FREE – Revolutionary 4D Audio CDs to give away

ELECTRONICS in ACTION

December 1993 £2.25

Photo CD

From TV screens to magazines

Video Visuals

High quality, low cost home movie editing

Back to the Sixties

Vintage sounds using todays stereo technology

2 Kodak Photo CD players to be won

Sit back and view your photo album on television or just listen to a favourite CD

See page 12 for details

ISSN 0969-3564

AMSTRAD DMP4000 Entire printer assemblies including printhead, platen, cables, stepper motors etc. Everything bar the electronics and case. Good stripper!! Clearance price just £5 REF: MAG5 or 2 for £8 REF: MAG8

VIEWDATA SYSTEMS Brandnew units made by TANDATA complete with 1200/75 built in modem, infra red remote controlled keyboard, BT approved, Prestel compatible, Centronice printer port, RGB colour and composite output (works with any TV) complete with power supply and fully cased. Price is just £20 **REF: MAG20** Also some customer returned units available at £10 each **REF: MAG10**

PPC MODEM CARDS. These are high spec plug in cards made for the Amstrad laptop computers. 2400 baud dial up unit complete with leads. Clearance price is £5 **REF: MAG5P1**

INFRA RED REMOTE CONTROLLERS Originally made for hi spec satellite equipment but perfect for all sorts of remote control projects. Our clearance price is just £2 **REF: MAG2**

TOWERS INTERNATIONAL TRANSISTOR GUIDE. A very useful book for finding equivalent transistors, leadouts, specs etc. £20 **REF: MAG20P1**

SINCLAIR C5 MOTORS We have a few left without gearboxes. These are 12v DC 3,300 rpm 6"x4", 1/4" OP shaft. £25 **REF: MAG25**

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

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**

***FM CORDLESS MICROPHONE** Small hand held unit with a 500' range! 2 transmit power levels. Reqs PP3 9v battery. Tuneable to any FM receiver. Price is £15 **REF: MAG15P1**

LOW COST WALKIE TALKIES Pair of battery operated units with a range of about 200'. Ideal for garden use or as an educational toy. Price is £8 a pair **REF: MAG 8P1** 2 x PP3 req'd.

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

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

LQ3500 PRINTER ASSEMBLIES Made by Amstrad they are entire mechanical printer assemblies including printhead, stepper motors etc etc In fact everything bar the case and electronics, a good stripper! £5 **REF: MAG5P3** or 2 for £8 **REF: MAG8P3**

PHILIPS LASER 2MW helium neon tube. Brand new full spec £40 REF: MAG40. Mains power supply kit £20 **REF: MAG20P2**. Fully built and tested unit £75 **REF: MAG 75**.

SPEAKER WIRE Brown two core, 100 foot hank £2 REF: MAG2P1

LED PACK of 100 standard red 5mm leds £5 REF: MAG5P4

JUG KETTLE ELEMENTS good general purpose heating element (about 2kw) ideal for all sorts of heating projects etc. 2 for £3 REF: MAG3

UNIVERSAL PC POWER SUPPLY complete with flyleads, switch, fan etc. Two types available 150w at £15 REF:MAG15P2 (23x23x23mm) and 200w at £20 REF: MAG20P3 (23x23x23mm)

OZONE FRIENDLY LATEX 250ml bottle of liquid rubber, sets in 2 hours. Ideal for mounting PCB's, fixing wires etc £2 each REF: MAG2P2

***FM TRANSMITTER** housed in a standard working 13A adapter!! the bug runs directly off the mains so lasts forever! why pay £700? or price is £26 REF: MAG26 Transmits to any FM radio.

***FM BUG KIT** New design with PCB embedded coil for extra stability. Transmits to any FM radio. 9v battery req'd. £5 REF: MAG5P5

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

TALKING COINBOX STRIPPER originally made to retail at £79 each, these units are designed to convert and ordinary phone into a payphone. The units we have generally have the locks missing and sometimes broken hinges. However they can be adapted for their original pupose or used for something else?? Price is just £3 **REF: MAG3P1**

100 WATT MOSFET PAIR Same spec as 2SK343 and 2SJ413(8A,140v,100w) 1 N channel and 1 P channel, £3 a pair **REF: MAG3P2**

VELCRO 1 metre length of each side 20mm wide (quick way of fixing for temporary jobs etc) £2 **REF: MAG2P3**

MAGNETIC AGITATORS Cosisting of a cased mains motor with lead. The motor has two magnets fixed to a rotor that spin round inside. There are also 2 plastic covered magnets supplied. Made for remotely stirring liquids! you may have a use? £3 each **REF: MAG3P3** 2 for £5 **REF: MAG5P6**

TOP QUALITY SPEAKERS Made for HI FI televisions these are 10 watt 4R Jap made 4" round with large shielded magnets. Good quality general purpose speaker. £2 each **REF: MAG2P4** or 4 for £6 **REF: MAG6P2**

TWEETERS 2" diameter good quality tweeter 140R (would be good with the above speaker) 2 for £2 **REF: MAG2P5** or 4 for £3 **REF: MAG3P4**

AT KEYBOARDS Made by Apricot these quality keyboards need just a small modification to run on any AT, they work perfectly but you will have to put up with 1 or 2 foreign keycaps! Price £6 **REF: MAG6P3**

XT KEYBOARDS Mixed types, some returns, some good, some foreign etc but all good for spares! Price is £2 each **REF:MAG2P6** or 4 for £6 **REF: MAG6P4**

PC CASES Again mixed types so you take a chance next one off the pile £12 **REF:MAG12** or two identical ones for £20 **REF: MAG20P4** component pack bargain 1,000 resistors +1,000 capacitors (all same value) £2.50 a pack. **REF:MAG2P7**

1994 CATALOGUE OUT NOW

BULL'S BULLETIN BOARD

MASSIVE

WAREHOUSE CLEARANCE

FANTASTIC £20.00 REDUCTION

REFURBISHED PC BASE UNITS
COMPLETE WITH KEYBOARD

FROM ONLY **£29.00**

AMSTRAD 1512 BASE UNITS

GUARANTEED

PERFECT WORKING ORDER.

A LOW COST INTRODUCTION TO THE HOME COMPUTER MARKET.

AMSTRAD 1512SD

1512 BASE UNIT, 5.25" FLOPPY DRIVE AND KEYBOARD. ALL YOU NEED IS A MONITOR AND POWER SUPPLY. WAS £49.00

NOW ONLY **£29.00**

REF: MAG29

AMSTRAD 1512DD

1512 BASE UNIT AND KEYBOARD AND TWO 5.25" 360K DRIVES. ALL YOU NEED IS A MONITOR AND POWER SUPPLY WAS £59.00

NOW ONLY **£39.00**

REF: MAG39

SOLAR POWER PANELS

3FT X 1FT 10WATT GLASS PANELS
14.5v/700mA
NOW AVAILABLE BY MAIL ORDER
£33.95

(PLUS £2.00 SPECIAL PACKAGING CHARGE)

TOP QUALITY **AMORPHOUS SILICON CELLS** HAVE ALMOST A TIMELESS LIFESPAN WITH AN INFINITE NUMBER OF POSSIBLE APPLICATIONS, SOME OF WHICH MAY BE CAR BATTERY CHARGING, FOR USE ON BOATS OR CARAVANS, OR ANYWHERE A PORTABLE 12V SUPPLY IS REQUIRED. **REF: MAG34**

ALSO 1FT X 1FT GLASS SOLAR PANELS 12v 200mA ONLY £15.00. **REF: MAG15P3**

FREE SOFTWARE!

Brand new, UNUSED top quality *Famous brand* licensed software discs. Available in 5.25" DSDD or 5.25" HD only. You buy the disk and it comes with free BRAND NEW UNUSED SOFTWARE. We are actually selling you the floppy disc for your own **"MEGA CHEAP" storage facilities**, if you happen to get software that you want/need/like as well........ you get a "MEGA BARGAIN" to!

DSDD PKT10 £2.99 REF: MAG3P7 PKT100 £16.00 REF: MAG16
HD PKT10 £3.99 REF: MAG4P3 PKT100 £25.00 REF: MAG26P1

LARGER QANTITY PRICES AVAILABLE ON APPLICATION

££££££WE BUY SURPLUS STOCK££££££££

TURN YOUR SURPLUS STOCK INTO CASH.
IMMEDIATE SETTLEMENT. WE WILL ALSO QUOTE FOR COMPLETE FACTORY CLEARANCE.
COMING SOON

1994 CATALOGUE.

PLEASE SEND 42P, A4 SIZED SAE FOR YOUR FREE COPY.

MINIMUM GOODS ORDER £5.00. TRADE ORDERS FROM GOVERNMENT, SCHOOLS, UNIVERSITIES, & LOCAL AUTHORITIES WELCOME. ALL GOODS SUPPLIED SUBJECT TO OUR CONDITIONS OF SALE AND UNLESS OTHERWISE STATED GUARANTEED FOR 30 DAYS RIGHTS RESERVED TO CHANGE PRICES & SPECIFICATIONS WITHOUT PRIOR NOTICE ORDERS SUBJECT TO STOCK. QUOTATIONS WILLINGLY GIVEN FOR QUANTITIES HIGHER THAN THOSE STATED

***SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK**

BULL ELECTRICAL

250 PORTLAND ROAD HOVE SUSSEX BN3 5QT

MAIL ORDER TERMS: CASH PO OR CHEQUE WITH ORDER PLUS £3.00 POST PLUS VAT.

PLEASE ALLOW 7 - 10 DAYS FOR DELIVERY
TELEPHONE ORDERS WELCOME
TEL: 0273 203500
FAX: 0273 323077

VISA

COMMODORE MICRODRIVE SYSTEM mini storage device for C64's 4 times faster than disc drives, 10 times faster than tapes. Complete unit just £12 **REF:MAG12P1**

SCHOOL STRIPPERS We have quite a few of the above units which are 'returns' as they are quite comprehensive units they could be used for other projects etc. Let us know how many you need at just 50p a unit (minimum 10).

HEADPHONES 15P These are ex Virgin Atlantic. You can have 8 pairs for £2 **REF: MAG2P8**

PROXIMITY SENSORS These are small PCB's with what look like a source and sensor LED on one end and lots of components on the rest of the PCB. Complete with fly leads. Pack of 5 £3 **REF: MAG: 3P5** or 20 for £8 **REF: MAG8P4**

FIBRE OPTIC CABLE Made for Hewlett Packard so pretty good stuff! you can have any length you want (min5m) first 5m £7 **REF: MAG7** thereafter £1 a metre (ie 20m is £22). **REF: MAG1** Max length 250m.

SNOOPERS EAR? Originall made to clip over the earpiece of telephone to amplify the sound-it also works quite well on the cable running along the wall! Price is £5 **REF: MAG5P7**

DOS PACKS Microsoft version 3.3 or higher complete with all manuals or price just £5 **REF: MAG5P8** Worth it just for the very comprehensive manual! 5.25" only.

DOS PACK Microsoft version 5 Original software but no manuals hence only £3 **REF: MAG3P6** 5.25" only.

FOREIGN DOS 3.3-German,French,italian etc £2 a pack with manual. 5.25" only. **REF:MAG2P9**

MONO VGA MONITOR Made by Amstrad, refurbished £49 **REF:MAG49**

CTM644 COLOUR MONITOR. Made to work with the CPC464 home computer. Standard RGB input so will work with other machines. Refurbished £59.00 **REF:MAG59**

JUST A SMALL SELCTION of what we have- to see more get our 1994 catalogue (42p stamp) or call in Mon-Sat 9-5.30

HAND HELD TONE DIALLERS Ideal for the control of the Response 200 and 400 machines. £5 REF:MAG5P9

PIR DETECTOR Made by famous UK alarm manufacturer these are hi spec, long range internal units. 12v operation. Slight marks on case and unboxed (although brand new) £8 **REF: MAG8P5**

WINDUP SOLAR POWERED RADIO AM/FM radio complete with hand charger and solar panel! £14 REF: MAG14P1

COMMODORE 64 Customer returns but ok for spares etc £12 REF: MAG12P2 Tested and working units are £69.00 REF: MAG69

COMMODORE 64 TAPE DRIVES Customer returns at £4 REF: MAG4P9 Fully tested and working units are £12 REF: MAG12P5

COMPUTER TERMINALS complete with screen, keyboard and RS232 input/output. Ex equipment. Price is £27 REF: MAG27

MAINS CABLES These are 2 core standard black 2 metre mains cables fitted with a 13A plug on one end, cable the other. Ideal for projects, low cost manufacturing etc. Pack of 10 for £3 REF: MAG3P8 Pack of 100 £20 REF: MAG20P5

SURFACE MOUNT STRIPPER Originally made as some form of high frequency amplifier (main chip is a TSA5511T 1.3GHz synthasiser) but good stripper value, an excellent way to play with surface mount components £1.00 REF: MAG1P1.

