

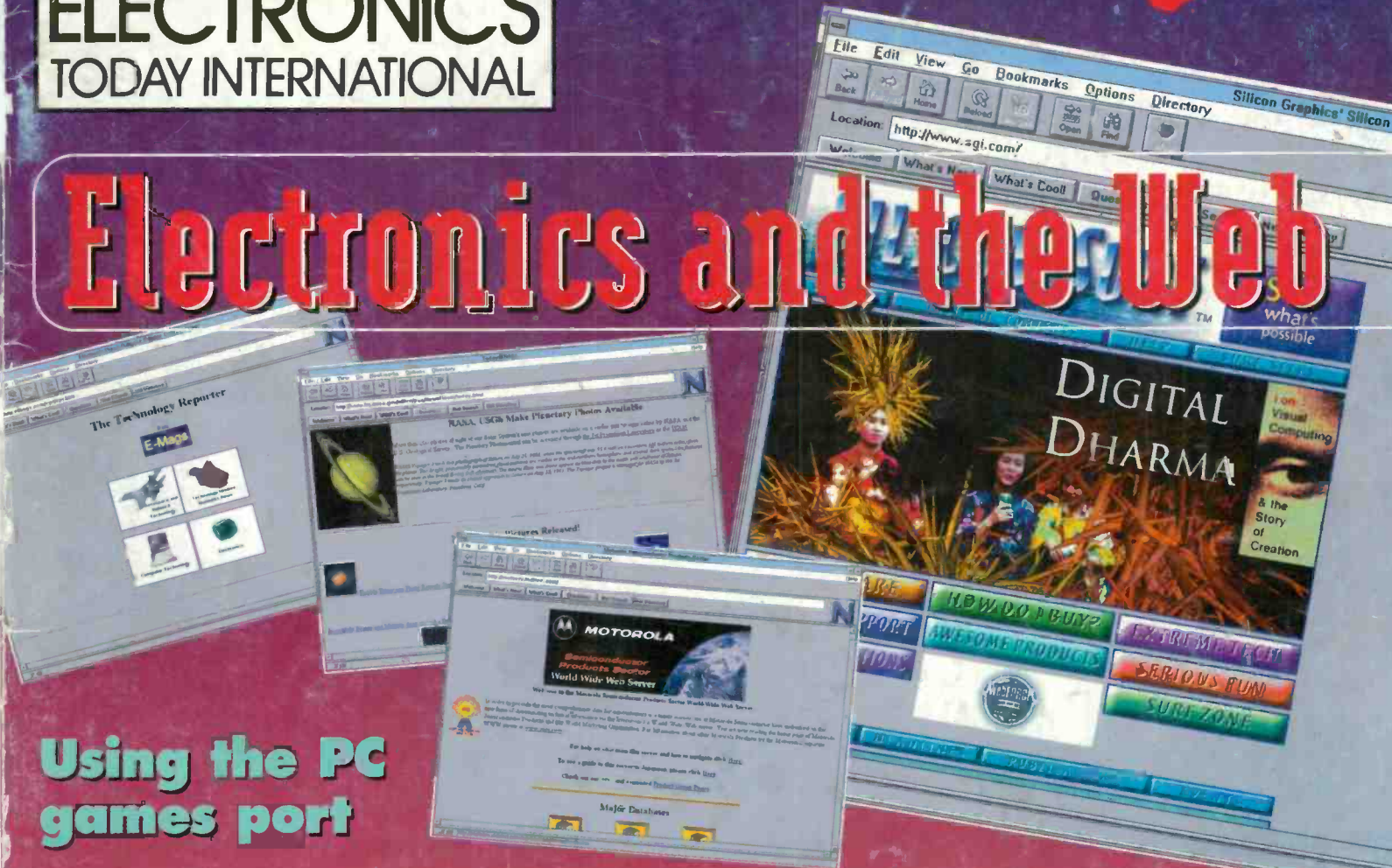
EI
ELECTRONICS
 TODAY INTERNATIONAL

FREE DISK

**Electronics Workbench
 for Windows PC**



Electronics and the Web



**Using the PC
 games port**

An 8031 single board computer

**Moving character
 matrix display**

PLUS

- Restoring antique electronics
- Portable audio mixer
- Rechargeable PSU

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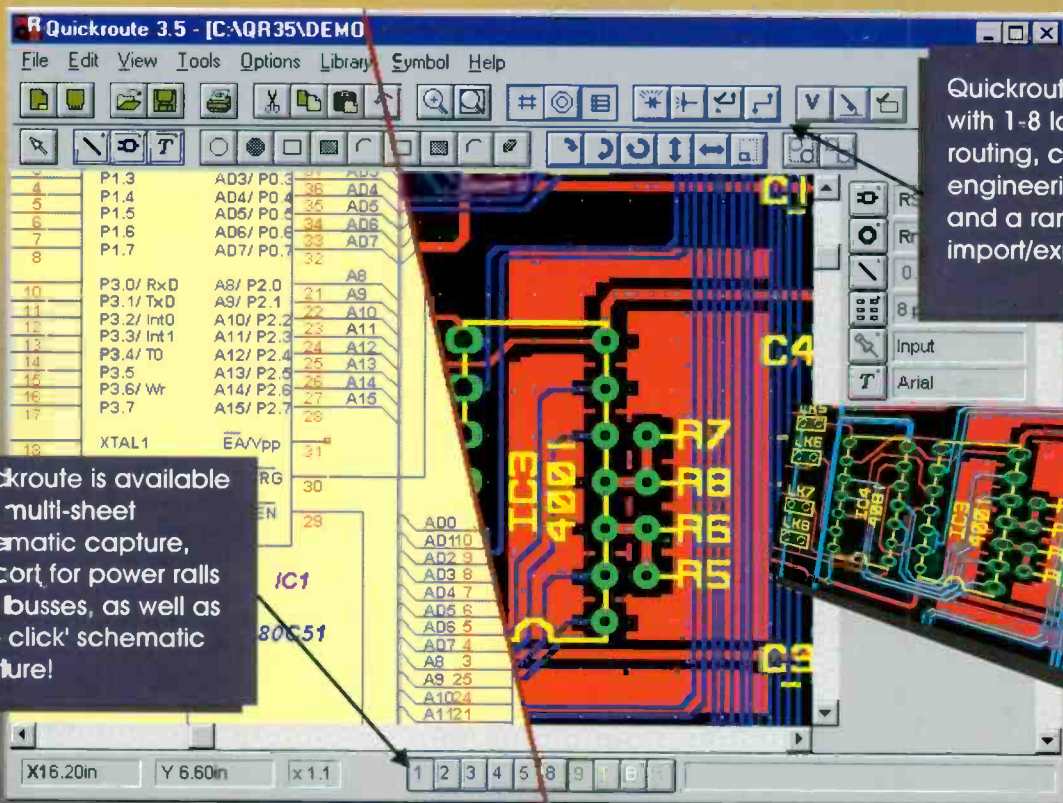
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NEXUS



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Quickroute is available with 1-8 layer auto-routing, copper fill, engineering change, and a range of import/export features.

Quickroute is available with multi-sheet schematic capture, support for power rails and busses, as well as 'one click' schematic capture!

"..a very capable package which will be of interest to many electronic designers, especially because of its low price."

* Review of Quickroute 3.5 PRO+, CAD/CAM March 96

"Ease of use: Accessible to complete novices"*

Quickroute 3.5 is a powerful, affordable and easy to use Integrated schematic & PCB design system for windows. With its multiple button bars, tool tips and parts-bin you will find that Quickroute helps you to work quickly and efficiently.

"Value for money: Very good"*

Whichever version of Quickroute you choose you can be sure of getting value for money! Quickroute is available with multi-sheet schematic capture, 1-8 layer auto-routing, copper fill, engineering change, and a range of popular file import/export features allowing connection to simulators and other software packages. See the table for a selection of features.

Prices are Designer (£149), PRO (£249) and PRO+ (£399). Post and packing is £5 (UK), £8 (Europe), £12 (worldwide). VAT must be added to the total price.

| | Designer | PRO | PRO+ |
|-----------------------------------|----------|-----|------|
| Integrated PCB & Schematic Design | ✓ | ✓ | ✓ |
| Schematic Capture | ✓ | ✓ | ✓ |
| Design Rule Checking (DRC) | ✓ | ✓ | ✓ |
| Multi-sheet schematics | | ✓ | ✓ |
| Export WMF & Tango | | ✓ | ✓ |
| Auto router (1-8 layers) | | ✓ | ✓ |
| Export Gerber/NC-Drill | | ✓ | ✓ |
| Extended Libraries | | ✓ | ✓ |
| Tango + Gerber Import | | ✓ | ✓ |
| Update PCB from schematic | | ✓ | ✓ |
| DXF & SPICE Export | | ✓ | ✓ |
| Copper Fill | | | ✓ |



Tel/Fax 0161 449 7101

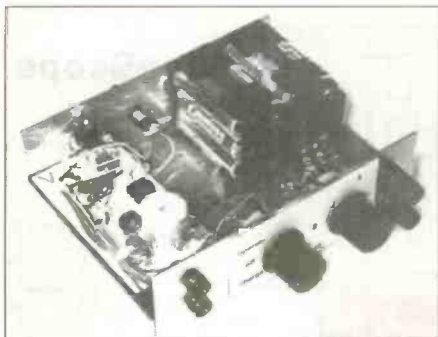


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Phone now for more information

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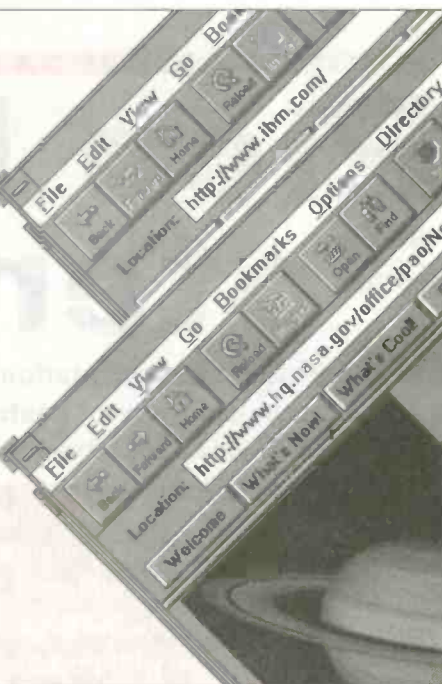
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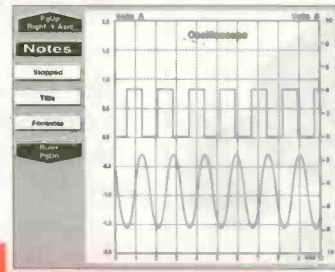
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Pico Releases PC Potential

Pico's Virtual Instrumentation enable you to use your computer as a variety of useful test and measurement instruments or as an advanced data logger.

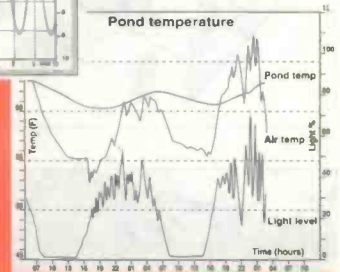


PicoScope
'Virtual instrument' software.

Hardware and software are supplied together as a package - no more worries about incompatibility or complex set-up procedures. Unlike traditional 'plug in' data acquisition cards, they simply plug into the PC's parallel or serial port, making them ideal for use with portable PC's.

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- 8 Thermocouple inputs (B,E,J,K,N,R,S and T types)
- Resolution and accuracy dependant on thermocouple type. For type K the resolution is better than 0.1°C.

TC-08 £ 199

TC-08 + Calibration Certificate £ 224

complete with PicoLog, software drivers and connecting cable. A range of thermocouple probes is available.



SLA-16 & SLA-32 Logic Analysers **Pocket sized 16/32 channel Logic Analysers**

- Connects to PC serial port.
- Up to 50MHz sampling.
- Internal and external clock modes.
- 8K Trace Buffer.

SLA-16 £ 219
SLA-32 £ 349
with software, power supply and cables



ADC-100 Virtual Instrument **Dual Channel 12 bit resolution**

- Digital Storage Scope
- Spectrum Analyser
- Frequency Meter
- Chart Recorder
- Data Logger
- Voltmeter

The ADC-100 offers both a high sampling rate (100kHz) and a high resolution. It is ideal as a general purpose test instrument either in the lab or in the field. Flexible input ranges ($\pm 200\text{mV}$ to $\pm 20\text{V}$) allows the unit to connect directly to a wide variety of signals.

ADC-100 with PicoScope £199
with PicoScope & PicoLog £219

ADC-10 **1 Channel 8 bit**

- Lowest cost in the Pico range
- Up to 22kHz sampling
- 0 -5V input range



The ADC-10 gives your computer a single channel of analog input. Simply plug into the parallel port.

ADC-10 with PicoScope £49
PicoScope & PicoLog £59

Carriage UK free, Overseas £9 Oscilloscope Probes (x1, x10) £10

PICO TECHNOLOGY



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

RADIATION DETECTOR SYSTEM Designed to be wall mounted and connected into a PC, ideal for remote monitoring, whole building coverage etc. Complete with detector, cable and software £19.95 ref BAR75.

WIRELESS VIDEO BUG KIT Transmits video and audio signals from a miniature CCTV camera (included) with its 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 tv 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 CONTROL AND DATA 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 alignment, 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 HIGH POWER RF TRANSMITTERS

AMPLIFIERS Assembled PCB transmitters, 4 types available, 12.6vdc 90 watt 1.5-30mhz 75 ohm in/out FM/AM £75 ref RF1 12.6vdc 40 watt 50-200mhz 50 ohm in/out FM/AM £65 ref RF2 28vdc 125 watt 1.5-30mhz 75 ohm in/out FM/AM £85 ref RF3 28vdc 100 watt 50-200mhz 50 ohm in/out FM/AM £75 ref RF4 A heat sink will be required, ring for price and availability. If you intend using these as audio transmitters you will need a also need a preamp. Complex modale available at £40 ref RF5.

COMPUTER/WORKSHOP/HIFI/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. £9 each Ref MM5.

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. Two channel proportional (plug in crystals etc) £35 ref LOT3.

THOUSANDS AVAILABLE RING/FAK 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 electronics 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 perse 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 coin slot mechanism, adjustable time delay, relay output, put a coin slot on anything you like TV's, videos, fridges, drinks cupboards, HIFI, 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 lam, group viewing screen, lots of accessories. £29 ref ANAYLT.

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

PLASMA SCREENS 22x310mm, 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

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

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

Anything from videos & caravans, provides a years protection from a 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 cleaning 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 £8.99 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 word processor, report writing, windowing, networkable up to 10 stations, multiple cash books etc. 200 page comprehensive manual. 90 days free technical support (0345-326009 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 top lead, 1.5m input lead, UK made, 220v. 3A SALE PRICE £4.99 REF EP7



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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.

4.6mm 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 60 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

RUSSIAN MONOCULARS Amazing 20 times magnification, coated lenses, carrying case and shoulder strap £29.95 REF BAR73

PC PAL VGA TO TV CONVERTER Converts a colour TV into a basic VGA screen. Complete with built in psu, lead and sware. 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 MAC4P11.

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 2 watt. £8.99 REF SA25.

ECLATRON FLASH TUBE As used in police car flashing lights etc, full spec supplied, 60-100 flashes a min. £6.99 REF SA15B.

*SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

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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

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RGB/CGA/EGA/TTL COLOUR MONITORS 12" in good condition. Back anodised metal case. SALE PRICE £48 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 PCs over a long distance utilizing the serial ports. Complete kit £8.99. Ref comp 1.

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

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

PLUG IN POWER SUPPLY SALE FROM £1.60 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 £15 REF: MAG15 12v psu is £5 extra REF: MAG5P2

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

***FM TRANSMITTER KIT** housed in a standard working 13A adaptor! 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 COIN SLOT 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 MAG13P1

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 R77.

RATTLE BACKS Interesting things these, small piece of solid perspex like material that if you try to spin it on the desk it only spins one way! In fact if you spin it the 'wrong' way it stops of its own accord and goes back the other way! £1.99 ref GI/J01.

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 OK/604.

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.

SANYO NICAD PACKS 120mmx14mm 4.8v 270 mAh suitable for cordless phones etc. Pack of 2 just £5 ref EP78.

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

STEREO MICROSCOPES 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. Ref 95/300.

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

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

COINSLOTTOCKENS 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! £65/set. Ref F/XP1.

TELEKINETIC ENHANCER PLANS Mystery 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 psychic phenomenon. £45/set Ref F/KE1.

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/HE2.

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 FGRA1.

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. £55/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 Commission of NEGEV in Israel. £10/set Ref F/ICV1.

VOICE SCRAMBLER PLANS Miniature 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. £65/set Ref F/V59.

PULSED TV JOKER PLANS Little hand held device utilizes pulse techniques that will completely disrupt TV picture and sound works on FM too! DISCRETION ADVISED. £85/set Ref F/TVJ5.

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. £85/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. £125/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. £65/set Ref F/ANT1K.

ULTRASONIC BLASTER PLANS Laboratory source of sonic shock waves. Blow holes in metal, produce 'cold' steam, atomize liquids. Many cleaning uses for PC boards, jewellery, coins, small parts etc. £65/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. £65/set Ref F/HGA7.

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

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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. £55/set Ref F/BD1.

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! £55/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. £85/set Ref F/PM5.

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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/76V 10AH BATT/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 2x6V 10AH sealed lead acid batts, pcb's and a 8A? 12v toroidal transformer (mains in). Condition not known, may have one or two broken knobs due to poor storage. £17.50 Ref VP2.

RETRO NIGHT SIGHT Recognition of a standing man at 300m In 1/4 moonlight, hermetically 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 professional 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, 1,200w 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.

LIQUID LEVEL DETECTOR KIT Useful for tanks, ponds, baths, rain alarm, leak detector etc. Will switch 2A mains. £5 Ref 1081.

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. £6 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 control supplied with 12 LEDs (you can fit tracs 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.

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



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

METAL DETECTOR KIT Range 15-20cm, complete with case, 9vdc. £8 Ref 1022.

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

16 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, 9ic 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 configuration is 286, VGA, 4.1, 640k, serial *SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

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HUGE BUBBLE MAKING KIT You'll be amazed at the size of the bubbles you can achieve with this bubble making kit. Once you have got the knack it is possible to make bubbles of up to 40 feet long. £11.99 ref E9.

FM CORDLESS MICROPHONE This unit is an FM broadcasting station in miniature. 3 transistor transmitter with electret condenser mic+fetamp design results 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

STETHOSCOPES A fully functioning stethoscope for all those intricate projects. Enables you to listen to motors, pipes, heartbeats, walls, insects etc. £6 Ref MAR6P6.

NICKEL PLATING KIT Professional 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.

Miniature adjustable timers, 4 pole o/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 FLY TRAP 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 MAG6P13 ideal for experimenters! 30 m for £12.99 Ref MAG13P1

ROCK LIGHTS Unusual things these, two pieces of rock that glow when rubbed together believed 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 R9.

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

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

2.6 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.

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Mitsubishi Launches High Performance Embedded Development Kit

Mitsubishi Electric, in conjunction with IAR Systems, has announced the introduction of the new DK16 embedded development kit for the M37700 family of 1Gbit microcontrollers. The new kit provides C source level debugging and costs £549 plus VAT. It comes complete with development board, IAR's Professional ROM Monitor Debugger and Macro Assembler. It is only available from Mitsubishi and IAR distributors Gothic Crellon and Micromark.

Mitsubishi's already successful DK16 development kit has now been upgraded and personalised to function with the IAR Rom Monitor. The low cost system also includes free technical support for IAR's ROM Monitor and Assembler, together with a discount voucher for IAR's C Compiler for Mitsubishi M37700 microcontrollers. Also included are a 5V power supply, 9-25 way adaptor and full documentation.

IAR's Assembler generates relocatable code and during the design process provides an extensive set of directives which allow total control of the code and data segmentation. Multiple modules are easily created within a file as are macro definitions and variable declarations. The Assembler also includes Xlink, the high speed memory based linker, locator and format generator, to produce 7700 prommable code.

IAR's Assembler is designed to interface fully with the company's 7700 C Compiler and also includes Xlib, the highly efficient and fast library manager.

In operation, IAR's Rom Monitor Debugger can be interfaced to provide source and command windows or alternatively user selectable windows. The source code execution lines are highlighted and break points can be placed directly on the source line. Registers can display all the contents at any point in time and enable alterations to the contents to be carried out using point and modify routines or specific commands.

The Monitor Debugger is designed to operate with IAR's Assembler and C Compiler and therefore enables full debugging of high and low level language. Its memory simulates the

device memory space. Multiple memory windows can be opened simultaneously and again contents alterations can be carried out using point and modify routines or specific commands. A Watchpoint displays the contents of the system variables and globals, locals, structures and arrays are all supported, with specific commands used for modifications.

A unique feature of the Monitor Debugger is the Terminal I/O which enables the monitor screen to act as the system output and the keyboard to act as the system input. The powerful command set contains mouse click or keyboard function key triggers for frequently used commands.

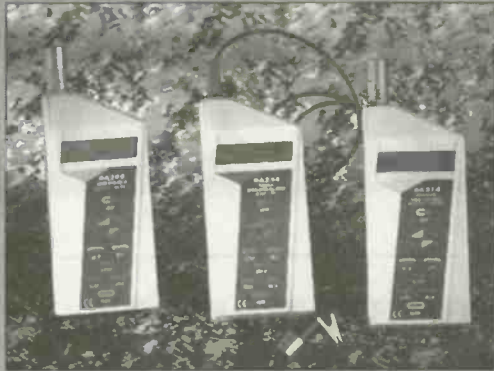
A built-in assembler disassembler is provided with the Monitor Debugger which also features a very high level of functionality to provide full symbolic debugging operations. Breakpoints and Watchpoints can be complex and unlimited. The IAR Linker generates Aubrof Formats providing the debugger with all the necessary information to perform register tracking of all dynamically allocated registers variables.

Notably the breakpoints are totally unlimited, whether they are the result of either complex conditions using macros or alternatively, simple line numbers.

For further information contact Mitsubishi Electric UK Ltd, Semiconductor Division, Hatfield. Tel: 01707-276 100.



Castle Sound Level Meters



Consisting of an Impulse SLM, an Integrating Leq meter and a Dosemeter, the range will enable companies who have been otherwise put off by cost or complexity to comply with the Health & Safety Regulations and meet their obligations to measure noise.

The new Castle Popular range employs the latest electronic technology and is micro-controller based providing powerful operation combined with long battery life. They are built to the demanding IEC 651 Sound Level Meter Standards. Designed to cover three dimensions of industrial noise measurement there are three models, the GA208 for simple, instantaneous SPL and Peak measurements, the GA255 Noise Dosemeter and the GA214 Integrating meter with time weighted averages (Leq) plus much more. Each model features a touch keypad for all major functions and an 8 digit LCD. Their tough, lightweight bodies are small enough to fit in any pocket for maximum portability, a real advantage for industrial users.

They comply with all the requirements of the European Noise at Work Regulations and come with comprehensive instructions and a complimentary book on noise measurement.

For further information contact: Castle Group Ltd, Scarborough. Tel: 01723 584250.

New Hitachi 16-bit microcontrollers

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For further information contact Mitsubishi Electric UK Ltd, Semiconductor Division, Hatfield. Tel: 01707-276 100.



Mitsubishi Fibre Optic Amplifier

Mitsubishi Electric has announced the introduction of the innovative FG-602S-T01 erbium doped fibre amplifier which provides single mode direct amplification for optical fibre signals for 1550nm window applications. The amplifier is optimally designed to provide flat gain particularly over 1535 to 1565nm and features alarm signal monitoring and automatic shutdown when transmissions cease.

Notably, the amplifier will amplify all channels operating in the window and is designed to accommodate simultaneously a high number of channels with very high data rates. The unit can amplify 60Gbits/s in a single pass, making it ideal for amplifying traffic between System X exchanges at large distances apart as well as for local loops in fan-out applications and spur highways.

The advanced amplifier design comprises an erbium doped fibre optic coil to provide the gain, with the optical signals travelling through the amplifying erbium doped fibre, bi-directionally pumped by 1480nm isolated laser diodes. Full temperature control for the pump lasers is electronically controlled within the amplifier housing and fibreoptic couplers combine the pumped signals into the doped optical fibre. The control circuitry generates TTL signals for pump bias and temperature alarms as well as for pump shutdown.

In operation, both input and output optical interfaces provide sufficient isolation to prevent signal reflection back to the system transmitter and to the internal laser oscillators. The amplifier is supplied in a compact, static safe casing measuring 152x122x25mm, with heat sink mounting facilities and interface and monitor connector sockets.

Minimum large signal inputs of +5.5dBm power are amplified by the unit to at least 15dBm. Small signal input power is 30dBm and gain is a minimum 28dBm, with a typical noise figure of 6dB. The erbium doped amplifier operates from maximum supplies of +6V and -6V. Typical

supply operation is from +4.75 - +5.25V at 3A for the positive supply and -5.46 - -4.94 at 3.6A for the negative supply. Operating case temperature is typically 25°C and 60°C maximum, with a storage temperature range of -40 to +70°C.

The optical interface is provided by two Coming MFD clad, single mode 9/125µm fibre optic links with AT&T ST type connectors. The electrical interface is via two 12pin male connectors for power supplies, alarm and disable functions, with a 14pin female connector for monitoring functions.

For further information contact Mitsubishi Electric UK Ltd, Semiconductor Division, Hatfield. Tel: 01707-276 100.



PC-104 for Embedded Control

IMS have expanded their range of PC-104 modules for embedded PC applications. The PC-104 modules offer the benefit of the standard PC-Bus architecture but on a miniature form size, measuring only 3.6" x 3.8" and with exceptionally low power consumption. PC-104 is therefore ideal for embedded applications where PC architecture is desired, but current PC Motherboard/Plug-in cards technology is too bulky and powerhungry.

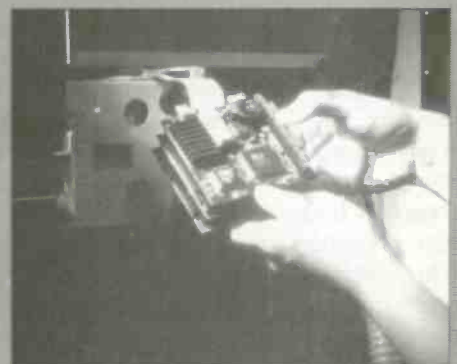
The current range offered by IMS includes a diverse mix of products, including such modules as CPUs, Peripheral Interfaces (Hard/Floppy Disk), Serial & Parallel I/O, SVGA & Flat Panel Display Controllers, I²C/MCIA, Ethernet Network, RS422/485 Communications, Solid State Disks, Digital I/O and Analogue A/D & D/A.

The PC-104 modules can be used as 'Lego' style building blocks, by interconnecting them in a stack, enabling a wide variety of configurations to be implemented thereby offering the versatility and flexibility required in many diverse embedded applications. Because of the miniature size, developers can now embed PC-Based control in a variety of machines and equipment, retaining the

development investment based on PC technology as well as benefiting from the enormous development support products available on the I²C.

Since its implementation in 1992 the PC-104 standard has rapidly become an emerging international standard for modular miniaturised PC Architecture based technology, finding applications in a diversity of markets from medical, communications, industrial, office equipment and many more.

For further information contact:
IMS Ltd,
Southampton,
Tel: (0703) 771143



Entering the WORLD WIDE WEB

We have all heard of the Internet and the World Wide Web, but are they of any real practical use to us in our working lives? Nick Hampshire takes a look at this question, as well as looking at how developments in the technology will affect all of us

To most people the terms 'Internet' and 'World Wide Web' simply imply something to do with computers and telephones. Something that is faintly subversive and the realm of obsessive technofreaks who pass the time until the wee hours of the morning 'surfing the net'. But is it something that 'serious' professional people such as engineers, scientists and business people will find useful, or as the popular press would have us believe is it totally given over to the weird and the wacky?

It is rather amusing that the popular image of both the Internet and the World Wide Web should be so firmly linked to such an image since both technologies were born from decidedly serious applications. The Internet arose from the US Department of Defence's need to create a global computer network to link supercomputers with defence establishments, defence contractors and universities. The World Wide Web was developed at the CERN atomic research establishment in Switzerland as a means of transferring research documents over the Internet.

So both the Internet and the World Wide Web were developed with very serious applications in mind, and they are still very widely used for serious applications. It is just a pity that in the mind of the general populace, and the media in particular, they have become firmly associated with an alternative youth culture. An image projection which has undoubtedly led to neither being taken that seriously by Government, business and the professions.

However, such people are ignoring the development of these two technologies at their peril. They are undoubtedly the basis of a future information transfer and communication technology based revolution which within a decade will sweep the entire world, through both the developed and underdeveloped nations. It will sweep aside many established concepts and ideas, will topple whole areas of industry, and create whole new areas. It is a revolution waiting in the wings.

To understand why this revolution will have such an impact we only need to look at some of the trends which are already developing in a technology which is still very much in its infancy. We also need to look at some of the technologies

which are being incorporated into it.

What is the Internet?

The proper starting place for our examination of these technologies will develop is to examine exactly what they are, and what form they take today. Since the Web is reliant upon the Internet it is proper that we start there.

The Internet is, in very simple terms, a very large loosely structured computer network which extends across the entire surface of the globe and connects together an estimated 30 to 40 million computers. The connections between these computers being composed of a wide range of different links, from conventional copper wire voice telephone lines, to dedicated very high capacity optical fibre links, and even in some cases radio links.

Indeed the primary reason for the success of the Internet is that it uses existing communication links, this has allowed it to expand very rapidly without a great deal of costly capital expenditure. The Internet as a public communications system relies upon a combination of commercial phone lines and a few very high capacity, long distance data links that have been built for military, commercial or academic applications.

Because of the way in which it is designed the Internet can make use of the 'spare' capacity on these lines thus permitting communications between computers on the other side of the world to each other but with only local or short distance phone charges. It can do this because the data that is being transferred between the two systems is transferred in small 'packets'.

Each data packet has added to it the address of both the system it is going to and that from which it has come. Since the packet is small it can easily be slotted into very small periods when a line is not being used. The origin and destination addresses then allow the packet to be independently routed in the best way as it is passed from one computer system to another. This accounts for the frequently very noticeable delay in response which will be familiar to any user of either the Internet or the Web.

This packaging of data into small addressed packets and its transmission through the network relies upon the development and use of a common communications protocol known as TCP/IP (this stands in fact for two protocols, the Transmission Control Protocol and the Internet Protocol). These protocols are designed to run on any type of hardware with any type of operating system. It is the TCP part which controls the data transport and ensures that the data reaches its proper destination.

All the computers that are permanently attached to the Internet are differentiated by giving them unique names, the IP address. These addresses are in the form of a sequence of four numbers separated by periods, and are translated into the more familiar address, such as -

www.emags.com

by the Domain Name System, or DNS. It should be noted that most users will not have either a domain name or an address since they will be accessing the system on a casual basis via an Internet Service Provider or ISP. However, the ISP's computer will have a domain name and address.

This means that with the TCP/IP protocols and the combination of Internet addresses and domain names it is possible to send data from any computer of any type attached to the Internet to any other computer of the same or different type attached to the Internet. The basic form in which such data is transmitted is the e-mail message.

We can thus say that the Internet is primarily a global computer network which allows the transmission between named computers of data in the form of e-mail messages

The birth of the Web

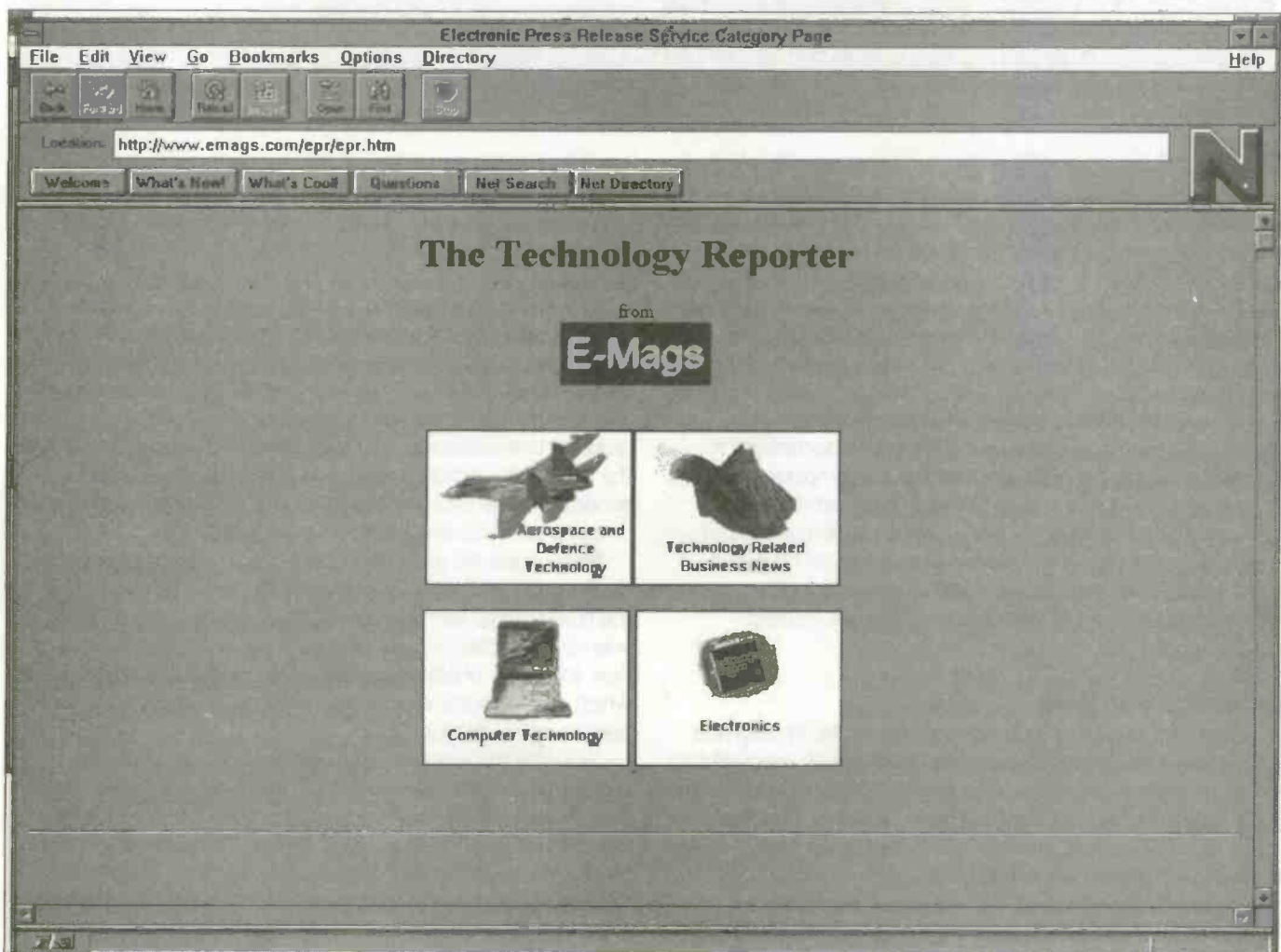
Based upon the existing Internet network the World Wide Web was first proposed in 1989 by physicists at CERN in Switzerland as a means of allowing scientists anywhere in the world to share text and graphical information. To do this they developed another protocol on top of TCP/IP, this protocol is known as the HyperText Transfer Protocol, or HTTP. This allowed users to remotely access documents stored on other systems, basically in the form of e-mail messages, and then display them on their own computer.

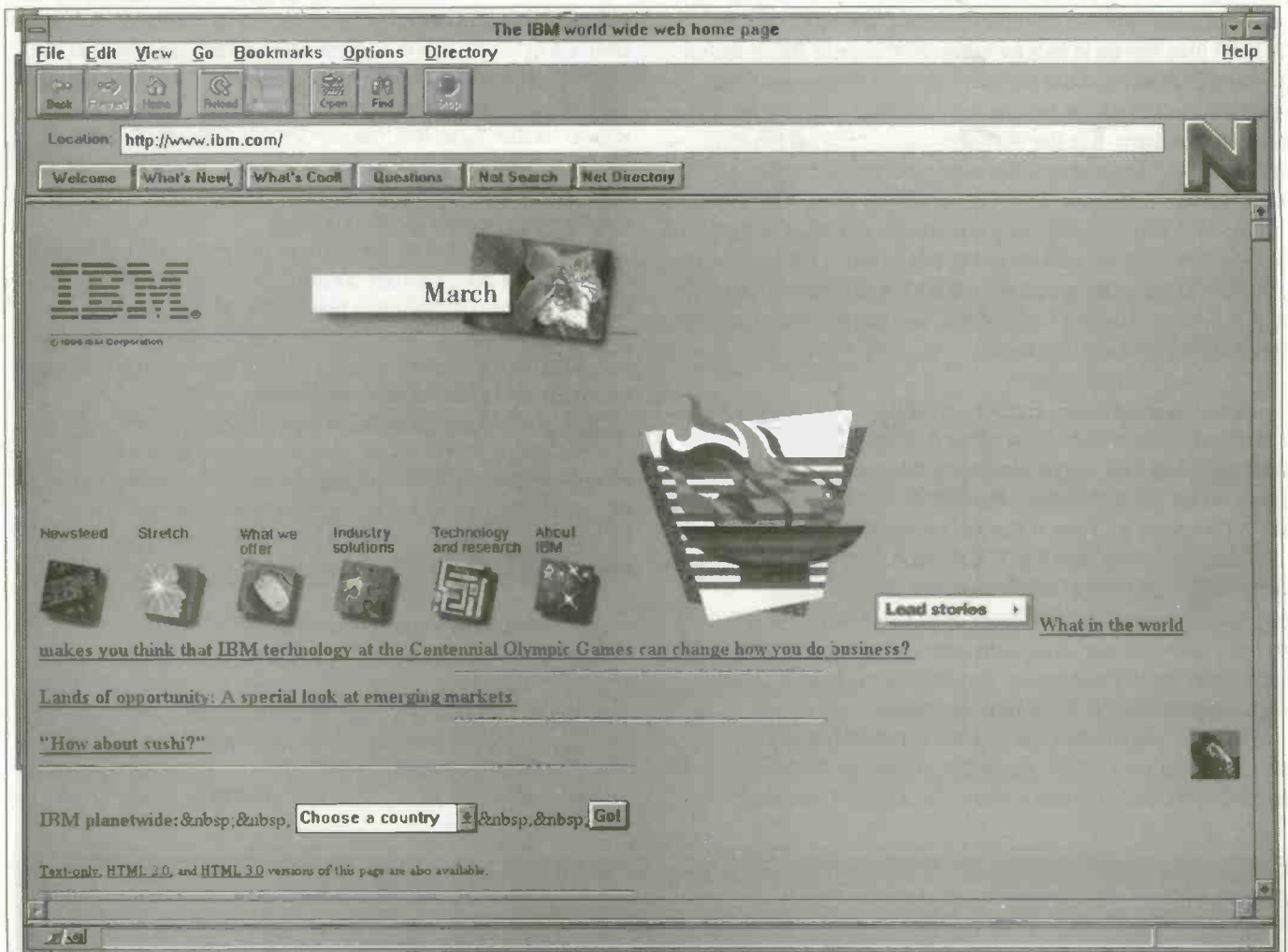
The information is accessed from named computer systems using the standard Internet domain name system. However, the Web naming system has been extended to allow the accessing of specific files stored in specific directories on the target computer system. This location is done with an address known as an Uniform Resource Locator, or URL.

