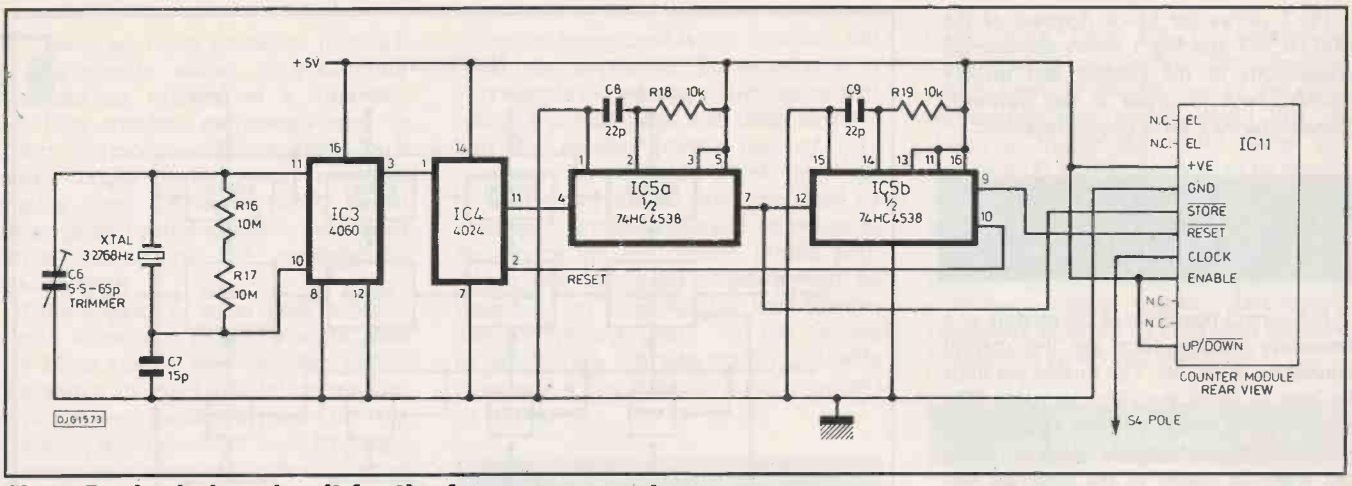


Fig.5. Basic timing circuit for the frequency counter.

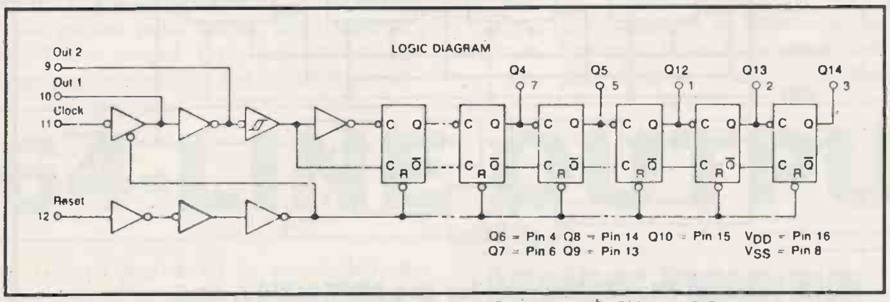


Fig.6. Logic diagram for the 4060 oscillator/divider chip.

can be slightly modified by C6 to correct for any manufacturing tolerances. (Anthony Smith covered the theory of crystals in his *Time and Frequency* articles of PE Feb-Mar 89.)

Using the Q14 output of IC3, the crystal-generated frequency is divided by 16384. IC4 then divides by four to achieve a basic 0.5Hz output at pin 11. When pin 11 is low IC5a and IC5b are inactive, with their respective outputs allowing the counter module (IC11) to count upwards, but without display updating. When IC4 pin 11 goes high it triggers the monostable IC5a which produces a negative-going pulse at its pin 7 for a duration set by R18 and C8, typically of around 0.5µs. This pulse triggers the latches within IC11 which accept the count state as it is at that moment. At the end of the pulse the latches reclose, leaving the count state displayed on the lcds. Simultaneously, the positive-returning edge of the pulse triggers the second monostable IC5b which produces two opposed pulses of equal durations as set by R19 and C9, also of about 0.5µs. The negative-going pulse from pin 9 resets the counter module IC11, and the positive-going pulse from pin 10 resets IC4. Consequently, IC11 counts for the duration that IC3 pin 11 is low, is updated and reset within about 1µs, whereupon the cycle recommences.

It should be noted that although IC3 and IC4 may be either the standard cmos or the equivalent HC versions, IC5 must be the HC version to meet the needs of IC11. The standard cmos 4538 (or the more familiar 4528) will not adequately trigger IC11.

SQUAREWAVE GENERATOR

A common configuration for producing a squarewave oscillator from two cmos inverters is shown in Fig.7. For comparatively low-frequency oscillation I've always found it to be a reliable oscillator circuit. However, data books caution that the configuration can sometimes be reluctant to start oscillating. Since the oscillator is intended for use at close to the maximum frequency rates I have played it safe and used three gates, as in Fig.8.

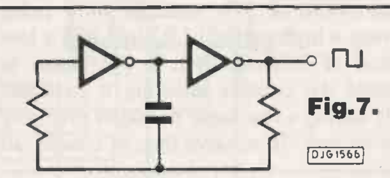


Fig.7.

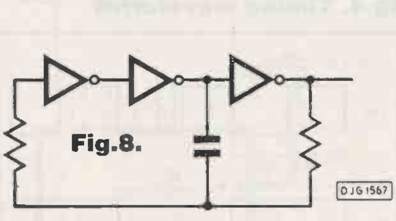


Fig.8.

Referring now to Fig.9, IC6a-c form the practical circuit derived from Fig.8. Using a trimmer capacitor for C10 and series of variable resistors, a wide range of preset and controllable frequencies can be produced. C10 sets the minimum capacitance that will reliably produce the maximum frequency, and VR8 presets the range controllable by VR6 and VR7, typically between about 80kHz and 1.4MHz, depending on the value set for C10. VR6 is used for coarse frequency selection, and VR7 for fine tuning. Due to the nature of the formula that determines the frequency, VR7 has more apparent effect when VR6 is at lower resistance settings. You will notice on the audio oscillator described later that I have used a multiturn wirewound pot for finely setting the frequency. In that circuit it is dc being controlled, but in the circuit around IC6a-c it is an ac signal that passes through the pots. Since a wirewound pot can behave inductively it cannot be used in place of VR6 and VR7. If you are inquisitive and try it, you will find that strange things happen to the frequency rates as you turn the pot throughout its range!

DECADE DIVIDERS

Following the squarewave generator is S1c which allows for selection of frequency source for feeding to the inverting buffer IC6f. Six decade counters in series, together with S4, allow selection of the frequency sent to the counter module, and to the output socket via R24. The latter is included to prevent accidentally shorting IC6f to ground.

IC7 to IC9 are each dual decade counters, having a basic block diagram as shown in Fig.10, from which you will see that each counter consists of a divide by two and a divide by five section. From the timing diagram of Fig.11 it is apparent that if directly dividing by ten, the mark space ratio at the final output is not symmetrical. Though this does not matter to the frequency counter, it can matter when using the output as a signal source for other purposes. The way round this is to connect up the chip so that it first divides by five, and then divides by two. The result is a squarewave output at one tenth of the input frequency.

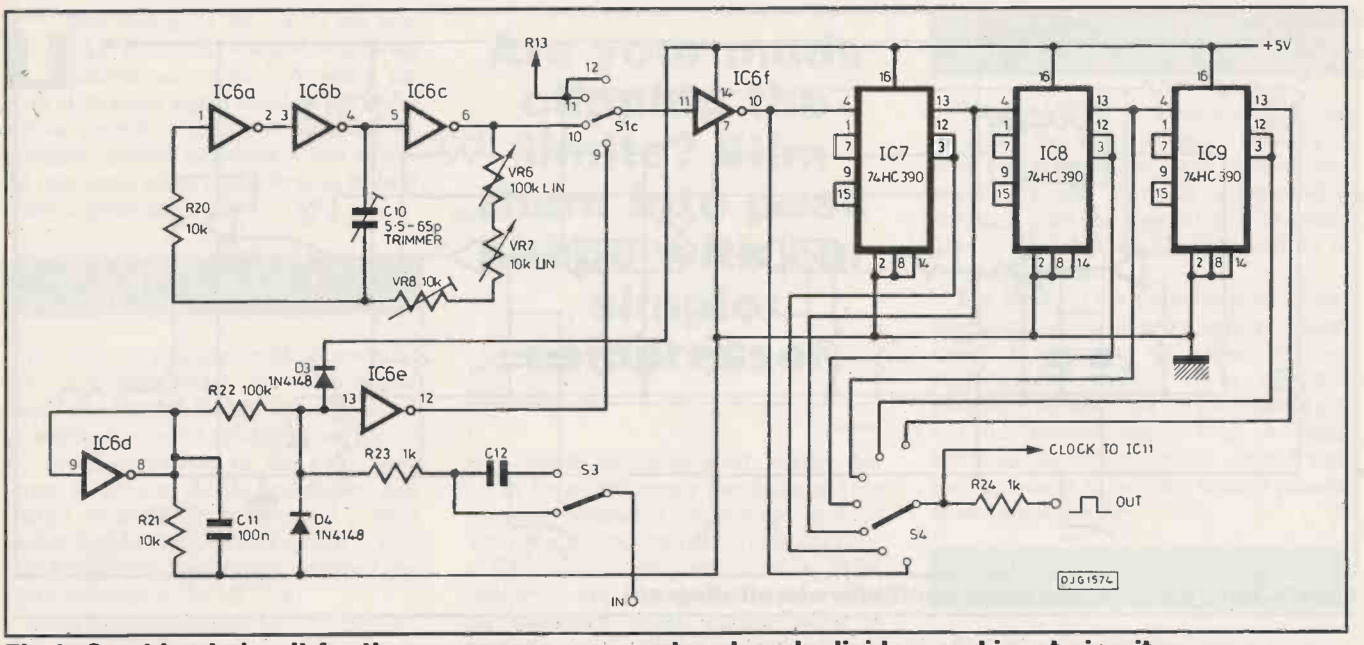


Fig.9. Combined circuit for the squarewave generator, decade dividers and input circuit.

With six decade counters available, S4 can select from seven options of frequency division, including the original frequency. So a 1MHz input can be selected for 1MHz, 100kHz, 10kHz, 1kHz, 100Hz, 10Hz, 1Hz. Since the controllable frequency range of IC6a-c is greater than a factor of ten, there is reasonable overlap between each switched range.

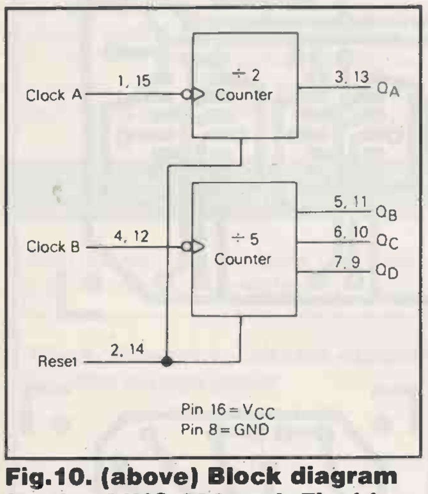


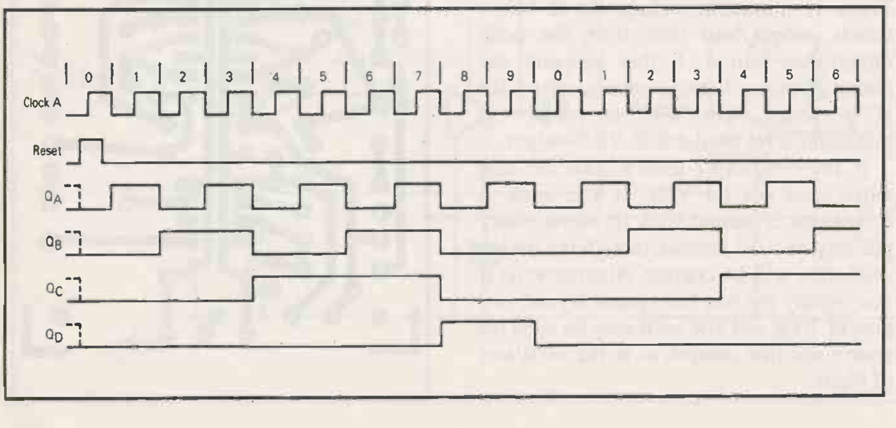
Fig.10. (above) Block diagram for the 74HC 390 and, Fig.11. (below) The timing diagram with QA connected to clock B.

INPUT CIRCUIT

By taking advantage of the linear range of one of the spare inverters of IC6, we can use it as a simple signal input amplifier. IC6d has its input and output connected together, forcing it to a mid-voltage output level. This becomes the reference level for the input to IC6e. Consequently, ac-coupled signals from the input socket are biased around that midway point. IC6e then behaves as an amplifier.

S3 selects whether the input signal is ac-coupled via C12, or dc-coupled by bypassing C12. R23, D3 and D4 restrict the input voltage level seen by IC6e to within its safe region. In other words the signal input to S3 can exceed the 5V rating of IC6. Up to about ±75V at S3 is acceptable (the rated limits set by D3 and D4). Input signals down to about 0.5V p-p satisfactorily swing the output of IC6e through the full 5V logic range providing the frequency is above about 50Hz. For lower frequency signals the input swing needs to be progressively greater until at 1Hz it needs to be 4V p-p.

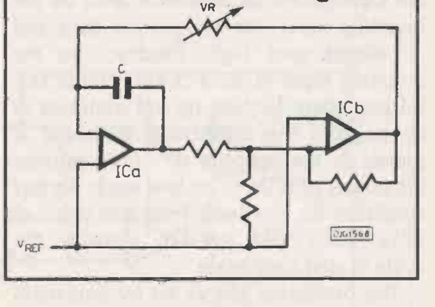
The 74HC390s used for IC7-IC9 have a maximum frequency capability of around 40MHz, though the maximum input frequency allowed by IC6 is in the region of 10MHz. Although the counter module will only accept frequencies up to around 3MHz (as qualified above), by selecting a lower division range by S4, frequencies up to the limit set by IC6 can be monitored. (If an additional switch were to be included to bypass IC6f, taking the input directly to IC7, 5V logic frequencies up to the maximum capability of IC7 could be monitored.)



ASSEMBLY

The audio oscillator circuit is a derivative of that formed by the two opamps in Fig.12 in which the capacitor across ICA is charged at a rate set by VR, and in the direction determined by the output state of comparator ICB. A slight variation on this circuit was shown in the *Vodalek* circuit of PE Aug 89.

Fig.12.



(You may perhaps wonder why I have not used an 8038 or XR2206 chip as the generator. Quite frankly, I'm bored with seeing circuits based on the 8038. It's a useful chip, there's no doubt, but year after year variations on its use have appeared with monotonous regularity. I really felt disinclined to add yet another variation to

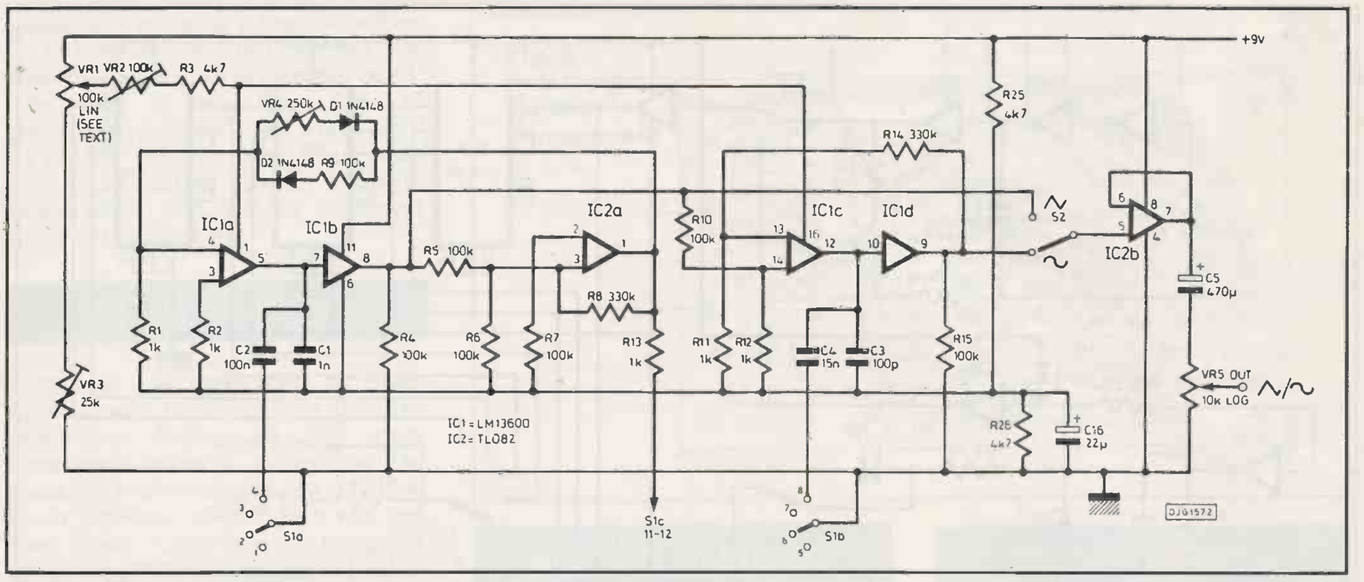


Fig.13. Sine and triangle wave oscillator circuit diagram.

the repertoire. I like the XR2206, and might have used it, but unfortunately it appears to be less widely available than it used to be, making its choice less viable for a project also destined for publication. So far as I can see no manufacturer has come up with an alternative function generator chip. Will someone please enlighten me if I'm wrong!)

In Fig.13, IC2a is the equivalent of ICB, but ICA is replaced by the configuration around IC1a and IC1b. These form one half of an LM13600 dual transconductance amplifier (tca).

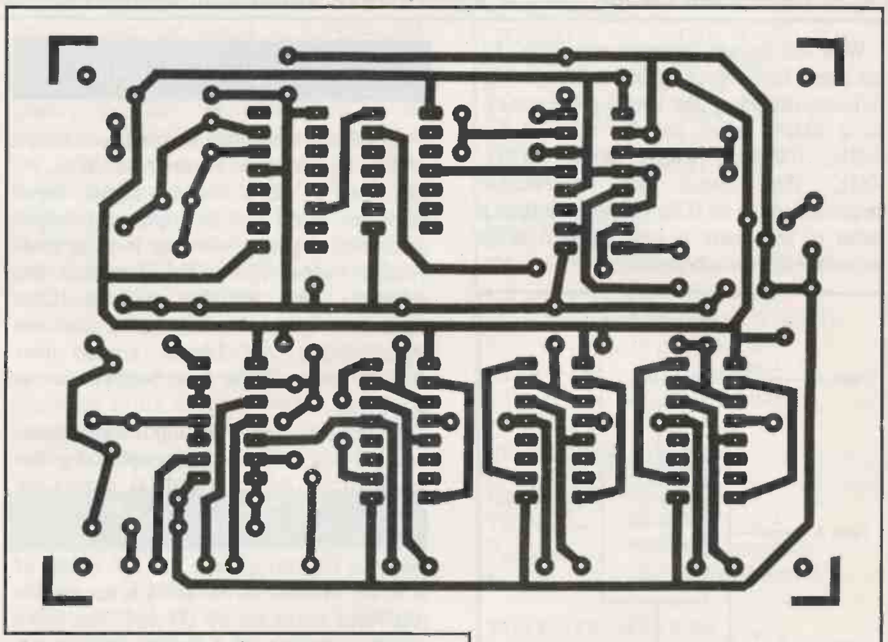
OSCILLATION FACTORS

With a tca the current present at its principle output, in this case pin 5, is determined by the current flowing into its control node, pin 1, and by the voltage differential at the two signal inputs, pins 3 and 4. In the configuration shown here the current flows into C1, so charging it. The charge level is buffered by IC1b and goes to the non-inverting input of IC2a. When the level passes the reference level on the inverting input, the comparator trips and its output goes high. Feedback to the inverting input of IC1a is via R9 and D2. C1 now starts discharging and continues to do so until the comparator threshold is passed in the opposite direction, causing the output of IC2a to go low again. In this condition the feedback from the input of IC1a is via VR4 and D1, allowing the cycle to start over again.

The oscillation rate is set by four main factors, the value of C1, the current flowing into the control node from the wiper of VR1, the feedback resistances of VR4 and R9, and the hysteresis control resistor R8.

VR1 and VR3 form a potential divider across the power lines. Relative to the voltage level selected by VR1's wiper, current flows into the control node via VR2 and R3, the former presetting the maximum flow, the latter limiting it in the event of VR2 being set for zero resistance. There is minimum voltage level below which current will flow from the node rather than into it. If that happens, the circuit stops oscillating, consequently VR3 is in series with VR1 to preset the minimum level available at VR1's wiper.

In my own unit I used a 100k ten-turn wirewound pot for VR1. If you wish to economise, a normal 100k lin mono rotary pot may be used instead, though the tuning resolution will be coarser. Alternatively, if you modify the box front panel layout, two pots of 100k and 10k each may be used for coarse and fine control, as in the oscillator of Fig.9.



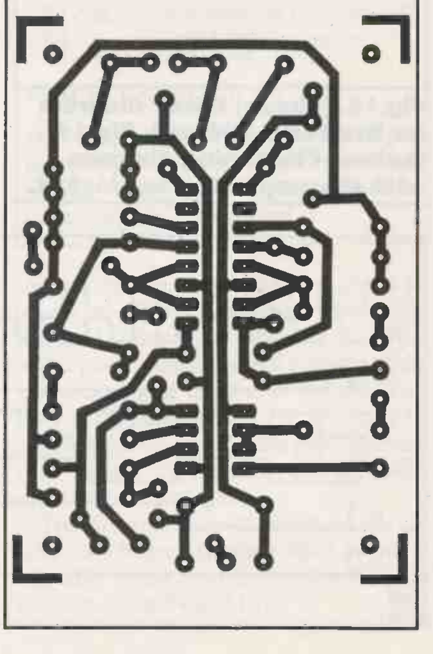


Fig.14. Pcb track foil patterns for (above) The digital logic and (right) The analogue oscillator.

COMPONENTS FOR COMPLETE FREQUENCY COUNTER AND TWIN OSCILLATOR

RESISTORS

R1, R2, R11-R13, R23, R24	1k (7 off)
R3, R25, R26	4k7 (3 off)
R4-R7, R9, R10, R15, R22	100k (8 off)
R8, R14	330k (2 off)
R16, R17	10M (2 off)
R18-R21	10k (4 off)

All 0.25W 5% carbon film or better.

CAPACITORS

C1	1n polystyrene
C2, C11, C12, C14, C15	100n polyester (5 off)
C3	100p polystyrene
C4	15n polyester
C6, C10	5.5p-65p trimmer (2 off)
C7	15p polystyrene
C8, C9	22p polystyrene (2 off)
C13, C16	22uF 16V elect (2 off)

POTENTIOMETERS

VR1	100k 10-turn wirewound, or 100k lin mono rotary (see text)
VR2	100k skeleton preset
VR3	25k skeleton preset
VR4	250k skeleton preset
VR5	10k log mono rotary
VR6	100k lin mono rotary
VR7	10k lin mono rotary
VR8	10k skeleton preset

SEMICONDUCTORS

D1-D4	1N4148 (4 off)
IC1	LM13600
IC2	TL082
IC3	4060
IC4	4024
IC5	74HC4538
IC6	4584
IC7-IC9	74HC390 (3 off)
IC10	7805

SWITCHES

S1, S2	min spdt (2 off)

MISCELLANEOUS

32768Hz crystal, box 9 x 5.25 x 2.5 in, pcb supports (8 off), stick on feet (4 off), knobs (6 off), input/output sockets to suit needs (4 off), 8-pin ic socket, 14-pin ic sockets (5 off), 16-pin ic sockets (3 off), printed circuit board set counter-display module type PCIM300 plus bezel type BEZ10 (from Cirkit Distribution Ltd).

WAVEFORM SHAPING

The waveform at the output of IC1b is roughly triangular, and that of IC2a approximately a squarewave. The lack of linearity is caused by the nature of IC1b. Strictly speaking it is not an ic, but a Darlington transistor pair whose emitter voltage at pin 8 will normally be below the base voltage at pin 7. This voltage differential causes IC2a to generate an uneven mark-space ratio pulse train. This is compensated for by slightly varying the feedback and feedforward currents between IC2a and IC1b. Hence D1, D2 and VR4. The diodes control the current flow direction, and VR4 changes the rate for that path compared to the path via R9. VR4's value allows for the feedforward rate to be set either slower or faster than the feedback rate, and is adjusted until the waveform at pin 8 is a symmetrical triangle wave.

The triangular waveform is fed to the shape selector S2, and then to the unity gain buffer IC2b. From there it goes to the audio output socket at an amplitude level controllable by VR5. Additionally, the triangle wave goes to the low pass filter circuit around IC1c and IC1d, and then to S2. The filter's cut off frequency is determined by the value of C3 and the current flowing into the control node at pin 16. Since this node is directly connected to that of IC1a, the two circuits track together. The effect of the filter is to reshape the triangle into a more sinusoidal shape. It is not a perfect sinewave, but is sufficiently close it to for most purposes. If a more precise shape is required the best value for C3 should be found by experimentation, though note that decreasing its value too far may result in diminishing the signal amplitude.

