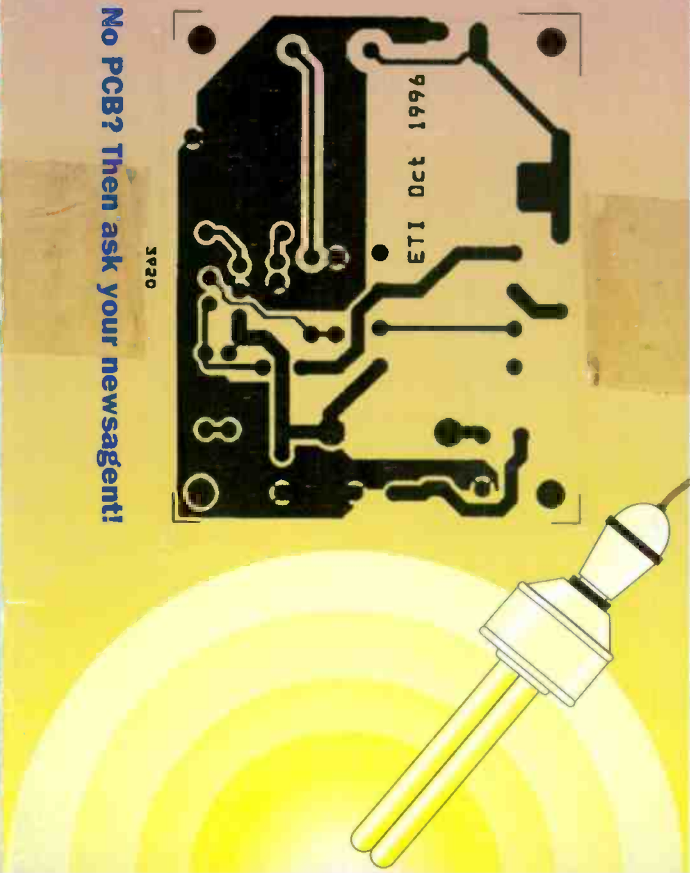
ETI

ELECTRONICS TODAY INTERNATIONAL

FREE PCB

12V High Power Portable Camplight

No PCB? Then ask your newsagent!



Electro Magnetic Levitation

Tomorrow's flying trains

PLUS

ETI Data Bus Monitor

"Off You Go" Press-to-Time Switch

Audio Squarewave Generator

- **Powerline Signal Controller**
- **PIC16C54 Software Test Board**

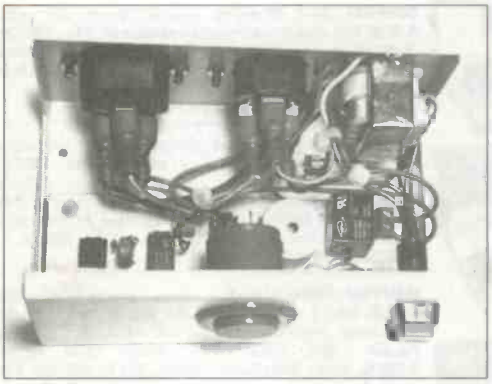
VOLUME 25 No. 10
OCTOBER 1996 £2.25

NEXUS

Contents

Volume 25 No.10

& Features Projects



Regulars

MOONSHINE BIBLE 270 page book covering the production of alchohol from potatoes, rice, grains etc Drawings of simple home made stills right through to commercial systems. £15 ref MS1

NEW HIGH POWER MINI BUG With a range of 800 metres or more and up to 100 hours use from a PP3 this will be popular! Bug measures less than 1" square! £28 Ref LOT102.

SINCLAIR C5 MOTORS We have a new ones available without gearboxes at £50 ref LOT25

BUILD YOU OWN WINDFARM FROM SCRAP New publication gives step by step guide to building wind generators. Armed with this publication and a good local scrap yard could make you self sufficient in electricity! £12 ref LOT81

PC KEYBOARDS PS2 connector, top quality suitable for all 286/386/486 etc £10 ref PCKB. 10 for £65.

TRACKING TRANSMITTER range 1.5-5 miles, 5,000 hours on AA batteries, also transmits info on car direction and motion!Works with any FM radio. 1.5" square. £65 ref LOT101

ELECTRIC DOOR LOCKS Complete lock with both Yale lock and 12v operated deadlock (keys included) £10 ref LOT99

GALLIUM ARSENIDE FISHEYE PHOTO DIODES Complete with suggested circuits for long range communications\switching £12 complete.

SURVEILLANCE TELESCOPE Superb Russian zoom telescope adjustable from 15x to 60x! complete with metal tripod (imposible to use without this on the higher settings) 66mm lense, leather carrying case £149 ref BAR69

WIRELESS VIDEO BUG KIT Transmits video and audio signals from a minature CCTV camera (included) to any standard television! All the components including a PP3 battery will fit into a cigarette packet with the lens requiring a hole about 3mm diameter. Supplied with telescopic aerial but a piece of wire about 4" long will still give a range of up to 100 metres. A single PP3 will probably give less than 1 hours use. £99 REF EP79. (probably not licensable!)

CCTV CAMERA MODULES 46X70X29mm, 30 grams, 12v 100mA. auto electronic shutter, 3.6mm F2 lens, CCIR, 512x492 pixels, video output is 1v p-p (75 ohm). Works directly into a scart or video input on a tv or video. IR sensitive. £79.95 ref EF137.

IR LAMP KIT Suitable for the above camera enables the camera to be used in total darkness! £5.99 ref EF138.

REMOTE CONTROLTANDATA TD1400 MODEM/ VIEWDATA Complete system comprising 1200/75 modem, auto dialler, infra red remote keyboard, (could be adapted for PC use?) psu, UHF and RGB output, phone lead, RS232 output, composite output. Absolute bargain for parts alone!£9.95 ref BAR33.

9 WATT CHIEFTAN TANK LASERS

Double beam units designed to fit in the gun barrel of a tank, each unit has two semi conductor lasers and motor drive units for alignement. 7 mile range, full circuit diagrams, new price £50,000? us? £349. Each unit has two gallium Arsenide injection lasers, 1 x 9 watt, 1 x 3 watt, 900nm wavelength, 28vdc, 600hz pulse frequency. The units also contain an electronic receiver to detect reflected signals from targets, five or more units £299 ea. £349 for one. Ref LOT4.

TWO WAY MIRROR KIT Includes special adhesive film to make two way mirror(s) up to 60"x20". (glass not included) Includes full instructions. £12 ref TW1.

NEW LOW PRICED COMPUTER/WORKSHOP/HI-FI RCB UNITS Complete protection from faulty equipment for everybody! Inline unit fits in standard IEC lead (extends it by 750mm), fitted in less than 10 seconds, reset/test button, 10A rating. £6.99 each ref LOT5. Or a pack of 10 at £49.90 ref LOT6. If you want a box of 100 you can have one for £250!

RADIO CONTROLLED CARS FROM £6 EACH!!!! All returns from famous manufacturer, 3 types available, single channel (left,right,forwards,backwards)£6 ref LOT1. Two channel with more features £12 ref LOT2.

THOUSANDS AVAILABLE RING/FAX FOR DETAILS!

MAGNETIC CARD READERS (Swipes) £9.95 Cased with flyleads, designed to read standard credit cards! they have 3 wires coming out of the head so they may write as well? complete with control elctronics PCB. just £9.95 ref BAR31

WANT TO MAKE SOME MONEY? STUCK FOR AN IDEA? We have collated 140 business manuals that give you information on setting up different businesses, you peruse these at your leisure using the text editor on your PC. Also included is the certificate enabling you to reproduce (and sell) the manuals as much as you like! £14 ref EP74

PANORAMIC CAMERA OFFER Takes double width photographs using standard 35mm film. Use in horizontal or vertical mode. Complete with strap £7.99 ref BAR1

COIN OPERATED TIMER KIT Complete with coinslot mechanism, adjustable time delay, relay output, put a coinslot on anything you like! TV,s, videos, fridges, drinks cupboards, HIFL takes 50p's and £1 coins. DC operated, price just £7.99 ref BAR27.

ZENITH 900 X MAGNIFICATION MICROSCOPE Zoom, metal construction, built in light, shrimp farm, group viewing screen, lots of accessories £29 ref ANAYLT.

AA NICAD PACK Pack of 4 tagged AA nicads £2.99 ref BAR34

PLASMA SCREENS 222x310mm, no data hence £4.99 ref BAR67

NIGHTSIGHTS Model TZS4 with infra red illuminator, views up to 75 metres in full darkness in infrared mode, 150m range, 45mm lens, 13 deg angle of view, focussing range 1.5m to infinity. 2 AA batteries required. 950g weight. £199 ref BAR61. 1 years warranty

LIQUID CRYSTAL DISPLAYS Bargain prices,
16 character 2 line, 99x24mm £2.99 ref SM1623A
20 character 2 line, 83x19mm £3.99 ref SM2020A
16 character 4 line, 62x25mm £5.99 ref SMC1640A

TAL-1 110MM NEWTONIAN REFLECTOR TELESCOPE Russian. Superb astronomical 'scope, everything you need for some serious star gazing! up to 169x magnification Send or fax for further details £249 ref TAL-1

WOLVERHAMPTON BRANCH NOW OPEN AT WORCESTER ST W'HAMPTON TEL 01902 22039

CENTRAL POINT PC TOOLS Award winning software, 1,300 virus checker, memory optimiser, disc optimiser, file compression, low level formatting, backup scheduler, disk defragmenter, undelete, 4 calculators, Dbase, disc editor, over 40 viewers, remote computing, password protection, encryption, comprehensive manual supplied etc £25 ref lot 97 3.5" disks.

GOT AN EXPENSIVE BIKE? You need one of our bottle alarms, they look like a standard water bottle, but open the top, insert a key to activate a motion sensor alarm built inside. Fits all standard bottle carriers, supplied with two keys. SALE PRICE £7.99 REF SA32.

GOT AN EXPENSIVE ANYTHING? You need one of our cased vibration alarms, keyswitch operated, fully cased just fit it to anything from videos to caravans, provides a years protection from 1 PP3 battery, UK made. SALE PRICE £4.99 REF SA33.

DAMAGED ANSWER PHONES These are probably beyond repair so just £4.99 each. BT response 200 machines. REF SA30.

COMPUTER DISC CLEAROUT We are left with a lot of software packs that need clearing so we are selling at disc value only! 50 discs for £4, thats just 8p each!!(our choice of discs) £4 ref EP66

IBM PS2 MODEL 160Z CASE AND POWER SUPPLY Complete with fan etc and 200 watt power supply. £9.95 ref EP67

DELL PC POWER SUPPLIES 145 watt, +5,-5,+12,-12, 150x150x85mm complete with switch, flyleads and IEC socket. SALE PRICE £9.99 ref EP55

1.44 DISC DRIVES Standard PC 3.5" drives but returns so they will need attention SALE PRICE £4.99 ref EP68

1.2 DISC DRIVES Standard 5.25" drives but returns so they will need attention SALE PRICE NOW ONLY £3.50 ref EP69

PP3 NICADS Unused but some storage marks. £4.99 ref EP52

DELL PC POWER SUPPLIES (Customer returns) Standard PC psu's complete with fly leads, case and fan. +12v,-12v,+5v,-5v SALE PRICE £1.99 EACH worth it for the bits alone! ref DL1. TRADE PACK OF 20 £29.95 Ref DL2.

GAS HOBS AND OVENS Brand new gas appliances, perfect for small flats etc. Basic 3 burner hob SALE PRICE £24.99 ref EP72. Basic small built in oven SALE PRICE £79 ref EP73

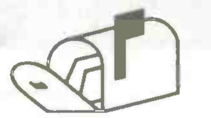
RED EYE SECURITY PROTECTOR 1,000 watt outdoor PIR switch SALE PRICE £6.99 ref EP57

ENERGY BANK KIT 100 6"x6" 6v 100mA panels, 100 diodes, connection details etc. £69.95 ref EF112.

PASTEL ACCOUNTS SOFTWARE, does everything for all sizes of businesses, includes wordprocessor, report writer, windowing, networkable up to 10 stations, multiple cash books etc. 200 page comprehensive manual. 90 days free technical support (01342-326009 try before you buy!) Current retail price is £129, SALE PRICE £9.95 ref SA12. SAVE £120!!!

COMPLETE PC 200 WATT UPS SYSTEM Top of the range UPS system providing protection for your computer system and valuable software against mains power fluctuations and cuts New and boxed, UK made Provides up to 5 mins running time in the event of complete power failure to allow you to run your system down correctly. LAST FEW TO CLEAR AT £49 SAVE £30 ref LOT61

BIG BROTHER PSU Cased PSU, 6v 2A output, 2m o/p lead, 1.5m input lead, UK made, 220v. SALE PRICE £4.99 REF EP7



Check out our WEB SITE

http://www.pavilion.co.uk/bull-electrical

RACAL MODEM BONANZA! 1 Racal MPS1223 1200/75 modem, telephone lead, mains lead, manual and comms software, the cheapest way onto the net! all this for just £13 ref DEC13.

4.5mw LASER POINTER. BRAND NEW MODEL NOW IN STOCK!, supplied in fully built form (looks like a nice pen) complete with handy pocket clip (which also acts as the on/off switch.) About 50 metres range! Runs on 2 AAA batteries. Produces thin red beam ideal for levels, gun sights, experiments etc. just £39.95 ref DEC49 TRADE PRICE £28 MIN 10 PIECES

BULL TENS UNIT Fully built and tested TENS (Transcutaneous Electrical Nerve Stimulation) unit, complete with electrodes and full instructions. TENS is used for the relief of pain etc in up to 70% of sufferers. Drug free pain relief, safe and easy to use, can be used in conjunction with analgesics etc. £49 Ref TEN/1

PC PAL VGA TO TV CONVERTER Converts a colour TV into a basic VGA screen. Complete with built in psu, lead and s/ware.. Ideal for laptops or a cheap upgrade. Supplied in kit form for home assembly. SALE PRICE £25 REF SA34

EMERGENCY LIGHTING UNIT Complete unit with 2 double bulb floodlights, built in charger and auto switch. Fully cased. 6v 8AH lead acid req'd. (secondhand) £4 ref MAG4P11.

YUASHA SEALED LEAD ACID BATTERIES Two sizes currently available this month. 12v 15AH at £18 ref LOT8 and 6v 10AH (suitable for emergency lights above) at just £6 ref LOT7.

ELECTRIC CAR WINDOW DE-ICERS Complete with cable, plug etc SALE PRICE JUST £4.99 REF SA28

AUTO SUNCHARGER 155x300mm solar panel with diode and 3 metre lead fitted with a cigar plug. 12v 2watt £8.99 REF SA25.

MICRODRIVE STRIPPERS Small cased tape drives ideal for stripping, lots of useful goodies including a smart case, and lots of components. SALE PRICE JUST £4.99 FOR FIVE REF SA26

SOLAR POWER LAB SPECIAL You get TWO 6"x6" 6v 130mA solar cells, 4 LED's, wire, buzzer, switch plus 1 relay or motor. Superb value kit SALE PRICE JUST £4.99 REF SA27

RGB/CGA/EGA/TTL COLOUR MONITORS 12" in good condition. Back anodised metal case. SALE PRICE £49 REF SA16B

PLUG IN ACORN PSU 19v AC 14w , £2.99 REF MAG3P10

13.8V 1.9A PSU cased with leads. Just £9.99 REF MAG10P3

UNIVERSAL SPEED CONTROLLER KIT Designed by us for the C5 motor but ok for any 12v motor up to 30A. Complete with PCB etc. A heat sink may be required. £17.00 REF: MAG17

PHONE CABLE AND COMPUTER COMMUNICATIONS PACK Kit contains 100m of 6 core cable, 100 cable clips, 2 line drivers with RS232 interfaces and all connectors etc. Ideal low cost method of communicating between PC's over a long distance utilizing the serial ports. Complete kit £8.99. Ref comp1.

VIEWDATA SYSTEMS made by Phillips, complete with internal 1200/75 modem, keyboard, psu etc RGB and composite outputs, menu driven, autodialler etc. SALE PRICE £12.99 REF SA18

AIR RIFLES .22 As used by the Chinese army for training puposes, so there is a lot about! £39.95 Ref EF78. 500 pellets £4.50 ref EF80.

PLUG IN POWER SUPPLY SALE FROM £1.50 Plugs in to 13A socket with output lead, three types available, 9vdc 150mA £1.50 ref SA19, 9vdc 200mA £2.00 ref SA20, 6.5vdc 500mA £2 ref SA21.

VIDEO SENDER UNIT. Transmits both audio and video signals from either a video camera, video recorder, TV or Computer etc to any standard TV set in a 100' range! (tune TV to a spare channel) 12v DC op. Price is £25 REF: MAG15 12v psu is £5 extra REF: MAG5P2

***MINATURE RADIO TRANSCEIVERS** A pair of walkie talkies with a range up to 2km in open country. Units measure 22x52x155mm. Including cases and earp'ces. 2xPP3 req'd. £30.00 pr.REF: MAG30

***FM TRANSMITTER KIT** housed in a standard working 13A adapter!! the bug runs directly off the mains so lasts forever! why pay £700? or price is £15 REF: EF62 (kit) Transmits to any FM radio.

***FM BUG BUILT AND TESTED** superior design to kit. Supplied to detective agencies. 9v battery req'd. £14 REF: MAG14

TALKING COINBOX STRIPPER COMPLETE WITH COINSLOT MECHANISMS originally made to retail at £79 each, these units are designed to convert an ordinary phone into a payphone. The units have the locks missing and sometimes broken hinges. However they can be adapted for their original use or used for something else?? SALE PRICE JUST £2.50 REF SA23

GAT AIR PISTOL PACK Complete with pistol, darts and pellets £12.95 Ref EF82B extra pellets (500) £4.50 ref EF80.

6"X12" AMORPHOUS SOLAR PANEL 12v 155x310mm 130mA. SALE PRICE £4.99 REF SA24.

FIBRE OPTIC CABLE BUMPER PACK 10 metres for £4.99 ref MAG5P13 ideal for experimenters! 30 m for £12.99 ref MAG t3P1

MIXED GOODIES BOX OF MIXED COMPONENTS WEIGHING 2 KILOS YOURS FOR JUST £5.99

4X28 TELESCOPIC SIGHTS Suitable for all air rifles, ground lenses, good light gathering properties. £19.95 ref R/7.

GYROSCOPES Remember these? well we have found a company that still manufactures these popular scientific toys, perfect gift or for educational use etc. £6 ref EP70

HYPOTHERMIA SPACE BLANKET 215x150cm aluminised foil blanket, reflects more than 90% of body heat. Also suitable for the construction of two way mirrors! £3.99 each ref O/L041.

LENSTATIC RANGER COMPASS Oil filled capsule, strong metal case, large luminous points. Sight line with magnifying viewer. 50mm dia, 86gm. £10.99 ref O/K604.

RECHARGE ORDINARY BATTERIES UP TO 10 TIMES! With the Battery Wizard! Uses the latest pulse wave charge system to charge all popular brands of ordinary batteries AAA, AA, C, D, four at a time! Led system shows when batteries are charged, automatically rejects unsuitable cells, complete with mains adaptor. BS approved. Price is £21.95 ref EP31.

TALKING WATCH Yes, it actually tells you the time at the press of a button. Also features a voice alarm that wakes you up and tells you what the time is! Lithium cell included. £7.99 ref EP26.

PHOTOGRAPHIC RADAR TRAPS CAN COST YOU YOUR LICENCE! The new multiband 2000 radar detector can prevent even the most responsible of drivers from losing their licence! Adjustable audible alarm with 8 flashing leds gives instant warning of radar zones. Detects X, K, and Ka bands, 3 mile range, 'over the hill' 'around bends' and 'rear trap facilities. micro size just 4.25"x2.5"x.75", Can pay for itself in just one day! £79.95 ref EP3.

3" DISCS As used on older Amstrad machines, Spectrum plus3's etc £3 each ref BAR400.

STEREO MICROSOPES BACK IN STOCK Russian, 200x complete with lenses, lights, filters etc etc very comprehensive microscope that would normally be around the £700 mark, our price is just £299 (full money back guarantee) full details in catalogue.

WE BUY SURPLUS STOCK FOR CASH

BUYERS DIRECT LINE 0802 660377

FREECATALOGUE

100 PAGE CATALOGUE NOW AVAILABLE, 50P STAMP OR FREE ON REQUEST WITH ORDER.

*SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

BULL ELECTRICAL

250 PORTLAND ROAD, HOVE, SUSSEX . BN3 5QT. (ESTABLISHED 50 YEARS).

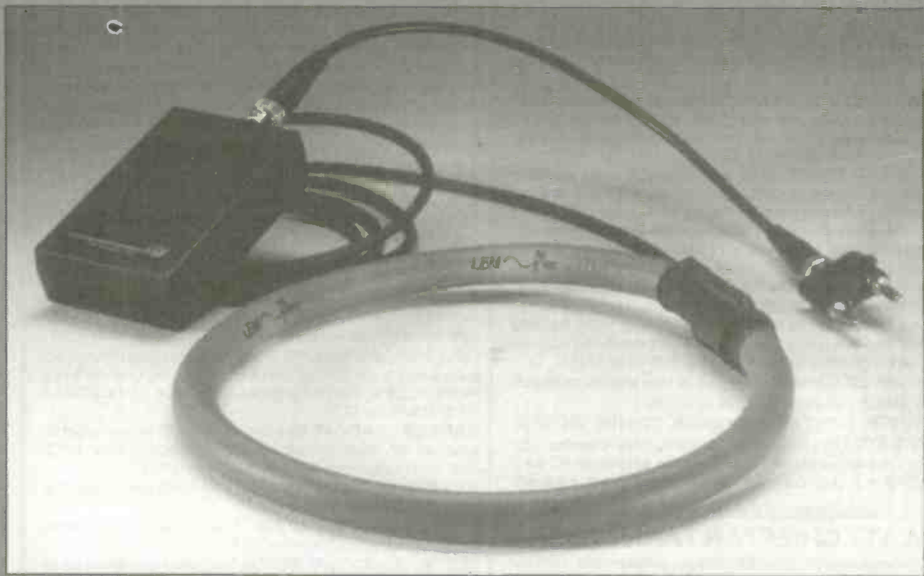
MAIL ORDER TERMS: CASH, PO OR CHEQUE WITH ORDER PLUS £3 P&P PLUS VAT.

PLEASE ALLOW 7-10 DAYS FOR DELIVERY PHONE ORDERS WELCOME (ACCESS, VISA, SWITCH, AMERICAN EXPRESS)

TEL: 01273 203500
FAX 01273 323077
E-mail bull@pavilion.co.uk

ETI ELECTRONICS TODAY INTERNATIONAL News...

Flexible current chaser

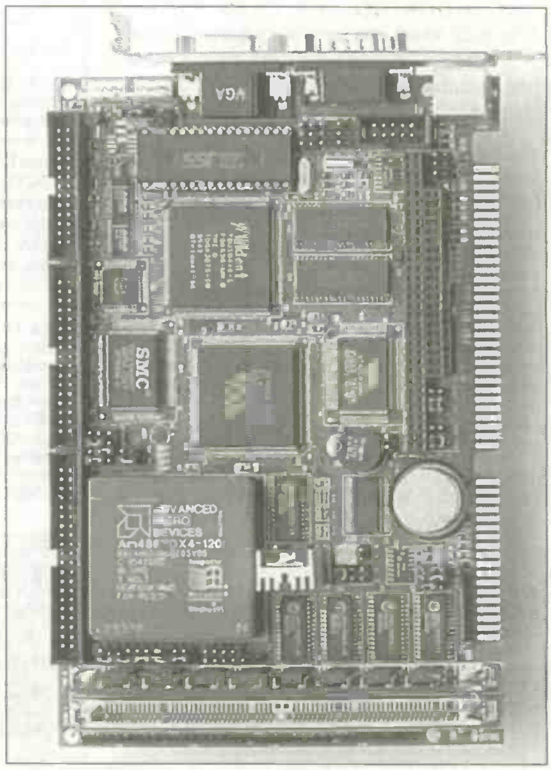


A flexible ac current probe specially for irregular-shaped conductors with difficult access is available from all Professional Instrument Distributor Association (PIDA) members. The LEM-flex ac current probe is compatible with any digital multimeter, chart recorder or oscilloscope. The compact, portable probe has back-on-itself flexibility with two standard current ranges to each unit, a wide bandwidth, 1% accuracy and electrical isolation with rugged durability. Standard models are available in lengths of 61, 91 and 122 cm, with dual ranges of 0-30/30-300A, 0-300/300-3000A and 0-60/600-6000A. Flexible air-core toroidal current transformers have overcome the limitations of iron-core current transformers, particularly with regard to rigidity.

Apart from their ability to go around multiple odd-shaped conductors in tight positions, with ideal applications are said to be in large variable-speed drives, phase currents in motor drives and UPS systems, output check of MG sets in standby power supplied, power semiconductor failure, current measurement of diodes or SCRs in power rectifiers on a test or permanent basis, and as front-end probes for power monitoring, harmonic analysis and data logging.

For information Tel Fred Hutchinson at Quiswood Ltd. 01756 799737.

486 microcontroller



The compact, multi-function PCA-6144V CPU card in the photo is a fully-featured 486DX2/DX4 industry-grade CPU card with on-board VGA display capability.

The local bus VGA controller has a Windows accelerator and 1mB of display memory. The card supports up to 64MB of on-board dram with a secondary level cache of 128K.

Other on-board features include an enhanced IDE hard disk interface, floppy disk controller, PC/104 interface bus connector allowing modular expansion of the board, two high speed i6C550 buffered serial ports (one RS232 and one RS-232/485), an enhanced bi-directional parallel port and a PS/2 mouse connector.

The card also has on-board power management to the "green function" standard, accessed via the BIOS, which provides three power-save modes: doze, sleep and suspend.

There is a 63-level on-board watchdog timer for fault-critical applications, allowing automatic reset in the event of a software failure. The board operates from a single 5V supply and is designed to run reliably between 0 and 60 degrees C.

The PCA-6144V is available from Integrated Measurement Systems (IMS), 305-308 Solent Business Centre, Millbrook Road West, Southampton SO15 0HW. Tel 01703 771143 Fax 017703 704301.

Tinner is lead-free

Intertronics have a lead-free soldering-iron tip-tinner in two sizes.

Modern self-cleaning solder does not entirely remove the problem of oxide deposits clogging the soldering bit and lowering its efficiency. IC lead-free tip tinner is designed to prolong bit-life and increase soldering efficiency, and being lead free helps to keep polluting by-products of soldering to a minimum.

The Tip Tinner is packages in an ESD-safe metal contained with an adhesive pad for fixing to the workbench.

The two packages are priced at £5.88 and £10.41. Information from Intertronics, Unit 9, Station Field Industrial Estate, Banbury Road, Kidlington, Oxon OX5 1JD Tel 01865 842842 Fax 01865 842172.

National Microelectronics Institute

Nine major semiconductor companies have banded together to found the National Microelectronics Institute (NMI) in the UK. Motorola, NEC, National Semiconductor (UK), Seagate Microelectronics, Siemens Microelectronics, Fujitsu, Newport Wafer Fab, Philips Semiconductors and GEC-Plessey will own the Institute, based on the campus of the Heriot-Watt University, collectively and will be working in partnership with the Department of Trade and Industry, the Scottish and Welsh Offices, and the Government Office for the North East.

The NMI will aims to provide a focus for coordinating the training, supply and research infrastructure for the semiconductor manufacturing industry in the UK. An important initial priority will be to focus on the availability of skilled technicians and engineers for the industry.

Launching the new Institute on July 8th, Ian Lang, President of the Board of Trade in the UK, said:

"Semiconductors are a key enabling technology for the creation of the Information Society, providing the means for the processing and storage of vast quantities of data.

The growth rates in this sector during 1995 were amongst the most remarkable on record for a major industry during peacetime. I am glad to say that the UK has secured a significant share of this expanding industry.

"This is an industry that requires ever-closer links with educational institutions and local agencies, and with its suppliers."

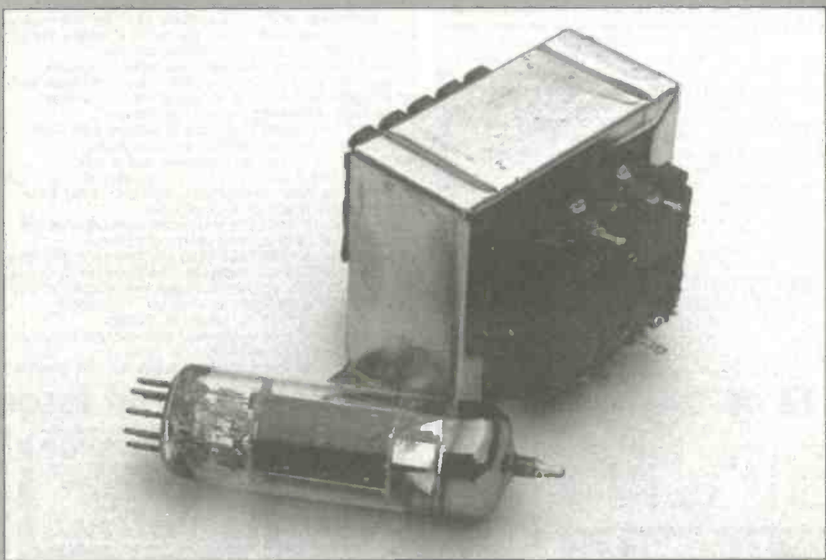
For information contact Sam McEwan Tel 0141 228 2299.

Modern transformers for ancient valves

A range of transformers specially designed to meet the needs of the regrowth in the valve market has been launched, aimed especially at electronics and amateur radio enthusiasts. The new VTM ragne is made by Variable Voltage Technology to traditional requirements bu tusing modern methods and materials, including high grade annealed copper wire and high quality grain-oriented lamination. VTM transformers have been designed to give a low flux density to ensure reduced magnetic fields. The meet the requirements of the EMC and low voltage directives. CE marking is available where appropriate. The transformers can be specified for either frame or vertical mounting, and are designed particularly for

- mains transformers for HT circuits with or without filament windings
- filament transformers
- mains smoothing chokes
- output transformers with triode or pentode connections, or for use in ultralinear mode. EL34 and EL84 valve types are catered for, and various loudspeaker impedance tappings are available.
- grid coupling transformers, fully screened, single ended or push/pull.

VVT is a specialist transformer designer and manufacturer that can customise its standard range transformers to meet non-standard requirements. Variable Voltage Technology Ltd., Unit 24, Samual Whites Estate, Medina Road, Cowes, Isle of Wight PO31 7LP Tel 01983 280592 Fax 01983 280593.



Surplus always wanted for cash!

THE *ORIGINAL* SURPLUS WONDERLAND!

THIS MONTH'S SELECTION FROM OUR VAST EVER CHANGING STOCKS

Surplus always wanted for cash!

LOW COST PC's -

SPECIAL BUY 'AT 286'

40Mb HD + 3Mb Ram

LIMITED QUANTITY only of these **12Mhz HI GRADE 286** systems Made in the USA to an industrial specification, the system was designed for *total reliability*. The **compact case** houses the mother-board, PSU and EGA video card with single 5¼" 1.2 Mb floppy disk drive & **integral 40Mb hard disk drive** to the front. Real time clock with battery backup is provided as standard. Supplied in good used condition **complete with enhanced keyboard, 640k + 2Mb RAM, DOS 4.01 and 90 DAY Full Guarantee.** *Ready to Run !*
Order as **HIGRADE 286** ***ONLY £129.00*** (E)

Optional Fitted extras: VGA graphics card	£29.00
1.4Mb 3½" floppy disk drive (instead of 1.2 Mb)	£19.95
Wordperfect 6.0 for Dos - when 3½" FDD option ordered	£22.50
NE2000 Ethernet (thick, thin or twisted) network card	£29.00

LOW COST 486DX-33 SYSTEM

Limited quantity of this 2nd user, supurb small size desktop unit. Fully featured with standard simm connectors 30 & 72 pin. Supplied with keyboard, 4 Mb of RAM, SVGA monitor output, 256k cache and integral 120 Mb IDE drive with single 1.44 Mb 3.5" floppy disk drive. Fully tested and guaranteed. *Fully expandable*
Many other options available - call for details. Only **£399.00** (E)

FLOPPY DISK DRIVES 3½" - 8"

5¼" or 3½" from only £18.95 !

Massive purchases of standard 5¼" and 3½" drives enables us to present prime product at industry beating low prices! All units (unless stated) are *BRAND NEW* or removed from often brand new equipment and are fully tested, aligned and shipped to you with a 90 day guarantee and operate from standard voltages and are of standard size. **All are IBM-PC compatible** (if 3½" supported on your PC).

3½" **Panasonic** JU363/4 720K or equivalent RFE	£24.95(B)
3½" **Mitsubishi** MF355C-L. 1.4 Meg. Laptops only	£25.95(B)
3½" **Mitsubishi** MF355C-D. 1.4 Meg. Non laptop	£18.95(B)
5¼" **Teac** FD-55GFR 1.2 Meg (for IBM pc's) RFE	£18.95(B)
5¼" **Teac** FD-55F-03-U 720K 40/80 (for BBC's etc) RFE	£29.95(B)
5¼" **BRAND NEW Mitsubishi** MF501B 360K	£22.95(B)
Table top case with integral PSU for HH 5¼" Flopp or HD	£29.95(B)
8" **Shugart** 800/801 8" SS refurbished & tested	£195.00(E)
8" **Shugart** 810 8" SS HH *Brand New*	£195.00(E)
8" **Shugart** 851 8" double sided refurbished & tested	£250.00(E)
Mitsubishi M2894-63 8" double sided *NEW*	£275.00(E)
Mitsubishi M2896-63-02U 8" DS slimline *NEW*	£285.00(E)
Dual 8" cased drives with integral power supply 2 Mb	£499.00(E)

HARD DISK DRIVES

End of line purchase scoop *Brand new* **NEC D2246** 8" 85 Mbyte drive with **industry standard SMD interface**, replaces Fujitsu equivalent model. Full manual. Only **£299.00 or 2 for £525.00 (E)**

3½" **FUJI** FK-309-26 20mb MFM I/F RFE	£59.95(C)
3½" **CONNER** CP3024 20 mb IDE I/F (or equiv)RFE	£59.95(C)
3½" **CONNER** CP3044 40mb IDE I/F (or equiv.)RFE	£69.00(C)
3½" **RODIME** RO3057S 45mb SCSI I/F (Mac & Acorn)	£69.00(C)
3½" **WESTERN DIGITAL** 850mb IDE I/F *Brand New*	£185.00(C)
5¼" **MINISCRIBE** 3425 20mb MFM I/F (or equiv.) RFE	£49.95(C)
5¼" **SEAGATE** ST-238R 30 mb RLL I/F Refurb	£69.95(C)
5¼" **CDC** 94205-51 40mb HH MFM I/F RFE tested	£69.95(C)
5¼" **HP** 9754B 850 Mb SCSI RFE tested	£89.00(C)
5¼" **HP C3010** 2 Gbyte SCSI *differential* RFE tested	£195.00(C)
8" **FUJITSU** M2322K 160Mb SMD I/F RFE tested	£195.00(E)
Hard disc controllers for MFM , IDE, SCSI, RLL etc. from	£16.95

THE AMAZING TELEBOX

Converts your colour monitor into a QUALITY COLOUR TV!!

TV SOUND & VIDEO TUNER
CABLE COMPATIBLE*

The TELEBOX is an attractive fully cased mains powered unit, containing all electronics ready to plug into a host of video monitors made by makers such as **MICROVITEC, ATARI, SANYO, SONY, COMMODORE, PHILIPS, TATUNG, AMSTRAD** etc. The composite video output will also plug directly into most video recorders, allowing reception of **TV channels not normally receivable on most television receivers*** (TELEBOX MB). Push button controls on the front panel allow reception of 8 fully tuneable 'off air' UHF colour television channels. **TELEBOX MB** covers virtually all television frequencies VHF and UHF **including the HYPERBAND as used by most cable** TV operators. A composite video output is located on the rear panel for direct connection to most makes of monitor or **desktop computer** video systems. For complete compatibility - even for monitors without sound - an integral 4 watt audio amplifier and low level Hi Fi audio output are provided as standard.

TELEBOX ST for composite video input type monitors	£36.95
TELEBOX STL as ST but fitted with integral speaker	£39.50
TELEBOX MB Multiband VHF/UHF/Cable/Hyperband tuner	£69.95

For overseas PAL versions state 5.5 or 6 mHz sound specification.
*For cable / hyperband reception Telebox MB should be connected to a cable type service. Shipping code on all Teleboxe's is (B)

DC POWER SUPPLIES

Virtually every type of power supply you can imagine. Over 10,000 Power Supplies Ex Stock Call for info / list.

IC's -TRANSISTORS - DIODES

OBSOLETE - SHORT SUPPLY - BULK

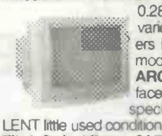
6,000,000 items EX STOCK

For *MAJOR SAVINGS* - CALL FOR SEMICONDUCTOR HOTLIST

VIDEO MONITOR SPECIALS

One of the highest specification monitors you will *ever* see - At this price - Don't miss it!!

Mitsubishi FA3415ETKL 14" SVGA Multisync colour monitor with fine 0.28 dot pitch tube and resolution of 1024 x 768. A variety of inputs allows connection to a host of computers including IBM PC's in CGA, EGA, VGA & SVGA modes, **BBC, COMMODORE** (including Amiga 1200), **ARCHIMEDES** and **APPLE**. Many features: Etched faceplate, text switching and **LOW RADIATION MPR** specification. Fully guaranteed, supplied in EXCELLENT little used condition.



Tilt & Swivel Base £4.75 **Only £119** (E) Order as **MITS-SVGA**
VGA cable for IBM PC included.
External cables for other types of computers **CALL**

As New - Used on film set for 1 week only!!
15" 0.28 SVGA 1024 x 768 res. colour monitors.
Swivel & tilt etc. Full 90 day guarantee. £145.00 (E)

Just In - **Microvitec** 20" VGA (800 x 600 res.) colour monitors. Good SH condition - from £299 - CALL for info

PHILIPS HCS35 (same style as CM8833) attractively styled 14" colour monitor with **both RGB and standard composite 15.625 Khz video inputs** via **SCART** socket and separate phono jacks. Integral audio **power amp and speaker for all audio visual uses**. Will connect direct to **Amiga and Atari** BBC computers. Ideal for all **video monitoring / security** applications **with direct connection to most colour cameras.** High quality with many features such as front concealed flap controls, VCR correction button etc. Good used condition - fully tested - guaranteed
Dimensions: W14" x H12¾" x 15½" D. **Only £95** (E)

PHILIPS HCS31 Ultra compact 9" colour video monitor with standard composite **15.625 Khz video input** via SCART socket. Ideal for all monitoring / security applications. High quality, ex-equipment fully tested & guaranteed (possible minor screen burns). In attractive square black plastic case measuring W10" x H10" x 13½" D. 240 V AC mains powered. **Only £79.00** (D)

KME 10" 15M10009 high definition colour monitors with 0.28" dot pitch. Superb clarity and modern styling. Operates from any 15.625 khz sync RGB video source, with RGB analog and composite sync such as Atari, Commodore Amiga, Acorn Archimedes & BBC. Measures only 13½" x 12" x 11". Good used condition. **Only £125** (E)

20" 22" and 26" AV SPECIALS

Superbly made UK manufacture. PIL all solid state colour monitors, complete with composite video & *optional* sound input. Attractive teak style case. Perfect for Schools, Shops, Disco, Clubs, etc.In EXCELLENT little used condition with full 90 day guarantee.

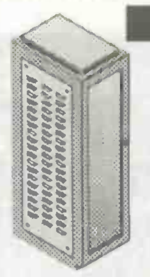
20"....£135 22"....£155 26"....£185 (F)

SPECIAL INTEREST ITEMS

MITS. FA3445ETKL 14" Industrial spec SVGA monitors	£245
2kW to 400 kW - 400 Hz 3 phase power sources - ex stock	£POA
IBM 8230 Type 1, Token ring base unit driver	£950
IBM 53F5501 Token Ring ICS 20 port lobe modules	£750
IBM MAU Token ring distribution panel 8228-23-5050N	£95
AIM 501 Low distortion Oscillator 9Hz to 330Khz, IEEE	£550
Trend DSA 274 Data Analyser with G703(2M) 64 i/o	£POA
Marconi 6310 Programmable 2 to 22 GHz sweep generator	£6500
HP1650B Logic Analyser	£3750
HP3781A Pattern generator & HP3782A Error Detector	£POA
HP APOLLO RX700 system units	£950
HP6621A Dual Programmable GPIB PSU 0-7 V 160 watts	£1800
HP3081A Industrila workstation c\w Barcode swipe reader	£175
HP6264 Rack mount variable 0-20V @ 20A metered PSU	£675
HP54121A DC to 22 GHz four channel test set	£POA
HP7580A A1 8 pen HPGL high speed drum plotter	£1850
EG+G Brookdeal 95035C Precision lock in amp	£650
View Eng. Mod 1200 computerised inspection system	£POA
Ling Dynamics 2kW programmable vibration test system	£POA
Computer controlled 1056 x 560 mm X Y table & controller	£1425
Keithley 590 CV capacitor / voltage analyser	£POA
Racal ICR40 dual 40 channel voice recorder system	£3750
Fiskers 45KVA 3 ph On Line UPS - New batts Dec.1995	£9500
ICI R5030UV34 Cleanline ultrasonic cleaning system	£POA
Mann Tally MT645 High speed line printer	£2200
Intel SBC 486/133SE Multibus 486 system. 8Mb Ram	£1200
Zeta 3220-05 A0 4 pen HPGL *fast* drum plotters	£1150
Nikon HFX-11 (Ephiphot) exposure control unit	£1450
Motorola VME Bus Boards & Components List. SAE / CALL	£POA
Trio 0-18 vdc linear, metered 30 amp bench PSU. New	£550
Fujitsu M3041R 600 LPM band printer	£1950
Fujitsu M3041D 600 LPM printer with network interface	£1250
Perkin Elmer 2998 Infrared spectrophotometer	£POA
VG Electronics 1035 TELETEXT Decoding Margin Meter	£3750
Andrews LARGE 3.1 m Satellite Dish + mount (For Voyager!)	£950
Sekonic SD 150H 18 channel digital Hybrid chart recorder	£1995
TAYLOR HOBSON Tallysurf amplifier / recorder	£750
System Video 1152 PAL waveform monitor	£485
Test Lab - 2 mtr square quietised acoustic test cabinets	£300
Kenwood 9601 PAL Vectorscope - NEW	£650

Please call for further details on the above items

19" RACK CABINETS



Superb quality 6 foot 40U
Virtually New, Ultra Smart
Less than Half Price!

Top quality 19" rack cabinets made in UK by **Optima Enclosures Ltd.** Units feature designer, smoked acrylic lockable front door, full height lockable half louvered back door and louvered removable side panels. Fully adjustable internal fixing struts, ready punched for any configuration of equipment mounting plus ready mounted integral 12 way 13 amp socket switched mains distribution strip make these racks some of the **most versatile we have ever sold.** Racks may be stacked side by side and therefore require only two side panels to stand singly or in multiple bays. Overall dimensions are: 77½" H x 32½" D x 22" W. Order as:

OPT Rack 1 Complete with removable side panels.	£335.00 (G)
OPT Rack 2 Rack, Less side panels	£225.00 (G)

32U - High Quality - All steel RakCab

Made by Eurocraft Enclosures Ltd to the highest possible spec, rack features **all steel construction** with removable side, front and back doors. Front and back doors are **hinged for easy access** and all are lockable with **five secure 5 lever barrel locks.** The front door is constructed of double walled steel with a **'designer style'** smoked acrylic front panel to enable status indicators to be seen through the panel, yet remain unobtrusive. Internally the rack features fully slotted reinforced vertical fixing members to **take the heaviest of 19" rack equipment.** The two movable vertical fixing struts (extras available) are pre punched for standard 'cage nuts'. A **mains distribution panel** internally mounted to the bottom rear, provides 8 x IEC 3 pin Euro sockets and 1 x 13 amp 3 pin **switched utility socket.** Overall ventilation is provided by fully louvered back door and double skinned top section with top and side louvres. The top panel may be removed for fitting of **integral fans** to the sub plate etc. Other features include: fitted castors and floor levelers, prepunched utility panel at lower rear for cable / connector access etc. Supplied in **excellent,** slightly used condition with keys. Colour Royal blue. External dimensions mm=1625H x 635D x 603 W. (64" H x 25" D x 23¾" W)

Sold at LESS than a third of makers price !!

A superb buy at only £195.00 (G)

***Over 1000 racks** - 19" 22" & 24" wide*
3 to 44 U high. Available from stock !!
Call with your requirements.

TOUCH SCREEN SYSTEM

The ultimate in 'Touch Screen Technology' made by the experts - *MicroTouch* - but sold at a **price below cost !!** System consists of a flat translucent glass laminated panel measuring 29.5 x 23.5 cm connected to an electronic controller PCB. The controller produces a standard **serial RS232** or **TTL** output which continuously gives simple serial data containing positional X & Y co-ordinates as to where a finger is touching the panel - as the finger moves, the data instantly changes. The X & Y information is given at an **incredible matrix resolution of 1024 x 1024** positions over the entire screen size !! **A host of available translation software** enables direct connection to a PC for a myriad of applications including: control panels, pointing devices, POS systems, controllers for the disabled or computer un-trained etc etc. Imagine using your finger with 'Windows', instead of a mouse !! (a driver is indeed available !) ***The applications for this amazing product are only limited by your imagination!!*** Complete system including Controller, Power Supply and Data supplied at an incredible price of only: ***£145.00*** (B)
Full MICROTOUCH software support pack and manuals for IBM compatible PC's £29.95 RFE - Tested

LOW COST RAM & CPU'S

INTEL 'ABOVE' Memory Expansion Board. Full length PC-XT and PC-AT compatible card with 2 Mbytes of memory on board. Card is fully selectable for Expanded or Extended (286 processor and above) memory. **Full data and driver disks supplied.** RFE. Fully tested and guaranteed. Windows compatible. **£59.95**(A1)
Half length 8 bit memory upgrade cards for PC AT XT expands memory either 256k or 512k in 64k steps. May also be used to fill in RAM above 640k DOS limit. Complete with data.
Order as: XT RAM UG. 256k. £34.95 *or* **512k £39.95** (A1)

SIMM SPECIALS

1 MB x 9 SIMM 9 chip 120ns	Only	**£16.50** (A1)
1 MB x 9 SIMM 3 chip 80 ns **£19.50**	or 70ns	**£22.95** (A1)
1 MB x 9 SIMM 9 chip 80 ns **£21.50**	or 70ns	**£23.75** (A1)
4 MB 70 ns 72 pin SIMM *-with parity-*	Only	**£95.00** (A1)

INTEL 486-DX33 CPU £55.00 INTEL 486-DX66 CPU £69.00 (A1)
FULL RANGE OF CO-PROCESSOR'S EX STOCK - CALL FOR £££

FANS & BLOWERS

EPSON DO412 40x40x20 mm 12v DC	£7.95 10 / £65
PAPST TYPE 612 60x60x25 mm 12v DC	£8.95 10 / £75
MITSUBISHI MMF-D6D12DL 60x60x25 mm 12v DC	£4.95 10 / £42
MITSUBISHI MMF-08C12DM 80x80x25 mm 12v DC	£5.25 10 / £49
MITSUBISHI MMF-09B12DH 92x92x25 mm 12v DC	£5.95 10 / £53
PANCAKE 12-3.5 92x92x18 mm 12v DC	£7.95 10 / £69

EX-EQUIP AC fans. ALL TESTED 120 x 120 x 38 mm specify 110 or 240 v **£6.95.** 80 x 80 x 38 mm - specify 110 or 240 v **£5.95**
IMHOF B26 1900 rack mnt 3U x 19" Blower 110/240v NEW **£79.95**
Shipping on all fans (A). Blowers (B). *50,000 Fans Ex Stock CALL*

Issue 13 of *Display News* now available - send large SAE - PACKED with bargains!

DISPLAY -ELECTRONICS-

ALL MAIL & OFFICES
Open Mon-Fri 9.00-5:30
Dept ET. 32 Biggin Way
Upper Norwood
LONDON SE19 3XF

LONDON SHOP
Open Mon - Sat 9:00 - 5:30
215 Whitehorse Lane
South Norwood
On 68A Bus Route
Nr.Thornton Heath &
Selhurst Park SR Rail Stations

NEW **DISTEL©**
The Original
FREE On line Database
Info on 20,000 + stock items!
RETURNING SOON !

ALL ☎ ENQUIRIES
0181 679 4414
FAX 0181 679 1927

SWITCH MasterCard VISA EST 25 YEARS

All prices for UK Mainland. UK customers add 17.5% VAT to TOTAL order amount. Minimum order £10. Bona Fide account orders accepted from Government, Schools, Universities and Local Authorities - minimum account order £50. Cheques over £100 are subject to 10 working days clearance. Carriage charges (A)=£3.00, (A1)=£4.00, (B)=£5.50, (C)=£8.50, (D)=£12.00, (E)=£15.00, (F)=£18.00, (G)=CALL. Allow approx 6 days for shipping - faster CALL. Scotland surcharge CALL. All goods supplied to our Standard Conditions of Sale and unless stated guaranteed for 90 days. All guarantees on a return to base basis. All rights reserved to change prices / specifications without prior notice. Orders subject to stock. Discounts for volume. Top CASH prices paid for surplus goods. All trademarks etc acknowledged. © Display Electronics 1996. E & O E. 06/6

Attention all old Keithley instruments!

TO celebrate its 50th anniversary, Keithley Instruments is sponsoring a conest to find the "oldest Keithley instrument" still in working order. A new Keithley Model 2000 digital multimeter will be awarded as first prize to the organisation (or, presumably, to individual owners, if there are such) that can locate the oldest working Keithley instrument. The winner must be able to demonstrate that the instrument can still collect data as it was originally designed to do. Keithley Instruments was founded in 1946 by Jospeh F Keithley in Cleveland, Ohio, USA and the company's first product was the Phantom Repeater. This was an amplifier with hihg input impedance and low output impedance, used to boost signals from low-level transducers and circuits so that they could be measured by the oscilloscopes and voltmeters available at the time.

In the 1950s, the Phantom Repeater was followed by electrometers, piooammeters and DC voltmeters that used many of the vital design features of the Phantom. Today, Keithley products, hardware and software, are used all over the world for electronic test and measurement, data acquisition and semiconductor characterisation. Anyone who works in an industrial research laboratory, engineering development department, quality control area, university or production line should start looking to see if they are using or simply storing a vintage Keithley Instrument that is still working as it was designed to do. "They are second to none in providing highly accurate and relaible data related to the electrical, temperature and periodic phenomena they test and measure", say Keithley of their instruments, and some were second to none in getting there first, too. If you know one of these instruments, send details of the model and serial number with a photograph of the working unit to Mr. Nick Challacombe, MD, Keithley Instruments Ltd., The Minster, 58 Portman Road, Reading, Berks RG30 1EA, UK, before 15th October 1996. We gather that the winner will be treated to a winner's welcome sometime in November.

Adapt to 73kHz

Following the Radiocommunications Agency's proclamation of a new amateur radio frequency (71.6 to 74.4 kHz), Cambridge Kits have put together the information to enable constructors to adapt the Cambridge 60 kHz Receiver for 73 kHz. Adding a variable capacitor (which can be re-used from an old broadcast receiver) to the superheterodyne receiver and retuning it enables it to tune to 70 to 75 kHz. The internal antenna can receive time signals from HBG in Switzerland on 75kHz. The receiver also has provision for an external antenna. The 60 kHz receiver (which is also part of Cambridge Kits' MSF clock kit) is £35.30 including case, decoding details, Basic listings, modification details and P&P. The new amateur band was issued by the Radiocommunications agency in response to requests from amateurs who wish to experiment with propagation through the ground by transmitting from underground caves, and is available for transmitting to 'A' licence holders investigating LF propagation. Transmitting on the band needs a licence variation, and applications should be made to the LF Allocation, The Chairman, RSGB HF Committee, Radio Society of Great Britain, Lambda House, Cranborne Road, Potters Bar, Herts EN6 3JE. Receiving authorised public signals needs no licence.