The URL incorporates the domain name, plus the appropriate path and file name in a standard format which is recognised by any piece of software which accesses and displays Web information (such programmes are known as browsers, and for PC users the best known are Netscape and Mosaic). Thus for E-Mags Technology Reporter starting page the URL is:

<http://www.emags.com/epr.htm>

Note that the starting HTTP defines the transfer format, which is then separated from the domain name by `://` the domain name is then separated from the path or file name by another `/`. In this example the file is stored in the system root directory. The file name for any Web file, or page as they are usually referred to, has an extension of HTM or HTML, this





indicates that it is a HyperText Mark-up Language file which can be interpreted and displayed by the browser software.

With the Internet, the Web and the HTTP protocol, you can use an URL to access a file stored on another computer, perhaps located on the other side of the world, and display the graphical or text contents of that file on your own system, very much as if it were stored on your own hard disk. The Web has thus converted the Internet into an extremely powerful data storage and retrieval system.

However, the Web designers were inspired originally by Ted Nelson's pioneering work on linked Hypertext documents for structuring and using information stored on computer. The use of HyperText links, in the form of URLs, is an extremely powerful feature of the Web since it allows large numbers of pages, perhaps stored on different computers, to be pulled together into a single document with a coherent logical structure that is a highly efficient way of communicating information.

Entering the Web

In 1991 there were just 300 pages stored on the World Wide Web, today, less than five years later, there are an estimated 30 million pages that are accessible over the Web, a figure that could easily double over the next twelve months. This is an awful lot of information, most of it fairly low grade, but scattered amongst it some real gems.

Perhaps the best way of thinking about the Web is to compare it to a conventional library, a library which at the

moment has the equivalent of about a quarter of a million books. That is a pretty big library by any standards. It would occupy about fifteen to twenty thousand feet of shelf space, and even for a fast reader that is a few lifetimes' worth of reading.

With so much information, there is a very serious problem associated with finding the specific information that you are looking for. In a conventional library this is, to a degree, solved by the use of a standard cataloging and classification system. This means that all the books are divided and physically grouped into categories and sub categories in accordance with the main subject matter. Each title is then given a code according to its category which can be crossreferenced in card or computer indexes of titles, authors, etc.

Web pages are grouped in clusters, or 'web sites' around a 'home page' on individual computer servers, and to this extent the home pages can be viewed, and classified, in the same way as book titles. It is therefore not surprising that there are now a number of classified catalogues of web site home pages which make it somewhat easier for the Web user to find the necessary information.

Probably the most widely used catalogue of web sites, or as they are sometimes referred to - metaseite - is Yahoo which now indexes several hundred thousand web sites around the world covering a whole range of different subjects. In addition there are a large number of specialist metasites, thus E-Mag's Technology Reporter incorporates a comprehensive classified index of web sites in each of its technology areas, in particular

electronics and computing.

Such classification systems are fine when dealing with books, and Web site home pages. However, information stored on the Web is not as easily classified as books, since it is in the form of millions of individual pages. Indeed with the increasingly extensive use of hypertext links we can almost regard the entire Web as comprising a single volume with thirty million pages.

Creating an index for thirty million, soon to be forty, fifty, sixty million, pages of constantly changing information is virtually impossible, but engineers have come up with another solution, the intelligent agent. This is still a very new concept but is one which will ensure that the Web remains a practical information source. In essence an intelligent agent is a small piece of software that is designed to search through all the web sites looking for pages which match certain search criteria which it has been given.

Intelligent agents are very much a feature of the Webs future development. For the moment the best way to find useful information stored on the Web is via one of the metasites, in particular one of the specialist metasites.

What is on the Web?

It is estimated that there are at the moment over a million different Web sites, a great many consisting of just a single page, a few consisting of thousands of pages. Some sites have been created and run on large corporate budgets, others on a shoestring by private individuals. As for subject matter, there are now Web sites covering every subject that mankind has ever thought of, and fortunately for us over 98% of all sites

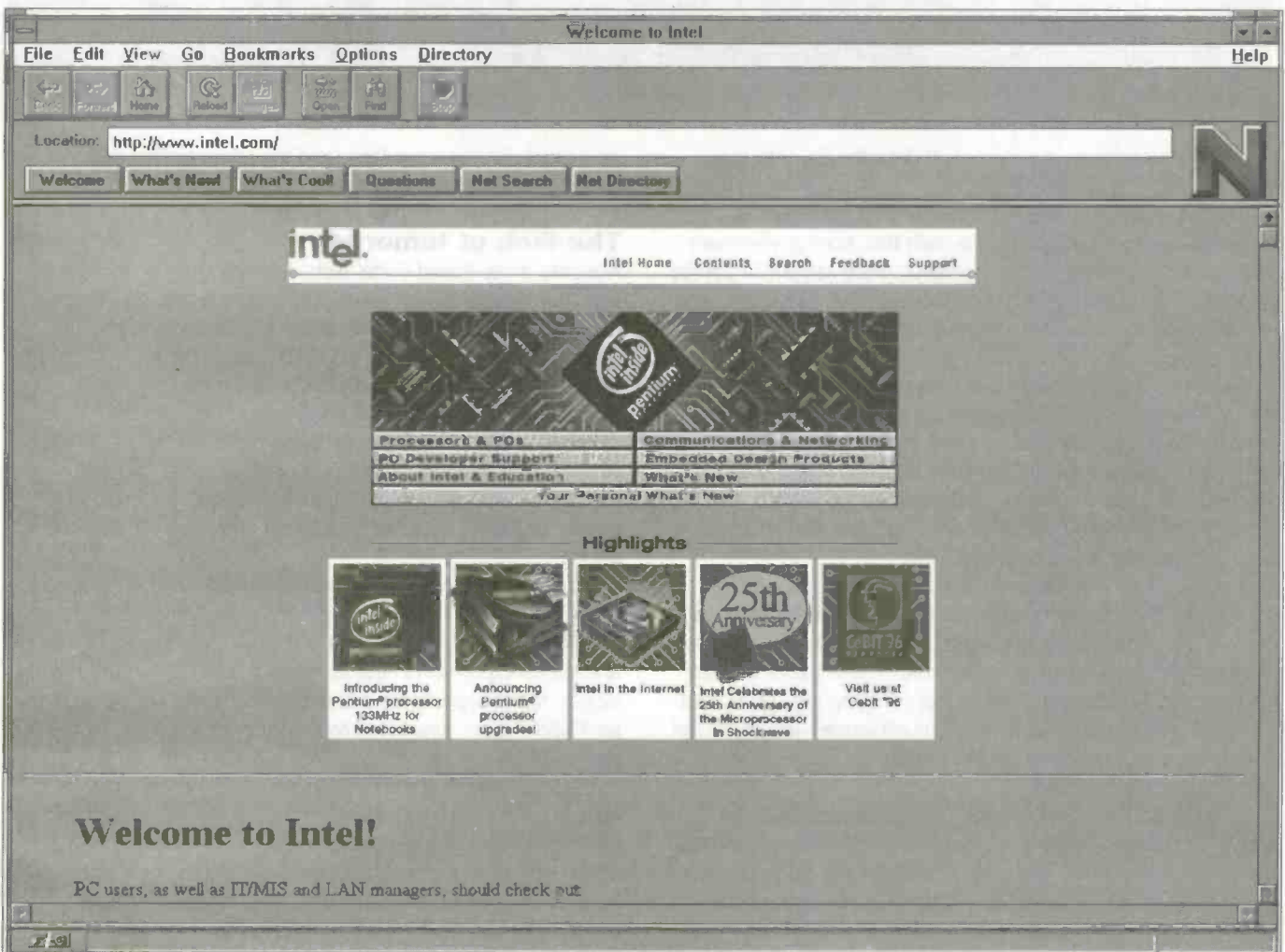
are in English.

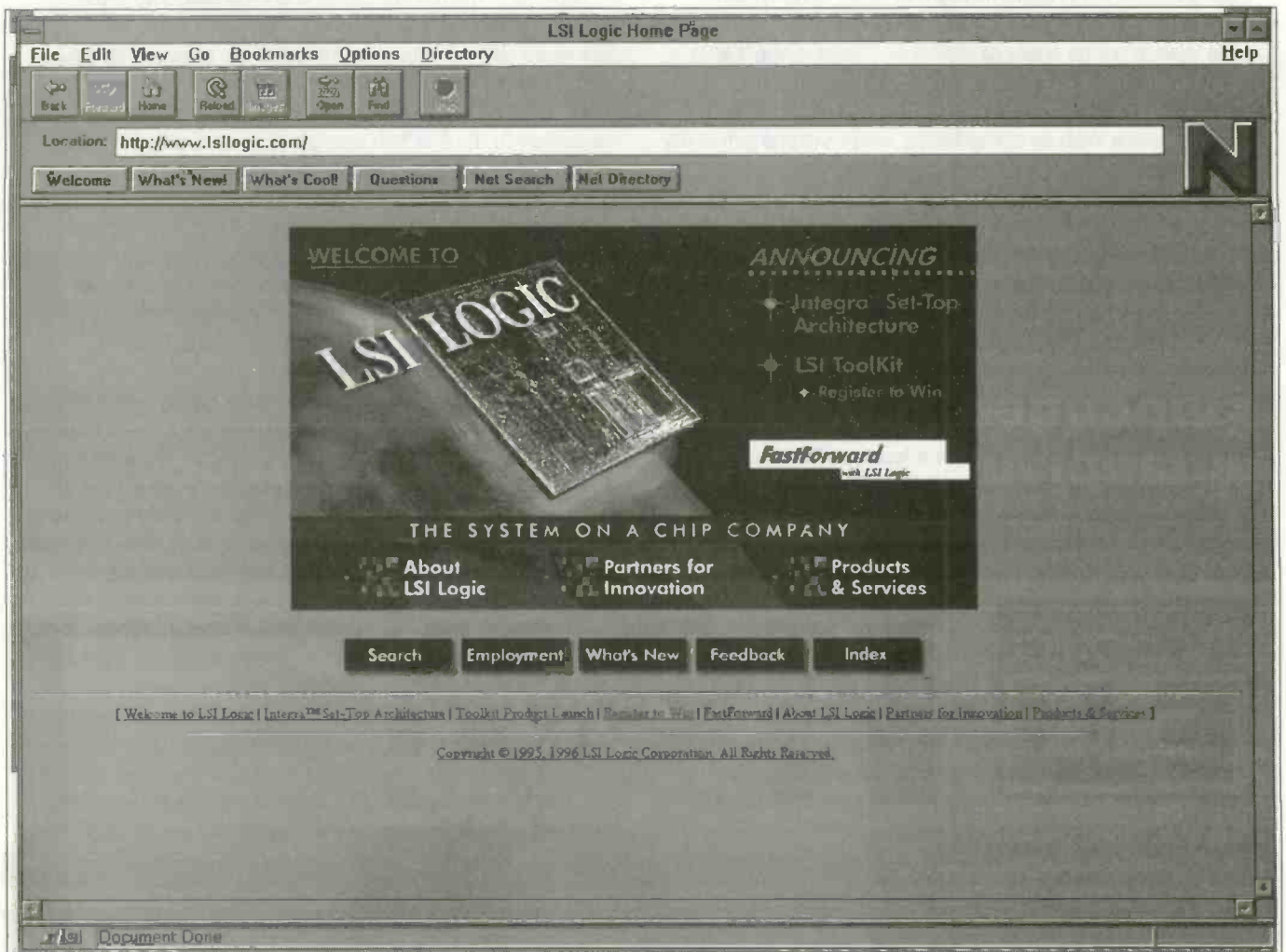
Broadly, however, we can divide Web sites into three distinct categories, the fairly large corporate sites, the academic and government sites, and the sites run by private individuals. For the businessman, scientist or engineer the main sources of useful information will be found almost exclusively in the first two categories of site. Indeed the vast majority of useful information stored on the Web is contained in fewer than ten thousand sites.

The first Web users were of course the academic and government Web sites, primarily US but increasingly from other parts of the world. These are probably the most information rich sites since they are primarily being used to disseminate information about particular research projects to other individuals working in similar areas.

Typical examples are the sites maintained by some of the big US government research establishments such as Sandia Labs, the Oak Ridge Labs, and of course the biggest of them all, NASA. The range and scope of research carried out at these labs is enormous and certainly not confined to military, atomic energy, and aerospace related subjects. They are a very good source of information about future trends in the development of technology and are well worth a visit.

An increasing number of companies, primarily in the USA, now run Web sites as a valuable aid to their sales, marketing, and product support departments. They are using their Web sites to give customers and potential customers information about the company and its products. They are also being used to disseminate product support information, such as software bug fixes, or new applications data. Some are even putting





their entire catalogues and technical data sheets onto their Web sites.

The information contained in these corporate sites is obviously of more immediate use than that from government and academic research labs. However, many large companies with their own research facilities, such as IBM, AT&T, etc., also maintain special Web sites for these labs; these too are well worth visiting.

Scientists and engineers can thus use the Web to find out information about new developments from both commercial and academic/government sources. In addition there are sites with more general information, such as those maintained by the Times/Sunday Times, FT, Telegraph and Guardian, the New Scientist, and a host of other magazines and information providers on both sides of the Atlantic.

The Web can also be used to locate information about otherwise unknown companies and products, in fact it is an ideal way of locating the specialist products and services that are often provided by small companies whose existence can be very hard to discover. Finding them may require quite a lot of Web searching but this is made much easier with the aid of a metasite or a site with a specialist catalog, such as the Technology Reporter site.

Another source of information offered by sites such as E-Mag's Technology Reporter is the publication of press releases, the raw material which technical journalists rely upon to keep themselves up to date, and as a source of news and new product reports. These can provide a lot of information about

new products, new services, and the latest technical developments, from companies big and small.

The Web of tomorrow

Not only is the World Wide Web expanding at an enormous rate, the technology on which it is based is also developing very rapidly. Text based Web browsers have given way to graphics based browsers, the Web page description language HTML is now under assault from a new more interactive system called Java. Neither does it stop here, for two dimensional graphics are now being replaced by 3-D VRML virtual reality graphics, and the user base is set for rapid expansion with the imminent launch of several low cost, high power, hardware systems developed exclusively for Internet users.

All these, and many other, developments underline several important trends in the development of both the Internet and the World Wide Web. The first is that we can expect to see an enormous expansion in the number of users around the world, indeed some experts are estimating that there will be as many as 1 billion users connected to the Internet and Web by the year 2000.

Secondly as data transmission speeds increase thanks to optical cables and high speed modems we can expect to see the Internet increasingly becoming a real time, high quality, multimedia data transmission system. People are already using Internet phones to make low cost long distance calls. A handful of radio stations are already broadcasting over the

Looking for information on the Web

Looking for specific information on the Web is not really that hard. The first step is to access one of the big metasites such as Yahoo, or a specialist technology index site such as Technology Reporter.

the URL for Technology Reporter: -
<http://www.emags.com/epr.htm>

If you use Technology Reporter you will find that the home page gives you a selection of icons relating to different categories of information. Simply use the mouse to click on the desired icon, and a menu page for that subject will be displayed. This menu allows you to look at press releases stored in that section, or look at the

various indexes of press releases. It also allows you to go to a hierarchically organised index of Web sites.

With a hierarchically organised index it is possible to narrow down a search for information to narrow down the search for particular information to a handful of sites rather than the tens of thousands that are stored on the system. Finding your way around the hierarchical index is simply a matter of using the indexes and navigation icons to go up and down the branches of the hierarchical index.

Technology Reporter also has a collection of company profiles and associated with many of these are lists of web site entry points, and the latest press releases from the company. All of which can be a veritable mine of useful information about the company and its products.

Internet, and there are even a few experimental net based TV broadcasts.

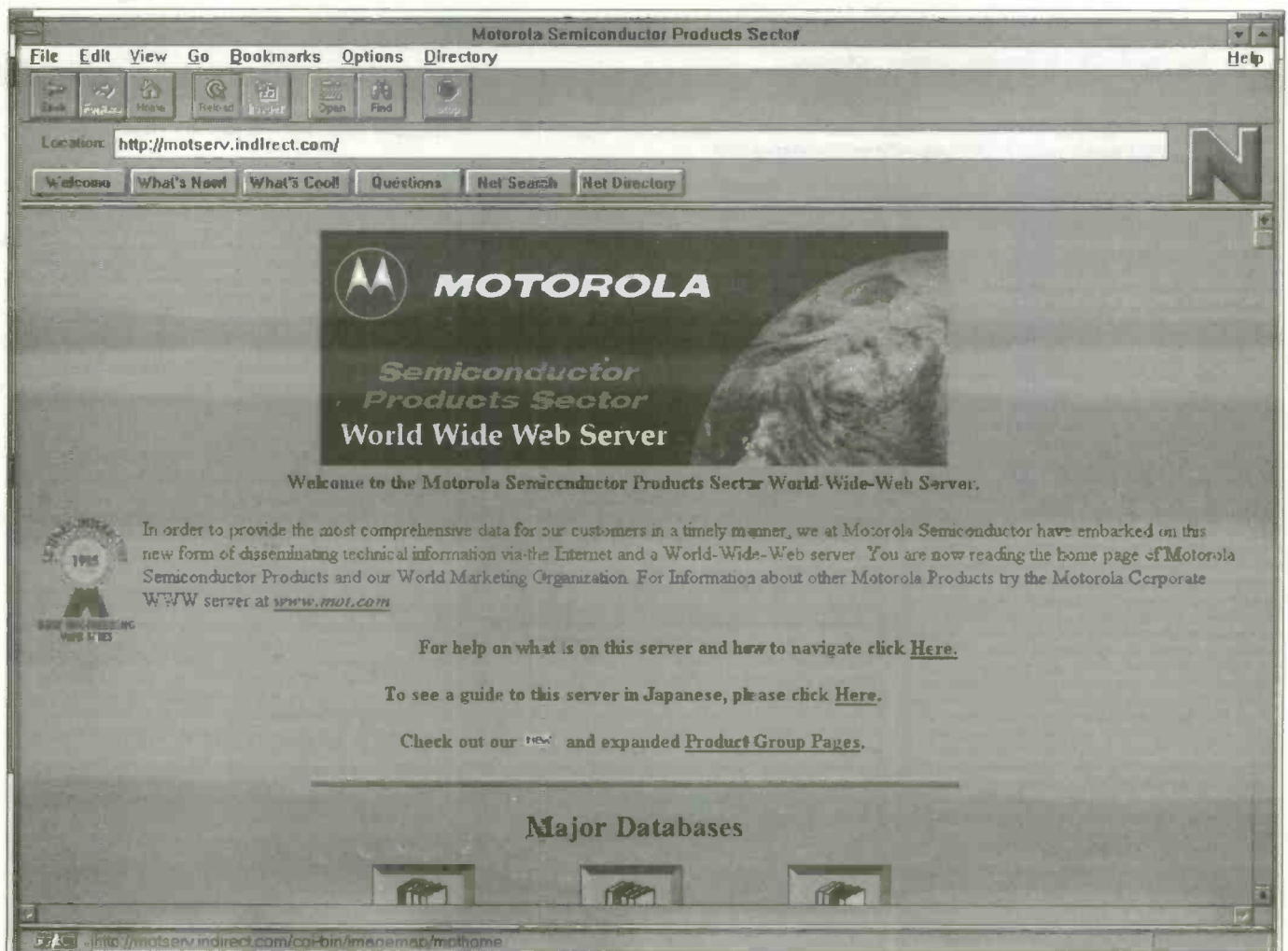
In fact it is very much on the cards that Internet based broadcasting of sound and 2-D/3-D video will be the next explosive development to hit us all. Once again experts are predicting the demise of much of wireless based broadcasting and its replacement with an 'on demand' system delivered by optical fibre networks.

A more highly developed version of the Internet could also make the much touted concept of telecommuting a lot more viable, and will certainly revolutionise education. For a start there is no reason why all the books in the greatest libraries of the world should not be accessible to anyone with a computer

attached to the network. Similarly it should be possible for everyone to have access to the finest teachers in the world.

The fact that robots can be remotely controlled over the Internet using virtual reality systems is opening up yet more avenues of development. People operating remotely located machines from an office thousands of miles away, surgeons operating on a patient living on the other side of the world, and virtual reality tourists visiting the deep oceans or driving across the surface of the moon.

Without a doubt Internet based technology is not the preserve of the computer freak, and the wacky proponent of alternative lifestyles, it is a key component of the future for all of us.



Doing business on the Web

The Web started off as an academic network, and quickly acquired a lot of individual users who were attracted by the anarchic structure of the system. There is no organisation which controls the Web, just the domain naming committees, so individuals found themselves free to say what they wanted to say without let or hindrance. Hence the current image of Internet and Web users as wacky odd-ball characters.

These individuals have helped to pioneer the Internet and Web, they further developed the technologies and experimented with what was possible and in so doing pushed the technology boundaries to where they are today. But the use of the Web as an alternative lifestyle network was bound to be limited, for as soon as it reached a certain size it began to attract the attention of businesses around the world.

The first businesses to use the Web were either in computer technology, especially Web related technology, or in businesses which sold to the kind of individuals who pioneered the use of the Web. These were music companies, alternative lifestyle and pop culture magazines, and companies like Coca-Cola.

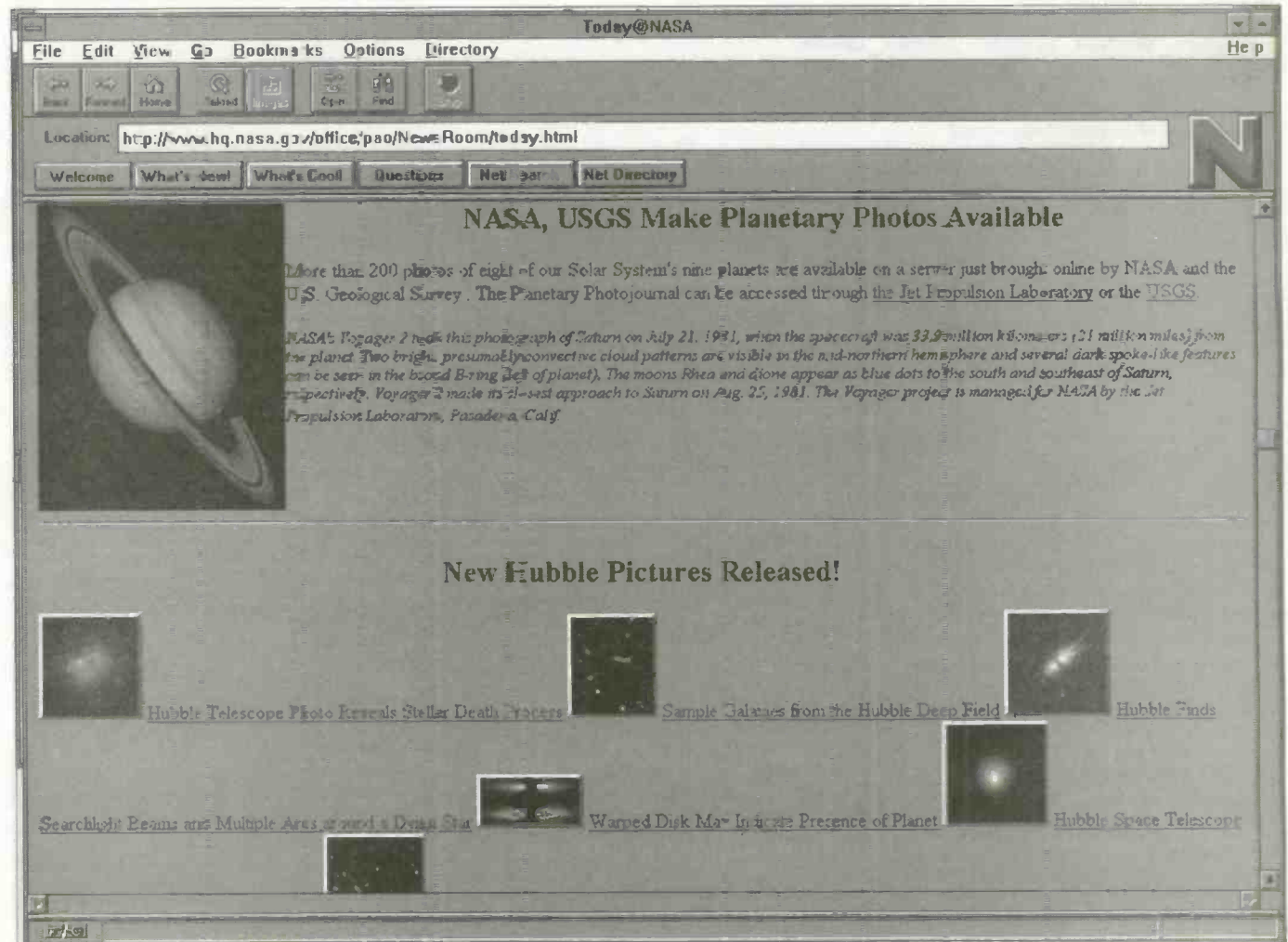
High technology companies, primarily in the US, also started to use the Web to provide initially customer support information, then sales support, and more recently investor support. These large high technology companies have been followed by a host of smaller companies, mostly in technology, who see the Web as a means of advertising their products and services on a global basis (unfortunately UK companies seem remarkably slow in investigating this opportunity for widening sales).

Advertising on the Web is something which has only started to appear over the last six months, and is still primarily confined to a few metasites such as Yahoo. This is probably because most companies see having a Web site of their own or renting a page from one of the companies which offer such a service as being the better option. After all a page can be rented for a year on a site like the Technology Reporter for just £50, compared with \$5000 for a small banner on one of the metasites.

Not surprisingly one area of Web development which has been the subject of a lot of work, and will continue to be for some time, is the technology for doing business over the Web. This basically means making the Web secure enough so that users can confidently use it to transfer money to or from another Web user, business, or Web based bank.

The initial developers of both the Internet and the Web were not trying to hide anything, indeed the exact opposite, so no consideration was given to methods of preventing anyone from 'listening in' to the data that was being transmitted. However financial information needs to be kept private which means that if users are to be able to pay for goods and services ordered over the net then that information has to be encrypted in such a way that nobody else can intercept it.

First generation secure server systems have now been developed which means that we will start to see the rise of organisations selling information, and entertainment over the Web. In fact this year should see the start of the Web's use as a proper commercial tool, and will mark a departure from the current main feature of the Web, the fact that the information on it is free.





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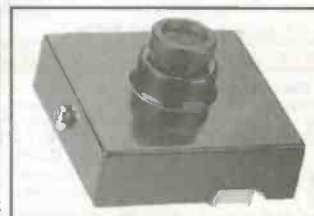
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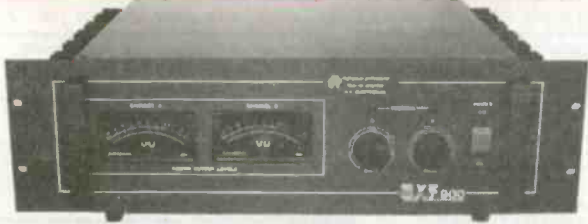
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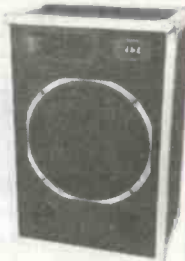
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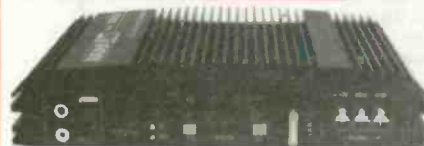
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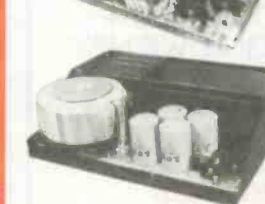
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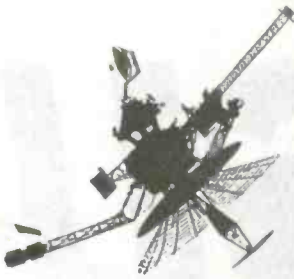
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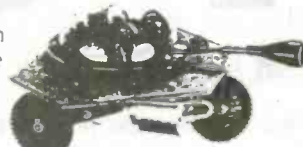


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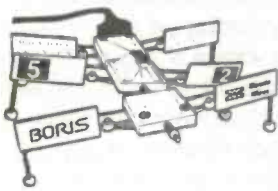
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Rechargeable PSU

Terry Balbirnie's handy bench power supply

This device differs from the usual type of amateur power supply unit because it is battery operated. This allows total freedom of use and completely safe operation. Power is obtained from a set of nickel cadmium cells and recharging is effected by plugging the unit into a car cigar lighter socket. The output is switchable from 3V to 12V in 1V steps and the current output limited to about 800mA. There is also an audible warning when the batteries need to be changed.

The prototype unit used standard (500mAh) "AA" size batteries and these were found to be adequate for most purposes. Using this type of cell keeps the size and cost down. Most "hobby" purposes need only a small current - 100mA or less. When drawing 100mA, 5 hours' service will be obtained before the need to re-charge. It is suggested that, in normal use, no more than 500mA is used and this will provide about 1 hour of operation. At a higher current, it may be difficult obtaining a full 12V output. Also, the period of service becomes rather short.

It would be a simple (but more expensive) matter to use high capacity "AA" cells. The 850mAh version would provide a 70% increase in capacity - that is, 8 hours' service at 100mA. It would also be possible to use physically larger cells such as "C" size with a corresponding increase in capacity. Charging standard "AA" batteries from "flat" takes 15 hours although the unit may be left connected for longer than that without harm. Higher capacity batteries will, of course, take correspondingly greater times. While charging, the total requirement of the circuit is 125mA approximately and this will impose negligible drain on a well-charged car battery.

Left in charge

Having a 12V output available poses a problem when charging the batteries from the 12V car system. This is because the source needs to have a higher voltage than the batteries being charged. The problem is overcome by dividing the cells into two groups of six. This gives sets having a voltage of about 7.5V each (regarding the nominal voltage of a single cell as 1.25V). The half-sets are then charged individually and since the voltage of each is less than 12V, the car battery is sufficient. When the supply is in use, the half-sets are connected in series to provide a nominal 15V output which is then regulated to the voltage required. When the cells are freshly-charged, the voltage of the pack will be about 17V. When almost discharged, it will fall below 14.5V and the "re-charge" buzzer will sound - quietly at first then more urgently.

The unit is controlled by two rotary switches on the front panel. The first (selector switch) has three positions: "off", "charge" and "operate". The other (output switch) has ten positions and selects a voltage from 3V to 12V as required. There are output terminals and LED indicators on the front and a socket on the back to which the charging lead is connected. When the switch is set to "charge", a red LED operates. While operating, a green one lights.

How it works

The complete circuit diagram for the Re-chargeable PSU is shown in figure 1. SW1 is the selector switch shown in the "charge" position. This switch consists of four independent sections (poles) labelled "SW1a", "SW1b" and "SW1c" (pole d is not used). The numbers correspond with those marked on the switch itself and it may be helpful to refer to these during

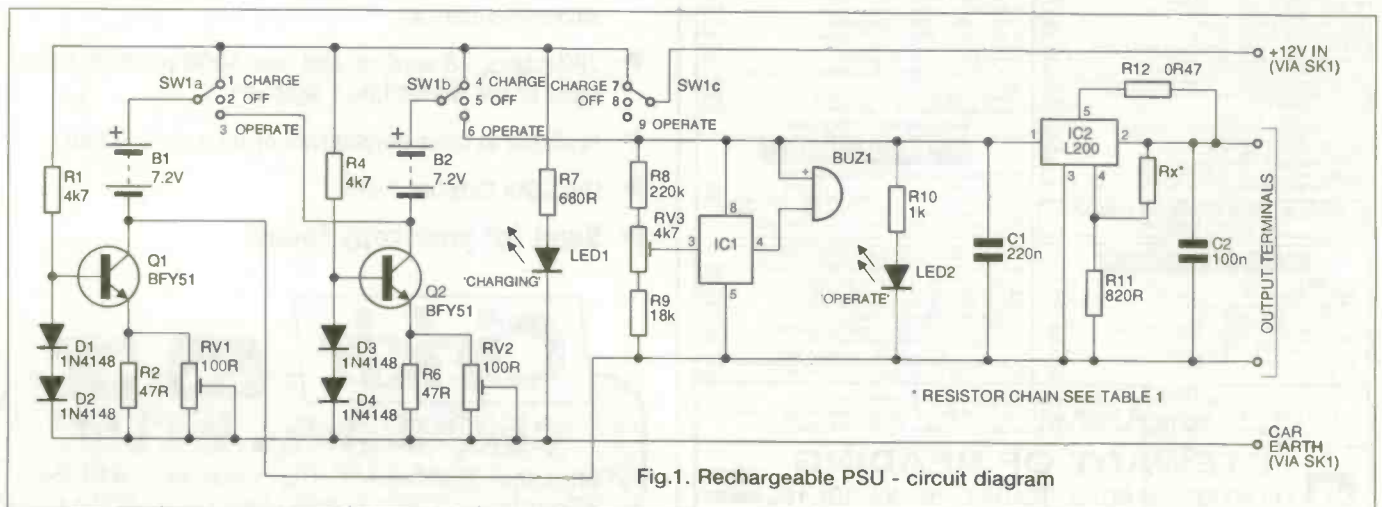


Fig.1. Rechargeable PSU - circuit diagram

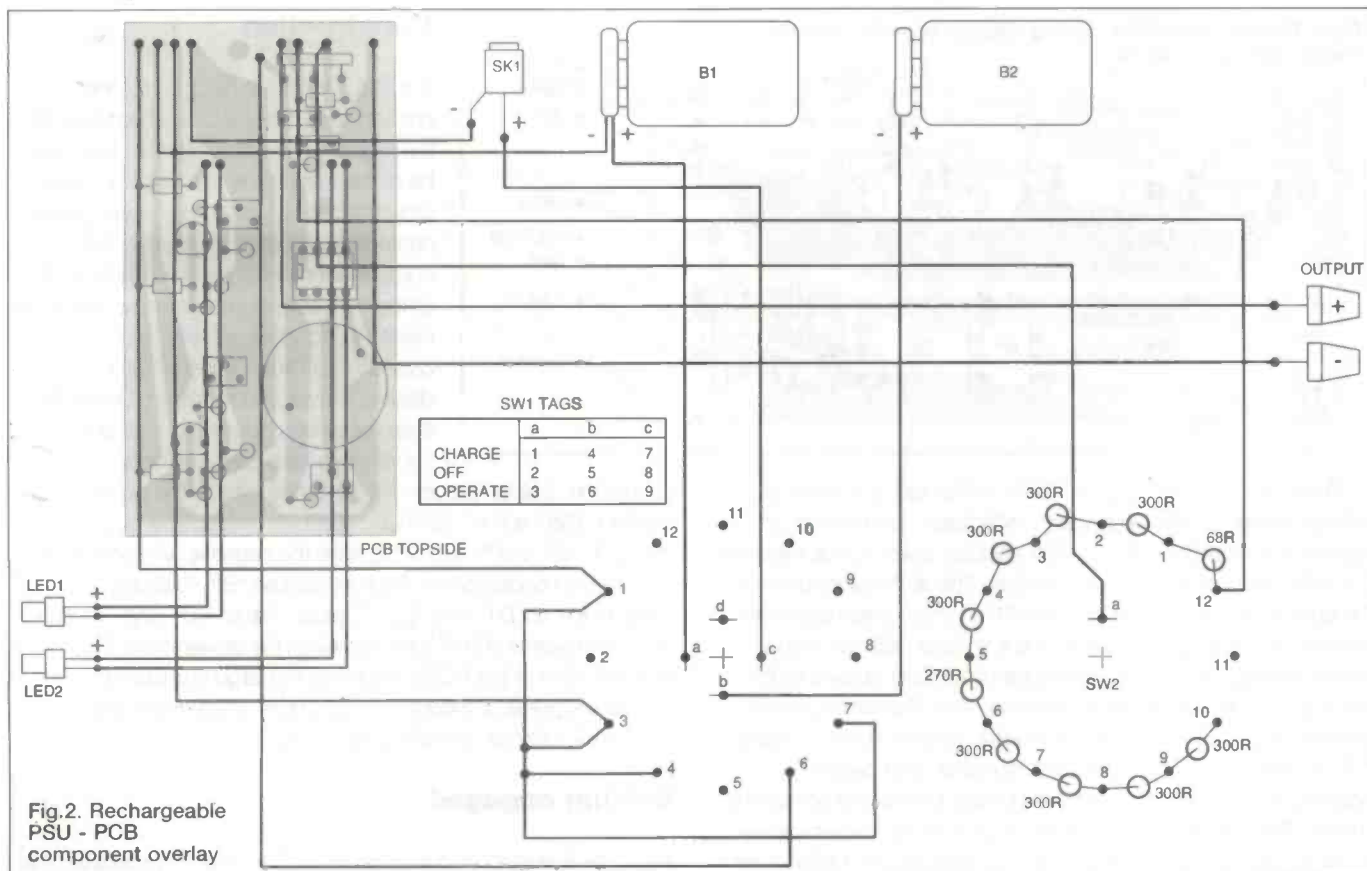


Fig. 2. Rechargeable PSU - PCB component overlay

construction. Pole c directs current from the +12V car feed to the rest of the circuit. Red "charging" indicator, LED1, lights with current limited by resistor, R7. Poles a and b send current to the twin circuits based on transistors Q1 and Q2 which are responsible for charging the cell half-sets, B1 and B2 respectively.