The squarewave output from IC2a is taken to S1c so that it can be fed to the counter module. It can also be used as squarewave source in its own right, at the division rate selected by S4. R13 is included in the squarewave path to limit the maximum input voltage seen by IC6f.

With C1 as the sole capacitor controlling the oscillation rate, the frequency variable by VR1 can be set for a range from almost zero to about 30kHz. On my own unit I've set for a range of 10Hz to 20kHz. Using S1a, by switching in C2 in addition to C1 the range is lowered by about 100 times, roughly 0.1Hz to 200Hz. S1b simultaneously switches in C4 so maintaining the filter tracking for sinewaves. If preferred, the capacitor values may be decreased to increase the frequency ranges.

POWER SUPPLY

The logic circuits of Fig.5 and Fig.9 require a 5V power line. The audio oscillator can also be run from a 5V supply, though the maximum output amplitude will be restricted to the maximum swings at IC1b and IC1d, which will always be at least a volt or so lower than the power line voltage. The audio circuit power line may alternatively be as high as 15V. Although the psu level will determine the signal voltage swing, it will also affect the frequency range. A lower psu voltage will produce a lower range, and viceversa.

Since I already use a well stabilised 9V supply to drive other workshop test equipment, this is the psu voltage I use to drive the audio circuit. IC10 in Fig.15 then regulates the 9V down to 5V for the logic circuits. The total current drawn varies with the oscillator frequencies selected, but the maximum is around 13mA.

If you don't already have a suitable psu, the circuit shown in the *Easi-Build PSU* project of PE July 89 is recommended.

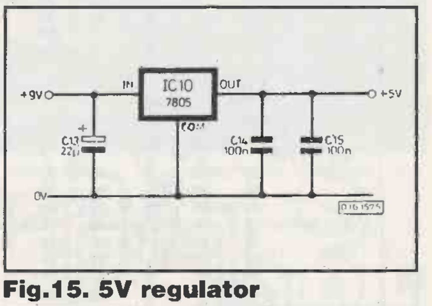


Fig.15. 5V regulator

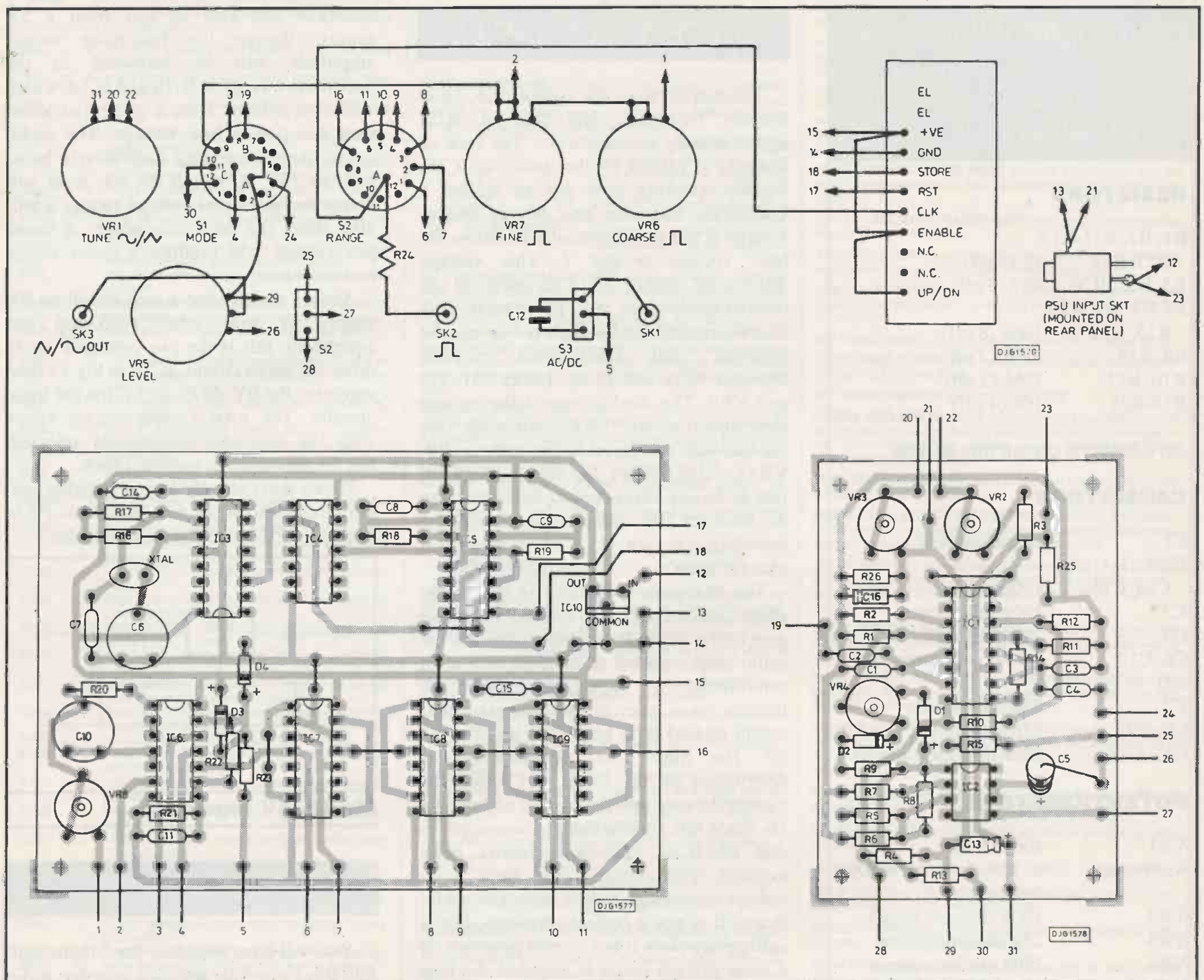
ASSEMBLY

You will have seen that the circuits split into three principle sections, counter, audio generator and logic generator. If you prefer, you can build any of the three sections without the others.

The audio generator has its own pcb, as shown in Fig.18. The counter and logic generator are on the same pcb, shown in Fig.17.

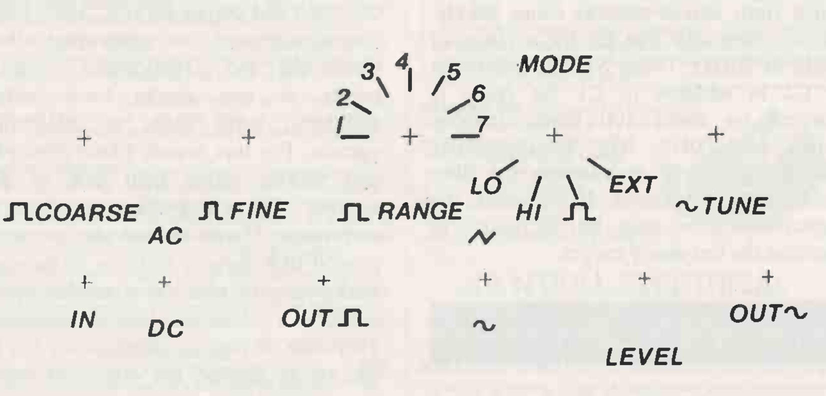
There's nothing unusual about either board, so just follow normal assembly and checking procedures. Fig.16 shows the master wiring diagram for the pcbs and panel controls.

There is a point to note, though, about the input and output sockets. Since I use a common ground line connecting all test equipment and experimental circuits I prefer to use single leads without additional earth leads to interconnect circuits. For this reason I use 2mm plugs and sockets rather than jack or BNC sockets. The wiring diagram reflects this preference. If you do not use a common ground line, then in addition to the signal lead you must also use a another lead to produce a common ground connection. Therefore, if your connections are via jack sockets or similar, the respective ground tags must be connected in order to complete the circuit.



ASSEMBLY DIAGRAMS

Fig.16. (Top) Wiring details for controls and clock-counter module.
Fig.17. (Above) Component layout for the digital circuits pcb.
Fig.18. (Right) Component layout for the analogue oscillator.
Fig.19. (Below) Front panel legends as used on author's unit. It is a reduced size image which should be enlarged to give 1.1 inches between pot centres.



SETTING-UP

Setting-up of the preset pots and capacitors has been covered in the circuit descriptions above. Most of them can be adjusted correctly by observing the numerical readout on the lcds. The most critical one in terms of timing accuracy is C6. If you don't have an oscilloscope or known frequency source, leave it at a midway setting. Likewise, the linearity preset VR4 may be left in a midway position if a scope is not available for more precise alignment.

If you are using a scope for checking and alignment, don't expect to see the Store and Reset pulses from IC5 unless the scope is a good one, since the pulses are extremely short and only occur once a second.

It was with relief that I put this piece of test equipment into service, replacing other items that had seen better days. Perhaps I may sometime overhaul the other items, but this unit has removed the frustration I had been experiencing for a few weeks, and also takes up less space. It's now in constant use - may yours be likewise. PE

HF RADIO

PART TWO
BY MIKE SANDERS

Mike Sanders continues his radio investigations with oscillators, loops phase detectors and mixers.

The hf receiver is made of many parts which can basically be thought of as three parts, namely the radio frequency (rf) stage, the detector and the audio frequency (af) stage, Fig. 1. There is little point in spending a lot of time and money designing one of these stages to perfection if the other two stages are going to be of poor quality.

One of the most useful stages is the oscillator driving the mixer, Fig. 2. That is not to say that the other stages are less important, but an important aspect of the oscillator is that it has to be set as close as possible to the selected frequency. A drifting oscillator will produce overlapping sidebands in an analogue transmission system (Fig. 3a) when a single channel is modulated, or Fig. 3b when several channels are modulated onto an rf carrier.

In a digital radio system drifting oscillators cause intersymbol interference, Fig. 4, since the pulses are drifting and this leads to timing problems when the pulse has to be regenerated, and the regenerator (repeater) cannot decide whether the centre of the pulse is A or B.

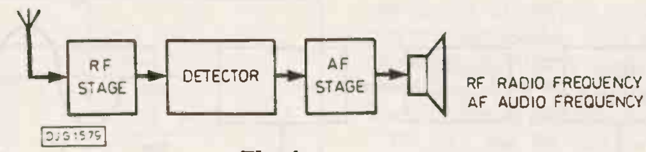


Fig.1.

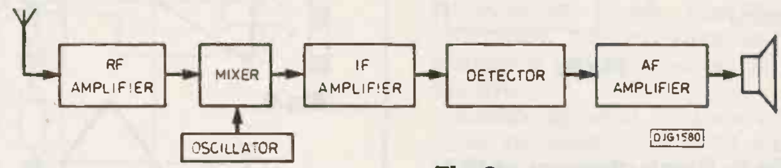


Fig.2.

Fig.3.

Fig.1. Basic radio receiver.
Fig.2. Expanded radio receiver.
Fig.3. Overlapping sidebands.

Fig.4.

Fig.5.

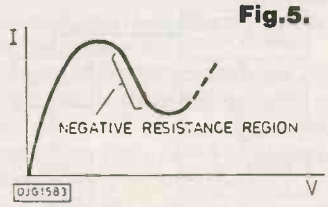


Fig.4. Intersymbol interference
Fig.5. Negative resistance

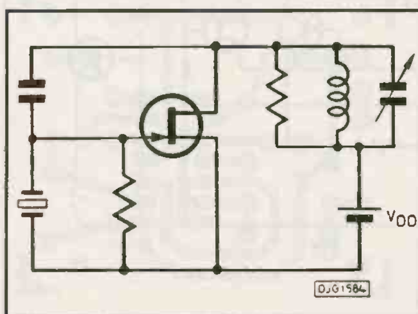
OSCILLATORS AND LOOPS

One method of keeping the oscillator frequency steady is by means of a phase locked loop, but first let us look at oscillators briefly. The criteria for oscillation is that there should be positive feedback with zero phase shift.

Some devices exhibit negative resistance, that is they absorb dc power and output power at hf. Examples of such devices are tunnel diodes, Gunn diodes and unijunction transistors with current/voltage characteristics as in Fig. 5. Fig. 6 shows how a crystal could be used in a Miller circuit to produce oscillation, and in a Colpitts oscillator as in Fig. 7.

The GT cut of crystal is almost immune to temperature changes, but the maximum frequency is only a few hundred kilohertz. The AT cut is the most commonly used with a frequency variation of a few parts per million between -50°C and +100°C. *(Crystals were discussed in Time and Frequency, PE Feb and Mar 89. Ed)*

Fig.6. Crystal in Miller circuit.



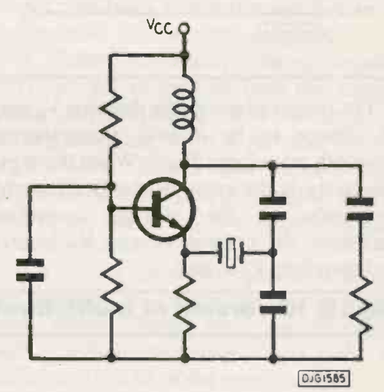


Fig.7. Crystal in Colpitts circuit.

PHASE LOCKED LOOPS

A phase locked loop is a circuit which allows an external reference signal to control the phase and frequency of an oscillator within the loop. If the reference has a varying frequency as in an fm (frequency modulated) wave, the loop frequency will track the input. This is used in fm and fsk (frequency shift keying) and tracking filters.

In Fig. 8, the tracking range depends on the values of the components in the loop. The output voltage (V_e) of the phase detector depends on the phase difference $\phi_d = \phi_s - \phi_o$, where ϕ_s is the phase of the input signal and ϕ_o is the phase of the voltage controlled oscillator.

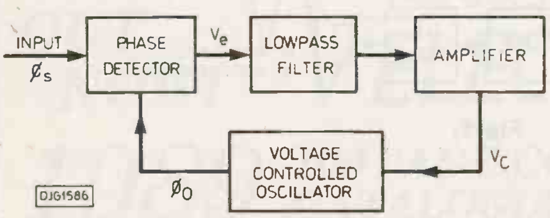


Fig.8.

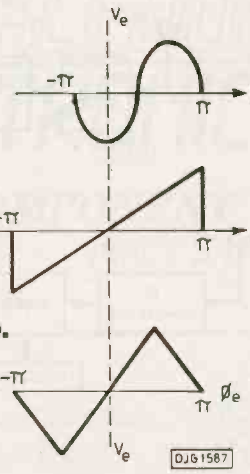


Fig.9.

Fig.8. Block diagram of PLL.
Fig.9. Output of phase detector.
Fig.10. Low pass filters.
Fig.11. Multivibrator.

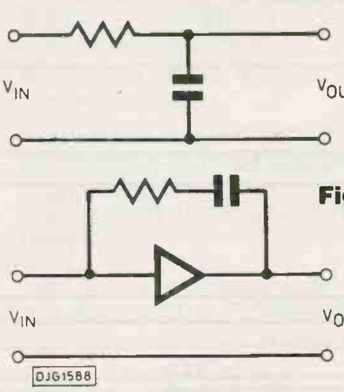


Fig.10.

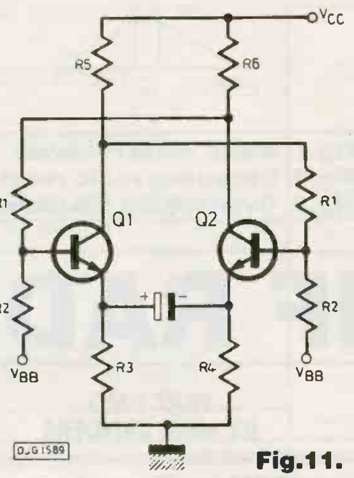


Fig.11.

The output of the phase detector V_e may be chosen to be a sine, triangular or sawtooth waveform. Fig.9. When the input frequency is the same as the free running frequency of the voltage controlled oscillator, the control voltage V_c is zero and therefore V_e is zero.

When the loop is locked, ϕ remains within $\pm\pi$ for the sawtooth waveform and within $\pm\pi/2$ for the sine and triangular waves. This is called the locking range, tracking range, holding range or synchronisation range.

The low pass filter is one of the types shown in Fig. 10. The oscillator may be sinusoidal or a square wave multivibrator, the latter being preferred in digital circuits. The voltage controlled oscillators for digital circuits have the basic form shown in Fig. 11.

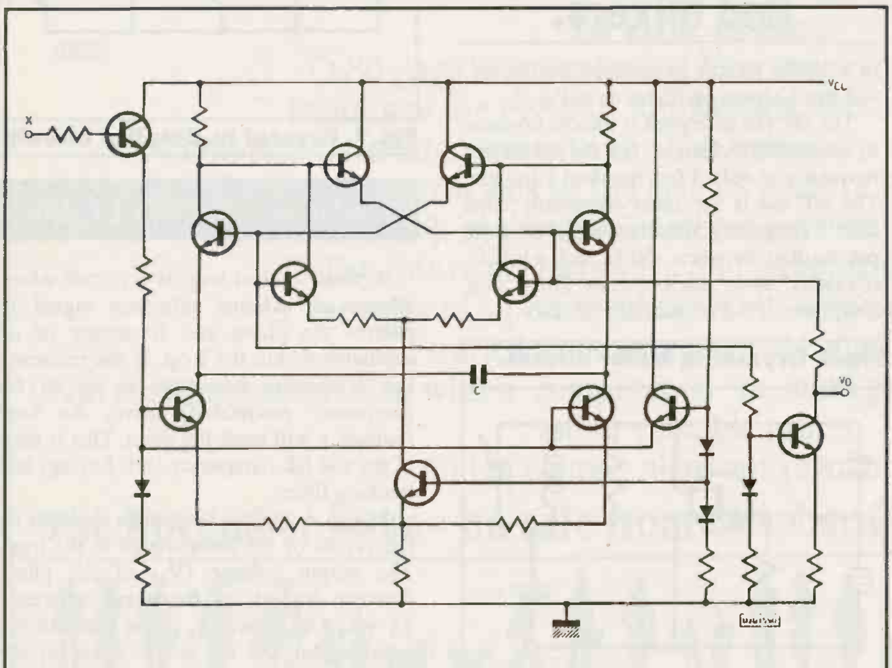
Assume Q1 is on and Q2 off and the capacitor C is charged to voltage V_c with the polarity shown. As the charge on the capacitor decreases, the potential at the emitter of Q2 decreases and Q2 is switched on. This causes a drop in voltage at the collector of Q2 which is connected to the base of Q1, switching it off.

If R_3 and R_4 are large most of the emitter current from Q2 flows into C charging it with the opposite polarity. As the current decays through R_3, Q1 turns on and the cycles repeat.

An integrated circuit version of the multivibrator is shown in Fig. 12 with the emitter resistors and the resistors coupling the collectors to the bases replaced by transistors. These transistors act as constant current sources, providing constant current charging to capacitor C, making the oscillation period a linear relation to the control voltage (V_c) which is applied to point X.

A block diagram of a phase locked loop which could be used in an fm tuner is shown in Fig. 13. The frequency of the crystal oscillator is divided by four to provide a 25kHz output which is compared with a similar output from the tuned oscillator. The difference in the two outputs is used to provide a control voltage from the phase detector. This control voltage is applied to a varactor diode which pulls the oscillator back to the desired frequency.

Fig.12. IC version of multivibrator



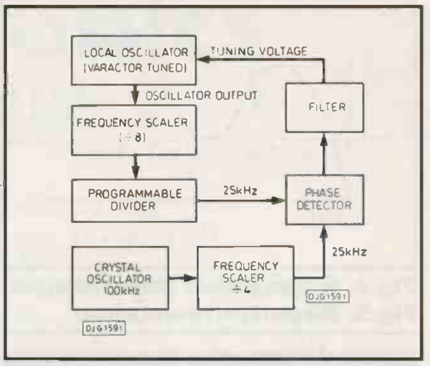


Fig.13. Phase locked loop for fm tuner.

PHASE DETECTOR

The principle of the phase detector is shown in Fig. 14. The two signals to be compared are passed through amplifiers and limiters and then differentiated. The spikes from the differentiator are used to turn the multivibrator on and off and the time that the multivibrator remains on is proportional to the phase difference. The output voltage is proportional to this phase difference and the RC combination acts as a low pass filter.

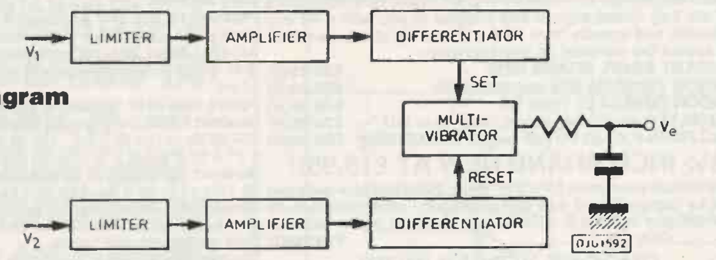


Fig.14. Block diagram of phase detector.

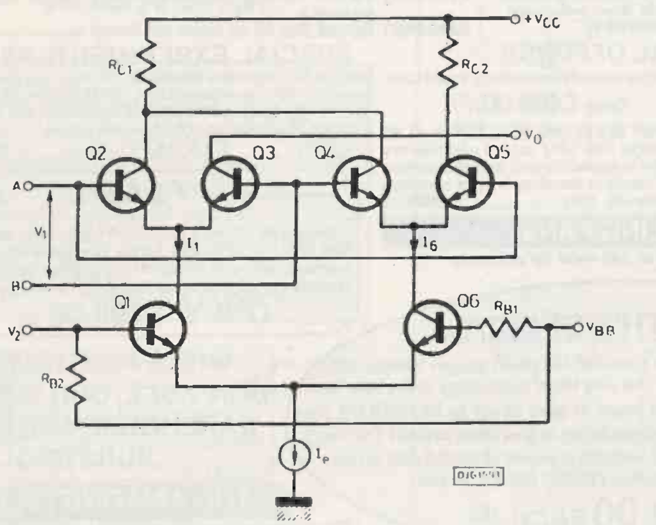


Fig.15. Phase detector circuit.

The circuit of one type of phase detector circuit used widely in phase locked loops (plls) as well as in product detectors, mixers and balanced modulators is shown in Fig. 15, Ie is a constant current generator drawing currents I_1 and I_6 through Q1 and Q6.

Therefore, if a voltage V_2 is applied to the base of Q_1 the current I_1 increases and I_6 decreases. The voltage V_1 to be compared in phase with V_2, is applied to terminals AB and the output V_o is a function of their phase difference.

MIXERS

With reference to Fig. 2, mixers are used to progressively reduce the frequency from rf down to a lower intermediate (if) frequency. This assists the rejection of interference caused by image frequencies.

Armstrong invented a mixer which he called the first detector. Almost any non-linear device will serve as a crude mixer since it will provide products not present in the input. The input output relationship in the time domain can be expressed by the Taylor series:

$$I_o(t) =$$

$$I_o + aV_i(t) + b[V_i(t)]^2 + c[(V_i(t)]^3 + ...$$

where I_o is the quiescent current and $V_i(t)$ is the sum of the input signals. If there is only one frequency in the input, the non-linear device will generate harmonics and also shift the dc value. On the other hand if there are several frequencies in the input, sum and difference frequencies are produced in addition to harmonics.

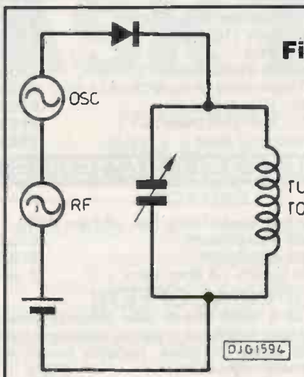


Fig.16.

Fig.16. Basic diode mixer.

Fig.17. Balanced diode mixer.

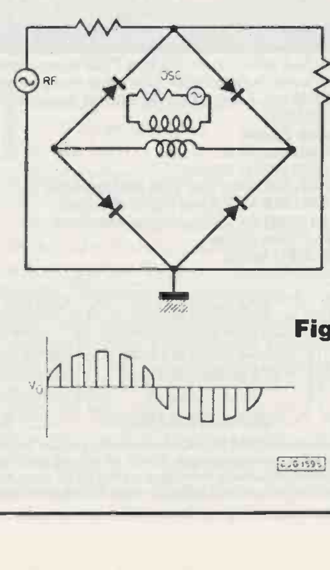


Fig.17.

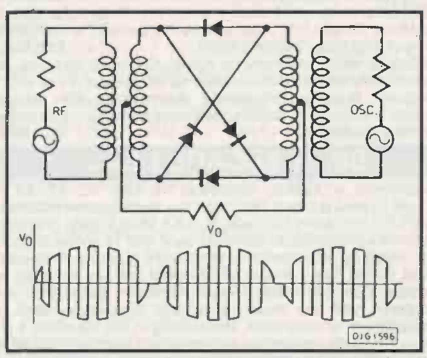
Sum and difference frequencies are generated by the squared terms and called the second order intermodulation products and those generated by the cubed term are called the third order intermodulation products, etc. Square law devices are ideal for mixer applications since they produce only a small number of undesirable frequencies.