MICROWAVE TIMER Electronic timer with relay output suitable to make enlarger timer etc £4 REF: MAG4P4

PLUG 420? showing your age? pack of 10 with leads for £2 REF: MAG2P11

MOBILE CAR PHONE £5.99 Well almost! complete in car phone excluding the box of electronics normally hidden under seat. Can be made to illuminate with 12v also has built in light sensor so display only illuminates when dark. Totally convincing! REF: MAG6P6

ALARM BEACONS Zenon strobe made to mount on an external bell box but could be used for caravans etc. 12v operation. Just connect up and it flashes regularly) £5 REF: MAG5P11

FIRE ALARM CONTROL PANEL High quality metal cased alarm panel 350x165x80mm. Comes with electronics but no information. £15 REF: MAG15P4

SUPER SIZE HEATSINK Superb quality aluminium heatsink. 365 x 183 x 61mm, 15 fins enamble high heat dissipation. No holes! £9.99 REF: MAG10P1P

REMOTE CONTROL PCB These are receiver boards for garage door opening systems. You may have another use? £4 ea REF: MAG4P5

LOPTX Line output transformers believed to be for hi res colour monitors but useful for getting high voltages from low ones! £2 each REF: MAG2P12 bumper pack of 10 for £12 REF: MAG12P3.

PORTABLE RADIATION DETECTOR

£49.99

A Hand held personal Gamma and X Ray detector. This unit contains two Geiger Tubes, has a 4 digit LCD display with a Piezo speaker, giving an audio visual indication. The unit detects high energy electromagnetic quanta with an energy from 30K eV to over 1.2M eV and a measuring range of 5-9999 UR/h or 10-99990 Nr/h. Supplied complete with handbook.

REF: MAG50

ELECTRONICS in ACTION

ISSUE 3 VOLUME 1

EDITOR
Paul Freeman-Sear

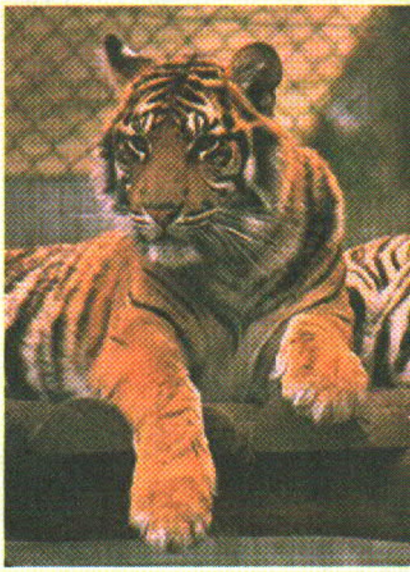
SUB EDITOR
Helen Armstrong

DESIGNER
Susan Campbell

TECHNICAL ILLUSTRATION
JPD

ADVERTISING SALES
Gilly Martin

CONTRIBUTORS
Andrew Armstrong
Helen Armstrong
Daniel Coggins
Keith Grant
Mike Meechan
Brian Padgett
Robin Saxby
David Silvester
Paul Stenning



QH Quantum House Publishing Ltd.
PO BOX 600, BERKHAMSTED
HERTS HP4 1NL
TELEPHONE 0442 842069
FAX 0442 842279

...of CDs and Electric Transport

In this 'CD' issue we have some goodies to give away, namely over 100 4D audio Compact Disc recordings from Deutsche Grammophon with over 72 minutes of recorded music and Two Kodak Photo CD/audio players. Our feature on Photo CD demonstrates the processes and the hoped-for popularity at home and in the commercial sector of this latest technology.

To take part in the competition for the CD players we suggest you turn to page 12 and for more information on how to get your free CD take a look at the 4D article on page.

Electric transport

It has long been the dream of many entrepreneurs to produce the electric car with equivalent performance characteristics of an internal combustion engine fuelled by petrochemicals. The attractions in todays ecological climate are obvious, but it seems the researchers are finding it more difficult to progress along conventional development lines. The results of this show only small increases in usable car range and 'the outage time' for electric refuelling has been a huge sticking point.

Although the Oxford project for placing a few electric buses onto the streets has to be applauded for the minor inroads made to cleaning up our cities, it has no major technological advances to offer. Let's hope the initiative will pay off.

Paul Freeman-Sear

Published by **Quantum House Publications Ltd**, PO Box 600, Berkhamsted, Herts HP4 1NL. Newstrade distribution by Seymour, Windsor House, 1270 London Rd, Norbury, London SW16 4DH Tel: 081 679 1899. Reproduction by Island Graphics, Chesham, Bucks. Tel: 0494 773082. Printed by Wiltshire (Bristol) Ltd, Philip St, Bedminster, Bristol BS3 4DS. Tel: 0272 760076

NEWS

Inmarsat high speed datalink

British Telecom Martlesham Heath has rolled up its sleeves to provide two state-of-the-art transmission systems for the Whitbread Round The World Yacht Race.

Inmarsat-C satellite terminals, part of a tracking and information system tested last year in the British Steel Challenge Race, are on each yacht, linked to Global Positioning System (GPS) receivers. The yachts transmit their positions six-hourly via the Inmarsat to the Race HQ in Southampton. British Telecom software then compares the new position with previous information to compute course and speed.

The GPS is accurate to about 50 metres, so that yachts can be individually tracked even in a group.

The energy-efficient transceivers draw a mere 15 watts and provide two-way communication more reliably than HF radio in high southern latitudes. A "panic button" can be pressed to send an alert to rescue services in an emergency.

For the first time, high-quality TV footage from the yachts will be available almost - if not quite exactly - as it happens. Ten of the 15 yachts carry advanced custom electronics to convert video camera signals to compressed digital data for transmission via an Inmarsat-A High Speed Data (HSD) link.

The pictures are compressed on a specially adapted BT videoconferencing codec at 384 or 768 Kbits per second and stored in the codec's computer. In favourable conditions, the picture files are transmitted at 64 kbit per second via the Inmarsat link.

Normally TV pictures sent via the high speed data pathway, 2000 times narrower than usual for TV transmission, would not be of broadcast quality. But taking around 12 minutes to send a compressed two-minute video clip allows the narrow-band high-speed link to send the picture data to another codec at Reuters TV in London, where it is uncompressed and played out at its original coded rate for editing or immediate transmission.

Eurosat TV Wrangle

For years, European bureaucrats and broadcast companies have been wrangling over which satellite broadcasting format will be the European standard. In the meantime, those companies who couldn't afford to wait and see which way the wind was blowing have got on and used the best standard available. There were arguments about what that was, too, but the then-Sky TV, satellite operator SES, and Canal Plus went ahead using PAL-type transmission standards, using a telecomms satellite which was not covered by the EC directives. The rest is history.

The European Commission eventually came up with the D2-MAC standard (after the D-MAC standard, a leading contender in earlier discussions) and tried to enforce it in the industry, offering grants for the transition period and hoping that it would provide the basis for wide-screen broadcasting (expected to start in 1994) and high definition television (HDTV) arriving in 1995. But they delayed too long, and satellite tv was already a fact.

Now it looks as though the wrangling is at an end. Recently 80 European companies signed an agreement to co-operate with each other in the search for a standard agreeable to all of them, without the intervention of the European Directive, any Commission money, or further delays. The European Launch Group (ELG) accepts that de facto standards are already in use and that future developments will need to dovetail with these, starting with digital television and following with HDTV. Membership and participation in the group is voluntary, so there will be no enforcements to distract operators from their primary aim of broadcasting, but everyone recognises the need to avoid VHS/Betamax-type format wars wherever possible in the very cost-intensive environment of international broadcasting.

The UK has more representatives signing than any other country. Japanese companies with manufacturing facilities in the UK, including Sony, JVC and Toshiba, have signed, which is a good omen for development and manufacturing of new systems in the UK. Amstrad, Pace and Cambridge Industries, major receiver suppliers, have signed, indicating that they both expect to stay with satellite broadcasting as it developed. British Telecom is absent, but it is felt to be unlikely that they will be totally uninvolved.

It's been reported that the US counterparts of the European satellite companies are not forging ahead in drawing up their own standards. If Europe can get its act together, it may find itself with a marketable technical lead in the field.

Electric buses for Oxford

The city of Oxford, like many busy modern towns with medieval town centres, has a car problem. The citizens want cars out of the city centre, and visitors want to get in and out without running themselves ragged in the process. It's a long-term problem.

A recent strategy, small scale but interesting, is the introduction of four fully electric buses on the round-town and station routes. The first vehicles of their kind in the UK, the buses hold 18 passengers each, have a top speed of 40mph, and no diesel fumes. The project is a joint initiative between Southern Electric and Oxfordshire County Council. The buses were designed by electric vehicle specialists International Automtive Design of Worthing and built to the long-wheelbase Optare MetroRider spec by Optare of Leeds.

The batteries, used in packs of six and specially made for the project, will recharge overnight at the bus depot and - more importantly, with a full recharge time of 12 hours and a range of only 55 miles - will top-up at a special charger alongside Oxford railway station, whence they will be collecting many of their fairs. Regenerative braking will also help to keep the batteries running. Use of cheap-rate electricity should cost the buses about 4p per mile, allowing a flat-rate 30p fare, cheaper than the current minimum on many Oxford hopper buses. Headlights, indicators and the other interior electrics run on a standard 24V lorry battery as normal.

It's hoped that the new buses will speed up passenger circulation in the city centre and improve communications with the railway station, vital in a city which encourages visitors and shoppers but actively discourages cars. The city's extensive park-and-ride facilities were described by a denizen of the local countryside with deliberate irony as "an adventure". Anything which makes Oxford access less adventurous will be welcomed.

Oxford has changed its tune in the last 70 years since poet A D Godley wrote, in 1914, on meeting the first buses roaring up the High Street:

Et complebat omne forum
Copia Motorum Borum.
How shall wretches live like us
Cincti Bis Motoribus?

Surrounding itself with Omnibuses now seems to be Oxford's hope for the future.

Cellphone contract

All the signs are that Mitsubishi does not expect its portable cellphones to slow down. The company has just signed up former Grand Prix racing driver and BBC Grand Prix commentator Jonathan Palmer's dealership for its telecomms products. The already-bruised award-winning MT-7 and a new relation, the MT-8, out later this year, are included in the agreement. The dealership, Jonathan Palmer FOneTime, is a new division of the JPM organisation. The telecomms division will operate nationwide service on portables and transportable telephone systems, with aftersales service and backup alongside Mitsubishi, and possibly installation and backup at a later date.

Jonathan Palmer is now with the McLaren racing team, working on the 231 mph McLaren F1. Jonathan Palmer PromoSport has evolved the Cellnet Driver Challenge road safety promotion competition, which tried the driving skills of 3000 competitors last year. The MT-7 analogue ETACS cellphone was one of the first in its field to offer the TACS-2 specification, and PIN code identification against unauthorised use. Trophy winner in the call security section of the Cellnet Caesar Awards, the MT-7 also won two Merit prizes, including one for user documentation. Next: the World Land Speed Record?

Graphical user interfaces for the blind

In the process of investigating the necessity for making computer graphical user interfaces accessible to blind and partially-sighted computer operators, the European project "Textual and Graphical User Interfaces for Blind People (GUIB)" has developed a keyboard/terminal with integrates synthesised speech, braille, and non-speech sound signals. The project's efforts to represent the intensely visual, highly-packed information-carrying nature of graphical user interfaces is still in an experimental stage but enough progress has been made to fill a booklet, Access to Graphical User Interfaces, by John Gill, summarising the research so far.