Nickel cadmium cells must be charged from a constant current source. This is provided in the following way. It is only necessary to consider the charging of one set - say, B1 - since the other operates in identical manner. Current flows through resistor R1 and the two diodes, D1 and D2, in series. Since a silicon diode develops 0.7V approximately between its ends while conducting (i.e. in forward bias), there will be about 1.4V across the pair. Current enters transistor Q1 base via R1 and collector current flows through the cells so charging them. There will be about 0.7V developed between base and emitter (since this junction is equivalent to a forward-biased silicon diode). It follows that 0.7V approximately will exist across the emitter resistor network, R2, R3 and RV1. Virtually the same current as that in the collector will flow through this network (ignoring the very small contribution made by the base current). Also, as stated above, the voltage across it will be 0.7 V. By choosing the appropriate emitter resistance, the charging current may therefore be controlled. A value of 50mA is recommended for charging "AA" cells. The emitter resistance needed to achieve this may be calculated using Ohm's Law thus:

$$R = V/I = 0.7/0.05 = 14\Omega$$

The voltage between Q1 collector and emitter adjusts automatically to maintain the charging current as set. This happens as the battery voltage rises in the course of charging. The purpose of RV1 is to adjust the charging current since the 0.7V levels mentioned above are not exact. Ideally, a value of about 30 ohms would be necessary but these are not available. To overcome the problem, a 100 ohm preset is used with a 47 ohm fixed resistor connected between its outer tags. This provides an adjustment between zero and about 33 ohms.

The response is no longer linear but this does not matter. Resistor R2 limits the current if RV1 were to be adjusted to zero.

Discharge

Suppose switch SW1 is now set to "operate". Pole c disconnects the car supply (in case the unit has been left plugged in), Pole a connects the positive terminal of battery half-set B1 to the negative terminal of half-set B2 so they now appear in series. Pole b connects the positive terminal of what is now a nominal 15V supply to regulator IC2 input, pin 1. The negative terminal of the set is connected direct to the 0V ("negative") output line. Green "operate" indicator, LED2, lights with current limited by resistor, R10. Ignore the section of the circuit centred on IC1 for the moment.

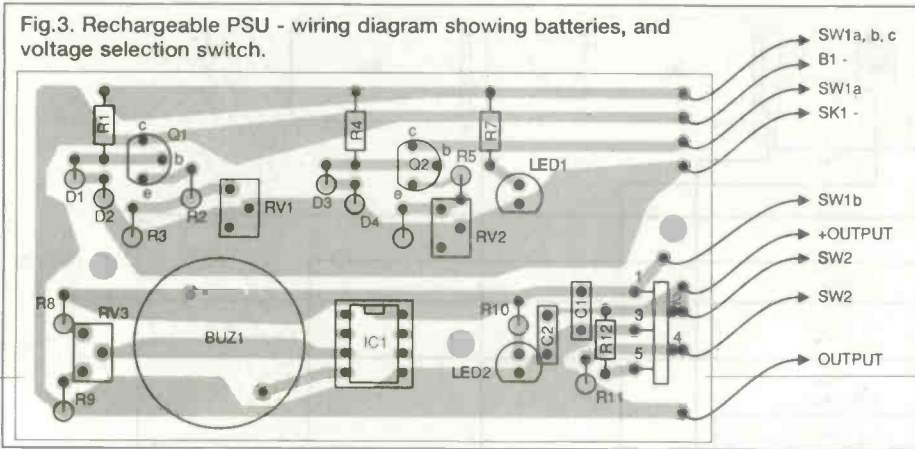
The regulator accepts the basic input and delivers a controlled voltage output. Its value will depend on resistors, R11 and Rx. R11 is fixed in value but Rx (referred to as the chain) is selected by rotary switch, SW2 (shown in figure 3 but not in figure 1) to provide the required voltages. Table 1 shows the resistors needed. The current limit is set by resistor R12 connected between pins 1 and 5 according to the formula:

$$I = 0.45/R.$$

With a value of 0.47 ohms as specified the current will, in theory, be limited to about 960mA. Due to additional stray resistance, it is likely to be less than this - 830mA in the prototype.

The regulator can only function correctly if the input voltage is at least 1.5V to 2V higher than the output. When 12V is selected, the batteries must therefore be capable of supplying at least 14V. The difference between supply and output voltages appears across the device. In the "worst" case, the input voltage will be 17V and the output 3V. If 800mA is drawn, there will be a power dissipation of over 11W. A heat sink is therefore needed and this is provided by the metal case.

Fig.3. Rechargeable PSU - wiring diagram showing batteries, and voltage selection switch.



When the battery charge is nearly exhausted, the terminal voltage will fall quickly - especially under load - and will fail to operate the regulator. This will first happen when 12V is selected but will quickly follow at lower voltages. This is the point at which the buzzer will sound. The section of the circuit which does this operates in the following way. IC1 is a voltage detector chip. When a voltage less than a reference of 1.15V is applied to the input (pin 3) the output (pin 4) becomes low. This sinks current through buzzer, BUZ1, from the positive supply rail, so sounding it. Fixed resistors, R8 and R9, in conjunction with preset potentiometer RV3 form a potential divider connected across the supply. RV3 will be adjusted at the end of construction to apply 1.15V to pin 3 when the supply is just falling below 14.5V or for best effect.

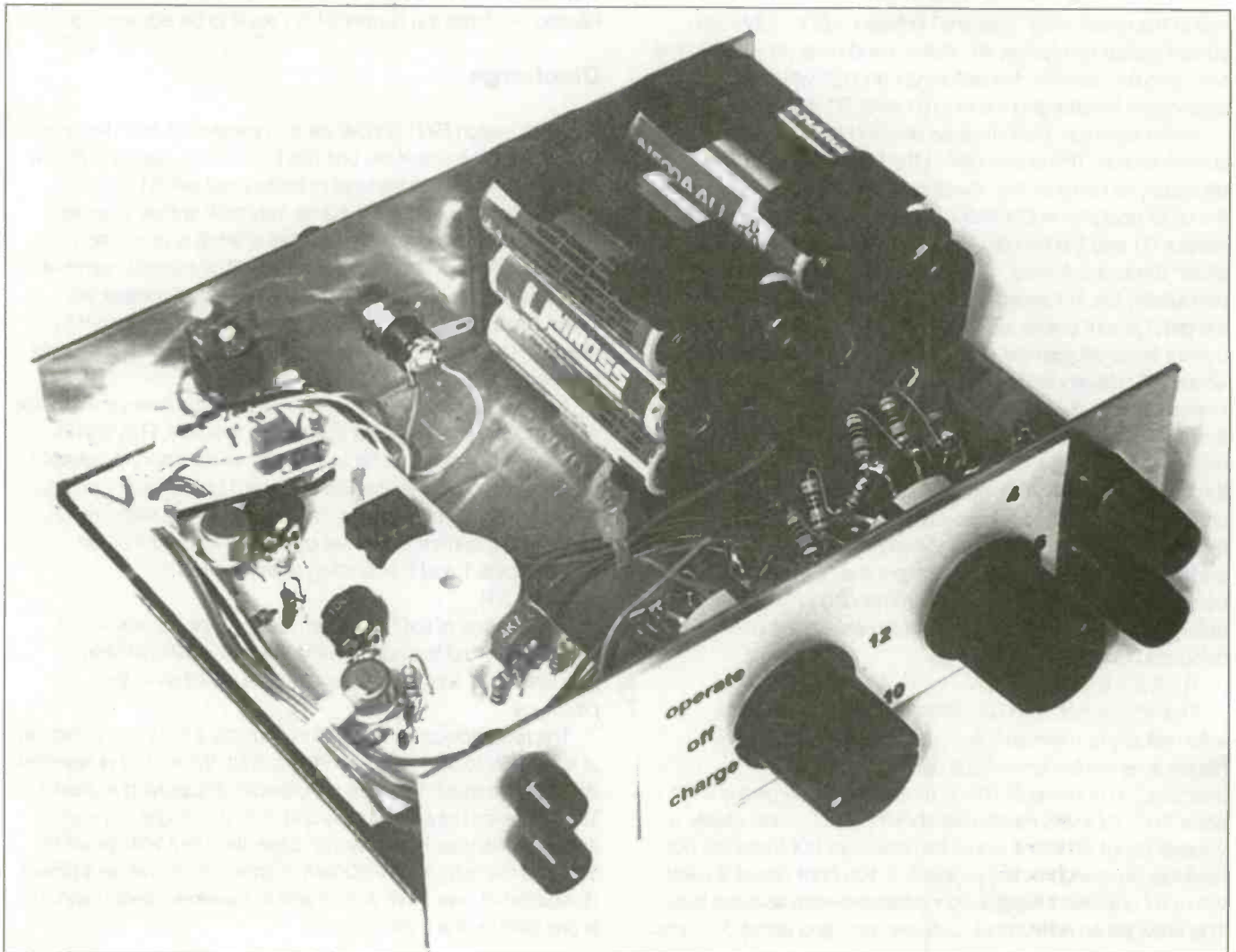
Construction is based on a single-sided printed circuit board (PCB) and the component overlay is shown in figure 2. Solder IC1 socket in position as well as all resistors (including presets) and capacitors. Follow with transistors, diodes, buzzer and regulator. Note that these latter components are polarity-sensitive so take care over their orientation. Solder pieces of connecting wire to the points labelled "SW1 a b c", "SW1a", "SK1 -", "SW1b", "+ output", "SW2" (2 off) and "- output". Solder the negative wire of one of the battery connectors to the pad marked "B1 -". Solder four wires to the "LED1" and "LED2" pads. Adjust RV1 and RV2 fully anti-clockwise and RV3 fully clockwise (as viewed from the regulator end of the PCB). In view of the large number of connecting wires, it would be wise to use different colours to reduce the chance of making a mistake.

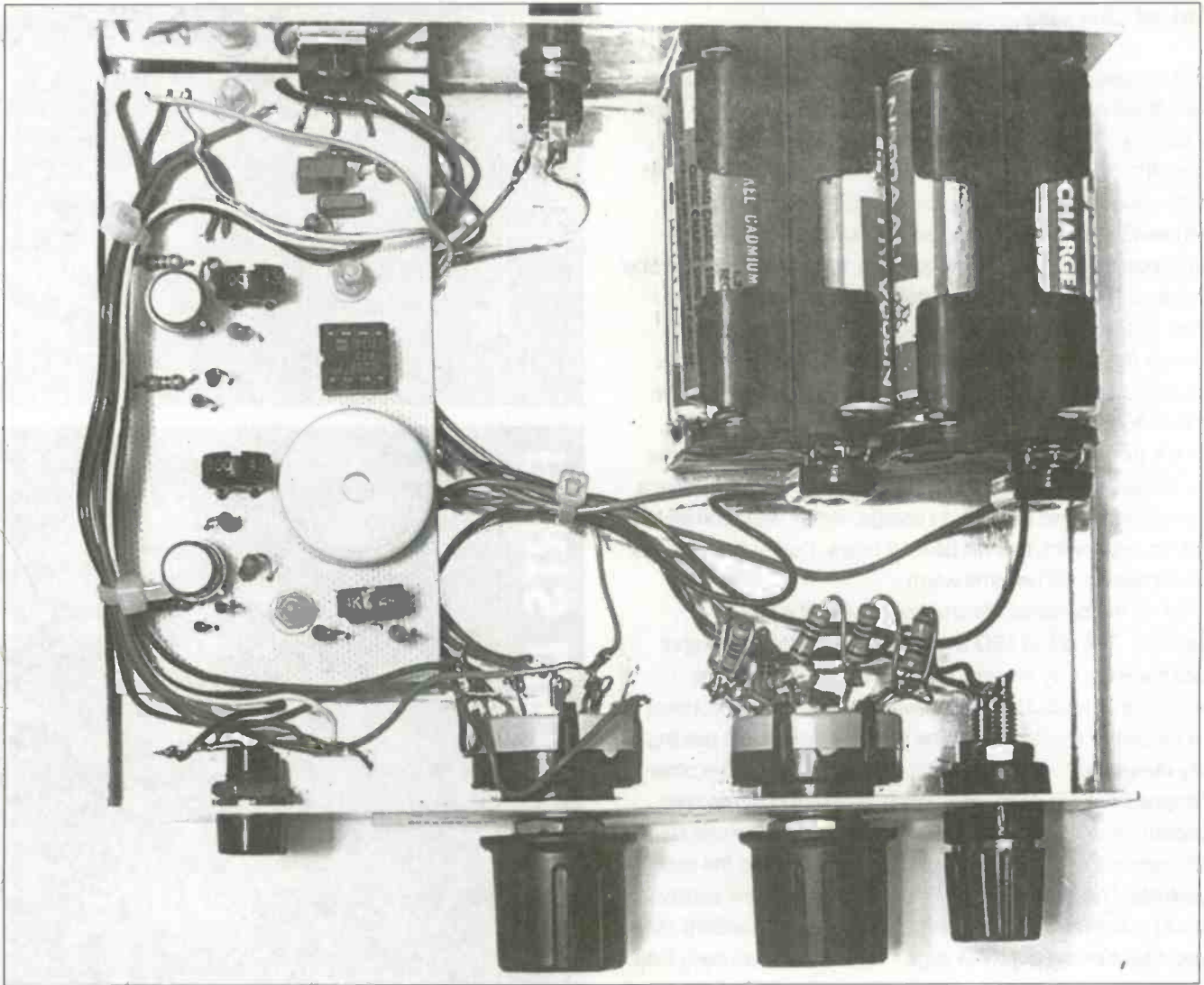
Getting engaged

Adjust switch SW2 end stop so that it has only 10 positions. This is done by removing the brass nut and tab washer beneath. It will

Construction

A metal case must be used for this project since it is used as a heat sink for the regulator. The cigar lighter plug must be of the fused type carrying a 1A fuse. Construction is based on a single-sided printed circuit board (PCB) and the component overlay is shown in figure 2. Solder IC1 socket in position as well as all resistors (including presets) and capacitors. Follow with transistors, diodes, buzzer and regulator. Note that these latter components are polarity-sensitive so take care over their





be seen that there is a ring of holes and the tab may be engaged into any one of these to provide the number of positions required. Rotate the spindle fully anti-clockwise and locate the tab in the tenth hole. Replace the brass nut and check that the switch operates correctly with the required ten positions.

Refer to Table 1 and solder the chain resistors around SW2 tags as shown in figure 3. These are used cumulatively - the values add up as the switch is rotated. Note that the first member - 68 ohms - is mounted with one end connected to tag 12. This is permissible because the moving contact never reaches this position - it is simply used as a take-off point. The other resistors should, in theory, all have a value of 296 ohms. Since this is not a standard value, 300 ohms is used. This would result in a slightly high voltage output. The single 270 ohm resistor almost entirely corrects this and the theoretical off-load voltages all lie within 1%. The actual voltages will depend on the tolerance of the resistors used - 1% is advised. Output switch, SW2, must be of the "make before break" type. This will result in the voltages rising regularly as the spindle is rotated. However, selector switch, SW1, should be of the usual "break before make" type.

Nice kit

Prepare the box by drilling the three holes in the base to correspond with those in the PCB. Drill the holes in the front panel for the rotary switches, LED indicators and output terminals. Drill the hole in the rear for the socket to which the input lead will be connected. Mount the circuit panel on short stand-off insulators

and mark the position of the hole in the regulator tab on the rear panel. Remove the PCB again and drill this hole. Re-mount the PCB attaching the regulator using a mounting kit (which consists of a thin mica washer and a plastic bush) to electrically isolate it from the metalwork. Check using a multimeter set to "ohms" with one probe touched on the metal tab and the other on the box. Infinite resistance should be indicated.

Refer to figure 3, mount all remaining components and complete the wiring, shortening any wires as necessary. Use a red terminal for the positive output and a black one for the negative. The "power-in" connector used for the input must have its outer (sleeve) terminal wired as the negative one. Observe the polarity of the LED indicators or they will not work - the shorter lead is the negative one. This connects to the large "land" area on the PCB in each case. With the specified box, the battery holders will be held tightly by the lid when this is in position and no further support is needed. A bracket may be made if a different box is used. Check that there are no protruding metal parts such as rivets on the battery holders (which could cause short-circuits to the case) and provide insulation if necessary.

Prepare a piece of twin wire for the input lead by soldering the cigar lighter plug to one end and the "power-in" plug to the other. The outer connection in each case is the negative one. Fit a 1A fuse in the plug. Make sure that the positive supply wire will end up connected to SW1 pole c. Check that the cigar lighter socket is live with the ignition key removed. If not, it will need to be re-wired so that it is.

Out of the way

It is now necessary to adjust the charging current and to check the voltage output. Insert the cells in their holders taking care to observe the orientation of each. Push on one terminal of each PP3-type connector swivelling the other connection out of the way. With the selector switch off, connect the supply then switch to "charge". The red LED should light. Set the multimeter to a current range covering 100mA and clip a probe on one of the unconnected battery snap terminals and the other on the battery. The charging current will then flow through the meter. This is likely to be in the region of 20mA. Adjust the corresponding preset so that 50mA flows - within 2mA is acceptable. Do not leave it drawing a much higher current than this for a long time or the transistor will become hot. Repeat with the other battery. Connect the battery snaps correctly and leave the cells to charge. If they were completely "flat" to begin with, this will take 15 hours. During this process, the transistors will become warm.

When the batteries are charged, switch the unit to "operate". The green LED should come on. Turn the output switch spindle fully anti-clockwise - i.e. to 3V. Adjust the multimeter to a voltage range covering 12V d.c. and connect the probes to the terminals. The meter should give a reading very close to 3V - say, within 5%. Proceed through the other voltages checking each one. If there is anything amiss here, suspect the soldering at one of SW2 tags. With the unit set to 12V, connect a 12V 5W lamp (car sidelight bulb) to the output terminals. This draws 420mA approximately and the supply should maintain this for more than 1 hour using standard "AA" cells. Measure the output voltage - under load it will have fallen a little. Measure it again every 10 minutes. It will be clear when it begins to fall more rapidly to, say, 11V indicating that the regulator is unable to maintain the supply. Adjust RV3 at this point so that the buzzer just begins to sound. It may be necessary to re-adjust it slightly over a few days of trial to achieve the best effect.

If all is well, assemble the case checking for trapped wires and short-circuits. Drill a few holes in the top section above BUZ1 position to allow the sound to emerge if it proves to be too quiet. Attach self-adhesive plastic feet to the bottom of the case. It now only remains to label the switches and put the unit into service.

Final points

Note that the switching current of SW1 is only 150mA although it can carry 5A. It is, therefore, important not to switch the unit on or off using SW1 when a higher load than this is connected. This precaution does not apply to SW2 which carries only a small current. When a large current is drawn and a low voltage is selected, the case will become warm in use - this is normal. Also, at a high current, there may be difficulty maintaining a 12V supply. The red LED is not a signal that the batteries are actually charging - only that the switch is in the "charge" position. Do not leave it like that with no supply connected or the LED will drain the batteries.

TABLE 1

| Voltage (ohms) | Resistor value |
|-------------------|----------------|
| 3 | 68 |
| 4 | 300 |
| 5 | 300 |
| 6 | 300 |
| 7 | 300 |
| 8 | 270 |
| 9 | 300 |
| 10 | 300 |
| 11 | 300 |
| 12 | 300 |

PARTS LIST

Resistors

| | |
|--------|--|
| R1, R4 | 4k7 |
| R2, R5 | 4R7 |
| R3, R6 | 47R |
| R7 | 680R |
| R8 | 220k |
| R9 | 18k |
| R10 | 1k |
| R11 | 820R |
| Rx | Chain resistors: 56R (one off), 300R (8 off), 270R (11 off). See Table 1. All 1% metal film. |

Capacitors

| | |
|----|--|
| C1 | 220n min. metallised polyester 5mm pin-spacing |
| C2 | 100n min. metallised polyester 5mm pin-spacing |

Semiconductors

| | |
|------|--------------------------------------|
| Q1 | BFY51 |
| IC1 | ICL3211CPA voltage detector |
| IC2 | L200CV voltage and current regulator |
| LED1 | Red LED indicator |
| LED2 | Green LED indicator |

Miscellaneous

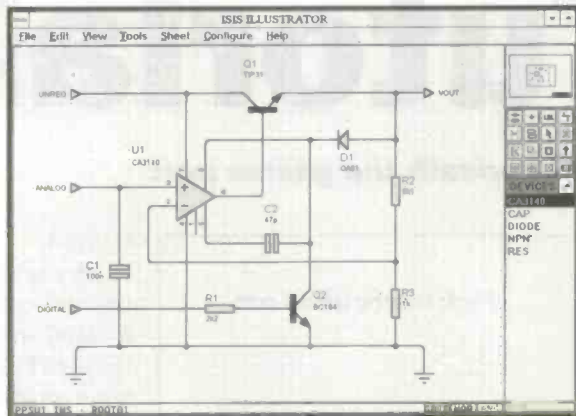
| | |
|--------|--|
| B1, B2 | 12 off "AA" nickel cadmium cells - see text. Cell holders for 6 "AA" cells with PP3-type connectors - 2 required. |
| SW1 | 4-pole 3-way rotary switch - break before make action. |
| SW2 | 1-pole 12-way rotary switch - make before break action. |
| BUZ1 | 10GB mounting buzzer - 12V d.c. 5mA operation 4-pin terminal posts - 1 red, one black 2.5mm "power-in" plug and socket TO-36 mounting kit for regulator PP3 battery connectors (2 required) Fused cigarette lighter plug and 1A fuse to 1. Control knobs Aluminium case (152 x 114 x 44mm) |

Buy Lines

Most of the components for the Rechargeable PSU are freely available. Check the prices of "AA" nickel cadmium cells with several mail order suppliers - you should not pay more than £1.1 each. Maplin supply the semiconductors, buzzer, switches, enclosure, etc.

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CADPAK is especially suited to educational, hobby and small scale schematic and PCB design. CADPAK includes both schematic drawing and 32-bit PCB drafting tools but as an entry level product, there is no netlist link between them.



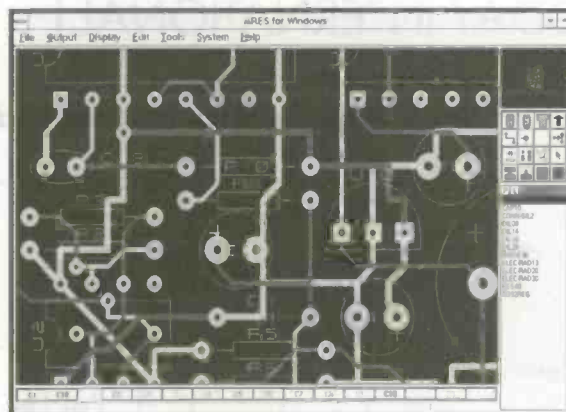
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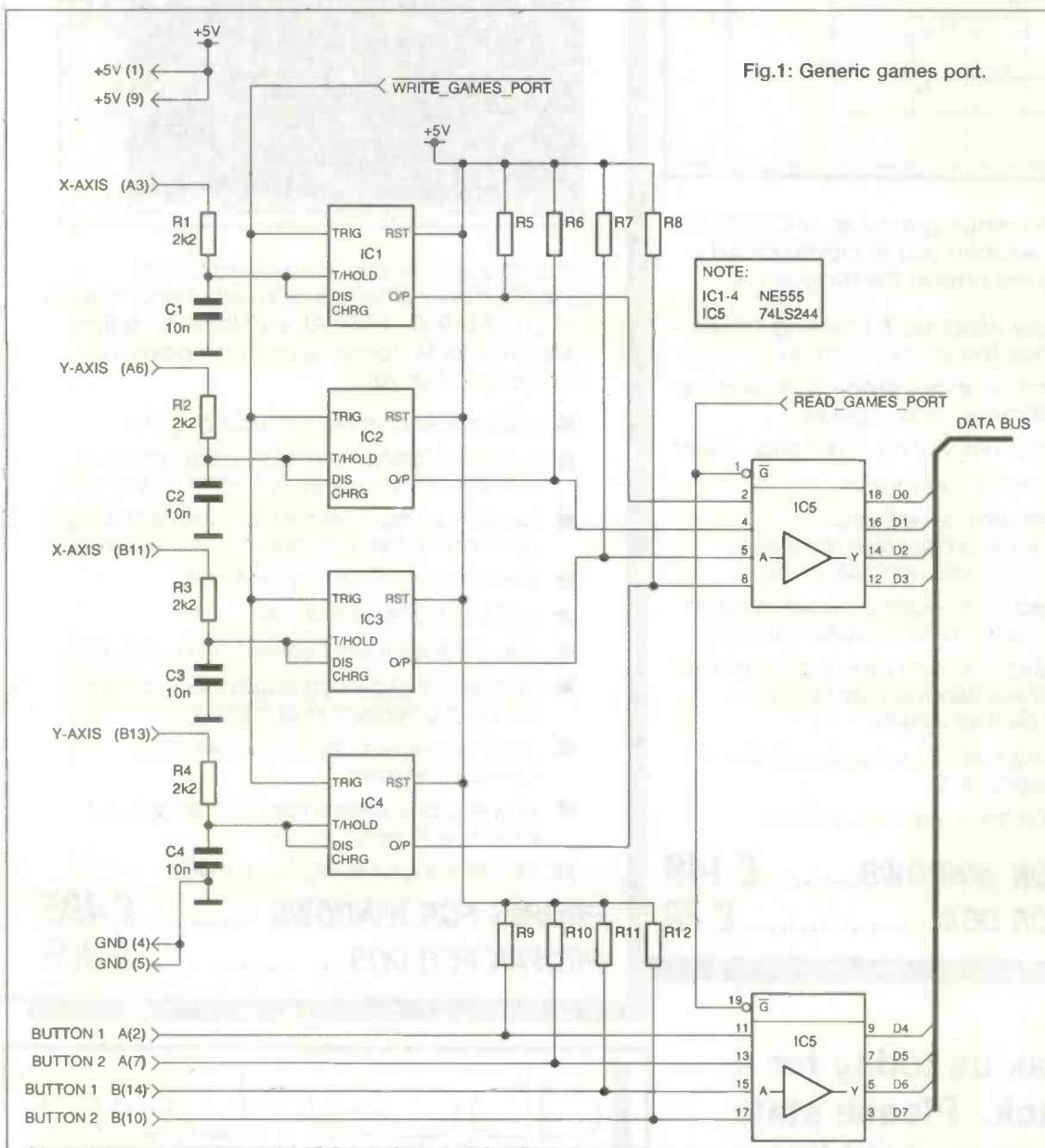
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Games Port Tutorial

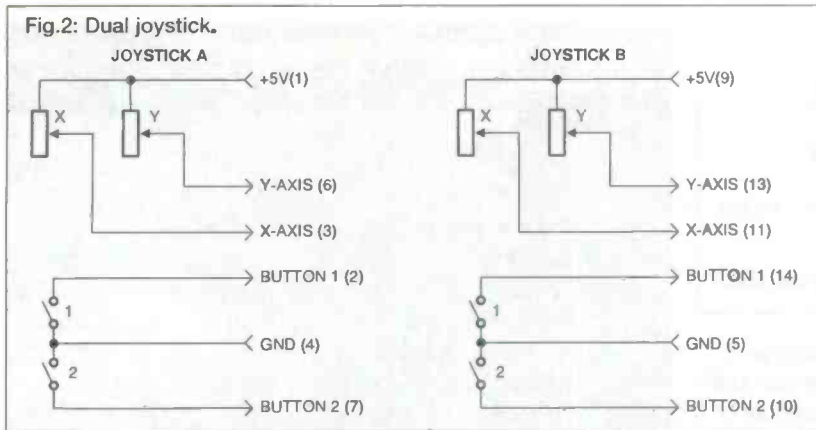
Stephen Smith looks at the unexplored world beneath the games port



If you are anything like myself, the first thing you do when you get a new computer is play games. Lost in this twilight world, we never usually give a second thought to the games port; its only obvious use is to plug in the joystick. But beneath the innocent exterior of the games port lurks an unexplored world to the

hobbyist. When you look at the input/output available on a standard PC, you see a parallel printer port (see making use of the PC parallel port, ETI, June '95) two COM ports (standard RS232 ports) and a games port. The games port may seem a strange addition to a primarily business computer, but the cost it adds to the highly integrated multi-I/O controller is so small that many computers have them, essentially, for free. Using this port to interface your own projects to your PC is easy and, potentially, very powerful. To use the games port for other tasks, you first need to understand its intended use. The PC games port is designed to interface to two analogue joysticks, each with two buttons. These analogue joysticks consist of two potentiometers at right angles (the x and y axis) that are linked to the joystick, so that the amount of movement in either direction is converted into a resistance across the potentiometer. The games port allows the PC to evaluate this resistance to assess the joysticks' position.

hobbyist. When you look at the input/output available on a standard PC, you see a parallel printer port (see making use of the PC parallel port, ETI, June '95) two COM ports (standard RS232 ports) and a games port. The games port may seem a strange addition to a primarily business computer, but the cost it adds to the highly integrated multi-I/O controller is so small that many computers have them, essentially, for free. Using this port to interface your own projects to your PC is easy and, potentially, very powerful. To use the games port for other tasks, you first need to understand its intended use. The PC games port is designed to interface to two analogue joysticks, each with two buttons. These analogue joysticks consist of two



A conventional method of reading such an analogue joystick is to put a constant DC voltage across the potentiometers and measure the voltage at the wipers of the potentiometers. This involves using an ADC to measure this value (as used in the BBC Micro). ADCs cost money and people want cheap games ports, so IBM designed a much simpler method of assessing the joystick's position. If a capacitor is placed in series with the potentiometer's resistance to be measured, the RC time constant can be used to read the joystick's position.

The IBM joystick port is located at I/O address 201Hex; writing anything to this location triggers a set of four one-shots that are used to measure the x and y positions of the two joysticks supported. Table 1 shows the bit allocations of the games port. Once the one-shots have been triggered the games port is continuously read until all of the one-shots have decayed. The number of times the location is read before the one-shots have decayed is counted by the controlling software and interpreted as a joystick position. The time of the one-shot is given by:

$$24.2 + (0.011 * \text{resistance}) \text{ micro-seconds}$$

but stray capacitance and lead resistance can, in practice, make this equation useless. When reading a joystick, however, it is the movement thus variation in this time that matters, so the absolute time and resistance does not matter. Using a software counter to time the one-shots does, however, make the process more complex as the original 4.77MHz PC counts a lot slower than your modern 486. This means that calibration of the joystick is essential. Measuring the joystick's readings at top left and bottom right allows the full travel of a joystick to be known.

Figure 1 shows a circuit diagram for a typical games port. The buttons pull the appropriate inputs to the buffer to ground whereas the position inputs are fed to a 555 configured as a monostable. The 2K2 input resistor allows any resistance to be measured, even down to a short circuit. The time of a 555 one-shot is given by $1.1RC$; here the time equals:

$$1.1(2K2 + R_{pot})10^{-6}$$

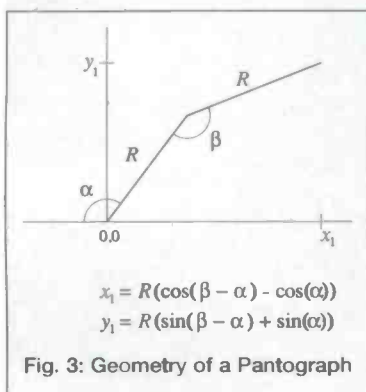


Fig. 3: Geometry of a Pantograph

Address decoding on the games port expansion card generates one of two signals when reading from, or writing to, I/O location 201Hex. These are shown as Read_Games_Port and Write_Games_Port in figure 1. The action of writing to the games port location triggers the 555.

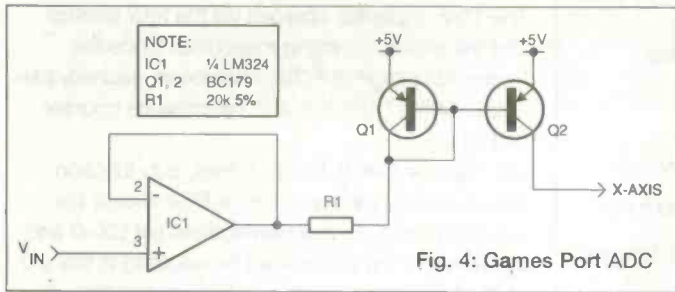
The 10nF capacitor charges via the 2K2 resistor and the resistance being measured. Once the threshold voltage of $2/3V_{cc}$ has been reached, the output of the 555 rises and the software counter can stop.

You can use the BIOS INT 15Hex, sub-function 84Hex to read the joystick in all PCs except the very early ones. To read the buttons set DX=0 and the status of the buttons will be returned in bits 4-7 of AL. To read the position set DX=1 and the positions of the joysticks will be returned in AX, BX, CX and DX (corresponding to bits 0-3 of the games port). For the people that use high level languages QBASIC has two functions for reading joysticks.

STICK to read the position and STRIG to read the status of the buttons. (Look at listing 2 and in the on-line help if you want more assistance.) Listing 1 gives an example Turbo C program to read the position and button status of a joystick. This code counts the length of the one-shot for each joystick potentiometer until all time out or the counter reaches MAXINT. (This is in case only one joystick is attached.) Reading the status of the buttons is a simple case of masking the appropriate bits.

Table 2 gives the pinout of the 15way D type that is used for the games port. The potentiometers go between +5V and the appropriate pin goes to the wiper. The buttons simply pull the appropriate pin down to ground. This is simply illustrated in figure 2. The +5V from the games port is usually unfused and, as such, great care should be taken when using it. The obvious uses for the games port include sensing any switches or resistances that vary up to 150K. These could include temperature measurement using a thermistor or even a pantograph. A pantograph is a mechanical instrument for copying drawings made up of a series of jointed beams that is fixed at one point, has a pen at another and has a pointer to trace the original drawing. When I was a child I had a pantograph that could copy drawings at a scale of 1:1, 2:1 or 1:2 depending upon the configuration of the pointer, pen and fixed base. Electronic versions of the pantograph allow drawings to be digitised by simply tracing the outline of the drawing. A geometric representation of an electronic pantograph is shown in figure 3. Two beams of length R are jointed with a pair of potentiometers. Therefore the angles that the joints make are represented by the resistance of the linear potentiometers. From these two values and a known beam length, the co-ordinates of the pointer can be found. To convert the joystick positions from the games port into an angle for the trigonometric equations, the system needs to be calibrated. Defining each angle to be zero by placing the pointer at the origin and having the beams horizontal to the left and at maximum when the beams are fully extended horizontally to the right, allows the coefficients for calibration to be calculated. (i.e. the zeroed figures are the offsets to be removed by the software and the fully extended readings correspond to 180 or pi radians.)

Figure 4 shows a very simple ADC based upon the PC games port. The op-amp buffers the input signal into a current mirror. The current being defined by the output voltage of the op-amp and the 20K resistor. Thus the capacitor in the one-shot is charged by a constant current defined by the input voltage. The pulse generated by the one-shot has a duration of $\frac{2}{3(4.3-V_{in})}$ mS. Unfortunately, this time is inversely proportional to the input voltage which means that the resolution at low input voltages is very poor, so try and keep the input voltage between 2.5V and 3.5V to improve the accuracy (although the circuit will work on input voltages as low as 1V, they are acquired with a very poor accuracy).



Listing 2 gives a short QBasic program to read in a voltage from such a converter. The diagram shows only one channel; four such channels can be implemented on the four position inputs of the games port, using the four op-amps in the LM324. This ADC is very crude, giving only about 6 bits resolution, but as the component cost is less than £2 for four inputs you cannot really complain. Replacing the 20K resistor with a larger value, such as 200K, gives a greater resolution but cannot be read by the STICK QBasic command. If the position inputs of the games port are driven by a logic level (0V or 5V) these inputs could be used to read in a digital signal. If 0V is present at an input the capacitor in the one-shot will not charge and the games port will read this as a logic 0. If 5V is present at an input the one-shot will run just off the 2K2 inherent resistance, which will create a pulse of approximately 24.2µs. Therefore, to read a logic level input the port needs to be left for a time greater than this after being triggered, before a valid reading is possible. Thus all the inputs of the games port are essentially digital and they could be used to input 8 bits of digital data.

WARNING

The +5V supply available on the games port is usually directly connected to the PC's main +5V supply. This supply is capable of delivering up to 20A that can blow a fuse on the games port, if you are lucky, or vaporise tracks on the games port's PCB. Either form of destruction leads to a dead games port or computer. Also, do not connect any externally powered circuit to your games port unless you have checked and double checked your work. It is important to note that modern PCs have their games ports on the same small piece of silicon as the serial ports, printer port, floppy and hard disk controllers. So, electrically, the games port is very close to expensive parts of your system, like the motherboard and hard disk. Damage to the games port puts these expensive parts in danger of devastation. Please do not let this deter you, just be careful.

The circuits and systems presented here are not intended to be full projects and as such no PCB or other support is available. These have been devised only as examples and ideas to inform you and invoke your imagination. The games port is an easy way of getting data into your PC, so have fun experimenting.

| Bit | Use |
|-----|----------------------|
| 0 | Joystick a, x axis |
| 1 | Joystick a, y axis |
| 2 | Joystick b, x axis |
| 3 | Joystick b, y axis |
| 4 | Joystick a, button 1 |
| 5 | Joystick a, button 2 |
| 6 | Joystick b, button 1 |
| 7 | Joystick b, button 2 |

The axis bits are 1 when the one-shot is active.
 The buttons are 0 when pressed

Table 1. Games Port Register Bit Allocation.

| Pin | Use |
|-----|----------------------|
| 1 | Joystick a, 5V |
| 2 | Joystick a, Button1 |
| 3 | Joystick a, x axis |
| 4 | Ground |
| 5 | Ground |
| 6 | Joystick a, y axis |
| 7 | Joystick a, Button 2 |
| 8 | No Connection * |
| 9 | Joystick b, 5V |
| 10 | Joystick b, Button 2 |
| 11 | Joystick b, x axis |
| 12 | No Connection * |
| 13 | Joystick b, y axis |
| 14 | Joystick b, Button 1 |
| 15 | No Connection * |

* The pins identified as 'No Connection' may be used by some cards for other functions, e.g. a MIDI interface on a Sound Blaster card.