Fig. 16 shows a basic diode mixer. The disadvantages are the high noise figure and the non-linearity of the diode characteristic. There is no isolation between the local oscillator and the radio frequency therefore the local oscillator could feed into the receiver's antenna. Also a large local oscillator current could overload the if stage and the conversion loss (rf in to if out) is greater than for other mixer configurations.

Fig. 17 shows a balanced diode mixer and the output voltage across a resistive load. This helps cancel most of the diode's non-linearity, isolate the local oscillator from the rf input and generally improve efficiency. This configuration can be used as a modulator or demodulator as well as a mixer since sum and difference frequencies are produced from two inputs.

Fig. 18 shows a double balanced diode mixer and the difference in configuration from Fig. 17 produces the full amplitude output from which it derives its names. The transistor version of a single ended mixer is shown in Fig. 19 and the balanced version in Fig. 20. Both these figures will be shown next month.

Fig.18. Double balanced diode mixer.



GLOSSARY

AM	amplitude modulation
CW	continuous wave
DSB/SC	double sideband suppressed carrier
FM	frequency modulation
PAM	pulse amplitude modulation
PCM	pulse code modulation
PPM	pulse position modulation
PWM	pulse width modulation
SSB/SC	single sideband suppressed carrier

Next month we shall continue by looking at modulation and amplifiers.

PE

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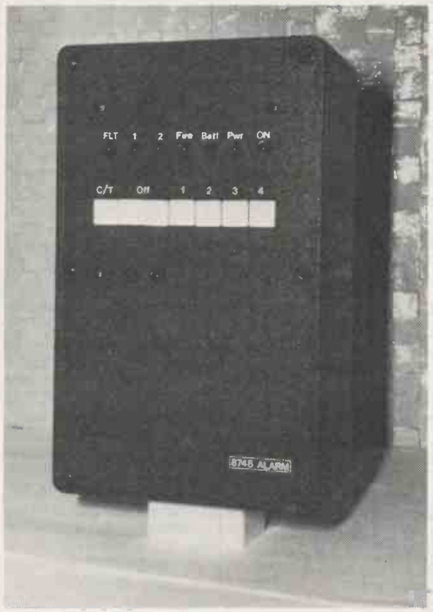
This article describes the construction and operation of a basic home alarm control system, based on a single chip microcontroller. The advantage of using a microcontroller is that complex facilities can be implemented, and even changed, without a large number of discrete chips.



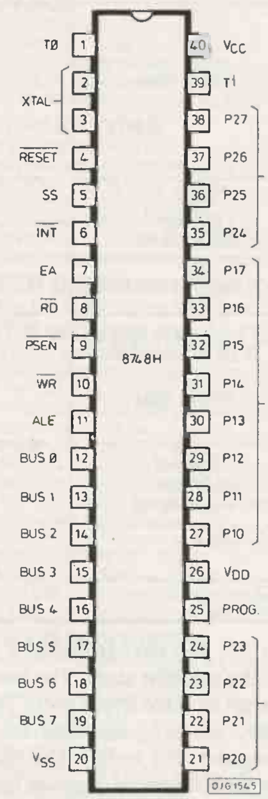


Fig.2. 8748 pin-outs

A basic alarm system based on the 8748 Microcontroller

HOME SECURITY CONTROLLER

BY KEVIN BROWNE

FACILITIES

The main facilities of the alarm controller are:

Variable entry and exit delays.
Variable alarm timing with auto reset.
A main alarm and strobe light output.
Entry and exit delay warning output.
Two independent switchable zones.
A panic, fire and anti-tamper zone circuit.
Automatic system test facility.
User changeable four digit security code.

MICROCONTROLLER CHIPS

Microcontroller chips are a complete microprocessor system, consisting of rom (read only memory), ram (random access memory), cpu (central processing unit), i/o (input and output interface), timer and clock circuitry all on one chip.

The microcontroller chosen for this project is the 8748H. This is manufactured by Intel and is one of a family of microcontrollers. (Table A).

Table A MCS XX-48 Microcontrollers.

Device	ROMLESS type	EPROM type	ROM (bytes)	RAM (bytes)
8048AH	8035AHL	8748H	1024	64
8049AH	8039AHL	8749H	2048	128
8050AH	8040AHL	–	4096	256

The functional block diagram of the 8748 is shown in Fig.1 and the pin layout in Fig.2.

ROM PROGRAM MEMORY

The 8748 has 1024 bytes of program memory available on chip. This at first glance may not seem much but since the majority of instruction codes for the 8748 processor are single byte, quite complex control programs can be accommodated with ease, indeed the program for this project is only 774 bytes in length. The rom memory in the 8748 is of the eprom type which can be programmed and erased in much the same way as ordinary eprom chips.

There are three locations in program memory of special importance:

Location 00 First instruction fetched after reset.
03 Interrupt routine start.
07 Timer interrupt routine start.

RAM DATA MEMORY

64 bytes of data memory are available, allocated as shown in Fig.3. The first eight bytes 0 to 7 are used for the general purpose

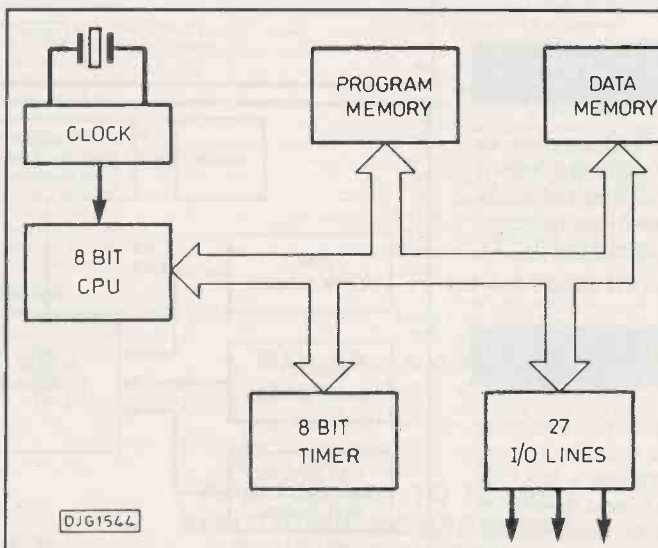


Fig.1. Functional block diagram of the 8748 Microcontroller

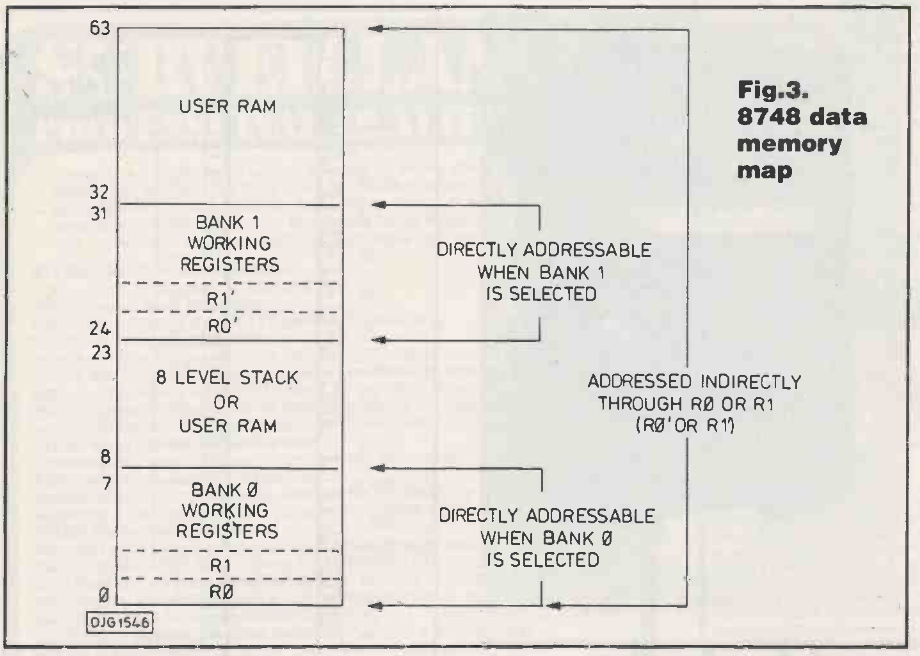


Fig.3. 8748 data memory map

registers R0 to R7. The next 16 bytes, 8 to 23 are used for the machine stack. The stack can be a maximum of eight levels deep. The next eight bytes, 24 to 31 are used for a second set of registers R0' to R7'. The final 32 bytes, 32 to 63 are general purpose user ram. However, any of the first 32 bytes may also be used as general purpose ram, provided that its primary allocation is not used. That is, restricting the stack size to four levels will allow a further eight bytes (16 to 23) to be used as general purpose ram.

REGISTERS

There are two sets or registers, consisting of eight general purpose registers, R0 to R7, and a second set of eight, R0' to R7', which may be selected to replace the main set using a Select Register Bank instruction. (SEL RB0 or SEL RB1). Registers R0 and R1 are also used to indirectly address the ram memory. The 8748 also has an accumulator 'A' and a timer register 'T'.

INPUT AND OUTPUT

27 date lines are grouped together as three ports of eight lines each, and known as Port 1, Port 2 and BUS. Three test inputs are also provided and which can be tested by the conditional jump instructions T0, T1 and INT.

TIMER

The basic crystal frequency is internally divided first by three to provide a clock signal, then by five to produce a machine cycle. The machine cycle is next divided by 32 and used to increment the timer register. Using a 6.14 MHz crystal the timer register can be made to overflow every 50 milliseconds, and when enabled generate a timer interrupt signal, so forming the basis of the Alarm Controller timing. See Fig.4.

CIRCUIT OPERATION

Fig.5 shows the block diagram of the complete alarm system. Figs. 6 and 7 show the control and display circuits.

DATA INPUT

Setting of various alarm timings and the security codes is implemented by two sets of eight dil switches applying a binary code to eight lines of the cpu input. These switches are read by the cpu on power up and during a test sequence. Their status is stored in internal ram for use when required.

All inputs and outputs to the 8748 are normally in the logic 1 high state. To read dil switchblock S1, logic 0 is output on port line P26. Any switches which are operated in this block will pull down the corresponding input line on Port 1 via D10 and D17. The port status is then transferred to internal ram and output P26 returned to logic '1'. Similarly, output P27, via D20 and D27, reads dil switchblock S2.

ALARM INPUTS

Each of the three zones has two alarm inputs, a closed loop circuit which, when broken activates the alarm, and an open loop activated by a short circuit.

Alarm inputs to the cpu are normally low. Consider Zone 1. Both inputs to IC1a are normally held high, one by R11 and one by IC1b, the input of which is held low by the closed loop circuit. A break in this circuit allows the input of IC1b to go high which in turn takes the output of IC1a high. This is

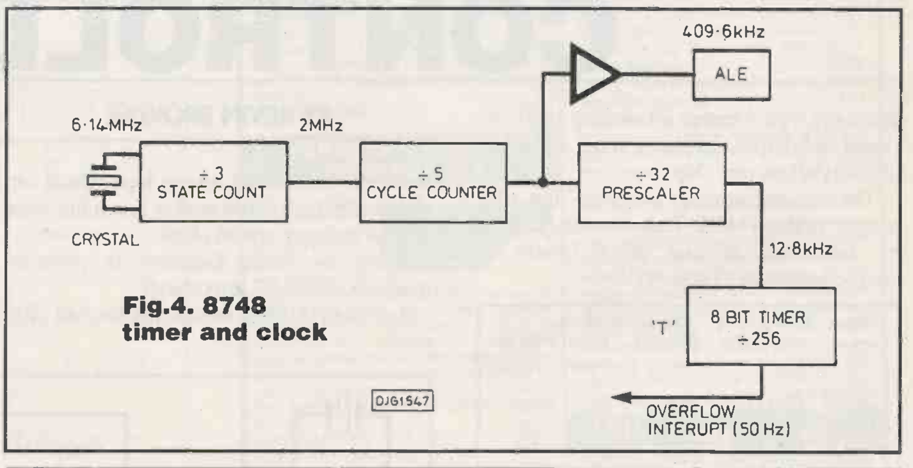


Fig.4. 8748 timer and clock

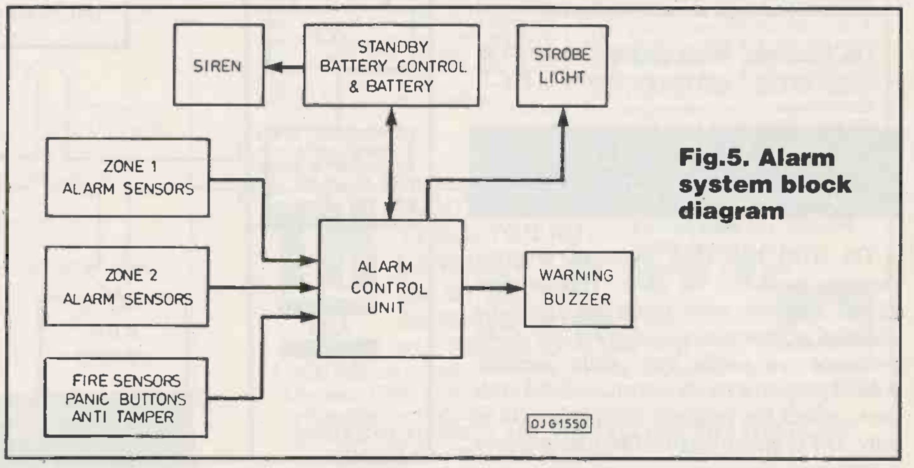


Fig.5. Alarm system block diagram

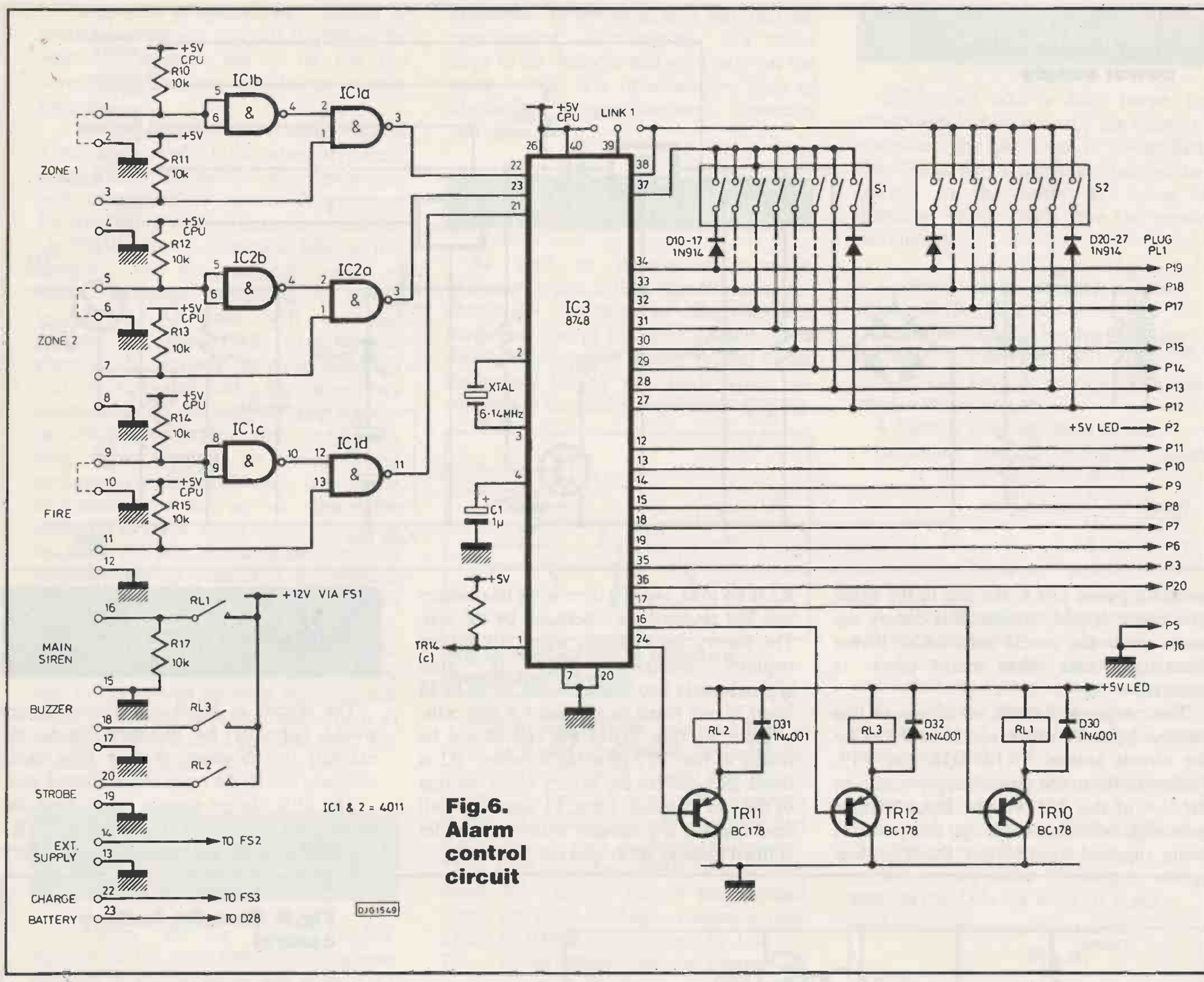


Fig.6. Alarm control circuit

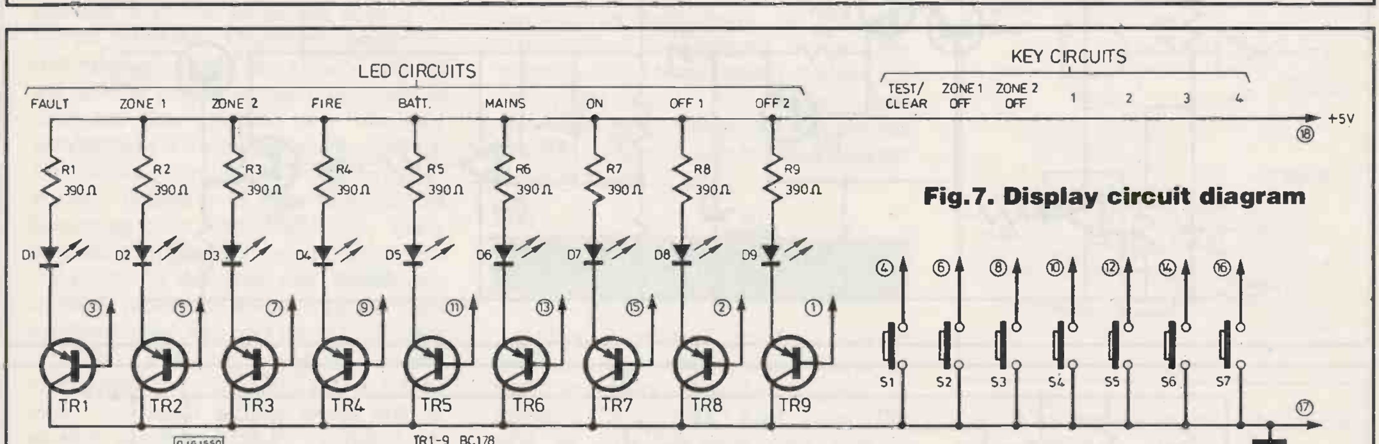


Fig.7. Display circuit diagram

detected by the cpu and acted upon accordingly. Similarly, a short circuit applied across the open loop circuit forces one input of IC1a low which will take IC1a output high and be registered by the cpu.

Zone 2 and the Panic/fire zone work in exactly the same way.

Outputs for the alarm relays and the led indicators are normally at logic 1 when off. A low logic 0 at any input turns on the corresponding buffer transistor and activates the respective led or relay.

POWER SUPPLY

In Fig.8, transformer T1 supplies 15Vac from the mains. The circuit TR6, R21, D39 provide led indication that mains power is present. Capacitor C3 provides smoothing at approximately 20V dc, which feeds, via fuse FS3, to the charge control circuit for the standby battery, and to IC5 to provide 12V for the alarm controller circuit. The 12V supply can also be fed via fuse FS2 to power external alarm equipment, such as infra-red detectors. A further supply via fuse FS1 provides power for an external siren. In the event of a mains failure, a 12V supply from the standby battery via D28 replaces the supply via IC5.

A 5V supply for the leds and relays is provided by IC6. A further 5V supply is provided via the circuit around TR13 and IC4 for the cpu and logic circuits.

B2 is a 9V battery used only if the 12V standby battery is omitted. Its purpose is to

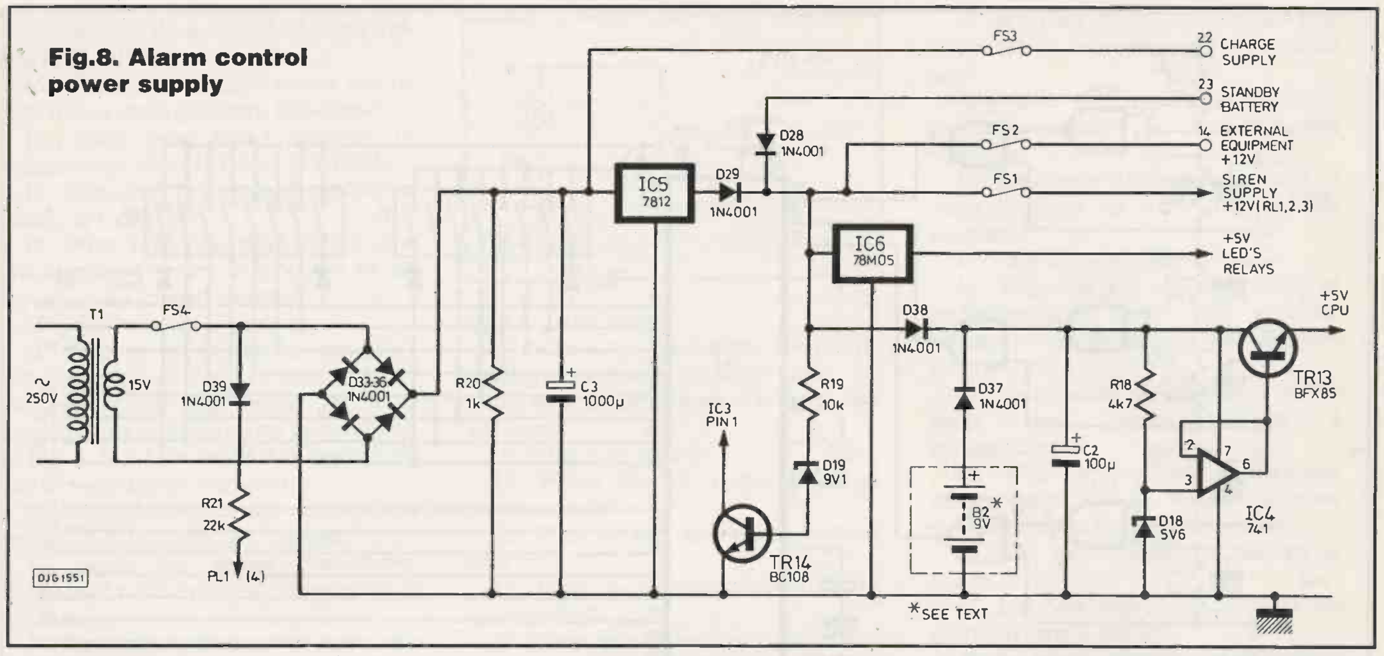


Fig.8. Alarm control power supply

maintain power just to the cpu in the event of a mains failure. Without this battery the alarm controller would re-initialise in the deactivated state when mains power is restored.

The cpu keeps a check on the use of this battery. Input T0 of the cpu is held low by the circuit around TR14, D19 and R19. Failure of the mains power supply results in the loss of this 12V supply. Input T0 thus goes high indicating to the cpu that power is being supplied from battery B2. The time B2 is on load, and the time since this battery was last changed are calculated by the cpu. The battery led indicates when this battery requires changing. This is after approximately two years unused, or 16 to 18 hours of use, based on alkaline AA size cells.

Input T1 (pin 39) of the cpu should be linked to Port P27 (pin 38) if battery B2 is fitted, this enables the battery check section of the cpu program. Input T1 should be left disconnected if a standby battery controller is fitted (battery B2 is also not required).

STANDBY BATTERY CONTROL

The circuit in Fig.9 is optional though would normally be mounted inside the external bell housing. A four wire cable connects this to the main alarm control unit.