For information on the 60 kHz receiver and modifications, Tel Cambridge Kits 01223 860150.

Shorts

The following statement about the Trafficmate navigation system on 433.92MHz has been issued by the Radiocommunications Agency: "Trafficmaster are operating the Trafficmate system on 433.92MHz at present and the system is required to comply with the spectrum management parameters of MPT 1340. This is a temporary frequency allocation and an alternative frequency has now been found for the Trafficmaster network. All Trafficmaster transmitters and receivers will be required to operate on the new alternative frequency after the 31st December 1998." The Radio Society of Great Britain has been in discussion about the overlap of certain new allocations in the traffic area with amateur radio bands (in this case in the 70 cm band) for much of the last year. The Radiocommunications Agency has also launched a new scheme to simplify application for a foreign radio licence for UK radio amateurs who wish to operate abroad for more than three months. Countries that have implemented the appropriate CEPT Recommendation will issue on request mutually recognised HARECs to those who have passed a relevant national exam. In the UK, Class B HARECs will be issued to anyone who has passed the RAE, and Class A HARECs to anyone who has passed the RAE and the RSGB's 12 wpm Morse test. Any individual who currently holds or has ever held a full UK licence will be eligible to apply, whatever their original qualifications. Requests for a HAREC should be addressed to the RA accompanied by a current UK licence or proof of an RAE pass (and Morse test pass where appropriate). Foreign or British citizens who have equivalent foreign qualifications can obtain a full UK licence on presenting a HAREC issued by another recognised CEPT administration. Enquiries to RA general enquiry point 0171 211 0211 or your national radio organisation. CEPT Recommendation T/R 61-01 will continue for stays under three months, where amateurs can operate under the authority of their UK licence.

MODS MODS MODS MODS

ETI August 1996 Simple Distribution Amp:
The component layout on page 33 shows D1, D2, D3 and D4 reversed. The circuit diagram on page 32 is correct.

Overseas Readers

Tel To call UK telephone numbers, replace the initial 0 with your local overseas access code plus the digits 44.

8 CAVANS WAY,
BINLEY INDUSTRIAL ESTATE,
COVENTRY CV3 2SF
Tel: 01203 650702
Fax: 01203 650773
Mobile: 0860 400683

(Premises situated close to Eastern-by-pass in Coventry with easy access to M1, M6, M40, M42, M45 and M69)

OSCILLOSCOPES

Cossor 3102 - 60MHz Dual Channel ... £250
Gould OS 255 - 15MHz Dual Channel ... £150
Gould OS 3351 - 40MHz Dual Channel ... £220
Gould 5110 – 100MHz Intelligent oscilloscope ... £850
Gould 1602 – 20 MHz D.S.O. with printer (cursors) ... £1150
Hameg – 203/203-4/203-5/203-6 - 20 MHz Dual Channel ... from £175
Hewlett Packard 1740A, 1741A, 17744A, 100MHz dual ch ... from £350
Hewlett Packard 1707A, 1707B – 75MHz 2ch ... from £275
Hewlett Packard 54200A - 50MHz - 2 Ch Digitizing ... £1000
Hewlett Packard 54201A - 300MHz Digitizing ... £1750
Hewlett Packard 54501A - 100MHz - Digitizing 4 channel ... £1950
Hewlett Packard 54100D - 1GHz Digitizing ... £4500
Hewlett Packard 182C – 4 channel - 100 MHz ... £350
Hitachi V650F – 60 MHz Dual Channel ... £350
Hitachi VC6265 – 100 MHz Digital Storage (AS NEW) GPIB ... £2250
Intron 2020 – 20 MHz Digital Storage (NEW) ... £750
Iwatsu SS 5702 - 20MHz Dual Channel ... £175
Iwatsu SS 5121 - 100MHz Dual Channel ... £425
Iwatsu SS 5710 - 60MHz Dual Channel ... £375
Kikusui COS 6100 – 100MHz, 5 Channel, 12 Trace ... £475
Kikusui DSS 6522 - 20MHz Digital Storage ... £475
Kikusui DSS 6522 - 100MHz Dual Channel ... £425
Meguro - MSO 1270A - 20 MHz Digital Storage (NEW) ... £750
Nicolet 3091 – LF D.S.O. ... £1100
Panasonic VP5741A - 100 MHz D.S.O. with Digital readout - waveform analysis - TV Signal Analysis Function - G.P.I.B. ... £2500
Philips 3211, 3217, 3240, 3243, 3244, 3261, 3262 (2ch + 4ch) ... from £125
Philips 3219 - 50MHz with analogue storage ... £400
Philips PM 3295A - 400MHz Dual Channel ... £1950
Philips PM 3295 - 350MHz Dual Channel ... £1500
Philips PM 3315 - 60MHz - D.S.O. ... £750
Philips 3263 - 100MHz Dual Channel with Microprocessor Controlled Timing ... £400
Philips 3540 - Logic Scope (25MHz Scope & Logic Analyser) ... £350
Tektronix 434 - 25MHz - 2 Channel. Analogue Storage ... £250
Tektronix 454 - 150MHz - 2 Channel ... £4??
Tektronix 468 - 100MHz - D.S.O. ... £750
Tektronix 2213 – 60MHz Dual Channel ... £425
Tektronix 2215 60MHz dual trace ... £450
Tektronix 2236 - 100MHz Dual Channel with Counter/Timer ... £9??
Tektronix 2335 Dual trace 100MHz (portable) ... £750
Tektronix 2445 150 MHz - 4 Channel ... £1250
Tektronix 2445A - 150MHz - 4 Channel ... £165
Tektronix 2225 – 50MHz dual ch ... £450
Tektronix 455 - 50MHz Dual Channel ... £350
Tektronix 464/466 – 100MHz An storage ... from £350
Tektronix 465/465B – 100MHz dual ch ... from £350
Tektronix 475475A - 200MHz/250MHz Dual Channel ... from £475
Tektronix 7313, 7603, 7613, 7623, 7633, 100MHz 4 ch ... from £300
Tektronix 7704 – 250MHz 4 ch ... from £650
Tektronix 7904 – 500MHz ... from £850
Tektronix 7934 500MHZ with storage ... from £1000
Telequipment D83 - 50MHz Dual Channel ... £200
Telequipment DM63 - 20MHz - 4 Channel ... £150

Other scopes available too

SPECIAL OFFER
HITACHI V212 - 20 MHZ DUAL TRACE ... £180
HITACHI V222 - 20 MHZ DUAL TRACE + ALTERNATE MAGNIFY ... £200

SPECTRUM ANALYSERS

Advantest 4133A – 100KHz – 20 GHz ... £6995
Eaton/Alltech 757 – 10KHz – 22 GHz ... £2750
Hewlett Packard 3580A – -5Hz-50KHz ... £995
Hewlett Packard 3709B - Constellation Analyser with 15709A High Impedance Interface (As New) ... £5750
Hewlett Packard 182T with 8559A (10MHz – 21GHz) ... £3750
HP 3582A – 25KHz Analyser, dual channel ... £2500
Hewlett Packard 35601A - Spectrum Analyser Interface ... £1000
Hewlett Packard 141T + 8552B + 8555A - (10MHz – 18GHz) ... £1600
Hewlett Packard 8505A - Network Analyser (500KHz – 1.3GHz) ... £4000
Hewlett Packard 3562A Dual Channel Dynamic Sig. Analyser ... £7500
Hewlett Packard 8590A 15 10KHz-1.5 GHZ ... £4250
Hewlett Packard 8592A - 50KHz - 22GHz Portable ... £10,000
Marconi 2370 – 110MHz ... £995
Marconi 2371 – 30KHz - 200MHz ... £1250
Meguro MSA 4901 - 1-300 GHz (AS NEW) ... £1995
Meguro MSA 4912 - 1-1 GHz (AS NEW) ... £3000
Polrad 641-1 – 10MHz – 18GHz ... £1500
Rohde & Schwarz – SWOB 5 Polyskop 0.1 – 1300MHz ... £2500
Tektronix 2710 9 Khz - 1.8 GHz ... £4250
Tektronix 7L18 with 7603 mainframe (1.5-60GHz with external mixers) ... £2000

MISCELLANEOUS

AVO RM215 - L/2 - AC/DC Breakdown, Leakage + Ionisation Tester ... £400
ANRITSU ME 462B DF/3 Transmission Analyser ... £3000
Anritsu MG642A Pulse Pattern Generator ... £1500
California 751TC - AC variable Power Source ... £1200
Datalab DL 1080 Programmable Transient Recorder ... £350
Dyanpert TP20 Intelliplace – Tape peel Tester – immacualte condition ... £1950
E.I.P. 548A - Frequency Counter (26.5 GHz) ... £2995
EIP 331 – Frequency counter 18GHz ... £700
Farnell AP70-30 Power Supply (0-70v/30A) Auto Ranging ... £750
Farnell SSG-520 Signal Generator (520 MHZ) ... £400
Farnell TSV 70 MkII Power Supply (70V-5A or 35V-10A) ... £200
Flure 5100A - Calibrator ... £3500
Flure 5101B - Calibrator with Tape Deck ... £5000
Flure 5100B - Calibrator ... £4500
Heiden 1107 – 30V-10A Programmable Power Supply (IEEE) ... £650
Hewlett Packard 3437A System voltmeter ... £350
Hewlett Packard 3456A Digital voltmeter ... £850
Hewlett Packard 3438A Digital multimeter ... £200
Hewlett Packard 3711A/3712A/3791B/3793B Microwave Link Analyser ... £3500
Hewlett Packard 3776A - PCM Terminal Test Set ... £POA
Hewlett Packard 3325A - 21MHz Synthesiser/Function Gen ... £1500
Hewlett Packard 3488A - HP - 1B Switch control unit (various Plug-ins available) ... £650
Hewlett Packard 334A - Distortion Analyser ... £300
Hewlett Packard 339A - Distortion Measuring Set ... £1500
Hewlett Packard 3581A Wave Analyser ... £750
Hewlett Packard 3455A 61/2 Digit M/Meter (Autocal) ... £750
Hewlett Packard 3776A - PCM Terminal Test Set ... £P.O.A.
Hewlett Packard 3779 A/C - Primary Multiplex Analyser ... from £1000
Hewlett Packard 3779A/3779C - Primary Mux Analyser ... from £600
Hewlett Packard 4275A - LCR Meter (Multi-Frequency) ... £4250
Hewlett Packard 4342A - 'Q' Meter ... £995
Hewlett Packard 4954A - Protocol Analyser ... £2995
Hewlett Packard 4953A - Protocol Analyser ... £2750
Hewlett Packard 432A – Power Meter (with 478A Sensor) ... £275
Hewlett Packard 435A or B Power Meter (with 8481A/8484A) ... from £750
Hewlett Packard 4948A - (TIMS) Transmission Impairment M/Set ... £2000
Hewlett Packard 4729B - Carrier Noise Test Set ... £2000
Hewlett Packard 4261A - L.C.R. Meter (Digital) ... £500
Hewlett Packard 4271B - L.C.R. Meter (Digital) ... £900
Hewlett Packard 5420A Digital Signal Analyser ... £350
Hewlett Packard 5335A - 200MHz High Performance Systems Counter ... £600
Hewlett Packard 5342A - Frequency Counter 18 GHZ ... £1500
Hewlett Packard 5342A - Microwave Frequency Counter (18GHz) ... £1500
Hewlett Packard 5314A - (NEW) 100MHZ Universal Counter ... £250
Hewlett Packard 5183 - Waveform Recorder ... £2250
Hewlett Packard 5238A Frequency Counter 100MHz ... £250
Hewlett Packard 5370A - 100MHz Universal Timer/Counter ... £450
Hewlett Packard 5385A Frequency Counter - 1GHz - (HP1B) with OPTS 001/003/004/005 ... £995
Hewlett Packard 6034 - 60v-10a System Power Supply ... £1500
Hewlett Packard 6623A Triple output system power supply ... £1950
Hewlett Packard 6652A - System P.S.U. 20v-25a ... £1950
Hewlett Packard 6253A Power Supply 20V-3A Twin ... £200
Hewlett Packard 6181C D.C. current source ... £150
Hewlett Packard 6255A Power Supply 40V - 1.5A Twin ... £200
Hewlett Packard 6266B Power Supply 40V-5A ... £220
Hewlett Packard 6271B Power Supply 60V-3A ... £225
Hewlett Packard 6002A - Autoranging P.S.U. 50V - 10A ... £650
Hewlett Packard 6034A - 0-60V-10A System P.S.U. ... £1500
Hewlett Packard 7475A - 6 Pen Plotter ... £250
Hewlett Packard 7550A - 8 Pen Plotter A3/A4 ... £450

HEWLETT PACKARD 6261B
Power Supply 20v-50A £450 ***Discount for Quantities***

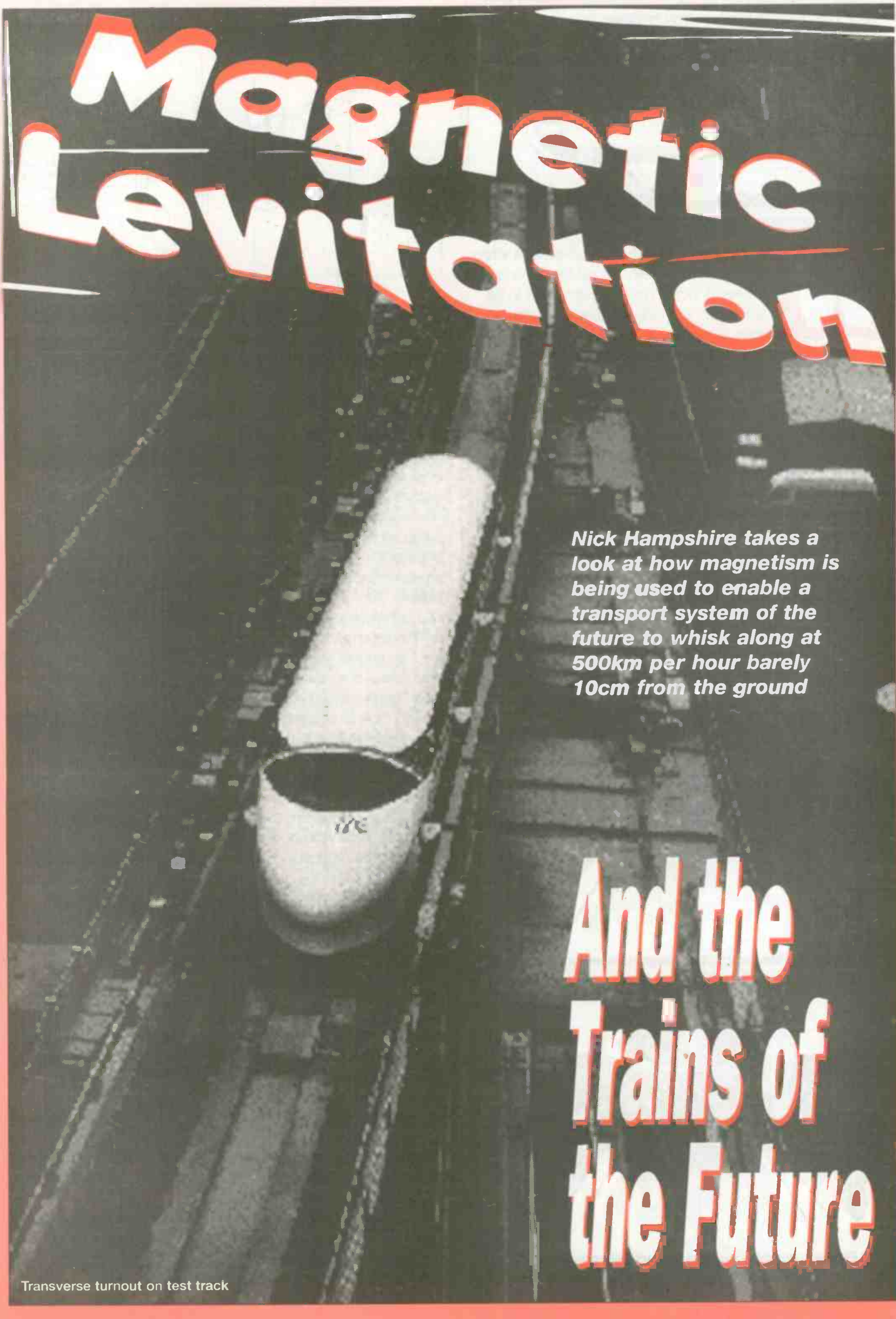
Hewlett Packard 8403A - Modulator ... £500
Hewlett Packard 8660D - Synthesised Sig Gen 10 KHZ-2.6 Ghz ... £4500
Hewlett Packard 8349B - Microwave Broadband 'Amplifier' (as new) 2 – 20GHz ... £4250
Hewlett Packard 8165A - 50 MHZ Programmable Signal Source ... £1650
Hewlett Packard 8350B - Sweep Oscillator Mainframe (various Plug-Ins available) extra ... £2650
Hewlett Packard 8656A - Synthesised Signal Gen (100KHz – 990MHz) ... £1750
Hewlett Packard 8683A - Microwave Signal Gen (2.3 6.5GHz) ... £2750
Hewlett Packard 8152A - Optical Average Power Meter ... £1250
Hewlett Packard 8158B - Optical Attenuator (OPTS 002 + 011) ... £1100
Hewlett Packard 83554A - Wave Source Module 26.5 to 40 GHz ... £3500
Hewlett Packard 8444A - Tracking Generator ... £775
Hewlett Packard 8011A Pulse gen. 0.1Hz-20MHz ... £500
Hewlett Packard 8620C Sweep oscillator mainframe ... £400
Hewlett Packard 8750A Storage normaliser ... £375
Hewlett Packard 8684A 5.4GHz to 12.5GHz Sig-Gen ... £2750
Hewlett Packard 8011A Pulse gen. 0.1Hz-20MHz ... £500
Hewlett Packard 8620C Sweep oscillator mainframe ... from £250
Hewlett Packard 8750A Storage normaliser ... £375
Hewlett Packard 8754A - Network Analyser 4 - 1300MHz ... £2950
Hewlett Packard 853A with 8559A - (0.01 – 21GHz) ... £4250
Hewlett Packard 8565A - (0.01 – 22GHz) ... £3750
Hewlett Packard 8684A 5.4GHz to 12.5GHz Sig-Gen ... £3500
Hewlett Packard 8903A - Audio Analyser (20Hz – 100KHz) ... £2600
Hewlett Packard 8958A - Cellular Radio Interface ... £4000
Hewlett Packard 8901A - Modulation Analyser ... £3400
Hewlett Packard P382A Variable Attenuator ... £250
Hewlett Packard 11729B - Carrier Noise Test Set ... £2000
Krohn-Hite 2200 Lin/Log Sweep Generator ... £995
Krohn-Hite 4024A Oscillator ... £250
Krohn-Hite 6500 Phase Meter ... £250
Marconi 2432A 500MHz digital freq. meter ... £200
Marconi - 2019A - 80KHz - 1040MHz - Synthesised Signal Generator ... £1950
Marconi 2871 Data Comms Analyser ... £2000
Marconi 6500 Automatic Amplitude Analyser ... £1750
Marconi 6960 (& 6910 Head) - Microwave Power Meter ... £900
Marconi 2018 - 80KHz - 520MHz SynthesisedAM/FM Signal Generator ... £950
Philips PM 5167 10MHz function gen ... £400
Philips 5190 L.F. Synthesiser (G.P.I.B.) ... £800
Philips 5390 Programmable R/F Signal Gen (1020 MHZ) ... £1250
Philips (5518-TX) - TV Pattern Generator ... £1500
Prema 4000 - 6 1/2 Digit Multimeter (NEW) ... £450
Racal Dana 9242D Programmable PSU 25V-2A ... £300
Racal Dana 9246S Programmable PSU 25V-10A ... £400
Racal Dana 3100 40-130MHz synthesiser ... £750
Racal 1992 - 1.3GHz Frequency Counter ... £800
Racal Dana 9081 Synth. sig. gen. 520MHz ... £550
Racal Dana 9084 Synth. sig. gen. 104MHz ... £450
Racal Dana 9303 True RMS/RFevel meter ... £650
Racal Dana 9303 R/F Level Meter & Head ... £650
Racal Dana 9917 UHF frequency meter 560MHz ... £175
Racal Dana 9302A R/F millivoltmeter (new version) ... £375
Racal Dana 9082 Synthesised am/fm sig gen (520MHz) ... £500
Racal 9085 Low Distortion Oscillator ... £POA
Racal 9301A - True RMS R/F Millivoltmeter ... £300
Racal 9921 - 3GHz Frequency Counter ... £450
Rohde & Schwarz AMF 2 - TV Demodulator ... £1250
Rohde & Schwarz LFM 2 - 60 Mhz Group Delay Sweep Gen ... £1600
Rohde & Schwarz UPSF 2 - Video Noise Meter ... £1400
Rohde & Schwarz - Scud Radio Code Test Set ... £500
Rohde & Schwarz SUF 2 Noise Generator ... £300
Rohde & Schwarz UPGS - Psophometer ... £150
Schaffner NSG 203A Line Voltage Variation Simulator ... £1250
Schaffner NSG 222A Interference Simulator ... £850
Schaffner NSG 223 Interference Generator ... £850
Schlumberger S.I. 4040 Stabilock - High accuracy 1GHz Radio Test Set ... £4995
Schlumberger 4923 Radio Code Test Set ... £1500
Schlumberger 4031 - 1GHz Radio Comms Test Set ... £7000
Schlumberger 2720 1250 MHz Frequency Counter ... £500
Stanford Research DS 340 - 15 MHz Synteslzed Function (NEW) and arbitrary waveform generator ... £1200
Systron Donner 6030 - Microwave Frequency Counter (26.5 GHz) ... £2750
Telequipment CT71 Curve Tracer ... £250
Tektronix TM5003 + AFG 5101 Arbitrary Function Gen. ... £1750
Tektronix 1240 Logic Analyser ... £750
Tektronix 651 HR Monitor ... POA
Tektronix DAS9100 – Series Logic Analyser ... £500
Tektronix – Plug-ins – many available such as SC504, SW503, SG502, PG508, FG504, FG503, TG501, TR503 + many more ... £POA
Tektronix 577 Curve Tracer ... £1150
Tektronix AM503 + TM501 + P6302 - Current Probe Amplifier ... £995
Tektronix PG506 + TG501 + SG503 + TM503 - Oscilloscope Calibrator ... £1995
Tektronix CG5001 - Programmable Oscilloscope Calibrator Generator ... £3995
Tektronix AA5001 & TM 5006 M/F - Programmable Distortion Analyser ... £2500
Tektronix 577 - Curve Tracer ... £1150
Time 9811 Programmable Resistance ... £600
Time 9814 Voltage Calibrator ... £750
Toellner7720 - Programmable 10 MHz Function Gen (AS NEW) ... £700
Wavetek 172B Programmable Sig Source (0.0001HZ-13MHZ) ... £P.O.A.
Wavetek 3010 – 1- 1GHz Signal Generator ... £1250
Wiltron 560 Scalar Network Analyser ... £800
Wiltron 6620S - Programmable Sweep Generator (3.6 - 6.5GMZ) ... £650

MANY MORE ITEMS AVAILABLE – SEND LARGE S.A.E. FOR LIST OF EQUIPMENT
ALL EQUIPMENT IS USED – WITH 30 DAYS GUARANTEE.
PLEASE CHECK FOR AVAILABILITY BEFORE ORDERING – CARRIAGE & VAT TO BE ADDED TO ALL GOODS

Magnetic Levitation

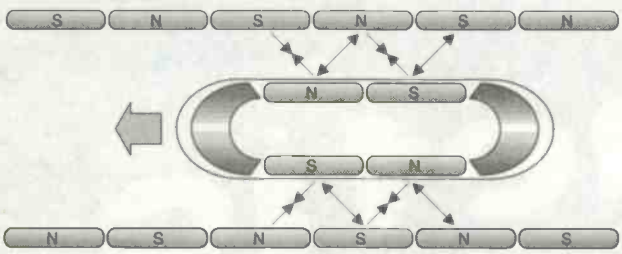
Nick Hampshire takes a look at how magnetism is being used to enable a transport system of the future to whisk along at 500km per hour barely 10cm from the ground

And the Trains of the Future



Transverse turnout on test track

Figure 1: superconducting magnet levitation



We have probably all had those dreams where one floats effortlessly across the surface of the earth. Some mystics even claim to be able to do it, although no-one has actually seen them floating through the countryside, and their techniques seem to rely more upon the effects of excessive ascetic zeal or drug taking than on science. But then we all know that gravity ensures that, barring the use of a great deal of energy, or of helium-filled balloons, or various aerodynamic effects, we will always be firmly placed upon the earth's surface. And, as we all know from painful experience of falling down, gravity is a force to be reckoned with. Anti-gravity devices may be beloved of science fiction writers and film makers, but they are totally outside the range of our current knowledge. So how is it that at various experimental sites across the world there are devices weighing many tons that can float a few centimetres above the ground without the aid of jet engines, helium, or aerodynamic surfaces? The answer lies in the use of magnetic fields to generate repulsive forces to create levitation. It is the well known effect that we discovered as kids playing with a couple of magnets, the fact that like poles repel

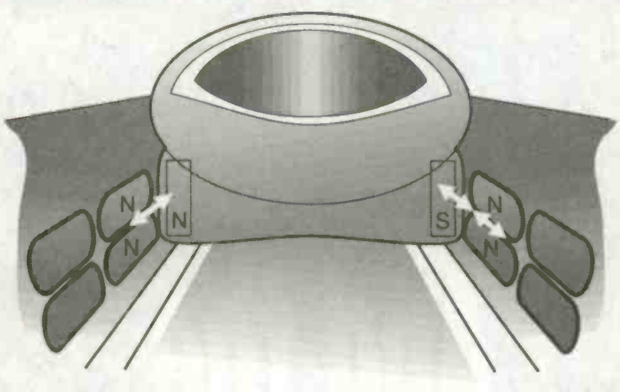


Figure 2: superconducting magnet based guidence

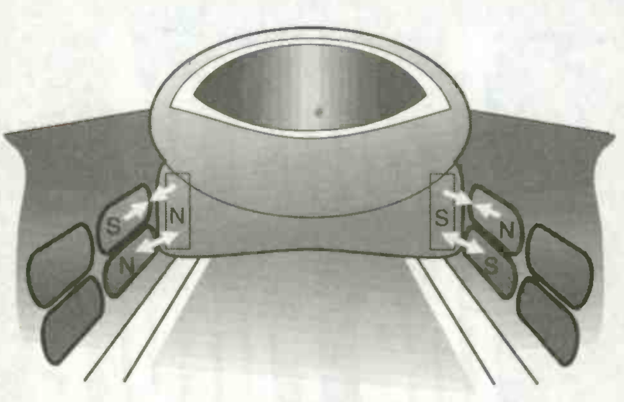


Figure 3: superconducting magnet based propulsion

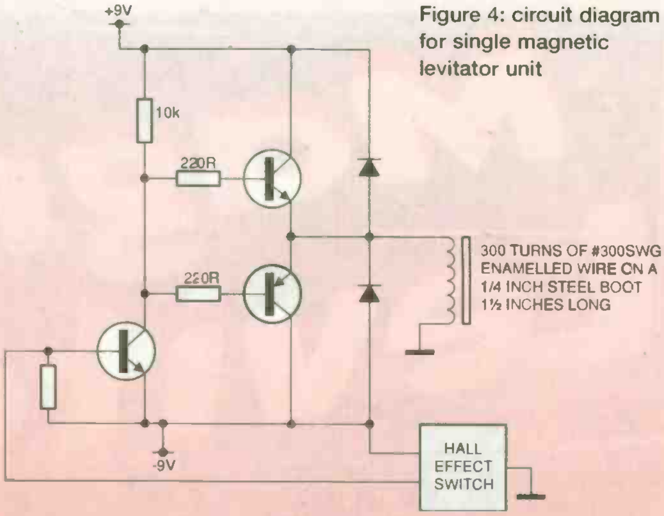


Figure 4: circuit diagram for single magnetic levitator unit

and opposite poles attract. The force of this repulsion and attraction is sometimes so strong that it is virtually impossible to push two like poles together.

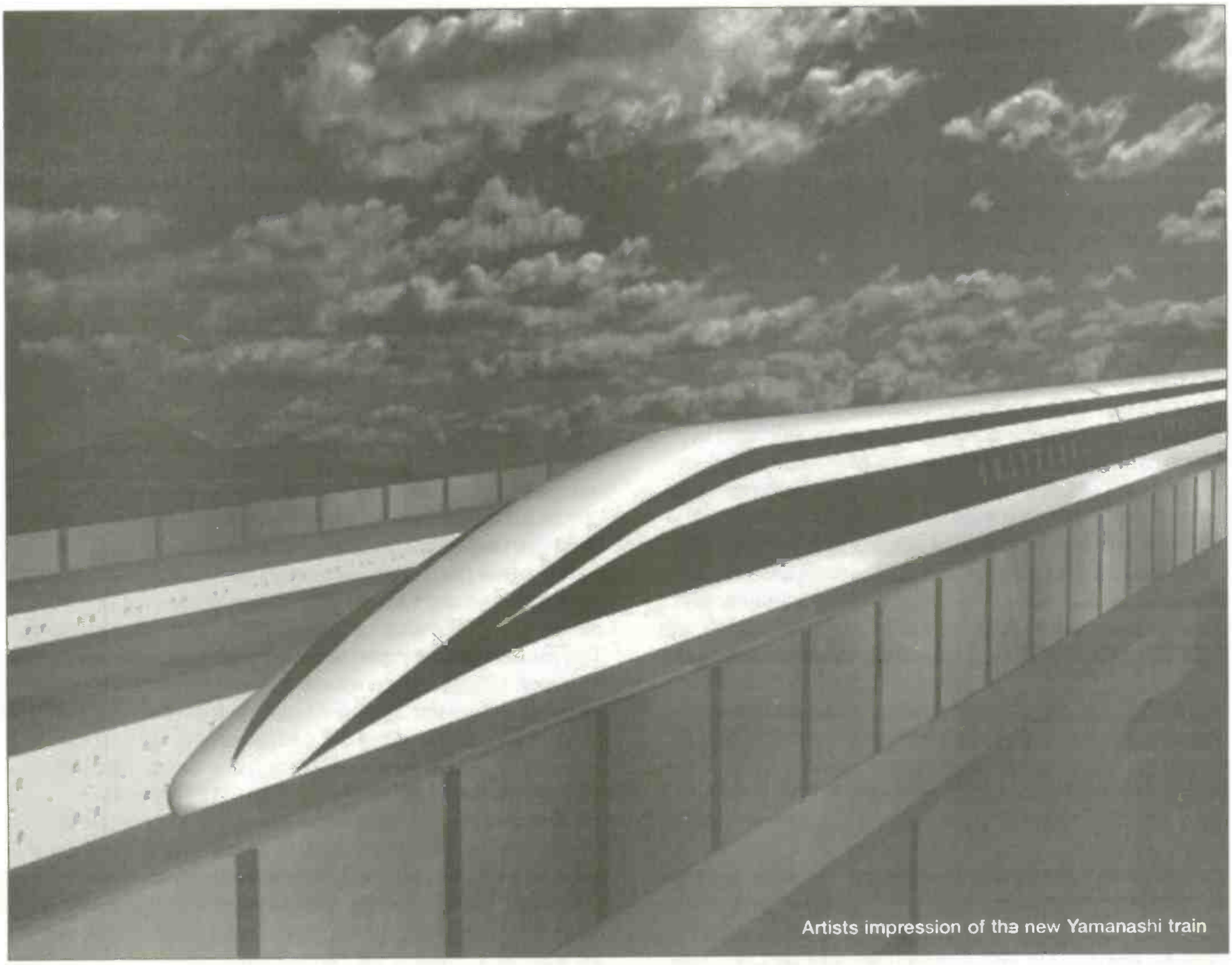
Floating on magnets

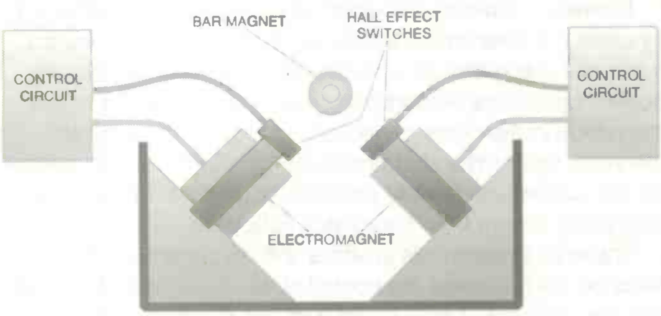
The forces of repulsion and attraction between two magnets or between a magnet and a piece of iron can be enormous, capable of lifting many times the weight of the magnet itself. We only have to think of the electromagnetic grabs used in scrap yards to lift and move tons of scrap iron. In a reverse manner it is therefore reasonable to think of using magnetic repulsive force to lift or, in other words, float quite heavy objects. You can prove this in a simple experiment: if you place two bar magnets with like poles together in a tube of sufficiently small dimensions to keep their ends in alignment the top magnet will 'float' above the bottom magnet. You can then add a considerable weight to the top magnet before the 'float' gap is closed completely.

This type of observation goes back hundreds of years, long before electricity was discovered, and it is not surprising therefore that the concept of using magnetic repulsion in some form of transport system is equally old. However, any attempts to put these ideas into practice using conventional permanent magnets were doomed because of the inherent instability of magnetic fields. Note that in the above experiment we had to keep the two magnets in alignment using a tube (see Box 1 for an explanation of the instability problem). This means that without severely constraining movement it is impossible to build, say a "maglev" - the term used by magnetic levitation researchers all over the world for many years now - train, using conventional permanent magnets.

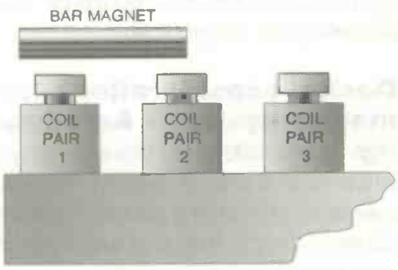
With the discovery of electromagnetism there was renewed interest in the concept, but all attempts were again doomed to failure by the same problems of instability. Nevertheless, at the same time, engineers and scientists managed to harness the forces of magnetic repulsion/attraction in the electric motor. Here, a number of electromagnets built into the rotor are alternately switched in polarity using a commutator, so that the rotor electromagnets alternately repel and attract the poles of a fixed permanent magnet, the resultant forces generating a rotation of the rotor. In an electric motor the instability problem does not arise because the entire structure is fixed in position using bearings on the rotor shaft.

The development of electronics meant that the mechanical assembly of commutator and brushes used in conventional electric motors could be replaced by electronic switching techniques. An example of this is the stepper motor. But, for





Figures 5a & 5b: construction of a magnetic levitation track using multiple levitator



the developers of maglev transport systems, this also meant that it was possible to use the electric motor principle to generate linear motion. Linear motion systems were developed in the early 1960s (primarily in the UK) by simply opening out the electromagnetic coils in a motor to produce a linear sequence of magnets, forming what was called a linear motor. By electronically switching these coils in the same type of sequence used in an electric motor it was possible to move a magnetic object along the line of coils, floating just above them. Reverse the sequence and the object would move in the other direction. This was the first practical step towards a maglev train, it demonstrated all the key requirements for such a system: levitation above a track, and motion along the track with controllable direction and speed.

The Japanese approach

The British pioneered the technology in the 60s and early 70s, but all funding was cut off in an ill-judged bout of Government cost-cutting during the early 70s. But, despite this setback, there has been ongoing research in both Japan and Germany for the last 30 years as we said before (see Table 1 for a history of Japanese maglev development). Of these two countries Japan has made by far the biggest commitment to research and development of a full commercial maglev train.

Japanese engineers working on this project at RTRI have developed a system which uses a combination of superconducting magnets and the old British developed linear motor technology. Using this combination they have built and designed a series of prototype maglev vehicles that fulfil the designers' aims of super high-speed, high safety factors, high reliability, low environmental impact and minimum maintenance.

The research and development program for Maglev (the name given to the project which combines superconducting technology and linear motors) has been underway at RTRI since 1970. The first few years were spent on laboratory tests to verify the feasibility of running such a train at speeds of up to 500km/h. The success of these early tests led in 1975 to commencement of the construction of a 7-km test track. This facility was opened in April 1977 and has subsequently enabled the engineers to test full sized prototypes. The Miyazaki test track is located in Miyazaki Prefecture. It has a length of 7km and minimum radius curvature of 10,000m. On this test track in 1979, an early prototype model, the ML-500, attained 517km/h using an inverted-T shape guideway. The guideway was modified to U shape in the next year. A manned two-car vehicle, the MLU001, first ran in November 1981, and registered a speed of 400.8km/h in 1987.

The latest vehicle, the MLU002N, was unveiled in 1993 and is running on the Miyazaki test track today. It reached a speed of 431km/h last January. One of the main aims behind the current development work being conducted by RTRI is enhancement of the reliability and durability of the superconducting magnet (SCM). The SCM suffers from external magnetic disturbances caused by the presence of the ground coils and from mechanical vibrations generated by vehicle dynamics. These disturbances cause quenching troubles, or the sudden disappearance of magnetomotive force of the SCM. RTRI's engineers have been studying these problems with a comprehensive range of test studies, and have, as a result, developed countermeasures such as stiffening the SCM and decreasing the total current density of superconducting coils. Besides the problems associated with the SCM the designers are also working on a whole range of developments, such as aerodynamic brakes that use the aerodynamic drag of panels on the car roof; disc brakes for high-speed running; ground coils which consist of sidewall levitation coils and double-layer propulsion coils; a high-power supply system for pulse width modulation (PWM) inverters using gate turn-off (GTO) thyristors, and turnouts for high- or low-speed passing.

The success of the Maglev project prompted the Japanese Government to increase funding in 1990, and at the same time authorise the construction of a new test line which should allow the designers to take development right up to the final design of the first Maglev systems for public use. The new test line named Yamanashi Maglev Test Line is now under construction. The Yamanashi test line is being built in the Yamanashi Prefecture and It is expected that the first test run will start in spring, 1997. Two trains will be able to run at a speed of about 500km/h (the target speed is over 550km/h) on the Yamanashi test line which has a curve section (minimum radius curvature of 8,000m), a steep-slope section (maximum gradient of 4%), a tunnel section, and double-track section (5.8m between track centres). In addition, the track site will incorporate a planned facility for performing operational simulation tests that involve vehicles, power conversion stations, train control systems, guideways, and environmental considerations.

How does a Superconducting Maglev actually work?

The current Japanese development work on a maglev train is based upon the use of both linear motor technology and superconducting magnet technology. These are combined into a very complex system which has some components mounted in the track and others in the moving train. Mounted in the train bogie units are the superconducting magnets, and in the walls of the U-shaped track is a sequence of figure eight shaped electromagnetic coils that are linked under the track, or guideway, as it is more commonly called.

We can divide the operation of the system into three distinct areas: magnetic levitation, lateral guidance and propulsion. The levitation height is about 10cms, with similar gaps between the train and the guideway side walls, and as we have already seen the design speed for the system is up to 550Km/hr. These are design tolerances and speeds that have pushed the technology to the limit (we will be looking at some of these design problems later on in this article).

Magnetic levitation (figure 1) depends upon the interaction of the coils mounted on the guideway walls and the bogie mounted superconducting magnets. The figure-eight shaped levitation coils are installed on both the side walls of the guideway in a position so that when the on-board superconducting magnets pass at high-speed they are several centimetres under the axes of these coils. The result of having a superconducting magnet passing each pair of coils is that an electric current is induced within the coils, which then temporarily act as electromagnets.

The coils thus generate two magnetic forces which act at the same time, on the one hand pushing the superconducting magnets upwards, and on the other hand pulling them upwards, thereby levitating the maglev bogie. With such a small gap between the guideway side walls and the maglev vehicle lateral guidance is extremely important. At very high speeds even a slight scraping of the vehicle against one wall due to, say, the pressure of a side wind, could be catastrophic. This means that it is important that the control system is as foolproof, simple, and completely automatic as possible. The technique which the Japanese team have employed certainly meets these criteria. What the designers have done is to connect the two levitation coils facing each other (figure 2), forming a circuit loop. When a maglev vehicle with its superconducting magnets is displaced laterally, an electric current is induced in this loop, with the result that a repulsive force acts on the levitation coil near the bogie and an attractive force acts on the other levitation coil that is farther apart from the bogie. The two forces thus automatically pull the train back towards the centre of the track.

Forward or reverse propulsion of a maglev train is achieved by using the linear motor technique (figure 3). This means that a repulsive force and an attractive force induced between the bogie mounted superconducting magnets are used to propel the vehicle in the desired direction. To provide the required magnetic repulsion and attraction the propulsion coils located on the guideway side walls are energised by the three-phase alternating current from a trackside substation.

These propulsion coils create a shifting pattern of magnetic fields on the guideway, the control of which can determine not only direction but speed. Faced with this shifting pattern of magnetic fields, the bogie mounted superconducting magnets are both attracted and pushed by the shifting field, thus propelling the maglev train.

Design considerations for a commercial maglev system - Aerodynamic Issues

High-speed (500Km/h) trains using magnetic levitation have a whole host of unique design problems which must be overcome prior to the development and use of commercial systems. One of the most important of these is the aerodynamics of the vehicle.

The technological success of high speed maglev vehicles, like most aerospace systems, hinges upon a good aerodynamic design - a very large part of the design process is influenced by aerodynamic considerations. Such considerations have a major role in determining propulsion techniques, structural design, and control system

Continued on P. 16

DC TO DC CONVERTERS
DRM58 input 10-40vdc output 5v 8A £15
DRM128 input 17-40vdc output 12v 8A £50
DRM158 input 20-40vdc output 15v 8A £50
DRM248 input 29-40vdc output 24v 8A £40
DRS123 input 17-40vdc output 12v 3A £20
DRS153 input 20-40vdc output 15v 3A £20
DRS243 input 29-40vdc output 24v 3A £15

SOLID STATE RELAYS
CMP-DC-200P 3-32vdc operation, 0-200vdc 1A £2.50
SMT20000/3 3-24vdc operation, 28-280vac 3A £4.50
SMT20000/4 3-24vdc operation, 28-280vac 4A £5.00
ZRA6025F 28-280vd/ac operation, 28-280vac 25A £7.00

200 WATT INVERTERS Nicely cased units 12v input 240v output 150watt continuous, 200 max. £49 ref LOT62.

6.8MW HELIUM NEON LASERS New units, £65 ref LOT33

COINSLOT TOKENS You may have a use for these? mixed bag of 100 tokens £10 ref LOT20.

PORTABLE X RAY MACHINE PLANS Easy to construct plans on a simple and cheap way to build a home X-ray machine! Effective device, X-ray sealed assemblies, can be used for experimental purposes. Not a toy or for minors! £6/set. Ref F/XP1.

TELEKINETIC ENHANCER PLANS Mystify and amaze your friends by creating motion with no known apparent means or cause. Uses no electrical or mechanical connections, no special gimmicks yet produces positive motion and effect. Excellent for science projects, magic shows, party demonstrations or serious research & development of this strange and amazing phychic phenomenon. £4/set Ref F/TKE1.

ELECTRONIC HYPNOSIS PLANS & DATA This data shows several ways to put subjects under your control. Included is a full volume reference text and several construction plans that when assembled can produce highly effective stimuli. This material must be used cautiously. It is for use as entertainment at parties etc only, by those experienced in its use. £15/set. Ref F/EH2.

GRAVITY GENERATOR PLANS This unique plan demonstrates a simple electrical phenomena that produces an anti-gravity effect. You can actually build a small mock spaceship out of simple materials and without any visible means- cause it to levitate. £10/set Ref F/GRA1.

WORLDS SMALLEST TESLA COIL/LIGHTENING DISPLAY GLOBE PLANS Produces up to 750,000 volts of discharge, experiment with extraordinary HV effects, 'Plasma in a jar', St Elmo's fire, Corona, excellent science project or conversation piece. £5/set Ref F/BTC1/LG5.

COPPER VAPOUR LASER PLANS Produces 100mw of visible green light. High coherency and spectral quality similar to Argon laser but easier and less costly to build yet far more efficient. This particular design was developed at the Atomic Energy Commision of NEGEV in Israel. £10/set Ref F/CVL1.

VOICE SCRAMBLER PLANS Minature solid state system turns speech sound into indecipherable noise that cannot be understood without a second matching unit. Use on telephone to prevent third party listening and bugging. £6/set Ref F/VS9.

PULSED TV JOKER PLANS Little hand held device utilises pulse techniques that will completely disrupt TV picture and sound! works on FM too! DISCRETION ADVISED. £8/set Ref F/TJ5.

BODYHEAT TELESCOPE PLANS Highly directional long range device uses recent technology to detect the presence of living bodies, warm and hot spots, heat leaks etc. Intended for security, law enforcement, research and development, etc. Excellent security device or very interesting science project. £8/set Ref F/BHT1.

BURNING, CUTTING CO2 LASER PLANS Projects an invisible beam of heat capable of burning and melting materials over a considerable distance. This laser is one of the most efficient, converting 10% input power into useful output. Not only is this device a workhorse in welding, cutting and heat processing materials but it is also a likely candidate as an effective directed energy beam weapon against missiles, aircraft, ground-to-ground, etc. Particle beams may very well utilize a laser of this type to blast a channel in the atmosphere for a high energy stream of neutrons or other particles. The device is easily applicable to burning and etching wood, cutting, plastics, textiles etc £12/set Ref F/LC7.

MYSTERY ANTI GRAVITY DEVICE PLANS Uses simple concept. Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or science project. £6/set Ref F/ANT1K.

ULTRASONIC BLASTER PLANS Laboratory source of sonic shock waves. Blow holes in metal, produce 'cold' steam, atomize liquides. Many cleaning uses for PC boards, jewllery, coins, small parts etc. £6/set Ref F/ULB1.

ULTRA HIGH GAIN AMP/STETHOSCOPIC MIKE/SOUND AND VIBRATION DETECTOR PLANS Ultrasensitive device enables one to hear a whole new world of sounds. Listen through walls, windows, floors etc. Many applications shown, from law enforcement, nature listening, medical heartbeat, to mechanical devices. £6/set Ref F/HGA7

ANTI DOG FORCE FIELD PLANS Highly effective circuit produces time variable pulses of accoustical energy that dogs cannot tolerate £6/set Ref F/DOG2

LASER BOUNCE LISTENER SYSTEM PLANS Allows you to hear sounds from a premises without gaining access. £12/set Ref F/LLIST1

LASER LIGHT SHOW PLANS Do it yourself plans show three methods. £6 Ref F/LLS1

PHASOR BLAST WAVE PISTOL SERIES PLANS Handheld, has large transducer and battery capacity with external controls. £6/set Ref F/PSP4

INFINITY TRANSMITTER PLANS Telephone line grabber/room monitor. The ultimate in home/office security and safety! simple to use! Call your home or office phone, push a secret tone on your telephone to access either: A) On premises sound and voices or B) Existing conversation with break-in capability for emergency messages. £7 Ref F/TELEGRAB.

BUG DETECTOR PLANS Is that someone getting the goods on you? Easy to construct device locates any hidden source of radio energy! Sniffs out and finds bugs and other sources of bothersome interference. Detects low, high and UHF frequencies. £5/set Ref F/BD1.

WOLVERHAMPTON BRANCH NOW OPEN AT WORCESTER ST W'HAMPTON TEL 01902 22039

ELECTROMAGNETIC GUN PLANS Projects a metal object a considerable distance-requires adult supervision £5 ref F/EML2.

ELECTRIC MAN PLANS, SHOCK PEOPLE WITH THE TOUCH OF YOUR HAND! £5/set Ref F/EMA1.

PARABOLIC DISH MICROPHONE PLANS Listen to distant sounds and voices, open windows, sound sources in 'hard to get' or hostile premises. Uses satellite technology to gather distant sounds and focus them to our ultra sensitive electronics. Plans also show an optional wireless link system. £8/set ref F/PM5

2 FOR 1 MULTIFUNCTIONAL HIGH FREQUENCY AND HIGH DC VOLTAGE, SOLID STATE TESLA COIL AND VARIABLE 100,000 VDC OUTPUT GENERATOR PLANS Operates on 9-12vdc, many possible experiments. £10 Ref F/HVM7/TCL4.

INFINITY TRANSMITTERS The ultimate 'bug' fits to any phone or line, undetectable, listen to the conversations in the room from anywhere in the world! 24 hours a day 7 days a week! just call the number and press a button on the mini controller (supplied) and you can hear everything! Monitor conversations for as long as you choose £249 each, complete with leads and mini controller! Ref LOT9. Undetectable with normal RF detectors, fitted in seconds, no batteries required, lasts forever!

SWITCHED MODE PSU'S 244 watt, +5 32A, +12 6A, -5 0.2A, -12 0.2A. There is also an optional 3.3v 25A rail available. 120/240v I/P. Cased, 175x90x145mm. IEC inlet Suitable for PC use (6 d/drive connectors 1 m/board). £10 ref PSU1.

VIDEO PROCESSOR UNITS?/6v 10AH BATTS/12V 8A TX Not too sure what the function of these units is but they certainly make good strippers! Measures 390X320X120mm, on the front are controls for scan speed, scan delay, scan mode, loads of connections on the rear. Inside 2 x 6v 10AH sealed lead acid batts, pcb's and a 8A? 12v torroidial transformer (mains in). Condition not known, may have one or two broken knobs due to poor storage. £17.50 ref VP2

RETRON NIGHT SIGHT Recognition of a standing man at 300m in 1/4 moonlight, hermatically sealed, runs on 2 AA batteries, 80mm F1.5 lens, 20mw infrared laser included. £325 ref RETRON.

MINI FM TRANSMITTER KIT Very high gain preamp, supplied complete with FET electret microphone. Designed to cover 88-108 Mhz but easily changed to cover 63-130 Mhz. Works with a common 9v (PP3) battery. 0.2W RF. £7 Ref 1001.

3-30V POWER SUPPLY KIT Variable, stabilized power supply for lab use. Short circuit protected, suitable for profesional or amateur use 24v 3A transformer is needed to complete the kit. £14 Ref 1007.

1 WATT FM TRANSMITTER KIT Supplied with piezo electric mic. 8-30vdc. At 25-30v you will get nearly 2 watts! £12 ref 1009.

FM/AM SCANNER KIT Well not quite, you have to turn the knob yourself but you will hear things on this radio that you would not hear on an ordinary radio (even TV). Covers 50-160mhz on both AM and FM. Built in 5 watt amplifier, inc speaker. £15 ref 1013.

3 CHANNEL SOUND TO LIGHT KIT Wireless system, mains operated, separate sensitivity adjustment for each channel, 1,200 w power handling, microphone included. £14 Ref 1014.

4 WATT FM TRANSMITTER KIT Small but powerful FM transmitter, 3 RF stages, microphone and audio preamp included. £20 Ref 1028.

STROBE LIGHT KIT Adjustable from 1-60 hz (a lot faster than conventional strobes). Mains operated. £16 Ref 1037.

COMBINATION LOCK KIT 9 key, programmable, complete with keypad, will switch 2A mains. 9v dc operation. £10 ref 1114.

PHONE BUG DETECTOR KIT This device will warn you if somebody is eavesdropping on your line. £5 ref 1130.

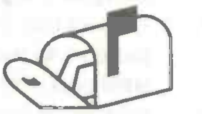
ROBOT VOICE KIT Interesting circuit that distorts your voice! adjustable, answer the phone with a different voice! 12vdc £9 ref 1131

TELEPHONE BUG KIT Small bug powered by the 'phone line, starts transmitting as soon as the phone is picked up! £8 Ref 1135.

3 CHANNEL LIGHT CHASER KIT 800 watts per channel, speed and direction controls supplied with 12 LEDS (you can fit triacs instead to make kit mains, not supplied) 9-12vdc £17 ref 1026.

12V FLOURESCENT LAMP DRIVER KIT Light up 4 foot tubes from your car battery! 9v 2a transformer also required. £8 ref 1069.