Table 2. Games Port Pin Allocations

```

/* Listing1.
   Joystick reading example program.
*/
#include stdio.h
#include values.h
#include dos.h
const int MASKXA=1;
const int MASKYA=2;
const int MASKXB=4;
const int MASKYB=8;
const int GAMES_PORT=0x201;
void joy(int *xa,int *ya,int *xb,int *yb)
{
    int State,Count;

    outportb(GAMES_PORT,0); /* Dummy Write to
    Trigger one-shots */

    State=inportb(GAMES_PORT);

    for(Count=0;(State&0x0f) !=0 && (Count 999
    MAXINT);Count++)
    {
        if ((State & MASKXA) != 0) *xa=Count;
        if ((State & MASKYA) != 0) *ya=Count;
        if ((State & MASKXB) != 0) *xb=Count;
        if ((State & MASKYB) != 0) *yb=Count;

        State=inportb(GAMES_PORT);
    }
};
main()
{
    int xa,ya,xb,yb;

    for(;;)
    {
        joy(&xa,&ya,&xb,&yb);
        printf("The Joysticks read:
        %d,%d,%d,%d\n",xa,ya,xb,yb);
    };
    return(0);
};
REM Listing2
CLS
Start:
    V1 = 4.5 - 100 / STICK(0)
    V2 = 4.5 - 100 / STICK(1)
    V3 = 4.5 - 100 / STICK(2)
    V4 = 4.5 - 100 / STICK(3)
LOCATE 10, 5, 0
PRINT V1, V2, V3, V4
GOTO Start

```

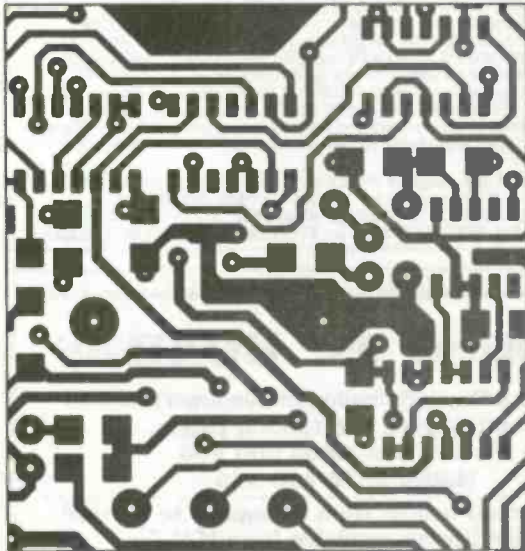
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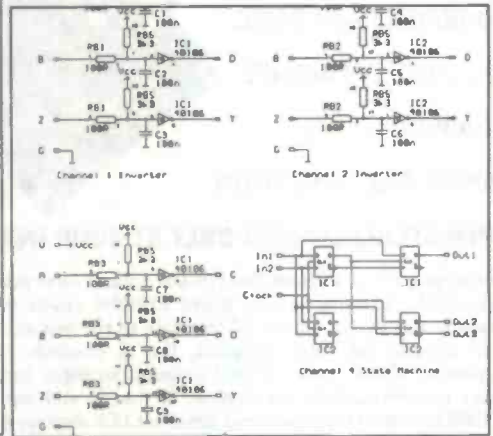
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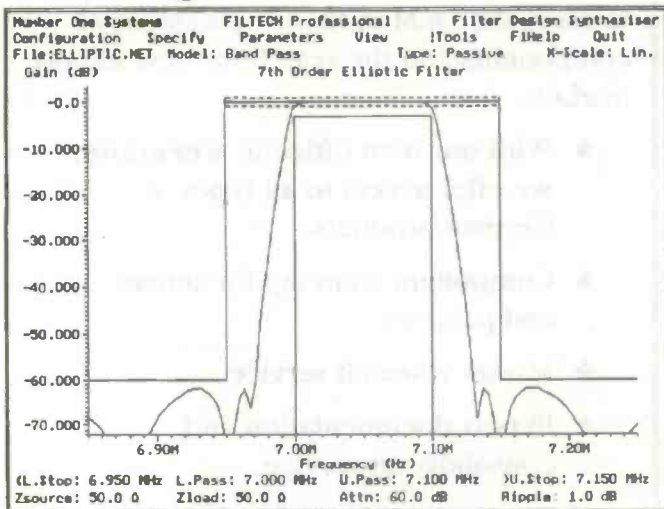
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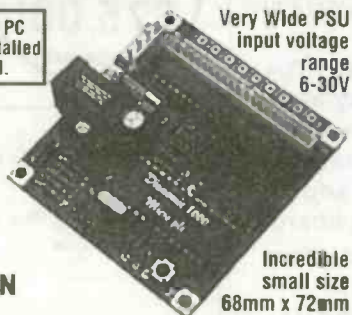
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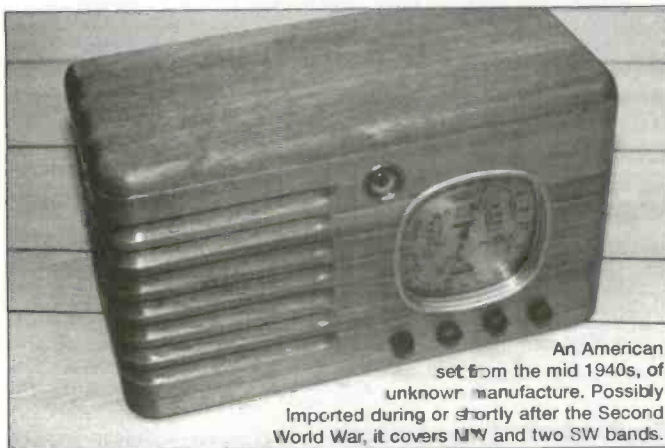
SERVICING AND RESTORATION

PART 2

Paul Stenning continues his exploration of 'antique electronics'

Last month we took a general look at the restoration and repair of 'antique electronics', in particular old valve radio sets. This month we delve further into the practical aspects starting with a look at the circuit diagrams of two receivers. Circuit 1 is the Ekco U245. This is a small transportable bakelite set made in 1955. It is designed for use on AC or DC mains, and covers the MW and LW wavebands only. The circuitry is reasonably

standard, apart from the biasing of the output stage. Circuit 2 is the Bush VHF61. This is a larger bakelite table set made in 1956. It is designed for use on AC mains only, and covers MW, LW and VHF. The circuit is fairly typical of a higher quality receiver, and features a tone control, gramophone input, 'Piano Key' waveband selection switches, and a 'Magic Eye' tuning indicator. These circuit diagrams were kindly supplied by Anode Electronics.



An American set from the mid 1940s, of unknown manufacture. Possibly imported during or shortly after the Second World War, it covers MW and two SW bands.



The Ferguson 621U. A three-waveband VHF, MW, LW set from the late 1950s, constructed on a PCE.

Applying a Test HT supply

Before the set is connected to the mains, apply a test supply to the HT rail. This will show up some leaky capacitors, and will hopefully reform the electrolytics. It is not necessary to fit the valves at this stage. My High Voltage Capacitor Reformer unit is ideal for this purpose. Switch it to the 240V setting and connect a meter to the appropriate terminals to monitor the current.

Connect the negative lead to a convenient point on the chassis and the positive lead to the positive terminal of the electrolytic capacitor that is connected directly to the cathode of the rectifier valve. This is often the red tag on the main smoothing can. On our example circuits, this is the positive terminal of C32 on the Ekco and the positive terminal of C58 on the Bush.

Switch the HT supply on, and watch the current reading. It will probably start high (maybe 30mA), and will hopefully drop after a few seconds as the smoothing capacitors charge up. If you are lucky it will drop to maybe 1mA, which is acceptable leakage for the electrolytics. However it is more likely to remain at a higher level, and there can be several reasons for this.

Check for potential divider circuits across the HT supply. Most sets do not have one, but our example Ekco does - R15 and R16. For this test to be meaningful the lower one (R16 in this case) should be temporarily disconnected.

If the current reading is still over 1mA once the potential dividers have been accounted for, we need to establish where it is going. The most likely explanation is leaky capacitors.

Leaky capacitors

Elderly electrolytics often have high leakage currents. These will

A group of the above sets.



sometimes improve if they are left powered by the capacitor reformer for a few hours.

I prefer to remove the electrolytics from the chassis for reforming if it is likely to take more than a few minutes. This allows each section of a can to be reformed separately, without the effects of other components. If the leakage is fairly bad the electrolytic could get warm after a while, in which case switch off the power and allow it to cool down again. The maximum acceptable leakage current is about 1mA for each 30uF.

Look for signs of resistors or capacitors getting warm (such as molten wax). But don't poke your fingers into the chassis with the power on! Any capacitors that are getting warm will need to be replaced. If a resistor is getting warm, work out which capacitor(s) it is supplying. Thus on our sample Ekco, if R9 was getting warm, C24 would be suspect.

Even if nothing is getting warm we can use the same logic to establish the cause of the current consumption. Measure the voltage drop across any resistor (or resistive component such as a transformer winding) that is feeding one or more capacitors. If the capacitor is OK there will be no voltage drop.

You can also check other potentially leaky capacitors by this method. In particular I would urge you to check the coupling capacitor to the grid of the output valve. Measure the voltage between the grid and the chassis. If it is even slightly positive, change the coupling capacitor (C27 on the Ekco).

If there are several leaky capacitors in a set, the chances are that other components of the same type will be in a similar state. In this case I would change all of that type, to save problems later.

Capacitor types

The capacitors in question here are those values from about 0.001uF (1nF) to 0.47uF (470nF). The smaller value capacitors do not seem to

give any trouble. There are various types of capacitor used, and some are worse than others.

Probably the most common - and the most trouble - are the wax coated paper types. These are tubular components, with a distinctive sticky yellow wax coating. Most of these capacitors will be found to be leaky, and I usually replace them all as a matter of course. Many later sets use Hunts Moldseal capacitors. These are small brown or black tubular plastic components which are fairly unreliable. If the case is cracked or fractured it should be replaced, otherwise it may be OK.

Many Philips sets use black capacitors coated with pitch. These are usually fairly reliable, but when they do fail they tend to go short circuit.

Some later sets use small tubular capacitors, which have the appearance of a piece of thin tube with two wires wrapped around it. From my experience these are reliable.

Replacement capacitors

Any replacement must be of similar shape and size as the original, and must have a suitable voltage rating. Valve component suppliers such as Anode electronics stock suitable capacitors, often at favorable prices. You may be able to obtain a mixed pack of 50 or 100 components, containing the more useful values.

The replacement capacitors may not be available in the same capacitance values as the original components. This is not normally a problem, simply fit the closest available. For example a new 0.047uF component could be used to replace a faulty 0.04uF or 0.05uF capacitor.

Electrolytic capacitors

The cans are not readily available now, although valve radio dealers often stock something suitable. The usual approach is to fit a replacement modern axial capacitor below the chassis and leave the

The Philips B2G81U. A small AC DC set released in 1959, constructed on a printed circuit board.



The Bush VHF61. One of our example sets.



can, disconnected, on the chassis so it looks correct. Some restorers remove the innards from the original cans and fit the modern replacement capacitors inside.

Anode Electronics stock a range of 450V axial electrolytics in values from 1uF to 47uF which should cover most eventualities.

Fitting replacement components

Any replacement components must follow (as close as possible) the path and position of the originals. In particular this applies to those close to the chassis and those in the RF stages. Connections to the chassis should be made to the original point if possible. The original layout would have been planned and optimised to avoid instability, so it is best not to deviate from this.

Any lead that is close to another component or the chassis should be sleeved with PVC sleeving (or a bit of wire insulation) to avoid any risk of short circuits.

Preparing to apply the mains

The mains flex must be replaced with modern cable. The only exception to this is if the cable contains ballast resistance (this cable is thicker than normal).

If the set is an AC/DC type, one side of the mains will be connected directly to the chassis, or via a low resistance (as in our example Ekco). This should be connected to neutral (blue wire) for safety.

Check that the mains on/off switch works. If it is a single pole type it should ideally be replaced with a double pole switch. Failing that, make sure it is switching the live side of the mains, and rewire it if necessary.

Make sure the dial lamps are the correct types and functional. Check the mains voltage setting matches the supply voltage in your area.

Reconnect the output transformer and speaker. Make sure any speaker switching arrangements are set so that the internal speaker is

connected. Finally fit the valves, making sure they are in the correct positions.

Applying the mains

Connect a test meter between the positive terminal of the main HT smoothing capacitor and the chassis. Set this to a DC voltage range of at least 300V.

Arrange some sort of safe mains connection that you can switch on and off easily. Always keep your finger near the mains switch when the set is on - so it can be switched off quickly.

Switch the power on for just a few seconds. Hopefully all the valve heaters will start to glow, and the dial lamps should illuminate. If any valves heaters do not glow, or some are brighter than others, the reason should be investigated. Valves are fairly robust, but the heaters must not be overrun for any period of time or the cathode will be damaged.

If all the heaters seem OK, leave the set on for a little longer and watch the HT voltage reading. After maybe five to ten seconds this should start to rise, and will reach a maximum of perhaps 250V to 300V after a further five or ten seconds. The voltage will then begin to drop again, by between ten and forty volts, as the output valve warms up.

Check the service information for the correct voltage on the cathode of the rectifier valve. In the case of our sample Ekco it is 190V, and on the Bush it is 252V. The actual voltage can vary by perhaps 15V either way, but greater discrepancies should be investigated.

If you have a digital meter with a high input impedance you should measure the voltage directly across the control grid resistor of the output valve. It should be virtually zero. If there is a positive voltage here, the coupling capacitor is leaky.

Quick Checks

If the set does not show signs of life, all is not lost. A few simple tests and observations may help to narrow down the faulty section.

Listen closely to the speaker for signs of life. If you can hear some sort of hum or noise the power supply and amplifier are probably doing something. If it is completely silent, check the connections between the output transformer and speaker, in particular the switch or whatever is used to disable the internal speaker. The primary of the output transformer may be open-circuit.

Turn the volume up and touch your finger on the centre tag of the volume control pot. If the amplifier is working you will hear a loud buzzing from the speaker. This would confirm that the amplifier and power supply are alive.

With the volume turned up, operate the wavechange switch. If there are healthy crackles from the speaker, the IF and detector sections are probably alive.

If the IF seems OK, try connecting an aerial or a length of wire to the control grid of the mixer-oscillator valve (pin 2 of V2 on the Bush). If this produces some sort of noise or even stations, the connections and components between the valve and the aerial socket or ferrite rod aerial may be suspect.

Confirm that the set is dead on all wavebands. If some wavebands are working, the fault is narrowed down to those components or circuits that are used only on the faulty bands.

Detailed circuit operation

The following descriptions only cover the more common arrangements. I have not attempted to explain the operation of the circuit, except where valve techniques differ widely from transistor arrangements.

Power supply circuit arrangements

There are two basic arrangements, depending on whether the set is designed for use on AC and DC mains, or AC mains only.

The Bush is an AC only set. The transformer T2 supplies the valve

The Bush VHF80C. A small three waveband set released in 1960.



heaters, which are connected in parallel, from a low voltage (in this case 6.3V) winding. On some sets the rectifier heater is powered from a separate transformer winding to reduce the stress on the heater-cathode insulation. The dial lamps are powered from the main heater winding.

The mains transformer often has two or more tapings on the primary, for different mains supply voltages. To avoid damaging the valves, it is important to check that the setting is correct for the local supply voltage in your area.

A separate centre-tapped secondary winding, typically 250-0-250V, is used for the HT supply. This is full wave rectified by V8 (EZ80). If the HT supply is absent, check that the AC supply is reaching both anodes of the rectifier valve. Mains transformers occasionally fail, but this is often caused by a fault elsewhere.

A few specialist companies offer a transformer rewinding service, but this can be expensive. RS stock a modern HT transformer (196-072) for £24.85, which may be a suitable replacement in some cases. Anode Electronics and a few other dealers may have a suitable second hand component which would be somewhat cheaper and more in keeping with the age of the set. If the requirements are unusual, the best approach may be one of the transformer winding kits. A 50VA kit is normally suitable, and costs about £11.

If the AC is present but the DC HT supply is absent, the rectifier valve is probably faulty. Check first that the heater is being driven.

If there is sparking and fireworks inside the rectifier valve, there is probably a short circuit or heavy current demand on the HT supply. This is probably due to a faulty smoothing capacitor or maybe a fault in the output stage. Do not leave the set in this state for any time as the risk of destroying the mains transformer is very high. You will definitely need a new rectifier valve, even if the transformer survives. Sparking inside the rectifier valve can also be caused by the valve itself being faulty, but this is less common.

AC/DC sets

The main drawback of AC only sets, as far as manufacturers were concerned, was the cost and weight of the mains transformers. This could explain the popularity of AC/DC sets in the 50's, even though DC mains was becoming less common.

In AC/DC sets (such as the Ekco) the valve heaters are connected in series. The current ratings are the same (often 100mA) and the voltages differ. If one valve heater should become open circuit, the circuit will be broken and none of the heaters will glow.

The total voltage of the heater chain is normally lower than the mains supply voltage, and the remainder is dropped by a resistor. In the Ekco R21 is the dropper resistor, which drops about 93V and dissipates 9.3 Watts. Sometimes the dropper resistor is replaced or supplemented by a thermistor to keep the heater current more constant.

Mains supply voltage selection is arranged by additional series resistors. In the Ekco, R22 is included in the circuit when the voltage is set to the 225-250V position.

If one valve does not glow it has probably lost its vacuum. If some valves do not glow and others are excessively bright, one of the valves may have a heater to cathode short circuit.

If you need to check the heater current, the easiest method is to measure the voltage across one of the valve heaters and compare this to the value in the valve data book. Alternatively measure the voltage across the dropper resistor and calculate the current using ohms law. If the difference is greater than about 5% either way, the reason should be investigated.

Dial lamps

Dial lights are sometimes connected into the heater chain. There may be a thermistor or resistor in parallel with them, to enable the set to keep working if one of the lamps fails. The dial lamps may alternatively

be in series with the supply to the whole set, possibly shunted by a resistor or thermistor.

The dial lamps will probably not be running at maximum brightness when the set is warmed up and working normally. During the initial warming up process the lamps will vary in brightness, and may be very dim or very bright depending on the circuit arrangement.

Dropper resistor

The dropper resistor and voltage selection resistor are often contained in one component. This is often a green (or sometimes grey) tubular component with several tags, mounted on the top of the chassis. These high power resistors run very hot, and often fail by going open circuit.

You may be able to obtain a suitable second-hand component from a valve component dealer. Failing that, the normal solution is to bridge the faulty section with a new resistor of suitable power rating. The resistors often have odd values, in the Ekco the main section is 930R. A suitable replacement would be a 1K0 11W ceramic resistor.

AC/DC HT supply arrangements

The mains is half-wave rectified, to produce the HT supply. This is carried out by V5 (UY41) in the Ekco set. R20 is a surge limiting component. If the HT supply is missing, check that the AC supply is reaching the anode of the rectifier. The surge limiting resistor is prone to failure, resulting in no HT. If the AC is present but the HT supply is absent the rectifier valve is probably faulty.

C34 in the Ekco is a suppression component, which prevents modulation buzz when the set is tuned to a strong signal. This capacitor often fails by blowing itself to pieces. The replacement MUST be suitable for direct connection across the mains.

Faulty valve holders

A fairly common problem, particularly on cheaper sets, is poor contact between the valve and the valve holder. This is not limited to the power supply, and can occur anywhere in the set.

The problem is often caused by the contacts in the holder losing some of their spring tension. They can often be tightened by pushing a small jewelers screwdriver between the contact and the body to close the contact slightly. This must be done with great care to avoid breaking the contact or body.

Sometimes the valve holder contacts will be broken, or weakened by corrosion. There are various "techniques" used by service engineers for overcoming valve holder problems, but these are more appropriate to quick repairs than serious restoration.

With some types of valve holder it is possible to extract the contacts from above once the connections have been desoldered and the tags straightened.

It is often easier to replace the defective contacts with those from another valve holder, than to replace the complete holder.

Before disconnecting anything, make a note of the connections. The solder should be removed from the tags with a desoldering tool. If the existing solder does not melt and flow very well, apply some new solder before removing the lot with the desoldering tool.

Valve holders are often fixed to the chassis by rivets, which need to be drilled out. The new holder can be fixed in place with small screws and nuts.

Smoothing circuits

On earlier sets chokes were often used for decoupling, with comparatively low value electrolytic smoothing capacitors (8uF or 16uF). As higher value capacitors became available (32uF to 50uF), the chokes were replaced with power resistors which were much cheaper and less bulky. Some earlier sets use an energised speaker, the field winding being used as a smoothing choke.

Other power supply arrangements

Some AC/DC sets have the dropper resistor incorporated in the line cord. This can be identified by the mains cable being thicker than normal. The length affects the resistance, so it must never be shortened. If you suspect it has been, check with the service sheet or measure the heater current as described previously.

This line cord is no longer available so you may have no choice but to fit a suitable resistor inside the case of the set, but this could cause problems with heat dissipation. Some imported sets from countries with lower mains supplies (such as the USA) were fitted with long line cord resistors to drop the excess voltage.

Some continental AC/DC sets are designed for use on either 220V or 117V supplies. The heater chain is divided into two sections with their own dropper resistors. On the lower voltage setting they are connected in parallel, and on the higher voltage setting they are in series.

A few sets use a combination of AC and AC/DC circuit techniques. I have seen a Bush set using a series heater chain driven by the mains transformer. I have also seen a Ferranti set that uses a small transformer to drive the 6.3V heaters, the HT being derived by rectifying the mains.

The HT rectifier may be a metal or selenium rectifier. Either of these could be replaced with a 1N5404 silicon rectifier diode in the event of failure. If there is no surge limiting resistor or thermistor in series with the original rectifier, add a 120R 2.5W resistor in series with the silicon replacement.

Foreign sets

Continental 220V sets can be modified by adding a resistor in series with the supply to the set to drop about 25V. A 18R 5W resistor is often suitable, and can be positioned inside the set (it will dissipate about 3.5W).

110V sets from the USA are more of a problem. Many of these will have been modified by adding a large dropper resistor internally, to drop the extra 130V.

Some American AC/DC sets use a 300mA heater chain, so the total mains current consumption is about 350mA. The dropper resistor would be about 370R and would dissipate some 45 Watts, causing serious overheating. The best approach with 110V sets is to use an external 240V-110V transformer.

Battery valve sets

Batteries for battery sets are no longer available. The normal supply required is 90V at about 20mA for the HT and 1.5V at about 300mA for the LT (Heaters).

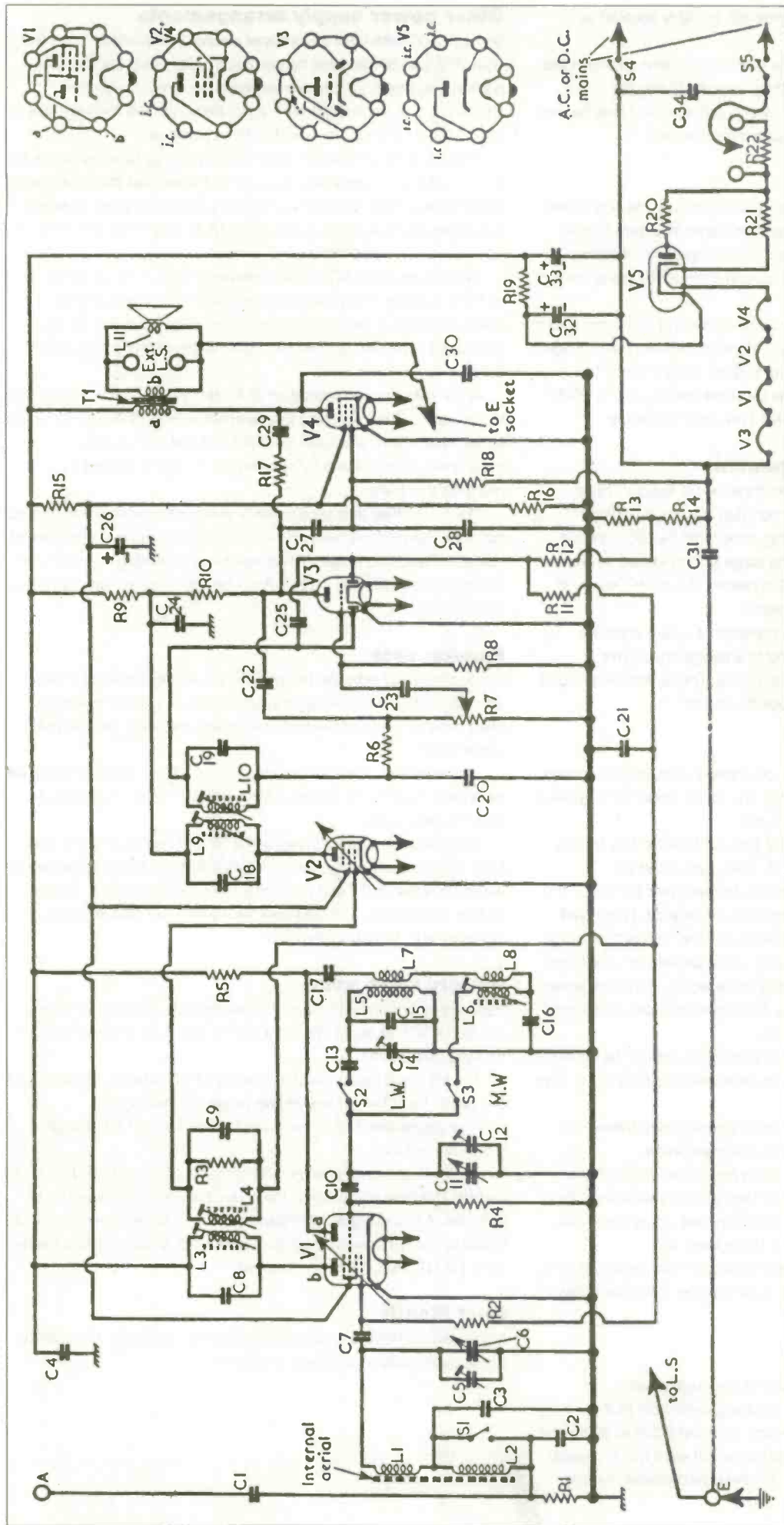
The HT could be obtained from ten 9V PP3 batteries in series, but this would be rather expensive and would not last for long.

A single alkaline 1.5V D cell would suffice for the LT, but again it would not last long.

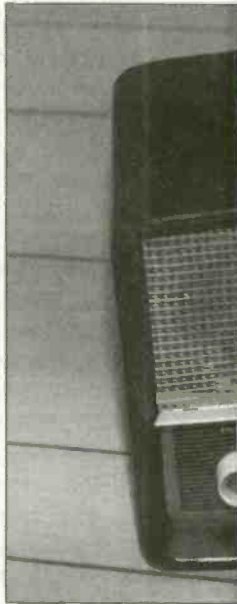
The best approach is some sort of mains power supply. This could be built in a case that will fit in the space previously occupied by the batteries. A unit designed jointly by myself and Nigel Rogerson will be available from Anode Electronics in early 1996. When ordering please state the HT and LT voltages required.

Next Month

In the next part of this series we will continue our detailed look at the circuit configurations and likely problems.



Circuit diagram of the Ekco U245. A.G.C. delay bias and grid bias for V4 is developed across R13 and R14. Valve base connections, as seen from the underside of the chassis, are inset on the right of the main part of the diagram.



CIRCUIT 1-EKCO U245 - COMPONENT LIST

| Valves | | Capacitors | | Resistors | | Coils * | | Other Components * | |
|--------|-------|------------|---------|-----------|------|---------|------|--------------------|-----|
| V1 | UCH42 | C1 | 0.01uF | R1 | 22K | L1 | 1.4 | T1a | 430 |
| V2 | UF41 | C2 | 2600pF | R2 | 470K | L2 | 3.5 | T1b | - |
| V3 | UBC41 | C3 | 47pF | R3 | 680K | L3 | 11.5 | S1-S3 | - |
| V4 | UL41 | C4 | 100pF | R4 | 47K | L4 | 11.5 | S4,S5 | - |
| V5 | UY41 | C5 | - | R5 | 47K | L5 | 6.3 | | |
| | | C6 | - | R6 | 47K | L6 | 3.4 | | |
| | | C7 | 300pF | R7 | 500K | L7 | 3.2 | | |
| | | C8 | 100pF | R8 | 10M | L8 | 1.5 | | |
| | | C9 | 100pF | R9 | 1K | L9 | 11.5 | | |
| | | C10 | 100pF | R10 | 220K | L10 | 11.5 | | |
| | | C11 | - | R11 | 1M | L11 | 2.5 | | |
| | | C12 | - | R12 | 1M | | | | |
| | | C13 | 345pF | R13 | 39R | | | | |
| | | C14 | 40pF | R14 | 47R | | | | |
| | | C15 | 200pF | R15 | 10K | | | | |
| | | C16 | 421pF | R16 | 33K | | | | |
| | | C17 | 0.001uF | R17 | 1M | | | | |
| | | C18 | 100pF | R18 | 1M | | | | |
| | | C19 | 100pF | R19 | 470R | | | | |
| | | C20 | 50pF | R20 | 160R | | | | |
| | | C21 | 0.1uF | | | | | | |
| | | C22 | 50pF | | | | | | |
| | | C23 | 0.01uF | | | | | | |
| | | C24 | 0.1uF | | | | | | |
| | | C25 | 15pF | | | | | | |
| | | C26 | 2uF | | | | | | |
| | | C27 | 0.002uF | | | | | | |
| | | C28 | 0.002uF | | | | | | |
| | | C29 | 0.002uF | | | | | | |
| | | C30 | 0.02uF | | | | | | |
| | | C31 | 0.05uF | | | | | | |
| | | C32 | 50uF | | | | | | |
| | | C33 | 50uF | | | | | | |
| | | C34 | 0.05uF | | | | | | |

* approximate DC resistance in Ohms

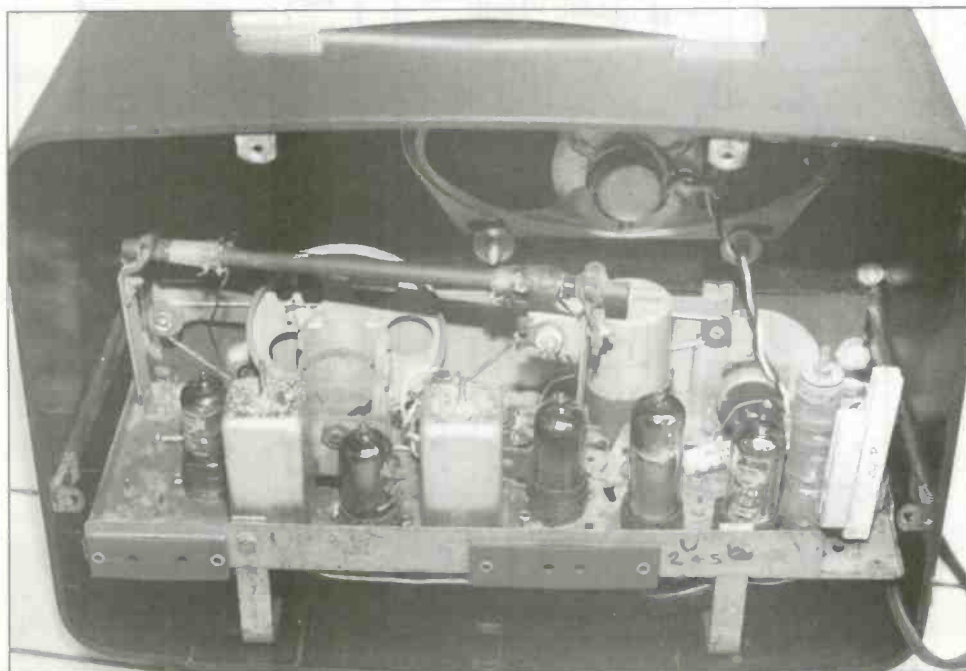


Above: The Ekco U245. One of our example circuits.

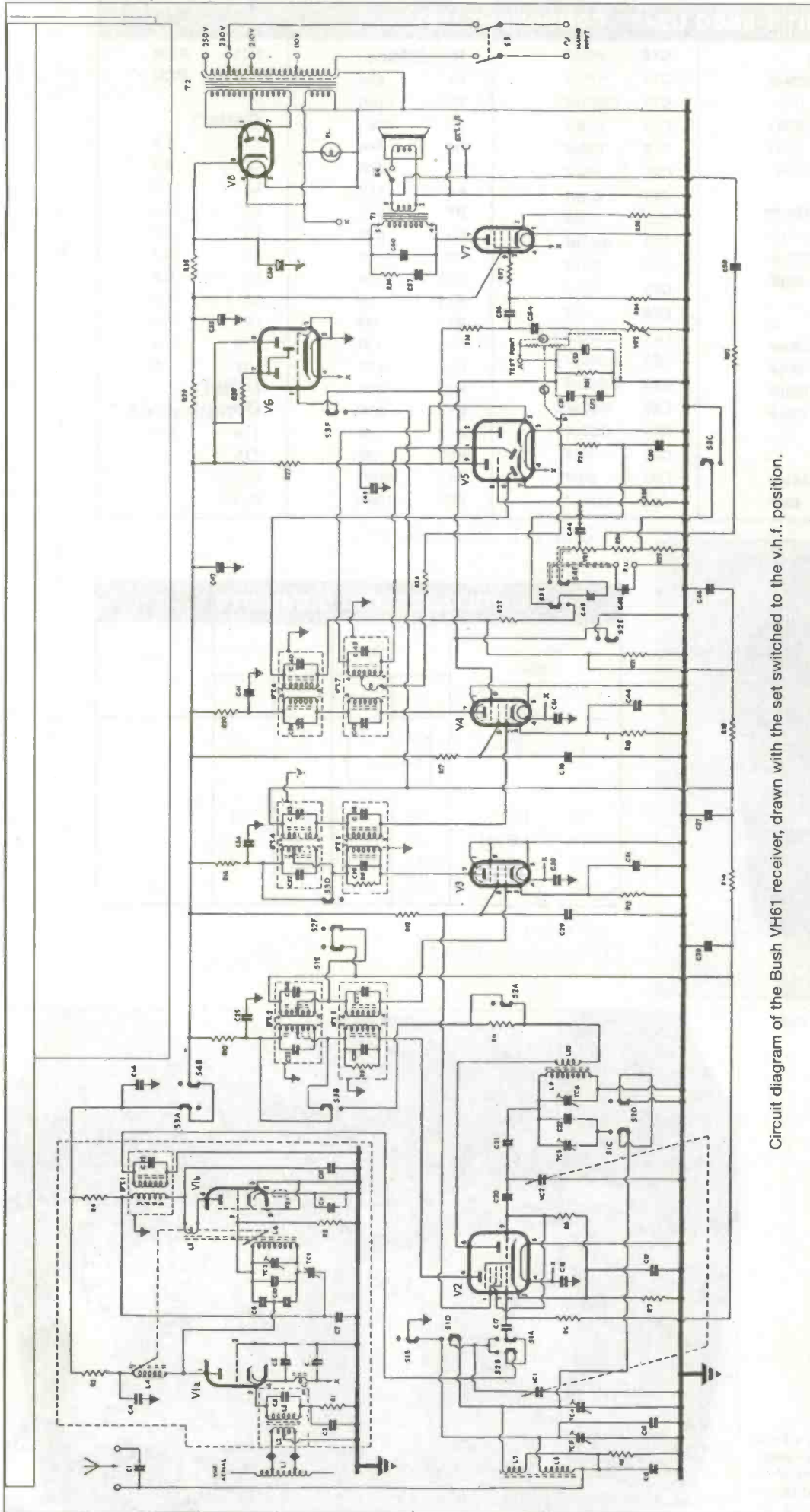
| VOLTAGES AND CURRENTS | | | | | |
|-----------------------|------------|------|--------|-----|------------------|
| Valve | Anode | | Screen | | Cath. (V) |
| | V | mA | V | mA | |
| V1 UCH42 | 170 | 1.7 | 72 | 2.9 | — |
| | Oscillator | | | | |
| | 55 | 2.3 | | | |
| V2 UF41 | 165 | 3.8 | 72 | 1.1 | — |
| V3 UBC41 | 78 | 0.4 | — | — | — |
| V4 UL41 | 157 | 27.0 | 72 | 3.7 | — |
| V5 UY41 | 205 | — | — | — | 190 ² |

¹ AC Reading

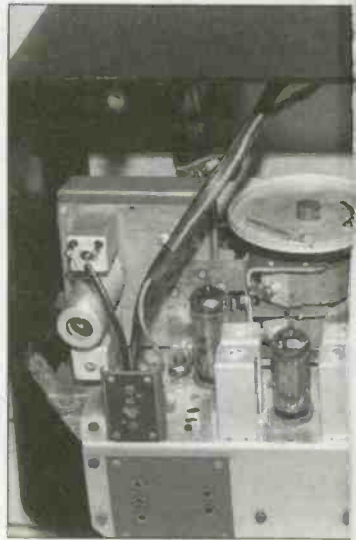
² Cathode Current 45mA



Right: An internal view of the Ekco U245 (one of our example sets). Note the additional resistors connected across the faulty dropper resistor to the right of the set.



Circuit diagram of the Bush V461 receiver, drawn with the set switched to the v.h.f. position.