The 20V charge supply, taken from the alarm control unit is regulated by IC3, TR1 and TR2 to form a constant voltage supply

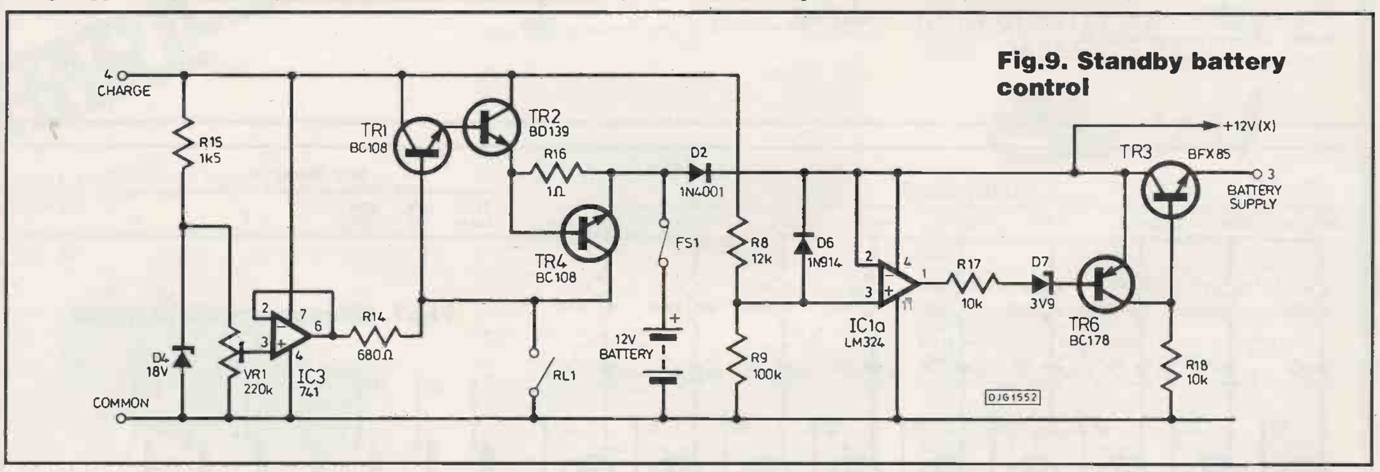


Fig.9. Standby battery control

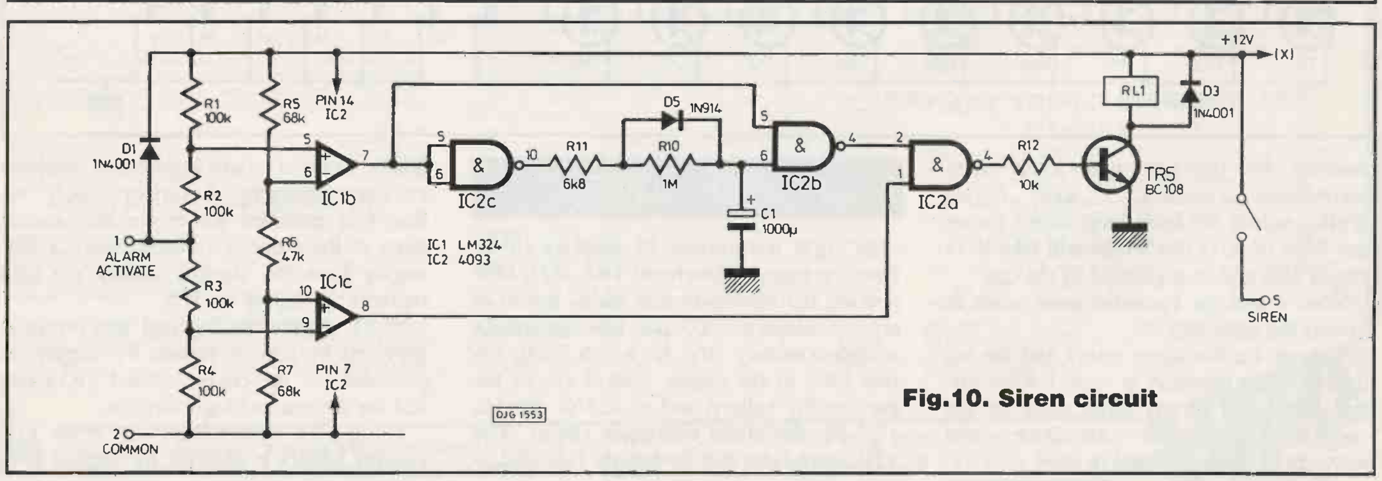


Fig.10. Siren circuit

suitable for charging the sealed type of lead acid battery. The precise charge voltage is set by VR1. TR4 and R16 provide a current limiting circuit of approximately 800mA, the charge voltage being gradually dropped across R14 as this limit is reached.

TR3, TR6 and IC1a control the switching of the 12V battery supply back to the main alarm unit. While the charge supply is present IC1a output is high, so turning off TR6. TR3 disconnects the battery from the main alarm unit. When the charge supply is lost (in the event of a mains failure) this is detected by IC1a, the output of which goes low, turning on TR6. TR3 connects the battery supply to the main alarm control unit. R8 and R9, forming a potential divider, set the voltage at which the detector circuit operates (15V). D6 is included to prevent the voltage at the input of IC1a from exceeding the supply voltage to IC1.

SIREN CONTROL

The main siren, in Fig.10, is controlled via the alarm input lead. This is normally at 0V via R17 in the main alarm control unit. IC1b and IC1c are used as voltage comparators. The switching voltages being set by resistor chain R5, R6 and R7 to 7.6V and 4.4V respectively. The output of IC1b is normally logic 0 and that of IC1c at logic 1. IC2c keeps C1 charged. IC2b and IC1c both feed logic 1 to IC2a. TR5 remains off and the relay unoperated.

When an alarm signal is generated by the alarm control unit, the condition on the alarm input lead changes from 0 volts to 12 volts. This change is detected by IC1c, and the alarm relay is operated via TR5 and IC2a. The 12V alarm condition is also fed via D1 to supply power to the relay and alarm siren. The battery charge supply is turned off by the relay contacts RL1 in Fig.9.

If, at any time, the alarm input lead is disconnected from the main alarm unit this condition is detected by IC1b, the output of which goes high. Both inputs of IC2b go high together; one input supplied from IC1b and the other from the charge on C1. The relay is then operated via IC2a, the 12V in this case being supplied from the battery. C1 slowly discharges through R10 and R11 to time the siren operation to approximately five minutes. When C1 is sufficiently discharged, IC2b turns off TR5 via IC2a and stops the siren. Reconnection of the alarm input to the alarm control unit will reset the circuit, C1 being quickly charged via R11 and D5.

SYSTEM SOFTWARE

This is a brief description of the main points of the system software. The flowchart shown in Fig.11 shows only these main points.

The first part of the program consists of system initialisation. This is the routine

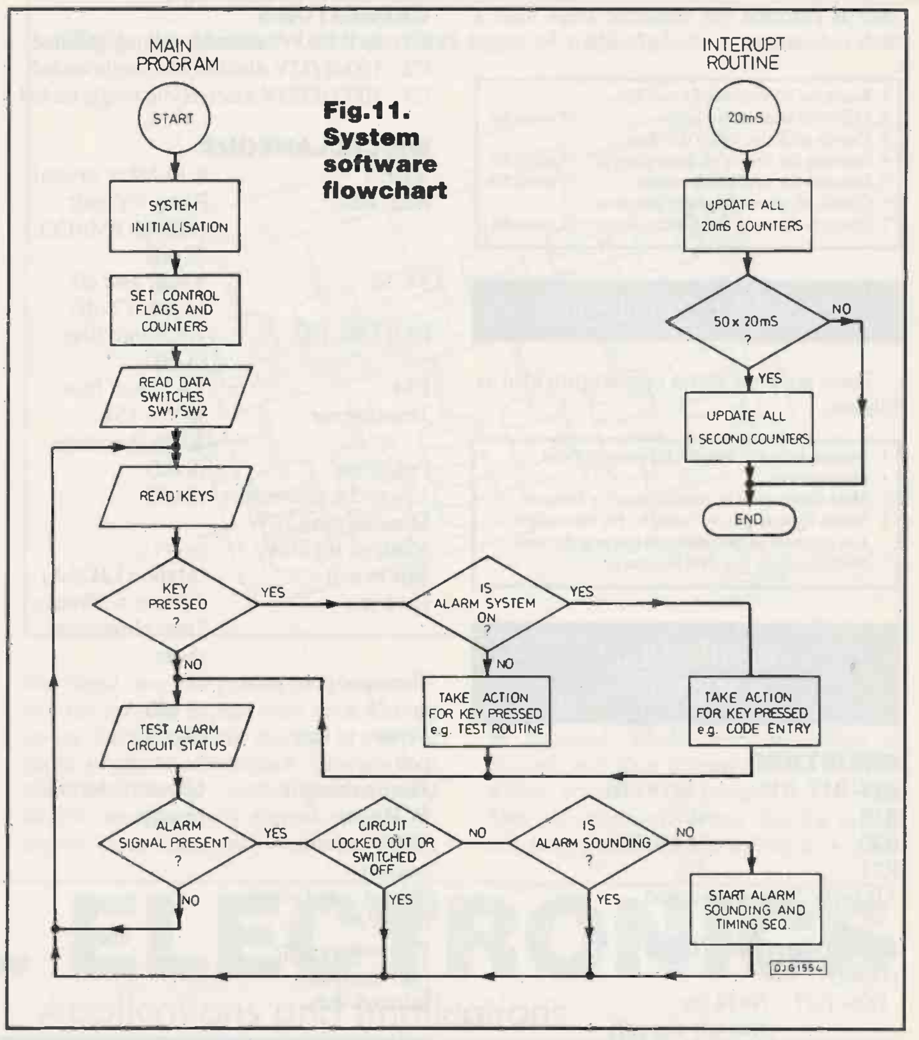


Fig.11. System software flowchart

Key	Action taken when the Alarm system is OFF.	Action taken when the Alarm system is ON.
T/C	Initiates the self test sequence.	Clears the security code input register.
Zone off	Toggles the status of a Zone.	Ignored.
Keys 1-4	Turns system ON after an exit delay period. A second press cancels the exit delay and switches the system ON Immediately.	Correct sequence turns the system OFF. Three incorrect entries of activates the alarm.

Table B

Zone	Action taken when the Alarm system is OFF.	Action taken when the Alarm system is ON.
1	No action.	Initiate entry delay then alarm. (note 1)
2	No. action.	Immediate alarm activation (note 1)
Fire	Alarm motivation. (note 2)	Immediate alarm activation.

Notes. 1. Only if zone is in the ON state otherwise no action.
2. If Zone is triggered when the alarm system is in the OFF state the subsequent key actions are as though the alarm system is in the ON state, ie, entry of the security code will deactivate the alarm.

Table C

work required to configure the system to our particular needs, clearing all memory, setting the timer and interrupt mode, storing the basic data and reading the two dil switches. The system is initialised in the disarmed state with all zones active.

After system initialisation, the main program loop is entered. First the seven key switches are tested and action is taken if any key is found operated. The action taken depends upon the status of the alarm system. (Table B.)

Next the three alarm inputs are tested, and again the action taken depends upon the status of the alarm system. (Table C.)

These operations form the main program loop. This loop is interrupted every 20 milliseconds by the internal timer. This is used primarily to debounce the key and alarm inputs; a key has to be operated or an alarm present for a minimum of 60 milliseconds, ie, three interrupt periods before it is considered valid. The 20 millisecond interrupt is then used to decrease a counter (programmed to divide by 50) so that every second the alarm output timers are updated.

TEST SEQUENCE

The self-test sequence performs the following operations. It takes approximately 18 seconds. If at any stage a fault is detected the sequence stops with a fault indication.

1.	Reads the dil switches S1 and S2.	
2.	Lights all alarm status lamps.	(5 seconds)
3.	Checks all alarm inputs are clear.	
4.	Operates the entry/exit buzzer output.	(5 seconds)
5.	Operates the strobe light output.	(5 seconds)
6.	Checks all alarm inputs are still clear.	
7.	Operates the main alarm siren output.	(2 seconds)

ALARM OUTPUTS

There are three alarm outputs provided as follows:

1. Buzzer, activated only during entry and exit delay periods.
2. Main alarm, reset by internal timer or keycode.
3. Strobe light output, activated by the main alarm. It is not reset by the timer and can only be reset by the keycode or a Test Sequence.

MAIN PCB COMPONENTS

RESISTORS

R10–R17, R19	10k (9 off)
R18	4k7
R20	1k (0.5W)
R21	22k

All 1/4W 5% unless stated.

SEMICONDUCTORS

D10–D17, D20–D27	1N914 (or 1N4148) (16 off)
D28–D39	1N4001 (12 off)
D18	BZY88C5V6 5V6 zener
D19	BZY88C9V1 9V1 zener
IC1, IC2	4011 (2 off)
IC3	8748 microcontroller
IC4	741 opamp
IC5	µA7812 12V 1A regulator
IC6	µA78M05 5V 500mA regulator
TR10–12	BC178 (3 off)
TR13	BFX85
TR14	BC108

CAPACITORS

C1	1µF 1/63V electrolytic single ended
C2	100µF/25V electrolytic single ended
C3	1000µF/35V electrolytic single ended

MISCELLANEOUS

Xstal 1	6.14 MHz crystal
RL1–RL3	Relay 6V spdt (Maplin FM91Y) (3 off)
S1, S2	8-way spst dil switch (2 off)
FS1, FS2, FS3	1A 20mm fuse (3 off)
FS4	2A 20mm fuse
Transformer	15V + 15V 20VA miniature
Fuse clips	(8 off)
12way 2A connectors	(2 off)
Minicon plug 20W	
Minicon skt 20W	
Box to suit	(Maplin LH23A)
Heatsink	120mm x 50mm x 1mm aluminium sheet
Threaded pcb space is 0.75 in	(4 off)
Screws to suit pcb	(8 off)
Plastic sheet	120mm x 50mm
PCB pins	(2 off)
T05 transistor heatsink	
9V AA size battery holder	
PP3 battery clip	
Sub miniature microswitch	

DISPLAY PCB COMPONENTS

RESISTORS

R1–R9	390R (9 off)

All 1/4W 5%

SEMICONDUCTORS

TR1–TR9	BC178 (9 off)
D1–D5	led 5mm red (5 off)
D6	led 5mm green
D7–D9	led 5mm orange (3 off)

MISCELLANEOUS

S1–S7	spst non locking switch (Maplin FF87U) (7 off)
Switch caps white	(Maplin FF94C) (7 off)
LED clip	5mm (9 off)
PCB	
6BA pcb spacers 0.25 in	(4 off)
6BA nuts/bolts	(4 off)

STANDBY CONTROL COMPONENTS

RESISTORS

R1, R2, R3, R4, R9	100k (5 off)
R5, R7	68k (2 off)
R6	47k
R8	12k
R10	1M
R11, R12	6k8 (2 off)
R14	680R
R15	1k5
R16	1R (0.5W)
R17, R18	10k (2 off)
VR1	220k hor min preset sealed

All 1/4W 5% unless stated

CAPACITORS

C1	1000/16V electrolytic

SEMICONDUCTORS

IC1	LM324 quad opamp
IC2	4093 quad nand Schmitt
IC3	741 opamp
D1, D2, D3	1N4001 (3 off)
D4	BZY88C18V 18V zener
D5, D6	1N914 (or 1N4148)
D7	BZY88C3V9 3V9 zener
TR1, TR4, TR5	BC108 (3 off)
TR2	BD139
TR3	BFX85
TR6	BC178

MISCELLANEOUS

RL1	Relay 12V dpdt (Maplin YX95D)
FS1	Fuse 1A 20mm
Fuse clips	(2 off)
PCB	
Spade terminals	(2 off)
Battery 12V	Sealed lead acid (Maplin YJ69A)
Heatsink	130mm x 60mm x 1mm aluminium
PCB spacers 10mm	(4 off)
6BA 0.75 inch nuts and bolts	(4 off)
Transistor mounting kit	
2 Amp connector 6 way	

PE

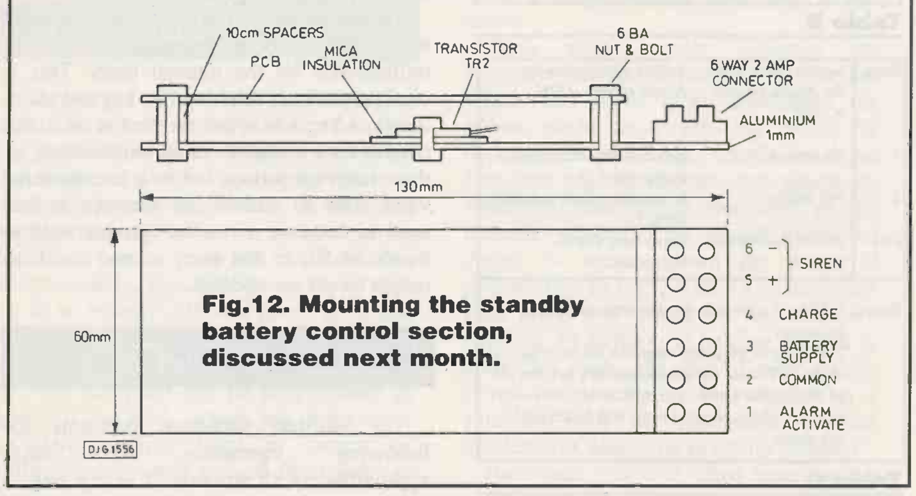


Fig.12. Mounting the standby battery control section, discussed next month.

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Z8856 Cherry computer keyboard. Very slim model 340 x 130 by only 14mm deep, including keys. Matrix output. 67 keys in pale/dark brown. No idea what computer they're from – but they're an absolute bargain at only £4.
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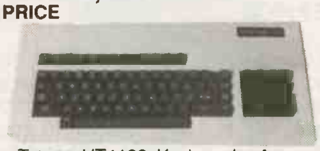

Z8833 Tatung VT4100 Keyboard. As previously advertised on earlier bargain lists (but these do not have a lead attached). New stocks just received of this popular cased 85 key with separate numeric pad keyboard. Supplied with circuit diagram. 450x65x125mm.
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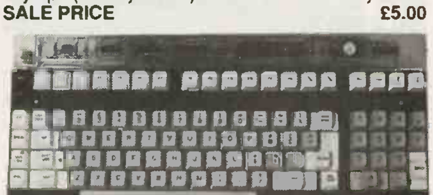

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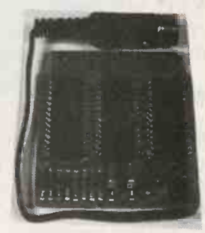

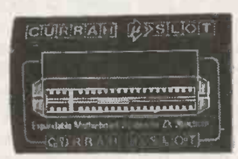

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K560 Semiconductors – Over the years we have purchased many transistors, diodes, ICs etc which for one reason or another have accumulated in one of our stock rooms. Rather than spend weeks sorting and listing them, we have decided to make them into packs. All components are full spec marked devices. Some may be coded. We believe this to be one of the best value packs ever offered, as many high value components are included. Packs are made up by weight; this means contents are very approximate – if there are several bulky power devices, there will be considerably fewer parts than those packs containing all small signal items.

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Pack of approx 100	£5.00	**£2.75**
Pack of approx 250	£12.00	**£6.00**
Pack of approx 1000	£40.00	**£20.00**

RESISTORS

K540 Resistor Pack – mostly 1/8, 1/4 and 1/2W, also some 1 and 2W in carbon, film, oxide etc. All have full length leads. Tolerances from 5 to 20%. Excellent range of values. 500 £2.50 2,500 £11.00
SALE PRICES 500 £1.25 2,500 £5.50

K503 100 Wirewound Resistors – From 1W to 12W, with a good range of values.
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K523 Resistor Pack – 1000 – yes, 1000 1/4 and 1/2 watt 5% hi-stab carbon film resistors with preformed leads for PCB mounting. Enormous range of preferred values from a few ohms to several megohms.
Only £2.50
SALE PRICE £1.25

K531 Precision Resistor Pack – High quality, close tolerance R's with an extremely varied selection of values mostly 1/4 and 1/2w tolerances from 0.1% to 2% – ideal for meters, test gear etc.
250 £3.00 1000 £10.00
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K505 20 Assorted Potentiometers – All types including single, ganged, rotary and slider. £1.70
SALE PRICE £0.85

K572 Networks 7,8,9 pin SIL; 14 & 16 pin DIL. Lots of different values.
Pack of 100 £4.50
SALE PRICE £2.25

K554 Thermistors – Mostly disc, rod and some valuable bead types. Identification/ data sheet included. Big variety up to 40mm dia! Catalogue value over £50.00
100 for £8.00
SALE PRICE £4.00

K525 Preset Pack – Big, big variety of types and sizes – submin, min and std, MP slider, multiturn and cermets are all included. Wide range of values from 20R to 5M.
100 assorted £6.75 250 £12.95
SALE PRICES 100 assorted **£3.37 250 £6.50**

CAPACITORS

K549 Variable Capacitors – Mostly small trimmers – airspace, mica and polyprop dialectrics, but also included are a few full size tuning caps. 25 for £5.75
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K544 Mullard Polyester Caps – Cosmetic imperfections, electrically OK. Wide range of values from 0.01 to 0.47µF in 100, 250 and 400V working. 200 for £4.75
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SALE PRICE £1.37

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£3.95 250 £8.95
SALE PRICES 100 £2.00 250 £4.50

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SALE PRICE £2.00

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SALE PRICE £10.00

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SALE PRICE £1.00

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40 switches for £2.95 100 £6.50
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K532 Relays – Wide selection of styles voltages and contacts. 4v-240v, AC/DC, SP and 4PCO 20 for £6.00
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K542 Reed Relays
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OPTO

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100 £5.95 250 £13.50
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SALE PRICE £2.00

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K551 6BA screws – In a variety of lengths and heads from 3/16" to 20mm long. Steel.
200 £2.00
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SALE PRICE 85P

K571 Cable Clips – 6 or 7 different sizes from 3.5mm to double T & E mostly black and grey. 100 assorted 99p
SALE PRICE 50P

K564 PCB stand-offs. A mixture of 8 different styles and sizes from 4.75 to 12.7mm high. 100 £2.40
SALE PRICE £1.20

K567 Wire Ties. 5 types to take 4-15mm dia cable bundles. 100 £1.70
SALE PRICES 85P

K565 Miniature PCB supports in nylon. 6 different styles – sizes from 6.35 to 13.24mm high. 100 £2.20
SALE PRICE £1.10

K566 Self adhesive cord clips in moulded nylon. 5 styles/sizes. Base size from 15.9 to 31.8mm square
Pack of 100 £2.70
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K568 Giant Plastic Pack Approx. 1000 pieces – standard and miniature PCB supports, self adhesive ribbon cable clips, straps, ties, cord clips. This lot would normally cost around £50.00
Our Special Price £12.00
Sale price £6.00

K563 Cable markers (ident sleeving). Over 1000 pieces, all with either letter or number. Assorted colours and sizes from 1-5mm dia. over 50 different!
Pack of 1000 £2.50
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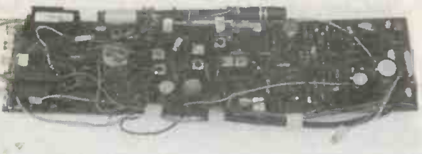


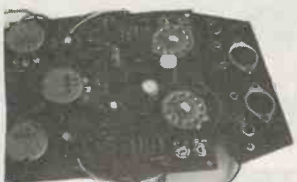
Z497 AM/FM Stereo Tuner Panel. Complete radio chassis with push-button selection for LW/MW/FM and ON/OFF. Ferrite rod for LW & MW selection, co-ax socket for FM aerial. Supplied with mains transformer and rectifier/smoothing cap, and wiring details. PCB is 330 x 90mm. Reduced to £7.95
SALE PRICE **£4.00**

1W Amplifier – mono

Z914 Audio amp panel 95x65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and vol. control. Just connect batt. and speaker. Full details supplied. Only £1.50; 10 for £12.00; 25 for £25.00; 100 for £75.00
SALE PRICES **75p each; 10 £6.00; 25 £12.50; 100 £37.50**

1W Amplifier – stereo

Z915 Stereo version of above 115x65mm featuring 2xTBA820M and dual vol. control. £3.50, 10 for £30, 25 for £65, 100 for £200
SALE PRICES **£1.75, 10 £15, 25 £32.50, 100 £100**



Z974 Mixer Amp Panel – 115x115mm and gives 1W O/P from a TBA820M chip. There are two inputs, one via a pre-amp, from phono sockets and separate volume controls. A third pot is used to fade from one input to the other. There are also 2 4p 3w rotary switches. Attached to the PCB by flying leads is a panel on which are mounted the 2 input skts, 2x5 pin DIN skts and 2 pin DIN speaker skt. A data sheet is supplied All this for just £2.50
SALE PRICE **£1.25**

Z4134 Speaker remote control box. This is a cream case 125x95x42mm housing a 57mm dia speaker and 2 control knobs, one for volume and one to switch main-remote-dual, the 3 core 6m long lead enables volume to be controlled from chair or bed. Simple to fit, instructions included. £3.95
SALE PRICE **£2.00**

Z4135 'STETHOPHONE' mini stereo head-phones, complete with stereo jack plugs, 8R. Hinged headband. £1.75
SALE PRICE **87P**

Hi-Res Monitor

Brand new and boxed, complete apart from case, the super high definition (1000 lines at centre) makes this monitor ideal for computer applications. Operated from 12V DC at 1.1A. Supplied complete with circuit and 2 pots for brilliance/contrast + connecting instructions. Standard input from IBM machines, slight mod (details included) for other computers.
Price £24.95 4 for £99.00
SALE PRICE **£12.50; 4 FOR £45.00**

Z494 Newbrain Motherboard. Micro-processor panel 265 x 155mm. Complete PCB for computer, Z80, EPROM, etc. 68 chips altogether + other associated components, plugs, sockets, etc. Brand new in original packing. £5.50
SALE PRICE **£2.75**

Z672 Newbrain motherboards. Complete but probably faulty. £3.50
SALE PRICE **£1.75**