VOX SWITCH KIT Sound activated switch ideal for making bugging tape recorders etc, adjustable sensitivity. £8 ref 1073.



Check out our WEB SITE

http://www.pavilion.co.uk/bull-electrical

PREAMP MIXER KIT 3 input mono mixer, sep bass and treble controls plus individual level controls, 18vdc, input sens 100mA. £15 ref 1052.

*SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

BULL ELECTRICAL
250 PORTLAND ROAD, HOVE, SUSSEX.
BN3 5QT. (ESTABLISHED 50 YEARS).
MAIL ORDER TERMS: CASH, PO OR CHEQUE WITH ORDER PLUS £3 P&P PLUS VAT.
PLEASE ALLOW 7-10 DAYS FOR DELIVERY PHONE ORDERS WELCOME (ACCESS, VISA, SWITCH, AMERICAN EXPRESS)
TEL: 01273 203500
FAX 01273 323077
E-mail bull@pavilion.co.uk

SOUND EFFECTS GENERATOR KIT Produces sounds ranging from bird chips to sirens. Complete with speaker, add sound effects to your projects for just £9 ref 1045.

15 WATT FM TRANSMITTER (BUILT) 4 stage high power, preamp required 12-18vdc, can use ground plane, yagi or open dipole. £69 ref 1021.

HUMIDITY METER KIT Builds into a precision LCD humidity meter, 9 ic design, pcb, lcd display and all components included. £29

PC TIMER KIT Four channel output controlled by your PC, will switch high current mains with relays (supplied). Software supplied so you can program the channels to do what you want whenever you want. Minimum system configeration is 286, VGA, 4.1,640k, serial port, hard drive with min 100k free. £24.99

FM CORDLESS MICROPHONE This unit is an FM broadcasting station in minature, 3 transistor transmitter with electret condenser mic+fet amp design result in maximum sensitivity and broad frequency response. 90-105mhz, 50-1500hz, 500 foot range in open country! PP3 battery required. £15.00 ref 15P42A.

MAGNETIC MARBLES They have been around for a number of years but still give rise to curiosity and amazement. A pack of 12 is just £3.99 ref GI/R20

NICKEL PLATING KIT Proffesional electroplating kit that will transform rusting parts into showpieces in 3 hours! Will plate onto steel, iron, bronze, gunmetal, copper, welded, silver soldered or brazed joints. Kit includes enough to plate 1,000 sq inches. You will also need a 12v supply, a container and 2 12v light bulbs. £39.99 ref NIK39.

Minature adjustable timers, 4 pole c/o output 3A 240v,
HY1230S, 12vDC adjustable from 0-30 secs. £4.99
HY1260M, 12vDC adjustable from 0-60 mins. £4.99
HY2405S, 240v adjustable from 0-5 secs. £4.99
HY24060m, 240v adjustable from 0-60 mins. £6.99

BUGGING TAPE RECORDER Small voice activated recorder, uses micro cassette complete with headphones. £28.99 ref MAR29P1.

POWER SUPPLY fully cased with mains and o/p leads 17v DC 900mA output. Bargain price £5.99 ref MAG6P9

9v DC POWER SUPPLY Standard plug in type 150ma 9v DC with lead and DC power plug. price for two is £2.99 ref AUG3P4.

COMPOSITE VIDEO KIT. Converts composite video into separate H sync, V sync, and video. 12v DC. £8.00 REF: MAG8P2.

FUTURE PC POWER SUPPLIES These are 295x135x60mm, 4 drive connectors 1 mother board connector. 150watt, 12v fan, iec inlet and on/off switch. £12 Ref EF6.

VENUS FLYTRAP KIT Grow your own carnivorous plant with this simple kit £3 ref EF34.

6"X12" AMORPHOUS SOLAR PANEL 12v 155x310mm 130mA. Bargain price just £5.99 ea REF MAG6P12.

FIBRE OPTIC CABLE BUMPER PACK 10 metres for £4.99 ref MAG5P13 ideal for experimenters! 30 m for £12.99 ref MAG13P1

ROCK LIGHTS Unusual things these, two pieces of rock that glow when rubbed together! belived to cause rain! £3 a pair Ref EF29.

3' by 1' AMORPHOUS SOLAR PANELS 14.5v, 700mA 10 watts, aluminium frame, screw terminals, £44.95 ref MAG45.

ELECTRONIC ACCUPUNCTURE KIT Builds into an electronic version instead of needles! good to experiment with. £7 ref 7P30

SHOCKING COIL KIT Build this little battery operated device into all sorts of things, also gets worms out of the ground! £7 ref 7P36.

FLYING PARROTS Easily assembled kit that builds a parrot that actually flaps its wings and flies! 50 m range £6 ref EF2.

HIGH POWER CATAPULTS Hinged arm brace for stability, tempered steel yoke, super strength latex power bands. Departure speed of ammunition is in excess of 200 miles per hour! Range of over 200 metres! £7.99 ref R/9.

BALLON MANUFACTURING KIT British made, small blob blows into a large, longlasting balloon, hours of fun! £3.99 ref GI/E99R

9-0-9V 4A TRANSFORMERS, chassis mount. £7 ref LOT19A.

2.5 KILOWATT INVERTERS, Packed with batteries etc but as they weigh about 100kg CALLERS ONLY! £120.

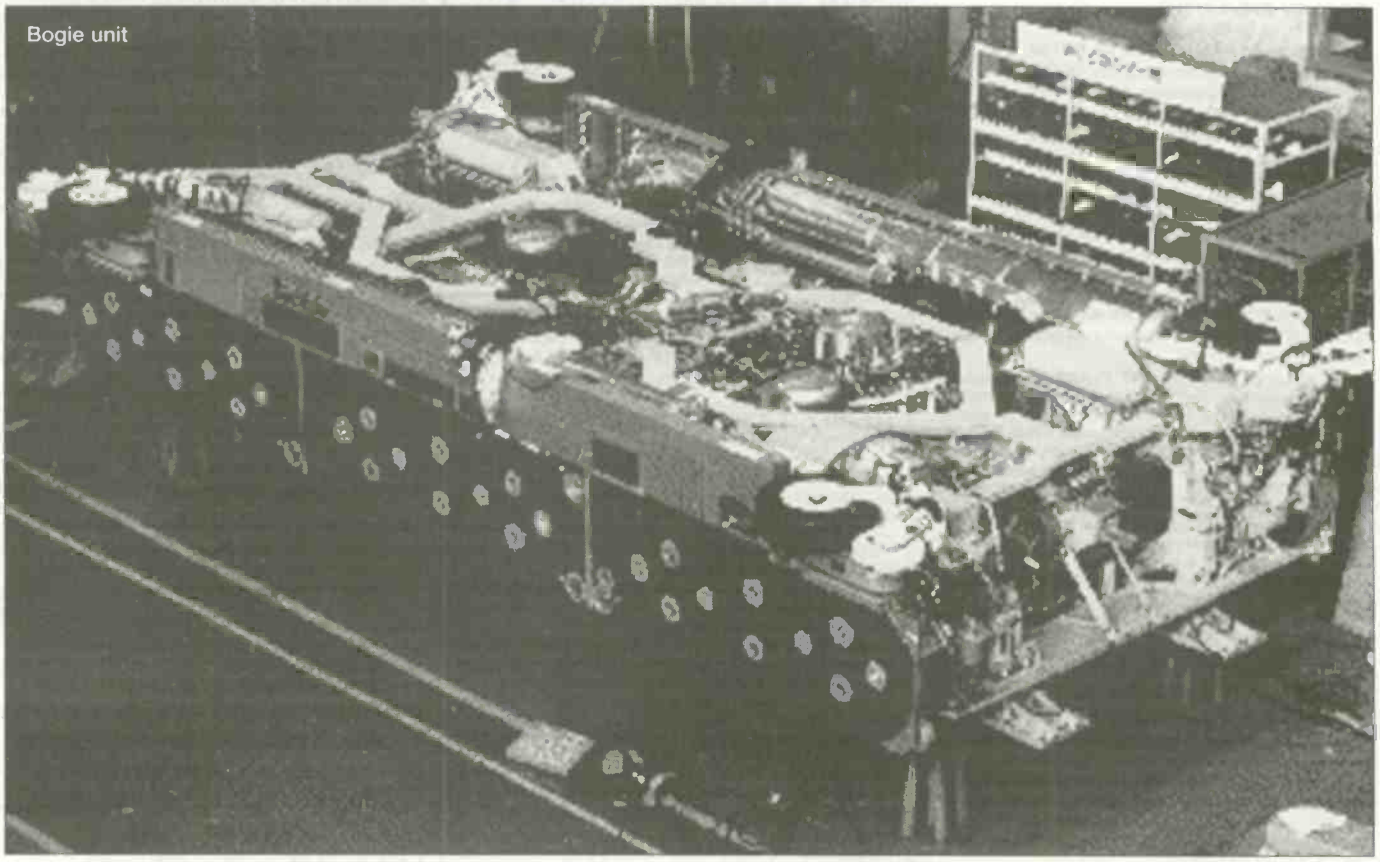
MEGA LED DISPLAYS Build your self a clock or something with these mega 7 seg displays 55mm high, 38mm wide. 5 on a pcb for just £4.99 ref LOT16 or a bumper pack of 50 displays for just £29 ref LOT17.

CLEARANCE SECTION, MINIMUM ORDER £15, NO TECHNICAL DETAILS AVAILABLE, NO RETURNS, TRADE WELCOME.

2000 RESISTORS ON A REEL (SAME VALUE) 99P REF BAR340
AT LEAST 200 CAPACITORS (SAME VALUE 99P REF BAR342
INFRA RED REMOTE CONTROLS JUST 99P REF BAR333
CIRCUIT BREAKERS, OUR CHOICE TO CLEAR 99P REF BAR335
MICROWAVE CONTROL PANELS TO CLEAR £2 REF BAR 329
2 TUBES OF CHIPS(2 TYPES OUR CHOICE) 90P REF BAR305
LOTTERY PREDICTOR MACHINE!! JUST £1.50 REF BAR313
HELLA/ROVER ELECTRIC H/LAMP LEVELLER £2 REF BAR311
SINCLAIR C5 16" TYRES TO CLEAR AT JUST 75P REF BAR318
LARGE MAINS MOTORS (NEW) TO CLEAR AT 75P REF BAR310
MODEMS ETC FOR STRIPPING £2.50 EACH REF BAR324
110V LARGE MOTORS (NEW) TO CLEAR AT 50P REF BAR332
MODULATOR UNITS UNKNOWN SPEC JUST 50P REF BAR323
GX4000 GAMES COSOLES JUST £4 REF BAR320
SMART CASED MEMORY STORAGE DEVICE, LOADS OF BITS INSIDE, PCB, MOTOR, CASE ETC. BUMPER PACK OF 5 COMPLETE UNITS TO CLEAR AT £2.50(FOR 5) REF BAR 330.
2CORE MAINS CABLE 2M LENGTHS PACK OF 4 £1 REF BAR337
PC USER/BASIC MANUALS, LOADS OF INFO. £1 REF BAR304
PCB STRIPPERS TO CLEAR AT 2 FOR 99P REF BAR341
3 M 3CORE MAINS CABLE AND 13A PLUG. 80P REF BAR325

WE BUY SURPLUS STOCK FOR CASH
BUYERS DIRECT LINE 0802 660377

FREE CATALOGUE
100 PAGE CATALOGUE NOW AVAILABLE, 45P STAMPS.



Continued from P. 14

requirements, not to mention the manufacture of the vehicle, its unit cost, and its life cycle cost. The aerodynamic problems involved in the design of maglev vehicles differ greatly from that of aircraft and conventional trains. The most important of these problems is the need to minimise the aerodynamic drag. At proposed speeds of 500Km/hr or more, which in aircraft terms is the same as 0.4 times the speed of sound (Mach 0.4) aerodynamic drag will be the largest component of drag. At lower speeds it is magnetic drag which is predominant. Of course aerodynamic drag on a maglev vehicle will not affect vehicle range (as is the case for aircraft) since power is derived through the guideway. However, lower drag will means less energy expended and therefore lower operating cost.

Unlike an aircraft, the suspension and control on a maglev vehicle is performed using magnetic and not aerodynamic forces. This means that at cruise conditions the vehicle weight is primarily supported by magnetic lift. From the design point of view this means that there is no need to try and maximise the value for aerodynamic lift. Instead, the aerodynamic design must ensure that ground effect forces do NOT create any conditions which will degrade system performance. Ground effect is a very important force in high speed vehicles travelling on, or very close to the ground.

It can produce a suction force (negative lift) due to the higher velocity underbody airflow. On Formula 1 racing cars, for example, maximisation of this suction force is one of the aerodynamic design goals, as it gives them greater stability. However, ground effect will degrade the performance of a maglev system because it will decrease the levitation effect of the magnetic field and increase the levitation requirements, and the energy used.

The reverse type of aerodynamic force is the positive lift that is used by aircraft to achieve flight. This could be used to augment the magnetic levitation system, but at just a few centimetres above the ground it is too unreliable.

The designers of maglev transport systems are therefore aiming to counterbalance lift and ground effect to create a vehicle with zero lift. A zero lift design will minimise induced drag and therefore ease magnetic propulsion requirements. On aircraft, aerodynamic moments are used to reorient the lift vector thereby manoeuvring the plane, however, maglev vehicles simply follow their guideway. This means that on maglev vehicles aerodynamic moments will need to be counteracted with magnetic coupling forces and minimised in order to lessen magnetic control requirements. As far as aerodynamic shape is concerned it is very important that maglev vehicles are insensitive to crosswinds. It should be remembered that a 30m long vehicle with 5cm lateral guideway clearance can sustain only a 0.2 degree yawing angle with the guideway before making contact. Since yawing moment diverges with side slip angle, crosswinds will make the maglev vehicle highly susceptible to excessive lateral displacements. A good aerodynamic design will minimise this sensitivity, and thus reduce the cost for lateral directional control.

Design considerations for a commercial maglev system - The environment

The fact that the guideway used by maglev vehicles will be on average no more than 10m above the ground brings with it additional aerodynamic design problems. Along most of the guideway's length the vehicle will be travelling at 500Km/hr, with the guideway going through urban and residential areas. This means that the vehicle must also be designed to minimise its aerodynamic disturbance on the surroundings. A maglev train travelling at high speed has the potential to generate a lot of noise.

Noise is derived from strong vortices and pressure waves produced by the airflow over the vehicle and through the vehicle/guideway clearance gap. This means that poor aerodynamic design could cause maglev to be an unwelcome environmental intrusion in many locations.

Noise also becomes an issue as a result of the close proximity to the ground. Aerodynamic noise is generated from the vehicle's turbulent boundary layer, trailing vortices, and wake. In the US a noise limit of 73 dB at 15 meters from the vehicle centreline was set by the US Federal Railroad Administration. In addition to this, the design must avoid pooling of rain water, dirt, and debris in undesirable areas such as the air intake for the ventilation system. The shape of the vehicle and, to a greater degree, that of the track and the region of interaction, must be laid out to avoid susceptibility to snow accumulation.

Design considerations for a commercial maglev system - Manufacture and economics

Because of the high technology involved, the enormous importance of aerodynamics, and the necessary tight manufacturing tolerances, maglev transportation systems are increasingly being viewed as a good business opportunity by aerospace companies looking to broaden their activities into other areas of commercial transportation, a factor which will undoubtedly give the newly revitalised US work on maglev a considerable advantage. Only the aerospace companies have the capability to handle the requirements for complex aerodynamic surfaces with their curvature continuity and smooth transitions, surfaces which tend to be very difficult to manufacture.

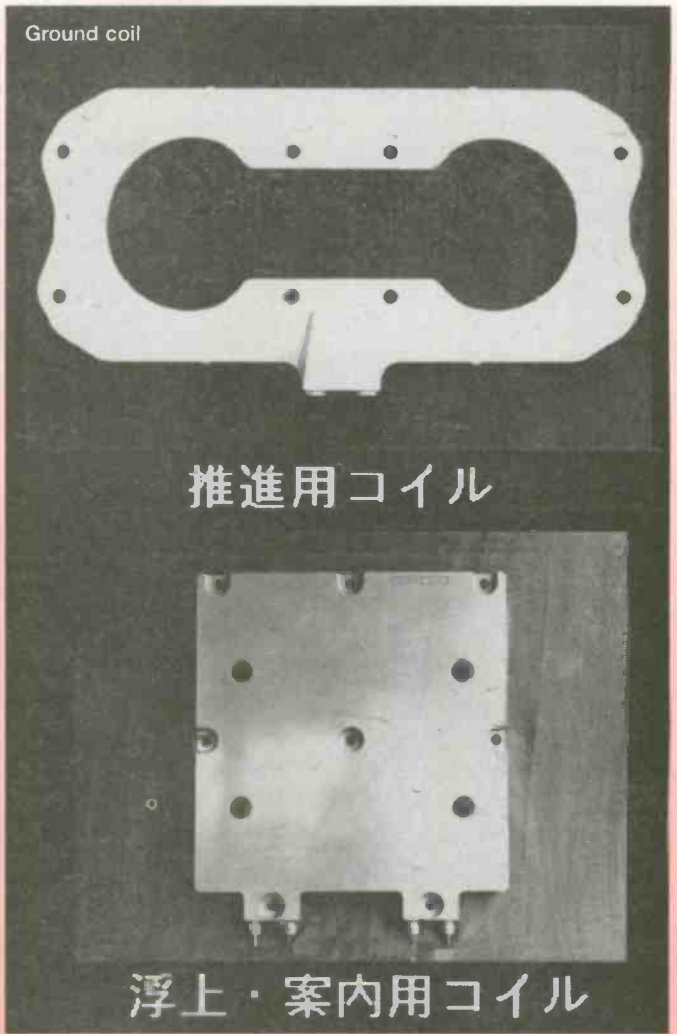
The expertise of such companies in the use of different manufacturing processes ranging from riveted aluminium to advanced composite materials will be very important. These requirements will affect the cost of production. More expensive materials will be needed, and surface smoothness and tighter tolerances will be more difficult to produce, and therefore also increase costs. However, high unit costs should be counterbalanced by low running costs and by the efficiency exhibited by such systems in moving people and goods rapidly over long distances.

Is there a future for maglev?

The great advantage of using magnetic levitation to 'float' something, such as a train, is that it virtually eliminates all the problems arising from friction in any system where surfaces are in contact with each other, like wheels on a track. This means much higher speeds, at lower energy consumption, lower mechanical wear, and fewer problems with heat derived from friction - indeed the virtual elimination of most moving parts.

In theory, a maglev train which has no physical contact with the ground should be capable of very high speeds, speeds which rival those of aircraft. Indeed, aerodynamics are a very important consideration in the design of maglev transport systems. Current developments in Japan, now the world's leaders in maglev research, have demonstrated speeds of up to 500km/hr with a full sized prototype. Besides a capability to travel at high speed, a maglev train should be extremely energy efficient since losses due to friction, heating etc are minimised.

With research currently concentrating on the use of superconducting magnets the efficiency should be even greater. Furthermore, compared with aircraft there will be no consumption of energy in order to climb to a cruising altitude. The operational efficiency and economic potential of maglev transportation systems in an era of impending energy shortage and concern about the environment has meant that the technology has started to attract a lot of attention in the last year or so.



The British may have pioneered the technology in the 60s and early 70s, however, the newest entrants, and probably the most important are the Americans. With the backing of the US Dept of Defence, the involvement of NASA, and some of the other heavyweight US research organisations, we can look forward to some interesting developments before the end of the century. Who knows, in a decade or two perhaps we will all be able to float across the countryside on a magnetic cushion.

Why not use a permanent magnet suspension system?

The difficulties involved in achieving stable suspension or levitation are derived from an inverse square law that relates force and distance.

This was first examined by the Victorian scientist William Earnshaw in his classic paper published in 1842, he shows mathematically that it is impossible for a pole placed in a static field of force to have a position of stable equilibrium when an inverse square law operates. This fundamental calculation is known as Earnshaw's theorem.

In the late 1930s the German scientist Braunbeck performed a similar analysis on unvarying magnetic and electric fields, and deduced that suspension or levitation is only possible when materials have a relative permeability, mu_r <1 or epsilon_r<1.

(To prove this, suspension has been achieved using diamagnetic materials, and as a result of the effect of currents in the suspended objects.)

It thus follows from both Earnshaw's theorem and Braunbeck's analysis, that stable suspension or levitation is impossible with a system of permanent magnets (or fixed current electromagnets) unless, of course, part of the system contains either a diamagnetic material (mu_r<1) or a superconductor (mu_r=0). It also follows that it is completely impossible to achieve levitation in electrostatic fields since there are no known materials with epsilon_r<1.

For more information on the theory behind maglev systems see: "Electromagnetic Levitation and Suspension Systems", B.V. Jayawant, Publishers: Edward Arnold, London, 1981.

Magnetic levitation circuitry - of the DIY type

The problem, from an amateur experimenter's point of view, with superconductivity projects is the requirement for buckets of liquid helium. Pretty nasty stuff, and not that easy to obtain, not to mention the fact that it evaporates faster than you can use it. So, by and large, superconductivity experiments are a no-go area until we can all get cheap samples of high temperature superconductors that only need cooling in liquid nitrogen. This means, of course, that constructing a superconductivity maglev train in your back garden is out of the question.

However, do not despair, for there is a way in which we can achieve this type of levitation effect without superconductivity. It involves the use of an ingenious feedback system to create an electromagnetic system that behaves in much the same way as a superconducting magnet, a magnet that will repel BOTH ends of any bar magnet and can thus be used to 'float' such a magnet.

Such a device is actually quite simple to build, and it works at room temperature. The main component is an electromagnet. You could use a surplus one, but it is generally far easier to make your own. For the core use some 0.25-inch iron rod (a bolt will do) at least an inch long. To make the coil you need to first of all construct a suitable former around the iron core and of sufficient dimensions to hold the wire coil in place. Use two 1in diameter discs of thick cardboard with a 0.25-in hole in the middle as the former ends, and some thin card wrapped into a tube around the rod as the centrepiece of the former.

Glue it all firmly in place before winding the coil. For this size of electromagnet the coil needs about 300 turns of 30 swg wire (use good quality enamelled copper wire, or even coated wire-wrap wire). Such an electromagnet will generate a fairly strong magnetic field given a supply voltage of around 9 to 12V.

For a circuit (see figure 4 for example) you will need two power supplies, one with +9V and GND, and the other with -9V and GND. Both share a common ground (batteries could be used if operated for very short periods). The two power supplies are needed to generate the polarity reversal within the electromagnet. The electronics are fairly straightforward, though make sure that the transistors and diodes are capable of handling the voltage as well as the current through the coil.

The Hall effect switch is the sort that is widely used in alarm systems (they are available from Maplin). The Hall effect switch is not mounted with the rest of the components but is positioned on one end of the electromagnet's core (hold it in position with some tape or Blu-Tak).

When the unit has been assembled and the power applied, the end of the iron core on which the Hall effect switch is mounted should repel any bar magnet, irrespective of polarity, that is brought close to it - the basis of any magnetic levitation system. Instability means that a single unit cannot be used to levitate a bar magnet. To do that you will probably need about six units mounted with their core ends (and attached Hall effect switches) at about 45 degrees to the horizontal and pointing towards each other, creating a magnetic 'trough' in which the bar magnet can 'float'. Two parallel rows of these coils and circuits will act as a simple maglev railroad track allowing a bar magnet to float along above them if it is gently pushed between the rows (figure 5). A circuit of this type operates in the following manner: when power is applied to the circuit the Hall switch is on and voltage is applied to the coil in a particular direction so that the tip of the coil's iron core to which the Hall switch is attached becomes a north pole. However, the Hall switch is positioned on the core so that this polarity of magnetic field turns the switch off. When the switch is off, the direction of voltage is reversed. This means that the tip of the core becomes a south pole, and as a result the Hall switch turns back on. Of course this results in polarity switching back again. The result is that when this circuit is running the Hall switch turns on and off very rapidly, and the magnetic field rapidly switches back and forth.

This means that effectively each pole of the electromagnet exhibits an average zero magnetic polarity. But if we bring another magnet close to the Hall sensor then the situation changes, with feedback trying to keep the zero polarity. This means that when no magnet is near the coil, the coil's average polarity is zero, but when a magnet is placed near the sensor the Hall switch adjusts the magnetic field to keep the sensor at zero polarity. This is exactly what happens in a superconductive magnet; it creates zero magnetic field inside itself and thus repels either pole of a permanent magnet. In other words our circuit is replicating the behaviour of a superconducting magnet, and not a drop of liquid helium in sight! In this circuit the coil-assemblies will therefore repel a bar magnet regardless of whether it is an N or an S pole. When an N pole approaches the Hall sensor, the circuit will send a current through the coil more in one direction than the other, which makes the coil's pole become "N" rather than zero, and it repels the magnet. The two opposing magnetic fields thus cancel each other to zero between the magnet and the coil, the position of the Hall effect switch. Unfortunately the circuit exhibits slightly negative stability. This means that small movements in the suspended bar magnet trigger the compensating magnetic field after a small time delay, which in turn will trigger slightly larger movements. The resulting oscillations will magnify and eventually get so severe that they will throw the magnet out of the device after a few seconds The only way to stop this problem is to make sure that the magnet is not moving initially. Oscillations will then build up very slowly or not at all.

Oscillations in the magnet can also be damped down by putting a thick copper bar just below the bar magnet. The induced current and electrical resistance of the bar will generate a small amount of mechanical damping to the changing magnetic fields. The result is a dampening of the magnet's motion, and the oscillations should decline in magnitude. However, the only real way to overcome the problems of instability and oscillation is to use a more complex form of feedback circuitry which will eliminate the loop delay which causes the oscillation.

Continued on P. 20

TRANSISTORS

PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE
BU105	80P	BU408D	75P	BUT18AF	80P	MJ15024	400P
BU108	100P	BU409	85P	BUT30V	1700P	MJ15025	700P
BU109	80P	BU426A	70P	BUT56A	100P	MJE13004	100P
BU110	90P	BU506DF	120P	IRF450	650P	MJE13005	60P
BU111	100P	BU508APH	80P	IRF520	150P	MJE13007	100P
BU124	60P	BU508AF	95P	IRF530	300P	MJE13009	100P
BU125	100P	BU508APH	80P	IRF540	300P	MJE15028	200P
BU126	65P	BU508D	90P	IRF610	150P	MJE15029	200P
BU133	125P	BU508DF	115P	IRF630	150P	MJE15030	250P
BU137	150P	BU508DR	130P	IRF640	400P	MJE15031	400P
BU180	100P	BU508V	110P	IRF730	175P	MJE18004	125P
BU184	100P	BU508VF	100P	IRF740	400P	OC28	350P
BU204	65P	BU801	70P	IRF820	150P	OC29	250P
BU205	70P	BU806	70P	IRF830	225P	OC35	350P
BU206	100P	BU807	60P	IRF840	200P	OC36	250P
BU207	150P	BU2508A	130P	IRF9530	400P	S2000A3	175P
BU208	70P	BU2508AAF	130P	IRF9540	300P	S2000AF	175P
BU208A	75P	BU2508D	130P	IRF9610	200P	S2055A	175P
BU208AT	200P	BU2508DF	150P	IRF9620	225P	S2055AF	200P
BU208D	130P	BU2520AF	225P	IRF9630	325P	2N3053	18P
BU209	90P	BU2520DF	225P	IRF9640	375P	2N3054	40P
BU225	120P	BU2525AF	325P	IRFBC30	200P	2N3055	38P
BU226	120P	BUH315	200P	IRFC40	400P	2N3055H	50P
BU312	90P	BUH515	200P	MJ2501	100P	2N3440	45P
BU325	55P	BUH517	275P	MJ2955	55P	2N3441	175P
BU326A	75P	BUH715	425P	MJ15003	250P	2N3442	85P
BU406	60P	BUT11AF	55P	MJ15004	300P	2N3771	85P
BU406D	85P	BUT12	80P	MJ15015	250P	2N3772	90P
BU407	55P	BUT13	310P	MJ15016	350P	2N3773	100P
BU407D	75P	BUT18	80P	MJ15022	250P		
BU408	60P			MJ15023	400P		

SATELLITE PSU REPAIR KITS

Experience shows that 50% of all receiver power supplies 'bounce' unless the correct precautionary measures are taken when being serviced. A kit of all the recommended parts is supplied for the most popular models, which when fitted should overcome this.

MAKE & MODELS	ORDER CODE	PRICE
PACE PRD800, PRD900	SATPSU1	650P
PACE SS900, 9200, 9010,9210, 9020, 9220	SATPSU2	650P
AMSTRAD SRD510, SRD520	SATPSU3	650P
AMSTRAD SRD500	SATPSU4	650P
AMSTRAD SRX340, SRX345, SRX350	SATPSU5	650P
PACE D100/150	SATPSU6	650P
CHURCHILL D2MAC	SATPSU7	650P
PACE MSS100	SATPSU8	730P
PACE MSS200/300 APPOLLO	SATSPU9	650P
PACE MSS500/1000	SATPSU10	1230P
FERGUSON SRD4	SATPSU11	835P
ECHOSTAR SR5500	SATPSU12	1735P
ECHOSTAR 6500/7700/8700	SARPSU13	3125P
AMSTRAD SRD600	SATPSU14	3125P
MIMTEC (Surensen)	SATPSU15	775P
AMSTRAD SRD700/SR950/SRX100/302 SRX501/502/1002/2001/SRD2000 SAT250	SATPSU16	730P

PACE 9000 SWITCH MODE TRANSFORMER
ORDER CODE; PACE9000 PRICE 800p

SERVICE AIDS

DESCRIPTION	VOLUME	CODE	PRICE
VIDEO HEAD CLEANER	75 ML	SP01	140P
VIDEO HEAD CLEANER	200 ML	SP27	250P
SWITCH CLEANER	176 ML	SP02	150P
SUPER 40	400 ML	SP15	250P
SILICONE GEASE	200 ML	SP03	170P
FREEZE IT	170 ML	SP04	220P
FREEZE IT	400 ML	SP16	550P
FOAM CLEANER	400 ML	SP05	170P
ANTI STATIC	150 ML	SP06	170P
AEROKLEANE	200 ML	SP07	200P
AERO DUSTER	150 ML	SP08	220P
AERO DUSTER	400 ML	SP17	550P
PLASTIC SEAL	200 ML	SP09	200P
GLASS CLEANER	250 ML	SP10	160P
COLDKLENE	250 ML	SP13	200P
EXCEL POLISH 80	250 ML	SP18	150P
ADHESIVE 120	400 ML	SP19	190P
LABEL REMOVER 130	200 ML	SP20	240P
REFURB 140	400ML	SP21	240P
TUBE SILICON GREASE	50 GRAMMES	SP11	200P
TUBE SILICON SEALANT WHITE	75ML	SP22	280P
TUBE SILICON SEALANT CLEAR	75 ML	SP23	280P
TUBE HEAT SINK COMPOUND	25 GRAMMES	SP12	150p
DRIVE CLEANER	200ML	SP24	150p
SCREEN CLEANER	200 ML	SP25	150P
COMPUTER CARE KIT		SP26	2100P
ANTI STATIC FOAM CLEANER	400 ML	SP28	175p
AIR DUSTER	400 ML	SP29	450P

ALL THE ABOVE ITEMS ARE MANUFACTURED BY SERVISOL

IF YOU PURCHASE MORE THAN ONE SERVISOL PRODUCT POSTAGE & PACKAGE WILL BE CHARGED AS FOLLOWS: 300p FOR 5 CANS 450p FOR MORE THAN 5 CANS

GRANDATA LTD

K.P. HOUSE, UNIT 15, POP IN COMMERCIAL CENTRE, SOUTHWAY, WEMBLY, MIDDLESEX, ENGLAND HA9 0HB
Telephone: 0181-900 2329 Fax: 0181-903 6126
OPEN Monday to Saturday.
Times: Mon-Fri 9.00-5.30 Sat 9.00-2.00

FUSES

	TIME LAG (20mm)		QUICK BLOW (20mm)	
CURRENT RATING	ORDER CODE	PRICE	ORDER CODE	PRICE
100mA	FUSE36	75P	FUSE37	60P
160mA	FUSE01	75P	FUSE17	60P
250mA	FUSE02	75P	FUSE18	60P
315mA	FUSE 03	75P	FUSE19	60P
400mA	FUSE04	75P	FUSE20	60P
500mA	FUSE05	75P	FUSE21	60P
630mA	FUSE06	75P	FUSE22	60P
800mA	FUSE07	60P	FUSE23	60P
1A	FUSE08	60P	FUSE24	60P
1.25A	FUSE09	60P	FUSE25	60P
1.6A	FUSE10	60P	FUSE26	60P
2A	FUSE11	50P	FUSE27	60P
2.5A	FUSE12	50P	FUSE28	60P
3.15A	FUSE13	55P	FUSE29	50P
4A	FUSE14	55P	FUSE30	50P
5A	FUSE15	60P	FUSE31	50P
6.3A	FUSE16	60P	FUSE32	50P

CERAMIC PLUG TOP

CURRENT RATING	ORDER CODE	PRICE
3A	FUSE33	100P
5A	FUSE34	100P
13A	FUSE35	100P

20mm CERAMIC TIME LAG

CURRENT RATING	ORDER CODE	PRICE
6.3A	FUSE38	100P
8A	FUSE39	100P
10A	FUSE40	100P
3.15A	FUSE41	85P
4A	FUSE42	85P
5A	FUSE43	85P

32mm CERAMIC SLOW BLOW

CURRENT RATING	ORDER CODE	PRICE
8A	FUSE44	185P
10A	FUSE45	185P
15A	FUSE46	185P
20A	FUSE47	210P

38mm CERAMIC TIME LAG

CURRENT RATING	ORDER CODE	PRICE
10A	FUSE48	825P

****ALL THE ABOVE PRICES ARE ARE FOR PACKS OF 10 FUSES****

NB. ALL FUSES ARE MADE IN THE UK AND FULLY MEET BS4265 & BS1362 SAFETY STANDARDS AND SHOULD NOT BE COMPARED WITH CHEAP IMPORTED TYPES.

SOLDERING ACCESORIES

ANTEX SOLDERING IRONS

DESCRIPTION	CODE	PRICE
25 WATT 240 VAC (XS25W 240V)	S101	900P
15 WATT 240 VAC (XS 15W 240V)	S102	900P
25 WATT SPARE ELEMENT	S103	450p
15 WATT SPARE ELEMENT	S104	450p

SOLDERING STAND & SPONGES

DESCRIPTION	CODE	PRICE
SOLDERING STAND (MADE BY ANTEX)	S108	350p
SPARE SPONGE	S109	55p

SOLDER

DESCRIPTION	CODE	PRICE
18 SWG 500 GRAMMES	SI10	500P
20 SWG 500 GRAMMES	SI11	650P
22 SWG 500 GRAMMES	SI12	700P

DESOLDERING AIDS

DESCRIPTION	CODE	PRICE
SOLDER MOP STANDAR GUAGE 1.2mm x 1.5 METRE	SI07	80P
SOLDER MOP 1.2mm x 10 METRE	SI13	400P
DESOLDERING PUMP	SI05	320P
SPARE NOZZLE	SI06	60P

8 way PREPROGRAMMED Universal remote Control

A single remote control to operate Televisions, Videos and Satellite Receivers. Plus Auxilary Options!!

* Replaces up to 8 remotes with one
* Simple 4 digit setup routine
* Controls 1000's of models
* Teletext functions with Fastext
* Clear (large key) layout
* Code Search Facility
* Stylish and easy to operate
* Replace broken or lost remotes
* Original Remote not required

Order Code: 8 WAY Price: 1450P + VAT

8 way PREPROGRAMMED Universal remote Control

The Optimum 8 way universal remote control preprogrammed to operate up to 8 other remote controls for Televisions, Videos and Satellite Receivers. Plus Auxilary Options!!

* Pre-programmed with learning capability
* Replaces up to 8 remotes with one
* Jog/Shuttle thumb control
* Illuminated key pad
* Clear key layout
* Easy access secondary keypad
* Teletext & Fast text function.
* Stylish and easy to operate
* Replace broken or lost remotes
* Original Remote not required
* Freefone Helpline (UK Only)

Order Code: OPTIMUM 8 Price: 2100P + VAT

PLEASE PHONE US FOR TYPE NOT LISTED HERE AS WE ARE HOLDING 30,000 ITEMS AND QUOTATIONS ARE GIVEN FOR LARGE QUANTITIES

Please send £1 P&P and VAT at 17.5%. Govt, Colleges, etc. Orders accepted. Please allow 7 days for delivery. Prices quoted are subject to stock availability and may be changed without notice. TV and video parts sold are replacement parts.

Access & Visa Card accepted

WE STOCK TV AND VIDEO SPARES, JAPANESE TRANSISTORS AND TDA SERIES. PLEASE RING US FOR FURTHER INFORMATION.

Continued from P. 18
This can be done by using an analogue Hall sensor connected to an amplifier, and the signal from the Hall sensor can then be used to generate the required damping.

The US starts to take an interest

The Federal Railroad Administration (FRA) and the US Air Force (USAF) have announced an agreement to develop magnetic levitation technologies for use in missile defence warhead testing as well as high-speed ground transportation. The Federal Railroad Administrator Jolene M Molitoris said: "We are excited about the prospect of working with the Air Force on the development of multipurpose applications of this new technology. This partnership is an excellent example of the Clinton Administration's commitment to develop high technology projects that will yield maximum benefits, with both military and civilian applications. Magnetic levitation (maglev) trains have the real potential to help relieve congestion along our nation's already overcrowded highways and airways.

"A maglev passenger train could cut the travel time from downtown Los Angeles to downtown San Francisco to about 1 hour and 30 minutes — today, it takes nearly 10 hours travelling by traditional rail service", she added.

Maj. Gen. Stewart E. Cranston, commander of the USAF Development Test Center, said: "Magnetic levitation technology will give the Department of Defence a capability to conduct realistic, hypersonic testing of warhead lethality and propulsion systems at an affordable price. We are pleased to work with the Federal Railroad Administration to develop commercial applications for this technology."

The FRA's Deputy Administrator Donald M. Itzkoff has met with USAF officials at Holloman Air Force Base in New Mexico to discuss the construction of a maglev upgrade to the existing Holloman High-Speed Test Track. "By working with the Air Force to develop very high-speed maglev vehicle control capabilities, we believe we will also derive technology benefits applicable to future high-speed passenger train service", Itzkoff added. Maglev is part of the Department of Transportation's forthcoming assessment of high-speed ground transportation commercial feasibility. A demonstration of electromagnetic propulsion capability will also be developed and tested.

The USAF will use the track's guideway to test the effects of high-speed payload velocities and the FRA will determine potential safety and performance applications for high-speed trains. The project, as funded by the USAF, will test superconducting magnet design and fabrication, verification of computer codes which predict dynamic magnetic fields, effects of track irregularities and aerodynamic impact of velocities up to 300 mph on test vehicles. Maglev technology uses magnetic forces to levitate the vehicle and to either attract or repel for propulsion, for both suspension and guidance.

Maglev trains have the potential to travel at speeds in excess of 250 mph. Currently, Congress has provided the FRA with limited funding for maglev safety-related work. The FRA was, however, the lead agency in an interagency co-operative effort in 1991 with the Department of Energy and the US Army Corps of Engineers, concerning the viability of a US maglev transportation system. The results were published in the National Maglev Initiative (NMI) report. The NMI and the FRA's expertise in maglev will be utilised by the USAF as a resource as they further develop their research.

History of maglev R&D in Japan

1962 - Research for linear motor propulsion and non-contact run started

1970 - Study on electrodynamic levitation system using superconducting magnet started formally

1972 - LSM-propulsion experimental superconducting maglev test vehicle (LSM200) succeeded in levitated run and LIM-propulsion experimental(ML100) succeeded in levitated run

1975 - LSM-propulsion experimental superconducting magnet test vehicle(ML100A) succeeded in perfect non-contact run

1977 April - Miyazaki Maglev Test Center opened

1977 July - Test run of ML-500 inverted-T guideway started at Miyazaki Test Track 1979 Jan. Simulated tunnel run tested

1979 May - Run with helium refrigerator on board tested(ML-500R)

1979 December - 517km/h run attained

1980 November - Test run of MLU001 on U-type guideway started on Miyazaki Maglev Test Track

1981 November - 2-car unit test run started

1982 September - Manned 2-car unit test run started

1986 December - 3-car unit registered 352.4km/h run

1987 January - Unmanned 2-car unit attained 405.3km/h

1987 February - 400.8km/h run of manned 2-car unit attained

1987 April - Railway Technical Research Institute reorganised as a foundation, taking over the R&D work so far pursued by JNR

1987 May - Test run of MLU002 started

1988 December - Substation cross-over test carried out

1989 March - Aerodynamic brake system tested(MLU001)

1989 November - 394km/h run attained(MLU002)

1990 March - Test on traverser type turn out started

1990 November - Start of initial phase in construction of the Yamanashi Maglev Test Line celebrated

1991 June - Test run on sidewall levitation system started

1991 June - Test run energized by inverts started

1993 January - Test run of MLU002N started

1994 February - MLU002N attained 431km/h run

Note:

LSM: - Linear Synchronous Motor
LIM: - Linear Induction Motor

Pictures courtesy of RTRI, Japan

HEAD OFFICE:
Unit 3,
Central Trading Estate,
Staines, Middlesex. TW18 4UX
Tel: 01784 442253
Fax: 01784 460320

ElectroValue

Buying Guide 1996

SHOP:
680 Burnage Lane,
Burnage, Manchester. M19
1NA
Tel: 0161 432 4945
Fax: 0161 432 4127

Analogue ICs

CGY40	24.42
CGY50	4.21
HKZ101	10.04
TL071CP	0.26
TL072CP	0.28
TL074CN	0.36
TBA120S	0.84
TBA120T	0.99
TBA120U	0.99
UAA170	1.77
UAA180	2.07
TBB200	4.36
TBB206G,SMD	5.19
L293E	2.40
L297	3.75
LM301AN	0.27
TCA305A	2.81
DG308	2.25
LM308N	0.65
LM311N	0.30
LM324N	0.29
LM335Z	1.00
LM339N	0.31
LM348N	0.38
TCA355B	2.73
TCA355G,SMD	2.52
LM358N	0.31
LM380N	1.26
LM380N8	1.31
LM381N	2.52
LM382N	2.52
ZN414Z	1.20
ZN416E	1.50
ZN423	1.16
ZN425E	4.75
ZN427E	10.50
ZN428E	8.30
TCA440	1.95
TL497	1.35
555	0.17
556	0.26
NE566	0.45
NE567N	0.26
SLB0587	2.00
SAB0600	4.91
LM710N	0.42
741C8 8DIL	0.21
747C14 14DIL	0.45
748C8 8 DIL	0.31
TCA785	3.74
TBA800	0.84
TBA810S	0.45
TBA820	0.84
TBA820M	0.50
TCA965B	3.67
TCA991	1.40
ZN1034E	2.45
TAE1453G,SMD	1.49
1458	0.32
1488	0.25
1489	0.25
TDA2002	0.60
TDA2003	0.60
ULN2003	0.40
ULN2004	0.40
TDA2030	0.95
TAE2453A	1.47
TAE2453G,SMD	2.03
SDA2506/5	3.70
SDA2516/5	1.53
CA3046	0.89
CA3080E	0.78
CA3130E	0.94
CA3140E	0.47
MC3340	2.20
SG3524	1.00
LM3900N	0.45
LM3909N	1.42
LM3914N	1.90
LM3915N	1.25
SAB4209	4.04
TLE4214	2.62
RC4558P	0.40
TDA4601	1.73
TDA4601D	1.90
TDA4605	1.86
TDA4700A	9.58
TDA4718A	4.73
7106	2.35
7107	2.35
ICM7555	0.51
ICL7611	1.25

Voltage Regulators

Positive 100ma TO92	
78L05 +5v	0.27
78L06 +6v	0.27
78L08 +8v	0.27
78L10 +10v	0.27
78L12 +12v	0.27
78L15 +15v	0.27
78L24 +24v	0.27
Positive 1Amp T0220	
7805 +5v	0.26
7806 +6v	0.27
7808 +8v	0.27
7810 +10v	0.27
7812 +12v	0.26
7815 +15v	0.27
7818 +18v	0.27
7820 +20v	0.27
7824 +24v	0.27
Positive 2Amp T0220	
78S05 +5v	0.78
78S09 +9v	0.97
78s10 +10v	0.97
78S12 +12v	0.78
78S24 +24v	0.97
Positive Variable	
723C14 14DIL	0.35
LM317T	0.45
LM317K	1.58
LM338K	5.50
L200CV	1.20
Negative 100maTO92	
79L05 -5v	0.26
79L12 -12v	0.26
79L15 -15v	0.26
79L24 -24v	0.50
Negative1AmpT0220	
7905 -5v	0.26
7906 -6v	0.32
7908 -8v	0.32
7912 -12v	0.26
7915 -15v	0.32
7918 -18v	0.32
7820 -20v	0.32
7924 -24v	0.32
Negative Variable	
LM337T	1.00

Digital ICs 74LS

74LS00	0.13
74LS02	0.13
74LS03	0.22
74LS04	0.22
74LS05	0.13
74LS08	0.13
74LS10	0.13
74LS11	0.13
74LS13	0.13
74LS14	0.15
74LS20	0.13
74LS21	0.13
74LS22	0.13
74LS27	0.13
74LS30	0.13
74LS32	0.13
74LS37	0.13
74LS38	0.13
74LS40	0.13
74LS42	0.21
74LS47	0.62
74LS51	0.13
74LS54	0.23
74LS73	0.30
74LS74	0.15
74LS75	0.17
74LS76	0.30
74LS83	0.26
74LS85	0.35
74LS86	0.17
74LS90	0.25
74LS92	0.26
74LS93	0.31
74LS96	0.42
74LS107	0.21
74LS109	0.18
74LS112	0.23
74LS113	0.18
74LS122	0.26
74LS123	0.26
74LS125	0.24
74LS126	0.38
74LS132	0.18
74LS136	0.14
74LS138	0.28
74LS139	0.28
74LS145	0.47
74LS148	0.63
74LS151	0.28
74LS153	0.28
74LS154	0.63
74LS156	0.27
74LS157	0.28
74LS158	0.28
74LS161	0.28
74LS163	0.28
74LS164	0.28
74LS165	0.46
74LS166	0.28
74LS169	0.36
74LS173	0.21
74LS174	0.28
74LS175	0.28
74LS191	0.31
74LS193	0.31
74LS194	0.31
74LS195	0.31
74LS197	0.30
74LS221	0.31
74LS240	0.36
74LS241	0.38
74LS242	0.28
74LS243	0.28
74LS244	0.28
74LS245	0.28
74LS247	0.28
74LS251	0.21
74LS253	0.31
74LS256	0.30
74LS257	0.31
74LS259	0.25
74LS266	0.16
74LS273	0.36
74LS279	0.31
74LS290	0.47
74LS293	0.31
74LS295	0.55
74LS298	0.21
74LS366	0.18
74LS367	0.18
74LS368	0.18
74LS373	0.32
74LS374	0.32
74LS375	0.28
74LS390	0.24
74LS393	0.21
74LS541	0.35
74LS670	0.68

74HC

74HC00	0.21
74HC02	0.21
74HC03	0.21
74HC04	0.21
74HC08	0.21
74HC10	0.21
74HC11	0.21
74HC14	0.24
74HC20	0.22
72HC21	0.22
74HC27	0.22
74HC30	0.22
74HC32	0.22
74HC42	0.36
74HC51	0.24
74HC73	0.28
74HC74	0.25
74HC75	0.32
74HC85	0.36
74HC86	0.24
74HC93	0.39
74HC107	0.24
74HC109	0.26
74HC112	0.25
74HC113	0.27
74HC123	0.36
74HC125	0.25
74HC126	0.36
74HC131	0.38
74HC133	0.20
74HC137	0.32
74HC138	0.24
74HC139	0.25
74HC147	0.32
74HC148	0.37
74HC151	0.30
74HC153	0.32
74HC154	0.97
74HC157	0.31
74HC161	0.36
74HC164	0.36
74HC166	0.36
74HC174	0.32
74HC175	0.33
74HC192	0.41
74HC193	0.41
74HC194	0.41
74HC221	0.36
74HC240	0.36
74HC241	0.36
74HC244	0.36
74HC245	0.37
74HC259	0.36
74HC266	0.27
74HC273	0.38
74HC279	0.36
74HC280	0.36
74HC283	0.37
74HC367	0.29
74HC368	0.29
74HC373	0.44
74HC390	0.42
74HC393	0.39
74HC540	0.48
74HC541	0.48
74HC573	0.43
74HC4002	0.22
74HC4015	0.56
74HC4016	0.31
74HC4017	0.45
74HC4020	0.52
74HC4022	0.42
74HC4028	0.42
74HC4040	0.54
74HC4046A	1.35
74HC4049	0.32
74HC4050	0.32
74HC4051	0.54
74HC4052	0.54
74HC4053	0.54
74HC4060	0.54
74HC4066	0.31
74HC4075	0.23
74HC4078	0.23
74HC4094	0.57
74HC4316	0.38
74HC4351	0.77
74HC4352	0.77
74HC4353	0.77
75HC4510	0.75
74HC4511	0.53
74HC4514	1.47
74HC4515	1.47
74HC4516	0.77
74HC4518	0.50
74HC4520	0.50
74HC4538	0.53
74HC4543	0.50

4000 Series

4000	0.15
4001	0.15
4002	0.15
4006	0.31
4007	0.15
4008	0.31
4009	0.21
4010	0.21
4011	0.15
4012	0.15
4013	0.21
4014	0.31
4015	0.34
4016	0.28
4017	0.31
4018	0.31
4019	0.25
4020	0.31
4022	0.31
4023	0.15
4024	0.26
4025	0.15
4026	0.42
4027	0.21
4028	0.31
4029	0.31
4030	0.26
4035	0.47
4040	0.31
4041	0.31
4042	0.26
4043	0.31
4044	0.31
4046	0.33
4047	0.26
4049	0.15
4050	0.24
4052	0.37
4053	0.37
4060	0.31
4066	0.18
4070	0.15
4071	0.21
4072	0.21
4075	0.17
4076	0.36
4077	0.18
4081	0.21
4082	0.24
4093	0.18
4502	0.42
4510	0.36
4511	0.32
4514	0.78
4516	0.31
4518	0.31
4519	0.31
4520	0.31
4522	0.42
4526	0.42
4528	0.36
4538	0.36
4541	0.31
4543	0.47
4555	0.36
4572	0.42
4585	0.36

Transistors

2N697	0.38
2N930	0.42
2N3053	0.26
2N3055	0.60
2N3702	0.14
2N3703	0.14
2N3704	0.14
2N3705	0.14
2N3706	0.14
2N3710	0.18
2N3711	0.14
2N3771	1.94
2N3772	1.94
2N3773	1.94
2N3819	0.42
2N3820	0.73
2N3904	0.14
2N3906	0.14
2N4036	0.73
2N4284	0.26
2N4289	0.27
BC107B	0.16
BC108B	0.16
BC108C	0.16
BC109B	0.16
BC109C	0.16
BC126	0.27
BC160	0.33
BC161	0.33
BC168B	0.12
BC177B	0.22
BC179B	0.22
BC182	0.14
BC182L	0.14
BC183	0.14
BC183L	0.14
BC184	0.14
BC184L	0.14
BC212	0.14
BC212L	0.14
BC213	0.14
BC213L	0.14
BC214	0.14
BC214L	0.14
BC237B	0.14
BC239C	0.14
BC300	0.30
BC301	0.30
BC327	0.14
BC328	0.14
BC337	0.14
BC338	0.14
BC516	0.14
BC517	0.14
BC546B	0.11
BC547B	0.11
BC548B	0.11
BC549C	0.11
BC550C	0.11
BC556B	0.11
BC557B	0.11
BC558C	0.11
BC559C	0.11
BC560C	0.11
BC639	0.23
BC640	0.23
BC877	0.27
BC879	0.23
BC880	0.23
BCY59	0.30
BCY70	0.26
BCY71	0.18
BD131	0.45
BD132	0.45
BD135	0.25
BD136	0.25
BD139	0.37
BD140	0.27
BD201	0.40
BD232	0.40
BD233	0.35
BD237	0.35
BD238	0.35
BD239C	0.40
BD681	0.37
BD682	0.35
BDX33C	0.40
BF167	0.50
BF173	0.50
BF177	0.26
BF178	0.36
BF420	0.14
BF421	0.18
BF457	0.22
BFX29	0.42
BFX84	0.42
BFX85	0.42
BFX87	0.37
BFX88	0.36
BFY50	0.42
BFY51	0.42
BFY52	0.42
BSS84	0.68
BSS87	0.94
BSS89	0.47
BSS92	0.47
BSS98	0.40
BSS125	0.97
BSS135	0.94
BSS192	1.03
BTS412B	2.83
BU208A	1.30
BU326A	1.60
BU407	1.00
BU426A	1.28
BU508A	1.23
BU508AFI	1.45
BU508D	1.32
BU508DFI	1.30
BU526	0.96
BU806	0.96
BUT11AF	1.30
BUW84	0.96
BUX85	1.10
BUZ11	1.60
BUZ11A	1.12
BUZ71	1.23
BUZ71A	1.08
BUZ73	1.58
BUZ74	1.56
BUZ80	2.98
BUZ80A	3.23
IRF520	0.77
IRF530	0.95
IRF540	1.66
IRF630	1.15
IRF640	1.85
IRF820	0.79
IRF822	0.70
IRF830	1.83
IRF840	1.83
MJE2955T	0.52
MJE3055T	0.52
MPS6534	0.44
MPSA12	0.14
TIP31A	0.31
TIP32A	0.31
TIP41A	0.36
TIP41C	0.63
TIP42A	0.36
TIP42C	0.63
TIP47	0.60
TIP110	0.50
TIP122	0.49
TIP127	0.49
TIP2955	0.66
TIP3055	0.72

Thyristors

2N5062	0.27
BR103	0.38
BR303	1.23
C106D1	0.55
TIC106D	0.47
TIC106M	0.65
TIC126D	0.65
Z0102NA	0.55

Triacs

BTA08600B	0.80
BTA16600B	1.28
TIC206D	0.57
TIC225D	0.78
TIC226D	0.63
TIC246D	1.10

FLASH TUBES By Heimann

AGA0017	2.82
AU0023	12.75
BUB0641	4.08
BUB0661	4.55
DU7670	6.74

TRIGGER TRANSFORMERS

PCB mounting:	
ZS1052	1.36
Flying leads:	
ZS1052/11	1.48

Surface Mounted Transistors

BC807/25	0.13	BCX71K	0.16
BC817/25	0.18	BF722	0.65
BC818/40	0.15	BFP180	0.92
BC846B	0.15	BFP181	0.87
BC847B	0.15	BFP183	0.87
BC856B	0.15	BFP193	0.87
BC857B	0.15	BFP280	1.14
BCV46	0.24	BFQ81	0.90
BCV47	0.24	BFR35AP	0.81
BCW60D	0.17	BFR92P	0.72
BCW61D	0.17	BFR181	0.69
BCW66G	0.17	BFR183	0.80
BCW68G	0.17	BFR193	0.68
BCX41	0.26	BFR280	0.76
BCX42	0.26	BFT92	0.84
BCX70K	0.16	BFT93	0.76

Other SMD products available:

Ceramic & tantalum capacitors
RF chokes
Ferrites
Hall-effect devices
Integrated circuits
LEDs & Opto-couplers
resistors
thermistors
varistors
temperature sensors

OPTO DEVICES

SMD LEDs		
LSS260 RED	0.4mcd min@ 10mA	0.25
LYS260 YELLOW	0.4mcd min@ 10mA	0.25
LGS260 GREEN	0.4mcd min@ 10mA	0.26
LEDs 3mm dia.		
RL3 RED		0.09
YL3 YELLOW		0.10
GL3 GREEN		0.10
LEDs 5mm dia.		
RL5 RED		0.09
GL5 GREEN		0.10
YL5 YELLOW		0.10
LEDs 10mm dia.		
L813ID red	12-40mcd	0.17
L813SRD red	200-350mcd	0.34
L813SRC red	2000-3000mcd	1.10
BLUE LEDs		
L53BT		1.45
5v AND 12v LEDS		
L53-ID5V 5v RED		0.14
L53-GD5V 5v GREEN		0.14
L53-ID12V 12v RED		
0.14		
L53-GD12V 12v GREEN		0.14
LDRs		
ORP12	12mm dia.	0.79

SIEMENS

We have the largest
Range of Siemens
Stock Items of any
U.K Distributor

ELECTROLYTIC CAPACITORS

RADIAL		
RE4.7100	4.7uF 100v	0.07
RE1063	10uF 63v	0.08
RE10100	10uF 100v	0.08
RE2235	22uF 35v	0.07
RE2263	22uF 63v	0.08
RE4725	47uF 25v	0.07
RE4763	47uF 63v	0.10
RE10016	100uF 16v	0.08
RE10025	100uF 25v	0.08
RE10063	100uF 63v	0.15
RE22025	220uF 25v	0.14
RE22063	220uF 63v	0.22
RE47010	470uF 10v	0.13
RE47025	470uF 25v	0.19
RE47050	470uF 50v	0.29
RE47063	470uF 63v	0.32
RE100010	1000uF 10v	0.22
RE100025	1000uF 25v	0.22
RE100063	1000uF 63v	0.53
RE220016	2200uF 16v	0.37
RE220025	2200uF 25v	0.38
RE470010	4700uF 10v	0.32
RE470016	4700uF 16v	0.51

HIGH VOLTAGE AXIAL

411385	1uF 385v	0.30
832.2350	2.2uF 350v	0.36
834.7350	4.7uF 350v	0.55
5010350	10uF 350v	0.74
5022350	22uF 350v	0.92
5047350	47uF 350v	1.50
41100350	100uF350v	1.86

AERIAL AMPLIFIERS

12HG TWIN	
10.24	
4WA 4 WAY	17.00
1WPTVA	
variable gain	9.05

SOLDERING IRONS

ANTEX	
ANCBP 15W	11.00
ANXSBP 25W	11.67
ANCS12 12v	9.85
ANST4 STAND	3.50

NICAD Rechargeables

RX3U AAA	0.18Ah	1.13
RX6U AA	0.5Ah	0.96
RX14U C	1.2Ah	2.06
RX20U D	1.2Ah	2.15
RX22 PP3	0.11Ah	4.68
QUICK CHARGE		
RX6P AA	0.65Ah	1.12
RX14P C	1.6Ah	2.15
RX20P D	1.6Ah	2.36
INDUSTRIAL		
RX14S C	2.0Ah	2.98
RX14SP C	2.2Ah	3.43
RX20SP D	5.1Ah	4.35
CHARGERS FOR ABOVE		
CX600 UNIVERSAL CHARGER		6.43
CX550PX4 4 CELL QUICK CHARGER (AA / AAA)		13.73
CX1200P UNIVERSAL QUICK CHARGER		14.45
PCB MOUNTING		
MP2.4 2.4v	0.1Ah	2.05
MP3.6 3.6v	0.1Ah	3.26
TELEPHONE		
GP700AA 3 x AA		4.25
GP280K3 3 x FLAT		5.10
LITHIUM		
CR2016		1.27
CR2025		1.27
CR2032		1.27

Camcorder Batteries

By Uniross. Compatible with most makes of Camera.