GUIs are rapidely becoming more popular with computer operators, especially those who have never interacted directly with the operating system, or who found the strings of text commands needed too difficult to remember. Unlike a decade ago, most of today's users are non-specialists glad to have a set of icons standing between them and the operating system. Unfortunately, working in text has a big advantage for non-sighted operators: it can be rendered quickly in audible speech. This is not the case with graphics, and blind or partially-sighted users are finding that they need the help of colleagues or other work-rounds to interact with GUI screens. Often they are unable to do so.

The GUIB project has looked into the use of different, symbolic, partially symbolic, or simply easily differentiated abstract sounds to represent the screen contents and the position of the mouse pointer as it moves around the screen. One experiment has involved a "sound screen" of five small loudspeakers to position a sound signal according to the position of the mouse pointer on the screen. Trials have found that three-dimensional sound space, now in common use in virtual reality systems, differentiates sounds better and gives a stronger indication of position, even though the visual image is apparently only two-dimensional.

Applied design at the front end

One aim of the project is to develop a method which can be applied to new GUIs as they appear, instead of waiting for each package to become established and then developing a translator for it. In the waiting period, visually disabled operators could fall behind a reasonable operating speed and lose work and their jobs. The project is funded by the Commission of the European Communities, involving organisations from six European countries, including the RNIB in the UK. Research however is also being drawn from the USA, where many of the GUIs are written, and Japan.

The booklet is available from the Royal National Institute for the Blind, 224 Great Portland Street, London W1N 6AA.

More powerful DSP chips

Analog Devices' new ADSP-21060 single-chip digital signal processor is being announced as industry's most powerful 32-bit DSP to date, a fully-integrated, high-performance, floating-point signal computer. The first DSP available in the Super Harvard Architecture Computer (SHARC - And yes, there is a fin on the logo) class, the ADSP-21060 is out to tear off its chunk of the market before the crowd gets there, flashing an impressive array of features. Built around the high-speed ADSP-21020 floating-point core, a dual-port 4-megabit SRAM with two serial ports, and external parallel port and a 10-channel direct memory access I/O controller, the ADSP-21060 carries a very high I/O bandwidth alongside very fast data processing. When the 3.3 volt versions is available, the total power consumption of the system will be less than current computers.

Super Harvard Architecture is a step up from DSP/Harvard Architecture and effectively allows multi-chip functionality on a single chip to a higher degree than before. The new DSP is reckoned to deliver two to ten times for performance of current top-end signal processing chipsets, and can link up to six ADSP-21060 units "gluelessly" with one host, cutting the need for interfacing logic.

Applications

The new chip is being aimed particularly at communications, speech, audio and video applications in the growing demand for digital comms, but graphics imaging, number processing and instrumentation get a mention as well. Interestingly, Analog Devices' cost comparisons show a higher initial cost for the chip over other top-end DSP chips, but a lower overall cost for a complete system, supported by the large number of peripheral functions integrated onto the chip. The specification includes instruction execution time of 25 nanoseconds, 40 MIPS processing speed with peak MFLOPS of 120 (80 sustained), and 128K internal RAM, in 1.59 square inch surfacemount package. For layout engineers, that's 74 MFLOPS per square inch, double the capacity of the nearest competitor.

One application which may benefit from fast, highly integrated processors like the ADSP-21060 is real-time speech recognition by computers, with all that implies for man/machine interaction, speed and remote control.

Land Speed record challenge by electric vehicle

Four GCSE pupils from St. Richard's RC School in Bexhill-on-Sea, Sussex are attempting to break the land speed record for lightweight electric vehicles with a car they have developed themselves. The team have received technical help and support from Lotus and the Motor Industry Research Association, which opened its aerodynamic wind-tunnel to test and adapt the car's streamlining.

Test driver Rudy Thomann of Lotus will be driving the car, which reached 120 mph during test drives at Greenham Common. The record for electric vehicles below 500kg is 100.242mph, so the St. Richard's car seems set to walk it.

The car uses thin-plate lightweight lead acid batteries by Deta. The car's 60 horse-power, 96-volt Nelco motor draws 600 amps and takes virtually the whole charge from the battery in 70 seconds, giving the engine a 30 percent extra kick of power.

Cellphone falls off motorbike and lives - Batteries don't

It seems that the much-unloved portable cellphone is expected to undertake tougher assignments than sitting in a first-class carriage with a yuppie annoying fellow-travellers these days. For instance, a Mitsubishi MT-7 portable, already an award-winner for other aspects of its performance, survived an unscheduled exit from a motorbike on the fast lane of an un-named motorway in the British Isles.

It appears the article, pocketed by its owner, biker/businessman John Caudwell, accidentally eased its way out of his leather racing suit as he zipped along the fast lane.

The phone bounced several times before - fortunately - coming to rest on the hard shoulder, from which its owner was able to retrieve it, no doubt in the process of trying to ring its maker to ask for a transfer. The LCD covering was smashed, the antenna was kinked, the casing severely gouged. When we saw the photograph we thought - they've dropped that one! The mast and battery were never recovered. But still the phone leapt into life when connected to a new battery.

Now we discover that Caudwell Communications is the UK's largest cellular phone distributor. They should know something about the machinery's survival rate in the field. Says John Caudwell: "The toughness, durability and performance capabilities of the Mitsubishi phone speak for themselves. The MT-7 survived a gruelling test, the result of which is most amazing." It might be tempting fate a bit to put this into the advertising, but it's nice to know that next time you hurl your telephone at the wall, it stands a good chance of bouncing back to you.

The only Achilles heel seems to be - as ever - the battery technology. Perhaps a little more work on keeping the module locked in place.

Signal to NOISE

A selection of your views and thoughts

I am new to Electronics in Action and therefore wish to comment.
I find this monthly very stimulating, remember I am 69 years old and have been in electronics all my life, and I welcome a change of monthly. I thoroughly agree with the letter about teaching science. I could add more such thoughts, the bright scholars are led into the Arts such that they can attain more GCSEs more easily and enhance the name of the school. We need more champions of electronics to enthuse people!
On a different note, can I ask for articles on organ voices, I have programmed many of these on synthezisers, and have constructed many formants but I cannot as yet obtain a voice anything like the Wurlitzer or Blackpool organ. I find all magazines ignore this area. Perhaps you might mention why.

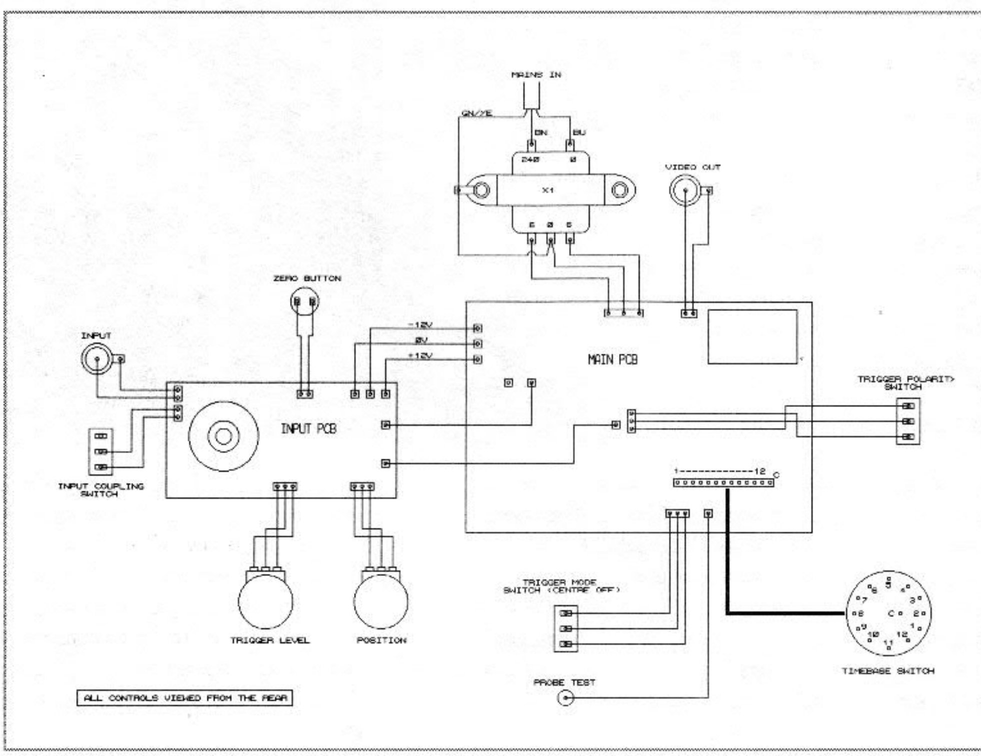
H W C Hollings
Witney
Oxon

Thank you for your comments. I have also spent some time in teaching and I'm afraid the answer to why more young people go for the Arts, apart from the financial incentive, is deep rooted. It certainly does not help to have the vast majority of politicians with an Arts based education totally ignorant of Science and Technology. The course of British society tends to lead from those that govern us. Given the right incentives, science presented in a stimulating way in schools can lead to far more exciting challenges and new discoveries. Taking a sideways look at our world in the way it works instead of taking the established way of conservative development could, in the words of the now famous phrase 'boldly go where no man or woman has gone before'- or should I say go boldly....?

On to your other point, we could have the answer to your question when we ask 'our man from Yamaha' to come up with a solution. Hold on for a few editions and we will see what can be done ......unless of course any reader out there has some answers. - ***Ed.***

I have enjoyed reading your magazine especially the test equipment section as I am taking my CG Part 2 year two and I need just the right type of equipment as you have had in your magazine in the last two issues.
I only took up electronics as I was classed disabled and I like helping old age pensioners with their electrical problems that are within my scope. I really like the telescope idea and I am thinking of building one for my own use. Keep up the good work especially the test equipment and you will have a loyal reader for all your future issues.
Good Luck to you.

K G Pullen
Swansea



Owing to unforseen circumstances the interwiring diagram for The Telescope (featured in our October and November issues) was omitted. We apologise for this oversight and reproduce it here.

Everyone smile for the Compact Disc

Helen Armstrong reports on the growing attraction of seeing pictures on 'CD'

Like 110mm film, electronic stills photography was a great idea which signally failed to ride 35mm off the range. New formats often survive their inception to fill a niche - even a major niche - but only a few become popular standards. Philips Compact Cassettes were a success in the audio field from the early '70s. Since then, only Compact Disc - another Philips project -has made it as a 'must have' audio format.

So what have CDs to do with stills photography? More to the point, what have audio CDs to do with stills photography? Dodging the latter question for now, it's possible that photographic compact disc, or Photo CD, by its Kodak name, could become the next popular photo format. One: Compact Disc has proved itself in one medium already; two: Photo CD has one foot firmly in a very established camp - it employs standard 35mm film and ordinary mechanical cameras as its picture source.

The difference is that the developed images can be stored digitally - on a Photo Compact Disc - or made into prints in the usual way. You can opt for either or both from the same set of negatives or slide transparencies. The images are scanned to a very high resolution, so good-quality thermal enlargements can be taken from the PCD files as well. And while PCD Players, which provide the output signal for televisions, need to be matched to local TV standards, the discs (unlike video-tapes) do not. A PCD can be played anywhere.

Photo CD Players are designed for connection to domestic televisions, but discs can also be read by Compact Disc Interactive (CD-I), and by certain CD-ROM players for interfacing to a computer. The standards referred to are the CD-R (recordable CD) 'orange book' standard for CD recording and CD-ROM-XA (Extended Architecture) 'bridge' standard on delivery. The aim is flexibility of use on present and future viewing media. To this end - Kodak thinks of it as 'future-proofing' - each image is stored in five different image files allowing increasing resolutions. To further maximise storage efficiency, each file draws data from the lower ones, instead of duplicating. The net effect is that a television can display the images at its own maximum resolution - the best that can normally be achieved by video camcorders and Electronic Stills Cameras - but as higher-resolution formats arrive, the same images can be displayed at higher resolutions. Photo CD intends to be robust in a world where formats come and go like yo-yos.