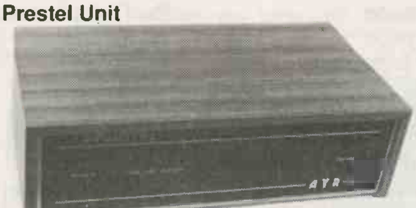
Z620 68000 PANEL PCB 190 x 45mm believed to be from ICL's 'one per desk' computer containing MC68008P8 (8MHz 16/8 bit microprocessor) + 4 ROMs all in sockets. TMP52220CNL, 74HCT245, HCT138, LS38 & LS08, also 2 x 20w SIL sockets & 2 x 14w SIL sockets. £5.00
SALE PRICE **£2.50**

Set Top Converter

Z8828 Made by Thorn EMI, this was used to receive cable television. 2 part aluminium case 211x158x82mm (no front panel) contains 2 PCB's: (a) control board with multiway switch, dual 7 seg plug in display, couple of chips. (b) main board with mains transformer, tuner, RF section etc. Rear panel has input and output sockets. 2m mains lead with moulded on 13A plug. £9.00
SALE PRICE **£4.50**

Z803 Auto Dialler. Sloping front case 240 x 145 x 90/50mm contains 2 PCBs: one has 4 keypads (total 54 switches) + 14 digit LED display. 2xULN 2004, ULN2033 and 4067; the other has 12 chips +4 power devices etc. Case contains speaker. For use with PABXs, could probably be modified for exchange line. Needs 12V ac supply £9.00
SALE PRICE **£4.50**

Prestel Unit



Z819 Brand new and boxed, complete with co-ax T connector, aerial lead and instruction book. Only one snag – the remote control hand-set is missing. Size of smart wooden case is 347x187x100mm. Mains operated. Old style BT plug. Made by Ayr Electronics, Model P £22.00
SALE PRICE **£11.00**

Z8862 Video game unit with 10 games, utilizing, the AY-3-8610 chip. Consists of 2 handheld units 145 x 60 x 45mm made of light and dark grey high impact plastic. Unit 1 has a control panel with 0-9, serve and reset buttons, 3 switches for bat size, ball speed and sound on or off, and built in joystick. Unit 2 has a serve button and joystick. the two units have 2m of 5 core cable between them, and the 3m lead from unit 1 has 3 x 3.5mm plugs; 1) 7-5V input; 2) audio out; 3) composite video out. Worth what we're asking just for the cases! £9.95
SALE PRICE **£5.00**

Dual Sheet Feeder

Z8837EXXON DUAL SHEET FEEDER Z200. Overall 395x210x285mm. Brand new and containing some very high class electronics. although of little practical use as it stands, it makes a great break down unit. It contains:
3x12V 36R 7.5° stepper motors by Airpax and associated gear trains drive belt etc.
2x12V Solenoids
1x12V electronic buzzer
2 extremely sensitive micro-switches.
1 PCB containing 4xTIP115, 4xTIP110, 2x7407, LM3302 comparator + T's. R's, C's, plugs, sockets etc.
1 control panel containing 4 LED illuminated push buttons + green LED on small PCB
1xOPB703A opto coupler
1xOPB7111 opto coupler

Obviously, a very expensive piece of machinery to produce – but once again our contacts in the trade have enabled GREENWELD to procure a few hundred for a fairly modest sum, allowing us to offer them at the bargain price of £24.95
SALE PRICE **£12.50**

Touch Pad

Z811 Cumana Touch Pad for the BBC computer. This remarkable add-on enables you to draw on the screen using a stylus with the touch sensitive pad. Supplied with 2 stylii, power/data connecting lead and demo tape with 4 progs. Contains state-of-the-art electronics. Originally being sold at £79.95 – but we can offer a limit quantity of these brand new and boxed for just £19.95
SALE PRICE **£10.00**

Fibre Optics

Scoop purchase of single and twin cable. For use with visible light or infra-red. Core 1mm dia, overall 2.25mm dia.
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Twin 90p/m; 20m coil £6.00
SALE PRICES **20M SINGLE £2.00**
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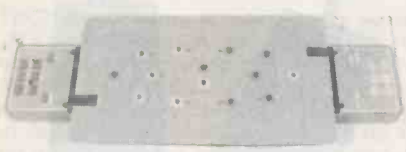
'JIMMY'

the electronic football game of skill



Z817 Exciting electronic football game – Waddingtons' 'JIMMY'. Brand new models in full working order, but without plastic peripherals, stickers etc. Red plastic case 420mm long x 93mm wide contains keypad and seven segment LED's to keep score either end. The centre section 'players' are represented by red 5mm LED's, 14 altogether. The main chip is the TMS1000, programmed to make odd noises whilst playing and a tune when a goal is scored. Also inside are 13 plastic transistors, 57mm 8R speaker, power supply socket, R's, C's etc. Powered by 2xPP3 batts. Solo or dual play. Supplied with instruction sheet, playing field complete with coloured 'players'. Good fun to play as a game and good value for the electronics within. Originally retailed at £19.95.
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SPO256A **Only £1.00**
10 for **£7.00** 100 for **£50.00**

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ASTEC Model AA12531
I/P: 115/230V ac 50/60Hz
O/P: V1 + 5v 5A
V2 + 12v 0.15A
Size: 160 x 104 x 45mm

Partially enclosed panel with fixing holes in steel case on 120 x 125mm centres.

Inputs and Outputs are on colour coded leads; there is also an EEC socket on a flying lead.

£6.95

ASTEC Model AC9231
I/P: 115/230V ac 50/60Hz
O/P: 50Watt max:
V1 + 12v 2.5A
V2 + 5v 6.0A
V3 12v 0.5A (+ or -)
V4 5v 0.5A (+ or -)

Size: 203 x 112 x 60mm

Fully enclosed case with built in tapped mounting holes.

Inputs and Output pins on edge of panel.

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Sim to K9 – 19mm high x 20mm dia with coloured tops.
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Ideal for powering single 3 1/2" or 5 1/4" drive. Mains input, stabilized smoothed outputs, 5V@1A + 12V@1A. Simple, easy to assemble kit with all parts and full instructions. **£4.95**

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P23	Z8858 20% off		Z4164 Sold out	P30	10% off
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	Z8861 20% off		Rest 25% off		given away

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DIGITAL ELECTRONICS

Part II – Applications and implications

BY OWEN BISHOP

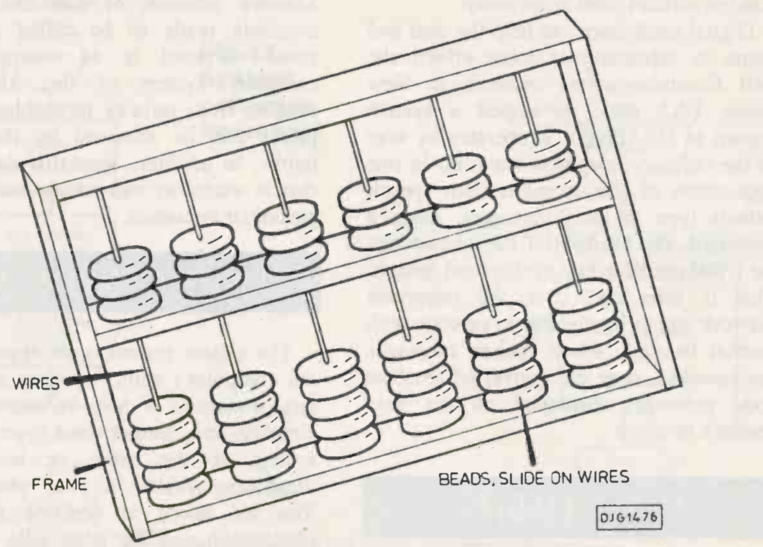
Owen takes an overall look at how digital electronics affects our lives, and sets an end-of-term exam!

To bring this series towards the end, we take stock of the impact of digital electronics on our lives. What is the nature of this impact? Does it improve the quality of our lifestyle? Does it raise problems too? What of the future?

END OF THE ABACUS

The abacus is an ancient type of calculator (Fig. 1). It was particularly common in the Far East. I first saw abacuses (or is it abaci?) when I visited Hong Kong in 1970. Every shop in that city had an abacus on the counter for totting up the customer's bill. It was fascinating to watch a proficient operator frenziedly clicking the beads up or down the rods and rapidly obtaining the total. Old-tech it may be but, for adding up accounts, using an abacus can still be as quick as using a pocket calculator. Despite this, in 1970 the day of the abacus was nearly at an end. When I visited Hong Kong again two years later, there was not a single abacus to be seen. The shop counters were littered with pocket calculators – every shop assistant seemed to have at least one – with which to work out the account. Digital electronics had had its devastating impact on tradition.

Fig.1. An abacus – the earliest type of calculator



The same trend has appeared at the supermarket checkout. Supermarkets started in Britain just about when the old-fashioned mechanical cash-registers were being replaced by electronic machines. At first, the check-out operator keyed in the prices and the register produced a printed slip showing the prices of the individual items and the total. The more suspiciously-minded of us keenly watched the display to check that the correct price was being keyed in.

Nowadays the check-out desk is linked to a central store computer. This holds details of all the items on sale at the store. Instead of keying in the price, the operator wipes a bar-code reader across the package or waves the item over a curiously-shaped aperture in the check-out desk. The code for the item is automatically read (with built-in provision for detecting errors of reading) and sent to the computer. The computer looks up the code in its data bank, and finds the name of the item and its price. These are displayed at the check-out and printed out on the sales slip – all in a fraction of a second. So now you can have an itemised list of your purchases, named and priced.

As point-of-sale facilities become more widely available, digital electronics takes over the matter of paying for the goods too. Hand your charge-card to the operator, and the account is paid from your account in an instant. 'Plastic money' is itself a result of digital electronics. Charge-cards and credit-cards, cash-dispensers and similar equipment all depend heavily on digital electronics and would be almost unworkable if one had to rely on traditional manual book-keeping. Such innovations are a great convenience, helping to make life smoother and easier.

COMMUNICATING

One of the biggest differences that digital electronics has made to the author's working life is the use of a wordprocessor. When I prepared my first contribution to PE in 1971 it was laboriously typed by hand. Having had no training in typing, my manuscript was a mass of typing errors with words and sentences crossed out by over-typing them with 'X's. Nowadays, using a word-processor, all the errors can be removed, whole sentences added or deleted, and long passages of text can be shifted around at the press of a key. This does not necessarily mean that the text is any more interesting and informative when it is written, but it must be very much easier for the Editor to check and for PE's typesetter to deal with! (*Yes! Ed*) But technology has its drawbacks. In the good old days of the typewriter I used to be able to sit outdoors on sunny days, enjoying the garden and getting a good sun-tan while working. Now I'm kept indoors, chained to the computer in a semi-darkened room. Perhaps a lap-top portable is the answer.

If it's a matter of getting material quickly to the Editor, digital electronics helps again. Fax machines are ideal for transmitting documents, including hand-written letters, drawings, diagrams and photographs through the public telephone network. Over 900,000 machines were installed world-wide in 1986 and the numbers continue to grow rapidly. Fax (short for *facsimile* – 'an exact copy') uses an optical scanner to read a document and converts this into digital signals, which it sends through a modem over the telephone system. At the receiving end, the signals are used to produce a copy of the document on a special thermal printer. A fax machine looks rather like an ordinary photocopying machine, and it takes less than a minute to transmit or receive an A4 page. The quality is about the same. Moreover, transmission is instantaneous. As a document is fed into a fax machine in an office in, for example, New Zealand, the copy emerges from a fax machine in a London office 12000 miles away.

Digital electronics can help the deaf and dumb to communicate more effectively. Bell Communications research in New Jersey USA have developed a system known as DEAFNET. It operates by way of the ordinary telephone network. In one application of this, persons with speech defects type in their messages, using a keyboard. The DEAFNET device converts the typed message into synthesised speech. This is then sent over the telephone network and is intelligible to persons with normal hearing. When spoken messages are received, they are converted to short code messages displayed on the deaf person's terminal.

COMPUTERS

All of the above-mentioned advances in the use of digital electronics depend upon computers. This is taking the word 'computer' in its widest sense. It includes not only the micro, mini and mainframe computers, used for wide-ranging purposes, but also the digital circuitry built into such devices as fax machines, washing machines and cash registers.

The essential point about a computer is that it is designed to process data. It can process

* *large amounts of data*
* *very quickly and*
* *without making a mistake.*

In the early days it became a habit to blame all kinds of mistakes on the computer. But a computer doesn't make mistakes. It only does what it is told to do. Practically all of the errors blamed on 'our computer' were the fault of the humans who programmed the computer wrongly or fed it with incorrect data. Nowadays, with people becoming more computer-aware, such excuses are no longer acceptable. This in turn means that persons using computers today have to accept full responsibility for the use they make of them.

DATA BANKS

The storage of masses of data is nothing new. Libraries have fulfilled this function for hundreds of years. What is new about the computer data storage is that it can be accessed so rapidly. Instead of browsing through several books for an hour or so, the data you need is available in microseconds. This puts the using of data on to an entirely different plane. Data that would take a life-time to collect and collate can now be processed in an hour or so. The computer can be programmed to search a data bank, extract any given items of data, analyse them in dozens of different ways, and present the results as printed tables or coloured graphics displays – all in a few seconds or minutes. Massive amounts of data can be held available ready to be called up in an instant. Prestel is an example of a computer system of this kind. Data ranging from railway timetables to share prices can be accessed by the general public. In addition, specialist data is held that is useful to individuals and firms in particular industries.

EXPERT SYSTEMS

The *expert system* is an application of the computer's ability to store and access large quantities of data. An example of the simplest non-computerised type of expert system is the table or booklet for diagnosing faults in your photographs. You are asked to describe the faulty photograph and the table tells you what you did wrong. You might consult the table under the heading 'Photo is plain black', for example, and be told that (a) you forgot to take off the lens cap; *or* (b) you forgot to press the shutter; *or* (c) it's a photo of a coal-cellar. The table gives you the expert's opinion.

A computerised expert system carries this idea many stages further. An expert system on poisons has been devised recently at the University of Surrey. It is intended to help doctors diagnose cases of poisoning in children under five. Almost half the cases of poisoning occur in children of that age group so rapid diagnosis, leading to rapid treatment, can be an important factor in saving lives.

The computer stores data on the 100 most toxic substances. The data for each poison includes its physical form (solid, liquid etc), distinguishing features such as smell, descriptions of the types of bottles or packaging used for each, the nature of the poisonous principle, how harmful it is, what symptoms it produces and what treatment is required. The computer asks the doctor to key in details of the poison as far as they are known. Possibly the doctor may have only a tablet to base the diagnosis on, or perhaps only a label torn from a bottle bearing only part of the name.

With such slender evidence the computer searches its database and decides which one more more substances the poison might be. It asks the doctor for details of the child (age, weight, sex), and can then tell the doctor what symptoms would be produced in that child by the possible poisons. This should allow the doctor to narrow down the range of possibilities to one poison. The computer then prints out details of the treatment required. In addition to helping doctors in individual cases, the data of each case is stored in memory so as to build up a valuable fund of information on the incidence of poisoning in young children.

An expert system is often based on the expert knowledge of a world authority or group of authorities on a given subject. The working day of an expert is of limited length so, in effect, this enables the expertise of that person or persons to be made available to many more people than would otherwise be possible.

ARTIFICIAL INTELLIGENCE

Using an expert system is almost like consulting with the expert directly. If the programme is planned with sufficient care, the questions asked and the answers given by the computer are identical with those that would be asked or given by the real expert in a live consultation. The computer *seems* to act as an intelligent human being. Indeed many people using such programs strongly feel that there *is* a human there, somewhere behind the scenes. Expert systems have been used in this way for the preliminary questioning of hospital out-patients, prior to their being examined by a qualified physician. The computer takes over the routine work, saving the time of the consultants for dealing with the more difficult aspects of each case. But the apparently human nature of the computer is merely a matter of clever programming. It is not real intelligence.

Artificial intelligence is an aspect of computer technology that has attracted many researchers. Is it possible to build a computer that will think for itself, that will think up its own responses, that will be able to solve problems that it has not been specifically programmed to solve? There are several aspects to AI:

ASPECTS OF AI

* ***problem-solving*** – a chess program solves the problem of what to do next by trying out all the possible combinations of moves on both sides for several moves ahead. Then it selects the one that gives the best outcome. It is successful against a human player because it can do all this very quickly, and it does not get confused or make mistakes. But a human player is able to solve the next-move problem in much 'cleverer' ways. The human may have a 'feel' for a situation, perhaps based on previous experience of similar situations. The human may try shock tactics – such as sacrificing a queen to put the opponent off-guard. The human player may vary tactics according to the known weaknesses of the opponent. Such psychological warfare is something of which computers are not yet capable.

* ***pattern-recognition*** – the computer is programmed to recognise regularities and patterns in masses of raw data. This includes the ability of the computer to recognise visual patterns, such as when a robot is able to identify nuts and bolts or mechanical parts by their shape.

* ***automatic programming*** – instead of writing a program, you tell the computer what the program has to do and the computer writes, tests and debugs its own program.

* ***natural-language processing*** – this is a major aspect of AI, important because it opens the way for humans to communicate with computers by speech. Programmes for translating one language into another (eg English into Russian) also fall into this category. The most difficult aspect of natural language processing is speech recognition. As Tom Ivall explained recently (PE Nov 1988), sentences or phrases with entirely different meanings may sound exactly alike. He quoted two examples 'A tax on shipping' and 'Attacks on shipping'. Spoken with unnaturally long gaps between the words these sentences are distinguishable, but spoken at normal speed they are not. How is the computer to know which is which? One of the goals of AI is to enable the computer to understand the context of the sentence sufficiently well to know which of the two is intended. Similarly, if the computer is going to be able to *completely* take over the function of the office typist, it must be able to distinguish between the letter that is being dictated to it and asides such as 'Oh help! Where did I put that file?' and 'Thanks, no milk and two sugars please.'.

PARALLEL PROCESSING

According to Sir Clive Sinclair, reported in PE June 1988, the computers that will be able to further the aims of AI are on their way. Computers employing risc microprocessors are already with us and give a tenfold increase in speed as explained last month. But the big development is that of *parallel processing*. The current generation of computers have a single processor of cpu. With parallel processing the computer has many processors all working simultaneously. Sir Clive predicts that there may be as many as 65000 processors in one machine. Such machines developed over the next 20 years will be able to recognise speech intelligently and you will be able to talk to them very much as you would talk to another human. Machines of this kind, incorporating one or more expert systems will be there in the home to act as family doctor, lawyer and adviser in general. Of course, even then, the computer will not be able to take the place of a human adviser completely. But it will know its own limitations and, in such cases, tell you from whom to obtain advice. We might also see the demise of the school as we know it today. Instead of crowding 30 children in a room to be taught by a human teacher, each child will be taught at home by a specialised expert system. The computer will respond to the needs and difficulties of the child in a way that the over-worked school-teacher can never hope to do. Schools will exist only for the more 'social' side of education, such as discussion groups, seminars, dramatics and sport.

EVER ONWARD

As well as developing computer architecture and design, manufacturers are continually striving to improve the hardware. One of the latest innovations is the surface mounted device. Instead of the component having wire leads which are soldered to the circuit-board tracks (Fig. 4).

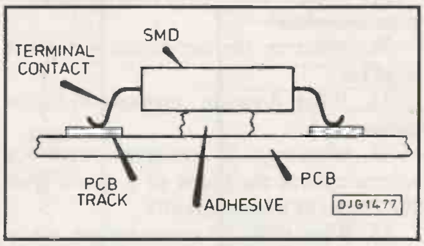


Fig.2. Mounting a surface-mounting device

Prior to soldering the smds are held in place by a spot of adhesive. Alternatively, a special solder paste is used that acts as an adhesive and then as a solder when heat is applied. SMDs are used in non-digital electronics as well as digital electronics. Their main advantage is that they are very small. For example one of the standard sizes, the 0805 package, measures only 0.08in by 0.05in (approx 2mm by 1.3mm). This allows more components to be mounted on each board, an important consideration in computer design. The shortness of the leads between the smd and the board results in reduced lead inductance. This means that circuits can operate at higher speeds, an important factor in digital circuits.

MEGACHIPS

Another continued trend is toward larger and larger memory chips. One of the latest is Philips Megachip, capable of storing 131,072 (128K) 8-bit words. The total of 1,048,576 bits (just over 1 megabit) is stored in memory cells each consisting of six transistors. This gives a total of 6,291,456 cmos transistors on a chip measuring only 7.7mm by 12.2mm. Yet the time to access any individual byte is only 25 nanoseconds. Even larger chips are becoming available, so the computer has virtually immediate access to an enormous amount of information. If even more data is required, there is bulk storage in the form of optical discs, capable of storing up to 20,000 megabits each, with fairly rapid access time. Videotapes can store up to 150,000 megabits.

RECAPPING

Before we take a deep breath next month and look at not only the benefits of computers but also some of the problems they bring, why not check what you have learned in the series by trying the questions below. We'll give the answers next month.

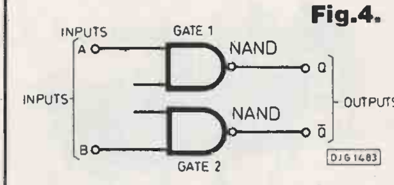
1. Write these decimal numbers in binary: 4, 15, 110, 254.
2. Write these binary numbers in decimal: 10, 110, 1101, 10101010.
3. In what ways do we usually represent 'true' in binary logic?
4. Identify these two truth tables:

(a) Inputs		Outputs	(b) Inputs		Outputs
A	B	Z	A	B	Z
0	0	0	0	0	0
0	1	0	0	1	1
1	0	0	1	0	1
1	1	1	1	1	0

5. What does ttl stand for and what is its operating voltage?
6. Name one of the cmos logic series and state its operating voltage range.
7. Work out the truth table of logic circuit in Fig. 3. What is the name of this logical operation?
8. (a) Complete the diagram of a bistable flip-flop in Fig. 4.
(b) Both inputs A and B are high; output Q is high; output $\overline{Q}$ is low.
How do we make the outputs change state, so that Q is low and $\overline{Q}$ is high?

Fig.3.

Fig.4.



9. What are the features of a Schmitt trigger gate?
10. A monostable multivibrator is built from a pair of NAND gates, a resistor and a capacitor. State two ways of making the pulse length longer.
11. What is the difference between the output of a monostable multivibrator and the output of an astable multivibrator?
12. A 555 timer is wired as a monostable multivibrator. The resistor is 33 kilohms, the capacitor is 47 microfarads. What is the length of the pulse?
13. What are the three main sections of a typical logic system?

14. Describe the action of a D-type flip-flop (TTL 7474).

15. What types of logic circuit can be built from a chain of D-type flip-flops?

16. Write these binary numbers in hexadecimal: 1101, 1011000, 11110001.

17. Write these hexadecimal numbers in binary: &4, &C, &56.

18. What is the essential feature of a synchronous counter, as opposed to an asynchronous (ripple) counter?

19. What is meant by *fanout*?

20. What do the initials ldr stand for? What happens to the resistance of an ldr as the amount of light falling on it is increased? Explain the action of the circuit in Fig. 5. If it is in the dark to begin with and the light is then increased.

21. Name three types of sensor that can be used in a light-sensitive interface.

22. Name the device that shows decrease of resistance as its temperature is increased.

23. Suggest two devices you could use to interface a logic circuit to a small dc motor.

24. What is meant by the term *tri-state output*?

25. What is meant by the term PISO?

26. The registers of an 8-bit shift register hold the data '01101010'. What would they hold after a single shift left? What effect does this have on the value in the register?

27. What are the differences between a register and a latch?

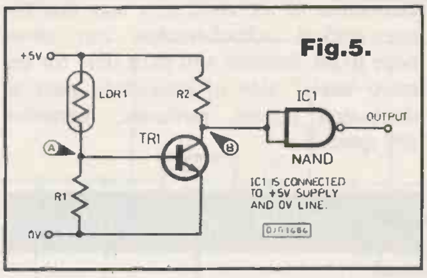


Fig.5.

28. What is the action of the WE (write-enable) input of a 2114 memory chip?

29. What is the difference between ram and rom?

30. What is an eprom?

31. Which part of a microprocessor processes data?

32. What is the accumulator register used for?

33. What does an analogue-to-digital converter do?

34. What type of converter would you use to control the speed of a motor from the output of a logic circuit?

35. What types of converter are useful for sending analogue data along a single line or to the serial input of a microcomputer?

36. What is a computer?

37. What does cpu stand for?

38. What do we call the three sets of connections used for transferring data from one part of a computer to another?

39. What do we call the coded byte which tells a microprocessor what to do next?

40. Name four types of instruction commonly used in machine-code programs.

41. What type of program is used to make it easier to write machine-code programs?

42. What are *mnemonics*?

43. What do we call the branch of computing that deals with problem-solving, pattern recognition, and automatic programming?

44. Name some devices used in the home that usually contain a microprocessor.

45. What development in computer design makes use of several or many processors operating simultaneously?

46. List four benefits of the use of computers.

47. List four aspects of computer use that need careful control.

48. An audio digitising circuit samples that the audio signal 5000 times a second. What is the highest frequency that is reproducible by this circuit?