The Bush DAC10. This set covers MW preset tuning. It was released in 1950

BELOW: An internal view of the Bush VHF61 (one of our example sets). The VHF tuner assembly is visible at the left of the chassis, next to the tuning capacitor. The mains transformer and voltage selector are on the right side. Below this on the rear of the chassis is the internal speaker switching screw and external speaker sockets. The tuning indicator is just visible on the speaker board to the left. Note that the output transformer (centre) is the RS replacement type suggested in the text. The tetrode solves the capacitance problem allowing operation at high frequencies. If it were connected directly to 0V it would act as another control grid and greatly reduce the anode current. It is therefore often connected to the HT rail via a resistor to drop some voltage, and decoupled to 0V with a suitable capacitor.



and LW, with manual and is very popular with collectors

CIRCUIT 2 - BUSH VHF61 - COMPONENT LIST

| Valves | | Resistors | | Capacitors | | Inductors (approximate DC resistances) | |
|--------|--------|--|-----------|------------|-----------|--|------|
| V1 | ECC85 | R1 | 150R | C1 | 47pF | L8 | 13R |
| V2 | ECH81 | R2 | 2.2K | C2 | 560pF | L9 | 4R |
| V3 | EF89 | R3 | 100K | C3 | 10pF | L10 | 1R |
| V4 | EF89 | R4 | 6.8K | C4 | 560pF | IFT2 pri | 14R |
| V5 | EABC80 | R5 | 10K | C5 | 560pF | IFT2sec | 14R |
| V6 | EM81 | R6 | 680K | C6 | 560pF | IFT4 pri | 14R |
| V7 | EL84 | R7 | 150R | C7 | 47pF | IFT4sec | 14R |
| V8 | EZ80 | R8 | 47K | C8 | 22pF | IFT6 pri | 14R |
| | | R9 | 22K | C9 | 22pF | IFT6sec | 14R |
| | | R10 | 10K 0.5W | C10 | 5.6pF | T1 pri | 380R |
| | | R11 | 2.2K | C11 | 560pF | T2 pri | 20R |
| | | R12 | 12K | C12 | 47pF | T2sec | 220R |
| | | R13 | 150R | C13 | 10pF | | |
| | | R14 | 1M | C14 | 0.01uF | | |
| | | R15 | 22K | C15 | 0.0075uF | | |
| | | R16 | 1K | | | | |
| | | R17 | 10K | | | | |
| | | R18 | 150R | | | | |
| | | R19 | 1M | | | | |
| | | R20 | 1K | | | | |
| | | R21 | 330K | | | | |
| | | R22 | 47K | | | | |
| | | R23 | 100R | | | | |
| | | R24 | 470R | | | | |
| | | R25 | 1K | | | | |
| | | R26 | 15M | | | | |
| | | R27 | 180K | | | | |
| | | R28 | 100K | | | | |
| | | R29 | 1K 6W | | | | |
| | | R30 | 470K | | | | |
| | | R31 | 22K | | | | |
| | | R32 | 4.7K | | | | |
| | | R33 | 120K | | | | |
| | | R34 | 470K | | | | |
| | | R35 | 1K 6W | | | | |
| | | R36 | 10K | | | | |
| | | R37 | 47K | | | | |
| | | R38 | 180R 0.5W | | | | |
| | | VR1 | 1M | | | | |
| | | VR2 | 1M | | | | |
| | | All resistors 0.25W unless otherwise stated. | | | | | |
| | | | | C16 | 90pF | | |
| | | | | C17 | 270pF | | |
| | | | | C18 | 0.01uF | | |
| | | | | C19 | 0.02uF | | |
| | | | | C20 | 68pF | | |
| | | | | C21 | 515pF | | |
| | | | | C22 | 450pF | | |
| | | | | C23 | 110pF | | |
| | | | | C24 | 110pF | | |
| | | | | C25 | 0.01uF | | |
| | | | | C26 | 47pF | | |
| | | | | C27 | 47pF | | |
| | | | | C28 | 0.04uF | | |
| | | | | C29 | 0.04uF | | |
| | | | | C30 | 0.01uF | | |
| | | | | C31 | 0.02uF | | |
| | | | | C32 | 110pF | | |
| | | | | C33 | 110pF | | |
| | | | | C34 | 0.01uF | | |
| | | | | C35 | 47pF | | |
| | | | | C36 | 47pF | | |
| | | | | C37 | 0.04uF | | |
| | | | | C38 | 0.04uF | | |
| | | | | C39 | 110pF | | |
| | | | | C40 | 110pF | | |
| | | | | C41 | 0.01u | | |
| | | | | C42 | 10pF | | |
| | | | | C43 | 47pF | | |
| | | | | C44 | 0.02uF | | |
| | | | | C45 | 0.01uF | | |
| | | | | C46 | 100pF | | |
| | | | | C47 | 40uF 350V | | |
| | | | | C48 | 0.01uF | | |
| | | | | C49 | 270pF | | |
| | | | | C50 | 270pF | | |
| | | | | C51 | 470pF | | |
| | | | | C52 | 470pF | | |
| | | | | C53 | 5uF 50V | | |
| | | | | C54 | 0.005uF | | |
| | | | | C55 | 20uF 350V | | |
| | | | | C56 | 0.01uF | | |
| | | | | C57 | 0.01uF | | |
| | | | | C58 | 40uF 350V | | |
| | | | | C59 | 0.1uF | | |
| | | | | C60 | 0.03uF | | |
| | | | | C61 | 0.02uF | | |
| | | | | C62 | 0.001uF | | |
| | | | | TC1 | 3-15pF | | |
| | | | | TC2 | 3-15pF | | |
| | | | | TC3 | 3-40pF | | |
| | | | | TC4 | 3-40pF | | |
| | | | | TC5 | 3-40pF | | |
| | | | | TC6 | 3-40pF | | |
| | | | | VC1 | 528pF | | |
| | | | | VC2 | 528pF | | |

VOLTAGES AND CURRENTS

| | | Anode V | Screen V | Cath. | |
|-----|--------|---------|----------|-------|------|
| | | | | V | mA |
| V1A | ECC85 | 150 | — | 1 | 6.7 |
| V1B | ECC85 | 127 | — | — | 6.3 |
| V2A | ECH81 | 105 | 85 | 1.7 | 11.3 |
| V3 | EF89 | 168 | 85 | 1.3 | 8.7 |
| V4 | EF89 | 165 | 135 | 2.3 | 15.3 |
| V5 | EABC80 | 70 | — | — | — |
| V6 | EM81 | 170 | — | — | — |
| V7 | EL84 | 245 | 210 | 6.5 | 36 |
| V8 | EZ80 | — | — | 252 | — |

All readings except, those for V1, obtained with receiver switched to medium wave, usunf Model 7 Avometer. Limited variations may occur without impairing the performance of the receiver

PORTABLE MIXER

PART 2

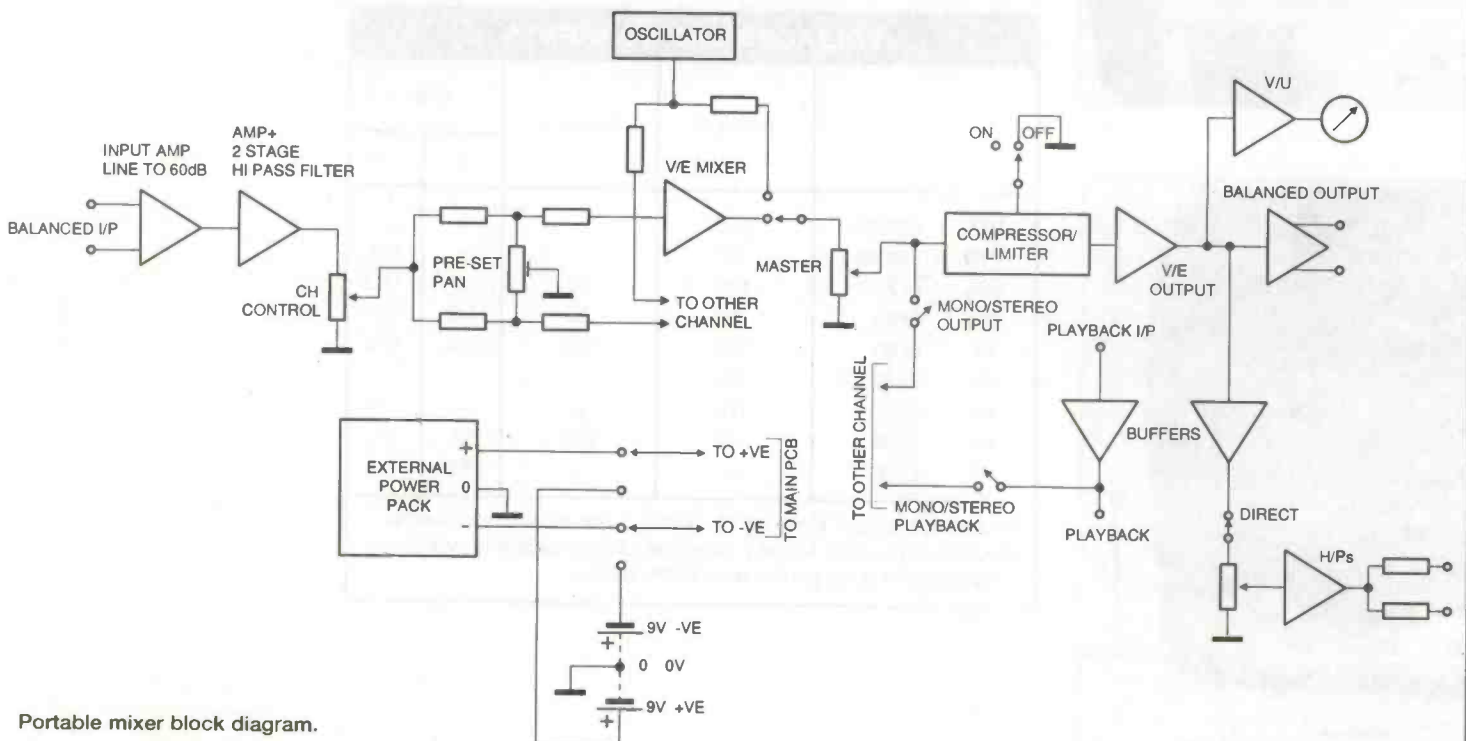
Tony Sercombe concludes his portable audio mixer project

Testing and Use

When construction of the board is complete, it is a fairly easy matter to test the individual amplifiers. This is best done before the controls are connected and the major part before fitting into the case. Although a DVM will suffice, the availability of an oscilloscope and AF generator is very useful.

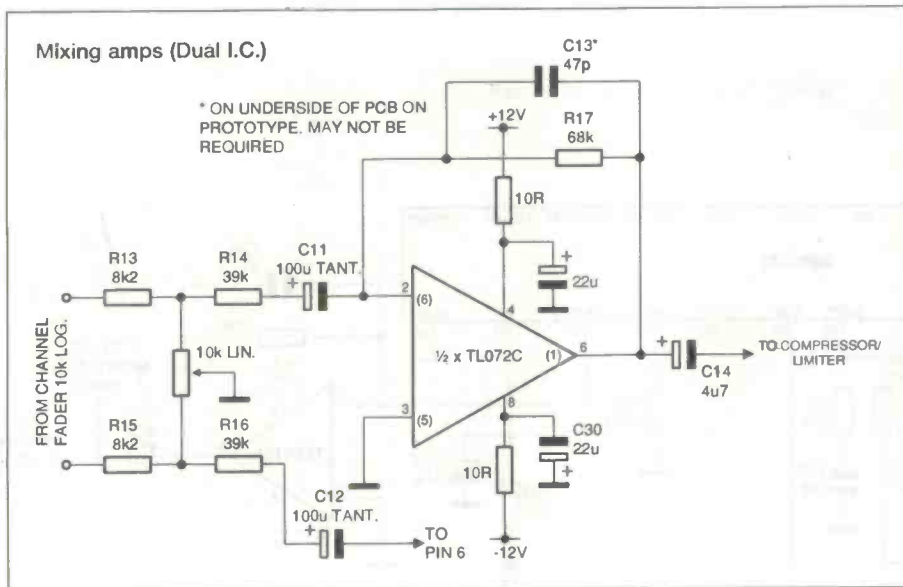
First, check the printed side of the board for whiskers of solder, accidental bridges etc. Then apply voltage and check it is correct before fitting the ICs into their sockets, taking the measurements at the actual socket pins. Insert one input IC at first. Always disconnect the supply when fitting or removing ICs. Now check the signal out for gain and, if possible, look at the waveform in case of any distortion. Insert the TLE 2027 IC and repeat, feeding the signal from the input as before. The LF roll-off checks are best left until the switches are fitted; in any

case listening through a microphone is a good subjective check if no 'scope is available. Do the same thing with the two virtual earth amps and the compressor IC. I normally use test links made up from 6 to 8 inches of connecting wire, terminated at each end with a crocodile clip. Use one of these to supply an earth link so that the IC has a flat response in terms of compressing or limiting. If more links are supplied for the channel level and the output master control, this test may be carried right through from input 1 to output. Check the overall response and the noise level, which will be rather 'hissy' at full gain with no input connected, but at position 1 and 2, it should be undetectable. In my case, I found an inherently noisy SSM 2017. Now go to the other channels and repeat the same thing. This time, it is simply the two channels' ICs that are being checked. Since the output amplifiers drive at 5 ohms, a



Portable mixer block diagram.

Mixing amps (Dual I.C.)



standard level. At this point the other output may be checked, and it should lie within a few millivolts of the first one, allowing for component tolerances.

The next task is to align the VU meters. Normally, the point '4' on a PPM is set at 1 Mw or 0.775 volt in 60 ohms. In this circuit, it is necessary to compromise somewhat. I chose -7 on the VU scale to represent 0.775 volt output, since there is no '8', with '0' or 100% representing absolute peak. On a PPM this would be shown as '6' on the scale. So, with the master control as before and the output at 0.775 volt, adjust both VU presets to read -7.

To set up the compressor/limiter, back off the threshold fully, and connect the circuit board links to the 'compress'

headset can be connected directly to the output. Now connect up the other side of the stereo channel with the links, from the second virtual earth amplifier and test as before. The same can be said of all the amplifier's checking gain, response and distortion. So far as possible, make certain the oscillator works by connecting a link to ground from the oscillator ground point. If it does not at first, adjust the value of the 2K7 resistor. Hook up a couple of LEDs to the battery indicator and, if possible, reduce both sides of the supply in tandem, and note the changeover point. This should be at, or just before, 6.0-6 volts. When you are generally satisfied that everything is working correctly, the board may be fitted into the case. It is best to fit the top panel controls and VU meters first. The side plugs and sockets etc may be left until later. If veropins have been used at the off-board connection point - and I suggest this is the best method - it is an easy matter to connect up the circuit points with the appropriate controls. Ordinary, light connecting wire may be used for this purpose, except that a screened balanced cable should be used to connect the inputs. I used three-pin XLR chassis mounting sockets for the input. The pin numbers as shown are standard, and a chassis mounting male for the auxiliary headphone output, the main operator output being the standard stereo jack socket. The mixer output can be contained within a multiway chassis mounting socket, and cable mounted plug to suit (the other end of the cable having connectors to suit).

When the circuit board has been fitted into the case, and the connections to the controls made, it is time for the final setting up.

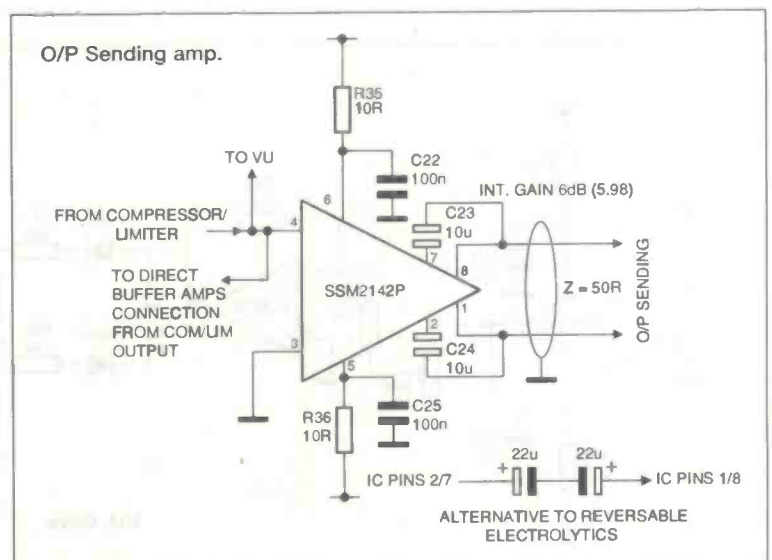
Start with the oscillator. With the master control at 2/3 rotation, and the compressor/limiter switched off, connect a DVM or AC millivoltmeter to one of the mixer outputs, with its range setting to 1 volt or more. Switch the oscillator on. If an oscilloscope is available, connect this across the oscillator output (across the master fader). First check the waveform shape - visual inspection is quite adequate. At this point, if frequency can be measured, this too can be checked. Otherwise, a fair check may be made aurally, with a headset connected across the output. But, remember to remove the headset for the next check, if it is connected across the same output. Now adjust the output level of the oscillator so that the output from the mixer is 0.775 volt. This is the

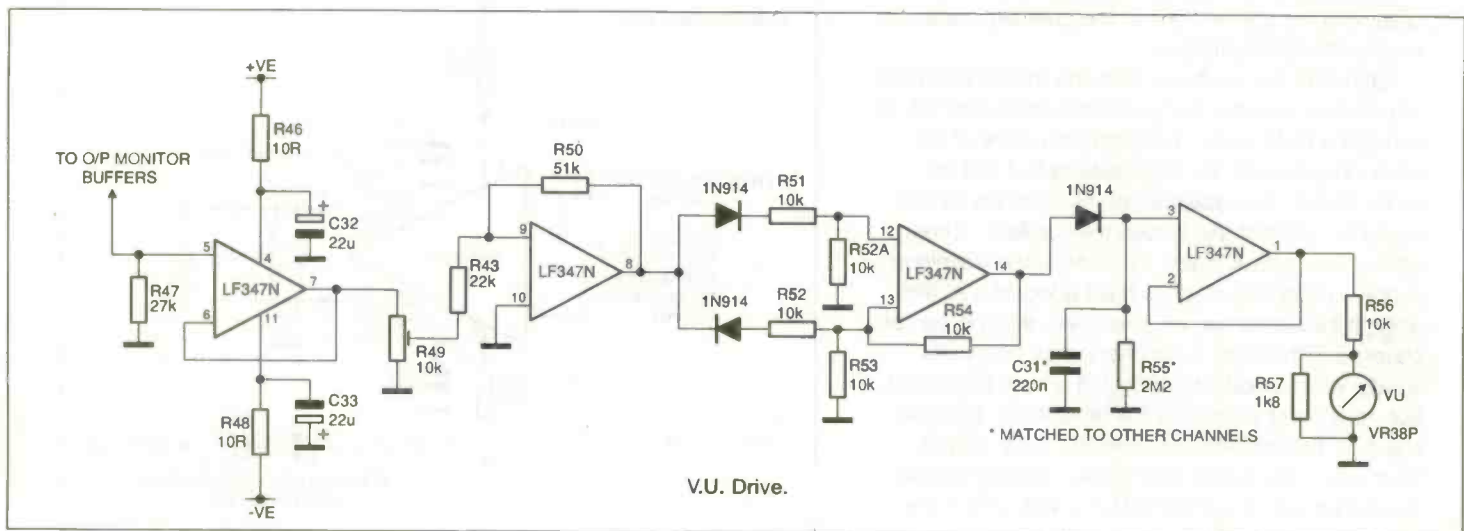
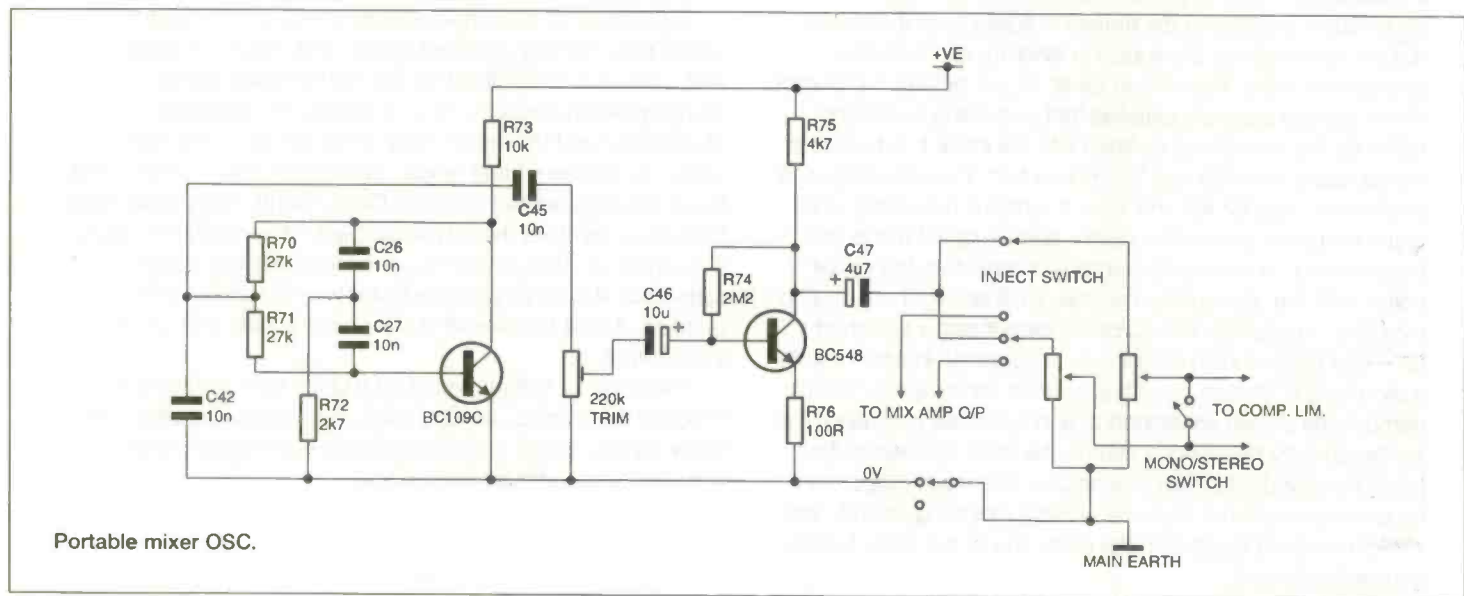
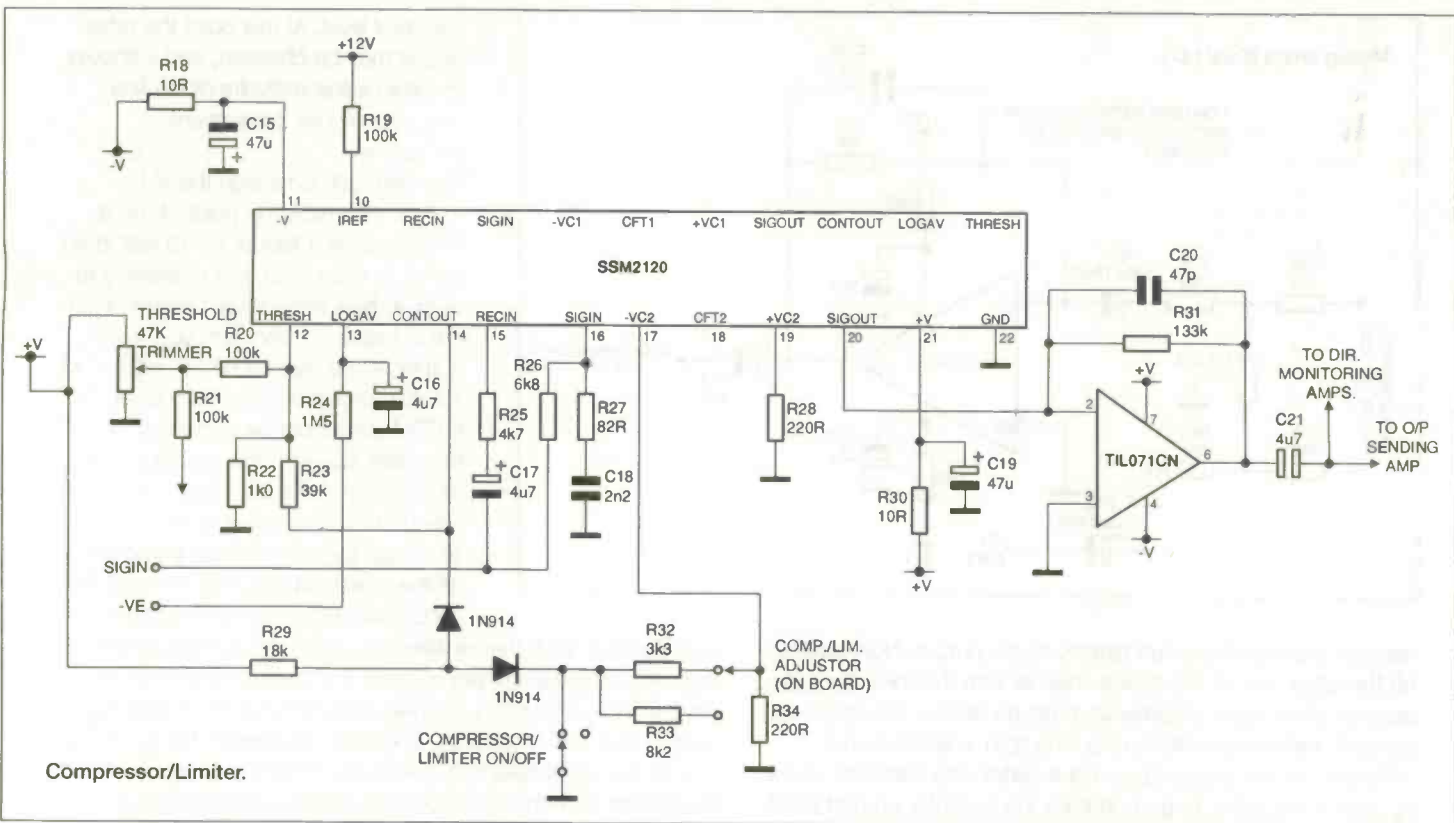
connections. With the oscillator on, open the master control fully, and advance the pre-set until the meters show a large drop in level, about 2/3 of scale. The compressor should be switched to 'on', of course. The ratio, as already mentioned, is 2:1, so the compress and limit action is fairly modest, but I find it sufficient for normal outdoor use. When connected as a limiter, it simply holds back on any large peaks that may occur.

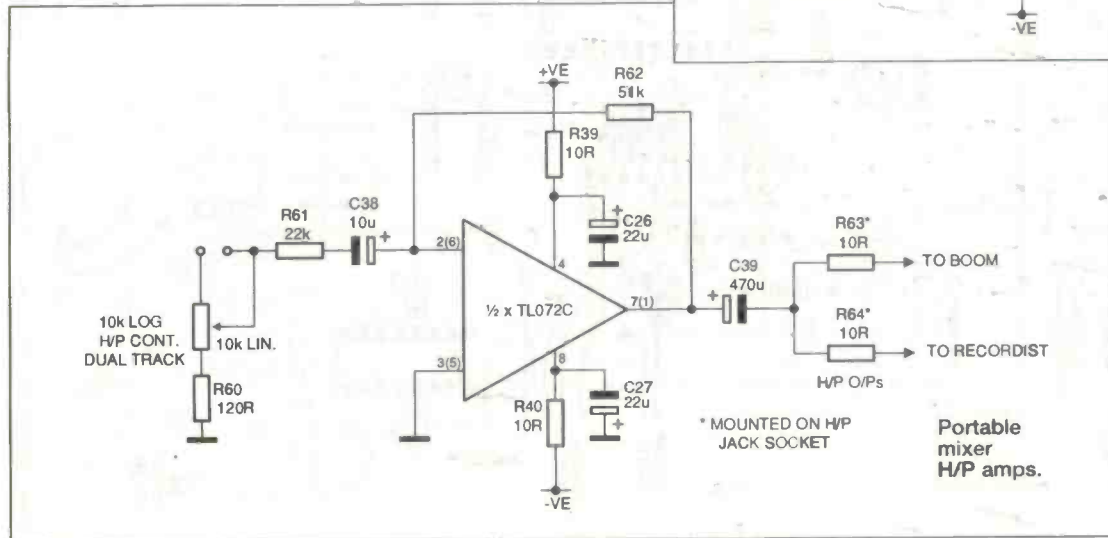
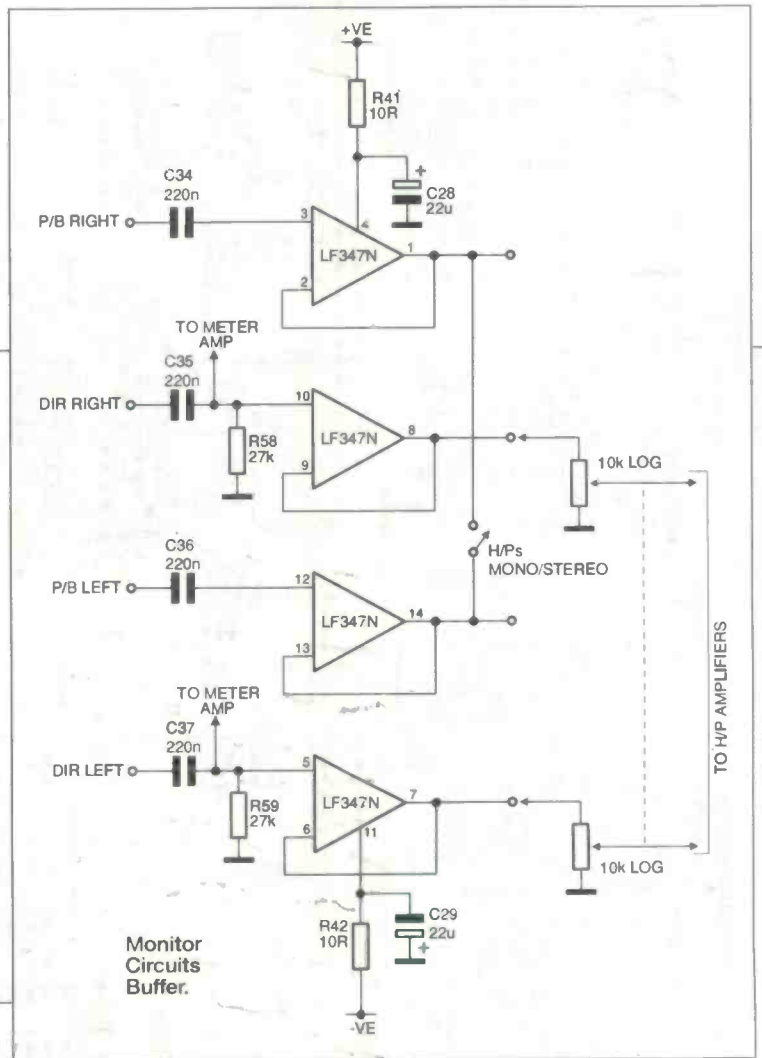
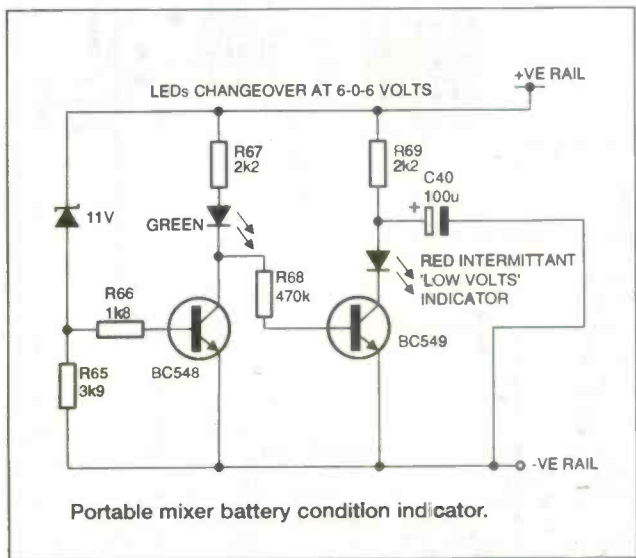
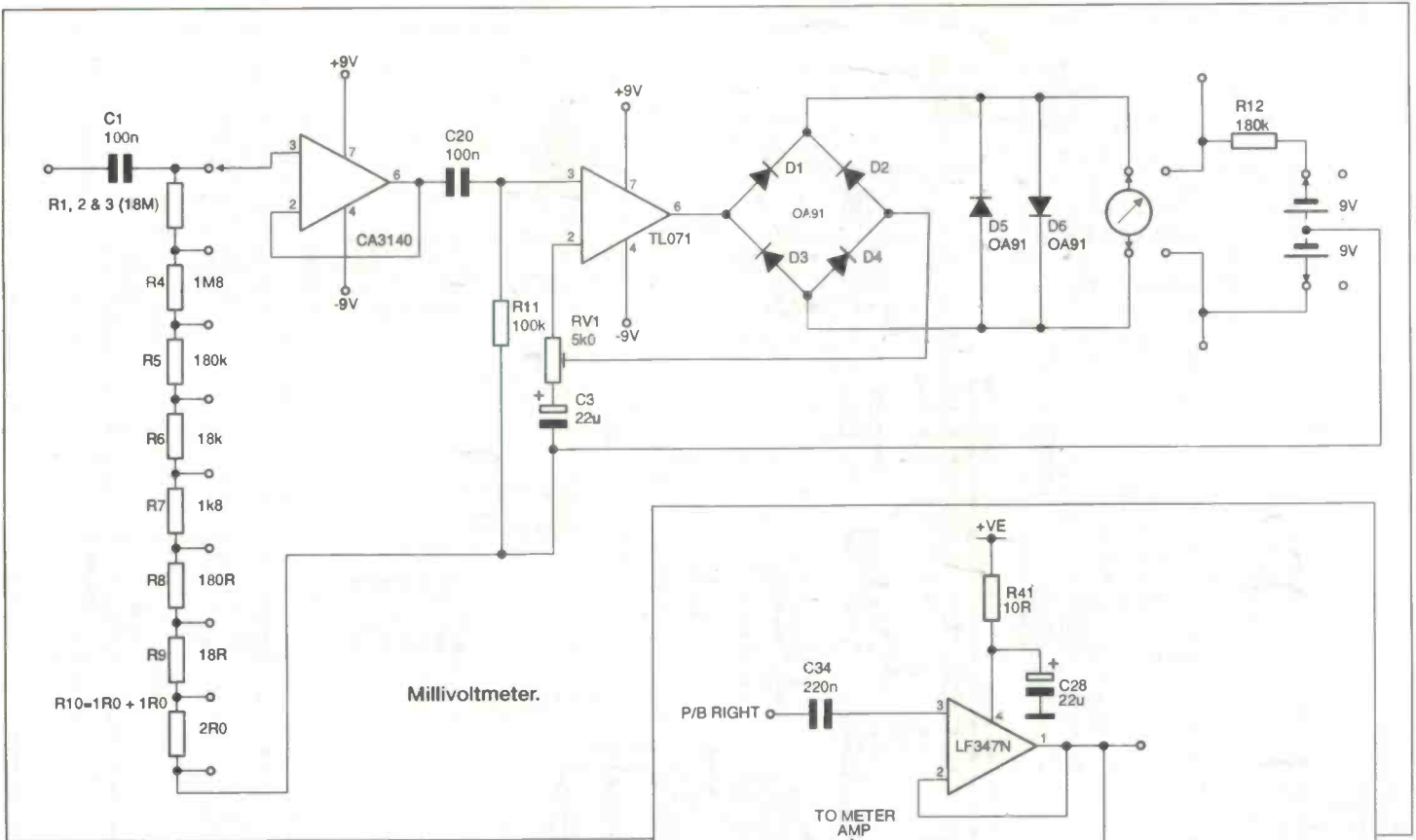
The setting up procedure is now complete. It is worth noting here that any standard output level may be adopted and, indeed, 0.775 volt will be too high in cases where domestic equipment is to be connected. The oscillator, compressor and VU meters may all be set up at any point within the control setting range, making the design very flexible. Exact readings are not required. Components, meters etc have tolerances, as does the test equipment. Stereo potentiometers are usually of 20%. Therefore, as long as readings are the same, this should be accepted, and will not be noticed in practice. Adjust the pre-set in the power supply to 9 or 12 volts output.

The p.s.u. is, in fact, based on a unit which appeared in Practical Electronics, January 1995. As previously stated, the mixer can be added to or reconfigured in almost any way required for a particular application.

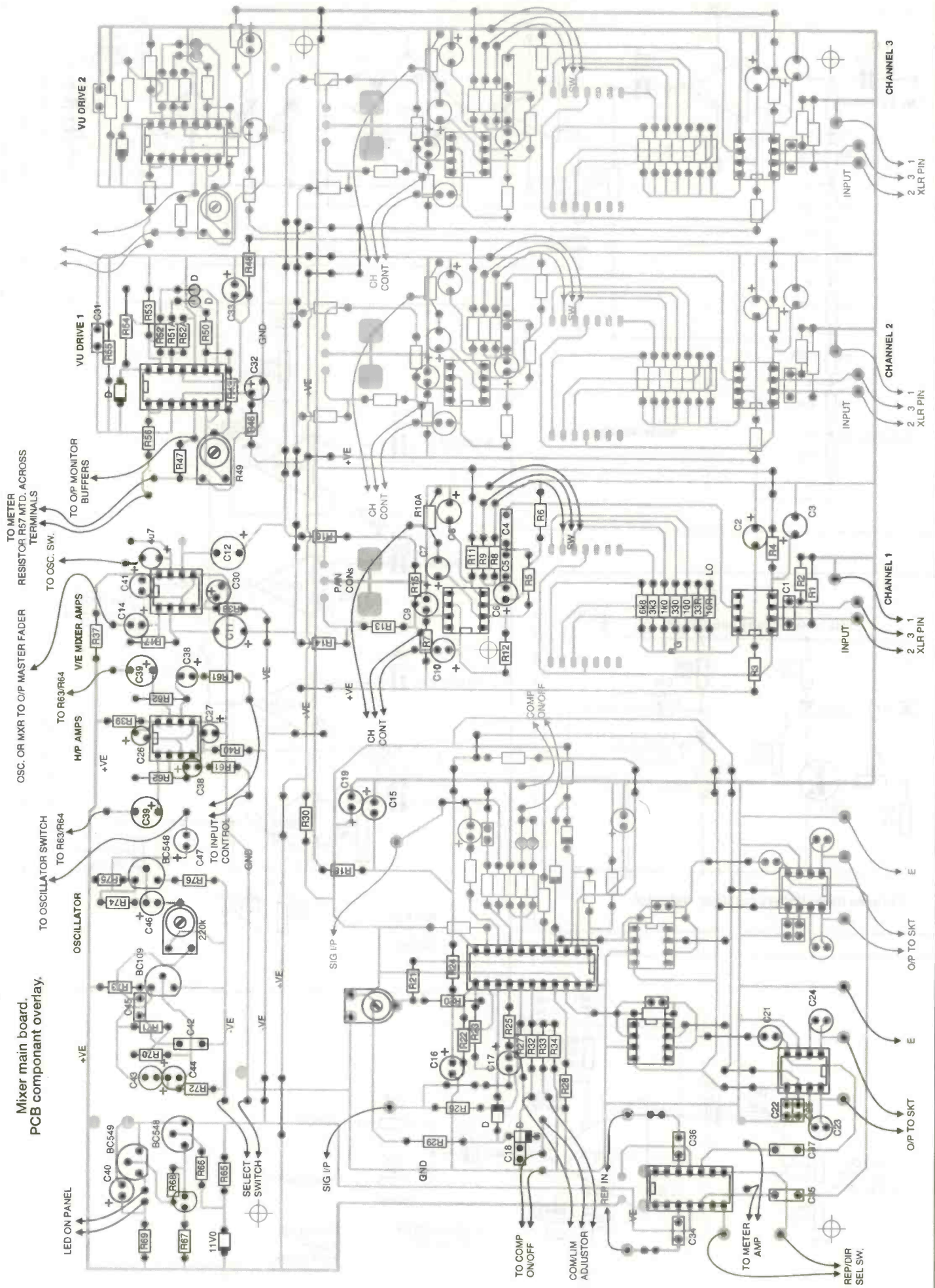
O/P Sending amp.