In fact, the format has been around for a couple of years, but early 1994 expects a considerable extension of processing facilities, which will in eventually turn Photo CD into a 'mini-multimedia' format which can be customised with sound and text to order.

The electronic processing only begins after the 35mm film has been processed into negative or slide strips in the normal way. This is different from disk- or ramcard-based photography, where the pictures are video-encoded and can be played back immediately, but it has a considerable advantage in quality. 35mm film originals give a much higher-resolution than video or current image-sensor photography, and the image-transfer allows a high standard of accuracy, with colour balance adjustment where needed, substantially capturing the photographic quality of the original.

Primary Hues

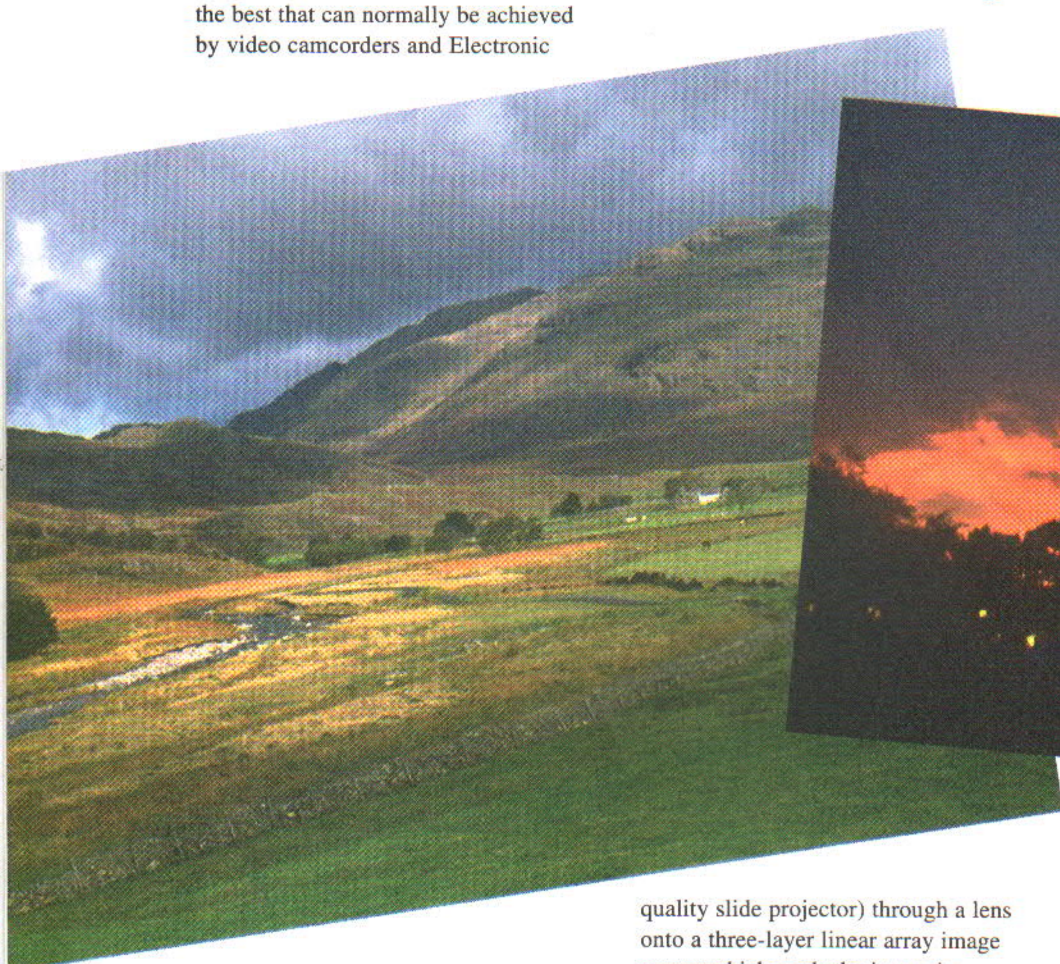
The film is scanned in a PCD Film Scanner, projected (this part of the machine is like a self-contained high-quality slide projector) through a lens onto a three-layer linear array image sensor which reads the image in horizontal lines of red, green and blue densities. (The density is the intensity value of the colour in question.) The scanner reads the additive (projected light) primaries red, green and indigo (blue), rather than the subtractive (colour pigment) primaries, magenta, yellow and cyan, used for printing. A television set uses the RGB primaries (coded in a rather different form) to build up its picture.

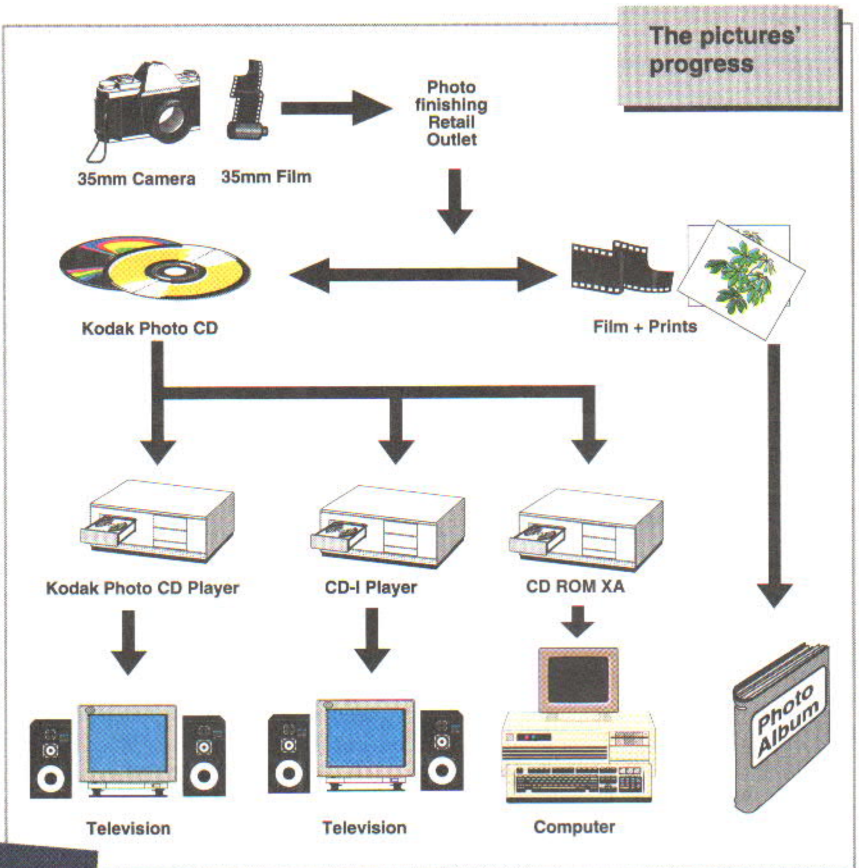
As the analogue film image is sampled and quantised into bytes, groups of three density values between 1 and 256, one each for R, G and B, are allocated to each pixel (picture element).

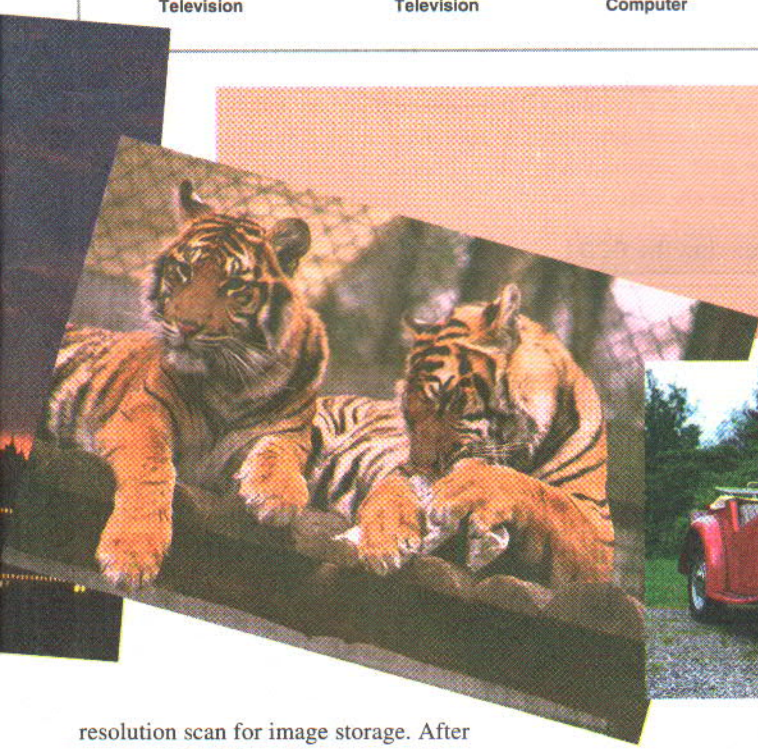
Digital sampling divides up the information contained in the analogue original into fine slices or packets ('quantisation'). Quantised data is stored in bytes of memory. One byte can only contain so much detail, so the more finely the information is divided, the less information each byte will have to carry and the more precisely each detail can be defined. PCD scanning samples a 35mm image on a grid of 3,072 pixels across by 2,048 vertically, giving over 6 million pixels over a postage-stamp sized area. The RGB is in three separate layers, each with 6 megabytes of colour intensity information, giving over 18 million samples for each image. This is an enormously finer resolution than any TV or monitor can display right now, and finer than high definition television (HDTV) as well. Kodak reckon that Photo CD resolution is fine enough to display on devices with four times the resolution of any currently planned HDTV system.

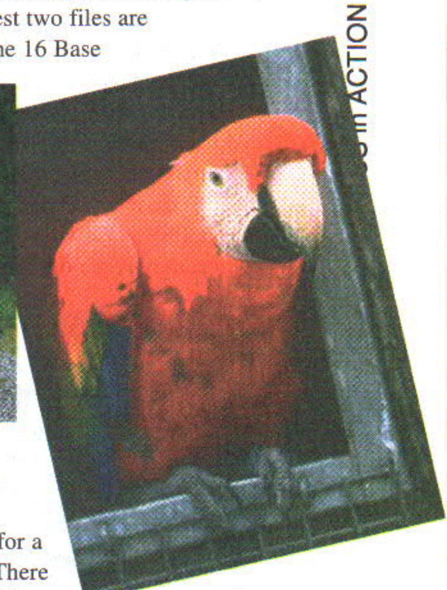
Because the picture information is stored digitally as groups of numeric values, signal distortion is kept to a minimum, and each playback or reproduction is as exact as the previous one. CDs are no longer thought to be virtually immortal, but they do have very good survival capabilities.

The Photo CD scanning process actually makes two scans, a low-resolution scan for checking, for example, whether the image is horizontal or vertical, and a high









resolution scan for image storage. After scanning, the information is passed to the PCD Data Manager, a dedicated workstation based on a Sun Microsystems computer. Software in the Data Manager uses an automatic colour balance algorithm to check and correct the images for overall exposure and colour balance. At this stage, custom processes like cropping, zooming, rotating and other image manipulations - montaging or adding text and graphics - can be done on request. The images are then recorded onto the Photo Compact Disc.

The colour encoding uses a Kodak-developed scheme called PhotoYCC which takes the 12-bit RGB data from the PCD Reader and splits it into luminance (Y, the monochrome brightness scale, which the human eye is most sensitive to, and which carries most of the image detail) and chrominance (C, colour) information at 8 bits per channel. Separating the Y and C allows maximum file compression in areas carrying the minimum detail. The dynamic range (difference between the lightest and darkest details) captured by the system is reckoned at 350:1 or better, far more than is needed for any current video system.

Television passed historically through a luminance-only stage before colour signals were added, so the PhotoYCC format can produce output signals in composite video (broadcast television), S-Video (Y/C, higher-quality video) or RGB (higher-quality video and computer monitor) signals.