49. Why is it better to use a 12-bit a-to-d converter in a digitising circuit, rather than an 8-bit converter?

50. What are the advantages of digitising audio signals?

DON'T MISS NEXT MONTH'S CONCLUDING ARTICLE. PE

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Access

THE FIRST OF A NEW SERIES IN WHICH INTERESTING QUESTIONS ARE GIVEN IN-DEPTH ANSWERS.

ASK PE

NUMBER ONE WITH ANSWERS BY ANDREW ARMSTRONG

Dear Ed,

I want to control the volume of my hifi system remotely, and the only way I can think of to do it is to use a motor to turn a pot. There must be another way to do it, because tv remote controllers don't work that way. Can anyone advise me how to tackle this problem?

R.V. Jones, Milton Keynes.

You picked just the right time to ask, as we start this new column of questions and answers.

Probably the lowest distortion means of adjusting gain over a wide range is to do as you suggest, and use a motor to adjust a potentiometer. This is not practical in any normal case, so what you need is, in effect, a voltage controlled gain adjustment system. One common remote control ic, the ML922, provides three separate analogue outputs, each of which can provide the control voltage for a gain adjustment system.

The easiest way to proceed from there is to use an MC3340P electronic attenuator ic. This is a single channel controller, so two would be needed for stereo. Unfortunately, if more than 10dB attenuation is used, the distortion rises and the quality becomes suitable only for a cardboard stereo system or a portable radio. In addition, the noise output is quite high, and in order to combat this, the ic must be used at signal levels which leave little overload margin.

Despite the drawbacks, the MC3340 is useful in some circumstances. If this ic is not good enough, a better quality (but expensive) answer is to use a four quadrant multiplier, such as the AD534 at a cool £27.

Another approach for the amateur is to use a switching system, in which the signal is switched on and off at a frequency well above the audio range, with a variable mark:space ratio. The high frequency switching component is filtered out, leaving an audio signal attenuated according to the mark:space ratio of the switching system. For this to work properly, switching must be clean and must not introduce distortion due to nonlinear on resistance. For signals around the 0db level, the 74HC4053 is a reasonable choice.

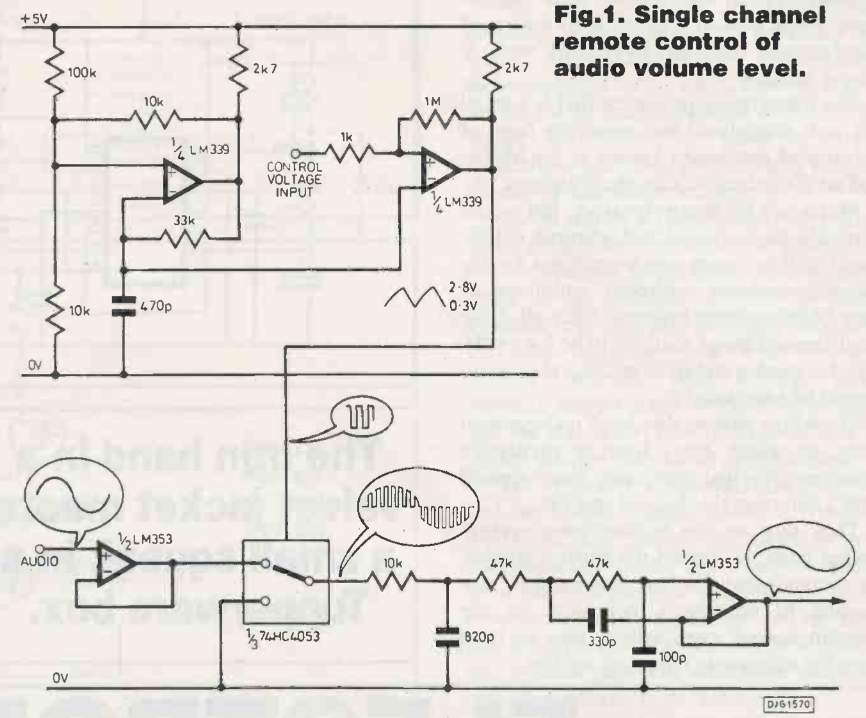


Fig.1. Single channel remote control of audio volume level.

A possible circuit for this is shown below, together with sample waveforms. This circuit has not been prototyped in this form, though I have used the various circuit elements shown in other applications.

The 74HC chip is used because it operates much faster than its 4000 series counterpart. It has provision to be powered from split supplies, and it is powered from ±5V, with the -5V connected to pin 7. The LM393 comparator is powered from 0 and +5V to provide a switching signal at normal logic levels.

The switched audio signal is fed to a single RC network followed by an active filter. This restores normal audio shape to the waveform, but at a lower average level. The switching signal can be used to control as many channels as necessary, so the obvious application is to use two of the three parts of the 74HC4053 to provide a stereo volume control. Don't forget to connect the inhibit pin of the 4053 (pin 6) to 0V to enable the chip. PE

TOMORROW'S SOAP

I for one, have become increasingly disturbed that more programmes of a scientific nature are not shown on tv. Although there are many programmes which the broadcasters may consider to fall into that category, and even though they can be extremely interesting, there are very few which take a more academic look at science and technology. Yes, I know audience ratings have to be considered and that too academic an approach may have limited appeal, but I am sure that there are more viewers who have stronger scientific thirsts for knowledge than broadcasters appear to believe.

BBC's *Tomorrow's World*, which I usually watch, is an example of one programme I feel could be upgraded. The production team work hard; they make the programme interesting; but why can't they give us more hard scientific facts? And why can't they video-record more of the session to get round demo-malfunctions? The statement, "well, it worked at the rehearsal ...", should now be a thing of the past. At present, malfunctions are frustrating to the viewer, and must be absolutely infuriating to the manufacturer of the demo item. I've also found that following-up on a programme item to obtain more information is not the easiest of procedures.

My ears thus pricked-up when I heard that Paul Bonner, director of programme planning at ITV, had announced that tv would be playing a greater role in scientific education. About time too, I thought. Hopes were dashed, though, when I learned that his statement related to the plan to have scientists on the scriptwriting teams of soap operas, to boost their scientific content! Honestly, isn't it about time we made better use of tv's educational possibilities, especially now we have more channels available?

As distinct from the non-declared peace between the border town of Berwick and Russia, there has for some years now in another rural corner of Northumbria been an unreported state of all-out warfare.

The transgressor in this conflict is a small but well disciplined and tenacious band of velvet-clad gentlemen known as the Moles, and on the defensive side, the Chickens.

Moles are by nature invasive, but would normally be respected and admired cohabitants of the countryside were it not for the recently declared territorial ambitions of their Northumbrian brigade. After all, if an Englishman's home really is to be his castle, then his garden and its horticultural produce should be sacrosanct!

Try telling that to this local underground army, on whom every form of persuasive deterrent ploy had previously been applied with a demonstrable lack of success.

They dug up the bi-directional spring-loaded traps, by-passed the sunken jam-jar, circumnavigated the concrete barriers, and seemed to develop a penchant for the paraffin-soaked earth which was to have been the ultimate in chemical warfare.

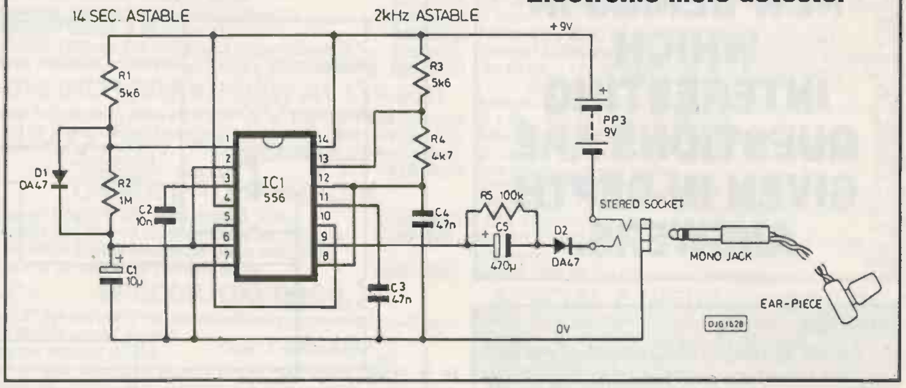


Fig.1. Circuit diagram of the Electronic Mole-detester

The iron hand in a velvet jacket meets a small squeak in a Tupperware box.

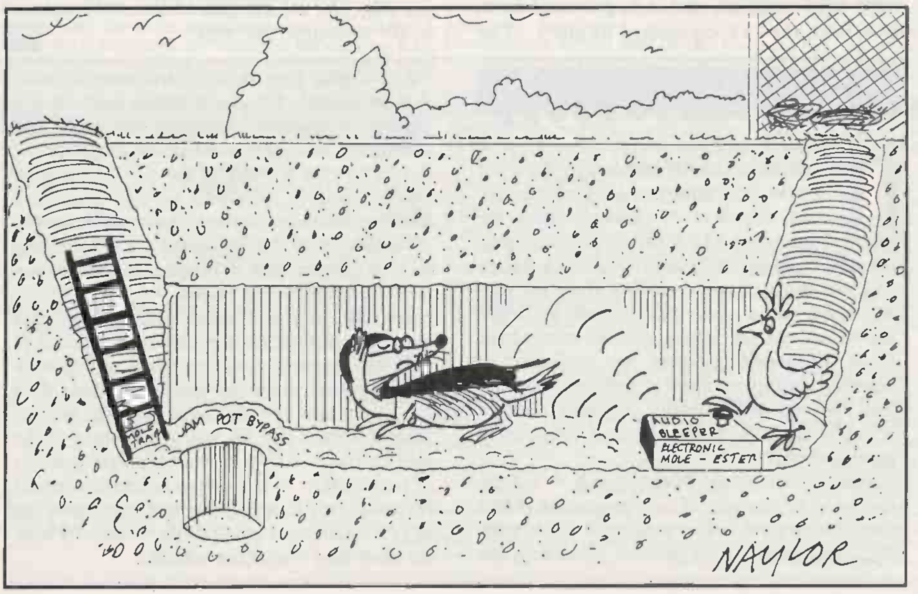
ELECTRONIC MOLE-DETESTER

BY EDWIN CHICKEN MBE

Nothing it seemed would deter them in their determination to usurp this particularly well stocked garden – but wait! .... did not the Royal Air Force succeed in repelling hordes of invading starlings by broadcasting over loudspeakers the alarm-cries of a female starling in distress? .... and was it not stated in a nature programme on tv that moles were sensitive to noise especially if it be reminiscent of their own natural sound emissions?

Perhaps electronic warfare might succeed where psychological and chemical warfare had failed. The solution was elegant in its simplicity and it has subsequently proved to be a most successful dissuader.

An electronically generated audio-bleeper placed within the main burrow where it crossed the territorial boundary between open countryside and garden, stopped them dead in their tracks, metaphorically speaking of course, and persuaded them to re-orientate their line of advancement.



THE MOLE-DETESTER

In Fig.1., the first astable oscillates at a very low frequency with a time-period of about 14 seconds, and its output voltage excursions are used to switch on and off the succeeding astable B which oscillates at the higher frequency of 2kHz.

The 2 kHz output signal from astable B is applied to a miniature sounding-device such as a crystal or electromagnetic earpiece from a transistor radio, to produce a burst of high-pitched sound at intervals of about 14 seconds, which while not very loud to the human ear is totally alien and confusing to the mole in its underworld kingdom.

There is nothing magical or biologically significant about the choice of 14 seconds for the on-off period, it is just an acceptable time-constant which results from the use of standard values of R and C components.

On the other hand, the choice of 2kHz for the bleep noise was adopted after careful consideration of the sounds made by the moles which starred in the tv nature film mentioned earlier.

In the astable multivibrator mode, the voltage at the output pin of a 555 timer circuit switches repetitively between almost 0V and almost full positive line voltage at a time-rate determined by the combination of two resistors and one capacitor, given by:-

$Ts = 0.7 \times C1 \times (R1 + 2xR2)$ for Astable A

$= 0.7 \times 10 \times 10^{-6} \times (5.6 \times 10^{3} + \{2 \times 1.0 \times 10^{6}\})$

$= 14$ seconds

and

$Ts = 0.7 \times C4 \times (R3 + 2xR4)$ for Astable B

$= 0.7 \times 47 \times 10^{-9} \times (5.6 \times 10^{3} + \{2 \times 4.7 \times 10^{3}\})$

$= 494 \times 10^{-6}$ seconds

and since frequency Hz = 1/Time in seconds then:

$F = 1/(494 \times 10^{-6}) = 2$ kHz approx.

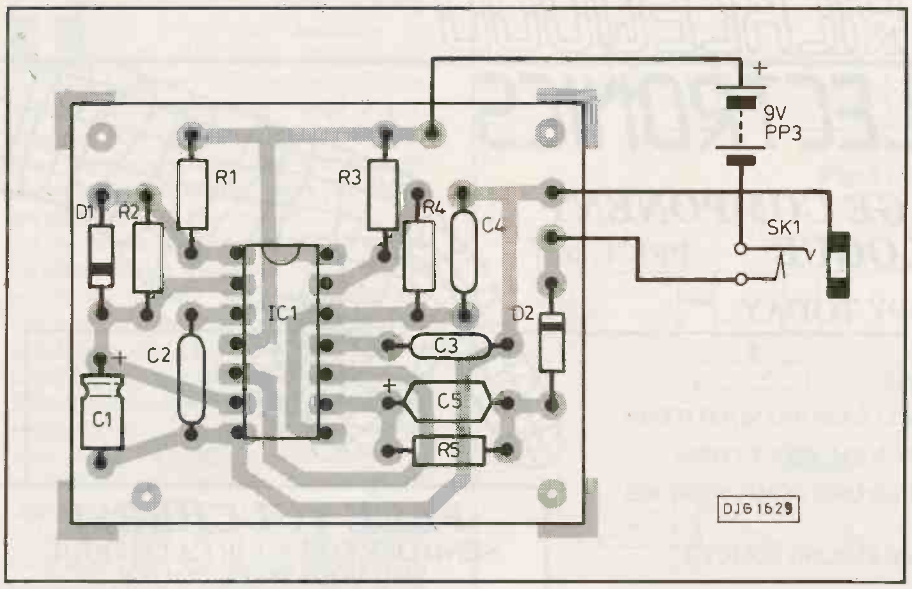


Fig.2. Component layout on pcb.

Now the 2kHz astable can only oscillate if its Reset pin 10 is connected to the positive supply rail, so by connecting it instead to the output pin 5 of astable A, the 2 kHz oscillation will only occur while the output of the 14sec astable is voltage-HIGH.

Normally, the on/off time ratio (or duty cycle) for this type of astable multivibrator is 50/50, which in this case would mean that the 2 kHz astable would be operative for seven seconds and inoperative for the next seven seconds repetitively.

However, in the interests of battery economy and without detracting in any way from the deterring effect of the Mole-ester, the duty cycle of astable A is modified by the inclusion of D1 connected across the main timing resistor R2.

The result of this is to drastically reduce the on period to about 0.5 second, while retaining the overall 14 second time period, such that a short bleep of 0.5 sec duration is emitted once every 14 seconds.

Battery economy is further enhanced by using the low-power cmos version of the 556 integrated-circuit rather than the standard version. The pin connections are identical, but the difference in current demand is considerable:-

Standard 556 .... 12mA quiescent, 150mA/0.5sec bleep
Cmos 556 .... 2mA quiescent, 60mA/0.5sec bleep

At this low current drain even a standard PP3 battery would give considerable service, but better again the high-capacity type, albeit at extra initial financial outlay.

The cost of a battery on/off switch has been avoided by using instead the ear-piece socket, whereby the battery is automatically disconnected when the ear-piece is removed.

Capacitors C2 and C3 while not playing an active role in the astable operation, are necessary to ensure correct functioning of the circuits.

COMPONENTS

Resistors

R1, R3	5k6
R2	1M
R4	4k7
R5	100k

0.25W carbon film 5%

Semiconductors

IC1	556 Low-power cmos
D1, D2	OA47 Germanium diodes

Capacitors

C1	10µ 25V electrolytic
C2, C3	10n ceramic
C4	47n ceramic
C5	470µ 25V electrolytic

Miscellaneous

3.5mm min stereo chassis-socket.
PP3 Battery and twin miniature press-stud.
Earpiece or crystal microphone insert.

Capacitor C5 and diode D2 at the output of the 2kHz multivibrator are only necessary if the chosen sounder is of the electro-magnetic type. C7 blocks the flow of dc current into the sounder device so enabling it to perform correctly, and D2 prevents the astable from latching into a permanent oscillatory condition which can sometimes occur as a result of back-emf when driving an inductive load such as this.

C5, D2 and R5 can be omitted if a crystal-sounder is used.

The latter can be either a crystal ear-piece, or the insert from a crystal microphone, both of which are readily available at very low cost and are equally effective.

Resistor R5 which is shown connected across the output capacitor C5 was found by experiment to produce an intriguing *chirp* on the 2 kHz bleep, but only with cmos 556 chips, and then not with all of them. It may be omitted without adverse effect.

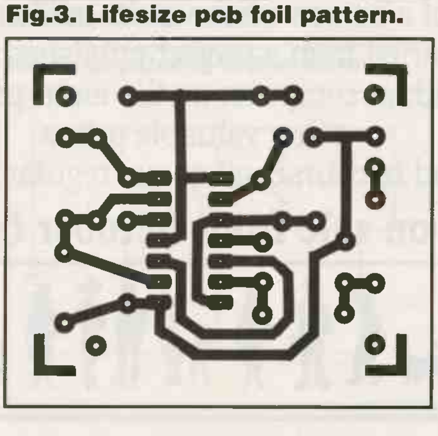


Fig.3. Lifesize pcb foil pattern.

CONSTRUCTION

For simplicity and speed of construction, the components may be hard-wired onto a 25x30mm piece of copper strip-board 0.1 inch hole-spacing. Alternatively, a pcb may be used as shown in Fig.2.

Connection to the PP3 battery is by a twin miniature press-stud with integral wire leads. The red lead is the positive supply which is to be soldered directly to the circuit, and black is negative which connects to the circuit via the sounder-socket.

A 3.5mm miniature chassis-mounting stereo-socket is used to feed the standard mono earpiece, while also acting as the battery isolating switch for the negative supply lead. The related contacts close when the sounder-jack is plugged into the socket, so connecting the battery negative to the circuit.

If a crystal-microphone insert is used as the sounder, its connecting lead should be made about 750mm long, and terminated with a 3.5mm miniature mono jack. The cable need not be of the screened type.

No adjustments are needed as the circuit is self-starting and reliable, but if for experimental reasons a continuously sounding output signal is required, this can be obtained by temporarily connecting pin 10 to the positive supply.

In practice, it was found best to contain the circuit and its PP3 battery within a small plastic container with snap-on lid, with the sounder-socket mounted on the lid, leaving the sounder with its cable external to the container, such that it could be readily lowered into the mole-run.

If however it is found to be more convenient or effective to place the complete assembly in the burrow, then the container must be of diameter no greater than 40mm, which is about the size of the average mole-tunnel.

A search of the kitchen cupboards should produce a suitable container and also some thin plastic food-bags to act as weather-protection for the container and earpiece-sounder. PE

bookmark

Your Ed looks at some of the new books recently received.

Master Handbook of 1001 Practical Electronics Circuits. Edited by K.W.Sessions. Tab Books. £15.60. ISBN 0-8306-2980-7. In nearly 400 pages this book has nearly enough information to merit the title of encyclopaedia. The 1001 tested and proven circuits cover an enormous range of applications - alarms, audio, automotive, filter, logic, clocks, psus, radio, test and many more. The intention of the book is to minimise the time you need to spend searching for a circuit to use as part of a particular project. It is well categorised and indexed, and the circuit diagrams give examples of typical component values. Detailed descriptions of the circuits are not given, but those whose abilities have reached as far as the need for a book of this nature should usually have no difficulty in using the circuits. An extremely valuable source of information, and worth its list price.

All-Time Favourite Electronic Projects. Delton T.Horn. Tab Books. £5.25. ISBN 0-8306-3105-4. This is a useful little 100 page book that should find favour with readers who are beyond the early-starter stage. It is in two parts, one of projects for the home, the other for workshop items. The subjects covered include : intercom, car alarm, motor controller, digital clock, am/fm radio, audio and power amps, tape player amp, tone controls, constant current/voltage, d-a converter, logic probe, digital capacitance and frequency meters, multi-output psu, and dc voltmeter. There are good instructions and drawings, a little bit of maths in a place or two, and tabulated parts lists. All the parts appear to be readily available in the UK. I agree with the publisher's statement that the book should "provide many hours of fun, challenging, hands-on electronics experience".

A Concise Introduction to UNIX. N.Kantaris. Babani BP259. £2.95. ISBN 0-85934-202-2. Note should be taken of the word "concise" in the title. If you keep this in mind you will not be disappointed that the book does not take an in-depth look at the UNIX operating system commands. As yet I have no experience of UNIX, and I am not sure that I could get a firm grip on it from this information. However, the book states that it is written for the non-expert, busy person and, as such, it has an underlying structure based on "what you need to know first, appears first". It explains the structure of the UNIX operating system, how its directories can be employed, how to use the file commands, how to get the editor to write programs for various compilers, and how to use other important functions. The book will probably serve its purpose as an introduction to UNIX, and be a useful memory-jogging guide once you know the system.

Encyclopaedia of Electronic Circuits - Volume Two. Rudolf F. Graf. Tab Books. £23.40. ISBN 0-8306-3138-0. Ah! You'll love this book if you find pleasure from building circuits. Considering what it offers the price of this book is very low. With over 700 pages it is truly a giant of a book containing more than 700 electronic circuits - enough to make all but the most lethargic constructor switch on the soldering iron. There is no way I can list here the circuits or even their main subject headings, which range from alarms to touch switch circuits. The book is a companion to Volume One published in 1985. What a shame I don't have that volume as well. Definitely a book for the workshop library.

Digital Logic Gates and Flip-Flops. Ian R. Sinclair. PC Publishing. £8.95. ISBN 1-870775-06-6. Thank you PCP and Ian Sinclair for producing a book that intelligently looks at the basic building blocks of all digital circuits. (I have lately been inundated by books from America which have had several chapters on Logic as their standard beginnings. With many of those books I was left with the feeling that the chapters were there just to fill up space.) This (English) book is intended for enthusiasts, students and technicians who seek to establish a firm grasp of the fundamentals of digital electronics. It is not a book of self-contained constructional projects, but it will certainly assist those who wish to increase their knowledge of logic theory and to design their own digital circuits. I recommend this book as an adjunct to and extension of our own Digital Electronics series.

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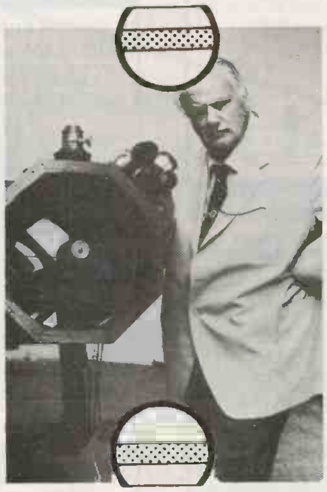
AUGUST 1989: NEPTUNE MONTH

SPACE WATCH



BY DR PATRICK MOORE CBE

What mysteries will be revealed and what new questions raised when Voyager 2 passes Neptune and the first phase of Solar System exploration ends?

Twenty years ago we were still marvelling at the first successful manned flight to the Moon. Now, we await the end of the first phase of our exploration of the Solar System: the pass of Neptune by Voyager 2, which was launched in 1977 and has therefore been travelling in space for a dozen years.

In fact, the first successful interplanetary probe was Mariner 2, which made its rendezvous with Venus in 1962; but by cosmical standards Venus is a very near neighbour, and when travelling to the outer parts of the Solar System all the so-called "minor" problems become anything but minor. For example, one cannot use solar power to generate energy, because there is not enough sunlight, and a deep-space probe has to carry what is to all intents and purposes a small nuclear power-plant. The distances, too, are immense. Neptune moves round the Sun at a mean distance of over 2,790,000,000 miles – and takes almost 165 years to complete one orbit.

At the time when I write these words, Voyager 2 is on course and in full operation. It has already passed by Jupiter (1979), Saturn (1981) and Uranus (1986), and is working as well as ever. So what can it be expected to tell us about Neptune?

Neptune, remember, is a giant planet, with a diameter of just over 30,000 miles. It is slightly smaller than Uranus, but appreciably more massive. Of course its surface is gaseous; but it and Uranus, as a pair, differ markedly from the Jupiter/Saturn pair. Their composition is less like that of the Sun, and they contain more substances such as ammonia and water. It has even been suggested that they are in some ways akin to giant comets!

Uranus shows little detail on its pale, greenish disk, and the planet has an axial tilt of more than a right angle, so that at times (as now) one pole is directed toward the Sun and the Earth. There seems to be no major internal heat-source. Neptune differs from its "twin" in several important respects. It is bluish rather than green, and even from Earth some cloudlike features can be made out; as Voyager 2 approaches, these patches show up well, so that as long ago as last spring Neptune was displaying much more detail than Uranus had done from much closer range. Neptune does not share Uranus' strange inclination; the angle is less than 30 degrees – not so very different from that of the Earth. And like Jupiter and Saturn, but unlike Uranus, Neptune has a strong source of internal heat.