VP22 6v 1.4Ah	14.37	VP522 9.6v 1.6Ah	43.77
VP10 6v 1.7Ah	16.65	VP752 9.6v 1.7Ah	24.34
VP66 6v 1.7Ah	16.65	VP520 12v 1.5Ah	43.77
VP77 6v 1.7Ah	17.80	VP30 12v 2.3Ah	29.00
VP22H 6v 1.9Ah	24.34	EL300 Charger	16.99
VP73 9.6v 1.2Ah	28.70		
VP962 9.6v 1.3Ah	24.15		

VALVES

ECC81/12AT7	5.50
ECC82/12AU7	5.50
ECC83/12AX7	5.50
ECF82	6.00
EL34/6CA7	8.00
EL84/6BQ5	4.50
ECL82	5.85
ECL86	5.85
KT66	10.00
KT88	13.00
EZ80	5.25
EZ81	3.75
GZ34	6.50
6L6GC	6.50

VALVE BASES

B9A PCB	1.50
B9A CHASSIS	1.50
OCTAL - CHASSIS	1.95

SOLDER SUCKERS

SR3A (ORYX)	9.50
LILO (ORBITEC)	5.40

D TYPE CONNECTORS

Plugs	
DP9B 9 pin	0.19
DP15B 15 pin	0.26
DP25B 25 pin	0.32
Sockets	
DS9B 9 pin	0.20
DS15B 15 pin	0.26
DS25B 25 pin	0.33
Hoods	
DH9 9 way	0.34
DH15 15 way	0.43
DH25 25 way	0.44

SCART CONNECTORS

PS2480 plug	0.63
MRS671J line socket	0.98
T113F 1.5m Scart - Scart lead	2.10

POWER LEADS

For computers etc. 13A plug to IEC 6A socket, 2 metre	
677ML	1.50

SWITCHES

MINIATURE TOGGLE	
3101 SPDT	0.39
3201 DPDT	0.50
10A TOGGLES	
29AS SPST	1.17
29BS DPDT	1.38
29ES DPDT centre-off	1.40

HOW TO ORDER

Totalize your order / Add £1.00 p+p Then V.A.T
Mail and telephone orders to Staines please

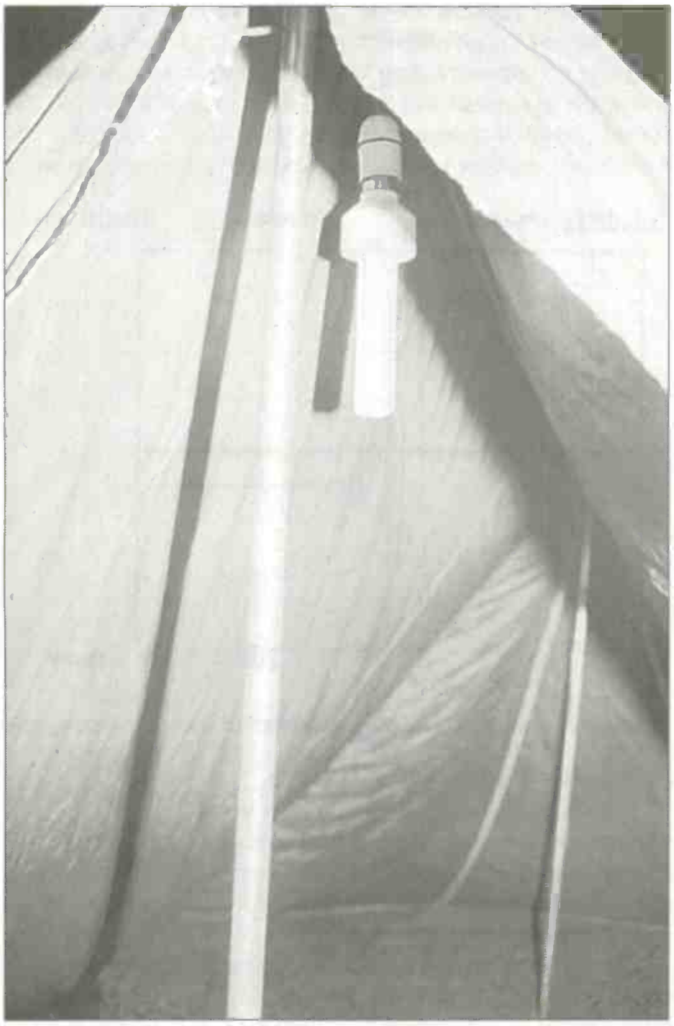
Visitors always welcome at the Manchester Shop or By prior arrangement at Staines warehouse.

All Prices are exclusive of V.A.T and may change without prior notice. E&OE

"Camplight"

You can build this circuit on our free PCB on the cover of this issue of ETI

Andrew Armstrong has developed a portable power 250-volt DC generator that he uses to power a low-consumption mains-voltage fluorescent lamp from a 12V car battery.



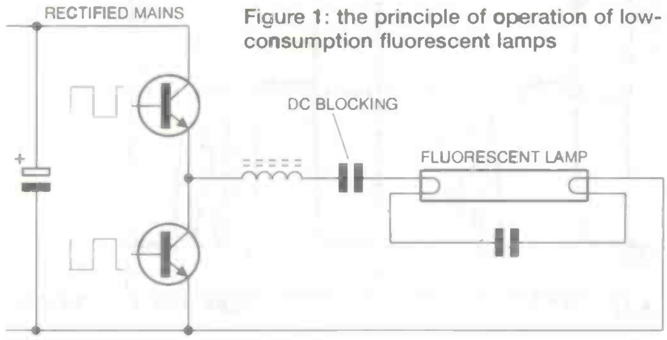


Figure 1: the principle of operation of low-consumption fluorescent lamps

On a summer camping trip, I was given to reflect that my trusted 12V fluorescent light of many years' service was not only somewhat battered and lacking a cover, but also that it didn't distribute the light where I wanted it. In its earlier days it had been clipped to the ridgepole of a small tent and was fine but now, in a larger tent with a vestibule, a light more like a lantern seemed to be called-for.

I normally work under a 3500K colour temperature low consumption lamp of the type intended to replace a conventional domestic lightbulb. The 18W model I use is specified to give out slightly more light than a 100W incandescent lamp. The colour temperature, being higher than most, gives a light with enough blue in the spectrum to tell, for instance, the difference between red and purple on a resistor colour code easily. It also make most things look a little brighter - in short, it is ideal for a situation in which there never seems to be enough light because there are no walls and ceiling to reflect it back to you. An interesting fact about the low consumption lamps intended for use with this project is that they contain all the necessary electronics to drive a fluorescent lamp, but they are designed to work on 240V AC. However, what they do is to rectify the mains when it is first fed in, so they can run just as happily on DC. All that is needed is a DC supply of the average level on the capacitor which follows the rectifier in the fluorescent lamps. I found that 250V works well on a range of lamps, so this project is to provide a nominally 250V DC supply to run a low consumption mains lamp.

Many of you will have seen designs for 12V to fluorescent tube converters. Normally these use a blocking oscillator driving a transformer made on a ferrite pot core. This transformer steps the 12V supply up to a high enough level to run a fluorescent tube. However, low consumption lamps operate differently because of the higher supply voltage.

A normal mains fluorescent luminaire employs a choke in series with the fluorescent tube to limit the current once it has struck. When a fluorescent tube is conducting, the voltage

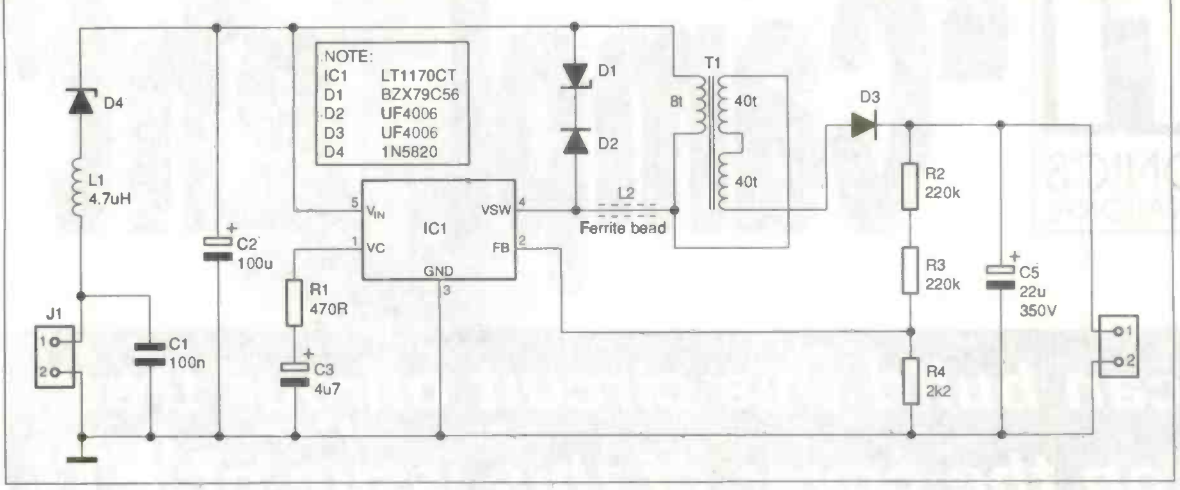


Figure 2: the circuit of the 250V DC source

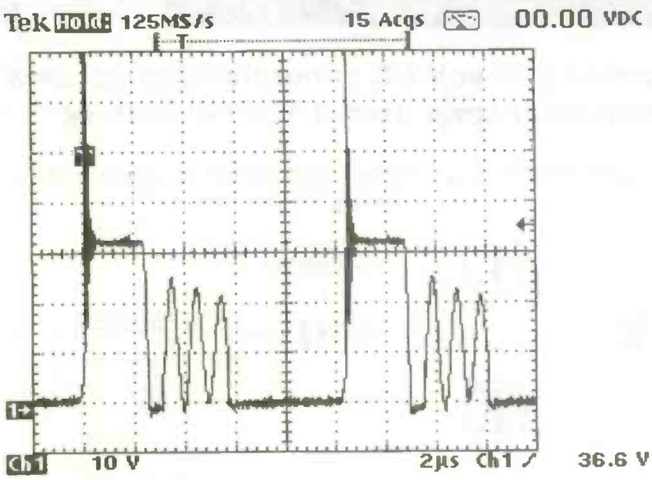
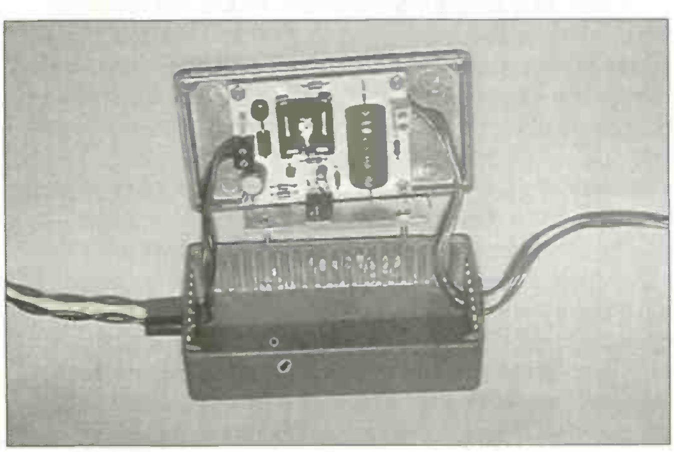


Figure 3: switching waveform on ICI pin 4

across it does not rise significantly as current increases, so without an external limiting component the current would rise to a destructive level and the lamp would be useless.

The choke contains a substantial iron core, and is inconveniently large and heavy.

Low consumption lamps use the same principle, but use a much smaller choke in conjunction with a higher frequency to give the required current (because the impedance of an inductor is 2 x pi x f x L where L is the inductance and f is the frequency). What they do is to switch a DC supply at a high frequency and use the result to drive the fluorescent lamp. The principle, omitting the control circuitry, is shown in figure 1.



The schematic

Instead of rectified mains as shown in figure 1, we use a DC supply generated by the circuit shown in figure 2. This design employs a Linear Technology switched mode converter chip, the LT1170, in a voltage-boosted flyback converter configuration.

Flyback converters operate by storing energy in a magnetic field, usually contained in a defined airgap in a magnetic component, and then discharging that energy into a load at a different voltage from that at which it was fed in. The maximum power output available from a given flyback converter is limited by how much magnetic energy can be stored in the magnetic component before it saturates, and how rapidly the energy can be stored and transferred. This circuit works at 100kHz, which is a respectable though not technologically difficult frequency for a flyback converter. The frequency is set

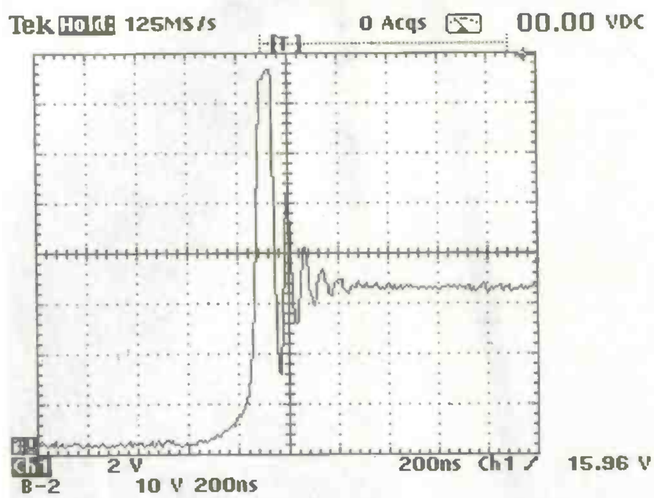


Figure 4: the switching waveform expanded to show a switching spike

by the on-chip oscillator of the LT1170.

The energy storage is provided by a ferrite E-core transformer with a gap in the centre limb. The component chosen is an EFD20, which is a 20mm-square “easy flat design” transformer using a ferrite suitable for frequencies of several hundred kilohertz.

At room temperature the 15mm-square transformer, which can store about half the energy of the 20mm-square one, is adequate for the job. However, allowance has to be made for the fact that the transformer core material is ferrite. The mechanism of magnetisation of ferrite is different from that of iron, with pairs of opposed magnetic moments of unbalanced strength, so that the difference between the two allows for a net magnetisation. The practical upshot of this is that ferrite saturates at lower flux densities than iron, its Curie point (the temperature at which is ceases to be magnetic) is lower, and

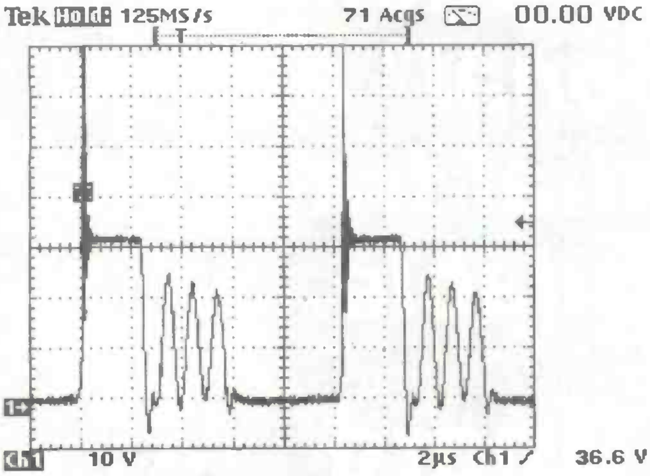


Figure 5: the switching waveform on IC1 pin 4 but without the ferrite bead

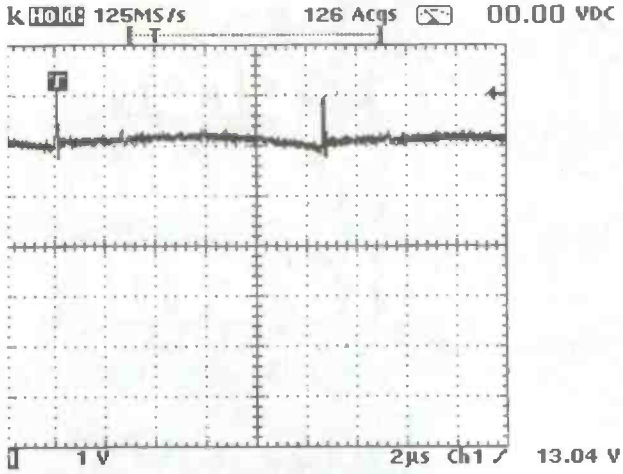


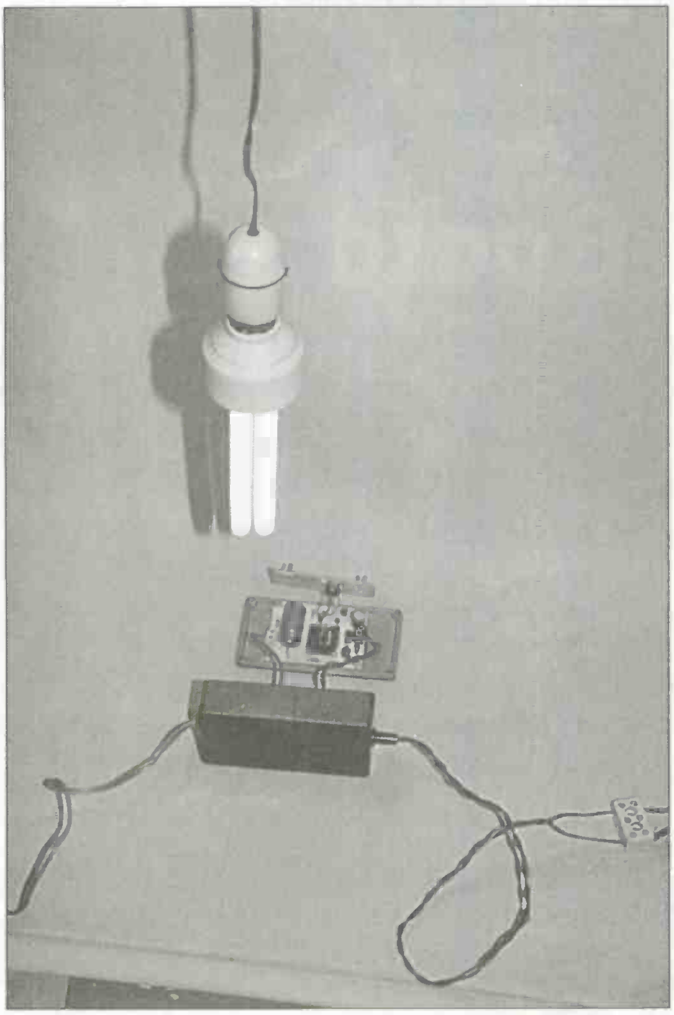
Figure 6: voltage across C2

its saturation flux density decreases as it warms up.

To allow for heat dissipation in the unit and still permit correct operation, the EFD20 is the smallest suitable transformer.

The structure of the circuit is largely conventional. Starting at the power input, J1, there is a filter to stop interference getting out down the input wire, and a diode to protect against reverse battery connection. C2 provides local decoupling. A specially low esr (equivalent series resistance) capacitor is used to minimise noise and maximise efficiency.

IC1 contains all the active electronics including the switching device. R1 and C3 provide a fairly low frequency pole for the feedback loop, aiming more for absolute stability than for rapid response to step changes of load (which are not expected to occur). In this type of converter the switching device will inevitably be subjected to some degree of switching spike caused by the leakage reactance of the transformer. To protect the chip from damage caused by such spikes, the maximum voltage is clamped by zener diode D1, with D2 being provided to prevent D1 from conducting when the switching device is on. The switching waveform is shown in figure 3, with the spike being very apparent. As can be seen, under the load conditions for which this trace was taken (21-watt lamp load) the switch is on for just over 4 microseconds, and then the transformer transfers energy to C5 for approximately 3 microseconds. After that there is approximately 3 microseconds when both D3 and the switching device are not conducting. Figure 4 shows an oscilloscope printout of the detail of the spike on IC1 pin 4. In this trace it can be seen that the first ring has a flattened top, where D1 conducts and limits the size of the spike. In the absence of the zener diode, the spike would go to approximately twice this voltage. One item not always seen in flyback converters is the ferrite bead L2. This is necessary to limit the rise of switch current during the first few tens of nanoseconds if the switching device turns on at or near the peak of one of the oscillatory cycles that occurs in the transformer once it has finished discharging energy into C5. To illustrate the effect of the ferrite bead, the waveform at the junction between L2 and T1 is shown in figure 5. Here, there is a -4V spike at the point of switch-on. With a slightly different amount of load, so that the switch-on occurs at the peak of the cycle rather than, as here, more than half way down, the spike can exceed 10V. In practice, what happens without L2 is that at some specific levels of load the control chip switches on for only about 100 nanoseconds on some cycles, when it switches at the peak of a ring. This alters the phase of the switching so that the next cycle can usually switch successfully. The switching jitters, and the efficiency drops. You will note that there is a significant period where the transformer is ringing and not either being charged or discharged with magnetic energy. This is necessary for two reasons: the control law is different if the converter operates in continuous mode, i.e. when either the switching device or the diode are conducting at all times. The second reason is that, if the switching device turns on while the diode is still conducting, then there is a significant switching loss in the diode which reduces the efficiency. Therefore, T1 has been designed so



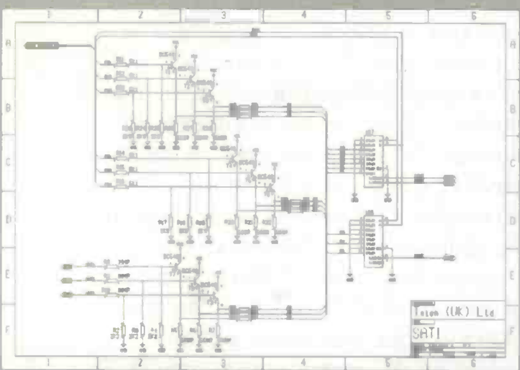
Is your PCB design package not quite as "professional" as you thought? Substantial trade-in discounts still available.

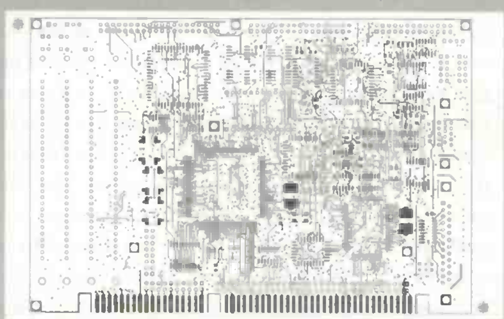
BoardCapture

Schematic Capture Design Tool

£395

- Direct netlist link to BoardMaker2
- Forward annotation with part values
- Full undo/redo facility (50 operations)
- Single-sheet, multi-paged and hierarchical designs
- Smooth scrolling
- Intelligent wires (automatic junctions)
- Dynamic connectivity information
- Automatic on-line annotation
- Integrated on-the-fly library editor
- Context sensitive editing
- Extensive component-based power control
- Back annotation from BoardMaker2





BoardMaker

BoardMaker1 - Entry level

£95

- PCB and schematic drafting
- Easy and intuitive to use
- Surface mount and metric support
- 90, 45 and curved track corners
- Ground plane fill
- Copper highlight and clearance checking

BoardMaker2 - Advanced level

£395

- All the features of BoardMaker1
- Full netlist support- BoardCapture, OrCad, Schema, Tango, CadStar
- Full Design Rule Checking both mechanical and electrical
- Top down modification from the schematic
- Component renumber with back annotation
- Report generator- Database ASCII, BOM
- Thermal power plane support with full DRC

BoardRouter

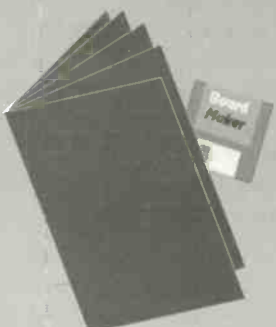
Gridless re-entrant autorouter

£200

- Simultaneous multi-layer routing
- SMD and analogue support
- Full interrupt, resume, pan and zoom while routing

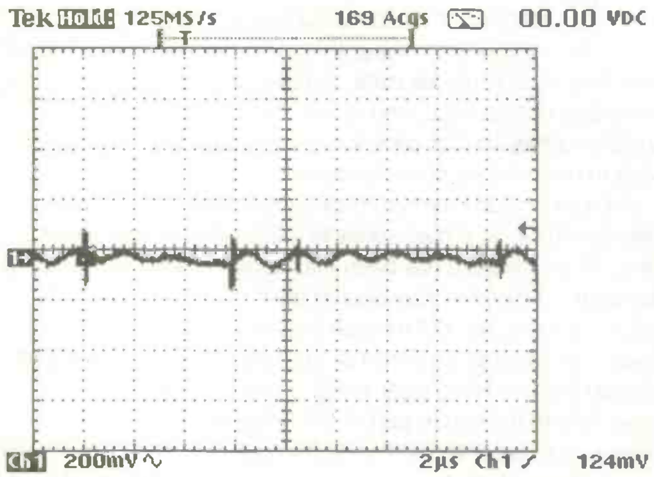
Output drivers - Included as standard

- Printers - 9 & 24 pin Dot matrix, HPLaserjet and PostScript
- Penplotters - HP, Graphtec & Houston
- Photoplotters - All Gerber 3X00 and 4X00
- Excellon NC Drill and Annotated drill drawings (BM2)



For futher information contact
Tsien (UK) Limited
Aylesby House
Wenny Road, Chatteris
Cambridge, PE16 6UT
Tel 01354 695959
Fax 01354 695957
E-mail Sales@tsien.demon.co.uk

tsien



Fiigure 7: interference on the input terminals

that the converter will not run into continuous mode at any rate of load. By the way, the effectiveness of the input filter is illustrated by the waveforms of figures 6 and 7. Figure 6 shows the interference waveform on the top of C2 at 1V per centimetre, while figure 7 shows the interference on J1 at 200 mV per centimetre. The peak interference voltage is reduced to approximately one-fifth by the addition of L1 and C1.

Building the transformer

In order to make this project work well, the transformer must be built just as shown. Any variation from the designs shown here may result in unreliability. For example, one more turn on the primary could send the system into continuous mode conduction at higher load levels, which might cause the failure of D3.

First of all, one of the 40-turn secondaries must be wound (it does not matter which one). It must be connected between the two pins as shown in figure 8, the transformer pin diagram.

It is vital that all the windings are done in the same direction, so that if you have started winding, say, clockwise at one side of the transformer, all subsequent windings must start at the same edge and go in the same direction.

After the first winding has been put on, a layer of tape should be placed over it. Ideally, thin Mylar tape should be used, but if this is not available, any thin non-conducting tape may be used. The enamel insulation on the wire is supposed to be adequate for the voltages in use, but the slightest scratch in assembly can impair this quality, so a layer of tape is very desirable as an extra protection.

The next layer to be wound is the 8-turn primary. To keep the windings as flat as possible, the same wire thickness is used for the primary as for the secondaries, but, because of the increased current in the primary, two wires are wound side by side to make this winding. A length of wire at least twice as long as required to go round the bobbin 8 times should be folded in half and the folded end looped over one of the pins to which the primary is connected. If necessary, because two wires join this pin, a little of the insulation at the point in contact with the pin should be scraped off to enable extra heat to get through to the self-fluxing insulation.

A single twist should be put in the wire to hold it tightly onto the pin, and then the paired wire should be wound carefully 8 times round the bobbin in the same direction as the winding already put on. It is preferable to space the turns roughly evenly over the length of the bobbin. When 8 turns have been applied, terminate the pairs of wires at the other primary connection pin. It is desirable to scrape a little of the insulation off both wires at this point to make sure that solder contacts them both and to avoid the possibility that only one of the two wires may end up properly connected.

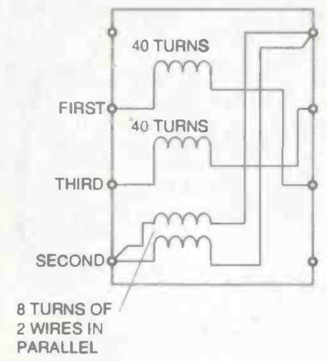
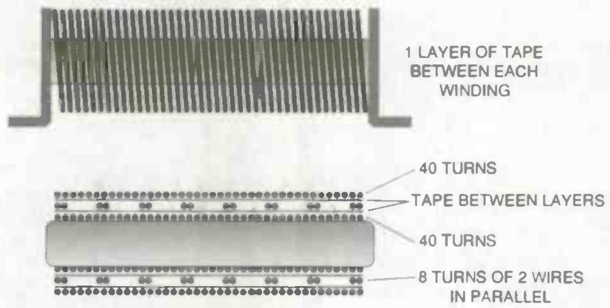


Figure 8: the order of the transformer windings

Then apply a further layer of tape, and wind the final 40-turn secondary, again making sure to do it in the same direction as the other two windings. Then solder the wires to the pins, making sure that the solder contacts the wire through the self-fluxing insulation. A hotter-than-normal soldering iron temperature is desirable for this process. In case of problems, carefully abrade the self-fluxing insulation on the wire where it contacts the pin.

Figure 9: the layers of winding and insulation tape on the core bobbin



The layering of the tape and windings is illustrated by the cross-sectional view in figure 9.

When the winding has been done and its conductivity checked with a meter, assemble the cores and clips as shown in figure 10. The transformer is now made and is symmetrical, so it can fit into the board either way round.

Assembly of the board

If the specified components are used, they should all fit on the pcb with no difficulty. Do NOT fit IC1 until you have read the sections on assembly. See the component overlay in figure 11.

The printed circuit board will be mounted, with only a moderate clearance, to the inside-lid of the metal case, so it is important that the component legs are cut fairly short and are soldered neatly (figure 12, shown board-up with the lid upturned).

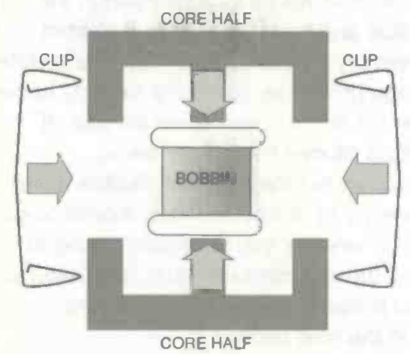
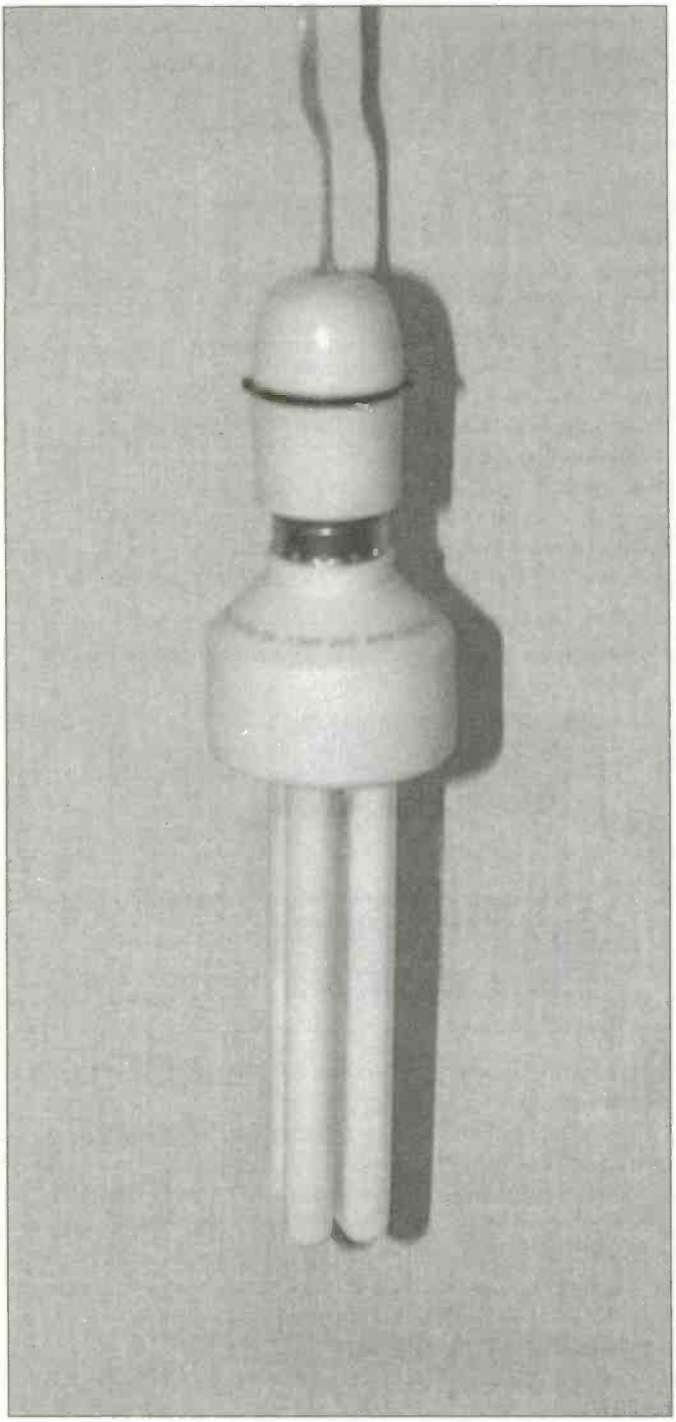


Figure 10: assembling the transformer

When clipping the resistor legs, be sure to keep one to thread through the ferrite bead that forms L2, and a second



one as a marker for use in the assembly process.

Mounting IC1

The IC is mounted on a heat-spreader plate (figures 13 and 14) which has captive bolts that will be located through the side of the case from inside and have the nuts put on from outside (see the box assembly diagram, figure 15). This is quite a fiddly process and, in the prototype, several of the legs broke off the essential IC1 after the lid had been taken on and off about a dozen times. I then clipped the legs of the IC somewhat shorter and connected them up with flexible wires that have shown no tendency to break. You may choose to do it either way, depending on whether you anticipate having to remove the lid often once the unit has been built. It is useful to figure out which way you prefer to connect the IC before carrying out the testing in the next section.

To test the equipment, IC1 needs to be connected up with its heatsink mounted, to prevent it from getting too hot too fast. The heatsink is the heat-spreader plate that will also be part of the mounting for the pcb in the case, therefore it is best to cut the heat-spreader plate, to drill it and the casework accurately at this stage, and fit the captive bolts into the spreader plate, so that once it is mounted on IC1, it does not have to be removed again for assembly.

A piece of aluminium 2mm thick by 20mm wide by 70mm long is suitable as a heat-spreader plate with the case used here. When the plate has been cut, clamp it to the inner side of the case, so that it is also located against the base (NOT the lip) of the case, and drill through it and the case two fixing holes, one towards each end of the spreader plate (this is just to keep the bolt-holes clear of IC1, which will be bolted separately to the centre part of the spreader plate). These holes should be drilled with a 2.5mm drill, then the plate should be unclamped from the case, and the holes in the case should be drilled out to 3.5mm diameter, which will allow an M3 bolt to pass through easily.

The heat-spreader plate needs captive bolts (bolts which do not drop out when the nut is removed), so you must file out the 2.5mm holes in the plate until they are just large enough to permit an M3 bolt to be forced into the plate with a screwdriver, cutting its own thread as it goes. When the bolt is almost screwed home, a tiny drop of Superglue should be placed on the inside of the head (do NOT get glue on the remainder of the thread, which will be needed later) and then it should be tightened down thoroughly. Once the Superglue has set, the bolts will in effect be part of the spreader plate.

Now that the position of the heat spreader plate is known, it is necessary to get an accurate measurement of where the hole for the IC should be drilled in the plate. The next step, therefore, is to mount the pcb onto the lid of the box, temporarily, but using the correct bolts and spacers. Mark and drill four holes to match the mounting holes in the pcb. Drill these to a diameter of 3mm and countersink. Then bolt the board into place using two of the bolts, diagonally placed, with their spacing washers.

Temporarily hook a piece of clipped component leg into the middle hole of the pcb where IC1 is to fit. Align the side of the lid with the side of the box, and carefully mark the rim of the box against where the component leg is. This marks the centre of IC1 when mounted, and is the vertical line on which the hole for IC1 needs to be drilled in the heat spreader plate. Locate the heat spreader plate into its mounting-holes on the box, and mark onto it a vertical line matching the position-mark on the rim of the box.

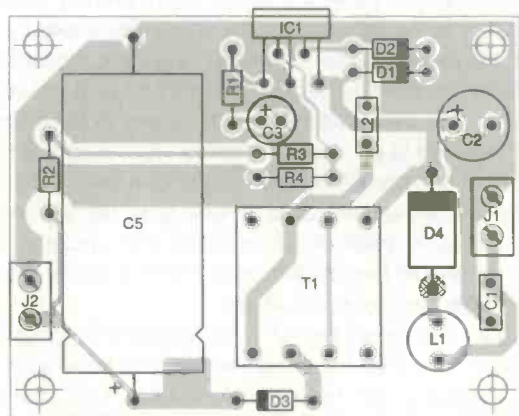


Figure 11: the component overlay

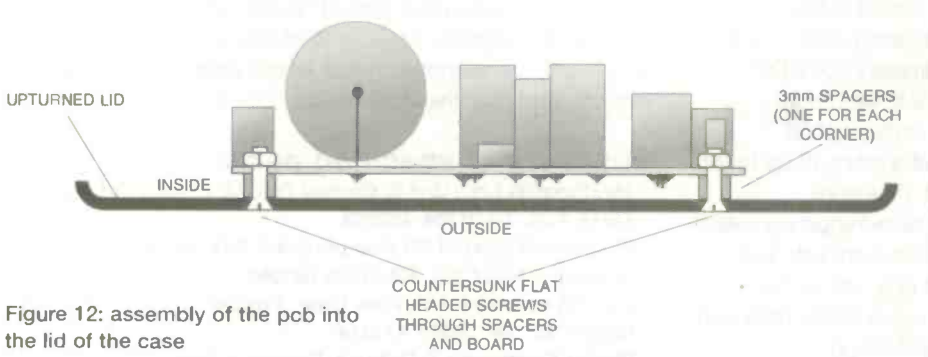


Figure 12: assembly of the pcb into the lid of the case

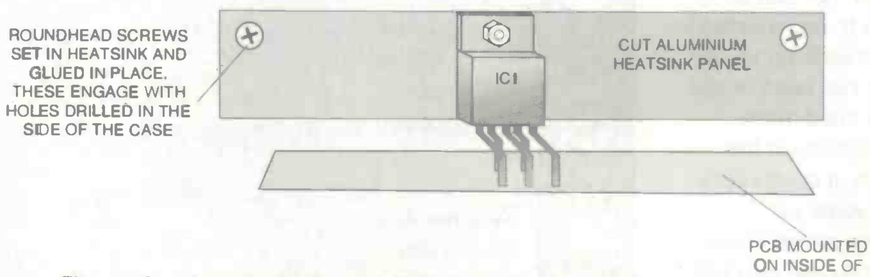
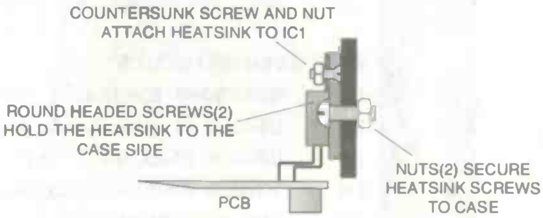


Figure 13 and 14: the heat-spreading plate mounted on IC1



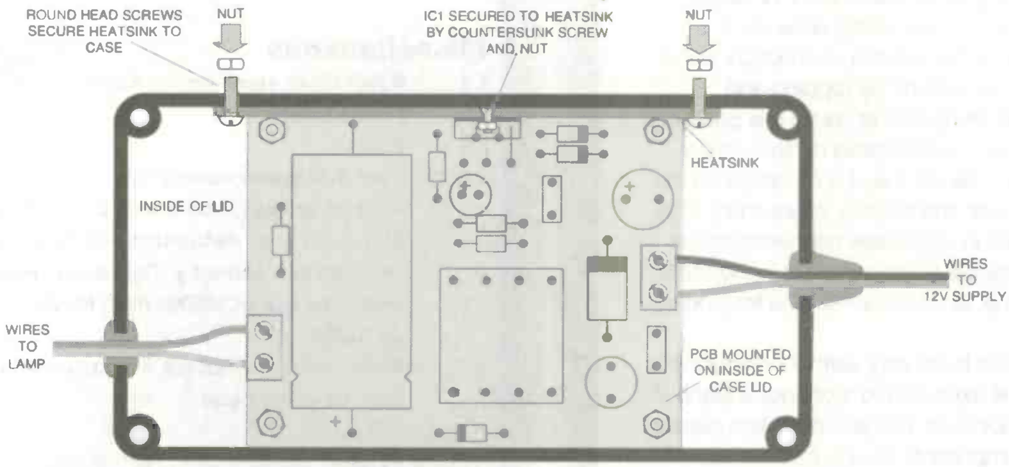
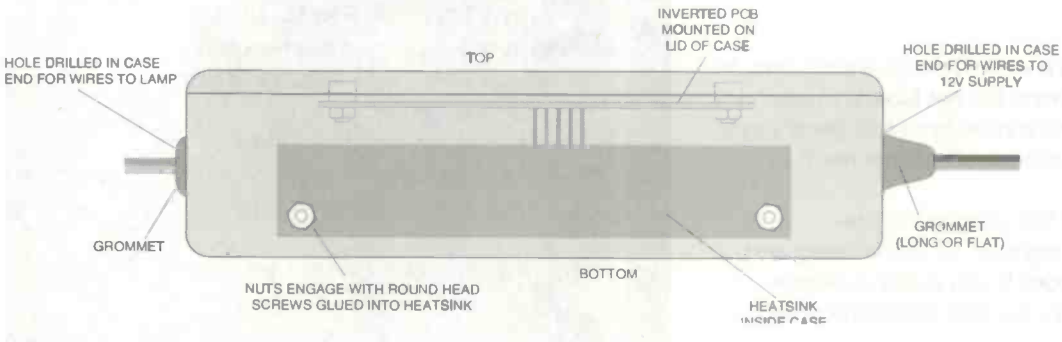


Figure 15: layout of the pcb in the lid, and assembly into the box. Note that the pcb lies upside-down in the box. Either tubular or flat grommets are suitable, so long as they protect the wires from fraying



Then, place IC1 onto the heat-spreader plate with its mounting-hole centred on the line, and with the tab downwards and almost lined up with the BOTTOM EDGE of the heat spreader plate (remembering that the pcb hangs upside-down in relation to the box). Mark the centre of the IC hole, and drill the heat-spreader plate at the marked point to a diameter of 3mm. Countersink this hole from the side away from the IC and make sure it is countersunk to sufficient depth that the head of the bolt does not protrude at all, as the finished heat-spreader plate must lie flush with the wall of the box to spread the heat properly. Mount IC1 to the heat spreader plate using a countersunk bolt with, if possible, a smear of heatsink compound between the IC and the plate. An insulating washer is not needed, because the tab of the chip is grounded. Now connect IC1 to the pc board, either by means of flexible wires or by mounting it directly. If it is to be mounted directly, then it may be best to locate the IC to the board without soldering it before the board is unbolted from the lid, and line it up so that the heat spreader plate bolts locate with the holes in the case. Then you may judge the position of the chip and solder it in the best angle to locate with the mounting hole. If flexible wires are used, the only note of caution is to make sure that all the wires go to the right holes. Whichever connection method is used, the pcb should be unbolted from the case for IC1 to be soldered. The unit should then be tested before fitting it into its case.

Testing and final assembly

First of all test the item using a dummy load resistor - 3.3k 20 watt would be ideal, but working on the principle that if it works properly at a low power it would normally be safe to try it on its normal load, a 47k 2-watt resistor would serve. Connect the load resistor, connect a voltmeter to the output, and connect a 12V supply, capable of giving at least 4 amps without hitting current limit, to the input. The unit should give approximately 250V DC output and show no signs of distress. If all is well so far, connect a lamp-holder and plug in a low-consumption fluorescent bulb of the electronic variety at a rating of up to 23 watts. The lamp should light within about 1 second.

Please note that lamps containing a mains-frequency ballast choke, such as the Thorn 2D lamps, will not work with this, and may be damaged by it. This unit can only just fit the aluminium case chosen for it, but it is a neat and tidy case and the next size up is clumsy and unnecessarily large.

The real problem is the height, but the cases in the catalogues with a greater height also have about twice the area. To make use of every millimetre of height, but pcb is mounted on 3mm spacers in the lid. If it were to be mounted in the main part of the box, the tab of IC1 would stick up too far and prevent the lid from fitting. When the unit has been tested, the wires with which it will be used should be fitted to the screw terminals, and suitable holes should be drilled in the ends of the case for the wires to pass through. It is important to fit grommets in these holes, otherwise the wires will inevitably wear through and short-circuit after a period of use.

First of all, mount the pcb onto the lid of the case using all four countersunk bolts and the 3mm spacers. Then, thread the wires through the grommets leaving only a small amount of slack. Then position the lid so that the bolts from the heat spreader plate locate through the holes in the case.