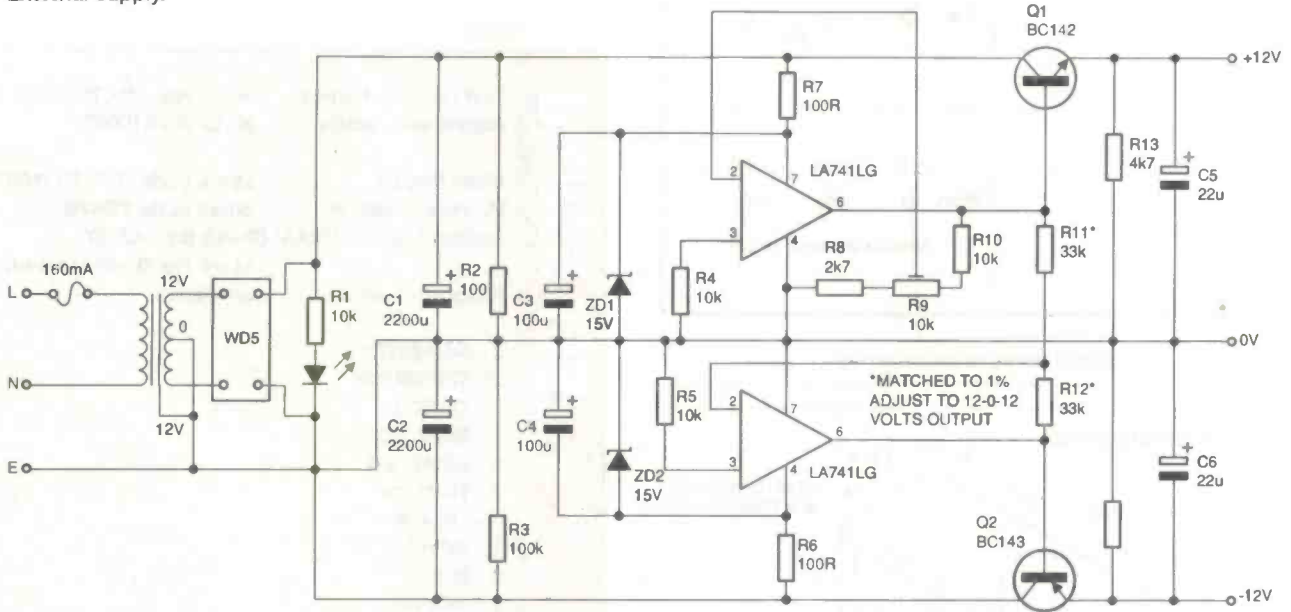




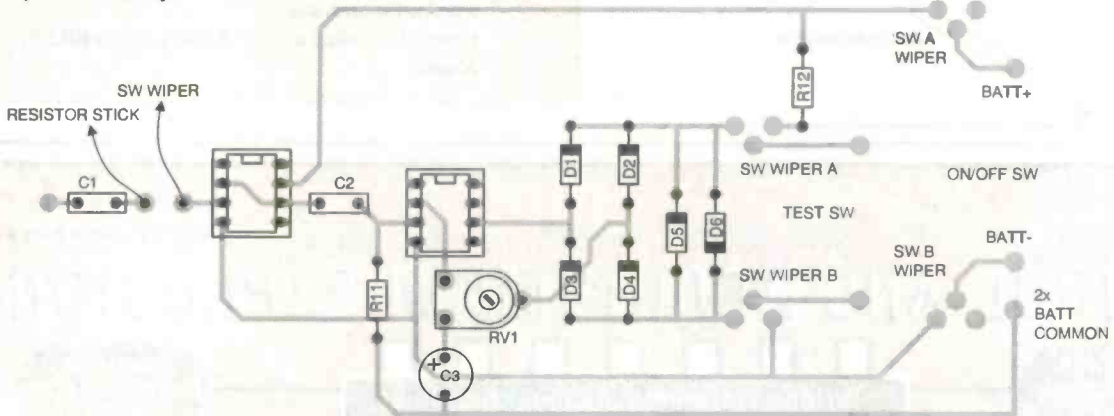
Mixer main board.
PCB component overlay.



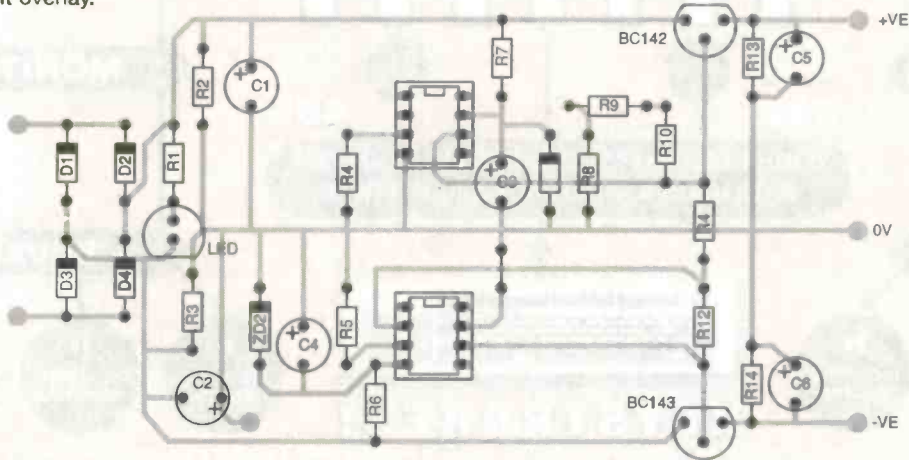
External supply.



Millivoltmeter PCB component overlay.



External supply PCB component overlay.



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| MITS. FA3445ETKL 14" Industrial spec SVGA monitors 2Kw to 400 Kw - 400 Hz 3 phase power sources - ex stock | £245 |
| Broadcast Electronics Inc FX30 FM exciter 80-108 MHz | £750 |
| Staneco STA15 15KW RF induction heater system | £900 |
| 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 Vio | £900 |
| HP APOLLO Rk700 system units | £950 |
| HP6621A Dual Programmable GPIB PSU 0-7 V 160 watts | £1800 |
| HP6264 Rack mountable variable 0-20V @ 20A metered PSU | £675 |
| HP54121A DC to 22 GHz four channel test set | £900 |
| HP7580A A1 8 pen PGM/L high speed drum plotter | £1850 |
| Marconi 6310 Programmable 2 to 22 GHz sweep generator | £6500 |
| EG-NG Brookdale 95033C Precision lock in amp | £650 |
| OTC Ltd 1550 SM Stabilised IR laser calibration source | £2250 |
| Ling Dynamics 2Kw programmable vibration test system | £900 |
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| Kelthrey 590 CV capacitor / voltage analyser | £900 |
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| Roken 80-250 24V0 single phase flow solder machine | £1200 |
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| 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 | £900 |
| Trio 0-16 vdc linear, metered 30 amp bench PSU. New | £550 |
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| Andrews LARGE 3.1 m Satellite Dish + mount (For Voyager) | £950 |
| Thurby LA 160B Logic analyser | £375 |
| Sekonky SD 156H 18 channel digital Hybrid chart recorder | £1995 |
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| System Video 1152 PAL waveform monitor | £485 |
| Test Lab - 2 mtr square quietised acoustic test cabinets | £300 |
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Please call for further details on the above items



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Superb quality 6 foot 40U
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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: 77 1/2" H x 32 1/2" D x 22" W. Order as:

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| OPT Rack 2 Rack, Less side panels | £225.00 (G) |

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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 non-abrasive. 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 louvers. 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 23 3/4" W)
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| 1 MB x 9 SIMM 9 chip 120ns | Only £19.50 (A1) |
| 1 MB x 9 SIMM 3 chip 80 ns | £23.50 or 70ns £24.95 (A1) |
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| INTEL 486-DX33 CPU £55.00 INTEL 486-DX66 CPU £69.00 (A1) | |

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| EPSON D0412 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 specifiy 110 or 240 v. £6.95. 80 x 80 x 38 mm - specifiy 110 or 240 v. £5.95 | |
| IMHOF B26 1900 rack mnt 3U x 19" Blower 110/240V NEW | £79.95 |

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£1 BARGAIN PACKS - List 5

If you would like to receive the other four £1 lists and a lot of other lists, request these when you order or send SAE.

TEST PRODS FOR MULTIMETERS with 4mm sockets. Good length very flexible lead, Ref: D86.
8 OHM PM SPEAKERS, size 8" x 4", pack of two. These may be lightly rusty and that is why they are so cheap but are electrically OK, Ref: D102.
PAXOLIN PANELS, size 6" x 6", approximately 1/16" thick, pack of two, Ref: D103.
13A SOCKET, virtually unbreakable, ideal for trailing lead, Ref: D95.
PIEZO BUZZER with electronic sounder circuit, 3V to 9V D.C. operated, Ref: D76.
DITTO but without internal electronics, pack of two, Ref: D75.
LUMINOUS ROCKER SWITCH, approximately 30mm sq, pack of two, Ref: D64.
ROTARY SWITCH, 9-pole 6-way, small size and 1/4" spindle, pack of two, Ref: D54.
FERRITE RODS, 7" with coils for Long and Medium waves, pack of two, Ref: D52.
DITTO but without the coils, pack of three, Ref: D52.
SLIDE SWITCHES, SPDT, pack of 20, Ref: D50.
MAINS DP ROTARY SWITCH with 1/4" control spindle, pack of five, Ref: D49.
ELECTROLYTIC CAP, 800µF at 6.4V, pack of 20, Ref: D48.
ELECTROLYTIC CAP, 1000µF + 100µF 12V, pack of 10, Ref: D47.
MINI RELAY with 5V coil, size only 26mm x 19mm x 1mm, has two sets of changeover contacts, Ref: D42.
MAINS SUPPRESSOR CAPS 0.1µF 250V A.C., pack of 10, Ref: 1050.
TELESCOPIC AERIAL, chrome plated, extendable and folds over for improved F.M. reception, Ref: 1051.
MES LAMP HOLDERS, slide on to 1/4" tag, pack of 10, Ref: 1054.
PAXOLIN TUBING, 1/4" internal diameter, pack of two, 12" lengths, Ref: 1056.
ULTRA THIN DRILLS, 0.4mm, pack of 10, Ref: 1042.
20A TOGGLE SWITCHES, centre off, part spring controlled will stay on when pushed up but will spring back when pushed down, pack of two, Ref: 1043.
HALL EFFECT DVICES, mounted on small heatsink, pack of two, Ref: 1022.
12V POLARISED RELAY, two changeover contacts, Ref: 1032.
PAXOLIN PANEL, 12" x 12" 1/16" thick, Ref: 1033.
MINI POTTED TRANSFORMER, only 1.5VA 15V-0V-15V or 30V, Ref: 964.
ELECTROLYTIC CAP, 32µF at 350V and 50µF section at 25V, in aluminium can for upright mounting, pack of two, Ref: 995.
PRE-SET POTS, one megohm, pack of five, Ref: 998.
WHITE PROJECT BOX with rocker switch in top left-hand side, size 78mm x 115mm x 35mm, unprinted, Ref: 1006.
6V SOLENOID, good strong pull but quite small, pack of two, Ref: 1012.
FIGURE-8 MAINS FLEX, also makes good speaker lead, 15m, Ref: 1014.
HIGH CURRENT RELAY, 24V A.C. or 12V D.C., three changeover contacts, Ref: 1016.
LOUDSPEAKER, 8 Ohm 5W, 3.7" round, Ref: 962.
NEON PILOT LIGHTS, oblong for front panel mounting, with internal resistor for normal mains operation, pack of four, Ref: 970.
3.5MM JACK PLUGS, pack of 10, Ref: 975.
WANDER PLUGS, pack of 10, Ref: 986.
PSU, mains operated, two outputs, one 9.5V at 550mA and the other 15V at 150mA, Ref: 988.
ANOTHER PSU, mains operated, output 15V A.C. at 320mA, Ref: 989.
PHOTOCELLS, silicon chip type, pack of four, Ref: 939.
LOUDSPEAKER, 5" 4 Ohm 5W rating, Ref: 946.
230V ROD ELEMENTS, 500W terminal-ended, 10" long, pack of two, Ref: 943.
LOUDSPEAKER, 7" x 5" 4 Ohm 5W, Ref: 949.
LOUDSPEAKER, 4" circular 6 Ohm 3W, pack of 2, Ref: 951.
FERRITE POT CORES, 30mm x 15mm x 25mm, matching pair, Ref: 901.
PAXOLIN PANEL, 8 1/2" x 3 1/2" with electrolytics 250µF and 100µF, Ref: 905.
CAR SOCKET PLUG with P.C.B. compartment, Ref: 917.
FOUR-CORE FLEX suitable for telephone extensions, 10m, Ref: 918.
VERO OFF-CUTS, approximately 30 square inches of use-ful sizes, Ref: 927.
PROJECT CASE, 95mm x 66mm x 23mm with removable lid, held by four screws, pack of two, Ref: 876.
SOLENOIDS, 12V to 24V, will push or pull, pack of two, Ref: 877.
2M MAINS LEAD, 3-core with instrument plug moulded on, Ref: 879.
TELESCOPIC AERIAL, chrome plated, extendable, pack of two, Ref: 884.
MICROPHONE, dynamic with normal body for hand hold-ing, Ref: 885.
CROCODILE CLIPS, superior quality flex, can be attached without soldering, five each red and black, Ref: 886.
BATTERY CONNECTOR FOR TP3, superior quality, pack of four, Ref: 887.
LIGHTWEIGHT STEREO HEADPHONES, Ref: 898.
PRESETS, 470 Ohm and 220 kilohm, mounted on single panel, pack of 10, Ref: 849.
THERMOSTAT for ovens with 1/4" spindle to take control knob, Ref: 857.
12V-12V-12V 10W MAINS TRANSFORMER, Ref: 811.
18V-0V-18V 10W MAINS TRANSFORMER, Ref: 813.
AIR SPACED TRIMMER CAPS, 2pF to 20pF, pack of two, Ref: 818.
AMPLIFIER, 9V or 12V operated Mullard 1153, Ref: 823.
2 CIRCUIT MICROSWITCHES, icon, pack of 4, Ref: 825.
LARGE SIZE MICROSWITCHES (20mm x 6mm x 10mm) changeover contacts, pack of two, ref: 826.
MAINS VOLTAGE PUSHSWITCH with white dolly, through panel mounting by hexagonal nut, Ref: 829.
POINTER KNOB for spindle which is just under 1/4", like most thermostats, pack of four, ref: 833.



MAINTENANCE FREE BATTERIES

The YUASA batteries are sealed lead-acid types and they can be used in any position and are virtually maintenance free. We have two popular ones in stock at bargain prices, the 12V 15AH will cost you only £10 if you collect or £12.50 including carriage if we have to send, Order Ref: 12.5P2. This battery would also stand in as a car battery in an emergency. The other one we have is much smaller, it is a 12V 2.3AH, regular price £14, yours for £5, Order Ref: 5P258. These batteries are in tip top condition, virtually unused and fully guaranteed. **DRY BATTERIES** All high wattage, heavy duty type. Four popular types in stock:- 1 1/2V HP7, sometimes known as the penlight battery, four for 60p, Order Ref: GT10. 1 1/2V HP2, sometimes known as the big torch battery, two for 60p, Order Ref: GT11. 1 1/2V HP11, also a popular torch battery, two for 50p, Order Ref: GT12. 9V, ever popular PP3, 2 for £1, Order Ref: GT13. **35mm PANORAMIC CAMERA**. Has super wide lens, ideal for holiday viewing, is focus free and has an extra bright and clear view finder. Brand new and guaranteed, individually boxed, £6.50, Order Ref: 6.5P2. **OV-20V D.C. PANEL METER**. This is a nice size, 65mm sq. It is ideal if you are making a voltage variable instrument or battery charger. price £3, Order Ref: 3P188. **FLASHING BEACON**. Ideal for putting on a van or tractor or any vehicle that should always be seen. Uses a XENON tube and has an amber coloured dome. Separate fixing base is included so unit can be put away if desirable. Price £7.50. Order Ref: 7.5P13.

BIG BUYER

Please note if you order 10 of an item you may deduct 10%. If you order 25, then deduct 25% but add VAT. If you need 100 or more, you can usually deduct 40% but please ring to confirm.

12V 2A TRANSFORMER, £2, Order Ref: 2P337.
12V-0V-12V TRANSFORMER, 35VA, £2.50, Order Ref: 2.5P13.
HIGH RESOLUTION MONITOR. 9" by Philips, in metal frame for easy mounting. Brand new, offered at less than the price of the tube alone, £15, Order Ref: 15P1.
15W 8" OHM SPEAKER AND 3" TWEETER Amstrad, made for their high quality music centre, £4 per pair, Order Ref: 4P57.
INSULATION TESTER WITH MULTIMETER. Internally generates voltages which enables you to read Insulation directly in Megohms. The multi-meter has four ranges: A.C./D.C. volts; 3 ranges milliamps; 3 ranges resistance and 5 amp range. Ex-British Telecom, tested and guaranteed OK, yours for only £7.50 with leads, carrying case £2 extra, Order Ref: 7.5P4.

We have some of the above testers not working on all ranges, should be repairable, we supply diagram £3, Order Ref: 3P176.

LCD 31/2 DIGIT PANEL METER. This is a multi-range volt meter/ammeter using the A-D converter chip 7106 to provide five ranges each of volts and amps. Supplied with full data sheet. Special snip price of £11.50 Order Ref: 11.5P2.

MINI BLOW HEATER. 1KW, IDEAL FOR UNDER DESK OR AIRING CUPOBOARD, ETC. Needs only a simple mounting frame, £5, Order Ref: 5P23.

MEDICINE CUPBOARD ALARM. Or it could be used to warn when any cupboard door is opened. The light shining on the unit makes the bell ring. Completely built and neatly cased, requires only a battery, £3. Order Ref: 3P155.

DON'T LET IT OVERFLOW! Be it bath, sink, cellar, sump or any other thing that could flood. This device will tell you when the water has risen to the pre-set level. Adjustable over quite a useful range. Neatly cased for wall mounting, ready to work when battery fitted, £3. Order Ref: 3P156.

£1.50 BARGAIN PACKS

NICAD BATTERY 3.6V with P.C.B. mounting prongs, Order Ref: 1.5P2.
6-DIGIT COUNTER 12V, Order Ref: 1.5P3.
PAIR OF ULTRASONIC MODULES, one sender, one receiver, Order Ref: 1.5P4.
100-CORE CABLE, any length, Order Ref: 1.5P6 per metre.
KEY SWITCH, two-position, complete with two Yale type keys, Order Ref: 1.5P12.
CASSETTE MOTOR, 9V brushless, Order Ref: 1.5P14.
80 OHM COAX TV CABLE, extra thin, 10m, Order Ref: 1.5P14.
WATERPROOF SPEAKER, 3 1/2" round, 8 Ohm 11W, Order Ref: 1.5P27.
6V 1A ENCASED POWER SUPPLY with input and output leads, Order Ref: 1.5P22.
FLUORESCENT CHOKE for 60W tube, Order Ref: 1.5P23.
3" TWEETER 8 Ohms 15W, Order Ref: 1.5P28.
13A SWITCH SOCKET, white, Order Ref: 1.5P29.
RELAY, flash-proof, 12V coil, SPCC, Order Ref: 1.5P31.
ENCASED PSU, twin outputs, 15V 850mA and 9V 550mA, both A.C. output, Order Ref: 1.5P32.
12V MOTOR, mini but quite powerful, 32mm diameter, 25mm long, Order Ref: 1.5P33.

£2 BARGAIN PACKS

20W TWEETER 4" x 4" 8 Ohm by Goodmans, Order Ref: 2P403.
MOVING COIL CHARGER METER, 0-3A, Order Ref: 2P366.
LIGHT-OPERATED SWITCH, kit of parts, Order Ref: 2P369.
W-SHAPED 30W FLUORESCENT TUBE by Philips. Ideal name plate illuminator, Order Ref: 2P372.
DIMMER SWITCH, standard size plate, colours - red, yellow, green, blue. Order Ref: 2P380.
TOROIDAL TRANSFORMER 7V 5A, Order Ref: 2P390.
TELEPHONE EXTENSION LEAD, flat plug one end, socket the other, 12m, Order Ref: 2P398.
INTERNAL TELEPHONE EXTENSION, 4-core cable, 25m, Order Ref: 2P339.
FIGURE-8 FLEX, mains voltage, 50m, Order Ref: 2P345.
INFRA-RED RECEIVER, has fitted TV receiver, Order Ref: 2P304.
LCD CLOCK MODULE with details on other uses, Order Ref: 2P307.
AM/FM RADIO RECEIVER with speaker but not cased, Order Ref: 2P308.
12V 200mA PSU on 13A base, Order Ref: 2P313.
2A MAINS FILTER AND PEAK SUPPRESSOR, Order Ref: 2P315.
45A DP 250V SWITCH on 6" x 3" gold plate, Order Ref: 2P316.
D.C. VOLT REDUCER, 12V-6V, fits into car lighter socket, Order Ref: 2P318.
SOLAR CELL 3V, five of these in series would make you a 12V battery charger, £1 each, Order Ref: 2P374.
PERMANENT MAGNET SOLENOID, opposite action, core is released when voltage is applied, Order Ref: 2P327.
HEATER PAD, not waterproof, Order Ref: 2P329.
DISK DRIVE, complete less stepper motor, has all the electronics to control stepper motor, Order Ref: 2P280.
15V 3320mA A.C. POWER SUPPLY, in case with 13A base, ideal for bell or chime controller, Order Ref: 2P281.
POWERFUL MAINS MOTOR with 4" spindle, Order Ref: 2P262.
20M 80 OHM TV COAX, Order Ref: 2P270.
LOCTITE METAL ADHESIVE, tube and some accessories, Order Ref: 2P215.
6-DIGIT COUNTER, mains operated, Order Ref: 2P235.
2-GANG 0.0 005 TUNING CAPACITOR, standard size, made by Jacksons, Order Ref: 2P240.
13A ADAPTORS, takes two 13A plugs, pack of 5 - £2, Order Ref: 2P187.
3-CORE 5A PVC FLEX, 15m, Order Ref: 2P189.
MAINS TRANSFORMER, 15V 1A, Order Ref: 2P198.
FLIP-OVER CLOCK, mains operated, only requires a simple case, Order Ref: 2P205.
THERMOSTAT with calibrated knob, oven temperatures, Order Ref: 2P158.
7-SEGMENT NEON DISPLAYS, pack of 8, Order Ref: 2P126.
MODERN TELEPHONE HANDSET, ideal office extension, Order Ref: 2P94.
500 STAPLES, hardened pin, suit burglar alarm or telephone wire, Order Ref: 2P99.
PAD SWITCH for under carpets, Order Ref: 2P119.
6 1/2" FAN AND MAINS MOTOR, Order Ref: 2P64.
24V STEREO POWER SUPPLY, Mullard, Order Ref: 2P80.
UP TO 90 MIN 25A SWITCH, clockwork, Order Ref: 2P90.
POWERFUL MAINS MOTOR, 1 1/2" stack, double spindle, Order Ref: 2P55.
POWER SUPPLY FOR MODELS, 6V to 12V variable and reversible, Order Ref: 2P3.
MAINS TO 115V AUTO TRANSFORMER 100W, ex-GPO, Order Ref: 2P6.
MAINS TIME AND SET SWITCH 25A, up to nine hours delay, Order Ref: 2P9.
MOTORISED SIX MICROSWITCHES but motor 50V A.C., Order Ref: 2P19.
TWIN EXTENSION LEAD, ideal lead lamp, Black & Decker tools, etc, 20m, Order Ref: 2P20.
MAINS COUNTER, resettable, 3 digit, Order Ref: 2P26.

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| Gould 1602 - 20 MHz D.S.O. with printer (cursors)..... | £1150 |
| Gould 3300B - 40 MHz Dual Channel..... | £250 |
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| Hewlett Packard 1980B - 100MHz, 2 Channel, HPIB Prog'ble..... | £750 |
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| Hewlett Packard 180D - 4 channel - 100 MHz..... | £350 |
| 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)..... | £900 |
| Kikusui COS 6100 - 100MHz, 5 Channel, 12 Trace..... | £475 |
| Leeroy 140 - 100MHz - D.S.O. 4 Channel..... | £2750 |
| Meguro - MSO 1270A - 20 MHz Digital Storage (NEW)..... | £900 |
| Nicolet 3091 - LF D.S.O..... | £1100 |
| Phillips 3211, 3217, 3240, 3243, 3244, 3261, 3262 (2ch + 4ch)..... | from £125 to £350 |
| Phillips 3219 - 50MHz with analogue storage..... | £400 |
| Phillips 3302 - 20MHz - Digital Storage..... | £475 |
| Phillips PM 3295A - 400MHz Dual Channel..... | £1950 |
| Phillips PM 3295 - 350MHz Dual Channel..... | £1500 |
| Phillips PM 3315 - 60MHz - D.S.O..... | £750 |
| Tektronix 468 - 100MHz - D.S.O..... | £750 |
| Tektronix 2213 - 60MHz Dual Channel..... | £425 |
| Tektronix 2215 60MHz dual trace..... | £450 |
| Tektronix 2235 Dual trace 100MHz (portable)..... | £800 |
| Tektronix 2335 Dual trace 100MHz (portable)..... | £750 |
| 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 475 - 200MHz Dual Channel..... | £475 |
| Tektronix 7313, 7603, 7613, 7623, 7633, 100MHz 4 ch..... | from £300 |
| Tektronix 7704 - 250MHz 4 ch..... | from £650 |
| Tektronix 7904 - 500MHz..... | from £850 |
| Tequipment D83 - 50MHz Dual Channel..... | £200 |

Other scopes available too

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)..... | £6750 |
| Hewlett Packard 182T with 8559A (10MHz - 21GHz)..... | £3750 |
| HP 3582A - 25KHz Analyser, dual channel..... | £2500 |
| Hewlett Packard 35601A - Spectrum Analyser Interface..... | £1000 |
| Hewlett Packard 8754A - Network Analyser 4 - 1300MHz..... | £2950 |
| Hewlett Packard 853A with 8559A - (0.01 - 21GHz)..... | £4250 |
| Hewlett Packard 8565A - (0.01 - 22GHz)..... | £4000 |
| 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 |
| 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 |
| Schlumberger 1250 - Frequency Response Analyser..... | £2500 |
| Tektronix 2710 9 KHz - 1.8 GHz..... | £4250 |
| Tektronix 496P - 9KHz - 1.8GHz (Programmable)..... | £4500 |

MISCELLANEOUS

| | |
|--|-----------|
| 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 |
| Datron 1061 - Precision Multimeter..... | £500 |
| Dyanpert TP20 Intellipace - Tape peel Tester - immaculate 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 TTS 520 Transmitter Test Set..... | £400 |
| Farnell TSV 70 MkII Power Supply (70V-5A or 35V-10A)..... | £200 |
| Helden 1107 - 30V-10A Programmable Power Supply (IEEE)..... | £650 |
| Hewlett Packard 4953A - Protocol Analyser..... | £2750 |
| Hewlett Packard 3437A System voltmeter..... | £350 |
| Hewlett Packard 3456A Digital voltmeter..... | £850 |
| Hewlett Packard 5420A Digital Signal Analyser..... | £350 |
| 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..... | £3500 |
| Hewlett Packard 5356A - 18GHz Frequency Converter head..... | £450 |
| Hewlett Packard 432A - Power Meter (with 478A Sensor)..... | £275 |
| Hewlett Packard 435A or B Power Meter (with 8481A/8484A)..... | from £750 |
| Hewlett Packard 3438A Digital multimeter..... | £200 |
| Hewlett Packard 6181C D.C. current source..... | £150 |
| Hewlett Packard 3711A/3712A/3791B/3793B Microwave Link Analyser..... | £3500 |
| Hewlett Packard 5385A Frequency Counter - 1GHz - (HP1B) with OPTS 001/003/004/005..... | £995 |

| | |
|---|-------|
| Hewlett Packard 6623A Triple output system power supply..... | £1950 |
| Hewlett Packard 3586A Selective level meter..... | £1750 |
| Hewlett Packard 3325A - 21MHz Synthesiser/Function Gen..... | £1500 |
| Hewlett Packard 5183 - Waveform Recorder..... | £2250 |
| 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 3488A - HP - 1B Switch control unit (various Plug-ins available)..... | £650 |
| Hewlett Packard 8660D - Synthesised Sig Gen 10 KHz-2.6 Ghz..... | £4500 |
| Hewlett Packard 4192A - L.F. Impedance Analyser (5Hz - 12MHz)..... | £6995 |
| Hewlett Packard 4261A - L.C.R. Meter (Digital)..... | £500 |
| Hewlett Packard 4271B - L.C.R. Meter (Digital)..... | £900 |

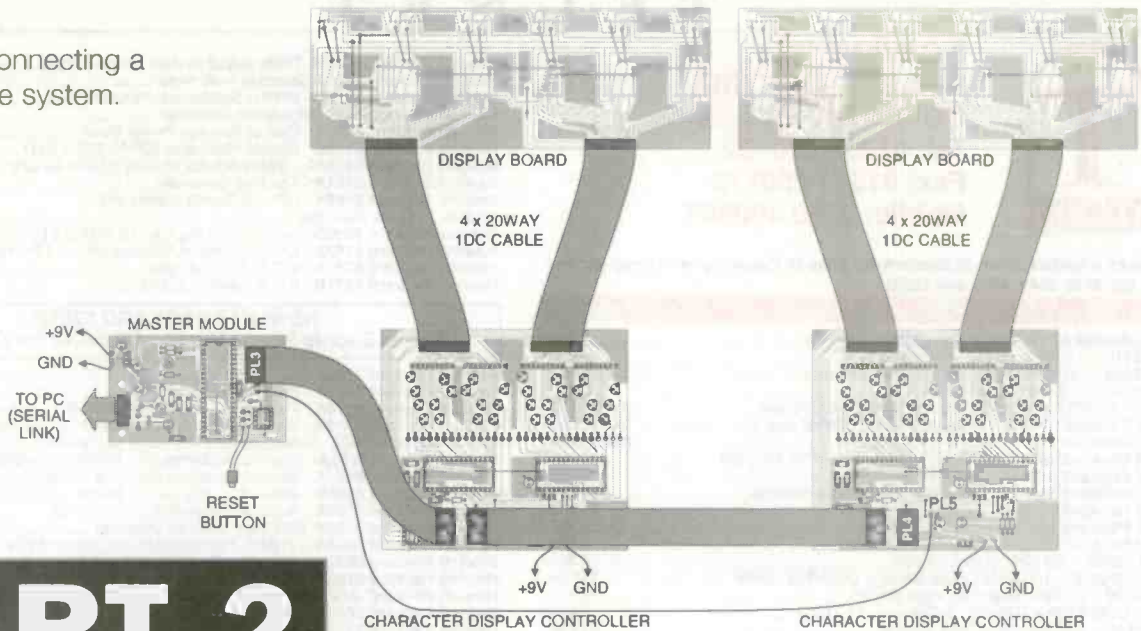
HEWLETT PACKARD 6261B

Power Supply 20v-50A £450 *Discount for Quantities*

| | |
|---|-------|
| Hewlett Packard 4342A - 'Q' Meter..... | £995 |
| Hewlett Packard 4954A - Protocol Analyser..... | £2995 |
| Hewlett Packard 8116A - Pulse/Function Generator (1MHz - 50MHz)..... | £2750 |
| Hewlett Packard 8349B - Microwave Broadband Amplifier (as new) 2 - 20GHz..... | £4250 |
| 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)..... | £3500 |
| Hewlett Packard 8901B - Modulation Analyser (150KHz - 1300MHz)..... | £4250 |
| Hewlett Packard 8903A - Audio Analyser (20Hz - 100KHz)..... | £2600 |
| Hewlett Packard 3455A 61/2 Digit M/Meter (Autocal)..... | £750 |
| Hewlett Packard 4948A - (TMS) Transmission Impairment M/Set..... | £2000 |
| Hewlett Packard 8601A - Generator/Sweeper (110 MHz)..... | £300 |
| Hewlett Packard 8165A - 50 MHz Programmable Signal Source..... | £1650 |
| Hewlett Packard 3746 A - Selective Level Measuring Set..... | £1750 |
| Hewlett Packard 6002A - Autoranging P.S.U. 50V - 10A..... | £650 |
| Hewlett Packard 8403A - Modulator..... | £500 |
| Hewlett Packard 334A - Distortion Analyser..... | £300 |
| Hewlett Packard 339A - Distortion Measuring Set..... | £1500 |
| Hewlett Packard 5314A - (NEW) 100MHz Universal Counter..... | £250 |
| Hewlett Packard 5350B - (NEW) 20GHz - Microwave Freq. Counter..... | £2500 |
| Hewlett Packard 6623A - Triple Output system P.S.U..... | £1950 |
| 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 2337A Automatic dist. meter..... | £150 |
| Marconi - 2019A - 80KHz - 1040MHz - Synthesised Signal Generator..... | £1950 |
| Marconi 2305 Modulation Meter..... | £2500 |
| Marconi 2871 Data Comms Analyser..... | £2000 |
| Marconi 6500 Automatic Amplitude Analyser..... | £1750 |
| Phillips PM 5167 10MHz function gen..... | £400 |
| Phillips PM 5565 - Waveform Monitor..... | £200 |
| Phillips PM 5567 - Vectorscope..... | £500 |
| Phillips PM 8226 - 6 Way Pen Recorder..... | £550 |
| Phillips 5190 L.F. Synthesiser (G.P.I.B.)..... | £800 |
| Phillips 5390 Programmable R/F Signal Gen (1020 MHz)..... | £1250 |
| Phoenix 5500A - Telecomms Analyser with various Interface Options..... | £1995 |
| 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..... | £850 |
| Racal Dana 9081 Synth. sig. gen 520MHz..... | £550 |
| Racal Dana 9084 Synth. sig. gen 104MHz..... | £450 |
| Racal Dana 9303 True RMS/R/Level meter..... | £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 |
| Schaffner NSG 200E Mainframe for NSG Plug-ins..... | £1250 |
| Schaffner NSG 203A Line Voltage Variation Simulator..... | £1250 |
| Schaffner NSG 222A Interference Simulator..... | £850 |
| Schaffner NSG 223 Interference Generator..... | £850 |
| Schlumberger 4021/4022 Radio Test Sets..... | £750 |
| Schlumberger S.L. 4040 Stablock - High accuracy 1GHz Radio Test Set..... | £4995 |
| Schlumberger 4923 Radio Code Test Set..... | £1500 |
| Schlumberger 2720 1250 MHz Frequency Counter..... | £500 |
| Stanford Research DS 340 - 15 MHz Synthesized Function (NEW) and arbitrary waveform generator..... | £1200 |
| Systron Donner 6030 - Microwave Frequency Counter (26.5 GHz)..... | £2750 |
| Tequipment CT71 Curve Tracer..... | £250 |
| Tektronix TM5003 + AFG 5101 Arbitrary Function Gen..... | £1750 |
| Tektronix 1240 Logic Analyser..... | £750 |
| Tektronix 1480 Waveform Monitor..... | £POA |
| Tektronix 521 Vectorscope..... | £425 |
| 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 576 - Curve Tracer (with Test Fixture)..... | £1250 |
| Tektronix AM503 + TM501 + P6302 - Current Probe Amplifier..... | £995 |
| Tektronix PG506 + TG501 + SG503 + TM503 - Oscilloscope Calibrator..... | £1995 |
| Tektronix CG5001 - Programmable Oscilloscope Calibrator Generator..... | £6995 |
| Time 9811 Programmable Resistance..... | £600 |
| Time 9814 Voltage Calibrator..... | £750 |
| Toellner 7720 - Programmable 10 MHz Function Gen (AS NEW)..... | £700 |
| Wavetek 2002B - Sweep generator (2.5 GHz)..... | £1950 |
| Wavetek 3010 - 1- 1GHz Signal Generator..... | £1250 |
| Wayne Kerr 8905 - Precision L.C.R. Meter..... | £850 |
| Wittron 560 Scalar Network Analyser..... | £800 |

**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**

Fig.8. Connecting a complete system.



PART 2

Matrix display message driver

In last month's article we looked at the circuit diagrams and the operation of the matrix LED display message system. In this article Robin Abbott takes a look at the construction, testing and operation of the system

As we saw last month there are three PCBs in the message display system, the master controller module, the character display controller card, and the display board. An oscilloscope is not essential for testing, but is useful particularly if the system cannot be made to work.

Master control card

This card is straightforward to construct. There are two links to install first, followed in order with the IC sockets, resistors, capacitors transistors and remaining components. The position for IC3 is drilled for a 78L05, or a 7805. If a large number of display controller cards are to be driven then a 7805 should be used. However, a heat sink is probably unnecessary even in this case. Make sure none of the ICs are inserted. Connect the board to a power supply of greater than 9V, and check the voltage on the power supply pins of IC1 and IC2. Now connect to a PC using a serial cable made up as shown in figure 7 and short out pins 25 and 26 of IC1. Connect to a terminal emulator and check that characters are echoed back to the PC. If not, check out the serial circuitry.

Now power down and insert IC1 and IC2. Install the PC control software. Use a terminal emulator on the PC, (such as Winterm.exe) and set the emulator to 9600 BPS, 1 stop bit, no parity and XON/XOFF signalling. Now check that when power is applied then a 'Z' is displayed on the terminal emulator (the OK diagnostic). Download the file called "send8c.txt" which is

supplied with the PC control software to the module. This may be done in Winterm.exe by using the Transfer | Send Text file menu option. This file commands the master module to enter a diagnostic mode where all received characters are looped back to the PC. Use the same technique to send any text file on the PC to the module and check that it is successfully received without error. This confirms operation of the 16C74, the serial circuitry (and XON/XOFF system) and the interrupt routines.

Now power the module down and up again and start the main control program, chardisp.exe. Use the Module | Communications menu option to set up the serial port to be used at 9600bps. The control program will check that the module is present and report on the result. The first action that must be undertaken is to download the font to the module without which no operations can take place. Use the Module | Download Font menu option, and select the font "normal.fon". The font will be downloaded, but this may take a few seconds. If all is well the program will report that the font has been verified OK.

Finally if you have an oscilloscope then check that the reset signal goes high for approximately 1 second after power up, and that the change and row drive signals look correct as shown in figure 3 of the first article. For almost all oscilloscope testing it is useful to connect channel 1 to row 1 drive, and trigger from this row. All other signals can then be referenced to row 1. The left and right communications signals should also

show transmissions in some rows. However, with no connections to display controller modules with pull up resistors, the location of these signals in rows may not be defined.

Display board and IDC cables

The display board has 21 links which were necessary to achieve a single sided PCB. These should be inserted first. The PCB may be modified according to the pitch of the display block pins. However, the basic layout should remain the same as most of the devices I have seen have the same pinout. The displays should be socketed to raise them off the board, and to allow easy replacement in case of LED failure. Use SIL sockets for this. The IDC connectors are soldered in last.

The IDC cables for the display boards and for the headers used between display controller cards are chosen for their ease of construction. Some amateur constructors are put off by the high price of special IDC connector insertion systems.

However, in practice, a small vice or a mole wrench may be used to gently squeeze the connector halves onto the cable. For the Bib headers a 14 pin DIL socket should be soldered into a piece of scarp veroboard. The header should be plugged into this socket, and the top half of the header connector squeezed on with the vice (bearing on the top of the connector and the bottom of the veroboard).

Display controller card

Insert all the links first - there are eight of these including one long link from underneath IC1 to underneath IC2. Next insert all the resistors. It is easiest to solder in the 30 vertically mounted base resistors in groups of 10 at a time. The four SIL resistors can be soldered next. However, if you are using very high drive currents (greater than 30mA), then it is recommended to use 9 pin SIL sockets, and to start with higher value resistors, and insert the correct values when operation is confirmed. This is because if the multiplexing circuitry fails (due, for instance, to a short) then the LEDs will certainly be blown if the drive current is set to 80mA! In the prototype, discrete resistors were used instead of SIL networks. Follow up with the IC sockets and finally the other components. IC3 will almost certainly need a heatsink if it is used to power the displays.