What about a magnetic field? All the giants have strong fields, and there is no reason to believe that Neptune will be the exception. Indeed, the field may be expected to be considerably stronger than that of Uranus. Presumably the inner satellite, Triton, remains immersed in the Neptunian magnetosphere. There will also probably be radiation zones, of the same basic type as our own Van Allen Zones but probably more marked.

The possibility of a ring-system has been widely discussed. Saturn's glorious system is unique; Jupiter has a thin, dark ring, and Uranus has revealed a set of rings which are also thin and dark, but contain large

THE SKY THIS MONTH

The early part of the evening is dominated this month by Venus, which is brilliant in the west after sunset. The phase is over 80 per cent at the beginning of August and still well over 75 per cent at the end, so that the planet shows up as a gibbous disk; do not expect to see any markings, even with a telescope. However, we know more about Venus than we had dared to hope a few years ago, and the latest probe, America's Magellan, is now on its way there, though it is going by a somewhat roundabout route and will not arrive at the neighbourhood of Venus until this time next year.

Mercury and Mars are close together in early August, and both are theoretically evening objects, but their elongation from the Sun is only about 20 degrees, and they will be hard to locate in the bright sky. Jupiter, in Gemini, is brilliant in the morning sky; Saturn, which passed opposition on 2 July, is visible for most of the hours of darkness, but is inconveniently low in Sagittarius. Saturn's senior satellite, Titan, is at eastern elongation on August 5 and 21, and at western elongation on August 13 and 29. A small telescope will show it, and it has been reported that keen-eyed people can glimpse it with good binoculars.

The Moon is new on the 1st and 31st, and full on the 17th. Unfortunately, moonlight will be obtrusive around August 12, which is the maximum of the annual Perseid meteor shower; however, a good number of Perseids should be seen all through the first two and a half weeks of the month – this is a very reliable shower. The associated comet, Swift-Tuttle, has not put in an appearance (it was last seen in 1862), and if its period is indeed around 120 years, as is the official view, it may have returned unseen some time ago.

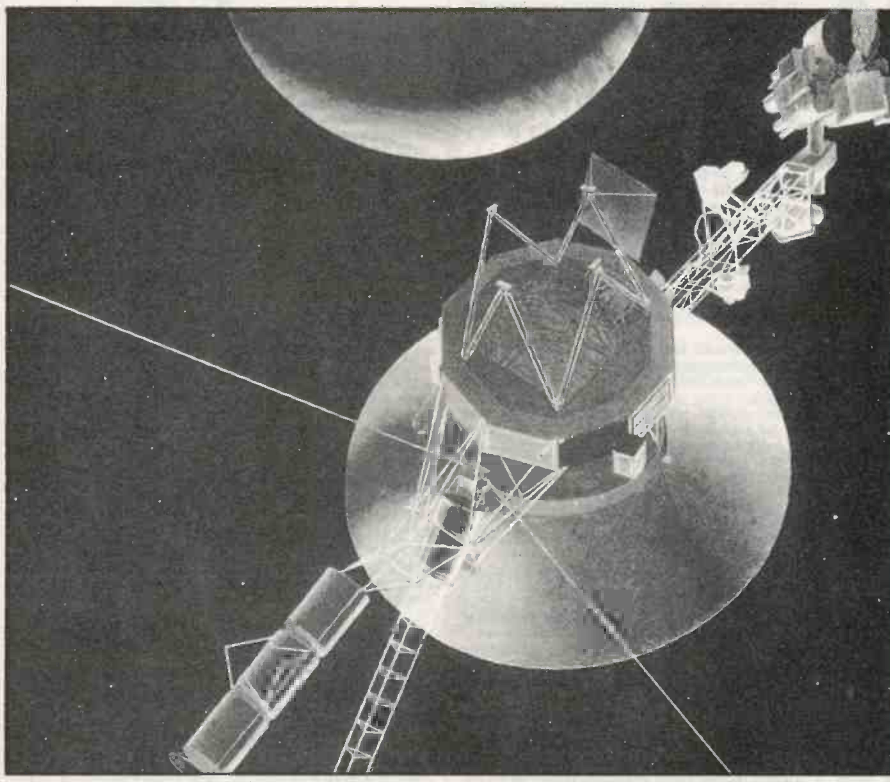
This month we had expected that another periodical comet, Brorsen-Metcalf, would be reaching naked-eye visibility, but it has failed to come up to expectations. By the law of averages, we are surely overdue for a brilliant comet!

The "summer triangle" of Vega, Altair and Deneb remains very prominent; Vega is near the zenith or overhead point, and is recognisable both because of its brilliance and because of its decidedly blue colour. Ursa Major, the Great Bear, is low in the north-west; the W of Cassiopeia, on the other side of the Pole Star, is high in the north-east. Very low in the south look for the glorious star-clouds of Sagittarius, which hide our view of the centre of the Galaxy. Sagittarius itself has no particular shape, but at the moment it is particularly easy to locate because of the presence of Saturn, which is much brighter than any star in the neighbourhood. In the east, the Square of Pegasus is coming into view, and will be very prominent all through the late summer and the whole of the autumn.

quantities of "dust". Normally it would be illogical to assume that Neptune, alone of the giants, is ringless; but the situation is complicated by the presence of a very large satellite, Triton, which is close to Neptune and has retrograde motion. In this Triton too is unique. All other known retrograde satellites are small and presumably asteroidal, but Triton is at least comparable with our Moon, and it has a powerful pull of gravity. Since it moves in a sense opposite to that in which Neptune spins, the conditions may be rather unstable. I have predicted that there will be no continuous ring-system; in a few weeks from now I will know whether I have been right or wrong. Ring-arcs are also possibilities, but again I admit to being somewhat sceptical.

Triton has probably a considerable atmosphere. What the surface conditions are like remains to be seen – we do not even know whether the atmosphere is as opaque as Titan's. The other known satellite, Nereid, is small and has a curious, cometary-shaped orbit; unfortunately Voyager will not make a close approach to it, but at least we ought to be able to tell whether or not it is icy and cratered.

The Voyagers have discovered extra satellites of all the three inner giants, and possibly some new Neptunian satellites will be detected – they may already have been found by the time you read these words. In any case, it is more than likely that Neptune will provide its quota of surprises. By the next issue of PE, we should know a great deal more than we do now.



Let us hope that Voyager 2 functions perfectly. If not, then we may have to wait many years before we can improve our knowledge of the outermost giant planet

The illustration of Voyager 2 is reproduced by courtesy of Astronomy Now and NASA JPL.

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BD180	6	Neon indicators in panel mounting holders with lens.
BD193	6	5 amp 3 pin flush mounting sockets make a low cost disco panel. Need cable clips
BD196	1	in flex simmerstat – keeps your soldering iron etc. always at the ready.
BD199	1	Mains solenoid, very powerful, has 1in pull or could push if modified.
BD201	8	Keyboard switches – made for computers but have many other applications.
BD211	1	Electric clock, mains operated, put this in a box and you need never be late.
BD221	5	12V alarms, make a noise about as loud as a car horn. Slightly soiled but OK.
BD242	2	6in ×4in speakers, 4 ohm made from Radiomobile so very good quality.
BD252	1	Panostat, controls output of boiling ring from simmer to boil.
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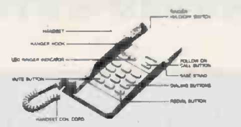

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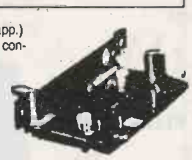

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6-CORE FLEX CABLE. Description same as the 4-core above. Price 15 metres for £2. Our ref. 2P197 or 100 metres £9. Order ref. 9P1.

13A PLUGS Good British make complete with fuse, parcel of 5 for £2. Order ref. 2P186.

13A ADAPTERS Takes 2 13A plus, packet of 3 for £2. Order ref. 2P187.

20V -0- 20V Mains transformers 2½ amp (100 watt) loading, tapped primary. 200-245 upright mountings £4. Order ref. 4P24.

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SINGLE SCREENED FLEX 7.02 copper conductors, pvs insulated then with cooper screen, finally outer insulation. In fact quite normal screened flex. 10m fo £1. Our ref DB668.

M.E.S. BULB HOLDERS Circular base batten type fitting. 4 for £1. Our ref DB127s.

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

3-CORE FLEX BARGAIN No. 1 – Core size 1.25mm so suitable for long extension leads carrying up to 13 amps, or short leads up to 10 amps. 15mm for £2. Ref. 2P190.

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INNER EAR STEREO HEADPHONES Ideal for lady listeners as they will not mess up your hair do! Come complete in a neat carrying case. Price £3. Our ref 3P56.

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SUM-MIN TOGGLE SWITCH Body size 8mm x 4mm x 7mm SBDT with chrome dolly fixing nuts. 4 for £1. Our ref BD649.

SUB-MIN PUSH SWITCH DPDT. Single hole fixing by hexagonal nut. 3 for £1. Our ref BD650.

COMPRESSOR

Are your mods clipping the limits? Slim them into peak shape with our simple compressor

BY JOHN BECKER

This month, in the first of our new *Ask PE* series, Andrew Armstrong shows one method by which the level of an audio signal could be put under remote control. I shall now illustrate an automatic control technique which allows the maximum audio signal level to be held below a given amplitude.

ATTENUATION

As may be expected with electronics, there are many ways in which signal amplitudes can be limited or compressed by automatic control circuits. Since one of the design objectives of the *Easi-build* series is to use simple techniques and readily available components, I have chosen for the heart of this circuit a well established chip specifically designed for audio attenuation, the MC3340.

Being designated as an audio attenuator, it is a chip intended to reducesignal amplitude from a maximum to a minimum level. It does not, unlike some amplitude control chips, provide amplification. This means that although the maximum limit to which the signal can be allowed to go can be preset, weak signals will not be brought up to that level. Within certain limitations, the circuit will simply attenuate any signals which try to go above the limit.

CLIPPING

Alert sceptics will no doubt retort that any circuit will only allow signals to go up to a certain maximum level, usually that set by the power supply line limits and the inherent parameters of opamps and so forth. For a good example of this, consider a 741 opamp supplied from a ±15V dualpower line. The data sheet shows that the maximum output voltage swing is typically ±14V. Obviously, then that is maximum obtainable output signal amplitude. But of course (and experienced constructors will probably wonder why I bother to mention such a basic fact that everyone should know from the cradle), amplitude limiting in this way is distinctly unclean. All that happens is that the nicely shaped tops and bottoms of signals become increasingly flattened as the signal tries to push beyond the limits. Unless you actually want to create distortion, such as fuzz effects, you won't like the sound of this harshly clipped limiting.

ATTENUATION CHIP

What we need is a circuit that will smoothly begin to attenuate the output level at some point well before the maximum, and then to progressively reduce it until the maximum is reached. This is just what the MC3340 will do if controlled correctly.

The MC3340 has been designed by the manufacturers to limit the output voltage swing in response to either of two methods. One method is to vary the resistance between the chip's control pin and the ground supply line, or other reference point. The second method that may be used is to vary the voltage present at the control pin.

CONTROL VOLTAGE

In the circuit here, I've chosen to use a technique based on the variable resistance method, though, as you will see, it's actually a voltage that is indirectly used to vary the effective resistance.

If you look at Fig.1, IC2 is the MC3340, and pin 2 is its control point. From there, R15 presets the minimum resistance between the control pin and the ground line. The resistor is not taken directly to ground, but is taken via the transistor TR1. If TR1 were to be fully turned on by a voltage on its base, then R15 would in effect be taken directly to ground. With TR1 turned off, the resistance between the control pin and ground would be virtually

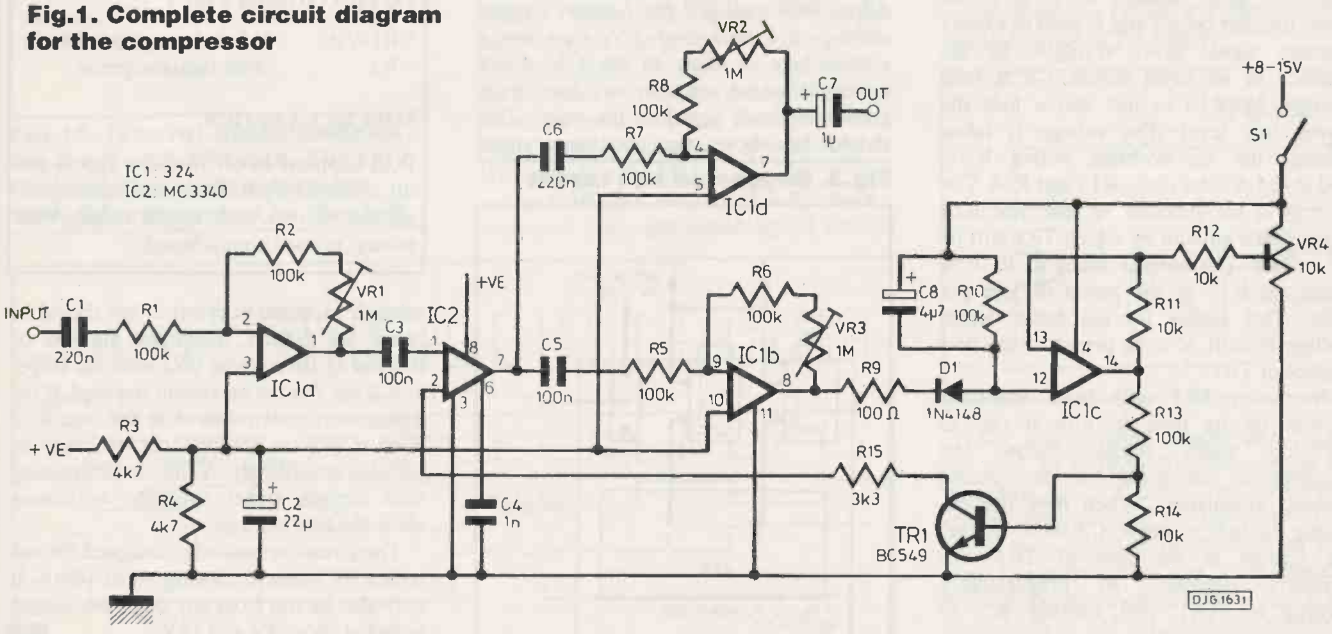


Fig.1. Complete circuit diagram for the compressor

infinite. By varying the voltage on the base of TR1 between the two extremes, the effective resistance can be indirectly varied.

In order to use these facts to progressively limit the signal output level, we need to sense the level of the audio input signal and to generate a control voltage related to it, applying the control signal to the base of TR1.

INPUT BUFFER

Although you could apply the audio signal directly to the input of IC2, I've included a buffer and gain stage immediately before it, using IC1a. The preset, VR1, allows for the gain at IC1a to be set anywhere between times one, and times eleven. In this way you can preset the unit to suit the general output level of your source signal. However, don't regard IC1a as a general purpose preamp capable of bringing up extremely low level signals. It won't do it. It's simply there to allow you to trim the average signal level up a bit to suit the rest of the circuit.

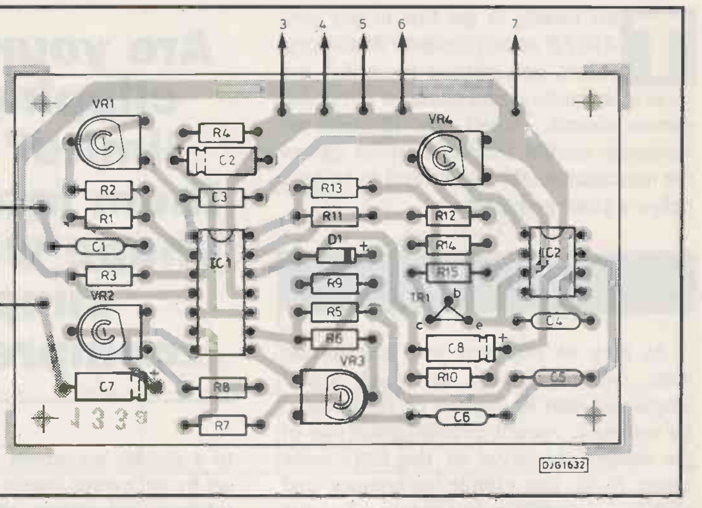
The signal goes through IC2 and is split into two paths. The first path is that taking it through IC1d and to the output point at C7. IC1d is another buffer and gain stage where, as with IC1a, the output level can be trimmed upwards by VR2 from times one to times eleven. This allows you to compensate for any slight overall signal strength loss across IC2. If you prefer, you could also include a 10k log final output level control pot immediately after C7.

CONTROL EXTRACTION

The other path is the control voltage extraction route. IC1b is another buffer and gain stage, similarly preset by VR3. The next stage, around IC1c, is a half wave rectifier circuit and is used to extract average signal level voltages. In the absence of an input signal, C8 is held charged by R10 to just above half the power line level. The voltage is taken through the non-inverting buffer, IC1c, and to the divider chain R13 and R14. The current at the junction of R13 and R14 controls the amount by which TR1 will be on or off. The second input to IC1c is taken via R12 to the preset divider pot VR4. This allows for the basic output voltage from IC1c to be preset for the best control of TR1.

Normally, TR1 will have sufficient current on its base to turn it on, so allowing audio signals below the compression threshold to be passed without attenuation. When they become strong enough to cause C8 to discharge, the current at the base of TR1 will similarly decrease, so progressively turning off TR1, and causing IC2 to increase the attenuation.

Fig.2. Pcb layout for the compressor



MOTOR BOATING

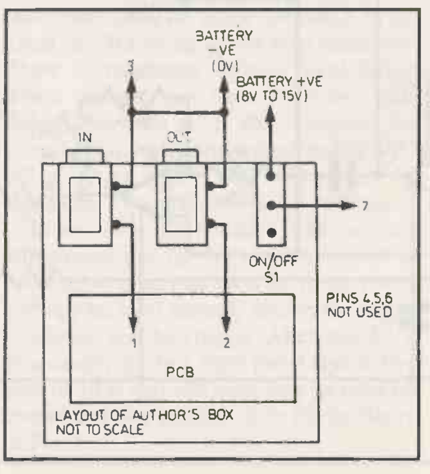
You will probably spot that if C8 was omitted, increased attenuation would instantly cause the output at IC1c to rise again, so decreasing attenuation at IC2, thus increasing the output at IC1, and consequently increase the attenuation ... ad infinitum! This most unsatisfactory situation has a name – motor boating; the effect sounds similar to the chugging of a motor boat. C8 has the purpose of slowing down the responses to increasing and decreasing outputs from IC2, and inhibits the feedback loop control to eliminate motor boating. Inevitably, the value chosen for C8 is a compromise between satisfactory responses to peak signals and instability. You might be interested to try different timing factors by using various values for C8 and R10, and seeing how the control responses vary.

SETTING UP

With no signal on the input, set VR1, VR2 and VR3 all to minimum resistance. Adjust VR4 until IC2 pin 2 shows a meter reading of a little over 3.5V (too low a voltage here is likely to result in motor boating when the unit is in use). Now apply a constant level signal to the input. This should be above the maximum signal strength expected in practice, but should be below the 500mV maximum allowed on IC2 pin 1. Then adjust VR2 until the output at IC2 pin 7 is the maximum required. If the maximum signal required at the output of IC1d is still too low, VR1 or VR2 may be adjusted accordingly. A little experimenting with various signal strengths will soon show the best settings.

The circuit is basically designed for use with a 9V battery, drawing about 10mA. It may also be run from any dc power supply between about 8V and 15V.

Fig.3. Suggested box layout



COMPONENTS

RESISTORS

R1, R2, R5-R8, R10, R13	100k (8 off)
R3, R4	4k7 (2 off)
R9	100R
R11, R12, R14	10k (3 off)
R15	3k3

All 0.25W 5% carbon film

CAPACITORS

C1, C6	220n polyester (2 off)
C2	22µF 16V elect
C3, C5	100n polyester (2 off)
C4	1n polystyrene
C7	1µF 16V elect
C8	4.7µF 16V elect

SEMICONDUCTORS

D1	1N4148
TR1	BC549
IC1	324 quad opamp
IC2	MC3340 attenuator

POTENTIOMETERS

VR1-VR3	1M skeleton preset (3 off)
VR4	100k skeleton preset

MISCELLANEOUS

PCB supports (4 off), battery clip, 8-pin dil socket, 14-pin dil socket, mono jack sockets (2 off), spdt toggle switch, box to suit, printed circuit board.

PE

64-LINE OUTPUT PORT

Another ingenious idea from PE's innovative readers.

There are many situations in which a simple means of controlling devices external to a computer, other than standard peripherals such as printers or modems, is required. Such devices might include, for example, complex stage lighting systems, model railway point control systems, automated musical instruments and multiple d/a converters.

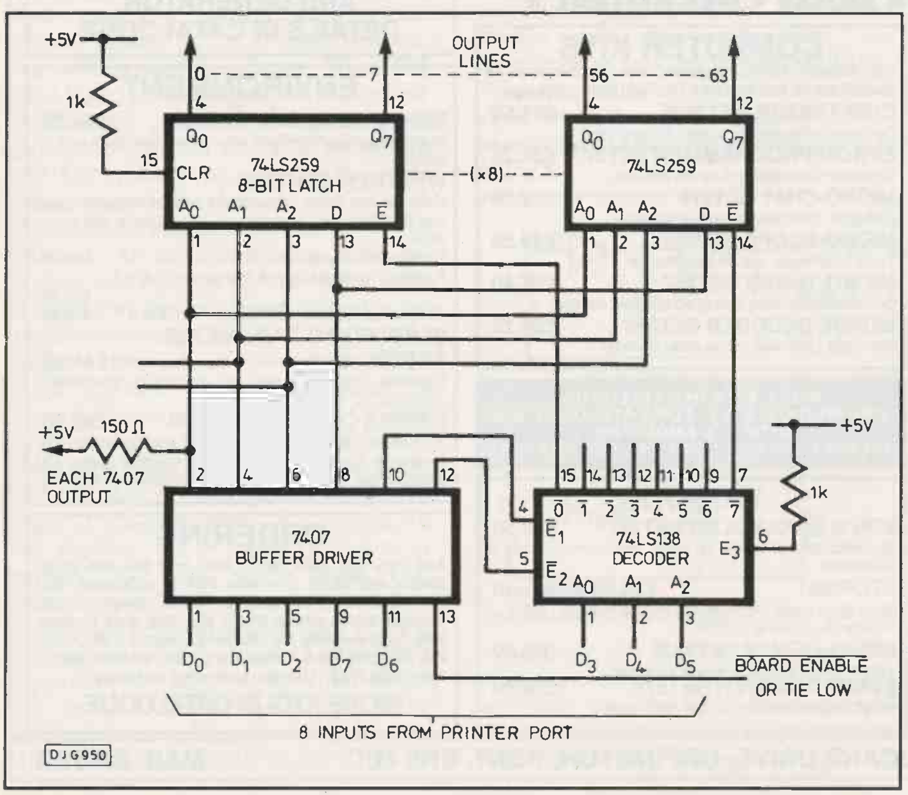
If the number of input lines required by such a device is limited to eight, then there is no reason why the data output lines from a standard parallel printer port can not be used for the purpose. One way or another, through a high level language, the computer's operating system or, most directly, by means of a machine code routine, it will be possible to set the states of the printer ports output lines high or low. Those output lines will either be directly connected to the input lines of the external device to be controlled or connected to those lines through some simple buffering circuitry. The choice of programming approach will often depend on the level of familiarity with the language or system, but if the external device requires very rapid changes of state on its input lines it might be essential to use machine code.

However, if the number of input lines required by the external device is more than eight, there is a problem. Purchase of one or more special purpose parallel interface boards for the particular computer being used is one solution, and is usually expensive. Fortunately, it is very simple to make a parallel output port with 64 output lines that plugs directly into the parallel printer port *of any computer*. As explained below, the states of the 64 output lines are established by sending a simple command sequence to the device via the parallel printer port. Again, the command sequence can be issued in any language the user prefers. The component count for the 64-line device is very low (ten readily available chips and a few capacitors and resistors) as is the cost.

THE CIRCUIT

The circuit diagram is shown in the diagram. The eight input lines are driven by the data output lines from the computers parallel printer port. Five of the input signals pass first through non-inverting buffers, the three 'lowest order' lines (D0, D1 and D2) driving a miniature address bus connected to the three address inputs (A0, A1 and A2) of the eight addressable data latches, each of which provides eight output lines. The three input lines D3-D5 supply the address inputs to a decoder, the outputs of which serve to enable one of the eight addressable data latches. Input line D6 serves to trigger the whole circuit and data line D7 carries the data to be loaded into the specified output line as described in the section on programming.

Pull-up resistors are required on the buffer outputs because the chip has open-collector output stages. Decoupling capacitors adjacent to each chip are used to suppress power rail transients.



PROGRAMMING

The state of each output is independently established by sending a short command sequence on input lines D0-D7.

If the output lines are numbered 0-63, then input lines D0-D5 select the output line that will be affected. The states of D0-D5 can be regarded as the 6-bit address of the required output line. Input line D7 determines whether the chosen output line will be set high or low when the command sequence is effected. A transition of line D6 from high to low implements the command; for example, if D7 is high when the transition occurs, the selected output line will be forced high. Two examples will make everything clear.

Example 1. To set the state of output line 53 high.