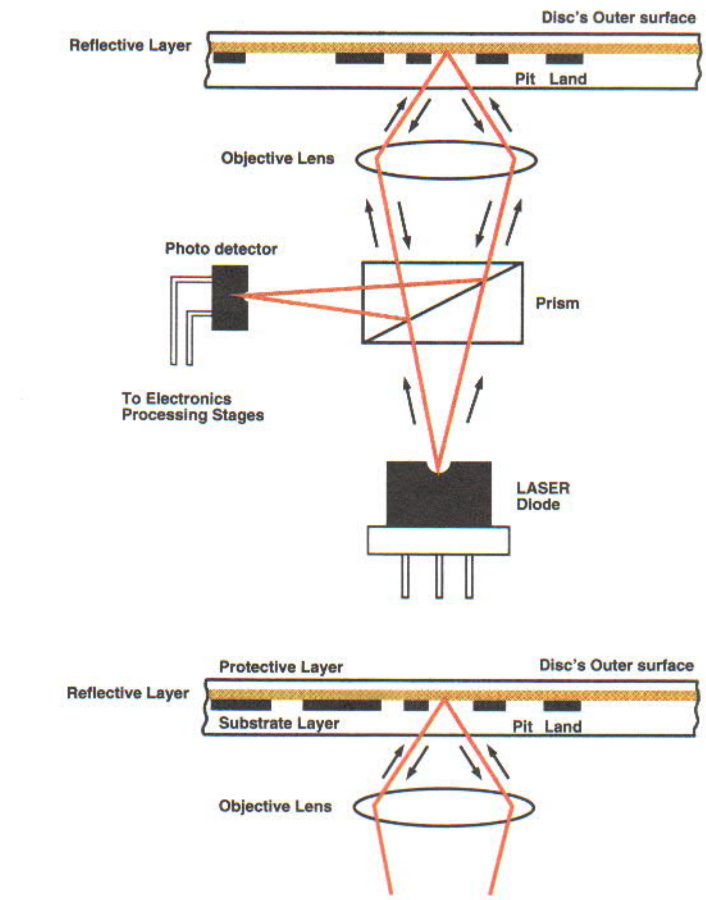
The data for each image is then 'packed' into batches of five files offering increasing resolution depending on the use of the image. 16Base (3.14 megabytes, compressed), for thermal prints and high quality enlargements; 4Base (.62 MB, compressed), for HDTV; Base (.563 MB, uncompressed) with 512 lines of 768 pixels, for TV and monitor display; Base/4 (.141 MB) for low resolution display, and Base/16 (.035 MB) for 'thumbnail' display. The files are stored hierarchically: the Base file is the central building block, and the more detailed 16 Base and 4 Base files draw some information already stored in files below them, saving memory space. Compression to about 25 percent of the original file size allows quick retrieval of the image. Greater compression would need more complex algorithms, more processing time (and more complex and more expensive machinery) and carry a greater risk of data loss. The compression allows each disk to store around 100 still images. Only the highest two files are compressed: the 16 Base file consumes most of the storage space for a given image. There are optional 64 Base and 256 Base files for larger film formats.

The image discs themselves have a gold layer with very high reflectivity instead of the 'silver' layer of audio CDs. These discs can store 640 megabytes of data, a capacity far above a computer hard disk. The accuracy of the lasers which cut and play back compact disks is much finer than the magnetic computer read-heads.

Photo CDs are not over-writable: they use WORM (write once, read many times) technology. But they are 'Multi Session'. Once the disc is recorded from your film by the photo developers, it can't be over-recorded or erased. However, you can take a partly-filled disc back to the shop with further films until it's topped up. After all - who takes 100 photographs at once? Kodak advise that it's best to record large batches of images in one session, but this is for price efficiency. You can also choose which images you want to keep from your negatives or conventional prints, and have the disc made up to your selection. Image collections can be arranged and themed like an album, and are provided with a printed inlay sheet with numbered mini-images as an index.

Finely focused beam

The disc is cut by a PCD Writer in much the same way as an audio CD. A finely focused laser beam, guided by data from the Data Manager, attacks a layer of light-sensitive dye on the blank disk to form 'pits' which expose the gold reflective layer beneath. The read laser in the user's PCD Player scans those pits and feeds the resulting digital information back to its processor to transmit to the television screen. The picture information can be manipulated by the PCD Player: cropped, rotated or panned. High resolution allows zooming up without jagged edges. PCD Players also handle hi-fi audio, offering high end facilities including bitstream, so ordinary audio CDs can be played on them, and users can look forward to having Photo CDs with added music and commentary in the fullness of time.



Cutting and reading the PCD

Thermal enlargements can be made straight from the disc at the processing shop. The RGB primary information is read off and used to calculate the subtractive primary values for printing. A PCD printer has somewhat over 2,000 elements to give a good-quality continuous tone print. The detail should be comparable to that of a photographic print rather than that of a glossy magazine cover.

This is not an idle comparison, because the print industry is now heavily computerised, and the ability to load and edit images digitally is being taken for granted. The transport and

2 Kodak

Electronics in Action in association with Kodak are giving *two* lucky winners the chance to be proud owners of Kodak Photo CD players. All you have to do is answer the 3 easy questions on the right and tell us what sort of projects and features you would like to see in future issues of Electronics in Action. We will draw the winners out of a large hat on 20th December 1993

Closing date for entries 15th December 1993 reproduction of high-quality photographs for printing is expensive; CDs are light and tough, and can carry a large number of digitally-encoded images. Many publishers and image libraries already use 35mm PCDs, and Kodak are set to provide the same facilities for larger commercial formats such as 120mm. Larger formats need larger file sizes, but with or without image compression, there is no problem in packing a number of large high quality images onto a 640MB disc.

In early 1994 Kodak expect to be offering a 'Portfolio' service. Graphics designers can edit originals from their own PCDs as a Macintosh computer file using proprietary Kodak software which is now being tested. Text, graphics, audio and the ability to branch through various information paths will be available, and when these have been combined to the designer's satisfaction a bureau will write a new combined-medium CD using the original PCD and computer files as the data source.

In-House Images

In the further future, designers and training managers will be able carry out these processes in-house to produce their own complex image files or interactive sound and vision CDs. Hardware and software companies including Apple, Microsoft, Hewlett-Packard, Adobe and Aldus are already endorsing PCD. It can already be read by Compact Disc-Interactive (CD-I), the sound and visual system widely used for training and cataloguing and other tasks needing sound/visuals branching, and by CD-ROM-XA, which can be used to interface with a computer. (PCD does not read CD-I software.) Many CD-ROM drives are not compatible with Photo CD, but as the PCDs only need some CD-ROM-XA capabilities, they can be read by certain CD-ROM players supporting Mode 2 data transfer. Several manufacturers now make Mode 2 Form 1, Multisession-compatible CD-ROM drives which support Photo CD. Check with your dealer that your CD-ROM drive has this capability if you want to go into PCD by that route. PCD Players themselves have considerable interactive and branching facilities and may be more economic than fully-fledged CD-I for some applications. This is mainly of interest to commercial users who want to manipulate and edit images or sequence them with sound and text. Home computers don't usually have enough memory to access and manipulate large high-resolution image files, but this is changing fast with low-cost hard disks. Already, the lower-resolution PCD images are read and manipulated with software like Photoshop. Once edited in their low resolution form, the image files can be handed to a bureau as guide-files to make the same changes on the high-resolution file, from which a new print can be taken. As and when prices come down a little further, small companies and serious home users will be looking at this.

Kodak is offering Photo CD Access Developer Toolkit software, under license to themselves, to enable software developers to embed the ability to handle full quality PCD images into their own software. Another, small, application, CD Access Software, allows the YCC-coded PDC files to be converted to TIF, PICT, EPS and other image formats in existing applications. If this is what you want to do and you have any doubts about compatibility with the destination format, Kodak can advise you.

Photo CD is expensive for the home photographer. PCD Players have come down about 30% to around £199, and the discs themselves cost around £5. Processing costs more than conventional prints. A lot will depend on the attractions of the compact disc - compact, convenient, long-lasting and accurate in reproduction - and the amusement of viewing sessions round the TV, sequencing, zooming, panning and rotating with the remote control while family and friends boo and hiss. It's also easy to overlook that the players also play audio CDs, so anyone considering compact disc, or replacing a player, might look at the photographic possibilities. CDs don't fade, tear or crumple, and as long as the medium hasn't been physically wrecked, copy PCDs suffer no loss of quality. Eventually, sound and graphics should be available for the home user, but this is still a long way off for simple price reasons.

For the commercial user, though, PCD holds the attraction of reduced costs by bypassing certain processes which are necessary at the moment, and gives more control over the end result.

Try out your reactions: a photographer friend comes around and whips a shiny disk from her top pocket. It could be her latest photomontage, the new Lemonheads album, or her holiday snaps.

Photo CD players to be won

1 In which year did George Eastman invent the box camera?
- **a** 1988
- **b** 1888
- **c** 1588

2 What is the standard film size found in most cameras?
- **a** 35mm
- **b** 35m
- **c** 35km

3 What does WORM stand for?
- **a** Waste Optimising Read Memory
- **b** Window Operating RAM Management
- **c** Write Once Read Many times

Question 1 **a**☐ **b**☐ **c**☐
Question 2 **a**☐ **b**☐ **c**☐
Question 2 **a**☐ **b**☐ **c**☐

I would like to see the following in EIA
Features ....
Projects ....

Print your name in **BLOCK CAPITALS**

Name ....

Address ....

....Postcode .... ☎......................

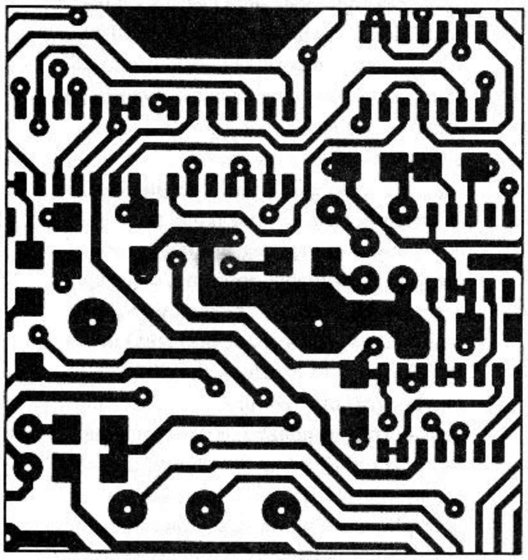
Please send your entry to: **Electronics in Action, PO Box 600, Berkhamsted, Herts. HP4 1NL**

EASY-PC, SCHEMATIC and PCB CAD

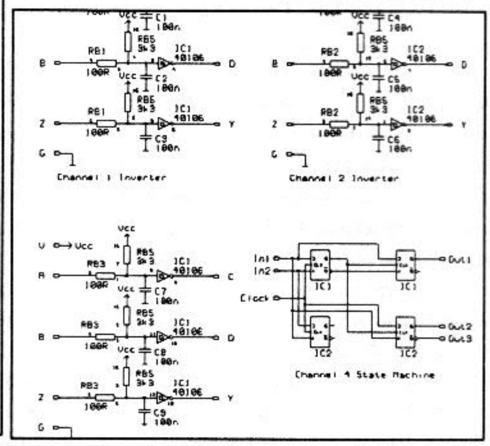
Over 17,000 Installations in 70 Countries World-wide!

Still Only £98.00!
Plus P&P+VAT

BRITISH **DESIGN** AWARD *1989*



- Runs on:- PC/XT/AT/ 286/ 386/ 486 with Hercules, CGA, EGA or VGA display and many DOS emulations.
- Design:- Single sided, Double sided and Multi-layer (8) boards.
- Provides full Surface Mount support.
- Standard output includes Dot Matrix / Laser / Ink-jet Printer, Pen Plotter, Photo-plotter and N.C. Drill.
- Tech Support - free.
- Superbly easy to use.

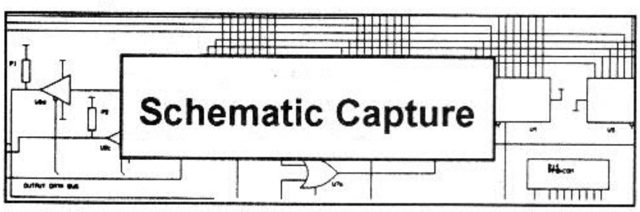


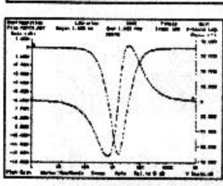
Options:-500 piece Surface Mount Symbol Library £48, 1000 piece Symbol Library £38, Gerber Import facility £98.