There are two veropins in the middle of the transistors for each PIC. These are used to supply the LEDs with power. If drive currents of 30mA or less are to be used then these veropins can be connected together and soldered to any component connected to +5V near the regulator, one end of Resistors R1, 2 or 3 is suitable. If drive currents of more than 30mA are to be used then the veropins must be connected to an external power supply of 5V of sufficient drive current. DO NOT be tempted to use a higher supply voltage with greater emitter resistor values, as the transistors will be turned on permanently by the static protection diodes to Vdd on the PIC 46C57 devices. A supply based on the SGS-Thomson L4975A can provide up to 5A at 5V. Maplin sell this device and can supply data sheets with example circuits.

To test the module build the display board as detailed above and connect it to the controller card using 20 way IDC cable. Do not insert IC1 or IC2 yet. It is possible to test all the connections at this stage, although this is laborious, and alternatively there is a lamp test function provided in the message control program. Check the power supply to IC1 and IC2, and then short the row drives on pins 1 to 7 of PL3 to Vdd (short each turn), and for each row connect the column drives on the port B and C pins of IC1 and IC2 to ground, one

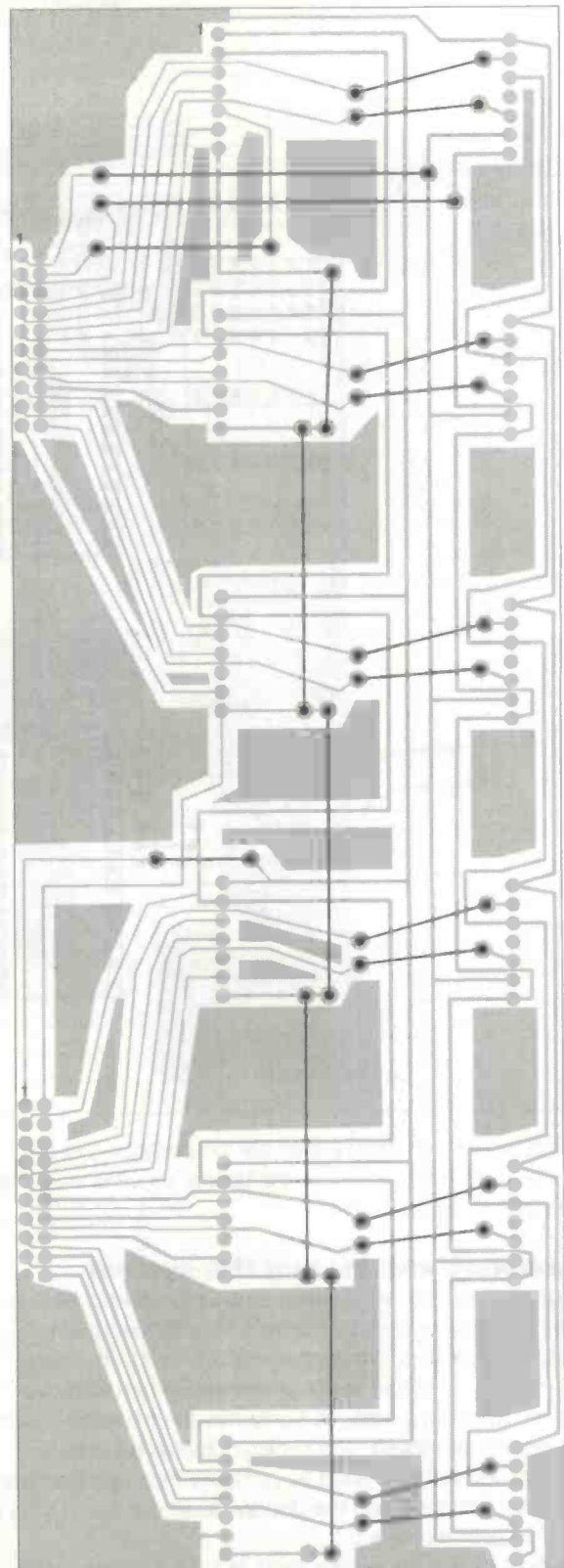
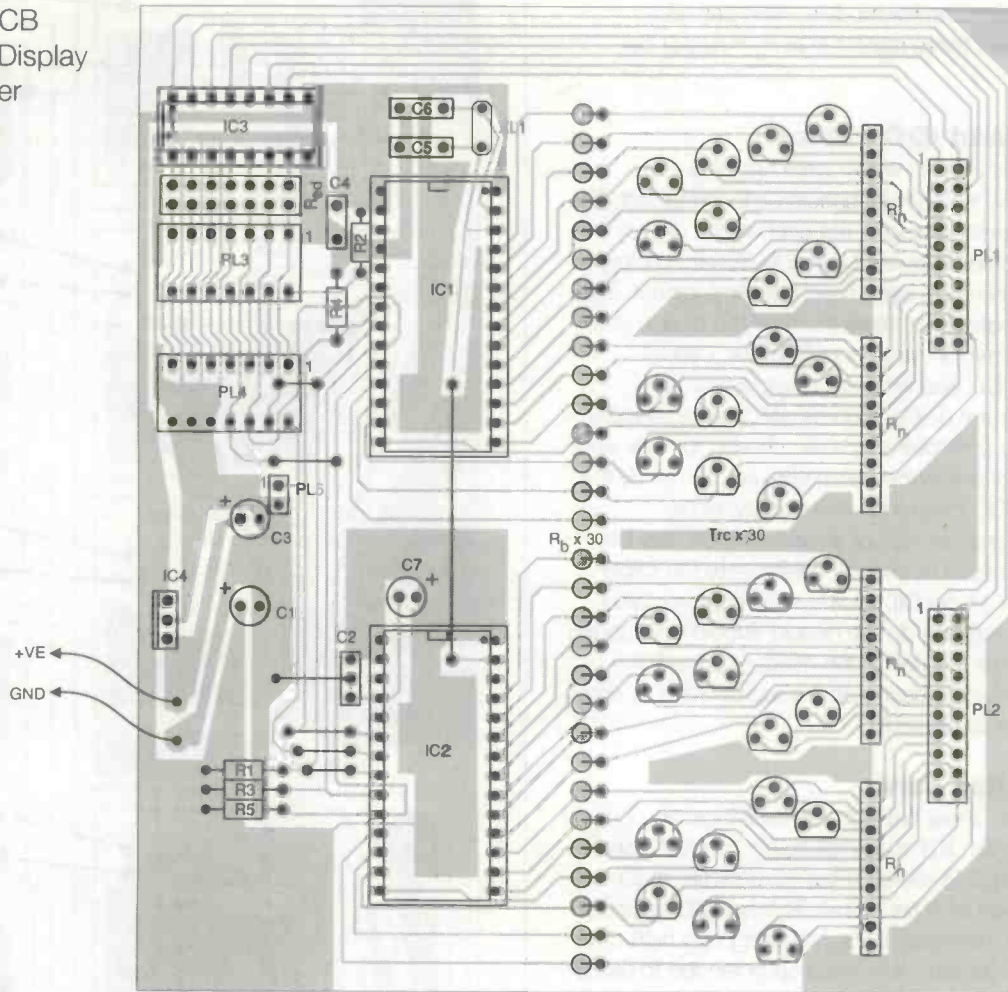


Fig.6. PCB overlay Display Board.

at a time; it is possible to check out every LED in this fashion. In case of failure check the signal path from the pin in error through the drive resistor, transistor, SIL resistor and IDC connectors. In the prototype three column drivers and one row driver had failures on initial checkout.

Power down, insert IC1 and IC2 and power up. At this stage IC1 and IC2 will be held in the reset state by the pull up resistor R5. Check that all column drive outputs are at +5V, and that the oscillator is operating on pin 26 of each PIC at 4MHz using a scope, or a frequency meter (with a voltmeter pin 26 will show about 2.5V +/- 1V if the oscillator is operating).

Fig.5. BCB overlay Display Controller Module.



There is little more testing that can be performed at this stage, the next action is to wire the boards together and check out the system as a whole.

Assembling and testing the system

Having tested out the individual boards, it is now possible to check the complete system. Figure 8 shows how to wire together the modules. Although figure 8 shows two display controllers it is advisable to check out the system with one display controller at a time, and only wire the whole lot together when they are all proven. The cables between the display controllers should be as short as possible; the cables between the display controllers and the display board can be as long as convenient (within reason).

Connect PL3 of the master module to PL3 of the display controller board, and the controller board to the display board. Wire the bottom pin of PL4 on the master module to the left hand pin of PL5 on the controller board. Connect to the PC, start the terminal emulator, and (provided that a font has been downloaded), then as characters are typed they should scroll across the display. If this is OK, then quit the emulator and start the character display controller application. The lamp test menu option will turn on all LEDs for one second to test the display and its connections. Now send the file test.txt (supplied with the controller) to the module by using the Module | Send File menu option. This will demonstrate variable speed scrolling, display dimming, flashing, inverse effects and scroll directions.

If the system does not work then there are a number of

areas to investigate. Check that the reset signal, and the change signals are correct at the PIC16C57's. The fundamental communications link is the global transmission link from the master module. If the lamp test works then this link is OK, and the next link to investigate is the link to PL5 from the master module which is the left output from the master.

Once it is operating successfully the system can be mounted into a suitable case. Construction details are not given here, as the mechanical construction will depend on application, the power supply, and the number of display boards used in the system. When mounting the master module then link 1 should be connected to an external reset button.

Using the PC controller software

The PC controller software runs under Windows 3.1, 3.11, or Windows '95. It is installed by running the program INSTALL.EXE on the disk, and running the program using the icon CHARDISP.EXE. The software is very straightforward to use, and is not essential for the use of the controller. The serial link protocol is described below to enable further applications to be developed.

The application contains a simple text editor, and the controls to enable messages to be sent to the module, to loop on the module, and also enables messages to be downloaded to the module to enable it to operate autonomously. Autonomous operation allows messages to be looped, and so to regain control it is necessary to undertake a special procedure. Connect the PC, power the system down, press the reset button (shorting the link on the master module), and

power up, keep the reset button pressed for at least 2 seconds after power up. Now the character display controller application can be used to disable the message using the Module I Clear Message menu option. Finally reset the module using the Module I Reset Module menu option to regain control.

Simple text files are sent to the module "as is". As a default all messages are sent at maximum brightness, with no flashing, no inverse text, and are scrolled from right to left. Line breaks are ignored. To control the messages and to provide effects a simple control system is employed. To use this, then a # character is embedded followed by a control character. Thus to clear the display then use #C, and to pause for about 1 second then use #P150. Figure 9 shows all the control codes that can be embedded together with their effects. The example file test.txt included with the software demonstrates all the control codes. The control codes work fine in messages downloaded into EEPROM store. If the message is to loop forever then place the code #A followed by a space at the end of the message file.

The following example will send the message "Display module" to the display, then cause it to flash for 2 seconds, and finally will scroll it slowly upwards off the top of the display. If it is downloaded to EEPROM then the message will loop forever.

```
#CDisplay Module
#F1 #P300 #F0 #DU #Z20
SSSSSS
#DL #Z4 #A
```

The S characters are not displayed because the scroll direction has been set to upwards, and a scroll upwards (or downwards) clears the display. Each S character simply causes one scroll.

Serial protocol operation

For those who wish to develop their own software, details of

the serial protocol and the operation of the EEPROM is given in this section. A knowledge of these protocols is not essential for construction and use of the project.

At the lowest level the module operates using the XON/XOFF protocol, and any application software must provide support for this - probably using interrupt driven software. Windows provides direct support for this protocol. To send the codes for XON (11H), XOFF (13H), and ESCAPE (1BH) then send an escape character followed by the code with bit 7 set. Thus to send XOFF, then send the bytes 1 BH followed by 93H. The master module operates the same protocol. The serial buffer sizes for the application software should be set to be of comparable size to the master module (the PC control software uses 64 bytes), this prevents large amounts of information being sent even though a transfer has been cancelled.

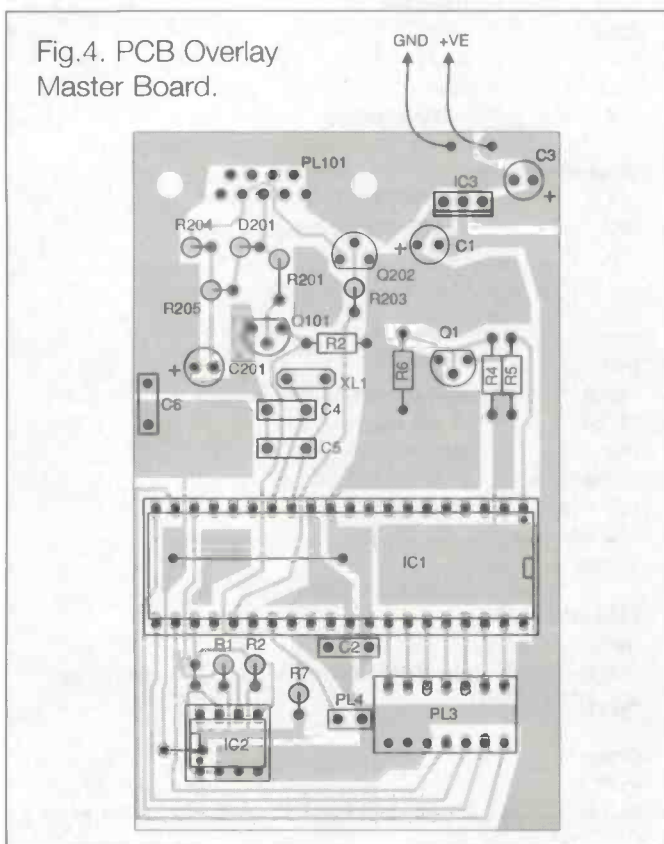
To send an ASCII character then simply send the code for that character to the master module. There are a number of control codes concerned with setting scroll direction, display clearing and programming the EEPROM; these are shown in figure 10. All of these codes have bit 7 of the byte set. Note that all commands return a 'Z' character to the PC when they have been successfully executed. Where a 2 byte parameter is provided then the low byte of the parameter should be sent first, followed by the high byte. Commands can be stored in EEPROM and will have the same effect as if sent from the PC. The only commands which cannot be executed from EEPROM are the EEPROM read and write commands (for obvious reasons).

The final information which may be required by an application program is the use of the EEPROM. To write information to the EEPROM the write command is used as shown in figure 10. This is followed by a 2 byte address, and the byte to be written. Thus to write the byte 67H to address 1234H, then the bytes 89H,34H,12H and 67H should be sent to the master module. When the byte has been written (which takes about 10mS) then the master module will return the 'Z' character. To read the EEPROM (for verification purposes) then the command 8A# is sent which returns the byte at address 0, subsequent bytes can be read by giving the 8BH command.

The address map of the EEPROM is as follows:

| | |
|---------|--------------------------|
| 00H-01H | Start address of message |
| 02H | Magic number 1, B6H |
| 03H | Magic number 2, 49H |
| 04H | Width of character font |
| 020H | Start of font |
| | Followed by the message |

The font holds 128 characters for each ASCII code from 00H to 7FH. Each character occupies a number of bytes in the EEPROM. The default font is normal.fon, and this holds 5 bytes per character, so the size of the font is 5x128, or 640 bytes. To find the start of character number 33, then multiply 33 by 5, and add 20H, this gives address 197 (in decimal). Each character is formed by up to five bytes which contain the character pattern in bits 6 to bit 0 (bit 0 is the top row of the display). The last byte in the character has bit 7 set, and this informs the master module that it must send a space between the characters. As the characters can have less than 5 bytes in width then the font can be proportional - character 'l' takes less width on the display than 'W' for example. The font width must be written to address 04H in the EEPROM. Details on creation of fonts are included with the application software.



Following the font, the message can be written. If a message is in EEPROM, then the first two bytes of EEPROM should give the message address. Then address 02H should contain the byte B6H, and address 03H should contain byte 49H. These "magic" numbers cause the master module to start reading data and commands from EEPROM when it is reset. To stop the master module doing this when it is reset then the bytes at address 02H and 03H can be set to 0.

Following the message then the end of the message must be indicated to the master module. This can be achieved with command byte 94H which returns control to the serial port, or command byte 95H which causes the master module to start reading from the start of the message again.

Obtaining components and software

All of the components are fairly standard with the exception of

the 16C74 which is available from Farnell on 0113-263-6311. The displays for the prototype were obtained as surplus from Greenweld, but other compatible displays are widely available. The 24LC65 is available from Maplin on 01702554161. The PC software and a programming service is available from Forest Electronic Developments, 10 Holmhurst Avenue, Christchurch, Dorset, BH23 5PQ. (01425) 275962. Send a blank 16C74, and as many blank 16C57XT/P devices as you would like programmed together with a cheque for £20.00. They will be programmed and returned with the PC software. Alternatively the 16C74 can be supplied for £9.50, and 16C57 devices for £5.50 in addition to the programming charge. (All VAT inclusive). The PC software is only available for Windows 3.1, 3.11, or Windows '95 on 3.5" disk.

Figure 7 - serial interface wiring

| Master module | PC connectortype: | | | |
|---------------|-------------------|------------|---------------|-------------|
| | 9 way Female | 9 way Male | 25 way Female | 25 way Male |
| Serial Skt | | | | |
| 2 | 3 | 2 | 3 | 2 |
| 3 | 2 | 3 | 2 | 3 |
| 5 | 5 | 5 | 7 | 7 |

PARTS LIST

Master card

Resistors, 5% metal film

| | |
|--------------|------|
| R1,2,201,203 | 22K |
| R4,5 | 1M |
| R6 | 220K |
| R7 | 1K |
| R202 | 10K |
| R204 | 2K7 |
| R205 | 300R |

Capacitors

| | |
|------|--------------|
| C1 | 10uF, 10V |
| C2,6 | 100n |
| C3 | 47uF, 16V |
| C4,5 | 22pF |
| C201 | 100uF, 16V |
| XL1 | 4MHz crystal |

Semiconductors

| | |
|---------|----------------------|
| IC1 | PIC16C74XT-P |
| IC2 | 24LC65 or compatible |
| IC3 | 78L05 or 7805 |
| TR1,202 | BC559 |
| TR202 | BC548 |
| D201 | 1N4148 etc. |

Other

| | |
|-------------|-------------------------------------|
| PCB | |
| PL101 | 9way, right angle mount D connector |
| PL1 | Veropins |
| PL3 | 14pin DIL socket |
| PL4,Link 1 | 2pin header |
| IC Sockets | 40 pin, and 8 pin |
| IDC cable | 14 way |
| IDC headers | 2 off, 14 pin DIL |

Character display controller card

Resistors, 5% metal film

| | |
|-------------|---------------------------------|
| R1,2,3,4,5 | 10K |
| Red (7 off) | 4k7 |
| Rb (30 off) | 4k7 |
| Rn (4 off) | SIL resistor network (see text) |

Capacitors

| | |
|------|--------------|
| C1,7 | 10uF, 10V |
| C2,4 | 100n |
| C3 | 47uF, 16V |
| C5,6 | 22pF |
| XLI | 4MHz crystal |

Semiconductors

| | |
|--------------|--------------------|
| IC1,2 | PIC16C57XT/P-04 |
| IC3 | UL2001A (see text) |
| IC4 | 7805 |
| Trc (30 off) | BC559 |

Other

| | |
|-------------|------------------------------|
| PCB | |
| PL1,2 | 20 way locking IDC connector |
| PL3,4 | 14 pin DIL socket |
| PL5 | 2 pin header |
| IC Sockets | 28 pin (2 off) |
| IDC cable | 14 way, 20 way |
| IDC headers | 2 off, 20 way |
| Veropins | |

Display Card

Semiconductors

| | |
|-------------|--|
| Display 1-6 | Any 5x7 LED matrix block, row cathodes e.g. TFB3X58 etc. |
|-------------|--|

Other

| | |
|-------|---|
| PCB | |
| PL1,2 | 20 way locking IDC connector, Right angle |

Figure 9, embedded control characters in text files

| Control codes | Effect |
|---------------|--|
| #A | Only has an effect in messages which have been downloaded to EEPROM. It should be placed at the end of the message and causes the message to loop back to the start |
| #Bn | Set brightness of display to n. If n is 0 then display is maximum brightness, if n is from 1 to 3 then display is dimmed (n=3 is the dimmest) |
| #C | Clear the display - turn off all LED's |
| #Dd | Set scroll direction. d is L,R,U or D for left, right, up, or down. Thus #DL sets the scroll direction to Left. |
| #Fn | Set flash mode. If n is 0 then flashing is turned off, if n is 1 then flashing is turned on |
| #In | Set inverse mode. If n is 0 then text is printed normally, if n is 1 then all text is printed in reverse |
| #M | Returns to the monitor in messages downloaded to the EEPROM. This is not required normally, but is used to return control to the PC whilst developing messages, and removed when they operate correctly. |
| #Pnnn | This causes the message to pause. nnn is a number from 1 to 30000. if nnn is 150 then the message will pause for about 1 second, so for example to pause for 10 seconds then use #P1500 |
| #R | Return the copyright message and software date |
| #S | Turn on all the LED's in the system |
| #Znn | Set speed of display shifting to nn. If n is 2 then the shift speed is maximum. The default speed is 4, a reasonable speed for scrolling messages up and down off the display is 20 |

Figure 10 - Control codes used for the master module

| Command bytes from PC | Parameters | Description |
|-----------------------|--|---|
| 80H | None | Return module count (not currently implemented) |
| 81H | None | Clear complete display |
| 82H | 2 byte count, Lo-Hi format | Pause for count multiplexing cycles. Each multiplexing cycle is 7.168mS, so there are 140 cycles per second |
| 83H | None | Forces the module to return a 'Z' character to confirm that it is present |
| 84H | None | Set scroll direction to Left |
| 85H | None | Set scroll direction to Right |
| 86H | None | Set scroll direction to Up |
| 87M | None | Set scroll direction to Down |
| 88H | None | Set all outputs to on-lamp test function |
| 89H | 2 byte address in Lo-Hi format followed by a data byte | Write the data byte to the supplied address in EEPROM. On completion return a 'Z' character (takes around 10mS) |
| 8AH | None | Read byte at address 0 and return it, follow with a 'Z' character |
| 8BH | None | Read the byte from the next address in EEPROM, follow it with a 'Z' character |
| 8CH | None | Loopround test. Transmit all characters received from the serial port straight back to the port. Stop when an escape character (1BH) is received. |
| 8DH | None | Reset the system, start the PIC16(=74 program at address 0 |
| 8EH | 1 byte speed | Set shift speed to supplied number, 2 is faster, FFH is slowest |
| 8FH | None | Set flash mode to ON |
| 90H | None | Set flash mode to OFF |
| 91H | 1 byte brightness | Set brightness of the display to the following 1 byte number, this should be 0 for maximum brightness, and 4 for minimum brightness (higher numbers will be dimmer on a static display, but will cause unpleasant flickering effects when the display shifts) |
| 92H | None | Set inverse mode to ON |
| 93H | None | Set inverse mode to OFF |
| 94H | None | Stop reading characters from EEPROM, and return to reading information from the serial port |
| 95H | None | When read from EEPROM this causes the master module to start reading the message from its start |

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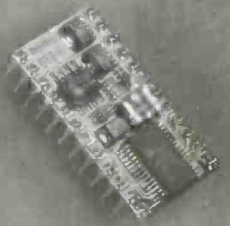
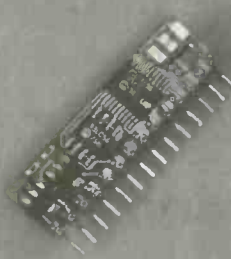
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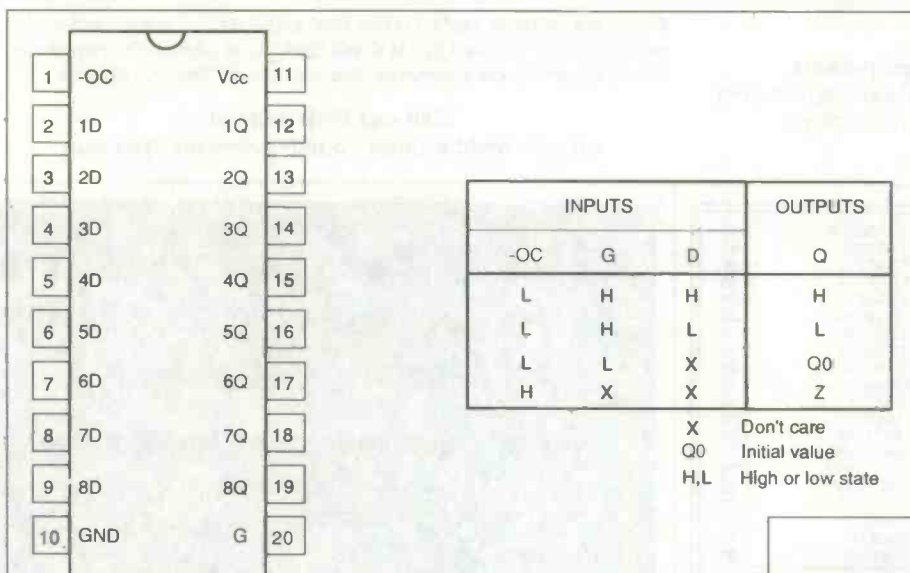
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PART 2

Single Board Computer

Dr Pei Ann continues the construction of the single board computer, starting with a look at the operation of the 8155 PIO



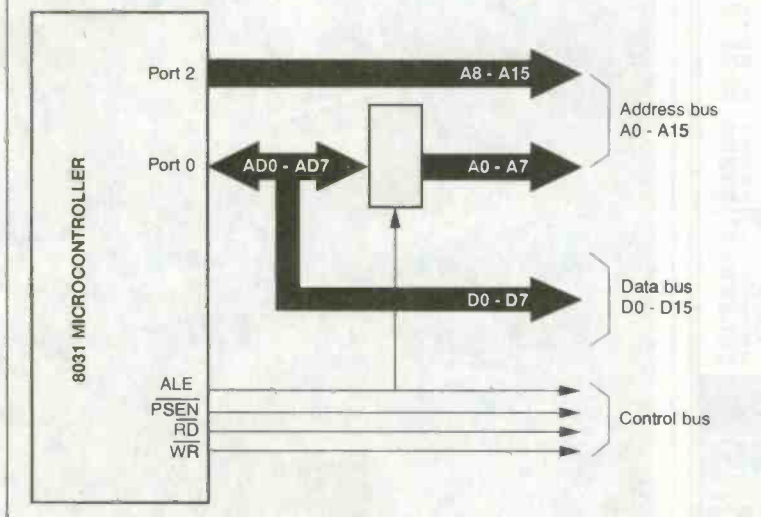
There are 4 registers associated with I/O operations of the 8155 chip. They are the C/S (command/status) register, Port A register, Port B register and Port C register. It also includes a 14-bit timer. These registers are selected by address lines A0, A1 and A2. A4 to A7 are ignored. The addresses are shown in the following table. Note that only when IO/M is held high (to enable I/O operation) can the registers be accessed.

Figure 8. 8155 internal registers

| Address | | | Register |
|---------|----|----|---|
| A2 | A1 | A0 | |
| 0 | 0 | 0 | Internal command/status register (C/S) |
| 0 | 0 | 1 | Port A register |
| 0 | 1 | 0 | Port B register |
| 0 | 1 | 1 | Port C register |
| 1 | 0 | 0 | Low 8 bits of the timer |
| 1 | 0 | 1 | High 6 bits and two bits of function controls |

C/S register has an address of 000B.

When writing data into the register, it becomes a control register. When reading data from it, it acts as





(a) Pin-out of 74LS138

| INPUTS | | | | OUTPUTS | | | | | | | | |
|--------|----|--------|---|---------|----|----|----|----|----|----|----|----|
| ENABLE | | SELECT | | | | | | | | | | |
| G1 | G2 | C | B | A | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| X | H | X | X | X | H | H | H | H | H | H | H | H |
| L | X | X | X | X | H | H | H | H | H | H | H | H |
| H | L | L | L | L | L | H | H | H | H | H | H | H |
| H | L | L | L | H | H | L | H | H | H | H | H | H |
| H | L | L | H | L | H | H | L | H | H | H | H | H |
| H | L | L | H | H | H | H | L | H | H | H | H | H |
| H | L | H | L | L | H | H | H | H | L | H | H | H |
| H | L | H | L | H | H | H | H | H | H | L | H | H |
| H | L | H | H | L | H | H | H | H | H | H | L | H |
| H | L | H | H | H | H | H | H | H | H | H | H | L |

$G2 = G2A + G2B$

(b) Function table

Figure 9 Bit functions of the control register

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|-----|-----------|-----------|----------|-----|----------|----------|
| TM2 | TM1 | IEB | IEA | PC2 | PC1 | PB | PA |
| Timer mode: | | Port B | Port A | 00=MODE1 | | Port B | Port A |
| 00= NOP | | interrupt | interrupt | 01=MODE2 | | 1=output | 1=output |
| 01= Stop | | | | 10=MODE3 | | 0=input | 0=input |
| 10= Stop after the present operation. | | | | 11=MODE4 | | | |
| 11= Start, after loading modes and counts | | | | | | | |

Bit functions of the status register

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|-------------------|-------------------------|-------------------------|--------------------------|--------------------------|-------------------------|--------------------------|--------------------------|
| TIME R | INTE B | B BF | INTR B | INTR A | A BF | INTRA A | |
| Counter interrupt | Port B interrupt enable | Port B interrupt enable | Port B buffer full/empty | Port B interrupt request | Port A interrupt enable | Port B buffer full/empty | Port A interrupt request |

a status register. The bit functions of the control register are shown in Table 8.

The bit function of the status register is shown in Table 9. Port A and Port B can be configured as input or output ports by setting bits 0 and 1 in the C/S register. Port C has 6 bits. The port can be configured as an input or an output by bits 2 and 3 of the C/S register.

The 6 bits can be also configured as handshake lines for Ports A and B: In this case, PC0 to PC2 lines will be allocated for Port A and PC3 to PC5 for Port B. The 4 modes of the Port C is shown in the following table:

@B1: The timer is a 14-bit count-down counter. For every pulse at the timer input (TIME IN), the content in the timer/counter will be decreased by 1. After the content becomes zero, a signal is given at the timer output pin (TIME OUT). This signal may be a single square pulse or a series of pulses depending on the configured operation mode. To program the timer, write to bit 0 to bit 13 of the timer registers (total number of bits is 14. The value to be written is in the range from 0002H to 3FFFH). Bits 14 and 15 select the time-out output modes:

Figure 11. 8155 timer/counter registers (upper and lower registers)

(Upper register)

| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|----|-----|-----|-----|-----|----|----|
| M2 | M1 | T13 | T12 | T11 | T10 | T9 | T8 |

high bits of the timer counts

(Lower register)

| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|----|----|----|----|----|----|----|
| T7 | T6 | T5 | T4 | T3 | T2 | T1 | T0 |

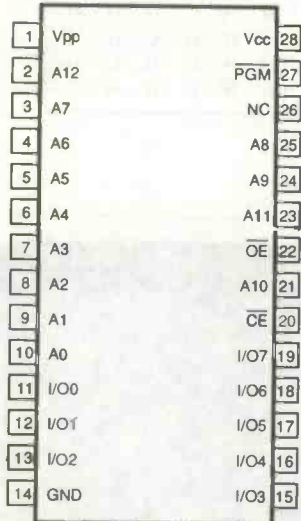
low bits of the timer counts

(Bit 14 and 15 of the counter register)

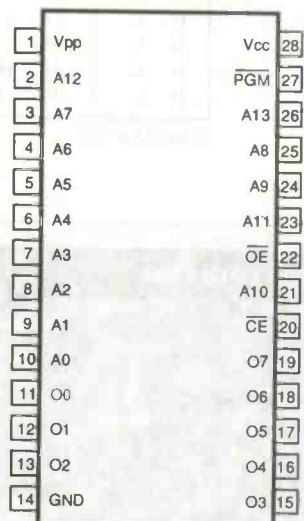
| M2 | M1 | Time-out signal shape |
|----|----|---|
| 0 | 0 | Single square (High-low-then-high) |
| 0 | 1 | Each time-out changes the voltage status of the output (Continuous square wave) |
| 1 | 0 | Single narrow low-going pulse |
| 1 | 1 | Continuous narrow low-going pulses |

Figure 10 Modes of PC0, PC1, PC2 and PC3

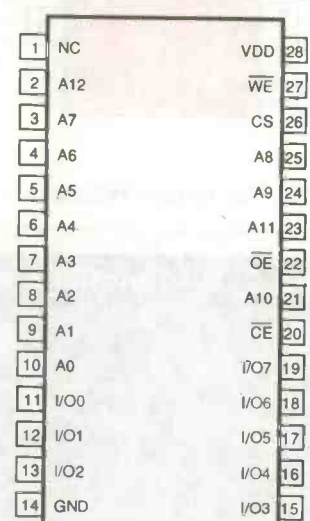
| Bit | Mode 1 | Mode 2 | Mode 3 | Mode 4 |
|-----|--------|--------|---------------------------|---------------------------|
| PC0 | Input | Output | Port A INTR | Port A INTR |
| PC1 | Input | Output | Port A buffer full (A BF) | Port A buffer full (A BF) |
| PC2 | Input | Output | Port A strobe (A -STB) | Port A strobe (A -STB) |
| PC3 | Input | Output | Output | Port B INTR |
| PC4 | Input | Output | Output | Port B buffer full (B BF) |
| PC5 | Input | Output | Output | Port B strobe (B -STB) |



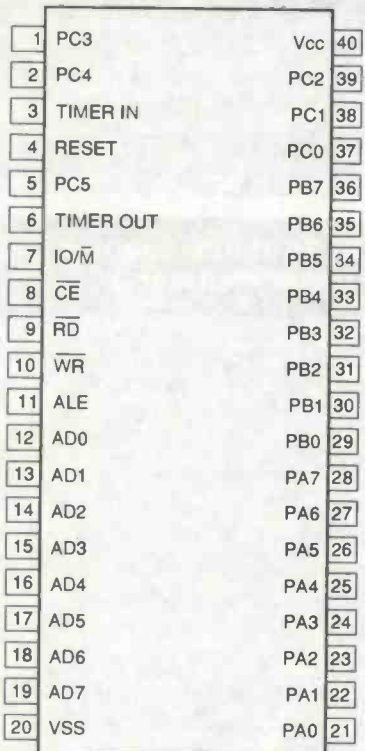
(a) 2764 8k byte EPROM



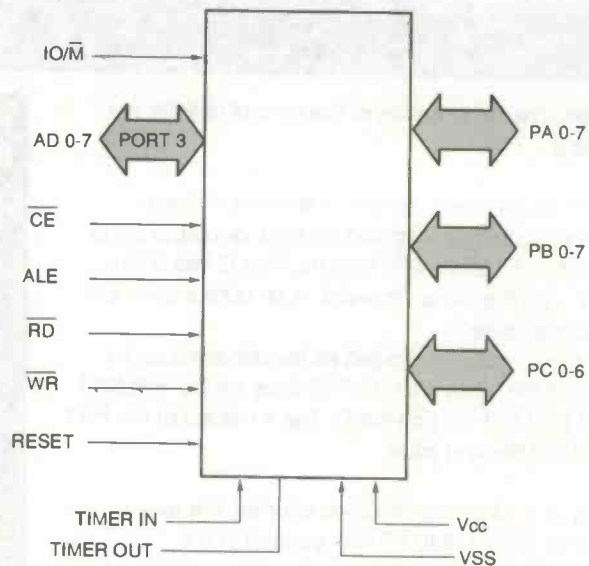
(b) 27128 16k byte EPROM



(c) 6264 8k byte CMOS RAM

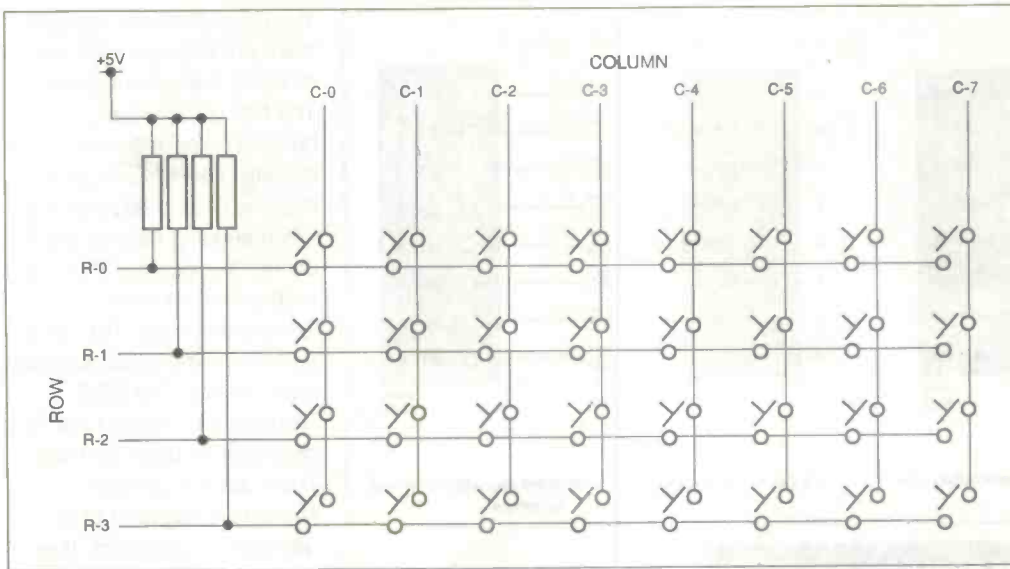


(a) Pin-out of 8155



(b) Logic symbol of the 8155

New values can be written to the timer register even if the timer is counting. However, to use the new value, a start command must be issued to the C/S register.



How the 8155 is used in the present SBC

The circuit showing how the 8155 is used in the SBC is given in Figure 3b. AD0-AD7 of the 8155 is connected to Port 0 of 8031. -RD, -WR, ALE are all connected to the corresponding pins of 8031. IO/-M is connected to A9 of 8031. If A9 is low, internal memory of 8155 can be accessed. If it is high, I/O registers can be accessed. Chip enable (-CE) is connected to Y0 of the second 74LS138 (IC6). The enables of IC6, -G2A and -G2B are connected to Y3 of the first 74LS138 (IC3). This combination allocates a 256 byte address range from 6000H to 60FFH to the internal RAM of the 8155. This RAM is reserved by the monitor program of the SBC. Users should not access this memory area, if the SBC operates under the control of the monitor program. Locations from 6100H to 6105H are the addresses for C/S register, PA, PB, PC and timer registers.