	D7	D6	D5	D4	D3	D2	D1	D0
Stage 1:	1	1	1	1	0	1	0	1
Stage 2:	1	0	1	1	0	1	0	1
Stage 3:	1	1	1	1	0	1	0	1

In this example, D5-D0 represent 53 in binary. D7 is '1' because output line 53 is to be set high. D6 changing from 1 to 0 in Stages 1 and 2 causes the output line to be set high.

Example 2. To set the state of output line 22 low.

	D7	D6	D5	D4	D3	D2	D1	D0
Stage 1:	0	1	0	1	0	1	1	0
Stage 2:	0	0	0	1	0	1	1	0
Stage 3:	0	1	0	1	0	1	1	0

In this example, D5-D0 represent 22 in binary. D7 is '0' because output line 22 is to be set low. D6 changing from 1 to 0 in Stages 1 and 2 causes the output line to be set high.

The circuit described can be directly connected into the parallel printer port of any computer and the states of its output lines established by sending a short command sequence to the printer port in any language available to the user.

R. Milner and A. Horsman, Leeds.

Free Reader Adverts

Searching for that elusive component? Surplus equipment to sell? Read the rules and fill in the form below to have your free ad published in PE BAZAAR.

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Scope tubes with data base and screens 4 inch round £5. 3 1/2 inch CV2286 £5. 1 1/2 inch VCR522 £8. Mr. E. Hall, 39 Arch Bell Avenue, Brighouse, W. Yorkshire HD6 3SU.

Geiger counter £53. Texas speech synthesiser £29. Heathkit V7AU V.V.M. £27. Atari 8-Bit speech synthesiser £20. Mr. R. Hearn, 10 Speedwell Close, Pakefield, Lowestoft, Suffolk NR33 7DU. Tel: 0502 566026.

Wanted: Spectrum sound generator. Circuit diagram and all components sheet. J. Powell, 31 Eddystone Rise, Simpsons Lane Estate, Knottingley, W. Yorks WE11 0HS.

Philips MDCR200 test cert. and data. Cost over £100. As new £35 perfect tape storage. Tel: 061-799 7365.

Quad 405 100W/channel Amp. 33 control unit. FM3 tuner. Showroom condition £275. Perth (0738) 37165. C. Korycinski, 17 Pitcullen Terrace, Perth.

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UK101 computer (24K0 cased with sound board Centronics port software and manuals £50 ono. Also Larnakit oscilloscope £45 ono. Tel: (0373) 826454 evening and weekends (Wiltshire).

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Wanted: service manual for Safgan DT-415 oscilloscope. Photocopy accepted. Will pay price. Mr. D. Walters, 53 Mount Libanus Street, Treherbert, Rhondda, M. Glam. CF42 5RH.

Components, transistors, resistors, capacitors, TTCs, Computer ICs etc. Also Spectrum 48K cassette software. Private sale. Offers. J.J. Hodge, 28 Snowden Court, Croesyceiliog, CwmBran, Gwent NP44 2JA.

Tektronix type 7603 oscilloscope. 4 trace (2 x 7A26 Amps), delay timebase (7B53A). 50 MHz B/W. Good condition. Offers? Tel: 021-550 8154.

Solartron dual beam oscilloscope, (valve type). Manual and/or circuit diagram, also test leads wanted. State price. Mr. J.W. Dixon, 19 Salkeld Road, Penrith, Cumbria CA10 1ND.

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Magazines: Practical Electronics 1966 to 1980; Practical Wireless 1966 to 1978. Complete and in binders. B. Marshall, 2 Normanton Way, Histon, Cambridge CB4 4XS. Tel: (0223) 237188.

Needed: memory map for TRS-80 micro colour computer model MC-10 (cat no. 26-3011). Photocopy will do. Thankyou. Mr. N.C. Fairman, Basement Flat 6, 59 New Dover Road, Canterbury, Kent. Tel: (0227) 66395.

Morse tutor Datong £38. Active antenna AD370 £40. TU1000 RTTY terminal £35. Tel: (0227) 458970. after 6pm.

Wanted: for A level project: BBC User Guide, 6502 Second Processor, EPROM Eraser, Master Circuit diagram. R.D. Clark, 29 Knightscroft Ave., Rustington, W. Sussex BN16 2HN. Tel: (0903) 784792.

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by Alfred T. Forbes
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(Brochure £3 refundable) Trade enquiries welcome.
Todd-Forbes Publishing, PO Box 3919, Auckland, New Zealand.

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Azimuth Test Cassettes, £5.85. Ian Harrison, 7 Mill Hill, Repton, Derby. Tel: 0283 702875.

INDUSTRY NOTEBOOK

WHY MERGERS AND TAKEOVERS?

BY TOM IVALL

"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?"

Whatever the outcome of the GEC-Siemens bid to take over Plessey, you can be sure that the general process of redistribution of ownership in the electronics industry will continue. Apart from hostile takeover bids there will be plenty more agreed mergers, acquisitions, joint ventures and other such arrangements.

Experts are predicting that in the next few years the world computer industry will consolidate into a smaller number of larger companies. In Western Europe the coming of the single market in 1992, with its free trading conditions across frontiers, will certainly hasten the removal of the less competitive electronics businesses in this part of the world.

A few months ago I asked rhetorically "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?" And I promised to explore this question more deeply.

It seems to me that this continually shifting pattern of acquisition and ownership must be understood on two levels. One is more or less technical – the level of economic laws and imperatives of competition which determine the working of free trade in an almost mechanistic fashion. You hear industrialists and others talking about "the logic of the situation" as if human wishes or decisions didn't come into it. But this is misleading (sometimes deliberately so), because there is a second, deeper level of explanation which is entirely about primitive human drives. And here "primitive" doesn't mean simple, but close to the mainsprings of human action.

On the 'technical' level of explanation, everything derives from competition in a free market. To stay in business and produce satisfactory sales, profits and incomes for its owners, a manufacturing company must compete on price for a given design and quality of product. It must secure an adequate share of the available market. This means in fact that the products must be manufactured at sufficiently low unit cost to obtain the required profit when sold. Secondly, to ensure that the technological design features of the products keep up with the continuous research and development. This r&d cost is particularly high in the semiconductor sector.

Thus to achieve both competitive prices and state-of-the-art design the manufacturer must operate efficiently to minimise unit costs. Both of these ends can be achieved by becoming larger in terms of turnover.

One important advantage of being larger, for example, is that it gives you opportunities for economies of scale. Savings are obtained by better utilisation of resources. This applies not only to the manufacturing processes as such but also to the r&d, management, marketing, advertising and selling activities and their costs. Furthermore a large company can get better financial terms for loans and purchasing materials and components than are available to a smaller one. And the larger a firm becomes, and thus the nearer it approaches the monopoly position it would like in its particular market, the greater the control it has over the price of the products in that market.

Firms can, of course, expand by internal growth, but in a fast-moving, highly competitive situation it is much quicker and surer to expand by acquisition.

Apart from reducing unit costs by economies of scale, there are many other possible reasons for mergers and takeovers. For example, a firm can acquire particular technology, skill or knowledge that it needs by buying up another company that already has them. Or a firm may be able to get into new markets or expand its existing markets by this means. Leaving aside complete acquisitions of other companies, there is a constant redistribution of resources going on as firms sell off parts of themselves which they don't want to other firms who do want them. A recent example was Thorn-EMI selling its vlsi subsidiary Inmos to SGS-Thomson Microelectronics.

The directors and managers who initiate mergers and takeovers on these objective principles are motivated by a self-interest which is identified with the collective interest of the company – its survival, prosperity, reputation and so on. This is what economics textbooks call "maximising satisfaction." It may take the form of pleasure from simply getting more money, pleasure from the use of that money, or pleasure from greater power in controlling more people and resources in a larger organization. In a takeover battle there is also the sense of achievement to be derived from winning it.

Satisfactions of this kind are not everybody's cup of tea. But we all have a need for psychological security. Some people get this by discovering a specific meaning in their lives. One school of psychology (Adlerian) says that this security depends on establishing a primary sense of self-worth. The very young child achieves it through bodily expressions which earn parental approval. Later this urge to self-esteem is socialized. It is transformed into a search for patterns of behaviour which everyone around will accept, support and perhaps admire. Thus self-esteem comes to depend on actions which have symbolic value.

In some cases there may be a symbolic value in things one already has, like good looks or inherited wealth. Or the symbolic value may lie in things achieved – physical, intellectual, spiritual and so on. One criterion of achievement is the amount of the world's goods you own. Here many people seem to obtain a sense of self-worth and psychological security by amassing far more than is necessary for ordinary material security.

From my own experience of industrialists, entrepreneurs and various assorted business types, I certainly think the Adlerian view is a plausible analysis of the drive behind merger and takeover activity. These barons of industry and commerce are able to satisfy their urge to self-esteem because the "logic of the situation" actually instructs them to increase their power over things and people. This power is real in a practical sense but its greatest value to them as members of society is symbolic. PE

POINTS ARISING

Dear Mr Becker

I am writing to clarify a slight misunderstanding which may have arisen from the Industry Notebook article 'In the Image of His Creation' published in the July 89 issue.

Brian Oakley was quoted as chairman of Logica. Whilst he is chairman of Logica Cambridge Ltd., one of Logica's subsidiary companies the chairman of Logica plc is in fact Philip Hughes.

I hope this clears up any questions which may have emerged.

Helen Pringle,
Corporate Relations, Logica International Ltd.

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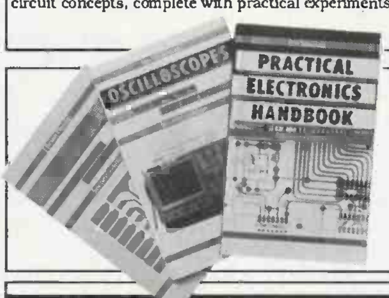

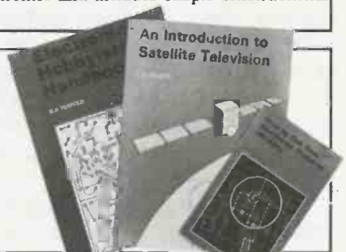

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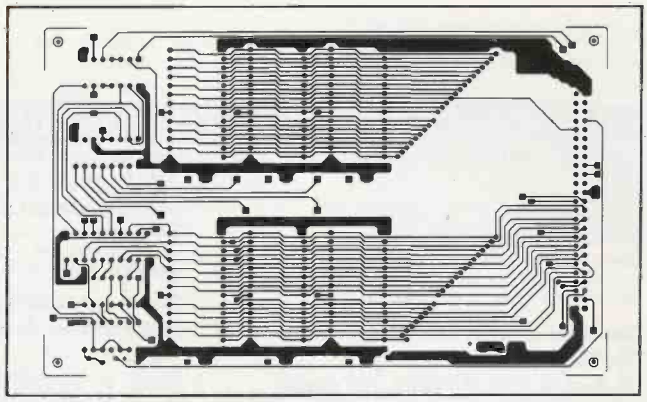

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PE COMPETITION

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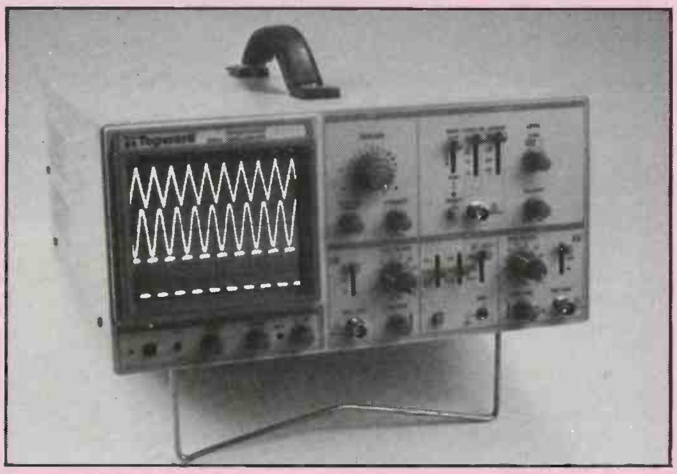
COMBINE FORCES TO ENABLE THREE OF YOU TO WIN A SUPERB MAPLIN TRIPLE-TRACE 20MHZ OSCILLOSCOPE!

WORTH NEARLY £300!



Generously donated by Maplin, these splendid XJ61R scopes are precision laboratory models that will enhance the workshop and test facilities for any reader fortunate enough to own one. And one could be yours just for the cost of a stamp!

Maplin's scopes have a wealth of facilities:

- 3 Channels - 3 Traces
- Sensitive 1mV/div vertical amplifiers
- 150mm rectangular screen with internal graticule
- X-Y mode for phase shift and frequency measurements
- TV sync separator for video signal monitoring 20ns/div X-sweep for fast signal observation
- Algebraic operation for Chans 1 and 2
- Easy and stable channel triggering
- 50mV/div Chan 1 output to counters etc
- Trigger hold-off for complex signal triggering

HOW TO ENTER

Just answer the five simple questions on the entry form and send the form to: *Practical Electronics*, Scope Competition, 193 Uxbridge Road, London W12 9RA. All correct answers will be put into a draw which will take place on 29th September 1989. The first three names drawn will each win one these Maplin scopes. The Editor's decisions (and definitions!) are final.

You may send a photocopy of the entry form providing you also attach the original entry coupon clipped from the corner of this page (not a photocopy of it).

MAPLIN SCOPE ENTRY FORM

Circle the correct answer to the following questions, or write in your own answer:

1. The initial letters C.R.T. stand for:
Cathode Radar Tube — Caesium Ray Tube — Capacitive Resonance Trigger — Other

2. The name Rayleigh is renowned for:
Bicycles — Plymouth Hoe — Maplin Sands — Electronic Supplies — Other

3. Signal phase and frequency comparison patterns on a scope screen are called:
Lissotrichous Figures — Lissajous Figures — Listeria Figures — Other

4. In a scope tube the electron beam starts its journey to the screen from the:
Anode — Dynode — Cathode — Pentode — Other

5. Which of these (if any) is the odd one out?
Oscilloscope — Video Camera — TV set — Radio — Computer — Cash Dispenser — Radar — None of these

6. What is the common link in Q5?

Name and address (in block letters):

....

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PE COMPETITION SEPT., 1989

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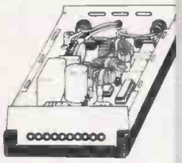
POWER CONDITIONER

FEATURED IN ETI
JANUARY 1988



The ultimate mains purifier intended mainly for lowering the noise floor and improving the analytical qualities of top-flight audio equipment.

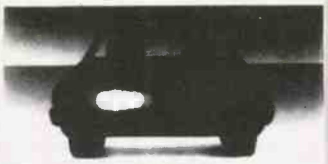
The massive filter section contains thirteen capacitors and two current balanced inductors, together with a bank of six VDRs, to remove every last trace of impulsive and RF interference. A ten LED logarithmic display gives a second by second indication of the amount of interference removed.

Our approved parts set consists of case, PCB, all components (including high permeability toroidal cores, ICs, transistors, class X and Y suppression capacitors, VDRs, etc.) and full instructions.

PARTS SET £29.80 + VAT

A low cost (but high performance) mains conditioner is also available.

MAINS CONDITIONER PARTS SET £5.40 + VAT
RUGGED PLASTIC CASE £1.80 + VAT



KNIGHT RAIDER

FEATURED IN ETI JULY 1987

The ultimate in lighting effects for your Lamborghini, Maserati, BMW (or any other car, for that matter). Picture this: eight powerful lights in line along the front and eight along the rear. You flick a switch on the dashboard control box and a point of light moves lazily from left to right leaving a comet's tail behind it. Flip the switch again and the point of light becomes a bar, bouncing backwards and forwards along the row. Press again and try one of the other six patterns . . . An LED display on the control box let's you see what the main lights are doing.

The Knight Raider can be fitted to any car (it makes an excellent fog light!) or with low powered bulbs it can turn any child's pedal car or bicycle into a spectacular TV-age toy!

The parts set consists of box, PCB and components for control, PCB and components for sequence board, and full instructions.

Lamps not included.

PARTS SET £24.80 + VAT

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All can be built in an afternoon!

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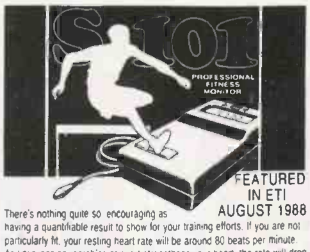


FEATURED IN ETI
AUGUST 1988

There's nothing quite so encouraging as having a quantifiable result to show for your training efforts. If you are not particularly fit, your resting heart rate will be around 80 beats per minute. As your jogging, aerobics or sport strengthens your heart, the rate will drop dramatically – possibly to 60bpm or less. With the S101, you can watch your progress day by day.

Breathing is important too. How efficiently do you take up oxygen? How quickly do you recover from 'oxygen debt' after strenuous activity? The S101 will let you know.

The approved parts set consists of: case, 3 printed circuit boards, all components (including 17 ICs, quartz crystal, 75 transistors, resistors, diodes and capacitors), LCD, switches, plugs, sockets, electrodes, and full instructions for construction and use.

PARTS SET £33.80 + VAT

Some parts are available separately. Please send SAE for lists, or SAE + £2 for lists, circuits, construction details and training plan (free with parts set)

THE DREAM MACHINE

FEATURED IN ETI
DECEMBER 1987

Adjust the controls to suit your mood and let the gentle, relaxing sound drift over you. At first you might hear soft rain, sea surf, or the wind through distant trees. Almost hypnotic, the sound draws you irresistably into a peaceful, refreshing sleep.

For many, the thought of waking refreshed and alert from perhaps the first truly restful sleep in years is exciting enough in itself. For more adventurous souls there are strange and mysterious dream experiences waiting. Take lucid dreams, for instance. Imagine being in control of your dreams and able to change them at will to act out your wishes and fantasies. With the Dream Machine it's easy!

The approved parts set consists of PCB, all components, controls, loudspeaker, knobs, lamp, fuseholders, fuse, mains power supply, prestige case and full instructions.

PARTS SET £19.80 + VAT

Ben Sweetland's best seller GROW RICH WHILE YOU SLEEP is now in stock. £2.95 (NO VAT)

THE MISTRAL AIR IONISER

The best ioniser design yet – this one has variable ion drive, built-in ion counter and enough power to drive five multi-point emitters. For the technically minded, it has nine main drive stages, five secondary drives, and a four section booster to give an output capability of almost fifteen billion (1.47×10^{10}) ions every minute, or 2.45×10^{11} ions per second. With extra emitters this can be increased still further!

PARTS SET £28.40 + VAT

The parts set includes case, printed circuit boards, 126 top grade components, all controls, lamps, hardware, a multi-point phosphor-bronze emitter and full instructions.

Some parts are available separately – please send SAE for lists, or SAE + £1 for lists, circuit and construction details and further information (free with parts set).

READY-BUILT MISTRAL

The Mistral Ioniser (and most of our other projects) can now be supplied built, tested and ready to go. For details, please contact *Peter Leah at P.L. Electronics, 8 Woburn Road, Eastville, Bristol BS5 6TT. Tel: 0272 522703.* Evenings Only

INTERNAL EMITTER £2.80 + VAT

Can be used in place of the P-B external emitter, or both can be used together for the highest ion output. Parts set includes PCB, ion emitters, components and instructions.

IPA BOARD CLEANER £0.98 + VAT

Essential for removing grease and flux residues from the Mistral PCB to achieve peak performance. Applicator brush supplied.

ION FAN £9.80 + VAT

An almost silent piezo-electric fan, mains operated, to pump ions away from the emitter and into the room. Increases the effectiveness of any ioniser by five times!

ION DISPERSION METER

FEATURED IN ETI
FEBRUARY 1989

The Q-ion is a hand-held meter which sniffs out ions in the air. It can tell the good ones from the duds if you're thinking of buying a commercial ioniser, check the efficiency and output of one you've made yourself, help you set up fans and position the ioniser for best effect, do an ion-survey of your house or office — in short, it will tell you anything you want to know about ions in the air.

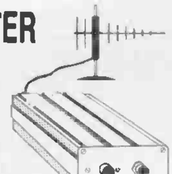
In direct mode the bar-graph readout will detect the presence of negative or positive ions and measure neg-ion strengths from 5×10^{7} to 10^{10} ions per second, which covers the levels you can expect when an air ioniser is in use. For the smaller concentrations of natural air ions, integrate mode will increase the sensitivity as far as you like.

Our approved parts set comprises: case, ion collector, printed circuit board, all components (including six ICs, schottky diode, cermets, VDR, zener, 37 resistors and capacitors, LEDs, plug, socket, earth lead, etc.) and full instructions.

PARTS SET £18.40 + VAT

Some parts are available separately — please send SAE for lists, or SAE + £1 for lists, circuit, construction details and further information (free with parts set).

TV BOOSTER



Good TV pictures from poor aerials is what this project is all about. Keith Brindley's Aerial Booster gives a massive 23dB gain to ensure good viewing for campers and caravanners, from indoor aerials, or wherever a properly positioned high-gain antenna is not practical.

Based on the OM335 hybrid amplifier, the booster has specifications to rival the best: wideband operation from 10MHz to 1.4 GHz, mid-band gain of up to 26dB and a wide supply range of 9V to 26V (it will run from car batteries for caravanners, dry batteries for campers, or a mains 'battery eliminator' in the home). No special UHF construction skills are needed — the project could be made by a careful beginner.

There are two parts sets for the project. AA1 contains the printed circuit board, OM335 hybrid amplifier, components and instructions. AA2 is the optional case set: rugged screened box, front and rear panels, waterproofing gaskets, feet, sockets and hardware.

AA1 PARTS SET £12.80 + VAT

AA2 PARTS SET £4.80 + VAT

AA3 OPTIONAL MAINS POWER SUPPLY PARTS SET £6.80 + VAT.

BIO-FEEDBACK

FEATURED IN ETI
DECEMBER 1986

Bio-feedback comes of age with this highly responsive, self-balancing skin response monitor! The powerful circuit has found application in clinical situations as well as on the bio-feedback scene. It will open your eyes to what GSR techniques are really all about.

The complete parts set includes case, PCB, all components, leads, electrodes, conductive gel, and full instructions.

PARTS SET £16.80 + VAT
BIO-FEEDBACK BOOK £4.50 (no VAT)

Please note: the book, by Stern and Ray, is an authorised guide to the potential of bio-feedback techniques. It is not a hobby book, and will only be of interest to intelligent adults.

POWERFUL AIR IONISER

FEATURED IN ETI
JULY 1986

Ions have been described as 'vitamins of the air' by the health magazines, and have been credited with everything from curing hay fever and asthma to improving concentration and putting an end to insomnia. Although some of the claims may be exaggerated, there is no doubt that ionised air is much cleaner and purer, and seems much more invigorating than 'dead' air.

The DIRECT ION ioniser caused a great deal of excitement when it appeared as a constructional project in ETI. At last, an ioniser that was comparable with (better than?) commercial products, was reliable, good to build . . . and fun! Apart from the serious applications, some of the suggested experiments were outrageous!

We can supply a matched set of parts, fully approved by the designer, to build this unique project. The set includes a roller tinned printed circuit board, 66 components, case, mains lead, and even the parts for the tester. According to one customer, the set costs 'about a third of the price of the individual components'. What more can we say?

Instructions are included

PARTS SET WITH BLACK CASE £12.60 + VAT
PARTS SET WITH WHITE CASE £12.80 + VAT

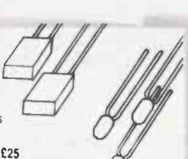
BURGLAR BUSTER

Be safe from intruders with our Burglar Buster alarm system! It has all the features you'd expect from a high-tech alarm: entry and exit delay, anti-tamper loop, delay warning and control-box protection.

The parts set includes *all four* PCBs and all components to go on them. Other parts (case, switches, etc.) are available separately, if you haven't got anything suitable in your spares box. Set contains 4 PCBs, ICs, transistors, relays, capacitors, resistors, diodes, regulator, piezo sounder and full instructions.

BB1 PARTS SET £12.80 + VAT

LEDs



Green rectangular LEDs for bar-graph displays.

50 for £3.50	500 for £25
100 for £6	1000 for £45

DIGITAL AND AUDIO EQUIPMENT LEDs
Assorted 3mm LEDs: red, green, yellow and orange.
25 of each (100 LEDs) for £6.80

BRAINWAVE MONITOR

FEATURED IN ETI
AUGUST 1987

The most astonishing project ever to have appeared in an electronics magazine. Similar in principle to a medical EEG machine, this project allows you to **hear** the characteristic rhythms of your own mind! The alpha, beta and theta forms can be selected for study and the three articles give masses of information on their interpretation and powers.

In conjunction with Dr. Lewis's Alpha Plan, the monitor can be used to overcome shyness, to help you feel confident in stressful situations, and to train yourself to excel at things you're 'no good at'.

Our approved parts set contains case, two PCBs, screening can for bio-amplifier, all components (including three PMI precision amplifiers), leads, brass electrodes and full instructions.

PARTS SET £39.80 + VAT ALPHA PLAN BOOK £2.50
SILVER SOLUTION (for plating electrodes) £3.80 + VAT

Parts set available separately. We also have a range of accessories, professional electrodes, books, etc. Please send SAE for lists, or SAE + £2 for lists, construction details and further information (free with parts set).

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