Electronic Designs Right First Time?

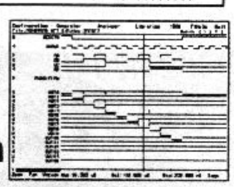
Ask for our fully functional Integrated Demo

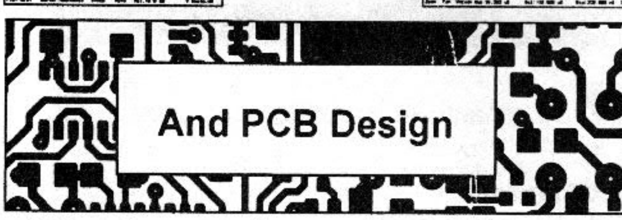
Integrated Electronics CAD





Analogue & Digital Simulation





For Less than £400/$775!

Affordable Electronics CAD

EASY-PC: Low cost, entry level PCB and Schematic CAD.	**$195.00**	**£98.00**
EASY-PC Professional: Schematic Capture and PCB CAD. Links directly to ANALYSER III and PULSAR.	**$375.00**	**£195.00**
PULSAR: Low cost Digital Circuit Simulator ~ 1500 gate capacity.	**$195.00**	**£98.00**
PULSAR Professional: Digital Circuit Simulator ~ 50,000 gate capacity.	**$375.00**	**£195.00**
ANALYSER III: Low cost Linear Analogue Circuit Simulator ~ 130 node capability	**$195.00**	**£98.00**
ANALYSER III Professional: Linear Analogue Circuit Simulator ~ 750 node capability.	**$375.00**	**£195.00**
Z-MATCH for Windows: NEW Windows Smith-Chart program for RF Engineers .	**$475.00**	**£245.00**
We operate a no penalty upgrade policy. You can upgrade at any time to the professional version of a program just for the difference in price.	*US$ prices include Post and Packing.*	*Sterling £ prices exclude P&P and VAT*

For full information, Write, Phone or Fax:-

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

Number One Systems Ltd.

REF: EIA, HARDING WAY, ST.IVES, HUNTINGDON, CAMBS, ENGLAND, PE17 4WR.
Telephone: 0480 461778 (7 lines) Fax: 0480 494042
International: +44 -480-461778, Fax:+44-480-494042 ACCESS, AMEX, MASTERCARD, VISA Welcome.

The Switcher Part 2

This month Mike Meechan looks at the construction of this audio solid state switcher.

Last month, we looked at the analogue and local control side of things as far as The Switcher (our solid-state audio routing module) was concerned. Before we move onto the VCA section, the constructional side of the two main boards (which were presented last month) must first be finalised. Interested parties might like to note that the overlay and parts list for the relay switching option associated with the main board will be presented at the end of the series. On a related note, it is relevant to mention that when the system was first developed, the price differential between the relay version and the solid-state version was minimal. However, in recent months, the price of the SSM 2412 has shot up astronomically, from around £3.00 a year ago to around £8.00 at the time of writing. This has serious repercussions on the overall cost of a switching unit intended for eight inputs, although the cost of said unit is still substantially less when compared to buying a preamp with a commensurate number of facilities of similar quality.

A-Z of the PCB

A brief look at the two appropriate component layouts of the front panel board and main analogue board (solid state version), depicted in Figures 1 and 2 respectively, show that extensive use of a ground plane has been made. A short word about the need for this. When digital control and high quality analogue (audio) circuitry come together, what can have been a workable system on breadboard can quickly become a nightmare of gigantic proportions when the design is commited to printed circuit board.

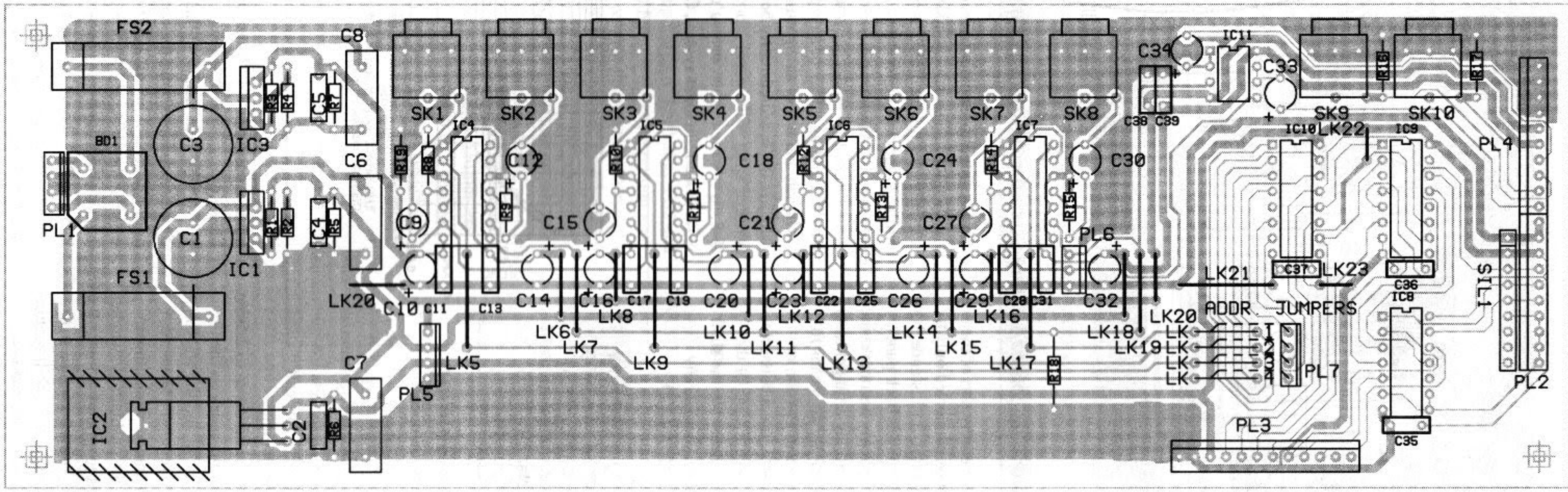
In an ideal world we'd use completely separate and isolated supplies for audio and digital circuitry

As digital outputs change state, there is a transient need for energy. On a positive transition, this current sourcing comes from the positive supply rail, and on a negative transition, the ground line sinks current. Inadequate supply decoupling at appropriate frequencies (up to about 50kHz), or narrow supply or ground tracks, will produce noticable resistance and a digital pulse of energy throughout the system can create upset. In audio, this manifests itself as an audible click or a splat on the output. Fat tracks mean much lower resistance and a ground reference which ostensibly remains where it is (ie at 0V) irrespective of how much current is flowing through it at any instant. Good supply decoupling in the immediate vicinity of each IC on the board, and hefty positive rails eradicate the problem on the supply side of things.

In an ideal world, we'd use completely separate and isolated supplies for audio and digital circuitry, and either connect them only at the system star earth, and adhere rigidly to this earthing philosophy throughout the rest of the board, or use opto-isolators to control things to keep things separate.

A halfway-house measure, (which is used in many commercial products where economics are top of the designer's list), is to use a limited star-earth arrangement. With this PCB topology, logic and audio supplies are kept separate except at one point, and a ground follows signal arrangement is used, with high impedance signals sharing a common earth return, and low impedance signals likewise, the various busses connecting only at the star earth. The boards shown here are a veritable pot-pourri of the above, but the system works, and any switching clicks are at or around the system noise floor.

Whilst on this subject, the relay version compounds any errors in this area of design by a very large order of magnitude, since electromechanical



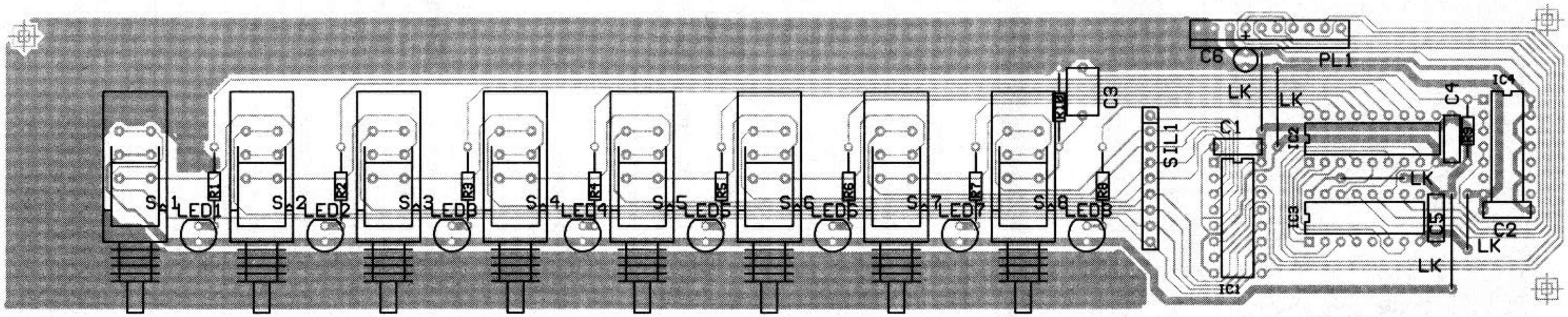


Fig.1 (left) Main Analogue Board/ PSU Component Positioning (Inputs 1-4)

Fig.2 (right) Front Panel Switch Board/Decoder Component Positioning

Designed on Boardmaker 2 from Tsien (UK)

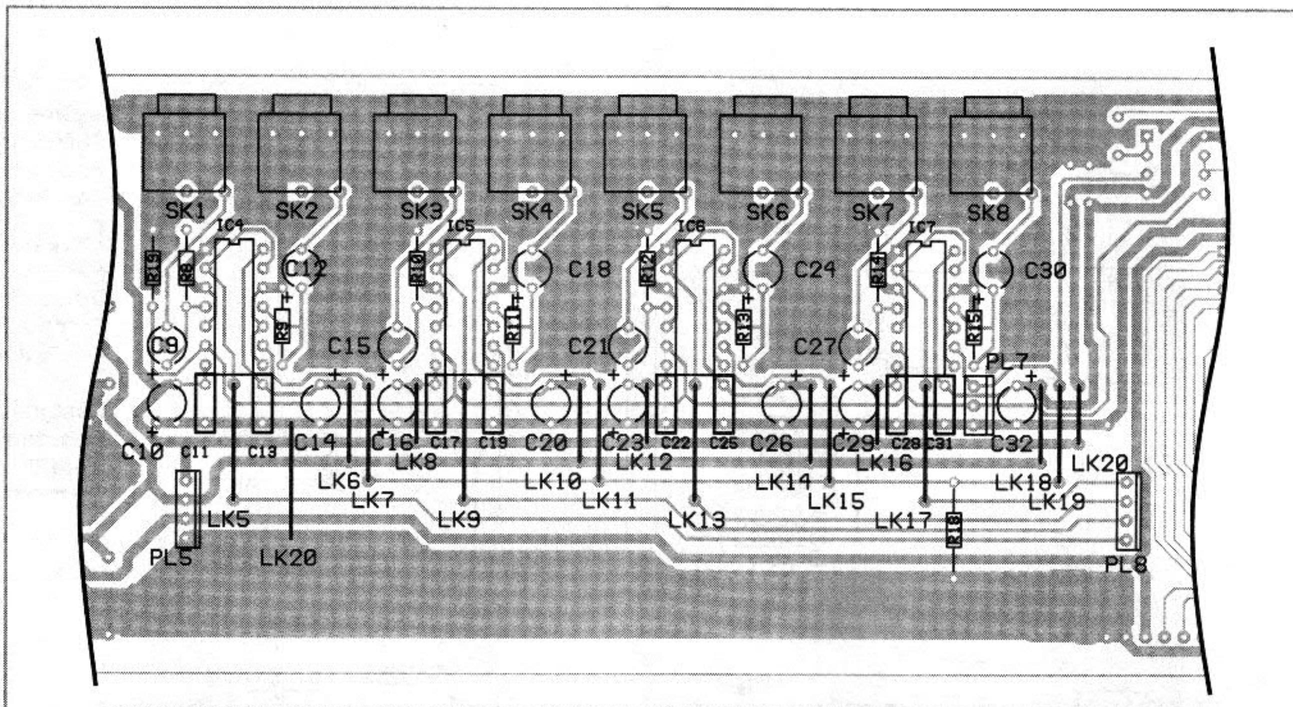


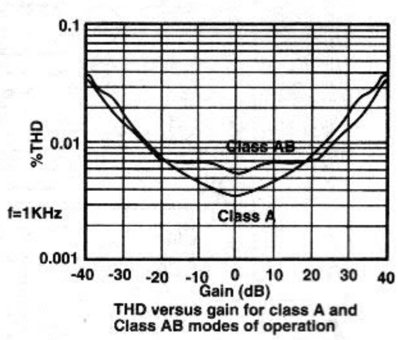
Fig.3 Main Analogue Board component positioning, Inputs 5-8 (No PSU or Digital Components)

devices are predominantly inductive. They absorb and expel a lot of energy as they are energised or de-energised. This energy has an effect similar to that caused by the transitions of logic gates, but it can be more devastating to any audio signals in close proximity because of the inherently larger currents involved. For this reason, track layouts are especially critical where relays and audio are mixed on the same board. We'll cover this subject in greater depth when we come to look at the relay version of The Switcher in next month's issue.