Be careful, as the weight of the heat spreader plate inevitably places some strain on the legs of IC1 at this stage. Screw the nuts a few turns onto the bolts so that they do not pull out again, then bolt the lid onto the case with its corner-screws. Then tighten up the nuts on the heat-spreader plate bolts. Needless to say, if you want to open the unit again, remember to remove the nuts that secure the spreader plate to the case BEFORE before trying to remove the lid, or all the hinging force will be borne by IC1. For safety reasons, it is desirable to fit an in-line fuse in the positive connection to the unit. The unit may be turned on and off by clipping and unclipping the wire to the battery terminals, but if it is preferred to use a switch, either an in-line switch rated up to 3 amps may be used or alternatively a switch may be mounted on the case and attached in series with the positive connection. This may necessitate the use of an in-line screw connector inside the case. Clearly, it is not sensible to put a switch in the 250V output connection to the lamp, so just connect the lampholder securely to the end of wire.

Please not that this unit has been very carefully designed to use the parts specified and is expected to work dependably if built exactly to the design. However, this sort of design places unusual demands on the components in use, and the use of substitute components may cause failure, and destruction of other parts of the circuitry.

In use

The unit generates a certain amount of heat in running, and the box may be expected to get warm but not too hot to touch. The electronics of the low-consumption lamp also generates a certain amount of heat, but again this should not reach a dangerous level.

Do be aware however that the wiring to the low-consumption lamp should be regarded as mains wiring, and treated with the caution accorded to any mains appliance wiring. This unit, and particularly any low-consumption lamp that may be used with it should not be operated if it has been subjected to significant amounts of rain or other source of damp. Low consumption mains lamps are meant for use indoors, and may therefore not be waterproof.

Suppliers of specified parts:

Electrovalue Ltd., Unit 3, Central Trading Estate, Staines TW18 4UX. Tel 01784 442253.
Electromail (part of RS Components) P O Box 33, Corby, Northants NN17 9EL Tel 01536 204555
Cirkit Distribution Ltd. Park Lane, Broxbourne, Hertfordshire EN10 7NQ Tel 01992 471314
Maplin Electronics P O Box 3, Rayleigh, Essex SS6 8LR 01702 554161

PARTS LIST

Resistors

R1	470R
R2	220k
R3	220k
R4	2k2

Capacitors

C1	100n
C2	100u 20V Electromail stock no. 188 3288
C3	4u7 Electrovalue stock no. LL4.750
C4	22u 350V Electrovalue stock no. 5022350

Semiconductors

D1	BZX79C56 Electromail stock no. 283-819
D2	UF4006 Electromail stock no. 264-282
D3	UF4006 Electromail stock no. 264-282
D4	1N5820 Electromail stock no. 183-7667
IC1	LT1170CT Electromail stock no. 299-711
T1 -	to be wound by hand. See separate parts list below

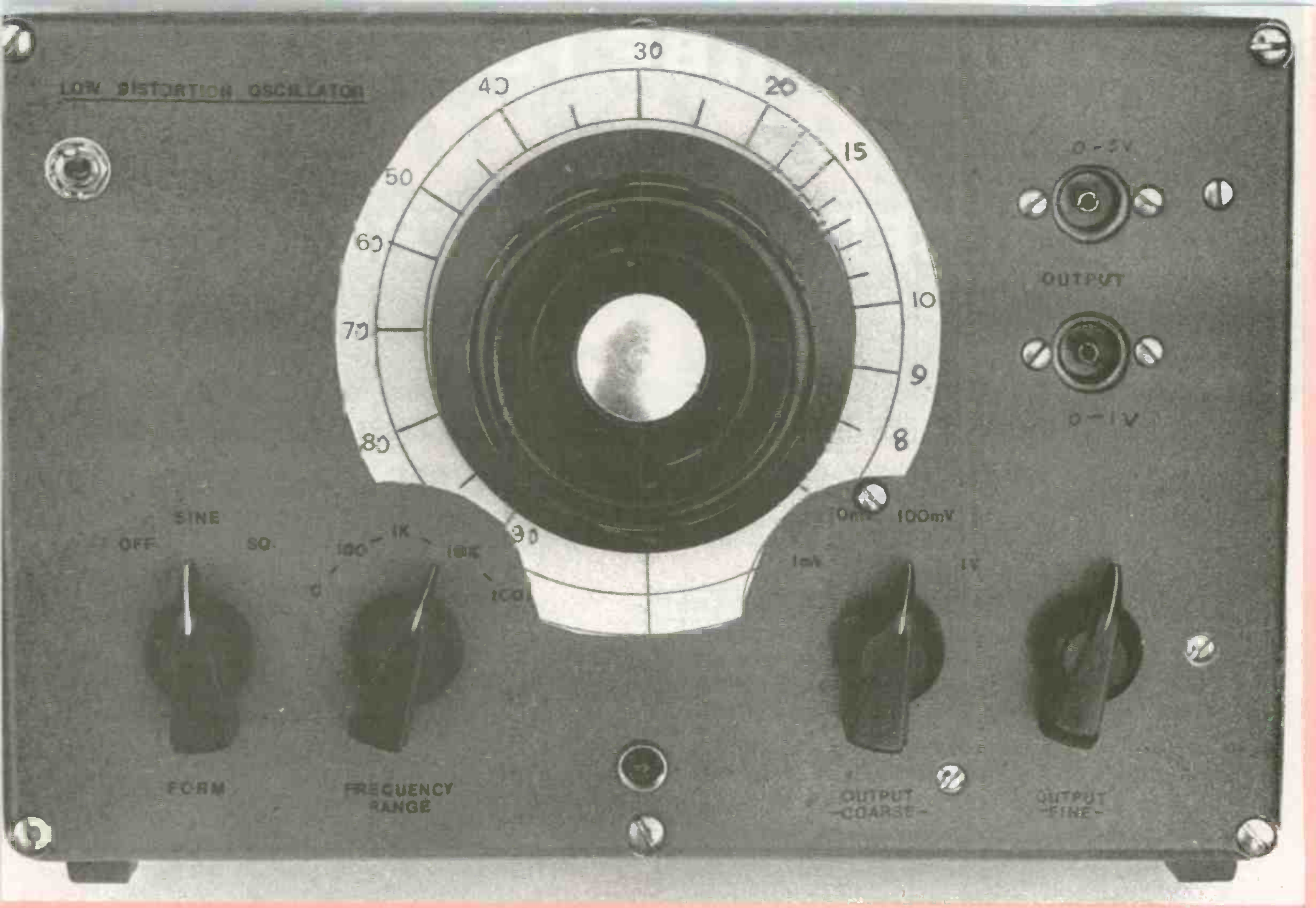
Miscellaneous

L1	4.7uH Cirkit stock no. 34-62178
L2	Ferrite bead
T1	8:40:40
J1,J2	2 pin 0.2" screw connectors
	Aluminium case. This MUST BE aluminium for proper heat dissipation. Plastic or steel will not work correctly. The case used in the prototype is a DCM5003 from Maplin, no. GU62
	Small piece of 2mm cut aluminium for the heat-spreader plate

4 off 3mm spacers
5 off 3mm bolts, counter sunk, 10mm long
2 off 3mm bolts, panhead, 12mm long

Transformer Parts List

All the parts are from Electrovalue
EFD CORE B66417 U100K187 EFD20
Stock code 417287K
EFD CORE B66417 GX187 EFD20
Stock code 417187G
Former B66418 V1008D1 EFD20
Stock code 418100081D
2 off clip B66418 A2000 EFD20
Stock code 4182000A



Squarer Circuit

An add-on squarer circuit for the low d/t oscillator by John Linsley Hood

A circuit for a very low distortion oscillator based on a two-lag loop was shown in the January 1996 issue of ETI. The major attractions of this design are its very low distortion - rather less than 0.001% at 1KHz - and its ability to switch from one frequency to another without any amplitude 'bounce'. (This amplitude unsteadiness is an unwanted characteristic of most low distortion signal generators, and it can be irritating if it is wanted to carry out tests over a range of frequencies.)

However, for the oscillator to be really useful in an electronics workshop involved, for example, in audio amplifier design, it is desirable that the instrument should also offer a good quality square-wave output, with a rapid, overshoot-free rise and fall time and a flat, droop-free, plateau between the high and low level transitions, of the kind shown in Fig. 1a.

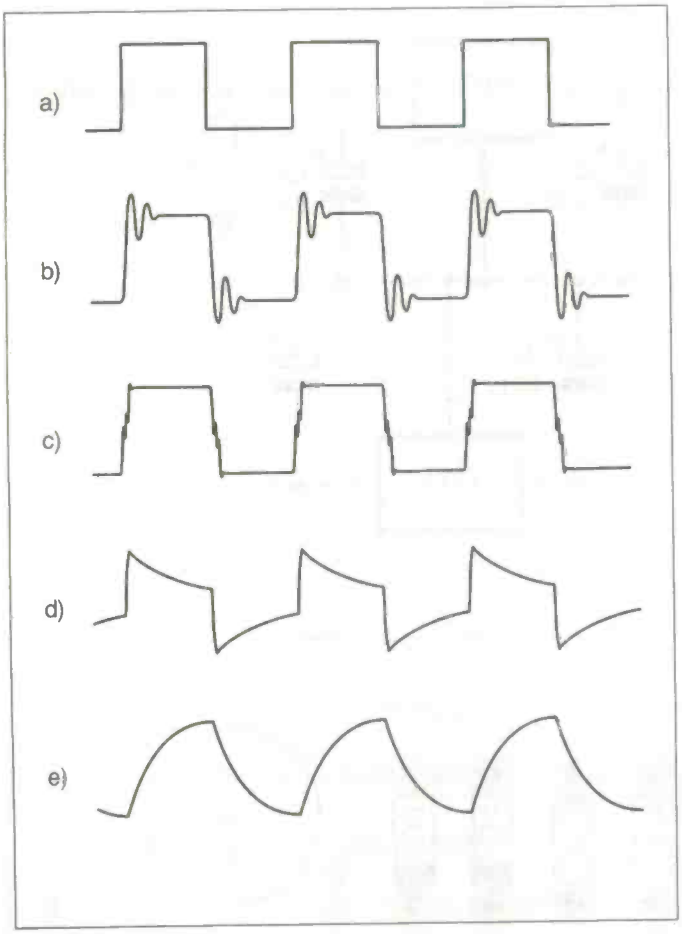
The value of such a test waveform in audio work is that, used in conjunction with an oscilloscope, preferably DC coupled, it can give a very rapid indication of the performance of the circuit under test, in that, for example, the waveform shown in Fig. 1b, would suggest a relatively poor degree of stability in an amplifier using loop negative feedback - a condition which could be explored using a selection of alternative output loads.

A more easily overlooked fault of the same kind is shown in Fig. 1c, and could be due to capacitative feedback between input and output wiring in an amplifier with a wide frequency response bandwidth. Whether such wide bandwidths are a good thing is debatable, but if the circuit permits them, it is equally necessary that they don't leave the circuit prone to RF instability, which could burn out expensive LS 'tweeter' units, the square wave generator circuit should provide an output waveform which is droop-free between the rise and fall transitions, so that waveforms of the type shown in Figs. 1d and 1e - indicating respectively poor LF and poor HF response - can be properly interpreted. Fortunately, this is quite an easy requirement to meet.

Square-wave generator design

Quite a range of circuits exists which will convert an input sine-wave into a flat-topped square-wave output, such as a CD4066 quad bilateral switch, actuated by a squared off input waveform, and used to switch an output between, say, a pair of +5V and -5V supply rails. Alternatively, a fast voltage comparator could be used, effectively acting as an amplifier which is driven into overload by its input signal, though such an arrangement would not necessarily

Continued on P. 35

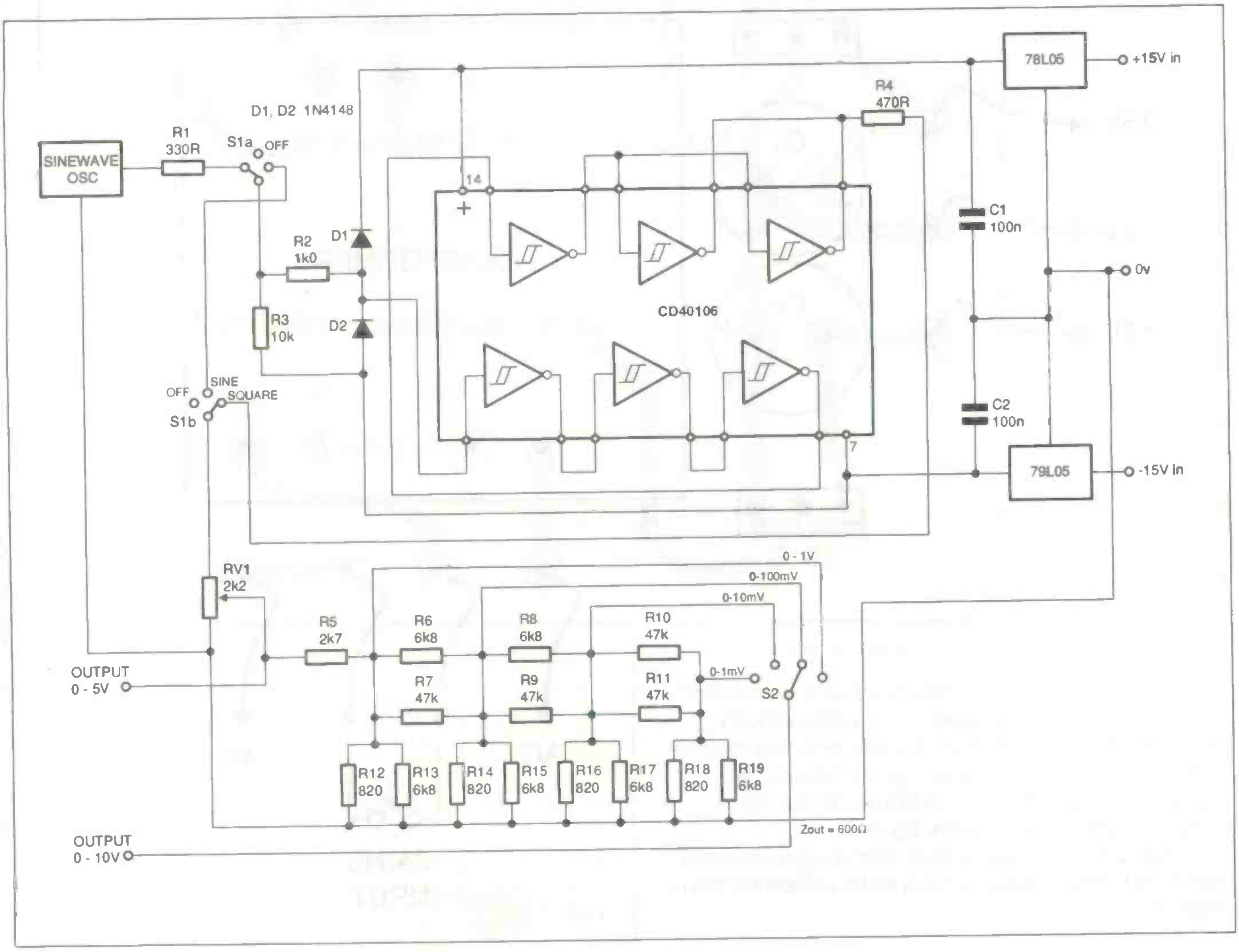


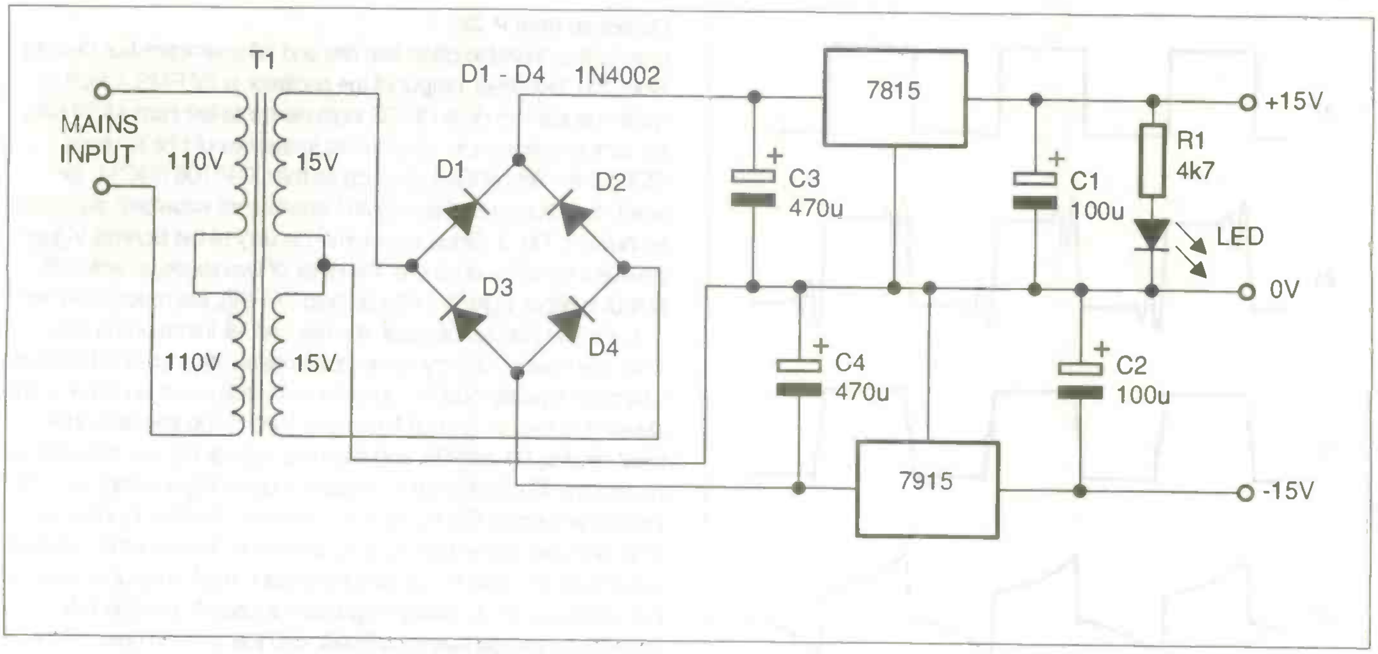
Continued from P. 32

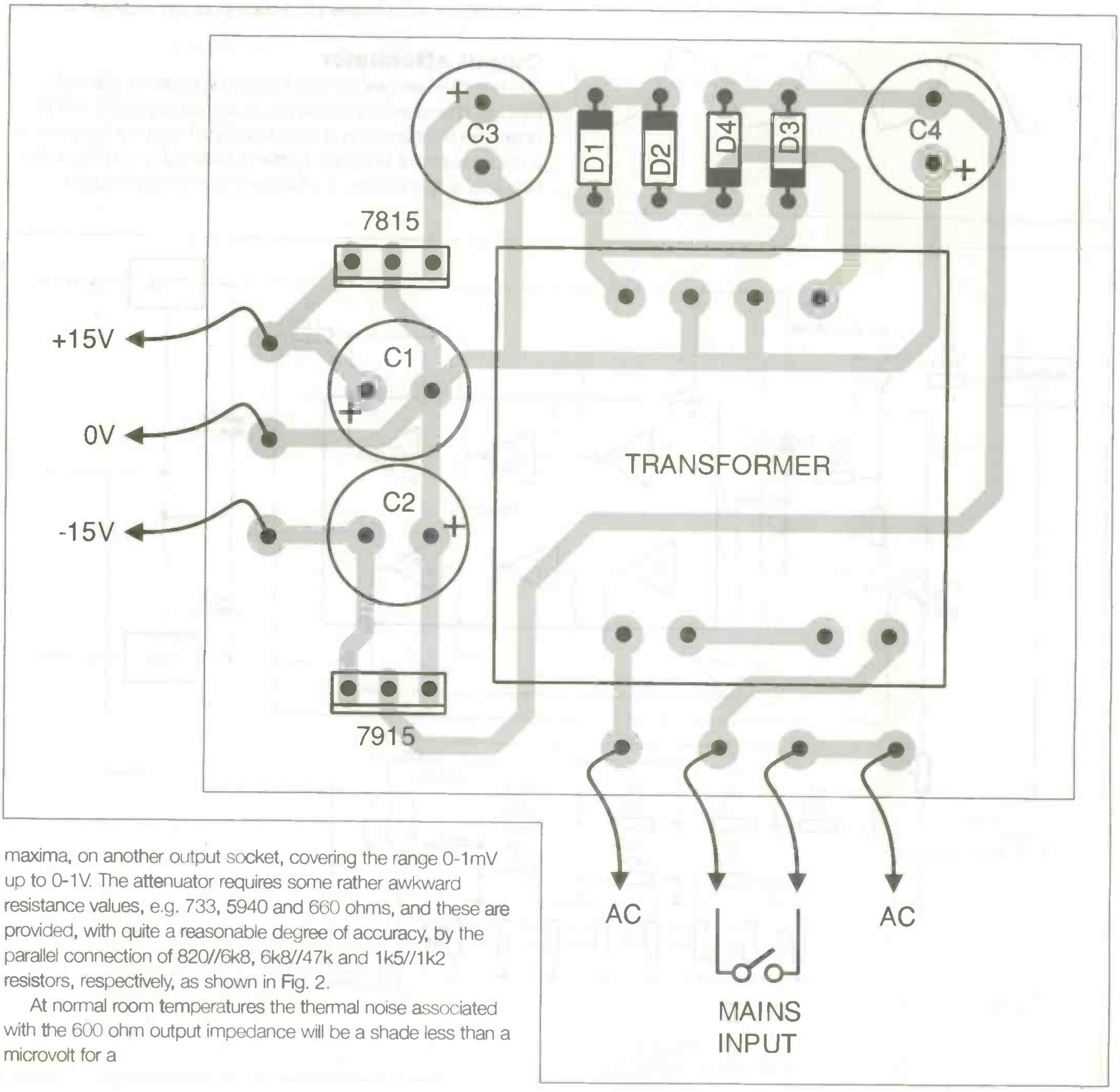
provide the desirable glitch-free rise and fall characteristics desired. Since the 'high level' output of the oscillator is 5V RMS, which is quite adequate to drive CMOS logic elements fed from +/-5V rails, the simplest, and most economical system would be to use a CMOS Hex Schmitt Trigger, such as the CD40106 (74C14) for which the circuitry and associated sine/square waveform switching is shown in Fig. 2. Since the internal circuitry of the Schmitt trigger causes it to 'latch' on one or the other of two states, in which its output is either logic '1' (+5V) or logic '0' (-5V), the requirement for a droop-free plateau between the rise and fall transitions is met, while the internal circuitry of the device generates rise and fall times which are typically 50nS in duration - which is less than 0.1% of the duration of the on- and off-times of a 10KHz square-wave. The input diodes, D1 and D2, and the input resistor R2, are included to protect the IC chip from an excessive input voltage swing, and the input bias resistor, R3, serves both to ensure that the input of the IC is clamped to the logic '0' (-5V) level when the circuit is switched out of use, and also to equalise the output 'mark to space' ratio. A pair of low power IC voltage regulators is used to provide low impedance voltage reference levels, and the last two gates of the CD40106 are also paralleled to reduce its output impedance.

Output attenuator

This is a three step section of a constant impedance attenuator, having a characteristic impedance, as seen at any point, of 600 ohms and an attenuation at each step (apart from the first which is a divide-by-five) of ten times, to give outputs either of 0-5V, on the high-level output socket, or a choice of four switched output

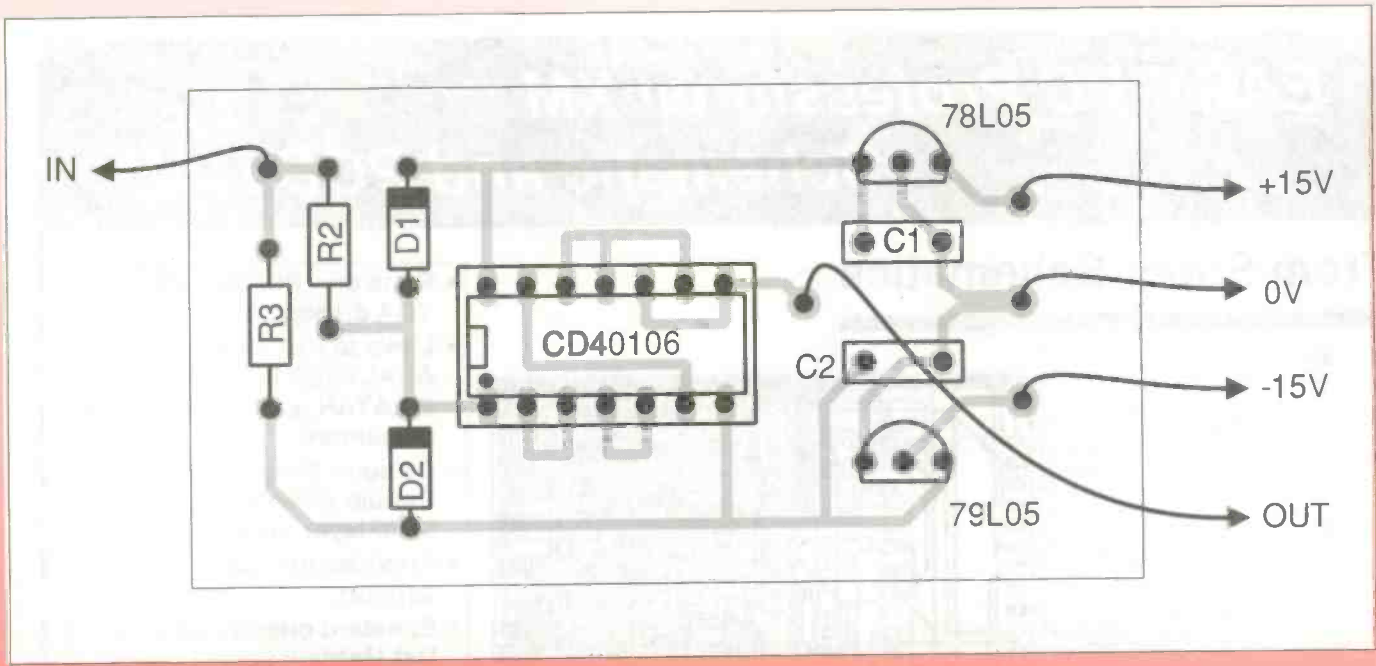






maxima, on another output socket, covering the range 0-1mV up to 0-1V. The attenuator requires some rather awkward resistance values, e.g. 733, 5940 and 660 ohms, and these are provided, with quite a reasonable degree of accuracy, by the parallel connection of 820//6k8, 6k8//47k and 1k5//1k2 resistors, respectively, as shown in Fig. 2.

At normal room temperatures the thermal noise associated with the 600 ohm output impedance will be a shade less than a microvolt for a



100KHz measurement bandwidth - i.e. about -60dB, with respect to 1mV - and this should be allowed for in low signal level noise measurements.

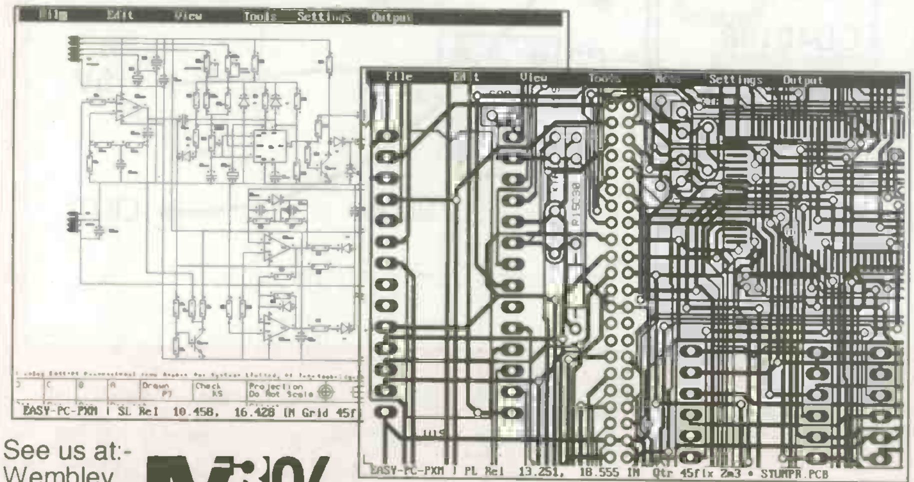
Range switching resistors and capacitors.
These are assembled, for convenience, between the tags of the respective 3- and 4-way switches.

Power supply unit
This is a conventional design with its output +/-15V lines stabilised by 7815 and 7915 IC voltage regulators, as shown in Fig. 3. The stabilised +/-5 volt lines for the squarer circuit are provided by a pair of 78L05 and 79L05 ICs mounted on the squarer unit PCR.

PCB layouts
These are shown in Figs. 4 and 5 and the completed instrument, enclosed for good screening in a 222mm x 146mm x 55mm diecast box (Deltron type 459-0070), is shown in Fig. 6.

EASY-PC Professional XM
Schematic and PCB CAD

From Super Schematics



- Runs on:- PC/ 386/ 486 with VGA display
- Links to PULSAR (logic), ANALYSER III (analogue) & LAYAN (electromagnetic) simulators.
- Design:- Single sided, Double sided and Multi-layer boards.
- Provides full Surface Mount support.
- Standard output includes Dot Matrix / Laser / Ink-jet Printer, Pen Plotter, Photo-plotter and N.C. Drill.
- Optional, powerful, 32 bit Multi-pass, Shape based, Shove Aside, Rip-up and Re-try Autorouter.

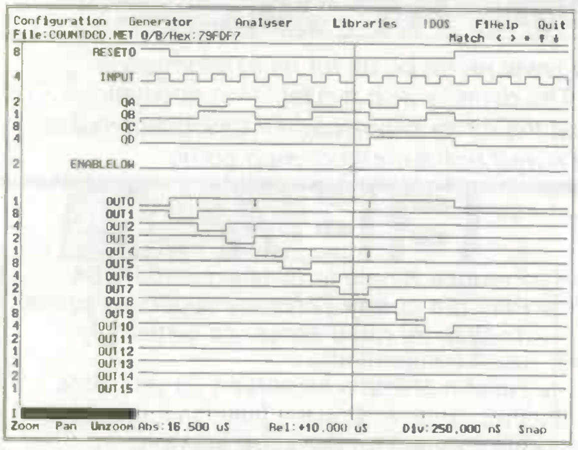
See us at:-
Wembley
Exhibition
8-10
October

MTT96 Microwaves and RF

To Perfect PCB's

Automatically links to Analog, Digital and Electromagnetic Simulators

PULSAR - Digital Circuit Simulation - from only £98



- Simulate Directly from EASY-PC Pro' Schematic.
- Check out designs quickly prior to prototyping.
- Glitches and Race Hazards highlighted automatically.
- Could easily pay for itself the first time it is used!

Affordable Electronics CAD

EASY-PC Professional: Schematic Capture and PCB CAD. Links directly to ANALYSER III, LAYAN and PULSAR.	From $245	£145
MultiRouter: 32bit Multi-pass Autorouter	$475	£295
LAYAN: Electro-Magnetic PCB Layout Simulator. Include the board parasitics in your Analogue simulations. Links with and requires EASY-PC Professional XM and ANALYSER III Professional	$950	£495
PULSAR: Digital Circuit Simulator	From $175	£98
ANALYSER III: Analogue Linear Circuit Simulator	From $175	£98
FILTECH: Active and Passive Filter Design program	From $245	£145
STOCKIT: New comprehensive Stock control program for the small or medium sized business	$245	£145
EASY-PC: Entry level PCB and Schematic CAD.	$135	£75
Z-MATCH : Windows based Smith-Chart program for RF Engineers.	From $245	£145

We operate a no penalty upgrade policy.
US$ prices include Post and Packing
Sterling Prices exclude P&P and VAT.

For full information, please write, phone, fax or email:-

- TECHNICAL SUPPORT FREE FOR LIFE
- PROGRAMS NOT COPY PROTECTED.
- SPECIAL PRICES FOR EDUCATION.

Number One Systems

UK/EEC: Ref. ETI, Harding Way, St.Ives, Cambridgeshire., ENGLAND, PE17 4WR.
Telephone UK: 01480 461778 (7 lines) Fax: 01480 494042
USA: Ref. ETI, 126 Smith Creek Drive, Los Gatos, CA 95030
Telephone/Fax: (415) 968-9306

e-mail: *sales@numberone.com*
International +44 1480 461778

VISA MasterCard

ada4prpu

Data Bus Monitor

Tim Parker's monitor displays 8-bit binary data in decimal as well as hexadecimal formats

How many times have you tried to check the bit states of an 8-bit output port using either a multimeter, oscilloscope or even an LED soldered on two lengths of wire, and then had to work out the value, adding them up something like 1+2+4+8...etc.?

Here's a project which should help to overcome all of these 'pains in the neck' for you, by displaying digitally the whole 8 bits in decimal or hexadecimal format. There are some display driving ICs available which accept BCD (binary coded decimal) inputs and convert this to seven segment outputs. These are fine if you only want to display a single number from 0 to 9, but how often is that? There was even an IC available some years ago which accepted 4 bit binary data and displayed this in hexadecimal, so you could always have used two of these, but these were expensive, and I don't know if they're still available. Even so, if they are, you would still be limited to hexadecimal readout only. What is strange is that, even from the beginnings of digital computers, no manufacturer has produced a readily available IC which will accept and convert 8 bit binary data, and certainly not one which gives a decimal readout as well.

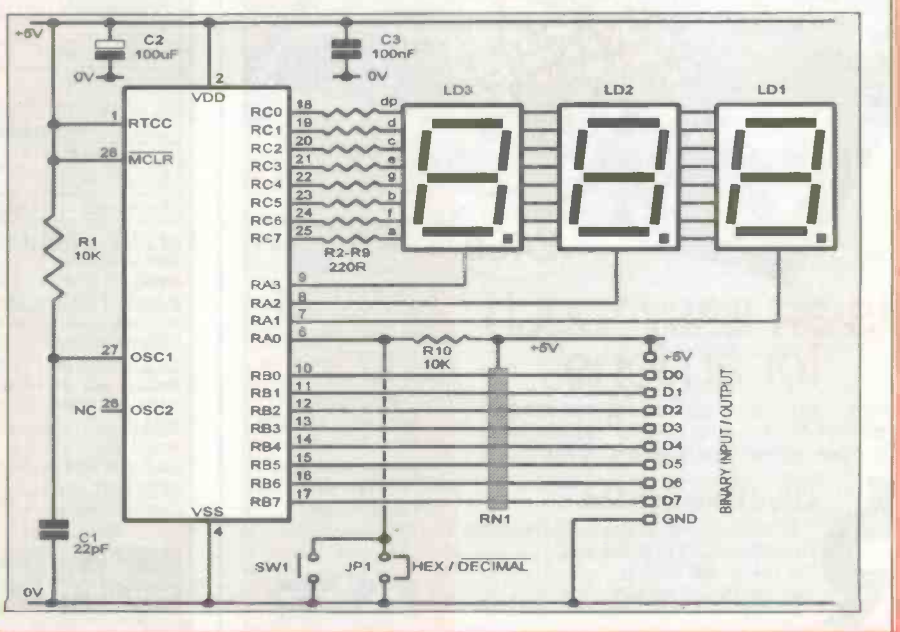
For educational purposes this format is a must for demonstrating the differences between the two codes. The circuit diagram of figure 1 shows how simply this can be achieved using the PIC16C55 microcontroller. Because speed is not an important factor in this design, the lower priced RC version of the PIC is used, and the oscillator frequency is set by the values of R1 and C1, which can be altered if you wish, but to stay within the manufacturers recommendations, don't reduce C1 much below 20pF or R1 below 2K2.

As is usual with designs of this nature, there is little to explain about the circuit diagram, since all of the work is carried out by the program within the microcontroller itself. The binary code is applied to port B (which is programmed for input only) and is converted to seven segment display codes. All of the corresponding segment connections of the three displays are paralleled together, but only one is accessed at any time. The digit data for each display is applied in turn to port C, and then the strobe line for the currently selected display - RA1 to RA3 - is pulled low for a predetermined length of time to light it up.

The display is then turned off again and the sequence is repeated for the two remaining ones. A point to bear in mind is that each display must be turned off at the end of the light-up period before moving on to the next digit, otherwise display 'ghosting' will occur. This is a most irritating effect where the previous digit data appears superimposed very dimly on the currently active one. The unwanted data is only present for as many clock cycles that it takes to set up the next digit data on port C, but because the displays are refreshed so rapidly, and continuously, the 'ghosting' appears to be occurring constantly, even thought it isn't. The jumper link JP1 and momentary switch SW1 can be closed to signal to the program to display the data on port B in decimal format, rather than the default hexadecimal. The switch can be pressed or released at any time, for switching briefly between display formats, ideal for quick conversion references and educational uses.

Continued on P. 41

Figure 1: The circuit diagram of the Data Bus Monitor: simple, but practical.



PORTABLE PROGRAMMER & EMULATOR

PROGRAMS EPROMS/FLASH TO 40 PINS WITHOUT ADAPTORS

EMULATES 8 & 16 BIT SYSTEMS

from £465

its an easy touch for anyone

Ideal for R&D or small volume production. ISO 9002 manufacture and strict use of manufacturers algorithms guarantees reliable programming.

- 2M ram, expandable to 8M - avoids multiple downloads and programming in blocks.
- Set programming & emulation for 16 bit systems.
- Tactile membrane with individual keys for all major functions.
- Supports sector protect/ unprotect feature on 29F010/040.
- Fast download. 15 seconds for 1M bit Intel file.

Lloyd Research Ltd.
7 & 7a Brook Lane, Warsash, Southampton, Hampshire SO31 9FH, England.
Tel: +44 (0)1489 574040.
Fax: +44 (0)1489 885853.

PIC EEZE

This is the easiest way to start using PIC microcontrollers. PIC EEZE is a powerful and versatile development system that allows you to start at the level you like and upgrade if needed whenever your ready. All systems have ZIF sockets, high quality PCBs (unlike similar priced systems). Fully featured Assembler/Simulator & Programming environment, designed to be software upgraded (All software upgrades are FREE).

Programs/ Features	PIC EEZE 1	PIC EEZE 2	PIC EEZE 3
16C54/55/56/57/58	–	YES	YES
16C61/62/63/64/65	YES	YES	YES
16C71/73/74	YES	YES	YES
16C84	YES	YES	YES
16C620/621/622	YES	YES	YES
Serial Eeproms	YES	YES	YES
In Circuit Emulation	–	–	YES
Lpak (learning package)	YES	YES	YES
Expansion Port	YES	YES	YES
BASIC compiler	–	–	YES
Price (built and tested)	£44.95	£52.95	£72.95

Upgrading is simple, just order the required system firmware and pay the difference

IN CIRCUIT EMULATION Target probe can be taken from the expansion port to application circuit. Your program can then be stepped/run etc. with results on screen and at probe.

BASIC COMPILER Allows you to make your own BASIC PICs and evaluate your program with Real Time Emulation through target probe. (Please write/call for details/availability).

LPAK plugs into the expansion port and has coloured LEDs, 7 segs, buttons and switches and minicore emulator to show PIC programming methods (includes examples). £28.00.

DPAK stand alone demo boards (2). One is like LPAK and the other will accept 18/28 pin PIC, has oscillator and power sections ready built. Can be used with breadboards or you own circuit etc. £28.00.

SUPPORT We will give continuing support to our users and products. Future expansion planned – 17CXX Programmer – smart card reader/writer and more.

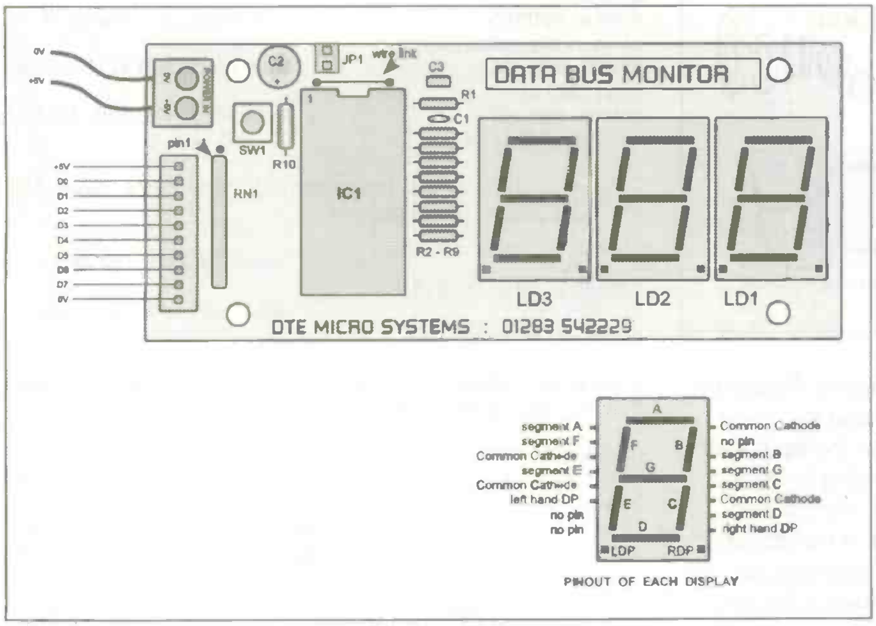
Please write or telephone for further information if required.

Lennard

Please add £2.00 P&P and make cheques payable to LENNARD RESEARCH

29 Lavender Gardens, Jesmond, Newcastle upon Tyne, NE2 3DD. Telephone (0191) 281 8050.

Figure 2: The components layout and pin connections to each of the LED displays.



Continued from P. 39

The jumper link, on the other hand, when fitted, provides long term viewing in decimal format only, thereby removing the need to keep the switch pressed all the time. You will see from the circuit diagram that the decimal point (dp) has been connected to RC0 on IC1. This has been done for completeness of connections to the LED displays, although these segments are not driven by the listed software, but that's not to say they cannot be. In fact, these types of displays have pin connections to both left and right hand decimal points, but it's the right hand one that has been used here. Although the connections to port B are labelled 'Binary Input/Output', in our application they are only used for input. The reason for such labelling is because the port could be programmed for output, and the program modified slightly to output binary codes at timed intervals on this port which correspond to the digital displays, which is very useful for educational purposes.

And due to the way the program has been written, these modifications do not require a complete re-write of the software, just so long as you have a basic understanding of PIC assembler. This educational aspect was also the reason for using the larger 0.8" LED displays, as opposed to the more usual 0.5" or 0.56" versions. It must be stressed though, these have a forward voltage drop across each segment of about 2 Volts, so the displays should be of the High Efficiency (HE) type, otherwise they are not going to be very bright.

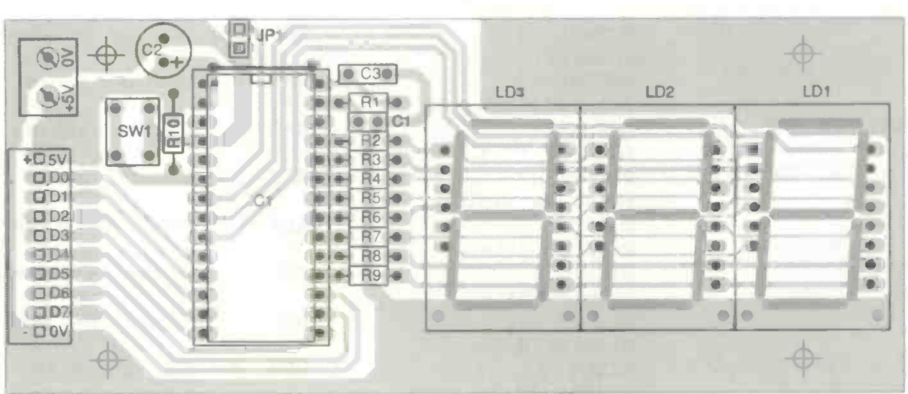
Construction

The PCB component layout is shown in figure 2. Construction is easy and fairly straight forward, and there aren't any special handling precautions required. To enable you to swap and change programs of your own, use an IC socket for IC1. Obviously, if the board is to be a fixed item, then IC1 can be soldered directly to it. The LED displays will only fit in one orientation, so there's no chance of getting them the wrong way round, unlike some other types which can easily be inserted upside down by mistake. Be careful when soldering the displays in place. There is only a fine gap between the pads and the copper tracks which run in between them. If, when you power up the board, you get strange digits displayed - particularly if they appear in all three of the displays - then the chances are that you've got an unintentional solder bridge across two or more adjacent tracks.

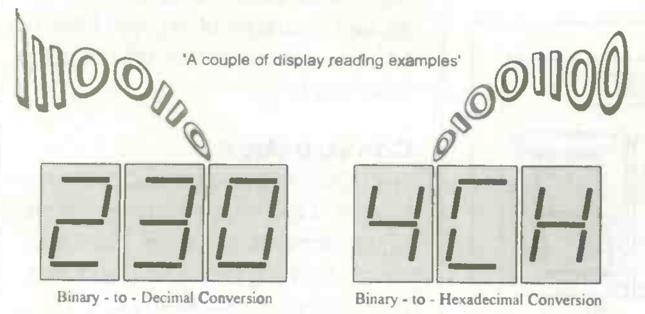
Don't forget the single wire link at the top of IC1, and take care with the direction of the SIL resistor network RN1, as these are very easy to solder the wrong way round. The pin 1 marker dot points towards the top of the board. A regulated +5V power supply can be applied to the board either via the two-way terminal block, or via the binary input/output pin header. Whichever you use, make sure it's connected in the correct polarity. If the board is to be used in educational establishments - schools and colleges etc. - it might be a good idea to apply power only to the terminal block, and to remove the top pin from the pin header so as to prevent the possibility of shorting out the power supply connections. Don't remove the bottom (0V) pin, as this will be required for a ground reference to any other equipment to which the board is linked, and also for shorting to the other binary code input pins to alter the input code. Once you're satisfied with the construction, insert a programmed PIC16C55RC/P into the IC socket (pin 1 upwards) and power up the board. With no inputs connected and with JP1 removed, the value 'FFH' will appear in the display. The two left hand digits are the value being read from the input port in hexadecimal. The right hand digit will always display the letter 'H' when hexadecimal display format is selected, in just the same way it is written on paper to clarify that the value is in hex. This might seem unnecessary at first, especially since decimal readouts don't contain letters anyway. But it would not be so clear if the two hexadecimal digits happened to be numbers.

Press and hold down SW1 to display the value in decimal format. The display now changes to '255'.

Figure 3: The components as laid out on the PCB.



A couple of display examples.



This is the decimal equivalent to FF in hexadecimal. Releasing SW1 will return once more to displaying the value in hexadecimal format. Now try shorting some of the input lines - D0 to D7 - to 0V. The display will adjust according to the changing values being read. In decimal mode, leading zero blanking is used to remove any unwanted '0's in the left hand displays. This means the value of (say) four is displayed as ' 4' (with two leading blanks), rather than '004', which is the way it would be written. In hexadecimal mode, the zero's are not suppressed at all, and even the value of nought (usually pronounced like 'zero zero hex') is displayed as '00H', which, again is the way it would normally be written to prevent confusion.