The ports of the 8155 can be used as general purpose input/output ports. In the present SBC, they are specially used for driving the LED display, keyboards and a piezo-electric sounder. When it is used with the display and keyboard, Ports A and B are both configured as outputs. Port C is configured as an input port. If the display and keyboard is not used, Port C can be configured as an output port, which will be used to drive the sounder.

Keyboard, display and others

The keyboard is an important device in this SBC. It allows users to input the program code (machine code) directly into the SBC. There are, in total, 32 key functions on the keyboard, which are supported by the keyboard monitor software. The first 16 functions are for digits input (0 to F) and the others are for controls. From the circuit diagram, it can be seen that those 32 functions are detected by an 8x4 scanning key matrix circuit. The 8 columns (Column-1 to Column-8), which supply the scan signal, are connected to Port A of the 8155. The 4 rows (Row-1 to Row-8), which receive the signal from the keyboard are wired to the lower four bits of Port C, which is configured as an input port. The four rows are pulled to +5V by four pull-up resistors.

A schematic of the principle of a scanning matrix keyboard is shown in Figure 14. The 8 scan lines in the column are normally high. Each of the column lines is brought low for a short period of time in turns. When one of the lines is in low state, the status of the four rows are monitored by the 8031. If there is not a key pressed, these four lines will be high (note

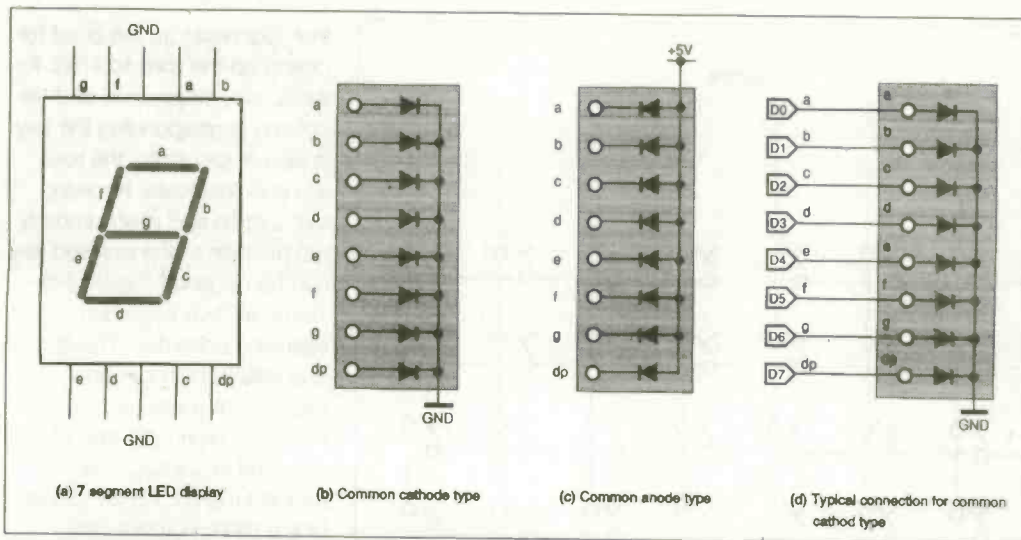
that four resistors are used for pulling up the lines to +5V). If there is a key pressed and the column corresponding the key is also at low state, the row line is at low state. Knowing the column and row numbers, the position of the pressed key can be obtained (Figure 14). There are two keyboard scanning schemes. The first one utilizes polling. The microcontroller scans the keyboard when it is free of doing other things. This method makes the better use of the CPU; however, the scanning interval is not regular. The other utilizes CPU

interrupt. For every fixed time interval (20 ms, for instance) an interrupt is generated which causes the microcontroller to respond to the interrupt - to scan the keyboard.

In this SBC, the 32 key functions are accomplished by a 16-key keypad plus a numerical/function selection key (selection key, in short). When the selection key is not pressed, the keypad is for inputting numerical digits. When it is pressed, the keypad is for inputting functions. This arrangement is achieved using a simple circuit as shown in Figure 3c. The two rows from the keypad are connected to the inputs of four tri-state buffers of a 74LS241 IC (see Figure 3c). Enable pins of the buffers are connected together to form a selection line. It is normally high because of the pull-up resistor. It can be pulled down to GND if the selection key is pressed. When the selection line is high, the lefthand side buffers 1 and 2 are enabled. When it is low, the buffers 3 and 4 are enabled. This allows the two rows of the keypad to be connected to PC0 and PC1, which are for numerical inputs, if the key is not pressed and the two rows are connected to PC2 and PC3, which are for function inputs, if the key is pressed. A selection of numerical digits and functions is therefore achieved.

7-segment display circuit

7-segment LED displays are used in this SBC. The pin-out, functions and types of the display is shown in Figures 15a to d. There are two types of displays. One is the common-anode type in which the anodes of the 7 LEDs are connected together (Figure 15c). In use, the common is connected to +5V of the power supply. An LED lights when its corresponding pin is brought to low state. The other type is the common-cathode type. In this case, the cathode of LEDs are connected together (Figure 15b). In use, the common is connected to GND of the power and an LED is enabled by pulling its anode to high state. Special code has to be sent to the display in order to display certain numerical digits or characters. The relation between some display symbols and their binary codes is shown in the following table:



In a microcontroller system, there are two common ways of using 7-segment displays. The first one involves hardware decoder and driver circuits. The advantage is that the CPU is required only when sending data to the circuit. It is obvious that this method needs extra hardware circuits. The other method is known as software display drive. The SBC employs this method and it is described in detail as follows. There are six common cathode 7-segment LED displays. In operation, they

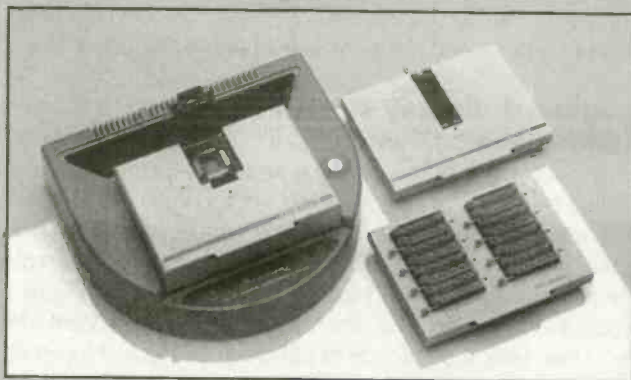
Figure 12. Binary codes of digits for common-anode and common-cathode displays

| Symbol | Common -anode | Common -cathode | Symbol | Common -anode | Common -cathode |
|--------|---------------|-----------------|--------|---------------|-----------------|
| 0 | C0H | 3FH | 9 | 90H | 6FH |
| 1 | F9H | 06H | A | 88H | 77H |
| 2 | A4H | 5BH | b | 83H | 7CH |
| 3 | B0H | 4FH | C | C6H | 39H |
| 4 | 99H | 66H | d | A1H | 5EH |
| 5 | 92H | 6DH | E | 86H | 79H |
| 6 | 82H | 7DH | F | 84H | 71H |
| 7 | F8H | 07H | blank | FFH | 00H |
| 8 | 80H | 7FH | | | |

are lit one after another in turns. At a time, there is only one display which lights. However, due to the effect of residual vision of our eyes, we see as if all displays are showing messages in the same time. The electronic circuit achieving such a display sequence is shown in Figure 3c. It can be seen that display data is output from Port B of the 8155. This data is supplied to the 7-segment LEDs via a 74LS245 (IC1) driver to boost the output current. The common cathode of the six LED displays, which are connected to Port A of the 8155 via TTL drivers of the 7806, are normally high and all the LEDs are unlit. By pulling one of the common cathode to GND, that 7-segment LED display will light, showing the display data.

Next month, the details of the construction of the SBC will be described.

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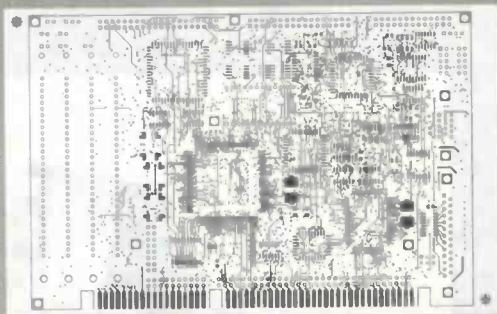
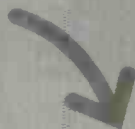
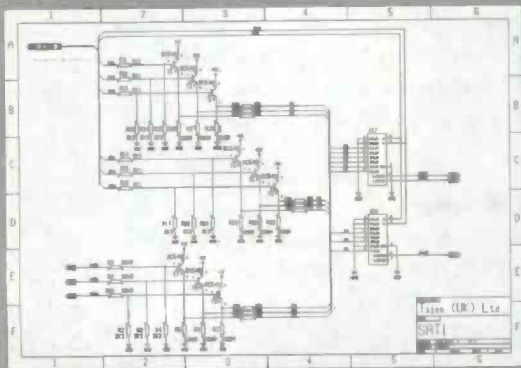
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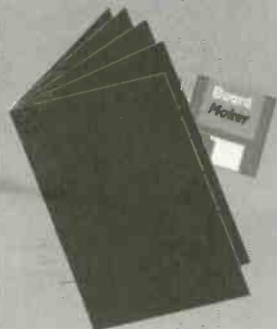
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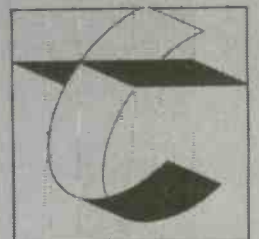
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Practically Speaking

BY TERRY BALBIRNIE

This month we shall continue looking at construction technique. This follows from my observations of GCSE examination projects over several years. It should help amateur constructors or those preparing for technology and electronics examinations.

Many circuits work even though they have been constructed badly. However, faults are more likely to develop and it sometimes happens that these only appear after a period of use. Poor construction often results in intermittent operation where the circuit might work when shaken or the circuit panel bent slightly. Another result of poor construction is that faults, once developed, are more difficult to find.

Any old iron

Poor soldering technique probably accounts for most circuits failing to work or for working intermittently. Soldering is an art which is only developed by practice and beginners should use scrap materials to make joints until they are satisfied with the result. Many examination candidates have had too little practice.

Amateur soldering irons often become so bad that even an expert would find difficulty making a good joint using them. After a short period of use, burnt flux collects on the bit and this must be regularly removed, using a damp sponge. After a long period of use, pitting tends to occur. Small pits do not matter but large ones make for difficult work. Plain copper bits may be filed to re-shape them and to remove the pitting. However, iron clad bits should be renewed. Note that soldering technique was looked at in detail in *Practically Speaking* December 1994 and January 1995.

When attaching wires to off-board components, it helps to make a mechanical connection before soldering - hooking wires around component tags or through any hole which might exist. The photograph shows a rotary switch with a wire hooked through the tag before soldering. This will stand up to vibration or pulling better than a joint made direct to the tag. Of course, for experimental work it is better to solder the wire without hooking it so that it is easier to remove again.

Cor, blimey

Constructors often give little thought as to the choice of connecting wire they use. It's often the case that they grab whatever happens to be lying around on the bench. If the mains supply is involved, it is essential to use the correct type of mains-rated wire and it is extremely dangerous to do otherwise. However, beginners' projects and school-type circuits will be battery-operated or powered from a commercial mains supply unit.

For point-to-point wiring, there are two types of wire commonly used - single (solid) core and stranded core. These are described in catalogues as "X/Y" where X is the number of

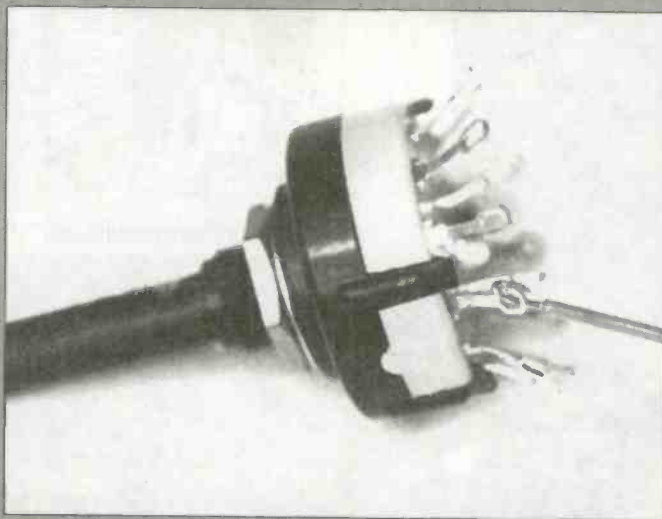
strands and Y the diameter of each strand in millimetres. For example, general-purpose single core wire may be listed as "1/0.6" i.e. one core of diameter 0.6mm. A general-purpose stranded wire would be described as "7/0.2" - a core consisting of 7 conductors, each 0.2mm diameter. The total cross-section area of the copper core determines the maximum current it can carry and this point will be looked at in a later *Practically Speaking* column.

Under strain

Single-core wire should never be used where it will be subjected to repeated bending since it will soon break. Suppose a switch is mounted on the lid of the case so that its connecting wires bend each time the lid is removed. Single-core wire should not be used for this purpose. This type of wire should be used where its ability to stay bent in one position means that it produces a neat layout. Stranded core wire will withstand bending much better and so must be used wherever repeated movement takes place. There is an extra-flexible wire (55/0.1) which will withstand this type of treatment for a long time. It is used for meter probes and similar purposes. Candidates rarely think ahead and mount switches and potentiometers on the same section of the box as the circuit panel so that, when the lid is removed, the wiring is not put under any strain.

The end of the tale

Wires may be neatly grouped using cable ties. These are placed around the wires, one end pushed into the other and the tail pulled tightly. This locks it in position. The excess tail is then cut off. Where many wires of similar type are connected to a component such as a rotary switch, it will help if they are colour-coded. This will avoid wiring errors. "Rainbow" ribbon cable is excellent for this purpose.



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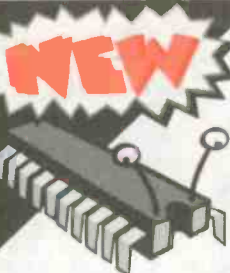
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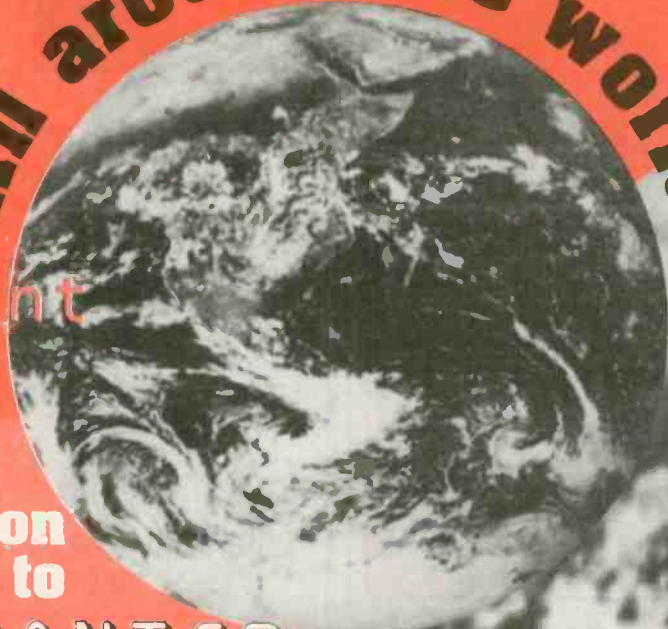
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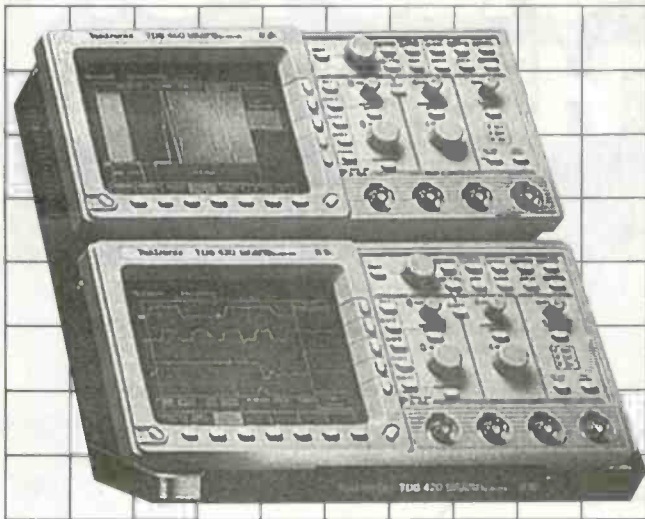
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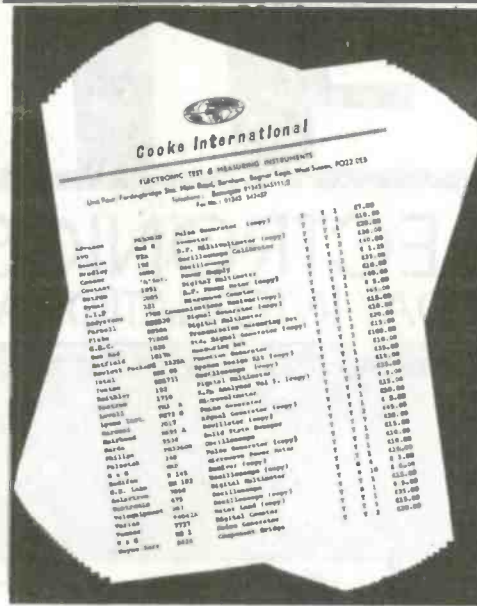
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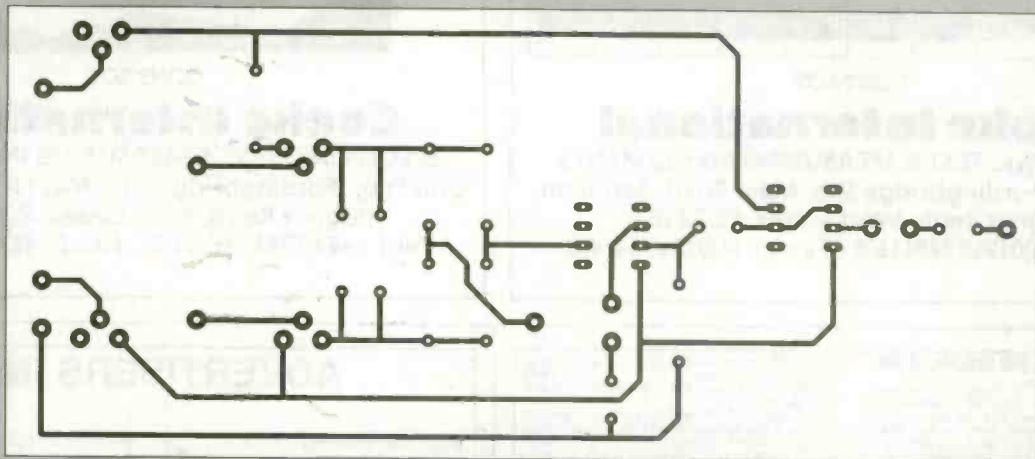
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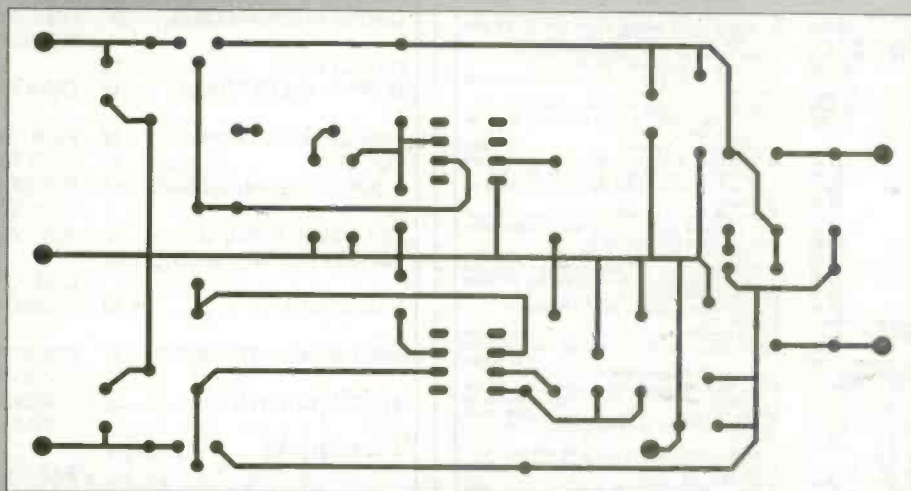
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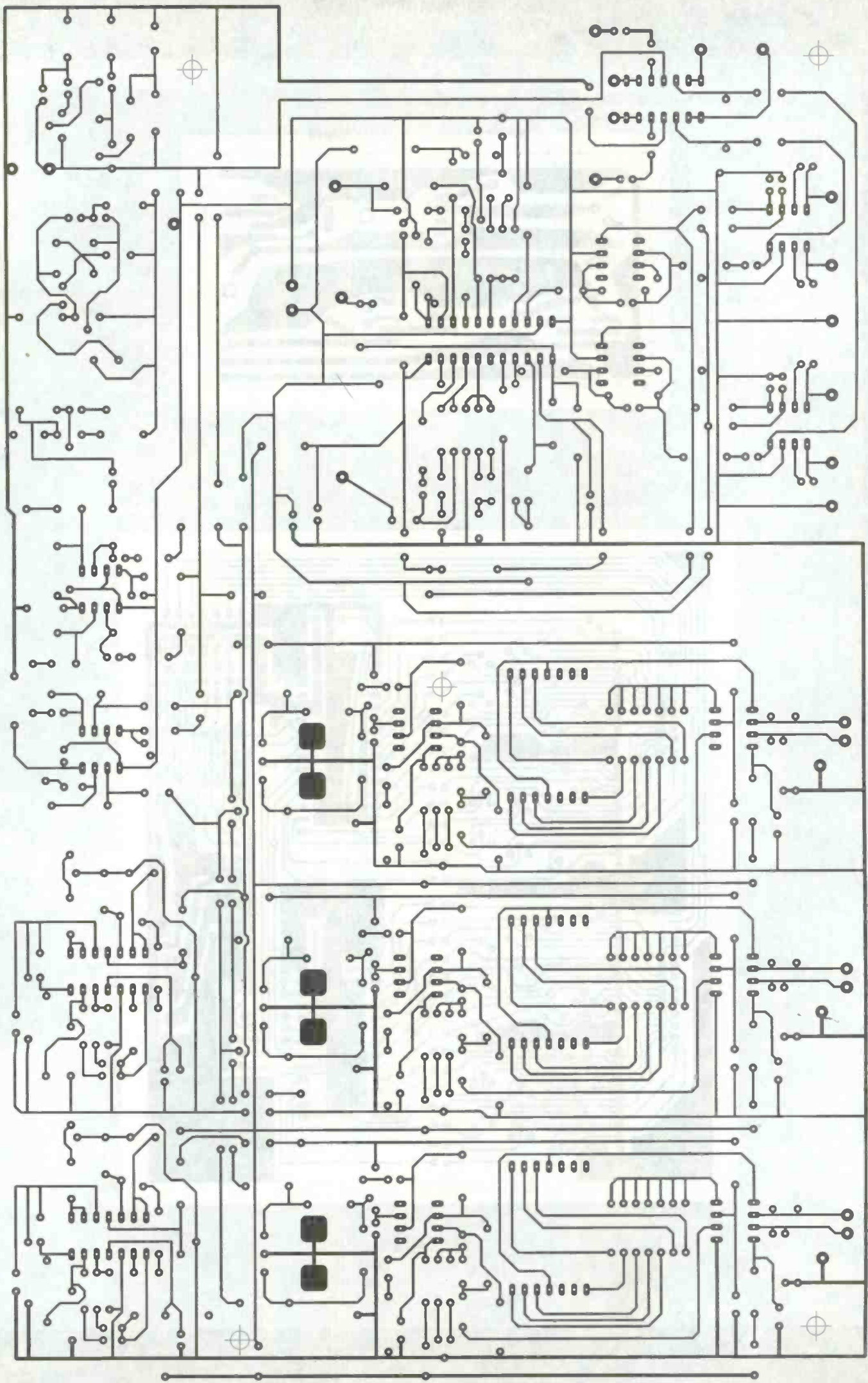
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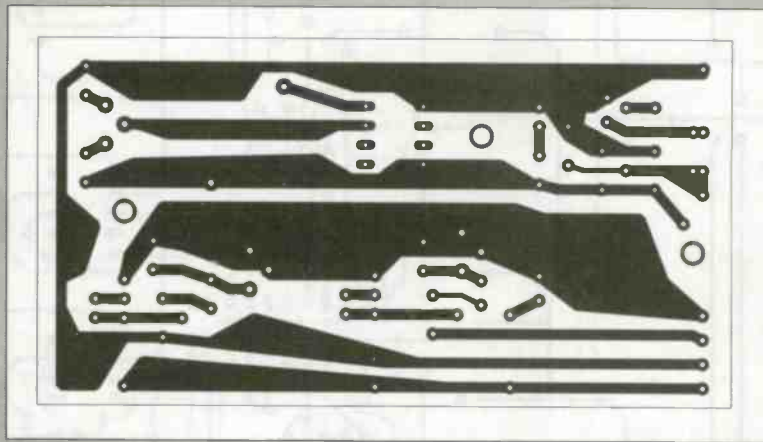
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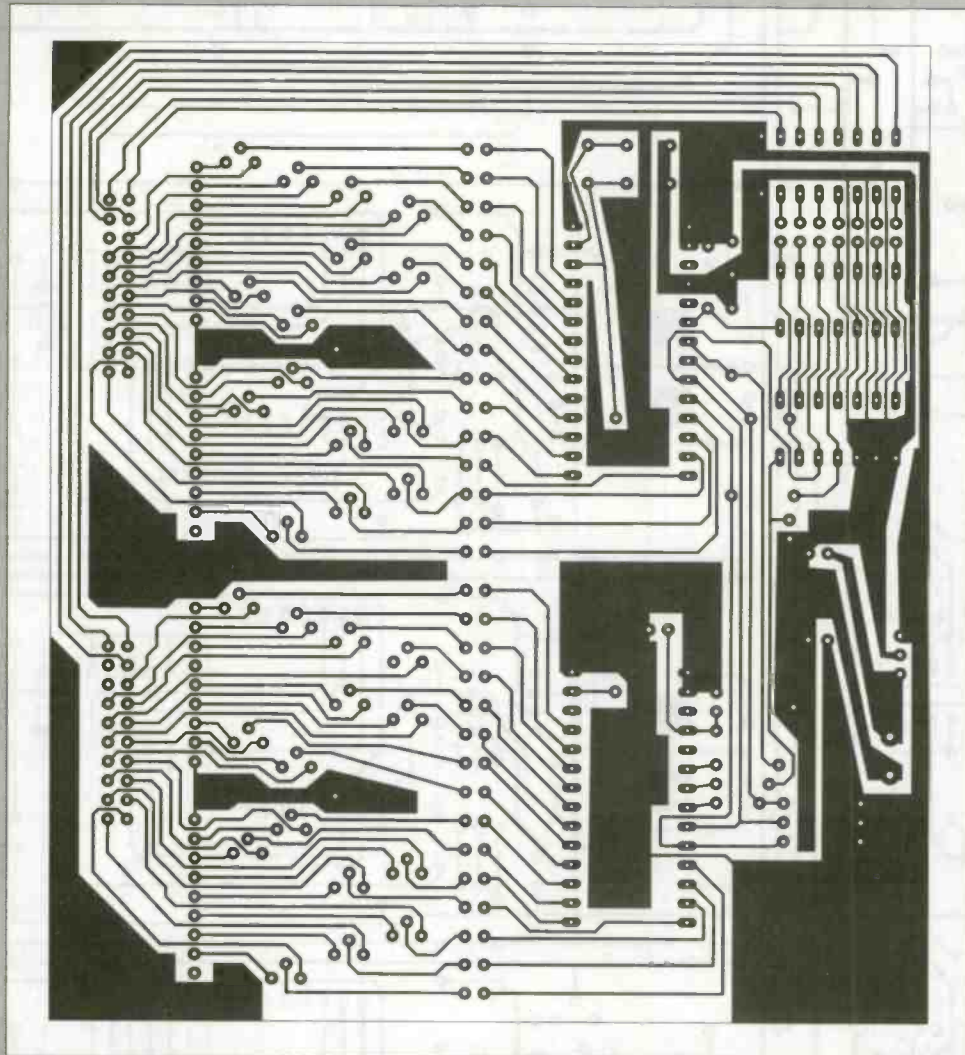
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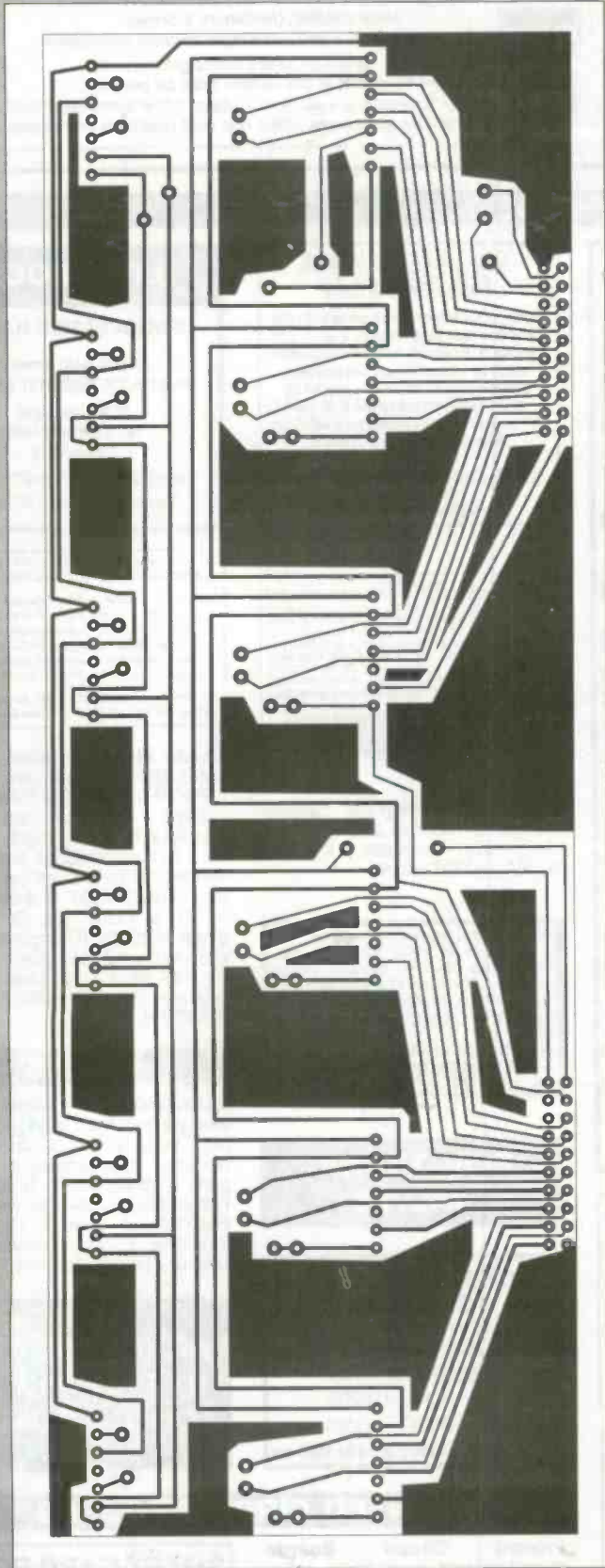




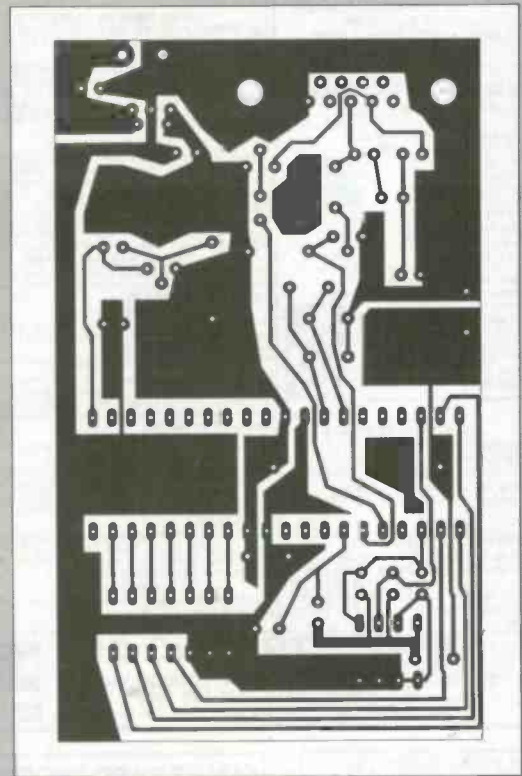
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Around the Corner

When the history of technology development in the latter half of the twentieth century comes to be written probably one of the most significant developments, and certainly one with potentially enormous impact on the future of everyone, is the development of optical fibre data communications. Very high speed data communications is a key component of virtually every technological advance that is being made today, and will probably assume even greater importance in the future. @B:Already we can start to see the results, the fax, and e-mail have started to supplant conventional letters in business communications, and are now starting to replace the letter in private communications. The Internet and World Wide Web are starting to become the primary source of information on a wide range of subjects, and are thus replacing books, magazines, libraries and newspapers. Radio broadcasts from all over the world can now be received over the Internet, and will soon be joined by TV broadcasts. The natural conclusion about these developments is that physical newspapers, and magazines, as well as radio and TV sets, all with rather restricted local coverage, are on their way out. They will be replaced by a global information network that uses optical fibre communications technology to bring the world to everyone's doorstep. The availability of high capacity data communications will not only affect the media, information, and entertainment industries; it will affect every industry, every human activity, and even the structure of society and the culture and attitudes of society. What is so revolutionary about it is that data communications have shrunk the world in a way that transportation systems could never do. Today, and in the future, every part of the world is, at most, just a few seconds away from every other part of the world. This means that if we couple high speed data communications with virtual reality and robotic technology it will be possible for any individual to be instantly 'transported' to any other part of the world. Not just in a visual/auditory way but with full tactile/sensory feedback and interactivity with the physical world at the location to which he has been 'transported'. The first steps along this path are already being taken with the development by the US military of remote surgery technology which will use 'robot surgeons' controlled directly by human

surgeons to perform operations in hazardous areas, such as battlefields. The human surgeons' use of virtual reality systems means that they get all the sensory feedback and interaction that they would get if they were physically in the same room as the patient, instead of being perhaps a few thousand miles away. Robot surgical technology can also be used to allow a specialist to perform an operation in another part of the world without either patient or doctor having to travel. Technology that can be used by a doctor to remotely perform a delicate operation can also be applied to any other activity that requires physical interaction with the remote environment. It will make it possible to work in hazardous, or unpleasant environments, such as the bottom of the sea, or in space. However, the greatest impact of this type of technology will be in more mundane activities. It will, for example, make it far easier to manufacture products near to the source of demand for those products even though certain skills may not be present in the local workforce. Instead of shipping in expensive skilled labour, enter virtual manufacturing systems. This technology could open up new concepts in manufacturing where small general-purpose factories fitted with remote control robotic equipment could be used to manufacture a very wide range of products for the local market. By almost manufacturing to demand products that are tailored to local needs, a company could both increase its sales as well as decreasing transportation and stock holding costs. A move which could be bad news for shipping companies and airlines. Airlines, and the traditional tourist industry could also be hit if this sort of technology was applied to the leisure industry. Imagine being able to go to an entertainment complex which could offer you the choice of visiting the Moon or Mars, swimming with sharks off the Barrier Reef, walking to the North Pole, or through the Amazon jungle. Experiences which, thanks to that combination of communications, virtual reality and robotics, would seem completely real and totally unique, not a theme park scripted experience. An experience where you were interacting with the real world, just as if you were physically there. This type of virtual tourism is being planned right now, and is probably just a few years away from being commercially available. Without a doubt communications is the key to the future.

Next Month.....

In the June 1996 issue of Electronics Today International we continue Paul Stenning's look at restoring antique electronics whilst from Terry Balbaine there is a project to build a simple, easy to use burglar alarm system. Bart Trepak introduces another PIC microcontroller project whilst Dr Pe An will continue his 8051-80535 single board computer project. The main feature articles will include a look by Douglas Clarkeson at the technology and application of wind power



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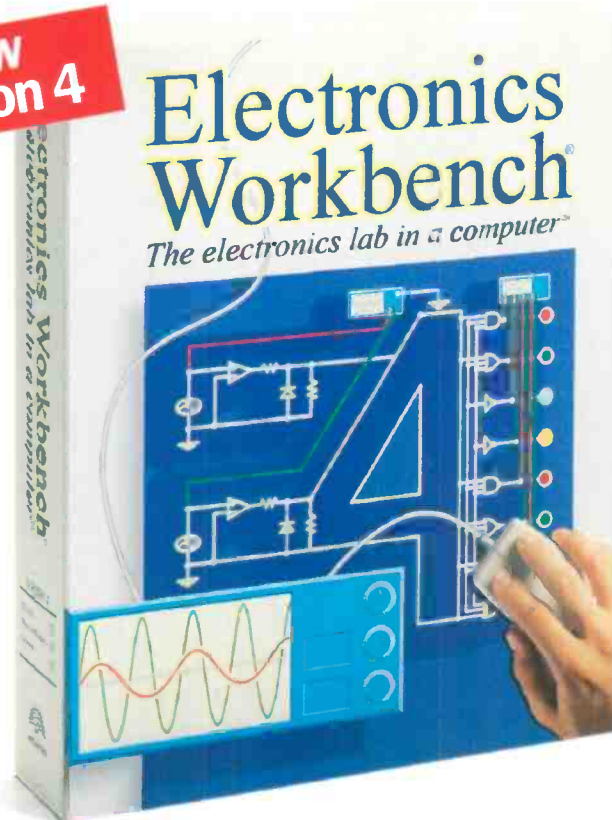
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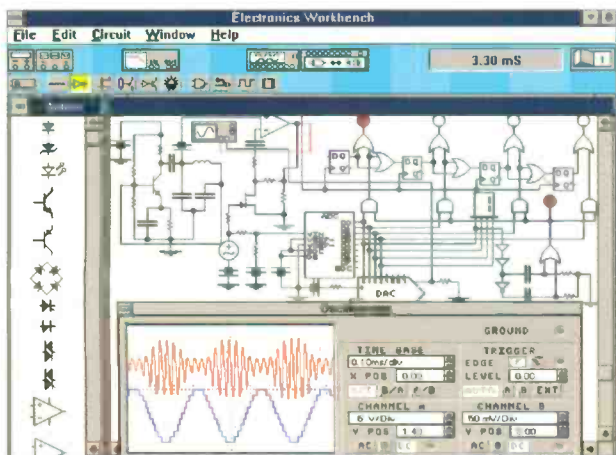
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