All Mods and No Cons

The PCB's have been designed with specific components in mind. Certain substitute parts WILL fit, whilst others will not. As an example, the particular ALPS pushbutton switches used could be omitted and replaced by other DPDT non-latching types and could be connected to the board using a flying lead/Veropin-style of arrangement.
Lead layout for the digital side of things isn't too critical, although any leads should be kept as short as possible. The PCB-mounting phono connectors, whilst not to everyone's taste, provide an uncomplicated, fast and cheap way of terminating audio signal sources. Again, these could be omitted, replaced instead by screened lead, DIN sockets (YUK!), 1/4" jack sockets, XLR's, banana plugs or whatever takes your fancy.
Interwiring on the audio side is inherently less tolerant of gross modification than the digital part is. Consequently, the earthy part of the connectors must be connected only to the PCB - it must not, for instance, be bolted to a metal chassis back panel. Hum loops very quickly become evident where slapdash earthing arrangements like these are used. By all means fit them first to a piece of Paxolin or plastic, or better still, use a connector such as an XLR where none of the signal pins are connected to the shell, but DO NOT attach them to any conducting, earthed material.

Fig.4 Distortion graph showing differences in characteristics of class A & AB operation



Component Stuffing

Certain holes must be opened out - enlarged - before any soldering can be commenced. The holes associated with the PCB-mounting phono sockets must all be enlarged to around 2mm in diameter although some versions may require up to 2.5mm holes. The mounting holes on the perimeter of the PCB, and the one for mounting the 5V regulator heatsink, require 3mm clearance, whilst those associated with the pushbutton switches must be enlarged to around 1.5mm. For all of the drilling operations, use sharp (brand new) drill bits and a drill running at 2000rpm or higher. We can now begin soldering. All of the links must first be fitted to the board, since some of the components which are added later partially obscure the links, or make the fitting of them at a later date a downright impossible task. Before fitting links LK1-4, decide whether you're building a four or an eight input switcher, and if it is an eight-input one, whether the board currently being worked upon will control Inputs 1-4, or 5-8. If it's the former, or you're content with just a four-input system, fit the links in positions 1-4. If not, leave the links out.
In a similar vein, decide at this juncture if you're going to build the optional infra-red control board, and if so, whether the VCA will feature as part of it. If the VCA system is to be fitted, PL4 and PL2 should be fitted later. If not, two short links connecting Pins 7 and 8, and 9 and 10 respectively, should be soldered in place. These carry both

PARAMETER	MEASUREMENT CONDITIONS	UNITS
Equivalent Input noise	f=1KHz	14nV/Hz
Gain Bandwidth product	VCA Configuration	12MHz
Slew Rate	VCA Configuration	10V/us
Gain Constant	Ratio of Outputs	-28mV/dB
Control Feedthrough (untrimmed)	Class A 60Hz Sine wave causing	-10mV
	Class AB	-1mV
Maximum attenuation	f=1KHz, Vcontrol=+4V	100dB
Noise	Class A, Rb=30K, BW=20-20KHz, AV=0dB	-85.5dBU
	Class AB', Rb=150K, BW=20-20KHz, AV=0dB	-94.5dBU
Total Harmonic Distortion	Class A, AV=0dB, Vin=+10dBU@f=1KHz	0.007
	AV=+/-20dB, Vin=+10dBU@f=1KHz	0.0115
	Class AB', AV=0dB, Vin=+10dBU@f=1KHz	0.007
	AV=+/-20dB, Vin=+10dBU@f=1KHz	0.017

Fig.5 Table of SSM 2018 VCA performance specifications

channels' Audio In and Out signals. As an aside, there are wire links on the board than I would normally desire, but single-sided boards are cheaper double-sided ones, and so, in the interests of economy, pure asthetics have been sacrificed somewhat.

Next, fit all of resistors and follow with the DIL sockets. Capcitors next, soldering the smaller ones before moving on to the electrolytics and suchlike. (The smoothing capacitors, C1 and C3 associated with the power supply section are the last components to be fitted to the audio board). Plugs and sockets, fuseholders, the bridge rectifier, regulator IC's and heatsink, (and pushbutton switches on the front panel board), are the penultimate fixture. Again, the number and identity of plugs fitted will depend upon the options chosen. The various overlays show this pictorially. LED's come last on the front panel board. Verify that these, particularly, are correctly orientated with regard to polarity - once the leads are bent to their required shape and cropped to length, any mistakes are effectively irreparable.

We are now ready to test the main analogue board. A 15-0-15 trasformer must be connected, via a suitable 4-way Minicon socket, to PL1. Power up and check for a DC voltage of around 19V on the input side of fuseholder FS1 and -19V on FS2. If these are present and correct, remove the primary source of power and insert 250mA slow blow fuses into the holders. Re-power and check that -17V is present on pin 7 of each of the DIL sockets for IC's 4-8, pin 4 of IC11, and that +17V is present on pin 14 of the first-mentioned holders, and pin 8 of IC11. (No IC's should presently be fitted to their sockets). Check also for +5V on pin 14 of the sockets for IC8, and pin 16 of the sockets for IC9 and 10.

If all is well, disconnect power and plug front panel PCB into the main board. Re-apply power and with reference to the circuit diagram shown last month, verify for the presence or otherwise of the supply voltages on the appropriate pins of each of the DIL IC sockets. Once this has been done to your complete satisfaction, remove power and fit all of the IC's into their correct sockets. Re-apply power and verify the operation of the switches/LED's, ie that pressing a particular pushbutton cancels the previous selection and causes its associated LED to light. Next, connect a stereo audio source to each of the inputs in turn and check that audio is present on the output sockets when the relevant source is selected as an input. (If you're going to be building the VCA/Remote Control board, and have fitted plugs PL4 and PL2, bridge pin 7 to pin 8, and pin 9 to pin 10 using wire links. This establishes an audio path from the output of IC11 to sockets SK9 and SK10). Both boards can now assume to be tested and complete.

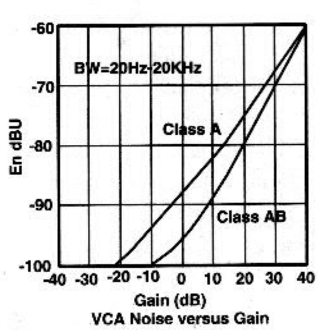


Fig.6 Noise graph showing differences in characteristics of class A & AB operation

More than Four Inputs?

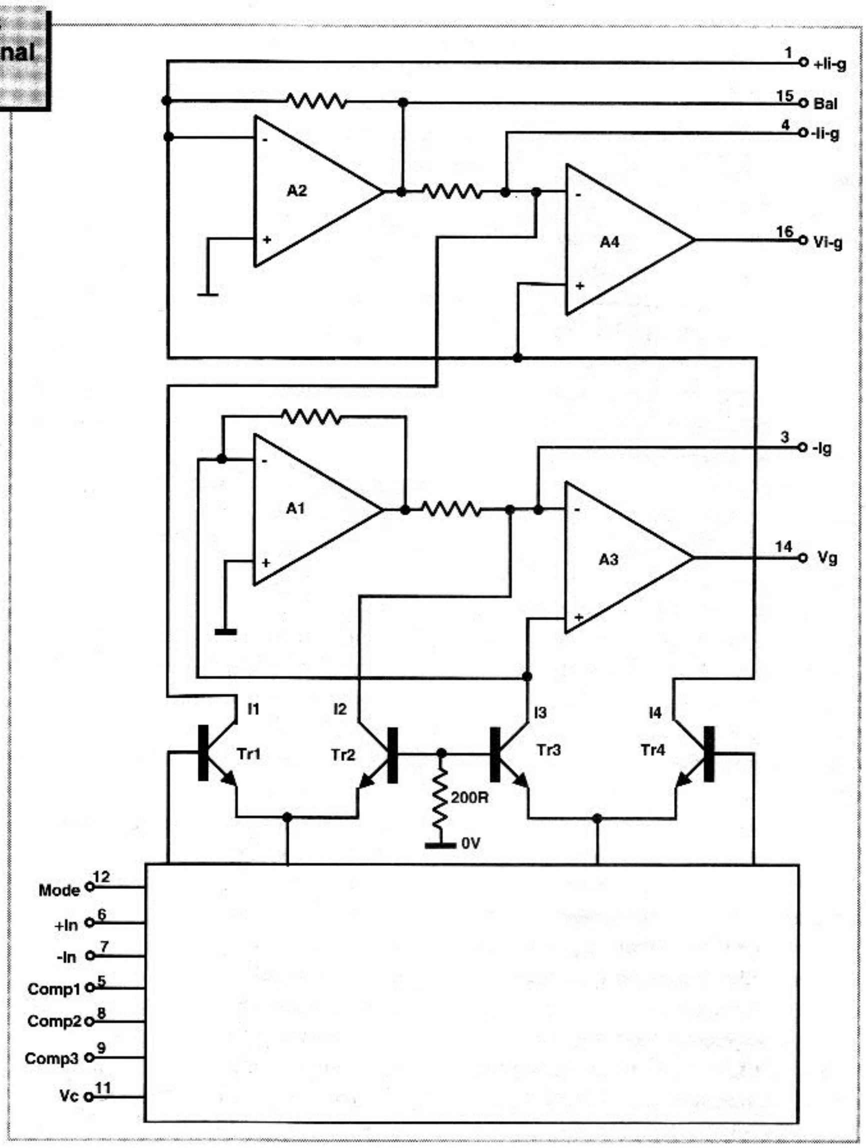
For inputs 5-8, a second main analogue board must be constructed. This is identical in all aspects to the first, but for the fact that all of the components associated with the power supply are omitted. Furthermore, links LK1-4 are also omitted, as are PL4 and PL2, IC's 8-10, and their associated decoupling capacitors and resistor arrays. Two 4-way Minicon socket/lead/socket assemblies transfer power (via PL5) and control signals (via PL7) between the two boards, whilst a 3-way socket/lead/ socket assembly (PL6) connects the audio output of the second board to the stereo bus that is IC11's input. Figure 3 shows an overlay of a board constructed in this fashion. The links LK1-4 are replaced instead by a 4-way plug PL8. In this way, the Q5-8 outputs from the BCD-decimal decoder IC on the main board are connected to the board carrying Audio Inputs 5-8 and used to actuate the solid state switches thereon.

Voltage Controlled Amplifiers

We are now ready to take a preliminary theoretical look at the VCA side of the optional digital remote control part of the system. The remote control boards - transmiter and receiver - as well as the constructional element of both of these boards -VCA and infra-red transmitter/ receiver - occupies the final part of this saga.