Software

The listing as presented is the complete program, as blown into the pre-programmed PIC16C55RC/P available for this project. From the size of it you will realise there is more than enough program memory remaining to include further routines of your own.

```
LIST  P=16C55, N=38, C=132, R=DEC
TITLE "ETI DATA BUS MONITOR"
;**********************************************
;* DATA BUS MONITOR                           *
;* Copyright 1996 DTE MICRO SYSTEMS           *
;* For use on the DTE DATA BUS MONITOR board  *
;**********************************************

;* WARNING.  THIS PROGRAM MAY NOT BE SOLD,
     *
;* TRANSMITTED OR COPIED IN ANY WAY (INCLUDING
     *
;* PROGRAMMING INTO EPROM) WITHOUT THE EXPRESS
     *
;* PERMISSION OF THE COPYRIGHT HOLDER DTE MICRO
SYSTEMS.                           *
;* ALL RIGHTS RESERVED. IT IS SUPPLIED SOLELY FOR
USE BY                             *
;* PRIVATE INDIVIDUALS FOR THEIR OWN PURPOSES AND
     *
;* WILL NOT BE USED FOR ANY FORM OF FINANCIAL GAIN
     *
;* WHATSOEVER. VIOLATION OF THESE CONDITIONS IS
     *
;* AN INFRINGEMENT OF COPYRIGHT LAW, AND MAY
RESULT                                  *
;* IN PROSECUTION OF THE OFFENDER BY THE COPYRIGHT
     *
;* HOLDER.
                                   *
;************************************************
; Define the general registers and I/O port
addresses

RTCC  EQU 01              ; Real Time Clock/Counter
register address
PC    EQU 02              ; Program Counter address
STATUS  EQU 03            ; Status register address
FSR   EQU 04              ; File Select Register
address
PORTA EQU 05              ; I/O Port A (lower 4
bits only available)
PORTB EQU 06              ; I/O Port B (all 8 bits
available)
PORTC EQU 07              ; I/O Port C (not fitted
on PIC16C54/56)

; Assign labels to programming constants used in
PIC assembly language.

W  EQU 0                  ; Destination register
becomes 'W' (acc.)
F  EQU 1                  ; Destination register
becomes 'F' (file)

; Assign labels to the various bit values of the
STATUS register (03h)

CARRY                     EQU 0 ; carry bit
DCARRY                    EQU 1 ; digit carry bit
ZERO                      EQU 2 ; Zero bit
PDOWN                     EQU 3 ; power-down bit
WATDOG                    EQU 4 ; watchdog time-out
bit

; Assign basic pin labels to the bit numbers for
I/O port A.

RA0   EQU 00 ; Port A I/O bit 0
RA1   EQU 01 ; Port A I/O bit 1
RA2   EQU 02 ; Port A I/O bit 2
RA3   EQU 03 ; Port A I/O bit 3

; Assign basic pin labels to the bit numbers for
I/O port B.

RB0   EQU 00 ; Port B I/O bit 0
RB1   EQU 01 ; Port B I/O bit 1
RB2   EQU 02 ; Port B I/O bit 2
RB3   EQU 03 ; Port B I/O bit 3
RB4   EQU 04 ; Port B I/O bit 4
RB5   EQU 05 ; Port B I/O bit 5
RB6   EQU 06 ; Port B I/O bit 6
RB7   EQU 07 ; Port B I/O bit 7

; Assign basic pin labels to the bit numbers for
I/O port C.

RC0   EQU 00 ; Port C I/O bit 0
RC1   EQU 01 ; Port C I/O bit 1
RC2   EQU 02 ; Port C I/O bit 2
RC3   EQU 03 ; Port C I/O bit 3
RC4   EQU 04 ; Port C I/O bit 4
RC5   EQU 05 ; Port C I/O bit 5
RC6   EQU 06 ; Port C I/O bit 6
RC7   EQU 07 ; Port C I/O bit 7

; Assign labels to the various (RAM) data file
registers used

      ORG  08 ; Set base address for RAM

COUNT1                    RES 1 ; General purpose
counter
DECIM1                    RES 1 ; Decimal store
for 1s digit
DECIM2                    RES 1 ; Decimal store
for 10s digit
DECIM3                    RES 1 ; Decimal store
for 100s digit
DIGIT1                    RES 1 ; Store for right
display data
DIGIT2                    RES 1 ; Store for middle
display data
DIGIT3                    RES 1 ; Store for left
display data
HEXLO                     RES 1 ; Hex store for
middle digit (LSB)
```

Continued on P. 44

Continued from P. 42

```
HEXHI                     RES  1 ; Hex store for
left digit (MSB)
IPBUFF                    RES  1 ; Input buffer
status byte
; end of Equates section

; ********************************

; Start of Program Memory

ORG  0000 ; SET ORIGIN ADDRESS

; General purpose delay routine. "COUNT1" starts
and ends at zero

DELAY
DECFSZ   COUNT1          ; WAIT ...
GOTO     DELAY
RETLW    0               ; FINISHED - RETURN

 ; Get input value from port B and store in
"IPBUFF"

GETDATA
MOVF     PORTB,W         ; GET DATA ON PORT B
MOVWF    IPBUFF          ; STORE IT IN "IPBUFF"

 ; Convert "IPBUFF" into Hexadecimal
 ; values in "HEXLO" and "HEXHI",
 ; and into Decimal values in
 ; "DECIM1", "DECIM2" and "DECIM3"

CONVERT
CLRF     DECIM1          ; CLEAR RIGHT DIGIT
DECIMAL STORE
CLRF     DECIM2          ; CLEAR MIDDLE DIGIT
DECIMAL STORE
CLRF     DECIM3          ; CLEAR LEFT DIGIT
DECIMAL STORE

; Hexadecimal conversion routine
SWAPF    IPBUFF,W        ; GET NIBBLE SWAPPED
"IPBUFF" IN 'W'
ANDLW    H'0F'           ; MASK OFF THE LEFT
NIBBLE
MOVWF    HEXHI           ; AND PUT IT IN "HEXHI"
(MSB)
MOVF     IPBUFF,W        ; GET "IPBUFF" IN 'W'
ANDLW    H'0F'           ; MASK OFF THE LEFT
NIBBLE
MOVWF    HEXLO           ; AND PUT IT IN "HEXLO"
(LSB)

; Decimal conversion routine

CONV2
MOVF   IPBUFF,W          ; IS "IPBUFF" ZERO ?
BTFSC  STATUS,ZERO       ; NO - THEN WORK OUT THE
VALUE
RETLW  00                ; YES - LEAVE "DECIM"s AT
ZERO
CONV3
INCF   DECIM1            ; ADD 1 TO RIGHT DIGIT
MOVLW                    10
SUBWF  DECIM1,W          ; HAS RIGHT DIGIT REACHED
10 ?
BTFSS  STATUS,ZERO       ; YES - NOT ALLOWED, SO
CORRECT IT
GOTO   CONV4             ; NO - CONTINUE BUILDING
VALUE
CLRF   DECIM1            ; RESET RIGHT DIGIT TO
ZERO
INCF  DECIM2             ; ADD 1 TO MIDDLE DIGIT
MOVLW                    10
SUBWF DECIM2,W           ; HAS MIDDLE DIGIT
REACHED 10 ?
BTFSS STATUS,ZERO        ; YES - NOT ALLOWED, SO
CORRECT IT
GOTO  CONV4              ; NO - CONTINUE BUILDING
VALUE
CLRF   DECIM2            ; RESET MIDDLE DIGIT TO
ZERO
INCF   DECIM3            ; ADD 1 TO LEFT DIGIT
CONV4
DECFSZ IPBUFF            ; SKIP IF "IPBUFF" HAS
REACHED ZERO
GOTO  CONV3                  ; OTHERWISE GO ROUND
AGAIN
RETLW   00                   ; EXIT

; Now convert the digit values into display codes

MOVF                   DIGIT1,W    ; GET RIGHT
DIGIT DATA
CALL                   GETCHAR     ; CONVERT TO
DISPLAY CODE
MOVWF                  DIGIT1      ; AND PUT IT
BACK
MOVF                   DIGIT2,W    ; GET MIDDLE
DIGIT DATA
CALL                   GETCHAR     ; CONVERT TO
DISPLAY CODE
MOVWF                  DIGIT2      ; AND PUT IT
BACK
MOVF                   DIGIT3,W    ; GET LEFT
DIGIT DATA
CALL                   GETCHAR     ; CONVERT TO
DISPLAY CODE
MOVWF                  DIGIT3      ; AND PUT IT
BACK
RETLW                  00          ; EXIT

; Get a display character bit
; pattern by converting 'W' to display code

GETCHAR
ADDWF  PC,F                   ; USE 'W' AS AN OFFSET
FOR 'PC'
RETLW  B'11101110' ; RETURN WITH "0" DISPLAY CODE
RETLW  B'00100100' ; RETURN WITH "1" DISPLAY CODE
RETLW  B'10111010' ; RETURN WITH "2" DISPLAY CODE
RETLW  B'10110110' ; RETURN WITH "3" DISPLAY CODE
RETLW  B'01110100' ; RETURN WITH "4" DISPLAY CODE
RETLW  B'11010110' ; RETURN WITH "5" DISPLAY CODE
RETLW  B'11011110' ; RETURN WITH "6" DISPLAY CODE
RETLW  B'10100100' ; RETURN WITH "7" DISPLAY CODE
RETLW  B'11111110' ; RETURN WITH "8" DISPLAY CODE
RETLW  B'11110110' ; RETURN WITH "9" DISPLAY CODE
RETLW  B'11111100' ; RETURN WITH "A" DISPLAY CODE
RETLW  B'01011110' ; RETURN WITH "b" DISPLAY CODE
RETLW  B'11001010' ; RETURN WITH "C" DISPLAY CODE
RETLW  B'00111110' ; RETURN WITH "d" DISPLAY CODE
RETLW  B'11011010' ; RETURN WITH "E" DISPLAY CODE
RETLW  B'11011000' ; RETURN WITH "F" DISPLAY CODE
;****************************************************

; Refresh the displays. The "DIGIT"s
; finally contain the bit patterns
; ready for displaying the characters
; require for Hex or Decimal readout.
; If display is Decimal then blank
; out any leading zeros except right digit.

DISPLAY
BTFSC PORTA,RAC            ; SKIP IF DECIMAL MODE
SELECTED
GOTO   DISP3               ; ELSE DISPLAY DATA IN
HEX FORMAT

; Display data in Decimal format
MOVF   DECIM1,W            ; GET RIGHT DIGIT DECIMAL
DATA
CALL   GETCHAR             ; CONVERT TO DISPLAY CODE
MOVWF  DIGIT1              ; PUT IT IN RIGHT DIGIT
MOVF   DECIM2,W            ; GET MIDDLE DIGIT
DECIMAL DATA
CALL   GETCHAR             ; CONVERT TO DISPLAY CODE
MOVWF  DIGIT2              ; PUT IT IN MIDDLE DIGIT
MOVF   DECIM3,W            ; GET LEFT DIGIT DECIMAL
DATA
CALL   GETCHAR             ; CONVERT TO DISPLAY CODE
MOVWF  DIGIT3              ; PUT IT IN LEFT DIGIT
; Now blank off any leading zeros
```

```
MOVF   DECIM3,W            ; GET LEFT DIGIT DECIMAL
DATA
BTFSS STATUS,ZERO ; BLANK IT OUT IF ZERO - '0'
GOTO   DISP4               ; NOT ZERO - LEAVE IT
ALONE
CLRF   DIGIT3              ; CLEAR ALL BITS IN LEFT
DIGIT
MOVF   DECIM2,W            ; GET MIDDLE DIGIT
DECIMAL DATA
BTFSC STATUS,ZERO          ; LEAVE IT ALONE IF NOT
ZERO
CLRF   DIGIT2              ; OTHERWISE BLANK IT OUT
GOTO   DISP4               ; LEAVE RIGHT DIGIT ALONE
ANYWAY

; Display data in Hexadecimal format

DISP3
MOVF    HEXHI,W            ; GET MSB OF HEX VALUE
CALL    GETCHAR            ; CONVERT TO DISPLAY CODE
MOVWF   DIGIT3             ; PUT IT IN LEFT DIGIT
MOVF    HEXLO,W            ; GET LSB OF HEX VALUE
CALL    GETCHAR            ; CONVERT TO DISPLAY CODE
MOVWF   DIGIT2             ; PUT IT IN MIDDLE DIGIT
MOVLW   B'01111100'
MOVWF   DIGIT1   ; PUT 'H' IN RIGHT DIGIT - "DIGIT1"

; "DIGIT"s contain the required display
; codes, now light up the displays
DISP4
MOVF   DIGIT3,W            ; GET LEFT DIGIT DATA
MOVWF  PORTC               ; PUT IT ON PORT C
BCF    PORTA,RA3           ; LIGHT UP THE DISPLAY
CALL   DELAY               ; WAIT FOR LIGHT-UP PERIOD
BSF    PORTA,RA3           ; AND TURN IT OFF AGAIN
MOVF   DIGIT2,W            ; GET MIDDLE DIGIT DATA
MOVWF  PORTC               ; PUT IT ON PORT C
BCF    PORTA,RA2           ; LIGHT UP THE DISPLAY
CALL   DELAY               ; WAIT FOR LIGHT-UP
PERIOD
BSF    PORTA,RA2           ; AND TURN IT OFF AGAIN
MOVF   DIGIT1,W            ; GET RIGHT DIGIT DATA
MOVWF  PORTC               ; PUT IT ON PORT C
BCF    PORTA,RA1           ; LIGHT UP THE DISPLAY
CALL   DELAY               ; WAIT FOR LIGHT-UP
PERIOD
BSF    PORTA,RA1           ; AND TURN IT OFF AGAIN

; The program now falls through
; back to the 'START' routine

; ***********************************************
; Beginning of the main program (entry point) *
; ***********************************************

START
MOVLW 255
MOVWF PORTA                ; SET ALL PORT A OUTPUTS
HIGH
TRIS   PORTB               ; SET PORT B FOR INPUT
MOVLW 01
TRIS   PORTA               ; SET RA0 FOR INPUT
CLRW
MOVWF PORTC                ; START WITH ALL DISPLAY
BITS OFF
TRIS   PORTC               ; SET PORT C FOR OUTPUT

CALL  GETDATA              ; READ AND CONVERT DATA
ON PORT B
GOTO  DISPLAY               ; DISPLAY IT AND GO
ROUND FOREVER
;**************************************************
; Set up the reset vector for the type of
processor used.
; This varies between devices but is at 1FFh on
the 16C54

 ORG  H'1FF'
 GOTO                      START
ZZZ   ;END OF PROGRAM MARKER
 END
```

PCB

The DTE 'Data Bus Monitor' printed circuit board can be purchased separately for £4.50.

A complete kit of parts for this project, which INCLUDES the PCB, a pre-programmd PIC16C55RC/P and everything else listed above, is available from the author by mail order only from:

DTE MICRO SYSTEMS
112 SHOBNALL ROAD
BURTON ON TRENT
STAFFORDSHIRE
DE14 2BB.

Complete kit of components as listed: (includes PCB and PIC16C55RC/P)	£22.00
Pre-Programmed PIC16C55RC/P only:	£10.00
DTE Printed Circuit Board only:	£4.50

Prices are inclusive. Please add £1.50 to the TOTAL order value to cover carriage & handling.

Cheques and money orders etc. should be made payable to 'DTE MICRO SYSTEMS', and must be in pounds sterling (£) and drawn on a British bank.

Goods will normally be dispatched within five working days from receipt of order (subject to availability and cheque clearance), but please allow up to 28 days for delivery.

PARTS LIST

Resistors

R1, R1010K	(2 off)
R2 - R9 220R	(8 off)
RN1	47K x 8 SIL Network

Capacitors

C1	100uF/16V Radial Electrolytic
C2	22pF Ceramic
C3	100nF Ceramic or Polyester 0

Displays

LD1 - LD3	0.8" High Efficiency (HE) Red 7-Segment LED Display (3 off)

Semiconductors

IC1	PIC16C55RC/P (programmed) (can be purchased separately for £10.00)

Miscellaneous

SW 6mm PCB Tactile Switch Socket
28 pin IC Socket Connectors
2-way PCB Pin Header
0.1" Jumper Link to suit
10-Way PCB Pin Header
2-Way PCB Terminal Block

A SIMPLE POWERLINE SIGNAL REMOTE CONTROL PART 1

By Bart Trepak

The advantages of being able to switch appliances on and off anywhere in the house from a central controller or computer are many and apart from the convenience can be used to improve energy usage and security. In the past, the obvious way to do this would have been to lay control cables from the central controller to each appliance, but the thought of running cables around the house to the various units with the prospect of chasing out walls, re-plastering, lifting carpets and floorboards etc. was enough to put anyone off the idea of the computer controlled home.

Of the systems now available for remote control, infra-red and ultrasonic controls are unsuitable as their range is limited to the confines of a single room.

This leaves only radio and direct wiring. Of these, radio is of course far more flexible allowing the positioning and re-positioning of appliances anywhere in the building but suffers from complexity of receivers and the necessity to use certain frequencies usually in the UHF band which makes setting up or fault finding extremely difficult without sophisticated (and expensive) test equipment. On top of this, approval and a licence is required for this form of communications as there is the difficulty of restricting the transmission to a single flat, house or building.

This leaves only the direct wiring method with all the disadvantages mentioned above. To overcome these, many designers have devised systems for utilising the existing mains wiring for sending the control signals and since most appliances will need to be mains powered and therefore sited reasonably close to a mains outlet, this would not seriously impair the flexibility of the system.

With all systems of this sort, there is always the temptation on the part of the designer to add more and more "features" as he thinks of them and a basically simple project grows and grows until the cost and effort in building it and getting it to work, let alone in teaching your granny how to use it almost rivals the upheaval of the installation of separate control wires to each appliance. With personal identification numbers, the ability to control 32 different appliances, security codes in case Mrs Jones in Ma da Vale has a similar system which may interfere with the smooth running of your computerised house and programming switches to identify each appliance, each receiver now consists of five or six ICs which, together with the power supply and coding switches, occupy a box about the size of a toaster and almost certainly surpassing it in complexity. As if this were not enough, an infra-red remote control is often also incorporated into the system to remotely control the remote controller!

All this may be necessary if one were designing a system to run a factory or hotel complex but in the home most people would be hard pressed to find half a dozen appliances which they needed to control remotely let alone 32 or more.

There is little point, for example, in being able to switch the TV on and off from another room (unless you just want to annoy the other members of your family) or to control the lighting in four or five rooms in the house independently to give the impression that the house is occupied when one or perhaps two lights would be enough.

This reasoning, together with many requests from people who simply wanted say, to only switch an electric blanket on early without having to go upstairs especially to do this, or have the morning coffee ready when they come downstairs, prompted this design. The circuit is however, easily modified to provide a limited number of other extra "channels" if required.

Coding

The mains wiring is not a particularly good medium for the transmission of signals. As well as having a 230V 50Hz sine wave on it, there are also all sorts of pulses and transients, caused by equipment being switched on and off, superimposed on it. As well as this, any signals which are transmitted along it tend to be attenuated to a greater or lesser degree by the various appliances which are connected to it. To enable the control signals to be distinguished from these much larger amplitude signals, it is necessary to transmit them on a relatively high frequency carrier (compared to 50Hz) but not so high that losses due to capacitance of the cables or other appliances cause a severe attenuation of the signal.

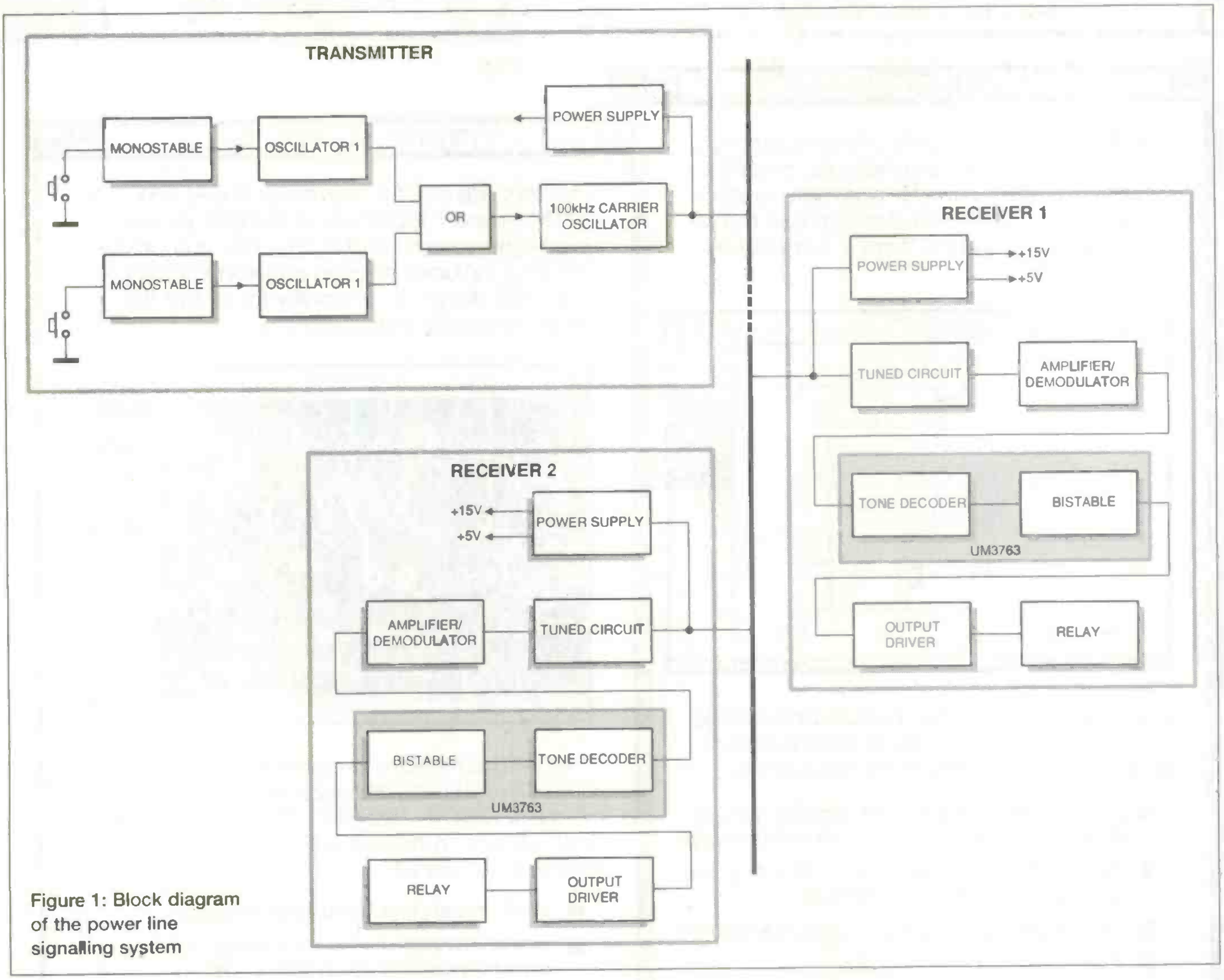


Figure 1: Block diagram of the power line signalling system

The best frequencies to use seem to be between about 80 and 150kHz and this system runs at approximately 100kHz. The normal domestic supply consists of three wires: Line (or Live), Neutral and Earth. In theory, the signals could be sent between any two of these.

Neutral and Earth would appear to be the most attractive since the voltage between them is not usually very large and certainly not the 230V ac which exists between L and N and the reason for this is that the Neutral is earthed at the substation and sometimes at the point at which the supply enters the house. This can effectively "short out" the signal, limiting its range and giving highly variable results. For this reason, the signal in this system is connected between the Live and Neutral. Obviously, any system with more than one channel needs to be coded so that each receiver can be switched on and off without affecting the status of the others.

In this circuit this is achieved by modulating the 100kHz carrier with a tone or, more simply, by switching it on and off at a lower frequency.

This makes both the transmitter and receiver very simple as no fancy digital encoders and decoders are required. The use of a tone sensitive integrated circuit in the receiver simplifies the design considerably and removes the need for any adjustments which makes the circuit particularly attractive to the hobbyist who may not have access to an oscilloscope or frequency meter.

The small number of parts also make it possible to make the receiver unit very small enabling it in many cases to be built into the appliance which you want to control. Alternatively, it could be fitted into a "plug box" of the type used for calculator power supplies so that the unit can also function as the mains plug with the added advantage that it can be removed and reconnected to other appliances as required.

Operation

The operation of the system is probably best understood by referring to the block diagram. We will consider first the receiver and in particular the operation of the tone decoder IC used in this circuit as this is central to the system operation and defines to a large extent the kinds of signals required and hence the circuits used to produce them at the transmitter.

The tone decoder ic is almost purpose made for this application (although it was originally designed as a whistle switch for use in those "answer back" key fobs which were so popular a few years ago) and contains an amplifier, tone decoder and an output bistable stage.

The centre frequency is not set by the usual resistor - capacitor network or a tuned circuit but by a single resistor which in fact sets the frequency of an internal clock oscillator. The circuit then responds to input frequencies of between 1/10 and 1/15 of this clock signal and produces an output by changing the state of the bistable latch each time it receives 256 cycles of a signal in the required frequency range.

The receiver therefore consists of a 100kHz input filter to recover the carrier signal from the much larger amplitude 50Hz

Continued on P. 49

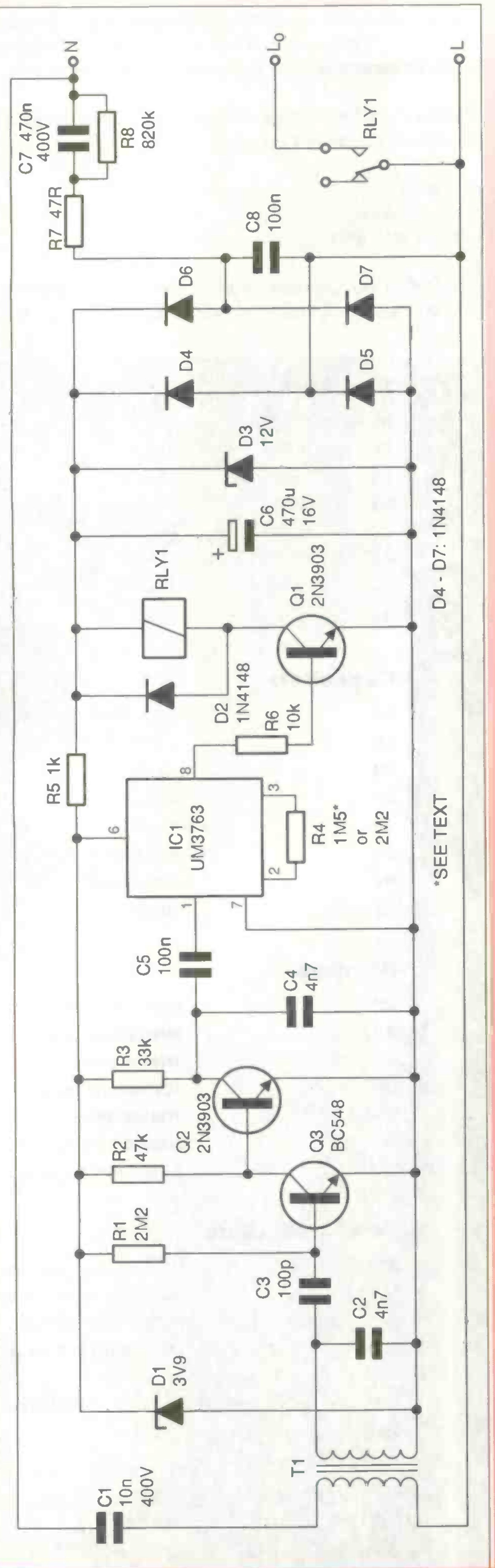


Figure 2: The power line signalling receiver

Continued from P. 47

mains voltage followed by an amplifier and demodulator to reproduce the transmitted tone. This is fed to the tone decoder - bistable ic - and is followed by an output stage which drives a relay. A dc power supply block to provide a low voltage supply to the circuit from the mains voltage completes the requirements for the receiver. On the transmitter side we clearly require an oscillator to produce the 100kHz carrier signal which is coupled to the mains. Since the carrier is to be switched on and off, the oscillator is controlled, via an OR gate, by two further oscillators which produce the two tones.

Normally, these two oscillators would be connected directly to the push button switches which would enable the relevant oscillator causing it to switch the carrier oscillator on and off at the required frequency.

If this were done in this case, the final state of the receiver would depend on how long the transmission lasted. If the carrier oscillator was switched on and off less than 256 times, the receiver would not switch at all, while if the transmission lasted for more than 512 cycles, the receiver would change state and then switch back again giving effectively the same end result.

One way around this would be to count the oscillator cycles at the transmitter and disable it after 256 cycles had been completed. In practice this did not prove to be necessary and a simpler approach of using a monostable was chosen. This is arranged to enable the oscillator for a period long enough to produce 256+ cycles but less than 512 cycles irrespective of how long the push button is pressed.

The block diagram for the transmitter which is also shown in figure 1 therefore consists of a 100kHz oscillator together with two low frequency tone generators which are enabled by monostables triggered by two push button switches. A simple mains supply completes the requirements for the transmitter.

The receiver

The complete circuit for a receiver is shown in figure 2, and as can be seen it is quite a simple affair and the various stages shown in the block diagram can easily be identified. The high frequency signal from the transmitter is passed via C1 to the transformer T1 which has its secondary tuned to the 100kHz carrier by C2 and forms the input filter.

The circuit is arranged so that transistor TR3 is normally turned on by base current flowing via R1 which ensures that TR2 is turned off and so its collector remains at the supply voltage which is about 5 Volts.

As soon as a signal is received at the base of TR3, this transistor will be turned off and since the signal consists of bursts of 100kHz, TR3 switches on and off at 100kHz during these bursts and remains on when the burst stops.

This causes TR2 to switch on and off during each burst quickly disharging C4 and as this capacitor can only charge up relatively slowly via R3, the voltage at the collector of TR2 remains "low" for the duration of the burst.

When the 100kHz signal stops at the end of the burst, the collector voltage rises again to the supply rail resulting in the original modulating waveform being reproduced at the collector of TR2 while the 100kHz carrier is removed. This signal is then fed via C5 to IC1.

IC1 is the frequency selective circuit which switches the output on and off alternately each time 256 cycles of a signal of between f/10 and f/15 are received where f is the oscillator frequency set by resistor R4. Since this is quite a wide frequency range no special tuning of the receiver or transmitter

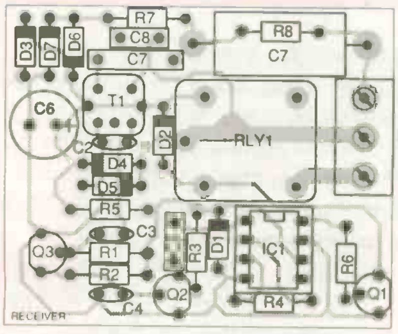


Figure 3: The receiver PCB and component layout

is required although it does mean that the number of possible channels is limited. The output of IC1 is used to switch the relay RL1 via transistor TR1 with D2 protecting the transistor against possible damage due to the back emf generated by the relay when it is switched off. The power for the circuit is obtained by the low loss "dropper" C7 with resistor R7 being included to prevent the capacitor from shorting the high frequency carrier signal.

R8 discharges C7 when the plug is removed from the mains socket to prevent any charge stored from giving anyone a shocking experience! The ac voltage is rectified by the diode bridge, limited to 12V by zener diode D3 and smoothed by C6 to provide a dc supply for the relay. IC1 and the amplifier require a 5 Volt supply and this is provided by R5 and the zener diode D1.

Construction

With so few components, construction should not cause any problems provided reasonable care is taken. The use of a printed circuit board is recommended as it will make the construction easier, safer and the finished unit smaller. A suitable layout is given in figure 3.

Remember that the circuit operates at mains voltage, so make sure that components do not touch each other and that there are no solder splashes between track which could cause a lot of damage to the circuit when power is applied.

The ic is a MOS device and therefore sensitive to static. Touching the pins should therefore be avoided and the device mounted in a socket if possible. Take care also to insert the diodes correctly especially the zeners which tend to have very small markings to identify their voltage.

Testing the finished unit will obviously have to wait until the transmitter has been constructed and this will be dealt with next month.

For the sake of completeness, the mains connections to the assembly are shown in figure 4.

The L and N are interchangeable as far as the circuit is concerned although it is more usual to switch the L line (as shown), with the load connected on the N side. If the unit is to be mounted in a plug box, a separate in-line fuse should be fitted in the L line as shown but if the receiver is mounted in a separate box with a socket for plugging the appliance into, the fuse could be that fitted in the mains plug used with the device. The final assembly of the circuit into its box should be postponed until the complete system has been tested.

If required, two receivers could be built with different value resistors fitted in position R4. These should be chosen so that the frequency of the receivers does not overlap, which could result in both units switching together. If more channels are required, further receivers with different R4 values can be built but the transmitter would also need to be modified to enable more tones to be generated.

In this case, R4 is best replaced by a preset and the value determined by trial and error. Once this has been done, the preset may be replaced by the nearest value fixed resistor.

Suitable alternative values for other frequencies will be given next month. Next month's article will deal with the construction of the transmitter and the testing of the complete system.

Prices include UK postage. Please add £2 for overseas orders. Send Postal Order or Cheque to:

B. Trepak
20 The Avenue
London W13 8PH

Mail Order Only. Overseas Orders must include payment in pounds Sterling with bankers' draft drawn on a British bank.

PARTS LIST

Resistors

R1	2M2
R2	47k
R3	33k
R4	1M5 or 2M2 (SEE TEXT)
R5	1k
R6	10k
R7	47R
R8	820k

Capacitors

C1	10nF/400V
C2	4n7
C3	100pF
C4	4n7
C5	100nF
C6	470uF/16V
C7	470nF/400V
C8	100nF

Displays

T1*	RD7 transformer
D1	3V9/400mW zener
D2	1N4148 diode
D3	12V/400mW zener
D4-D7	1N4148 diode
TR1-TR2	2N3903 NPN transistor
TR3	BC548 NPN transistor

Semiconductors

IC1*	UM3763 tone decoder IC
RLY1 12V/400R	coil contacts to suit load, PCB, 3-way terminal block, 8 pin ic Socket

* These items are available from the author at the following prices:

RD7 Transformer	£0.50
UM3763 IC	£4.50
Pack containing 2x UM3763 plus 3x RD7 transformers	£10.00

PROCESS TIMER and CONTROLLER

WITH EXTERNAL I/O INTERFACE

By Tim Parker

PART 3A *Software Development Board*

Having presented the main Process Timer/Controller and its associated power supply, we continue this month with a small but useful board, which enables programmers who are writing their own interface software for the main board to test out their code without having to connect the controller to their proposed target interface.

When writing programs for microcontrollers which will eventually have control over a particular interface, whether it be for automotive applications, light and motor control, or, dare we say, the proverbial central heating controller (oh dear, how those words have been worn thin over the years!), the resulting code must be perfect in its operation if the microcontroller is to perform the designated tasks correctly.

There's nothing worse than discovering that something's wrong once the main controller is connected to the target interface and powered up, and all manner of inexplicable things start happening.

The art of programming is to write, test and debug small sections of the program at a time, but as our confidence in writing software grows, it's easy to get so engrossed in what we're doing that we get "on a roll", and decide to carry on regardless, writing more and more code, almost instinctively believing that the program will work, and that we know exactly what will happen once the controller is connected to the interface.

But it doesn't, and it's frustrating enough that the outputs alone might not do what you thought you had programmed them to do, but this becomes doubly frustrating when these outputs are interacting with various input conditions which themselves, when applied, inaugurate further irrational behaviour in perhaps both the controller board and the programmer.

This is obviously no use at all if the interface is already connected to various output devices, which by now each seem to have a mind of their own, doing things that you didn't even expect them to, let alone what you want them to.Even worse, no matter which buttons you press, or what input signals you try to simulate, you cannot override or significantly influence the actions of the controller, and things usually go from bad to worse. The most commonly used button in these situations is marked ON/OFF.

Experienced programmers will know that all of this could be the result of just one single incorrect instruction in the program code - but which?

Perhaps not so strangely, at this point we return to the program, split it up into 'chunks' and start testing the code in sections to find out where it's going wrong, as we should have done in the first place. In these situations it's useful to have some means of testing the code prior to connecting the devices you intend to control.Basically, all that is needed is something that will visually indicate the state of each output bit, and provide the means to simulate the required (or expected) input signals.This is just the intention of the project presented here.

The circuit

This must be one of the most simple circuit diagrams there is,

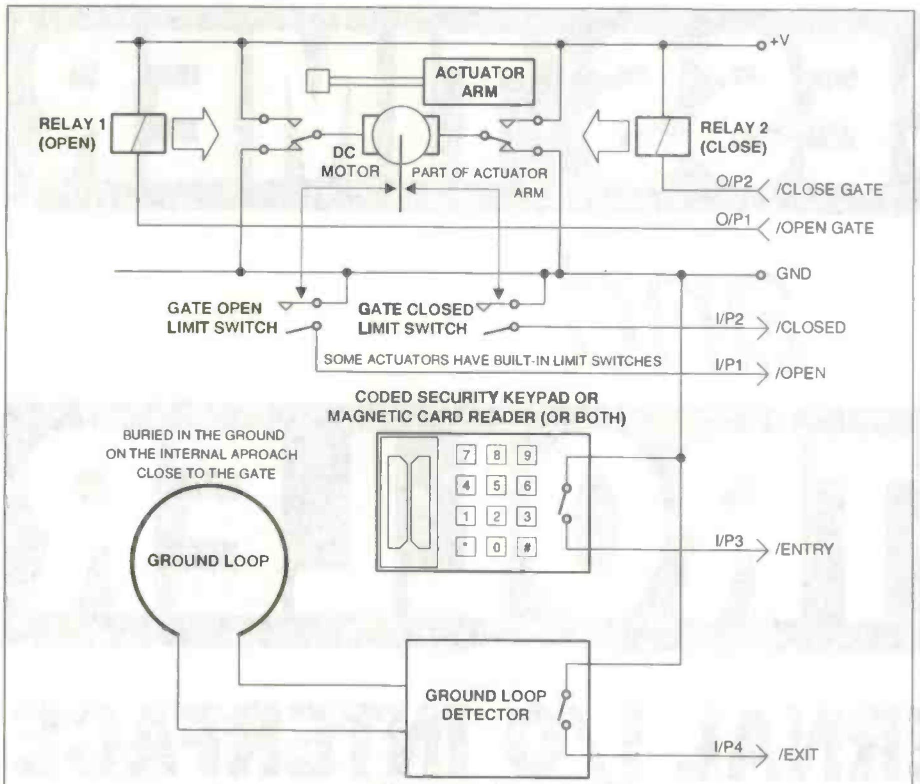


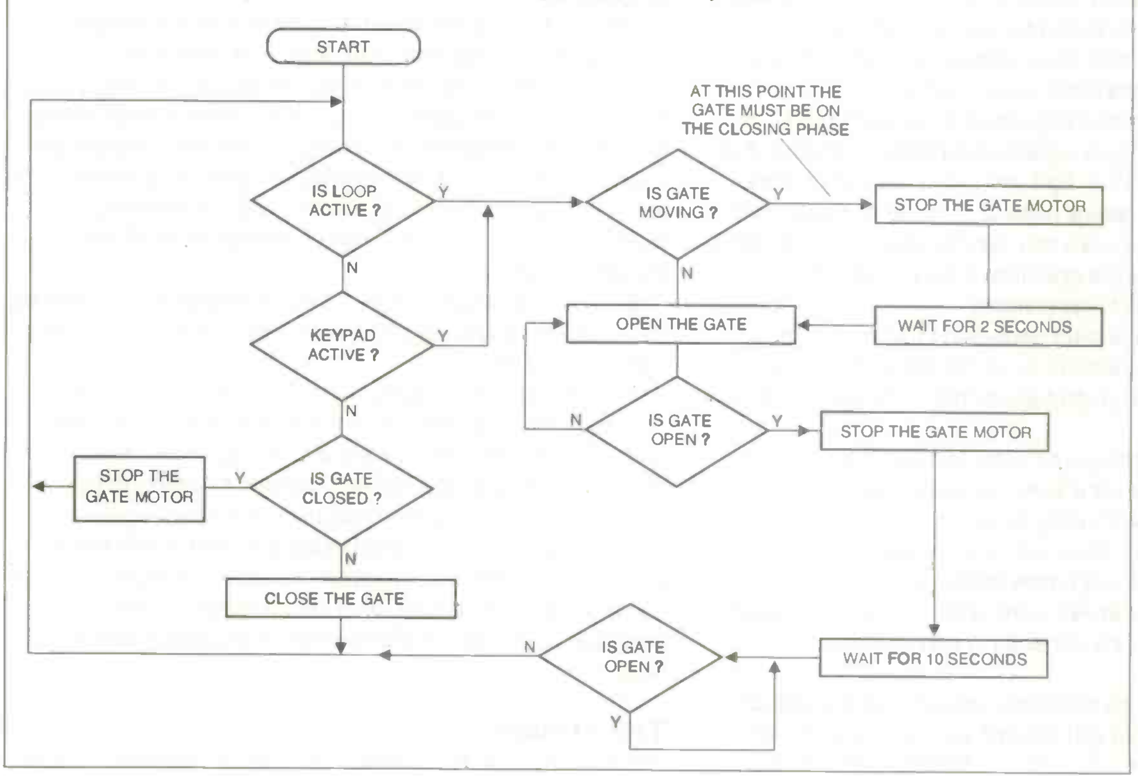
Figure 1: the basic requirements for access control using an automatic gate controller

but the usefulness of the board just goes to show how some of the simplest designs can also be some of the best, and it could get more use than some of your final interface designs themselves. The seven bits available on the Process Timer expansion bus output port are fed to the inputs of a 7-stage Darlington driver, IC1, which in turn is used to drive the seven LEDs connected to its outputs.These provide high/low status indicator lights for the expansion bus output port.When an LED is lit the corresponding output bit is high, and when an LED is off the output bit is low. Rather than connecting the LEDs directly to the outputs of the 74LS574 (IC3) on the main controller, they are powered from the regulated +5V supply, and IC1 is used to minimise the load on the expansion bus.

This allows the Software Development Board to remain in place while other interface boards are also connected to the expansion bus, which is extremely useful if your desired interface isn't doing what it should, because you can see what signals are being sent to it.An additional LED provides a power on indicator (LED8) and resistors R1 to R8 limit the current through each LED. The expansion bus input port is connected to two sets of switches.

The first set is formed by seven of the 8-way DIP switch SW1, the second set is made up of miniature PCB pushbutton switches PB1 to PB7.By using both types it is possible to use the pushbuttons for simulating momentary input signals, whilst the DIP switches provides long term or permanent input signals.When a switch is closed or pressed, the corresponding input bit on the expansion bus is pulled low to 0V.When a switch is open or released, the input bit is pulled high to +5V by the resistor network RN2 on the main controller board. The eighth pushbutton and DIP switch position provides control of the Output Enable (OE) line of the expansion bus.In most cases this will not be needed but has been included on this board for completeness of signal access.The OE signal was explained in part 1 of this series of projects, so a full explanation will not be repeated here, but basically, if you want to demonstrate the switches related to this signal (DIP switch 8 and PB8), together with their effect on the output status LEDs, then

Figure 2: simplified flowchart for the automatic gate controller program. The main objective is to keep the gate closed at all times when it is not required to be open, but priority is given to vehicles exiting the driveway, even if the gate has started on the closing phase, but not yet shut



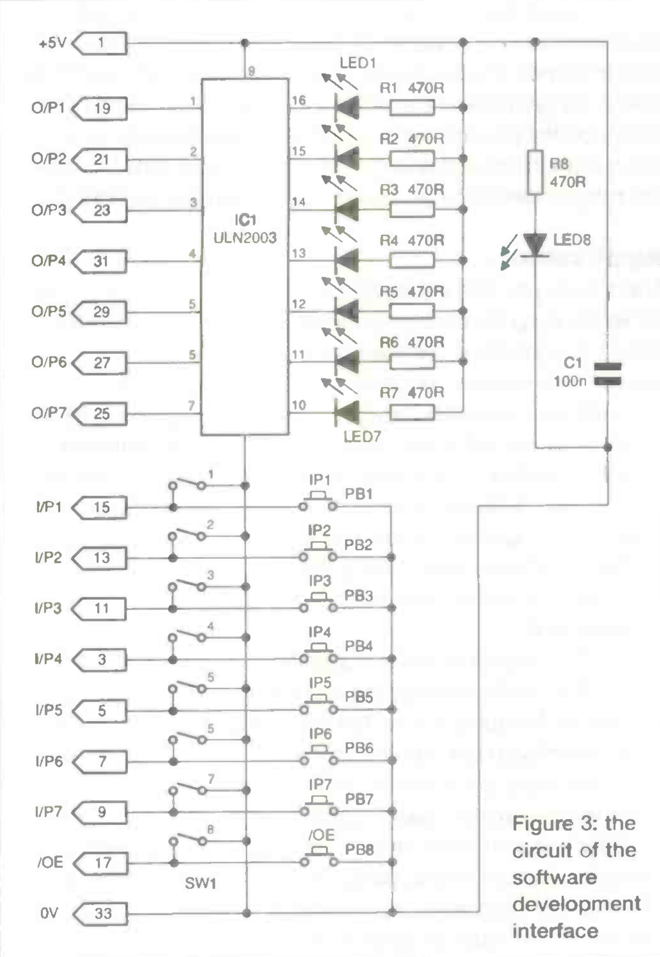


Figure 3: the circuit of the software development interface

you must place the jumper link JP1 on the main controller in the EXT (right hand) position.With the switch closed or pressed the LED indicators are enabled. When the switch is open or released the LEDs are disabled.

Construction

This is very easy, very straightforward.No static sensitive devices, no special handling precautions required.Make sure IC1 faces the right way, and don't forget the five wire links.The DIP switch can be fitted either way around, depending on whether you want the switches to close on the downward or upward stroke, but generally these types of switches are numbered 1 to 8, and the PCB is designed to use these numbers to correspond to the bit numbers of the input port, so for this they should read left-to-right as normal.

Connection and testing

In common with all other boards in this series, this one plugs directly into one of the board edge connectors of the expansion bus ribbon cable.

If you are using non-polarised connectors on your ribbon cable then ensure the board is plugged in the right way around. Testing the board is simply a case of plugging it in and writing some software to turn the LEDs on and off, and to read the state of the pushbuttons or DIP switches.

The followingshort routine, while not doing anything practical, will test the individual operation of each switch and LED. The operation of the software is very simple; close a DIP switch or press a button and the corresponding LED for that bit will light up.

Remember though, if any of the DIP switches are closed (ON) then its equivalent pushbuttons will have no effect.

Listing 1

A simple test routine for the software development board

```
;*****************************************************
*****************
;* SOFTWARE FOR USE ON THE DTE PROCESS
TIMER/CONTROLLER BOARD. *
;* (C) 1996TIM PARKER / DTE MICRO SYSTEMS. *
;* TEST ROUTINE FOR THE SOFTWARE DEVELOPMENT BOARD
*
;*****************************************************
*****************

LIST  P=16C54, R=DEC

ORG   0000                      ; SET ORIGIN ADDRESS

MOVLW B'00001000'
TRIS  05                        ; SET RA0 TO RA2 AS
OUTPUTS

TESTBUS
MOVLW B'11111111'
TRIS  06                        ; SET PORT B AS ALL
INPUTS
MOVLW 04                        ; GET IC4 STROBE
LINE
MOVWF 05                        ; AND PULL IT LOW
MOVF  06,00                     ; GET DATA ON PORT B
IN 'W'
MOVWF 07                        ; AND STORE IT IN f7
REGISTER
MOVLW 07                        ; GET 'ALL OFF' CODE
MOVWF 05                        ; SET ALL STROBE
LINES HIGH
MOVLW B'00000001'
TRIS  06                        ; SET UP RB1 TO RB7
AS OUTPUTS

; NOW LIGHT UP THE APPROPRIATE LEDs.
; BECAUSE THE PUSHBUTTONS AND DIP SWITCHES
; ARE ACTIVE LOW, AND THE LEDs ARE
; ACTIVE HIGH, THEN REGISTER f7 MUST BE
; INVERTED BEFORE WRITING IT TO THE
; OUTPUT PORT

COMF  07,00                     ; INVERT f7. PUT
RESULT IN 'W'
MOVWF 06                        ; PUT 'W' CONTENTS
ON PORT B
MOVLW 05                        ; GET IC3 STROBE
LINE
MOVWF 05                        ; AND PULL IT LOW
MOVLW 07                        ; GET 'ALL OFF' CODE
MOVWF 05                        ; SET ALL STROBE
LINES HIGH

GOTO  TESTBUS             ; DO IT FOREVER

 END                      ; END OF PROGRAM

;****************************************************
```

Built-in test routine

Here's a well kept secret (up until now, that is).The programmed (darkroom timer) PIC16C54 available for this project has a built-in test routine of it's own, which is far more comprehensive than the above listing.Not only does it provide pushbutton, LED and OE line testing, but also makes use of all four display digits to show what value is being read from the expansion bus input port, and what value is being written to the expansion bus output port.

To enter this test mode, first start with no power to the board, all DIP switches open, all pushbuttons released and the OE jumper on the process timer set to the EXT (external) position.Now hold down the bottom left hand RESET button on the process timer whilst powering up the board.

BUTTON	DISPLAY READINGS		LED STATUS INDICATORS 1 = ON						
	HEX	DEC EQVT.	1	2	3	4	5	6	7
NONE	FF : 00	255 : 0	0	0	0	0	0	0	0
PB1	Fd : 02	253 : 2	1	0	0	0	0	0	0
PB2	Fb : 04	251 : 4	0	1	0	0	0	0	0
PB3	F7 : 08	247 : 8	0	0	1	0	0	0	0
PB4	EF : 10	239 : 16	0	0	0	1	0	0	0
PB5	dF : 20	223 : 32	0	0	0	0	1	0	0
PB6	bF : 40	191 : 64	0	0	0	0	0	1	0
PB7	7f : 80	127 : 128	0	0	0	0	0	0	1

NOTE: DIP SWITCH 8 OR PUSHBUTTON PB8 MUST BE CLOSED IN ORDER FOR LED INDICATORS TO LIGHT

Table 1: single pushbutton results

There will be none of the usual 'bleeps' associated with the normal operation of the board; instead, it will start up silently with FF:00 shown in the display.If not, then you've got something wrong, so power down and check the boards for faults or incorrect switch settings.

The RESET button can now be released, since the board will remain in test mode until power is removed; none of the pushbuttons on the process timer are operative once the built-in test mode has been initiated.

The two left hand (minutes) digits show in HEX the value being read in from the expansion bus input port, and the two right hand (seconds) digits show the value being sent out to the expansion bus output port - again in HEX format.Pressing the pushbuttons will alter these readings accordingly, but at the moment will not result in the status LEDs lighting up.To enable these, close DIP switch 8 or hold down PB8 whilst pressing the other buttons.The LEDs should now light up in sympathy with the corresponding button presses, which confirms the correct operation of the expansion bus OE line (explained in part 1).

Table 1 below shows what values should appear in the displays and the state of the LEDs on the development board when any one (and only one) of the pushbuttons is pressed. Although only the codes corresponding to individual button presses are listed in the table, all of the available input values between 01h and FFh will be displayed when multiple combinations of the pushbuttons are held down simultaneously.

The built-in test routine software actually reads all 8 bits of the RB port on the PIC16C54, but the code 00h cannot be obtained from the input port because RB0 is not connected to the expansion bus.This bit always reads as 1 due to pull up resistor R10 on the process timer board.Equally, all 8 bits are written to the output port, but again RB0 has no effect on the expansion bus, although this bit on the PIC device is still turned on and off accordingly.

A word of caution here.Whenever 7-segment displays are used to display hexadecimal values, because of the limited availability of typographical characters it's important not to confuse the number '6' with the hex letter 'b', since they look very similar.The '6' makes use of display segment 'a' (the very top horizontal segment), whereas the letter 'b' has this segment left blank (off), and if you're not used to viewing hexadecimal digits in this way it's very easy to mistakenly read it as '6'.So if you think your readings are wrong, then just check the display again, it might just be that you have misinterpreted the digit.

The development board together with the built-in test routine could double up as an educational demonstration of different types of code formats, since the pushbuttons produce inverse binary codes, the status LEDs are driven using positive binary codes and the digital displays on the Process Timer show both these codes in hexadecimal format, which is one of the most preferred types used by programmers in general.

Application

There is no pre-defined application for this board, since it will serve the purpose of developing and checking the operation of almost any interface software for just about any application.However, for demonstration purposes an application is presented here for an automatic gate controller, where vehicular entry into (say) a private drive is restricted via a coded keypad or card reader, but the exit is unrestricted via a ground loop detector which automatically signals the gate to open as you approach.It is not the intention of this article to explain how to actually construct a complete automatic gate controller, but merely how to control it given the bare essentials required by it.

For the time being these operations will be controlled by, and visible on the software development board, but could be transferred for operation on the expansion bus interface board to be described next month.

At first sight, the function of an automatic gate (or barrier for that matter) controller seems pretty straightforward; restriction on entry, but with free exit. But these are far more complex in operation than you think, particularly on a commercial basis where a vast number of operational and public safety considerations must be taken into account. The absolute bare essentials together with some basic connections are shown in figure 1.

The software for this is complete in its functionality, but is very basic and by no means exhaustive.In the real world there are an awful lot of' what if ' questions that must be answered before you could even consider the final design for a working version. For instance: what if the vehicle broke down within the gate's path of swing? What if the limit switches fail? What if the power failed?What if a person gets trapped under or behind the gate? What if the emergency services have to force their way in, etc? These are just a few of the questions, the list could be endless.Fortunately, these and more have all been taken into account by the manufacturers and professional installers of this type of control equipment, where safety is considered of paramount importance.

Nevertheless, this software could be put to practical use on a scaled down model basis, and if you're mechanically minded, or already employed in this line of work, could even form the basis of a portable working demonstration unit for the real thing. The flowchart in figure 2 shows how the software must operate, so as to take account of some of the most basic situations that could arise.Priority is given to the entry keypad and exit ground loop to ensure that even if the gate is on its closing phase, it will stop, wait a couple of seconds and then reverse the motor to open the gate.The motor must be stopped before changing its direction of travel, otherwise too much strain is put on the bolts and bearings, not to mention the sudden power surge.In a real application the actuator could have a gate weighing upwards of 100kg bolted to it, albeit the actuator for these would, more than likely, consist of an electric pump driving a hydraulic arm, but the principle is the same.

Continued on P. 58

Comprehensive PIC solutions from FED

PICDESIM

PICDESIM is a fully integrated Windows PIC Simulator, to use with our Development Environment. It features:
Single step, skip over, and run, Conditional breakpoints, watch variables, trace any number of variables, graphical interfaces. Up to 50 times faster than MPSIM. Wide range of stimuli including asynch serial data. Integrates with our PIC Programmer

£30.00, £25.00 if purchased with our PIC Programmer

PIC Programmer

Program 16C54/55/56/57/58, 16C62xx, 16C64, 16C71/73/74, 16C84. Uses serial link to a PC. Windows and DOS software provided. Includes PICDE, the Windows based PIC Development Environment with on-line help, project management, editing, assembler.

Kit £40.00, Ready Built £50.00

PIC16C74/JW Erasable 20MHz £24.00
PIC 16C74-04 OTP 4MHz £8.00, 20MHz £11.00
PIC 16C57XT/P OTP 4MHz £5.00
PIC16C84-04P EEPROM erasable 4MHz £6.00
24LC65 8kx8 serial EEPROM £5.00

PIC BASIC

Easy to learn BASIC in a Windows Development Environment. No need for assembler or a UV eraser to program PICs. Modules operate from a serial link to your PC. The 16C74 module has these features:
8k EEPROM, up to 2000 lines of BASIC, 27 lines of programmable I/O, 8 A/D inputs, Interrupt deriven serial RS232 interface, Peripheral I2C bus interface, optional external ram.

16C57 Module Kit (8k, 4MHz) £30.00, Pre-built £36.00
16C74 Module Kit (8k, 4MHz) £35.00, Pre-built £42.00
16C74 Module Kit (8k, 20MHz) £40.00, Pre-built £46.00

PIC BASIC Compiler

New! A PIC BASIC compiler for the 16C74. It produces a hex code to program your 16C74 directly. Compatible with the EEPROM versions of PIC 16C74 BASIC modules.

Compiler £50.00

Serial Cable for Programmer or BASIC Modules £7.50

Forest Electronic Developments
10 Holmhurst Avenue, Christchurch,
Dorset, BH23 5PQ
Phone/fax: 01425 270191, Technical 01425 274068

Prices are inclusive, please add £3.00 for P&P and handling to each order.
Cheques/POs payable to Forest Electronic Developments.

VISA Access

Visit our Web page at http://www.ibmpcug.co.uk/~gmwarner/fed.htm

---

WE HAVE THE WIDEST CHOICE OF USED OSCILLOSCOPES IN THE COUNTRY

TEKTRONIX TAS465 Dual trace 100MHZ Delay/Cursors £1100
TEKTRONIX 2445 4Ch. 100MHZ Delay/Cursors £1500
H.P. Type 54200A Digitizing Oscilloscope 50MHZ £1000
PHILIPS PM3295 Dual Trace 350MHz Delay Cursors £2000
TEKTRONIX 465 Dual Trace 100MHz Delay Sweep £400
TEKTRONIX 2213 Dual Trace 60MHz £350
PHILIPS PM3217 Dual Trace 50MHz Delay Sweep £400
HITACHI V423 Dual Trace 40MHz Delay Sweep £350
GOULD OS11000 Dual Trace 30MHZ £200
HITACHI V223 Dual Trace 20MHz Delay Sweep ....£[illegible]
KIKUSUI 5530A Dual Trace 35MHz £220
GOULD OS300 Dual Trace 20MHz (No Handle) £180
HITACHI V209 Dual Trace 20MHz Mains Battery £400
PHILIPS PM97 Dual trace 50MHZ Scopemeter Dig Storage 25M/S £800
LEADER LCD100 DMM/SCOPE 200KHZ Dig Storage LCD display £300
TEKTRONIX 468 Dual Trace 100MHz Delay Sweep Dig Storage £750
HITACHI VC6041 Dual Track 40MHz Digital Storage £650
H.P. 1741A Dual Trace 100MHz Analogue Storage ....£[illegible]
TEKTRONIX 434 Dual trace 25MHZ Analogue Storage £250

THIS IS JUST A SAMPLE - MANY OTHERS AVAILABLE

MARCONI 2019 Synthesized AM/FM Sig. Gen 80KHz-1040MHz £1750
H.P. 8640B 500KHZ-512MHZ Phaselock/Syn Dig Fre Readout Sig Gen £800
H.P. 8640A AM/FM Sig Gen 10.24MHz £700
4H.P. 8620C Sweep Oscillator Main Frame only £200
RACAL 9081 Syn AM/FM Sig Gen 5 - 520MHz ....£[illegible]
WILTRON 6610A Programmable Sweep Gen 1-2GHz £1500
W&G Selective Level Meter SPM1 1 with Harmonic Distribution Analyser PSE11 ....£POA
MARCONI TF2331A Distortion Factor Meter 20Hz-20KHz 0.05% unused £225
MARCONI TF893B Audio Power Meter Sinad ....£[illegible]
MARCONI TF2163 Attenuator DC-1GHz £100
R&S Video Noise Meter UPSF2 with UPSF2E2 10MHJz-40MHz £1500
H.P. 8160A Programmable Prec Pulse Gen 50MHz ....POA
H.P. 436A Power Meter with 8481A £1250
PHILIPS PM5134 Sweep Func Gen 0.001Hz-20MHz Sine/Sq/Tri etc £500
PHILIPS PM5190 Syn Func Gen 0.001Hz-2MHz Sine/Sq/Tri £750
H.P. 5006 Signature Analyser £150
H.P. 5004A Signature Analyser £100
H.P. 8495B Attenuator DC-18GHz 0-70dB in 10dB Steps £350
HATFIELD 2105 Attenuator 50ohm £75
RACAL 9008 Auto Mod Meter 1.5 Mhz-20Hz £300
SCHLUM BERGER STABILOCK 4201 Test Set £800
ROBINS OM65 Digital L/C Meter - Unused £75
DI-LOG (Seaward) RC-24 RCCB Test Unit. Un-used £100
DI-LOG (Seaward) LT22 Line Earth Loop Testor Unused £100

BRUEL & KJOER EQUIPMENT AVAILABLE PLEASE ENQUIRE

SPECTRUM ANALYSERS

H.P. 8565A 0.01-22GHz £4000
TAKEDA RIKEN CR4122B 100KHz - 1500MHz £2000
AILTECH 727 0.001-20GHZ £2000
H.P. 182 with 8558B 100KHz-1500MHz ....from £1500
MARCONI 2382 100KHz - 400MHz £4000
MARCONI TF2370 30Hz - 110MHz £1000
H.P. 3582A Dual Channel 25KHz £2000
H.P. 3580A 5Hz-50KHz £1000
SOME H.P. 141T Systems Available - Please Enquire

H.P. 8620C Sweep Osc with 86290B 2 - 18 6GHZ £2000
H.P. 8656A Synthesized Sig Gen 0.1 - 990HMHZ £1750
H.P. 5342A Counter 24GHZ HPIB £1750
H.P. 5340A Counter 10HZ-18GHZ £750
MARCONI 2435 Freq Meter 10HZ-2GHZ ....£[illegible]
RACAL 1998 Frequency Counter 1.3GHz (Options GPIB &High Stab) ....£[illegible]
H.P. 1991 Universal Counter Timer 160MHz 9 digit £500
MARCONI 2437 Universal Counter/Timer DC - 100MHz 8 digit £175
MARCONI 2430A Frequency Counter 10Hz-80MHz 8 digit £125
RACAL 9916 Frequency Counter 10Hz - 520MHz £175
H.P. 3435A 3 1/2 digit Multimeter AC/DC/Ohms/Current LED £100
RACAL 9906A Universal Counter Timer 10Hz - 200MHz £250
MARCONI 2610 True RMS Voltmeter with GPIB £850
SOLARTRON 7150 6½ - 3½ digit DMM with IEEE (no handle) £350
THANDAR 1503 4½ Digit Multimeter with Adaptor £75
Fluke 8842A DMM 5 1/2 digit true RMS ???? ....£[illegible]
Fluke 8840A Digital Multimeter 5 1/2 digit £500
Fluke 77 Handheld DMM 3 1/2 digit with case £100
Fluke 8050A Bench/Portable DMH 4 1/2 digit True RMS ....£[illegible]
WAVETEK 182A Func Gen 0.004-4MHZ Sine/Sq/tri/TTL etc ....£[illegible]
THANDAR TG501 Func Gen 0.0005Hz-5MHzSine/Sq/Tri/Ramp/Pulse/etc £175
GOULD J3B Sine/Square Oscillator 10Hz - 100KHz £150
FEEDBACK FG600 Sine/Sq/Tri 0.1Hz - 100KHz £60
UNAOHM EP501 Audio Analyser £350
PHILIPS PM5565 Waveform Monitor £300
PHILIPS PM8917 Videp Line Selector £200
FERROGRAPH RTS2 Recorder Test Set £250
KEMO Dual Variable Filter VBF/3 0.1Hz - 10KHz £200
LEADER LSG216 Signal Generator £450
PHILIPS PM5509 Colour Pattern Generator ....£[illegible]
BLACK STAR ORION Colour Bar Generator £160
MARCONI TF2700 Universal Bridge Battery Operated ....from £150
WAYNE KERR B424 Digital Component Meter LCR £200
HEALTHKIT 1B RLC Bridge £60
FARNELL PSG520 Synthesized AM/FM Sig Gen 10MHZ - 520 MHZ £600
FARNELL SSG520 Synthesized AM/FM Sig Gen 10-520 MHZ £400
FARNELL TTS520 Transmitter test Set £400
FARNELL LFI Sine/Square Oscillator 10HZ-1MHZ ....£[illegible]
FARNELL LFM2 Sine/Square Oscillator 10HZ-1MHZ ....£[illegible]
SORENSEN DCR600-4 5B 0 - 500 Volts 0 - 4 5Amps £700
H.P. 6268 0 - 40 Volts, 0 - 30Amps £500
FARNELL AP60-50 0-60V, 0-50A, Auto ranging £1000
FARNELL 830/10 30 Volts 10 Amps Variable £150
FARNELL L30-50-30 Volts 0-5 Amps -2 Meters £150
FARNELL L30E 0 - 30Volts 0 - 5Amps Metered £100
FARNELL L30-2 9 - 30Volts 0 - 2Amps Metered £80
FARNELL LT30-1 0-30 Volts 0-1 Amp. Twice £130
FARNELL L30-1 0-30 Volts 0-1 Amp. Metered ....£[illegible]
THURLBY-THANDAR TSP3222 Programmable 32V, 2Amp Twice GP1B, Digital £500
THURLBY PL3200MD 0-30V, 0-2A Twice Digital £225
BRANDENBURG Model 472R +/- 3KV Metered £200

MANY OTHER POWER SUPPLIES AVAILABLE

NEW EQUIPMENT

HAMEG OSCILLOSCOPE HM1005 Triple Trace 100MHz Delay Timebase £847
HAMEG OSCILLOSCOPE HM604 Dual Trace 60MHz Delay Sweep £653
HAMEG OSCILLOSCOPE HM303 Dual Trace 30MHz Comp. tester £422
HAMEG OSCILLOSCOPE HM205-3 Dual Trace 20MHz Digital Storage £653
All other models available - all oscilloscopes supplied with 2 probes

BLACK STAR EQUIPMENT (P&P all units £5)
APOLLO 10 100MHz Counter Timer Ratio/Period/Time int etc £222
APOLLO 100 100MHz (as above with more functions) £325
1325 Frequency Period Counter 1.3GHZ £149
JUPITOR 500 FUNCTION GEN. 0.1Hz-500kHz Sine/Sq/Tri £125
ORION COLOUR BAR GENERATOR Pal/TV/Video ....£[illegible]
All other Black Star equipment available

OSCILLOSCOPE PROBES Switched X1 X10 (P&P £3) £13

Used Equipment - Guaranteed. Manuals supplied if possible.
This is a VERY SMALL SAMPLE OF STOCK. SAE or telephone for lists. Please check availability before ordering. CARRIAGE all units £16. VAT to be added to Total of Goods and Carriage.

STEWART OF READING
110 WYKEHAM ROAD, READING, BERKS RG6 1PL
Tel: 01734 268041 Fax: 01734 351696 Callers welcome 9am to 5.30pm MON-FRI

AN5521	1.35
AN5732	1.40
AN6327	9.85
AN6677	8.50
BA5114	1.55
BA6218	1.85
BA6219	1.20
HA11423	1.65
HA13119	2.50
KA6210	4.99
LA3220	0.60
LA4183	1.35
LA4445	1.90
LA4495	1.40
LA4588	2.55
LA7835	2.35
LB1415	2.25
LM301	0.25
LM317T	1.50
M491BBI	4.75
M49BBI	6.75
M51393	5.95
M58655	3.30
MB3730	1.70
MB3756	8.00
STK078	6.00
STK435	4.00
STK461	6.00
STK2250	7.45
STK4121/2	7.00
STK4141/2	5.50
STK4142/2	6.50
STK4162/2	6.25
STK4171/2	8.10
STK4191/2	8.50
STK4352	6.20
STK4372	5.65
STK4803	7.05
STK4843	7.05
STK5315	5.85
STK5332	1.80
STK5338	3.25
STK5361	4.15
STK5372	2.85
STK5372H	4.15
STK5412	3.75
STK5471	3.85
STK6732	14.00
STK7226	7.50
STK7308	4.05
STK7308	4.05
STK7348	4.05
STK7356	4.75
STK7004	6.50
STK73410	5.15

STK73410/2	5.95
STK73605	4.50
STR441	14.75
STR451	25.00
STR3125	5.50
STR4211	5.50
STR4090	11.15
STR20005	5.00
STR40090	4.00
STR50103A	3.85
STR54041	3.75
STR58041	3.75
STR80001	6.00
STR1706	4.75
STRD1806	4.50
STRD6008	10.00
TA227	1.85
TA7271	2.50
TA7280	2.25
TA7281	2.20
TA7698	5.00
TA8200	3.50
TA8210	3.00
TA8214	3.00
TA8215	3.00
TA8205	3.95
TA8659	13.00
TA75339	**
TDA1908A	2.00
TDA2170	3.00
TDA2270	2.50
TDA3500	4.99
TDA3562A-TFK	3.25
TDA3562A-PAILL	3.25
TDA3562A-SSSG	3.00
TDA3645	8.00
TDA3650	8.99
TDA3850	18.99
TDA4400	1.75
TDA4500	3.50
TDA4505A	4.10
TDA4505B	4.10
TDA4505M	5.25
TDA4505K	6.15
TDA4660	4.50
TDA4950	1.40

TDA5660P	2.50
TDA7072	3.99
TDA8370	14.00
TDA8405	8.00
TDA8732	5.95
TEA2018A	1.50
TEA2026C	4.50
TEA5170	1.40
TUA2000-4	4.25
U884B	2.35
U4606B	5.50
UAA1008	3.00
UPC1178	1.05
UPC1182H	5.15
UPC1278H	2.20
UPC1420	4.50
UPD1937	3.00
25A814	0.71
25A839	1.40
25A1062	1.00

ELECTROLYTIC CAPACITORS

250V Working	
1UF (5/pack)	1.00
4.7UF (5/pack)	1.50
10UF (5/pack)	1.70
22UF (each)	0.40
33UF (each)	0.56
47UF (each)	0.65
100UF (each)	1.28
400V Working	
1UF (5/pack)	1.10
4.7UF (5/pack)	1.50
10UF (each)	0.70
22UF (each)	0.75
4.7UF (each)	1.40

CERAMIC FILTERS

5.5MHZ SFE (5/pack)	2.40
6.0MHZ SFE (5/pack)	2.40
6.5MHZ SFE (5/pack)	2.40
10.7MHZ SFE (5/pack)	2.40
5.5MHZ CDA (5/pack)	2.40
6.0MHZ CDA (5/pack)	2.40
6.5MHZ CDA (5/pack)	2.40
10MHZ CDA (5/pack)	2.40

Please phone us for the types not listed. Please add 60p post & packing and then add 17.5% VAT to the total.
Callers by appointment only.

J.J. COMPONENTS
63 THE CHASE, EDGEWARE,
MIDDX. HA8 5DN, ENGLAND
Hotlines No 081 381 1700/081 952 4641
Free Fax order Line only : 0800 318498
General Fax 081 381 1700

PHONE FOR OUR FREE 1996 CATALOGUE

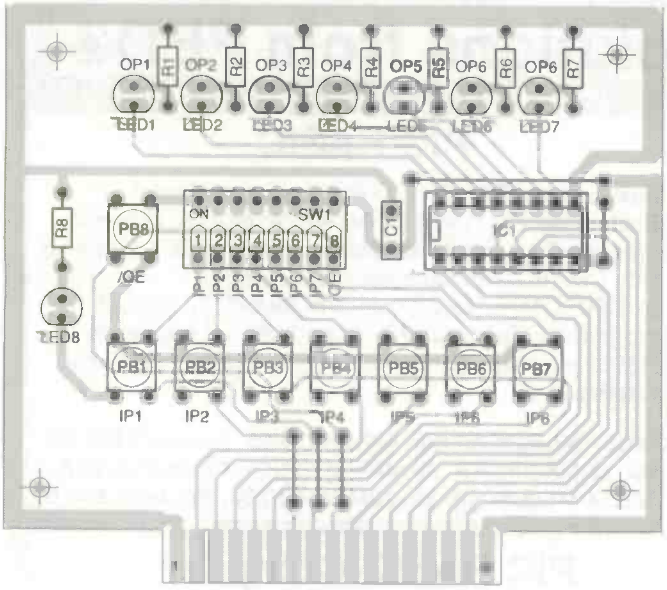


Figure 4: the component layout for the software test board

Continued from P. 56

With programs that are very short, or at least with very simple specific tasks, there is usually no need for a flowchart.But with more ambitious designs it's almost a necessity as the starting point to writing a reasonably structured program, to ensure you don't take up valuable memory space by writing masses of repeated code which perform the same function. The program presented performs a power-up test of the piezo transducer, the 7-segment displays and the two LEDs (6 and 7) used to indicate the status of the limit switches.Plus, it carries out all of the tasks in the flowchart, AND shows messages in the displays of the Process Timer board relating to the status of the gate at any time .When assembled, the whole program takes up a fraction more than just half of the available program memory of a PIC16C54 - 264 bytes to be precise, so there's plenty of room left for adding your own modifications.

In order to drive the gate motor, detect the limit switches, ground loop and keypad operations, 4 inputs and 2 outputs of the expansion bus are used by the program.

The brackets below show which LEDs are used to indicate the outputs, and which pushbuttons to press to simulate the inputs, they are:

O/P1 (LED1)Output for driving the gate opening relay.Turn on this relay to connect the +V power rail to the gate actuator motor, at the same time, turn off the gate closing relay to connect the power GND rail to the opposite motor pole.

O/P2 (LED2)Output for driving the gate closing relay.Turn on this relay to connect the +V power rail to the gate actuator motor, at the same time, turn off the gate opening relay to connect the power GND rail to the opposite motor pole.

I/P1 (PB1)Normally Open (N/O) limit switch input for gate open.This input goes low when the gate reaches the full travel of its open limit.

I/P2 (PB2)Normally Open (N/O) limit switch input for gate closed.This input goes low when the gate reaches the full travel of its closed limit.

I/P3 (PB3)Normally Open (N/O) keypad relay output.This input receives brief, low going pulses each time the code or card swipe is accepted.

The duration of the pulse is usually programmable at the keypad by the installer, and could be anything between 10 milliseconds and 20 seconds.

I/P4 (PB4)Normally Open (N/O) ground loop detector relay output.For our purposes we will assume that this input is low at any time there is a vehicle within the detection range of the ground loop, but, as with the keypad, this is usually programmable at the detector for different configurations by the installer.

If both O/P1 and O/P2 are in the same state - high or low - the motor will not be driven, since the same voltage will be present on both poles of the motor.

No damage will result to the motor, but it is always best to keep the poles held to GND when no movement is required, such would be the case in a power-fail situation when both of the motor driving relays would de-energise and drop out.

With permanent magnet motors this actually has a strong braking effect, because the magnetically induced current acts upon the low resistance of the armature winding and feeds the current back onto itself.

This, however, only works with motors which do not have a pre-armature speed control, so most of the small cassette player motors used these days won't be suitable, since they generally have an adjustable speed control fitted inside the motor housing, which renders them non-reversible. If you want to use this type of motor you will have to dismantle it, remove the speed control section and connect the supply wires directly to the connectors of the armature brushes.

Method of operation

Obviously the Process Timer expansion bus cannot be connected directly to relays and motors etc. without adding a suitable interface board (see next part), but the explanation of how it operates remains the same, and the functions do work correctly when you simulate the various input conditions via the pushbuttons or DIP switches on the software development board.

The default objective of the program is to keep the gate closed until such times that it is required to open.When a low signal is detected from the keypad or ground loop detector, caused by the correct code being entered or a vehicle entering the detection range of the ground loop respectively, the gate will open fully.

Once open, it is held there for a minimum of 10 seconds to allow the vehicle to pass through the gateway.

As long as the ground loop is clear after the 10 second hold time, the gate will attempt to close again.However, as a safety measure, if the ground loop is still active after this period, the gate will remain open and the Process Timer will emit a few bleeps every second, until the vehicle moves out of the detection range.

If the keypad or ground loop are activated during the gate's closing phase, the gate will stop for 2 seconds, and then reverse the motor to the opening phase.Once the gate has begun opening, it must be allowed to open fully, until it hits the open limit switch There is no way to override it in the same way as the closing phase.The meanings of the various messages which will appear in the displays are as follows:

SHUt The gate closed limit switch is made, so the gate is assumed to be shut.

runO The gate motor is running in the Open direction (the gate is opening).

runC The gate motor is running in the Close direction (the gate is closing).

StOP The gate was closing but either the ground loop detector or keypad input was activated, signalling the gate to open, so to prevent excess strain or damage the gate motor has been stopped for 2 seconds prior to reversing its direction.

HOLd The gate open limit switch is made, so the gate is assumed to be open, and is now on hold. In order for the vehicle to pass through the gateway it is now held open for at least 10 seconds before any attempt is made to close it.

LOOP The gate is attempting to close after being on HOLd, but there is something on the ground loop preventing it from doing so.

The gate will be held open until the obstruction is removed, after which the gate will begin to close immediately.

When displayed, the LOOP message flashes every second, and is accompanied by a two-tone bleep sound from the transducer.

Using the program

With the software development board plugged into the ribbon cable, set all DIP switches to the off position, the OE jumper link on the Process Timer to INT (left hand), and power up. There will be a few bleeps, followed by 88:88 in the displays and the two right hand LEDs lit on the software development board. This is the start up piezo, display and LED test routine.

From now on there is no need to touch the Process Timer, as everything is controlled from the software development board. After a couple of seconds runC will appear in the displays, and O/P2 LED will light. Because the processor receives a high signal from the gate closed limit switch it assumes the gate is open and is now trying to close it by turning on the gate close relay output bit.

Simulate the action of the gate closed limit switch by holding down pushbutton PB2. From the low input signal the processor assumes the gate has now closed, so the relay output bits are turned off, the limit switch indicator LED7 lights and the message SHUt appears in the displays. Releasing PB2 will simply reinstate stage 1 once more.

Simulate a keypad entry or ground loop detector signal by pressing PB3 or PB4 respectively. If PB2 is still held down (gate shut), the message runO is displayed and O/P1 LED lights. If not, then the message StOP appears for 2 seconds prior to runO being displayed.

The gate open limit switch input is high and the processor turns on the gate open relay output bit to open the gate. At this point you can release PB2, because the processor is now only looking for the gate open limit switch.

Press PB1 to simulate the action of the gate open limit switch. The gate is now put on hold for 10 seconds to allow the vehicle to pass through the gateway, and HOLd appears in the display during this period.

Release all buttons and the gate will close after 10 seconds. If, after the 10 second hold period, you still have PB4 pressed (loop active) the gate will remain open and LOOP flashes in the display, together with bleep sounds from the piezo. As soon as you release PB4 the gate will close and the whole process starts again.

The 5-page listing will appear next month if there is sufficent demand; otherwise, this listing, together with the simple Expansion Bus test routine and the main Darkroom Timer program of part 1 is on the software disk for this project, which is available from the author.

Still to come...

As we mentioned in part 1 of this series, the Process Timer/Controller does not have to be restricted to just timing applications. The ability to interface it via the expansion bus makes it suitable for a whole range of projects, and, as you may now realise, is not limited to small or simple designs just because it uses the low-end PIC16C54 device.

The next part of the project is a full blown I/O interface board which provides the means to connect the Process Timer expansion bus to the outside world.

On-board features will include changeover relays, open collector outputs and adjustable sensor inputs capable of handling up 50V on each input channel.

Some software examples will be supplied, and we will look at implementing a model of the automatic gate controller program on the board.

Kits and bits available

A complete kit of components for the Process Timer Software Development Board, which includes everything in the parts list, is available from the author by mail order only at the following address:

DTE Micro Systems
112 Shobnall Road
Burton on Trent
Staffordshire DE14 2BB

Complete kit for the Software Development Board (All components - including the PCB)	£11.00
The PCB can be purchased separately if required	£5.50
The programmed PIC16C54 is available separately at	£8.50
Fully documented source code text on 3.5 inch disk (The complete source code + various other files)	£8.50

All prices are inclusive, but please add £2.50 to the total order value to cover carriage and handling charges. If ordering from overseas, payment must be in pounds Sterling (£). Cheques, bank drafts or money orders etc. must be drawn on a British bank. Goods will normally be dispatched within five working days from receipt or order (subject to cheque clearance and availability), but please allow up to 28 days for delivery.

PARTS LIST

Resistors
R1 - R8 470R (8 off)

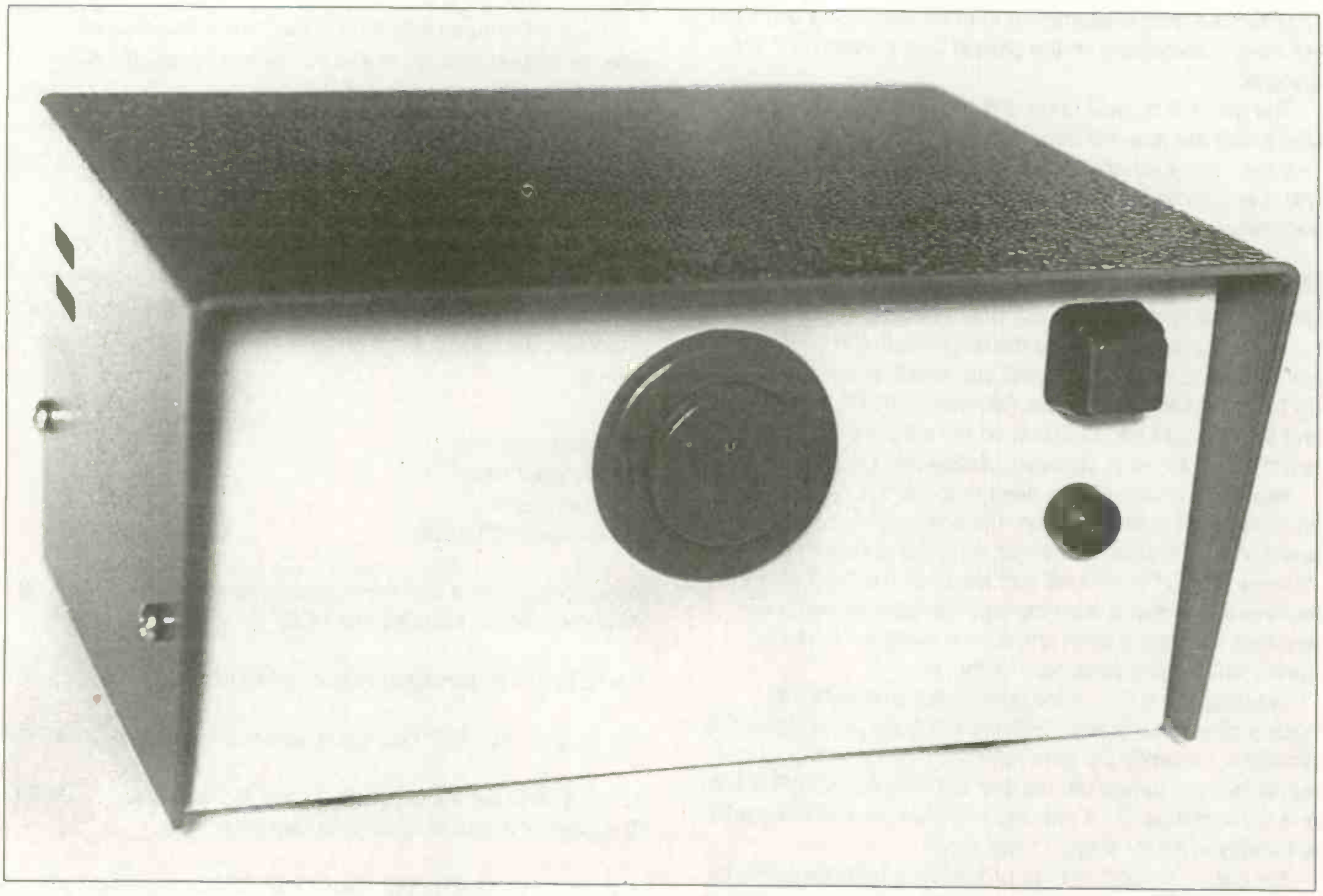
Capacitors
C1	100nF Ceramic or Polyester

Semiconductors
LED1-8	5mm high efficiency red LED (8 off)
IC1	ULN2003 - 7 Stage Darlington driver

Miscellaneous
SW1	8-way SPST DIP Switch
PB1-8	6 x 6mm miniature PCB switch (8 off)
Links	1/0.6 tinned copper wire (6")
PCB	DTE Process Timer Software Development Board

OFF YOU GO!

Terry Balbirnie's automatic shut-down switch



Do you ever leave your computer switched on all day so that you can return to it at odd times? Do the children forget to switch it off after having used it to play games? If the answer to either of these questions is yes, then this project could be useful to you.

Worthwhile savings

It may be inconvenient to shut down the computer itself especially when several programs are running. However, there would be no such problem if only the monitor were to be switched off at the end of a session. Doing this would represent a worthwhile saving. A typical monitor is rated at about 120 watts. If it was left switched on for 8 hours, it would consume almost 1kWh or electricity. Most people would not bother to switch off the monitor themselves. The Off you go! circuit has therefore been designed to cut off its supply automatically when there is no user present. It does this by interrupting the mains feed after a preset time between 10 and 40 minutes unless a push-button reset switch has been operated. Whenever the button is pressed, the timing begins again. Towards the end of the cycle, a buzzer beings to bleep. The button must now be pressed within a few minutes or the supply will be disconnected.

Dozing off

This circuit should not be used to switch off the computer itself. However it could be used to switch off the TV in a child's bedroom or elsewhere. It could also be connected to a bedside reading light or radio. This would be handy for anyone who regularly goes to sleep with appliances left switched on. Note that it should not be used where any memory would be lost due to total disconnection of an appliance from the mains. Certain TVs "lose" the stations and need to be re-tuned if they are disconnected for more than a few hours. The maximum load is 2A corresponding to about 500W on 240V mains. The circuit will therefore accommodate a wide variety of low-power appliances. The unit may be left plugged into the mains continuously. This is because at the end of the timing period, the supply to the circuit

Figure 1: the block diagram of the shut-down switch

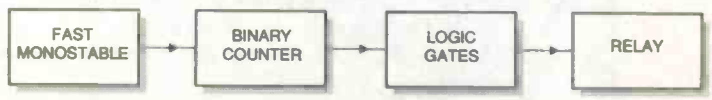
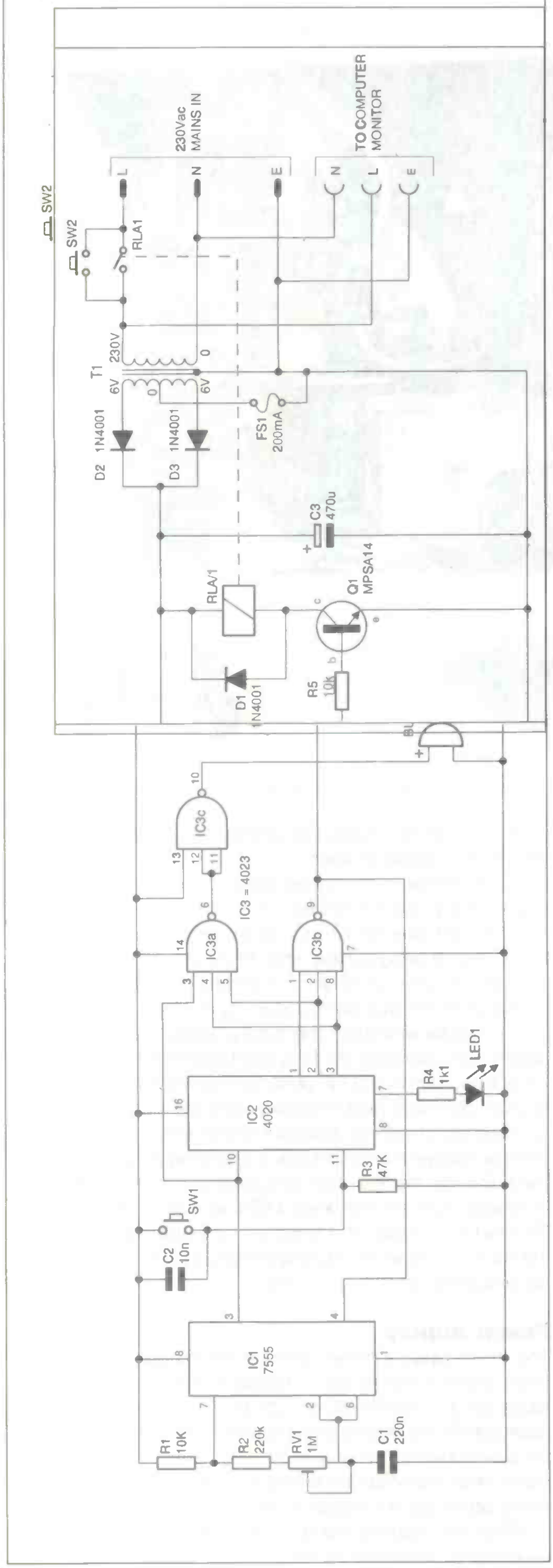


Figure 2: The circuit of the shut-down switch



itself is switched off so there is no current drain. The Off you go! circuit is housed in a metal enclosure. There is the push-button reset switch referred to above and a further mains on push-button switch on the front panel. (see photograph). A flashing LED indicator, also on the front, shows when the circuit is operating. On the back there is a pair of 3-pin mains connectors. The lead which would normally carry the supply to the monitor is connected to one of these. A new lead is then taken from the other one to the monitor.

How it works

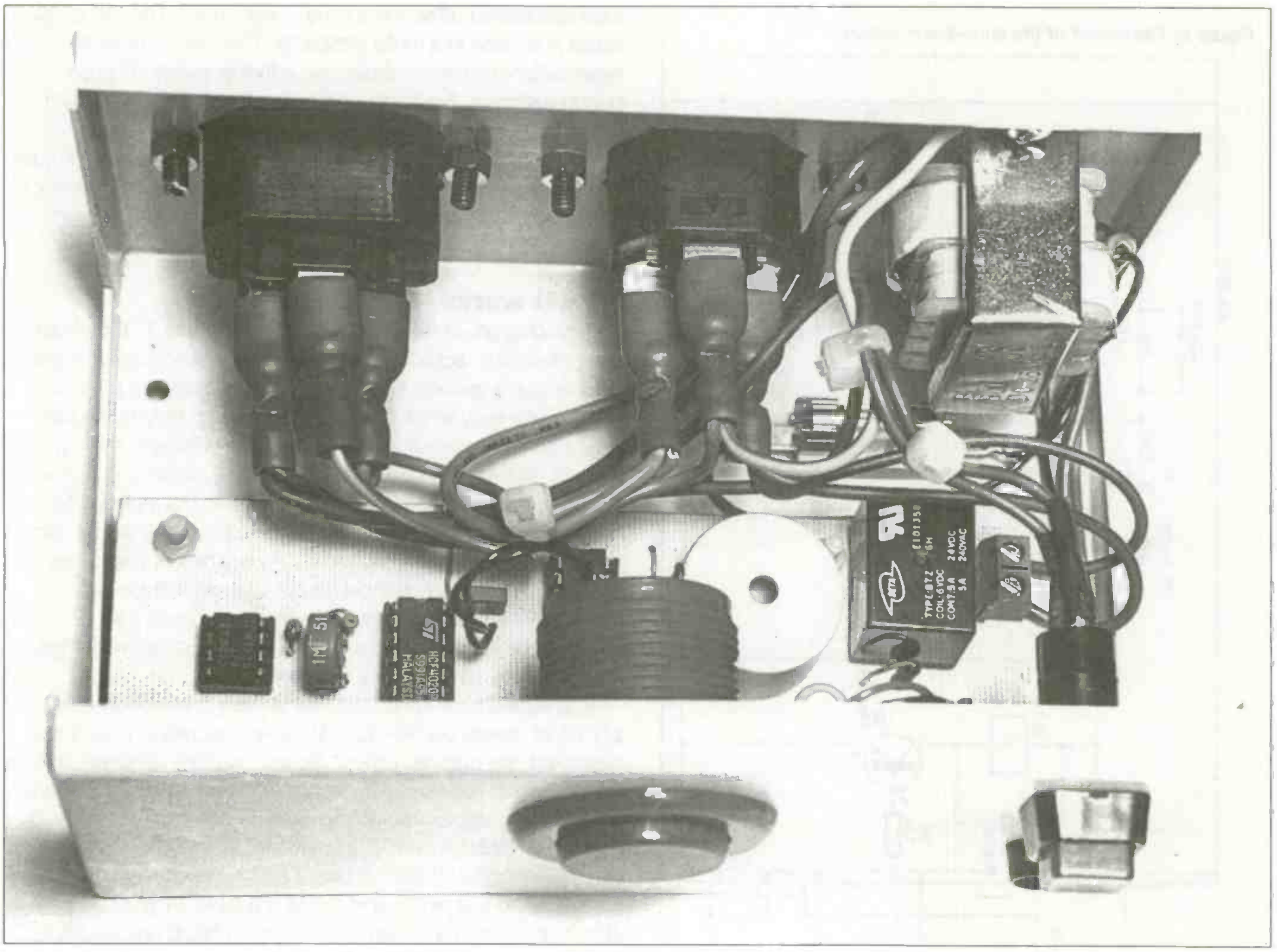
A block diagram of the system is shown in figure 1. The circuit comprises four sections in addition to the power supply: a fast astable (pulse generator), a binary counter, a system of logic gates and a relay which switches the mains supply to the load (e.g. a computer monitor). A detailed circuit diagram is shown in figure 2. The astable section consists of integrated circuit timer, IC1, and associated components. Assuming a supply exists, a continuous stream of pulses will be provided at the output, pin 3. The pulse repetition frequency is determined by the values of fixed resistors R1 and R2, preset potentiometer RV1 and capacitor C1. With the values specified, the preset may be used to adjust the frequency between 2.5 and 10 Hz. approximately (that is, 2.5 to 10 pulses per second).

The pulses from the astable are applied to the clock input, pin 10, of binary counter, IC2. Thus, as successive pulses are registered, the outputs ('twos', 'fours', 'eights', 'sixteens' and so on) go high in various combinations to provide the binary count. Most of the outputs are unconnected but the highest three ('1024s', '2048s' and '4096s') plus the '8s' are used. The final two ('2048s' and '4096s' at pins 2 and 3 respectively) are connected to IC3 pins 4 and 5. IC3 is a triple 3-input NAND gate (that is, there are three separate 3-input gates in one package) and pins 4 and 5 are two of the inputs to one of the sections (IC3a). The third input (pin 3) receives a signal direct from IC1 output. Most readers will be familiar with a two-input NAND gate. The characteristics of the 3-input variant are simply an extension of this. Here, there will be a high output (in this case, pin 6) unless all three inputs are high, whereupon it will be low (figure 3 shows the truth table with the inputs labelled A, B and C and the output labelled X).

Not there yet

Towards the beginning of the cycle, IC3 pins 4 and 5 will be low because counting has not progressed sufficiently far. The output of IC3a will therefore be high irrespective of the state of pin 3. Pins 4 and 5 will both go high when the count has progressed sufficiently for the '2048s' and '4096s' outputs to be high simultaneously - that is after counting 4096 + 2048 or 6144 pulses. Suppose the astable is set to its lowest rate of 2.5Hz. To reach a count of 6144 would take about 40 minutes. At the highest frequency of 10Hz it would take some 10 minutes. When these pulses have been counted, the output of IC3a, pin 6, will pulse high at the clock frequency reflecting the behaviour of pin 3. This is because as pin 3 becomes high, all three inputs will be high so the output will be low. As pin 3 becomes low, the output will be high. The output from IC3a is inverted by IC3c which is a further 3-input NAND gate. To understand how this comes about, refer once again to the truth table. Since two of the inputs - pins 11 and 12 - are connected together, they must have the same logic state. Meanwhile, the other input (pin 13) is made permanently high by connecting it direct to the positive supply line.

It will be seen that if the output from IC3a is low, pins 11 and



12 will also be low. The output of IC3c - pin 10 - will then be high (shown by line 2). If IC3a output is high, pin 10 will be low (shown by line 8). The pulses obtained from IC3c pin 10 then operate buzzer, BUZ1. At the lower clock speed there will be a rapid bleeping. At the higher one the pulsing will be so fast that the buzzer will produce a warbling tone.

Relay energised

Now look at the remaining 3-input NAND gate, IC3b. While any of its inputs are low, the output (pin 9) will be high. At the beginning of the timing sequence, Darlington transistor Q1 will therefore receive base current via resistor R5. Consequently, current will flow in the collector circuit and relay, RLA/1, will be energised. The normally-open ('make') contacts will be closed and the monitor and transformer, T1, will receive current. Diode D1 bypasses the high voltage pulse which appears across the relay coil when it switches off. Without it, semiconductor components in the circuit could be destroyed. Note that the high output state at IC3b pin 9 enables IC1 by making pin 4 (reset input) high.

IC3b output, pin 9, will remain high until all three inputs (pins 1, 2 and 8) go high simultaneously and this will occur when IC2 outputs '4096s', '2048s' and '1024s' are all high. This corresponds to a count of 4096 + 2048 + 1024 which is 7168 pulses (or 1024 pulses more than was needed for the buzzer to sound). At the slowest clock speed this will take about 48 minutes and at the highest one, 12 minutes. When this happens, the current flowing into the base of the Darlington transistor is interrupted and there will no longer be any current in the relay coil. The 'make' contacts will open and the appliance and transformer will be switched off. Additionally, IC1 pin 4 is made low and the astable disabled.

To summarise, at the slowest clock speed the buzzer will begin to bleep after 40 minutes and the mains will be disconnected after 48 minutes. At the highest clock frequency, the buzzer will being to bleep after 10 minutes and the supply will switch off after 12 minutes. Any time before the supply is cut off, the sequence may be re-started by making IC2 reset input, pin 11, high for an instant. This is the purpose of push-to-make switch, SW1. Normally, pin 11 is maintained in a low state through resistor R3 and this prevents false resetting due to possible pick-up of random signals along the wiring. Capacitor C2 holds pin 11 high for an instant on powering-up the circuit and this ensures that the counter is reset (that is, begins from zero). To show that the circuit is operating, IC2 '8's' output (pin 7) operates light-emitting diode, LED1 via current-limiting resistor, R4. The LED will flash at one-eighth of the clock frequency and this will be useful when checking the circuit since these pulses are sufficiently slow to be counted.

Power supply

The power supply is derived from the mains using a conventional arrangement of transformer T1 having a centre-tapped secondary, twin rectifier diodes, D2 and D3 and smoothing capacitor C3. No stabilisation is required because the astable frequency does not depend on the input voltage to any great extent. Also small changes in frequency, and therefore in the timing period, are not thought to be important .

When the circuit has timed out, the relay 'make' contacts will be left open. To activate the circuit, push-to-make switch SW2 is operated for an instant. This allows current to flow to the transformer primary which establishes a supply to the circuit. IC2 then begins counting and the relay is immediately energised. The 'make' contacts now take over in maintaining the supply and SW2 may be released. Note that since this switch also directs current to the load until the relay contacts "make", it is important for it to be suitable for mains use and have an adequate current rating (see components list).

Construction

Construction is based on a single-sided printed circuit board (PCB) and the component overlay is shown in figure 4. First drill the four mounting holes (one is in the large copper area below C3 position). Mount the ic sockets and the two sections of screw terminal block, TB1 and TB2, as indicated. Add the five link wires and follow with the resistors (including preset, RV1) and capacitors taking care over the polarity of C3.

Solder the three diodes, the Darlington transistor and the buzzer in position taking care over the polarity of these components. The diodes have a grey band round the body to denote the cathode (marked "k" in each case). The polarity of the buzzer is also marked on the body. Solder the relay in place. Adjust RV1 fully anti-clockwise as viewed from IC1 position. This will provide minimum timings which will be convenient for testing purposes. Solder 15cm pieces of light-duty stranded connecting wire to the free pads labelled "SW1" and "LED1".

Testing

The circuit panel should now be tested using a battery before the mains power supply is constructed. In this way, basic checks and setting-up may be carried out safely.

Attach the positive (red) PP9 connector to one of the terminals labelled "ac" (it does not matter which) and the negative (black) one to the terminal labelled "gnd". Insert the ics into their sockets observing the orientation. Since these are static-sensitive devices they could be damaged by charge which might exist on the body. It would therefore be wise to touch something which is earthed (such as a water tap) before handling the pins. Carefully twist the "LED" wires to the LED indicator observing the polarity. Alternatively, use a plain LED. The slightly shorter lead is the cathode (negative) one. Make sure that these wires and those for SW1 are not left touching.

Connect the battery. The relay will be heard to click and the LED should begin to flash at about once per second. After 10 minutes, the buzzer should begin to give a warbling sound and after a further 2 minutes the relay should click off and the LED go out. These timings are approximate but will act as a guide. Touch the "SW1" wires together momentarily to reset the circuit. Allow timing to proceed until the buzzer begins to sound. Touch the wires together again. The buzzer should be silenced and the timing should start again. Adjust RV1 for the required period (although this will not be known exactly until after a few days of use). I suggest that a short time is used for most purposes.

Getting prepared

If all is well, attention may be given to the enclosure and power supply. Prepare the case by making holes in the rear panel for the input plug, output socket and transformer (see photographs). It is vital to understand that the mains output (monitor feed) appears at the socket so that it is impossible to touch the pins.

Drill holes for the two push-button switches and LED indicator (or a mounting clip for a plain LED) in the front panel. SW1 should be chosen to have a very light action. Hold the circuit panel in position, mark the mounting holes on the base of the box and drill them. Also drill the hole for the fuseholder and attach it. Mount the transformer including a solder tag on its upper fixing. Attach the mains plug and socket. Note that the output socket should be mounted to the left of the input plug (as viewed from inside the case) - see figure 5. The neutral pins will then be adjacent to one another. Attach the circuit panel using 10 mm long plastic stand-off insulators on the bolt shanks. Check that the underside copper tracks and joints on the PCB remain several millimetres clear of the base of the box. Check especially that the relay contact connections cannot, under any circumstances, touch the metalwork. Provide additional insulation as necessary. Attach the LED indicator. Refer to figure 5 and complete the internal wiring. All mains connections (shown in bold type) must be made with mains type wire of 5A rating minimum. Note the earth connection which is made to the solder tag. This grounds the case and transformer and is an essential safety requirement. The connections to the plug and socket should be made using insulated spade receptacles. Do not solder wires direct to the tags because the plastic body easily melts. Note also that SW2 connections must be insulated using heat shrinkable sleeving or an insulating boot. The transformer secondary leads (blue in the prototype) are connected to the terminals labelled "ac in". The centre tap (black) lead is connected to the terminal labelled "gnd" via fuse FS1. Small cable ties were used in the prototype to keep the wiring tidy. If the plug on the mains input lead is of the 13A UK pattern, fit a 2A or 3A fuse. If the plug is not fused, a separate one must be included in the live (L) mains feed inside the case. Assemble the case and stick self-adhesive feet on the base to protect the work surface. Make up a lead for the monitor and connect it up. Plug the unit into the mains and check the circuit under working conditions. Note that when the mains supply cuts off, capacitor C3 keeps the timing circuit operating for a few minutes until it discharges. To avoid any problems with the circuit failing to trigger, make a habit of pressing SW1 (reset) before operating the mains on switch when the unit has timed out.

Safety precaution:

If the timing needs to be re-adjusted, unplug the unit from the mains before removing the lid of the case. RV1 should then be turned a little at a time and the lid replaced before plugging in. This procedure will avoid any possibility of touching live mains connections.

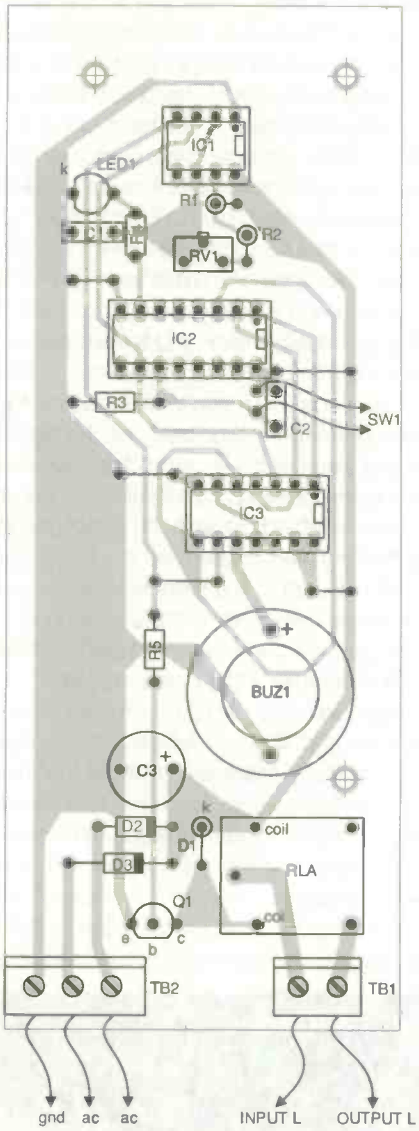
Figure 3: truth table for the 3-input NAND gate

Inputs A B C	Output X
0 0 0	1
0 0 1	1
0 1 0	1
0 1 1	1
1 0 0	1
1 0 1	1
1 1 0	1
1 1 1	0

Buylines

The buzzer must be loud enough for the purpose. The unit used in the prototype was obtained from Maplin order code: KU56L. The box and relay were also obtained from Maplin order codes: XY43W and JM17T respectively. Other components are freely available.

Figure 4: The component layout of the shutdown switch



PARTS LIST

Resistors

R1, R5	10k
R2	220k
R3	47k
R4	1k
RV1	1M sub miniature vertical preset

All 0.6W 1% metal film.

Capacitors

C1	220n min. metallised polyester 5mm pin spacing
C2	10n min. metallised polyester 5mm pin spacing
C3	470m radial electrolytic 16V

Semiconductors

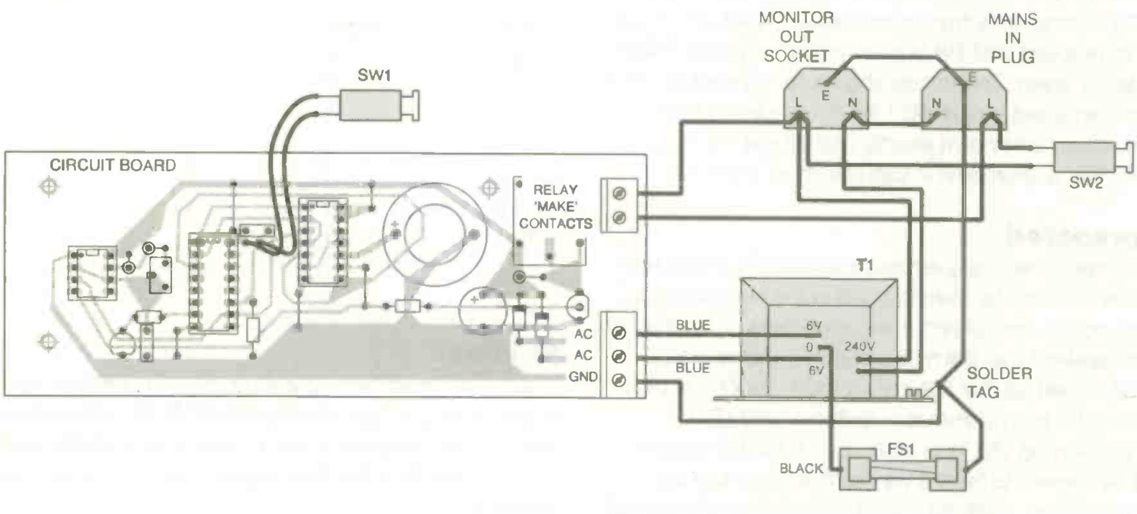
IC1	ICM7555
IC2	4020
IC3	4023
Q1	MPSA14
D1, D2, D3	1N4001
LED1	Red LED indicator (or plain LED and mounting clip)

Miscellaneous

FS1	20mm chassis fuseholder and 200mA fuse to fit.
BUZ1	3V to 24V dc buzzer - 90dB at 12V.
SW1	Push to make switch - see text.
SW2 rated	Push to make switch with 3A mains contacts.
RLA rated	Relay with 6V 100W coil and 5A mains-contacts.
PL1/SK1	IEC (Euro-style) 3-pin chassis plug and socket
T1	Miniature mains transformer with 6-0-6V centre tapped secondary rated at 250mA (3VA)
TB1	2-way PCB mounting screw terminal block - 5mm pin spacing
TB2	3-way PCB mounting screw terminal block - 5mm pin spacing

Circuit panel. 8-pin dil socket, 14-pin dil socket, 16-pin dil socket. Plastic stand-off insulators, small nuts and bolts, heat shrinkable sleeving, solder tag. PP9 battery and connectors (for testing). Metal box for project.

Figure 5: wiring up the unit



Pre-Hertzian Wireless:

The Needles and Fastnet Lighthouse System

PART 2

George Pickworth sets up an experiment to measure the success of Willoughby Smith's cable-less telegraphy system of a hundred years ago

Following Willoughby Smith's small scale trials with a rowing boat on a lake as described in the first part of this article, and the granting of a patent for the single cable system, the Telegraph Construction Company accepted the invitation from Trinity House to go ahead with the Needles project in 1892.

According to the writer J.J Fahie, the submarine cable entered the sea at Alum Bay, but there is some evidence that it eventually entered the sea near the pier at Totland, and that the complementary electrode was attached below low water mark to the legs of the pier; this would be logical (see figure 8a). The cable terminated at a mushroom shaped copper electrode lying on the sea bed 60 yards from the rock. The electrode also served as an anchor for the cable.

The secondary electrodes, aligned radially with the distant primary electrode, were securely anchored below low water mark on opposite sides of the rock, as in figures 8b and 9.

However, my experiments showed that if iron-sheathed submarine cable was used, the sheathing would have to be insulated from the water, or else it would provide a low resistance return path to the complementary electrode and virtually short-circuit the system. More about this later.

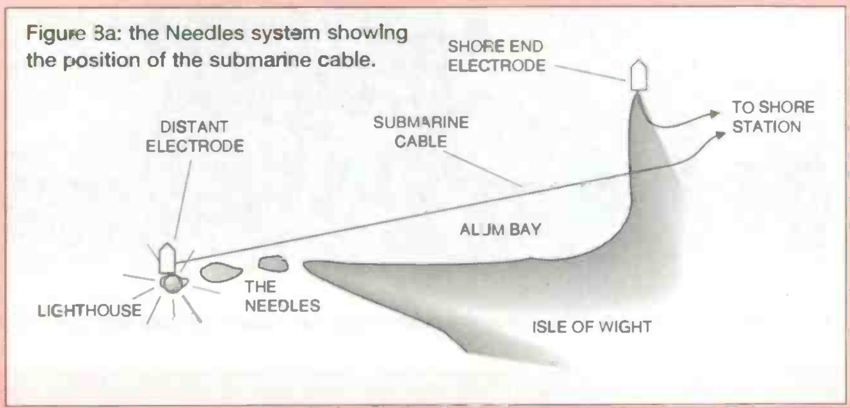


Figure 8a: the Needles system showing the position of the submarine cable.

Two-way communication

Despite the great difference in the spacing of the primary and secondary electrodes, the system was used for two-way communication. Operation proved entirely satisfactory and for the first time reliable communication with the lighthouse was maintained under all weather conditions. The lighthouse equipment was essentially the same as that used on land (see figure 10).

Interestingly, the original sender chopped DC into high frequency pulses that produced a tone in the distant receiver's earpiece. The advantage of the tone system was that it was almost immune to galvanic currents generated by the action of sea water on the electrodes.

However, the lighthousemen, accustomed to signalling with flags, preferred a mirror type galvanometer which deflected a beam of light across a screen (speaking galvanometer) .This had a simple adjustment to compensate for variations in Galvanic currents.

A further refinement was to install a call system employing a relay which rang a bell to attract attention, avoiding having to have someone constantly on duty watching the meter.

Fastnet lighthouse

Standing on a rock 80 feet high, 360 feet long and 150 feet wide, situated about 6 miles from the south west corner of Ireland, the Fastnet lighthouse was in one of the most exposed and inaccessible sites in the British Isles. Like the Needles lighthouse, it had been impossible to maintain communications with a continuous cable, as the cable was frequently broken

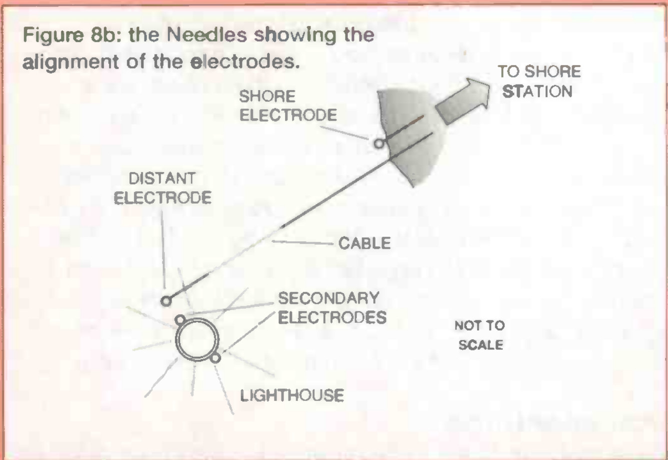


Figure 8b: the Needles showing the alignment of the electrodes.

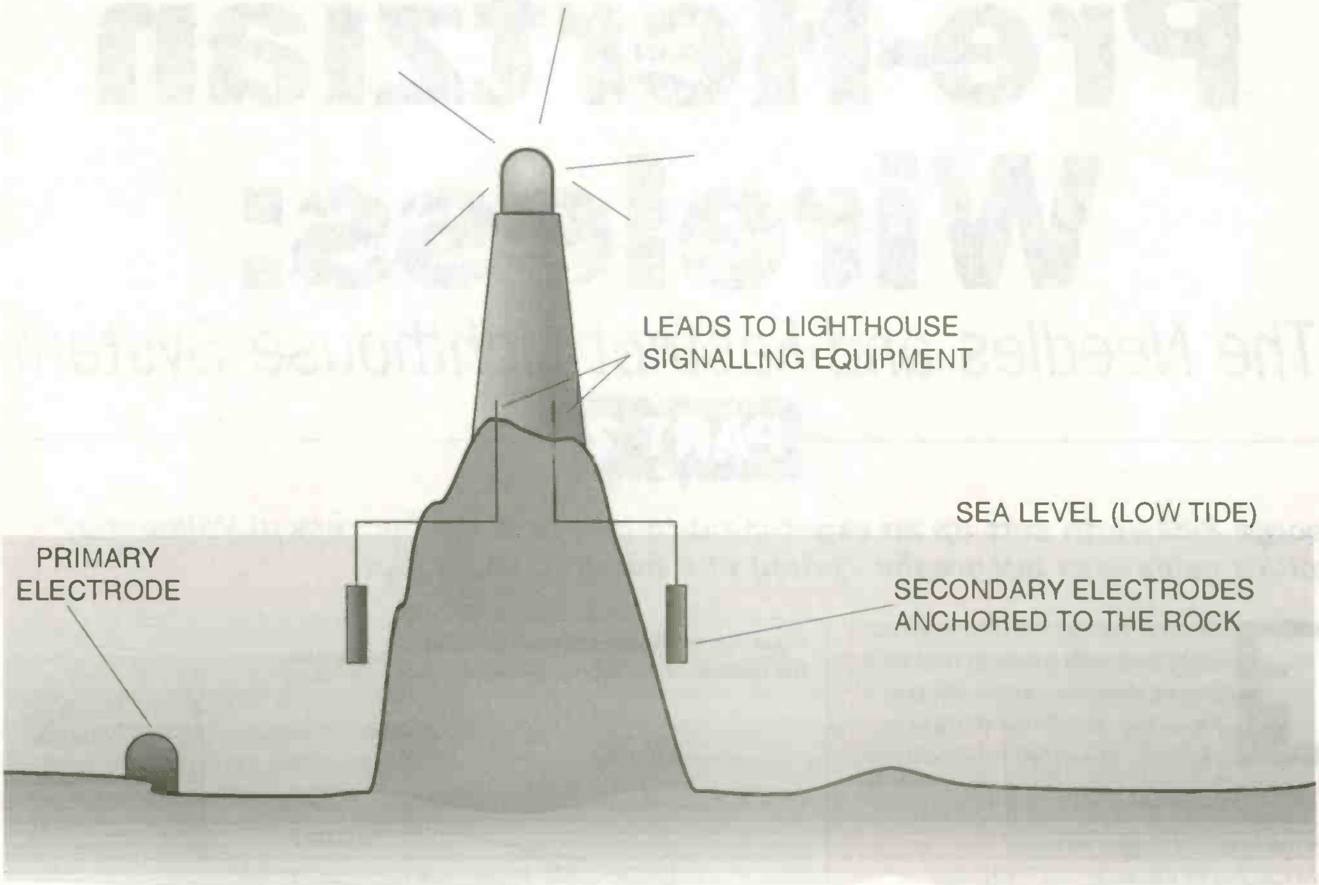


Figure 9: the Needles lighthouse system, showing the distant primary electrode and secondary electrodes.

where it came ashore. Poor visibility frequently prevented signalling with lamps or flags, often at those times when communication was most urgent, so, in 1892, the Needles system was adopted. According to Fahie, the shore end of the cable came ashore near Galley Cove, a few miles from Crookhaven Post Office, while the distant end terminated at a 500-pound mushroom-shaped copper electrode lying under 11 fathoms of water 100 feet from the rock.

The cable had a copper conductor weighing 107 pounds per nautical mile and was covered with 150 pounds of gutta percha per nautical mile. Its complementary electrode was placed in the haven itself, as in figure 11a. The alignment of the secondary electrodes is shown in figure 11b. Because heavy seas periodically swept over the rock, the wires leading from the electrodes to the lighthouse were placed in deep grooves chased into the rock and filled with Portland cement.

The secondary electrodes consisted of a number of copper rods inserted into 2.5-inch diameter sloping holes drilled through the rock so as to emerge into the water 20 feet below low water mark where they were not subjected to wave motion, as in figure 12. Installation was a difficult and costly operation. The signalling equipment was essentially the same as that used at the Needles lighthouse (figure 10). However, according to Fahie, ten large Leclanche cells (15V***) were used on the rock, and the current in the secondary circuit when sending signals was l.5A, while the galvanomter at the shore end of the primary circuit registered l50 microamps.

Iron sheathing

The iron sheathing round the cable was dispensed with for the final 100 feet and replaced by a thick covering of rubber sheathed with copper wire and covered with more rubber. The whole assembly was protected by glass rings. Fahie said that these drastic measures were to prevent Galvanic effects between the iron sheathing and the copper electrode, but I believe the main reason was to avoid a low resistance path to the complementary electrode.

Willoughby Smith's lake experiment

The four electrodes in use each consisted of aluminium tubes 20mm in diameter and l.25m long. Plastic-covered automotive cable was used as the submersible cable to the distant primary electrode, which was placed on the lake bed in 2 metres of water 150 metres from the bank

The electrode was kept in a vertical position by means of a weight and a plastic bottle. The vertical position of the primary electrode corresponded with the secondary electrodes; the plastic bottle served as a marker showing its precise position (see figure 13). The complementary primary electrode was laid in shallow water near the bank. The primary circuit was energised with 6 volts, and the current was measured at 125mA. The secondary electrodes were suspended in the water from the bow and the stern of a 2.5m GRP (fibreglass) dinghy and were connected to a microammeter with a resistance of 1500 ohms.

Bamboo cane

To enable the distance separating the primary and secondary electrodes to be maintained within close limits over 360 degrees, a bamboo cane with a plum-bob attached to the far

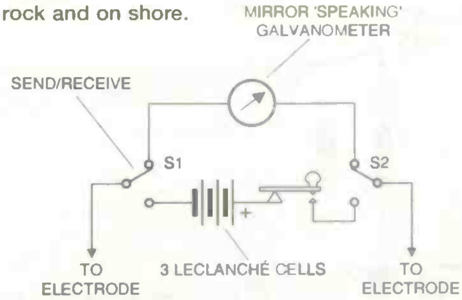


Figure 10: the Needles telegraphy equipment. The same type of equipment was used on the rock and on shore.

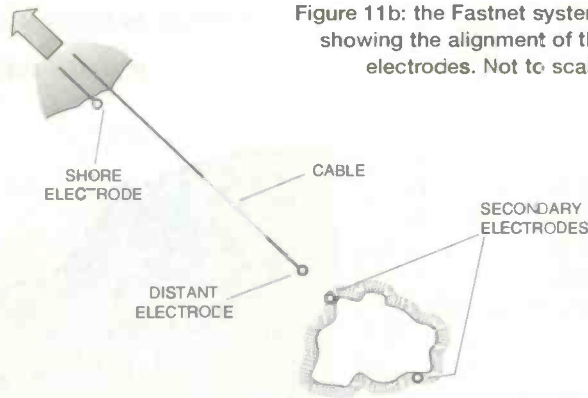


Figure 11b: the Fastnet system, showing the alignment of the electrodes. Not to scale.

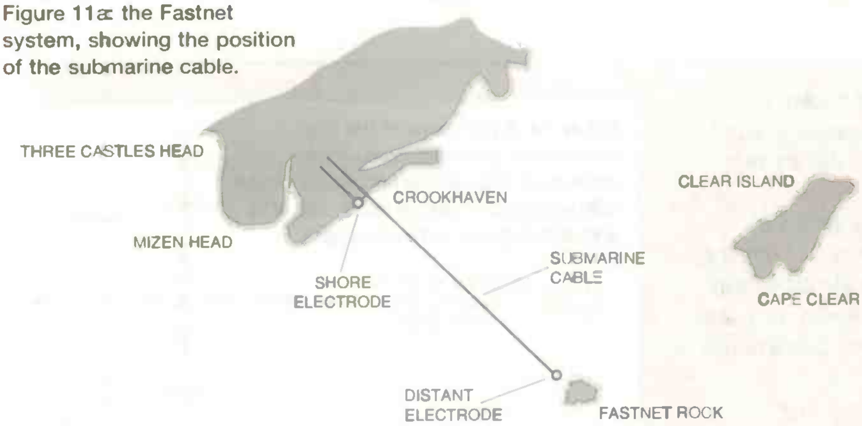


Figure 11a: the Fastnet system, showing the position of the submarine cable.

end was extended from the bow of the dinghy. During measurements, the dinghy was manoeuvred so that the plum-bob was directly over the bottle marking the position of the primary electrode.

When the distance separating the primary and secondary electrodes was 1.5m, the meter registered 130 to 150 microamps as the dinghy swung around the primary electrode (figure 14). However, the current fell rapidly as the dinghy was incrementally moved away from the primary electrode and was negligible at 10 metres.

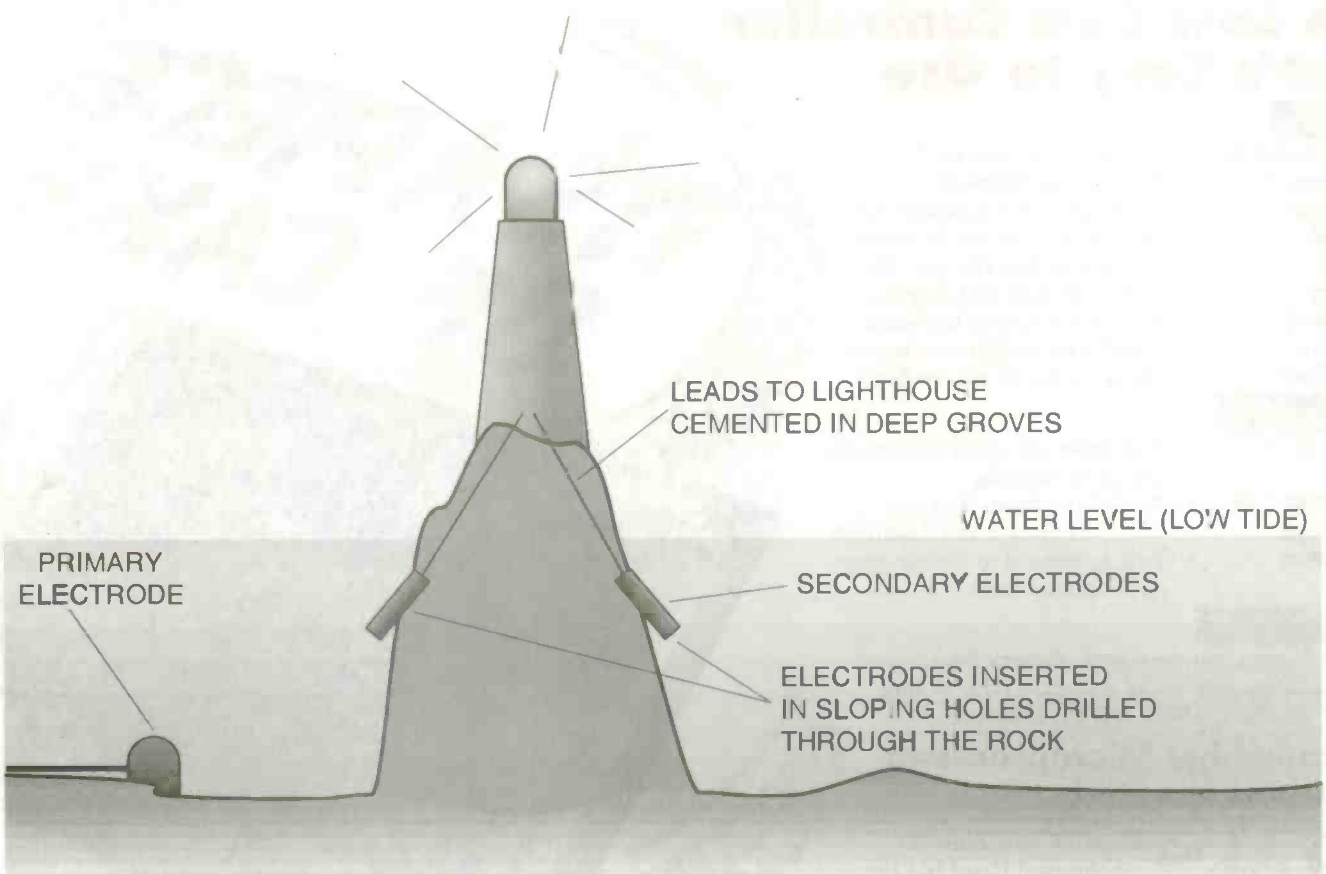


Figure 12: A sketch of Fastnet, showing how the electrodes were attached to the rock.

High resistance

Because the meter had a fairly high resistance it behaved as a voltmeter and therefore indicated a potential across the secondary electrodes.

A high resistance valve-voltmeter would have been more appropriate, but I used the microammeter to simulate a galvanometer.

Similar results were obtained when the secondary circuit was energised and the meter connected to the lake-side end of the primary circuit; this demonstrated that the system could be used for two way communication.

The meter reading fell dramatically when a length of galvanised iron wire, to simulate the effect of iron sheathing of a submarine cable, was laid alongside the insulated wire leading to the distant electrode; this substantiated my belief that the cable's sheathing would either have to be removed or be insulated from the water.

I wish to record my thanks to the proprietors of the Mill Marina, Thrapston, Northants, for allowing me to conduct these experiments on their lake.

Figure 13: Willoughby Smith's lake experiment reproduced by the author.

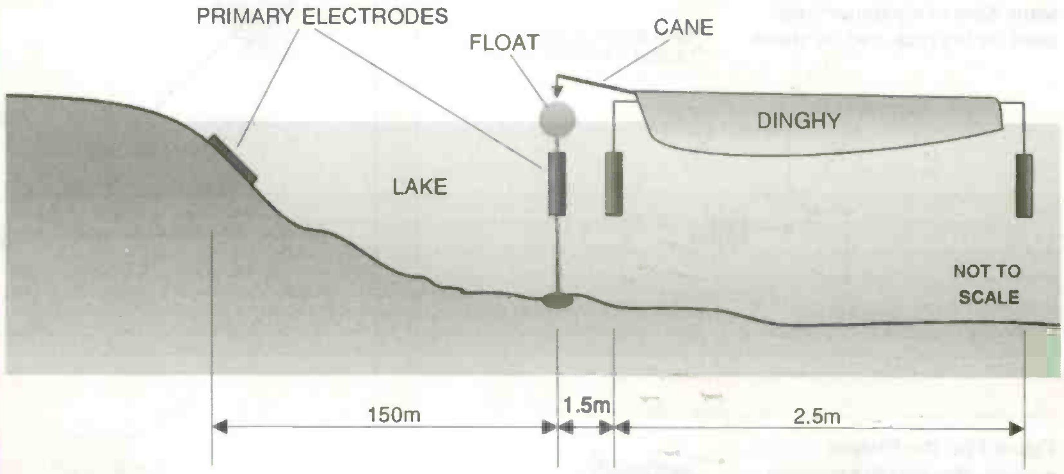
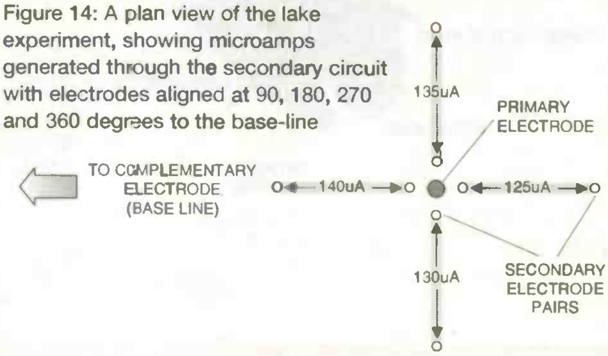
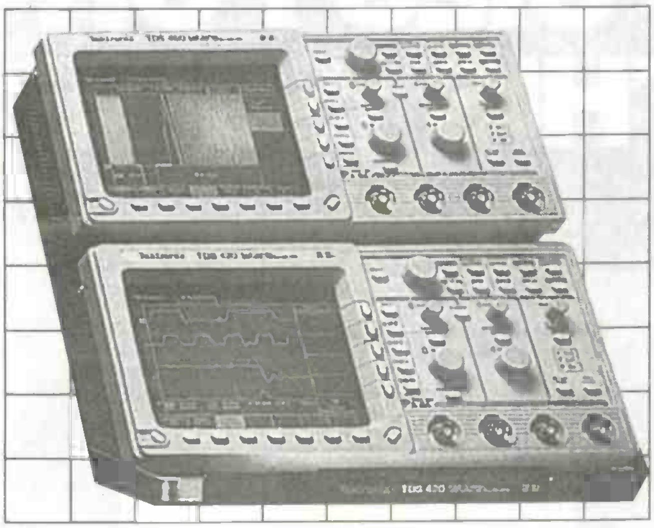


Figure 14: A plan view of the lake experiment, showing microamps generated through the secondary circuit with electrodes aligned at 90, 180, 270 and 360 degrees to the base-line



SUPPLIER OF QUALITY USED TEST INSTRUMENTS

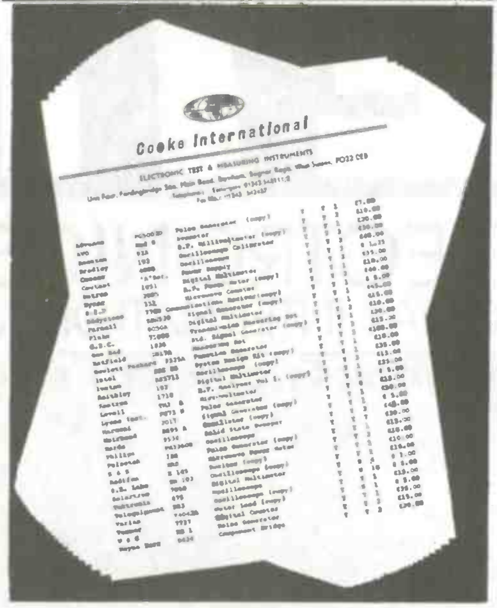


CONTACT

Cooke International

ELECTRONIC TEST & MEASURING INSTRUMENTS
Unit Four, Fordingbridge Site, Main Road, Barnham,
Bognor Regis, West Sussex, PO22 OEB U.K.
Tel: (+44)01243 545111/2 Fax: (+44)01243 542457
CATALOGUE AVAILABLE

OPERATING & SERVICE MANUALS



CONTACT

Cooke International

ELECTRONIC TEST & MEASURING INSTRUMENTS
Unit Four, Fordingbridge Site, Main Road, Barnham,
Bognor Regis, West Sussex, PO22 OEB U.K.
Tel: (+44)01243 545111/2 Fax: (+44)01243 542457
CATALOGUE AVAILABLE

KEENE ELECTRONICS

Quality Video Products

Universal RF modulator

Allows easy connection of any camcorder to a TV via the standard RF (aerial) socket. It can also be used with video processors or computers that have a suitable AV output.
Specification: Output level 74dBuV; Video modulation AM; Power supply 4–19V DC @ 25mA.
***Camcorder User* 'Gold Award' June 1996**

£29.99

viewneg video signal inverter

Viewneg For inverting video signals from camcorder or VCR. Complete with mains power adaptor £49.99
With **viewneg**, your camcorder and a slide to video copier... view photographic negatives direct on TV as video positives. It's a great way to show your photos. Record them on tape, too, for use later!
Viewneg kit 1 Buy this if you want to view negatives and you've already got a slide-to-video copier. Comprises Viewneg, mains power adaptor, negative strip carrier, blue colour correction gel and lead £69.99
Viewneg kit 2 For starting from scratch. Comprises Viewneg kit 1 as above, plus slide-to video copier. £114.99
Also available from JESSOP, TECNO and other leading video stores

Check out our Web site
http://www.keene.co.uk
for new products, special offers & more

- VIDEO PROCESSORS
- CABLES AND ADAPTORS
- TRIPODS AND BRACKETS
- LENSES AND FILTERS
- BATTERIES
- CHARGERS/DISCHARGERS
- VIDEO EDITORS
- LIGHTS
- SOUND MIXERS

Just some of the products from our free catalogue. Write or phone for your copy now.

KEENE ELECTRONICS

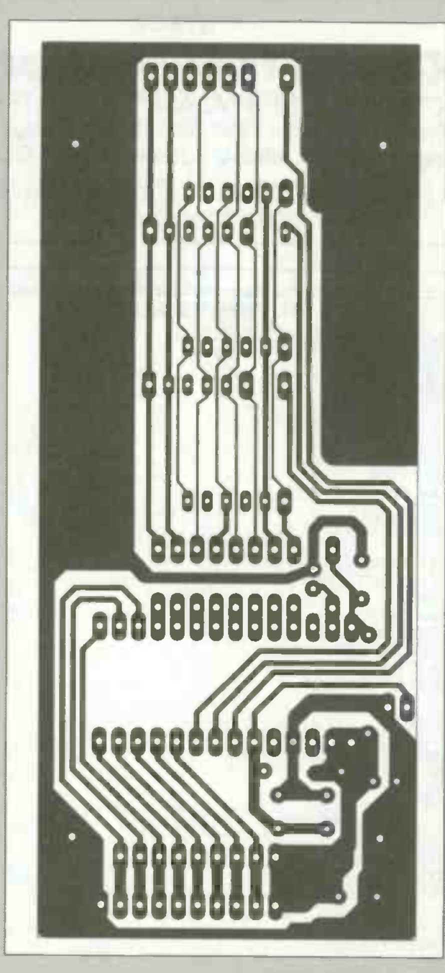
Tel 01332 830550
Fax 01332 830551
Unit 9 Old Hall Mills Business Park, Little Eaton, Derbyshire DE21 5DN

ADVERTISERS INDEX

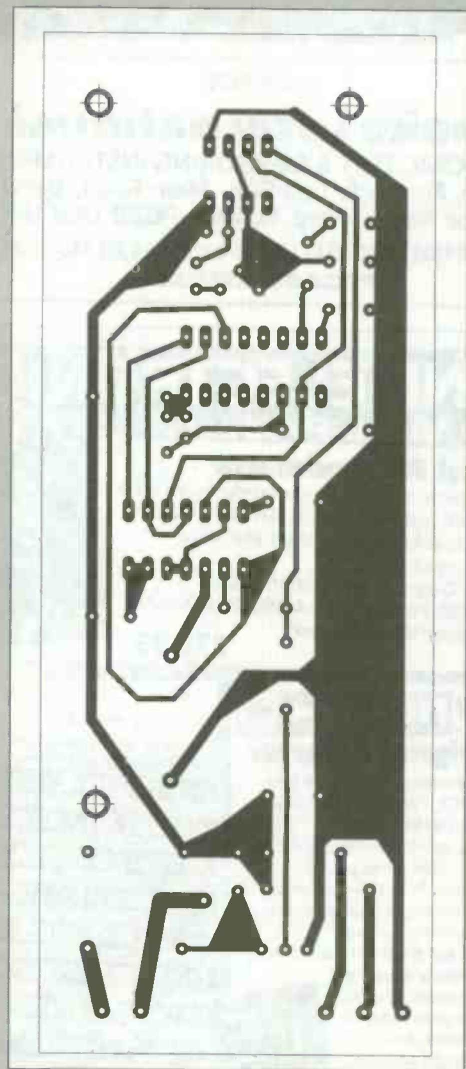
ELECTRONICS TODAY INTERNATIONAL

TOMORROW'S TECHNOLOGY TODAY

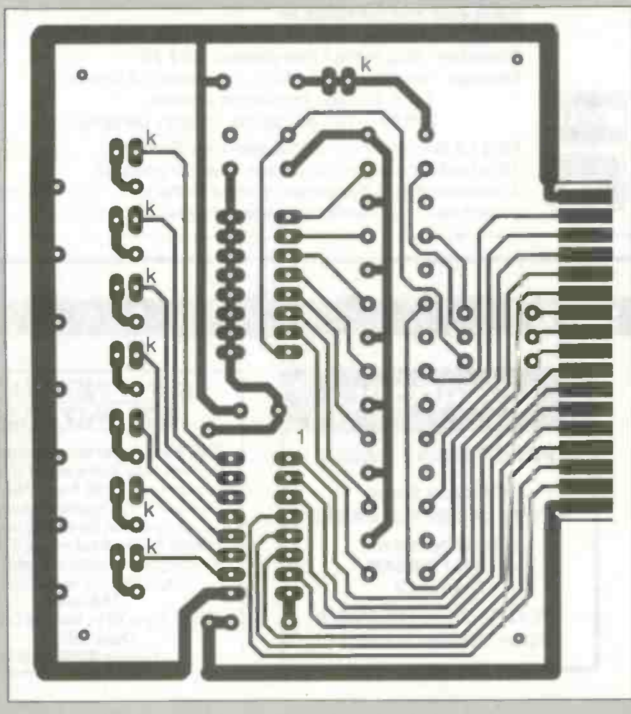
FOILS FOR THIS ISSUE



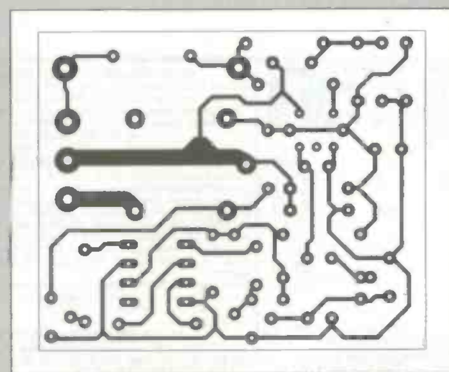
DATA BUS MONITOR



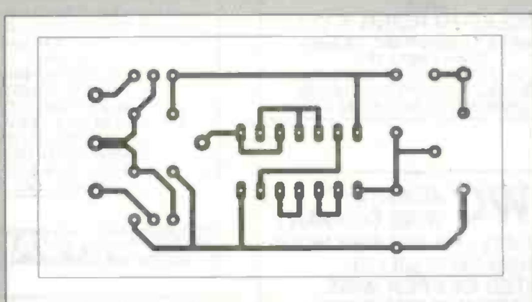
OFF YOU GO!



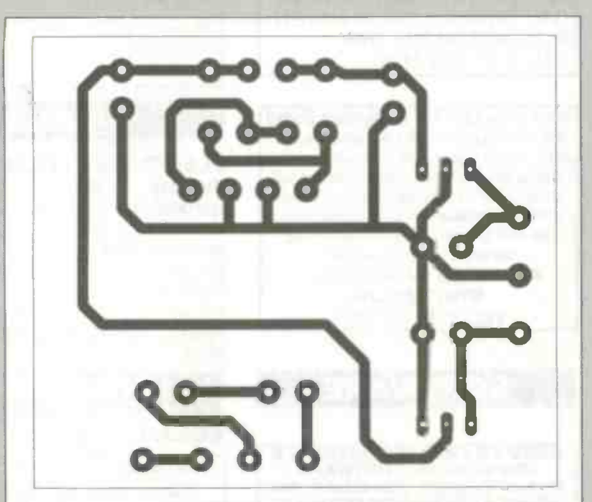
SOFTWARE DEVELOPMENT BOARD
(PT/C PT. 3)



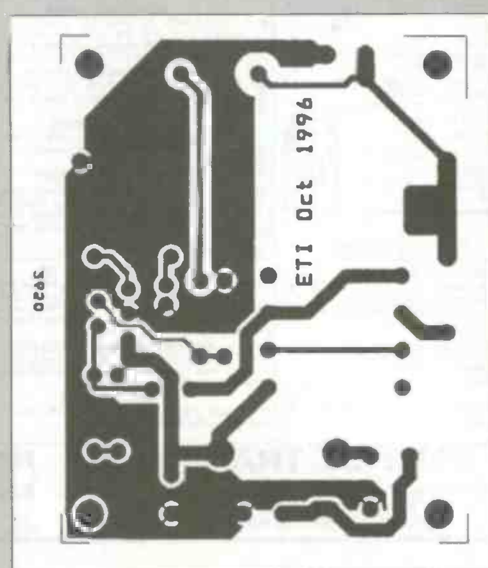
POWERLINE SIGNAL GENERATOR



SQUARER (1)



SQUARER (2)



CAMPLIGHT

ETI Classified

Andy Forder
01442 66551

Send your requirements to:
ETI Classified Department, Nexus, Nexus House, Boundary Way, Hemel Hempstead, HP2 7ST
Lineage: 75p per word (+ VAT) (minimum 15 words)
Semi display: (minimum 2.5cms)
£10.50 + VAT per single column centimetre

VISA — Access

Ring for information on series bookings/discounts.
All advertisements in this section must be pre-paid.
Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request).

FOR SALE

VARIABLE VOLTAGE TRANSFORMERS

INPUT 220/240V AC 50/60
OUTPUT 0-260V

	Price	P&P
0.5KVA 2.5 amp max	£31.90	£6.00
	(£44.53 inc VAT)	
1KVA 5 amp max	£41.15	£7.00
	(£56.58 inc VAT)	
2KVA 10 amp max	£59.40	£8.50
	(£79.78 inc VAT)	
3KVA 15 amp max	£78.65	£8.50
	(£102.40 inc VAT)	
5KVA 25 amp max	£139.15	
	(Plus Carriage)	

Buy direct from the Importers. Keenest prices in the country
COMPREHENSIVE RANGE OF TRANSFORMERS-LT-ISOLATION & AUTO
(110-240V Auto transfer either cased with American socket and mains lead of open frame type. Available for immediate delivery.

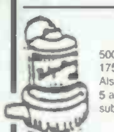
WIDE RANGE OF XENON FLASHTUBES
Write/Phone your enquires

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft 40 watt £14.00 (callers only)	(£16.45 inc VAT)
2ft 20 watt £9.00 (callers only)	(£10.58 inc VAT)
12in 8 watt £4.80 + 75p p&p	(£6.52 inc VAT
9in 8 watt £3.96 + 50p p&p	(£5.24 inc VAT)
6in 4 watt £3.96 + 50p p&p	(£5.24 inc VAT)

230V AC BALLAST KIT
For either 6in, 9in or 12in tubes £6.05 + £1.40 p&p (£8.75 inc VAT)
The above Tubes are suitable for Forged Bank Note detection, security marking etc.
Other Wave Lengths of U.V. TUBE available please telephone your enquires.

400 WATT UV LAMP
Only £38.00 + £4.00 p&p (£49.35 inc VAT)
160 WATT SELF BALLASTED BLACK LIGHT MERCURY BULB
Available with BC or ES fitting. Price inc VAT & p&p and VAT £25.55



12V D.C. BILGE PUMPS
500 GPH 15ft head 3 amp £19.98
1750 GPH 15ft head 9 amp £34.55
Also now available 24V D.C. 1750 GPH 15ft head 5 amp £35.55. All designed to be used submerged. PRICES INCLUDE P&P & VAT

SUPER HY-LIGHT STROBE KIT
Desiged for Disco, Theatrical uses etc.
Approx 16 joules. Adjustable speed £50.00 + £3.00 p&p (62.28 inc VAT)
Case and reflector £24.00 + £3.00 p&p (£31.73 inc VAT)
SAE for further details including Hy-Light and Industrial Strobe Kits.

5KVA ISOLATION TRANSFORMER
As New Ex-equipment fully shrouded Line Noise Suppression, Ultra Isolation Transformer with terminal covers and Knock-out cable entries. Primary 120/240V Secondary 120/240V 50/60 Hz. .005 pF Capacitance. Size L.37 x W.19 x H.16cm Weight 42 Kilos. PRICE £120.00 +VAT ex-warehouse. Carriage on request.

"BOFFINS SPECIAL"- UNIQUE OFFER
Surplus Precision Medical Unit, internally in excellent condition. Designed primarily to eject a precise controllable amount of fluid from a medical syringe (latter not supplied). Contains the following removable components. Dual Micro Processor Boards and EPROMS Escap Precision 12V DC Motor with 300:1 Gear Box and optical encoder coupled to a precision threaded drive mechanism. Mains supply with 6 x 1.5V Ni-Cad A.A. cells back-up. L.C.D. Digital read-out 17mm high with legends. Audible warning.
These are sold for the dismantling of the exceptional quality components, regret no Circuits available
Ridiculously low price: £20.00 + £4.00 p&p
(£28.20 incl VAT)

24V DC SIEMENS CONTACTOR
Type 3TH8022 DB 2 x NO and 2 x NC 230V AC 10A contacts Screw or Din Rail fixing. Size H 120 x W 45 x 0.75mm. Brand New Price £7.63 incl. P&P and VAT.

240V AC WESTOOL SOLENIODS
TT2 Mod 1 flat. 1 MAx stroke 1/4 in. Base mounting 1/2in. stroke 5lbs pull approx. TT6 Mod 1 Rat. 2 Max stroke 1/8 in. Front mounting 1/2in. Front mounting 1/2 in. stroke 15lbs pull approx. Price incl. p&p & VAT. TT2 £5.88, TT6 £8.81. SERIES 400 £7.64.

AXIAL COOLING FAN
230V AC 120mm square x 38mm 3 blade 10 watt Low Noise fan. Price £7.29 incl. P&P and VAT. Other voltages and sizes available from stock. Please telephone your enquiries.

INSTRUMENT CASE
Brand new Manuf. by Imhof L31 x H18 x 19cm deep. Removeable front and rear panel for easy assembly of components. Grey finish complete with case feet.
PRICE £16.45 INCL. P&P &VAT 2 off £28.20 Inclusive.

SEWING MACHINE MOTOR
Brand new 220/240v AC/DC SEW-TRIC 2 lead Brush Motor. Size L. 100mm x H. 70mm x W 55mm, Spindle. 1/4in. dia x 1in. long. £14.10 Incl. P&P & VAT

GEARED MOTORS
71 RPM 20lb inch torque reversable 115V AC input including capacitor and transformer for 240V AC operation.
Price inc VAT & p&p £27.73

SOLID STATE EHT UNIT
Input 230/240V AC, Output approx 15KV. Producing 0mm spark. Built-in 10 sec timer. Easily modified for 20sec, 30 sec to continuous. Designed for boiler ignition. Dozens of uses in the field of physics and electronics, eg supplying neon or argon tubes etc. Price less case
£8.50 + £2.40 p&p (£12.81 inc VAT) NMS

EPROM ERASURE KIT
Build your own EPROM ERASURE for a fraction of the price of a made-up unit kit of parts less case includes 12in 8 watt 2537 Angst Tube Ballast unit, pair of bi-pin leads, neon indicator, on/off switch, safety microswitch and circuit £15.00 + £2.00 p&p (£19.98 inc VAT)

WASHING MACHINE WATER PUMP
Brand new 240V AC, fan cooled. Can be used for a variety of purposes. Inlet 1½in. outlet 1 in. dia. Price includes p&p & VAT. £11.20 each or 2 for £20.50 inclusive.

MICROSWITCH
Pye 15 amp changeover lever microswitch, type S171. Brand new price 5 for £7.05 inc VAT & p&p

SERVICE TRADING CO
57 BRIDGMAN ROAD, CHISWICK, LONDON W4 5BB
FAX 0181-995 0549 0181-995 1560
ACCOUNT CUSTOMERS MIN, ORDER £10
Showroom open Monday/Friday
Ample Parking Space

LIVERPOOL

PROGRESSIVE RADIO
87/93 Dale Street
Tel: 0151 236 0982 0151 236 0154
47 Whitechapel
Tel: 0151 236 5489
Liverpool 2
'THE ELECTRONICS SPECIALISTS'
Open: Tues-Sat 9.30-5.30

£50 BT INSTRUMENT FOR ONLY £7.50

We refer to the BT insulation tester and multi-meter with which you can read insulation directly in megohms, AC volts up to 230, 4 ranges of DC volts up to 500, 3 ranges of milliamps and one 5A range and 3 ranges of resistance. These are in perfect condition, have had very little use, if any, tested and fully guaranteed. Complete with leads and prods £7.50, Order Ref 7.5P4. Carrying case which will take small tools as well, £2 extra. Postage £3 unless your order is £25 and over.
J & N Factors
Dept ETI, Pilgrim Works, Stairbridge Lane, Bolney, Sussex, RH17 5PA
Telephone: (01444) 881965

TURN YOUR SURPLUS TRANSISTORS, ICS ETC INTO CASH immediate settlement.
We also welcome the opportunity to quote for complete factory clearance
Contact:
COLES-HARDING & CO
Unit 58, Queens Road, Wisbech, Cambs PE13 7PQ
BUYERS OF SURPLUS INVENTORY ESTABLISHED OVER 20 YEARS
Tel: 01945 584188 Fax: 01945 475216

LEN COOKE ENTERPRISES
For the best value in Used Electronic Test Instruments
We buy, sell and service oscilloscopes, signal generators, frequency counters, spectrum Analysers, Power meters, logic testers, etc. Spare parts available for most Textronic scopes.
Tel: 0181-813-9946
Fax: 0181-574-2339
Mobile: 0802 177752
Mail order address: Unit 5, Southall Enterprise Centre, Bridge Road, Southall, Middx. UB2 4AI
We engineer what we buy, we support what we sell.

SWC SCIENTIFIC WIRE COMPANY
ENAMELLED COPPER WIRE TINNED WIRE SILVER PLATED COPPER WIRE SOLDER EUREKA WIRE NICKEL CHROME WIRE BRASS WIRE LI TZ WIRE BIFILAR WIRE MANGANIN WIRE TEFZEL WIRE NICKEL
SAE BRINGS LIST 18 RAVEN RD LONDON E18 1HW
FAX 0181 559 1114

SOFTWARE

ASTRA *Desk Top Accounting*™
Overture - Invoicing, Sales, Purchases, Nominal, VAT, etc
Premier - plus Stock, Jobs, EPOS, Barcodes, Serial No, etc
Professional - plus Multi-Currency/Depts/Location, etc
S&S Systems Ltd, Bretton Court, Manor Road, Wales Sheffield, S31 8PD, UK. (Software distributors and Apple dealers)
Tel: (01909) 773399 • Fax: (01909) 773645

How to build a PCI Expansion Board
3.5 inch Disc contains dimensions, pin outs, signal descriptions, information on cheap programmable logics and a full description of a simple prototype with circuit diagrams, FPGA programming list and C++ and assembler driving software. £20 inc of VAT
ADVANCED MANAGEMENT SYSTEMS LTD
TEL: 0181-689-3434

PLANS

ELECTRONIC PLANS, laser designs, solar and wind generators, high voltage teslas, surveillance devices, pyrotechnics and com-puter graphics tablet. 150 projects. For catalogue, SAE to Plancentre Publications, Unit 7, Old Wharf Industrial Estate, Dymock Road, Ledbury, Herefordshire, HR8 2HS.

COURSES

RADIO + TELECOMMUNICATIONS CORRESPONDENCE SCHOOL
12 MOOR VIEW DRIVE, TEIGNMOUTH, DEVON, TQ14 9UN
START training *NOW* with the *SPECIALISTS* for the following courses, Radio Amateur Licence C+G, Micro Processor, Telecomms, Tech C+G and Introduction to Television.
For our *FREE* Brochures Call *01626 779398*

SOFTWARE

HARD TO FIND SPECIALISED & UNUSUAL PC SOFTWARE
We have the largest range of specialised technical & scientific & rare programs for DOS & Windows in Europe, on CD ROM or Floppy disk.
1000s of programs in 250+ categories including Electronics, Radio, Audio, Math, Chemistry, Music, Education, Engineering, etc. Send Stamped SAE for Free printed catalogue of 4000+ items.
PDSL Dept ETI, Winscombe House, Beacon Rd, Crowborough, Sussex TN6 1UL.
Tel 01892 663298 Fax 01892 667473

PIC-MICRO CONTROLOLER

STAND ALONE PIC->PIC COPIERS AND BUSTERS.
Copy/Deprotect PIC Smart Cards (D2mac, adult etc) with the MAC2MAC copier. NO PC REQ. £69 PIC2PIC Copier (84, 67, 71) NO PC REQ. £67 Multi PIC programmer (16cxx) £37
MCJ DESIGN
Tel: 01202 770121
Fax: 01202 770121
E-MAIL:MCJDESIGN@AOL.COM

ETI

ELECTRONICS TODAY INTERNATIONAL, CLASSIFIED ADVERTISEMENT DEPARTMENT, NEXUS HOUSE, BOUNDARY WAY, HEMEL HEMPSTEAD HP2 7ST.

Rates: Linage 75p per word + VAT minimum 15 words.
Semi-display £10.50 per single column cm plus VAT. No reimbursements for cancellations.
All ads must be pre-paid.

Name ....

Address ....

.... Daytime Tel. No: ....

....

Signature .... Date ....

PLEASE DEBIT MY ACCESS/BARCLAYCARD No. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Expiry Date ....

FOR SALE COMPONENTS PLANS OTHER – PLEASE STATE

Around the Corner

There is a growing disparity between what the electronics hobbyist can do and what the professional can manage. There is always some difference between facilities available to professionals and amateurs in any field, but in electronics in recent years it has been growing faster than most.

Of course, I can still wire a few components together to make a simple, useful circuit - a simple preamplifier, for example, for my sound card so that I don't have to get so close to the microphone to generate voicemail. This is a minimalist project, but not something you can buy easily or cheaply, and the ability to assemble it rapidly as needed is a great advantage.

But - look at it from another angle: how many amateur projects use surface mount components? The few which do normally use only the largest resistors and capacitors (1206), while in industry, a straw poll shows that half to three quarters of pcbs now use smds (surface mount devices) and that 0805 components are beginning to give way to 0603 (which are 1.6mm by 0.8mm).

The designations refer to the size in inches - 0805 is 0.08 in by 0.05 in. I find 0603 difficult but far from impossible to use for prototypes - but these prototypes are on a hot air levelled pcb with solder resist. But I suspect that 0402 may prove a stumbling block, while 0201, which is already a reality in Japan, will only ever be machine assembled.

There are compensations, though. For instance, PIC programming is now well within the reach of amateurs. It has reached a stage when anything that need not run too fast, and uses more than a few standard logic devices, can be done conveniently in a PIC. Board size is reduced, and revisions do not normally need cut tracks and wire links, but just a few code changes. Perhaps PALs (programmable array logic) and even MACHs (an array of four PALs with extra I/O) will soon be accessible to amateurs as well.

But to return to traditional components: even these can present problems. I could only find the magnetic components for this month's cover project with Farnell Electronic Services, who have a minimum order of £25. Even small production runs face problems because, unless a distributor carries an item as permanent stock, you can get hold of two samples from Japan in three weeks, or multiples of 20,000 on order, but nothing in between. Even for a pot-core-half costing 20p in quantity this is a snag.

Luckily a supplier was found for the transformer core, and if you look far enough there is often a source for a suitable component, although it is quite frequently not the one you would, ideally, have preferred.

The Challenge - things that electronics hasn't fixed yet

"Despite everything that loudspeaker developers have done" says our Hifi enthusiast "We still do not have Hifi that delivers the same sound to the ear that we hear in the concert hall or jazz club, even allowing for atmosphere." Are we still trying to find the most pleasing failed approach to true hifi? What in your opinion is the best we can do, and what do you expect it to deliver?

Send your suggestions to the Editor at the address on the right.

Next Month

In the November 1996 issue of Electronics Today International we continue Tim Parker's Process Timer and Controller. Terry Balbirnie's sound-effects circuit imitates the sound of a telephone ringing, and can be put to a number of uses from drama to discouraging intruders. If you are suffering from a noisy neighbourhood, Robert Penfold has developed a variable-effect background sound generator to help fade traffic noises and so on into the background. We have the second and final part of Bart Trepak's mains signal controller.

We are working on a bench PSU specially designed for valve equipment, and a PIC-controlled data logger. We have some news about software for electronics students and designers, and Douglas Clarkeson continues his series on alternative energy source with Fuel Cells, another underexploited area which is gaining pace.

ETI
ELECTRONICS TODAY INTERNATIONAL

EDITORIAL
Editor **Helen Armstrong**
Sub Editor **Eamonn Percival**
Editorial Assistant **Lynn Bugden**
Consultant **Andrew Armstrong**

CREATIVE
Designer **Andrew Pollard**
Technical Illustration **John Puczynski**
Photography **Gary Sinfield**

ADVERTISEMENT SALES
Advertisement Manager
Andrew Forder
Advertisement Copy Control
Marie Quilter

MANAGEMENT
Divisional Director
John Bridges
Production Manager
Mike Burns
Production Administrator
Theresa Davis
Business Manager
Claire Jenkinson
Marketing Manager
Jason Doran
Copy Sales Manager
David Pagendam

ABC CONSUMER PRESS
ISSN 0142-7229

Subscription rates-UK £25.80 Europe £34.70 Sterling Overseas £36.20 US Dollars Overseas $54.00

Published by Nexus Special Interests, Nexus House, Boundary Way, Hemel Hempstead HP2 7ST. Telephone (01442) 66551. UK newstrade distribution by Comag Magazine Marketing, Tavistock Road, West Drayton, Middlesex, UB77QE. Overseas and non-newstrade sales by Magazine Sales Department, Nexus House, Boundary Way, Hemel Hempstead, HP2 7ST. Telephone (01442) 66551. Facsimile (01442) 66998. Subscriptions by Nexus Subscription Dept, Tower House, Sovereign Park, Lathkill Street, Market Harborough, Leicestershire, LE 16 9EF.
US subscriptions by Wise Owl Worldwide Publications, 4314 West 238th Street, Torrance, CA90505 USA. For Visa/Mastercard orders in USA - Telephone (310) 375 6258 Fax (310) 375 0548. Pacific Time: 9am-9pm Weekdays. 10am-6pm Weekends. Typesetting and origination by Ebony, Liskeard, Cornwall. Printed by Wiltshire Ltd. Bristol.

Nexus House, Boundary Way,
Hemel Hempstead HP2 7ST
Telephone (01442) 66551
Fax (01442) 66998

Get the best
Universal Diagnostic
tool kit on the market
SOFTWARE & HARDWARE THAT REALLY WORKS!
Micro-Scope 6.1
UNIVERSAL DIAGNOSTIC SOFTWARE
Fully O/S independent diagnostic software
Post-Probe
First Ever Universal P.O.S.T. Card for All PCs!
Use this Power-On-Self-test card to debug any "dead" PC that won't boot
Windows 95 COMPATIBLE
Our servicing turnaround time has been reduced by an average of 32%. Of all the diagnostic packages tried this is the first to live up to its advertising.
Solsoft SW.
We have been using Microscope and Postprobe for two months with great success. It really is as good as you have said in your publicity.
Cardiff Wales Airport.
I have spoken to our engineers about the Micro 2000 software/hardware package and received favourable reports. They say the best advantage Micro 2000 has over other packages is the fact that it is operating system independent.
Digital.
To be truthful we at Catalyst use Microscope on every machine when it "walks" in or out of the door of the office.
Catalyst Computer Systems.
Micro-Scope BURN-IN™
A proven way to increase quality control
Micro-Scope CLIENT™
A must-have Remote Diagnostics Tool
Micro-Scope CENSUS™
Lets you keep track of hundreds or even thousand of computers
UNIVERSAL DIAGNOSTIC TOOLKIT
UNIVERSAL DIAGNOSTICS TOOLKIT
NEW RELEASES
Call about our Tutorial and Troubleshooting Series on video cassettes! A wealth of technical help at your fingertips.
MICRO 2000
United Kingdom
Tel +44 (0)1462 483483
Fax +44 (0)1462 481484
Netherlands & France
Tel +31 (0)20 638 4433
Fax +31 (0)20 620 3437
Germany
Tel +49 (0)69 420 8278
Fax +49 (0)69 420 8270
Spain
Open June/July
Call UK for details.