The VCA section of The Switcher uses a studio-standard VCA from our friends at Analog Devices. Its performance is markedly different from some of the consumer IC's marketed for this purpose, since it was designed to be included as part of the fader automation systems of recording desks, or into the panning or equalisation sections of said equipment. It should be noted that any impairment perpetrated in the mixing console electronics is irreparable - it follows that noise and distortion characteristics of semiconductors destined for inclusion in mixer electronics must, in many instances, be in the vanguard, performance-wise, of devices currently available. This is whilst combining such characteristics with a cost which makes the component attractive from the point of view of economics. The SSM 2018 manages to achieve respectable figures in all of the places that matter ie noise, distortion, and cost. A table of these and other

Fig.7 SSM 2018 Simplified Internal Architecture



important characteristics is shown in Figure 5

The SSM 2018 VCA can be configured to operate in Class A, Class AB or anything in-between. Running the output devices in different modes of operation can become important in critical, high fidelity applications, since these different classes of biasing the VCA output stage alter the way it performs as regards noise and distortion. We'll discuss the differences presently. Also, because of the complexity of the VCA family of devices, and because we expect so much of them, sonically, in a decent application, we'll look rather thoroughly at what is going on inside this innocuous-looking IC before we get down to the nitty-gritty of the actual Switcher VCA circuitry itself.

A Background History

Surprising though it might seem, there are only five manuafacturers of VCA's in the world. Many of the individuals concerned with the development and perfection of the VCA have become legends in the pro-audio industry - their successes in this field can be measured by the fact that their surnames adorn many of the upper echelon class of audio FX and processors. The designers and patentees of VCA's have long since abandoned the R and D labs where they started their careers and gone on to head the corporate empires which manufacture these goodies. Because, between them, these five companies hold all of the key patents, there are a number of similarities between the competing types. In many respects, there is little or nothing to choose from, performance-wise, between the top-of-the-range offerings from each of the manufacturers. The Analog Devices IC is the only one freely available from electronic retailers such as Maplin and RS, the others being the exclusive domain of the big boys of the pro-audio industry and distributed only through specialist audio component retail outlets.

The only other quality VCA available through the recognised hobbyist component supply channels is another Analog Devices IC, the AD 7110KN. This is marketed as a "digitally-controlled CMOS audio attenuator". It accepts a 6 bit binary code and translates this into an attenuation setting. Signal-to-noise ratio available from this IC is 100dB, whilst distortion hovers around the 0.00125% mark. There is, sadly, a high price to pay for such outstanding performance - about £24.00 per IC.

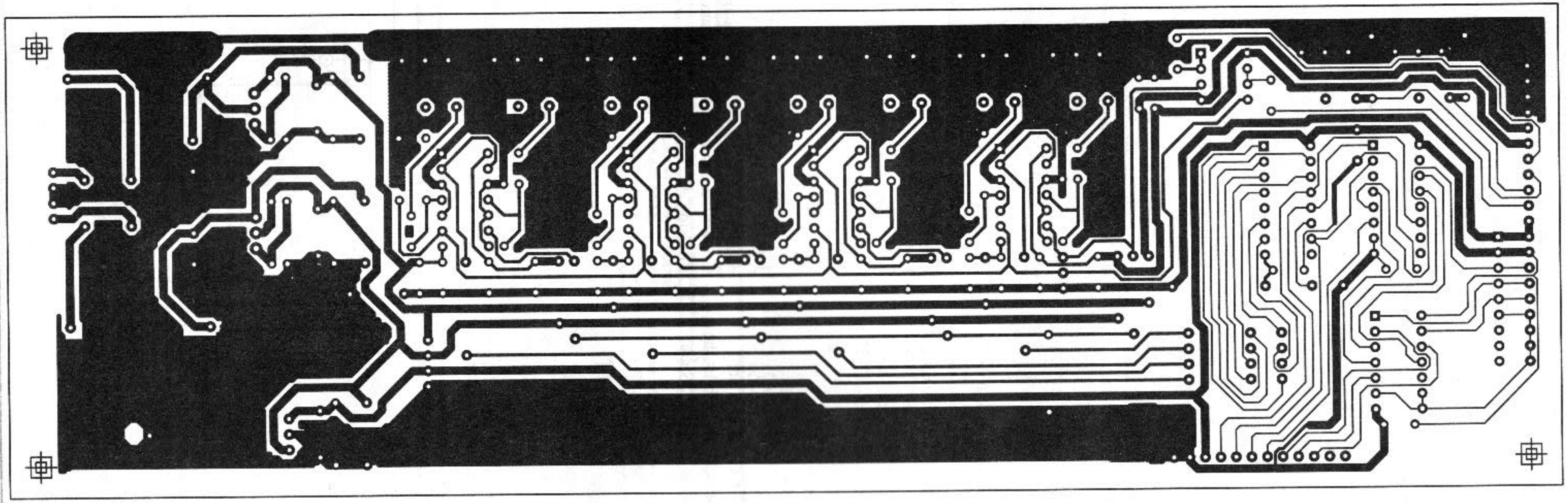
As far as the choice of the 2018 is concerned, it shouldn't be taken as an indication that the SSM series of VCA's are in any way inferior to these other, mysterious, aloof and hard-to-find types - it performs quite meritorously in all aspects important to professional users and audiophiles. As I said earlier, I shall not even bother mentioning the so-called "consumer" VCA/tone control/ preamplifier IC's intended for inclusion in less demanding dometic hi-fi applications - distortion figures of around 0.5% make them a rather unpalettable proposition - there is absolutely no place for their fitting in any system with pretensions towards fidelity of any size, shape or form...

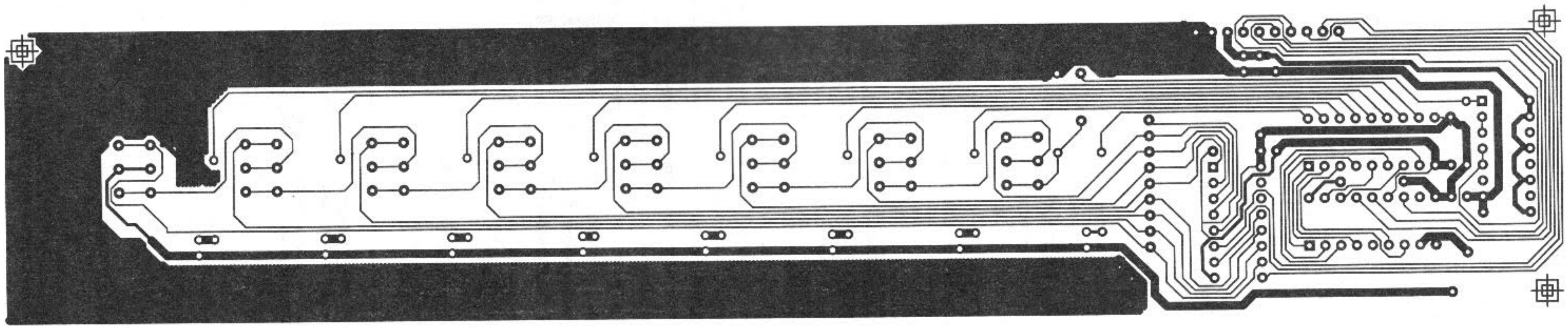
Is "A" Top of the Class?

As in any amplifier or related circuit, Class A means that the output devices operate with a constant bias current, while Class A-B operation means that the bias current varies continuously and proportionately to the absolute magnitude of the input signal.

Typically in thses configurations, high operating currents reduce distortion but worsen noise. This results because of the way in which semiconductor noise mechanisms work.

In essence, noise remains constant and distortion low in VCA devices operated in pure Class A. See Figure 5. Because the noise remains at a fixed level irrespective of the magnitude of the input signal, it is, of course, worst when low level signals are being handled (signal-to-noise ratio is compromised). With Class A-B, noise is worst with large-level input signals (more bias current flowing through the VCA's internal resistances and so greater noise voltages developed across them). As signal level drops, so does noise level, so the signal-to-noise ratio is ostensibly constant for a widely differing range of input levels. Distortion, however, is worsened, since the bias current is continuosly altering. The value of this





bias current is chosen as a compromise between good all-round noise performance and decent distortion performance at various operating levels.

Types of VCA's

As well as different operating modes, there are currently also two different ways of implementing the voltage-controlled attenuation (or amplification) function. One uses a method known as "current-steering", the other, "log-antilog". Since the SSM 2018 VCA - the one which this project uses - employs BOTH methods, we'll look at each in turn.

Current-steering, (also known more popularly as variable transconductance), divides current to reduce system gain. No attenuation is possible although the logarithmic nature of the process means that the large dynamic range span necessary for high quality audio signal handling is available from any IC using this kind of design architecture. These types give their best when attenuating a signal, performance failing slightly at or near unity gain.

The other type, log-antilog, as we might expect, operates in a completely different manner, and so gives its best under different operating conditions. Log-antilog types work by subtracting current from, or adding it to, the logarithim of the input signal current. An anti-logging function converts the current back to its original form. This method of operation means that the log-antilog type can give gain as well as attenuation. In contrast to the current-steering types, log-antilog types give best performance when operating at unity gain ie no attenuation.

The Analog Devices SSM 2018

The extremely flexible chip architecture of the SSM 2018 features inputs and outputs which can be configured for both differential and single-ended signals, with each able to further be configured for current or voltage modes of operation. All of the important input and output ports - audio in, audio out, and control in - are buffered. This improves performance whilst reducing external parts count when compared to other similar, competing devices. The IC has two voltage outputs and three current outputs available, the current outputs being able to deliver 750uA when operated from a bipolar 15V supply. Feedback resistors can be used to convert these currents, internally or externally, into voltages. One external resistor, R_B, programmes the gain core bias current and determines Class A, A-B or intermediate operation. This current must be derived from the positive supply rail and be of the order of 90-500µA for correct operation, since its omission cause the output signal to appear half-wave rectified. Figure 7 shows the unusual internal chip architecture.

The best noise performance is achieved in Class AB, although this is at the expense of a slight increase in distortion. This increase is much lower than other contemporary devices and small enough to be ignored in all but the most demanding distortion-free applications. This is borne out when distortion figures in Class A-B are compared to those achieved whilst the device is operating in Class A. Such noise/distortion characteristics are quite unusual, since low distortion AND low noise cannot normally be achieved. Historically, Class A-B was always the preferred mode of operation when low noise was of the greater concern, whilst Class A found a niche where a low distortion VCA system was required. The programmability of the IC allows the distortion/noise performance to be optimised for a given application. Intermediate Class operation yields an excellent compromise between the low noise of Class A-B and the superior distortion characteristics of Class A operation. As a final thought on the Class Wars, Class A-B gives better control feedthrough rejection than other classes.

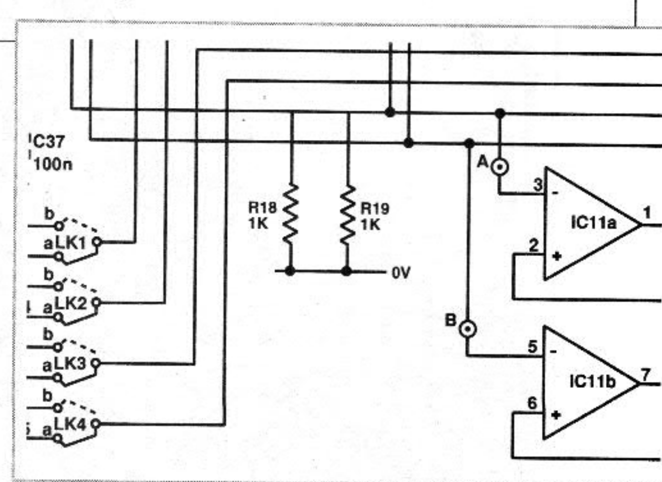
Next month, we describe in detail the various parts important to the unique operation of the SSM 2018, and then go on to divulge how it is used in our application. As a closing thought, if you're one of the subjectivist brigade who hates any superfluous semiconductors in the audio pathway, adding noise and distortion that wasn't present in the original signal, you might prefer the relay version in the final part when we'll present overlays and diagrams for this cheaper-by-thirty-pounds-version.

References

Analog Devices SSM 2018 Voltage Controlled Amplifier/OVCE Data Sheet, Revision A

Clang

In last months installment of The Switcher, two resistors – R18, 19 both 1k in value, were missing from Fig.12 Switcher main analogue/PSU board circuit diagram and the parts. They should be connected as shown in the abbreviated circuit diagram shown below.



The Power behind the MOSFET

Part 2

All you need to know and more from Andrew Armstrong

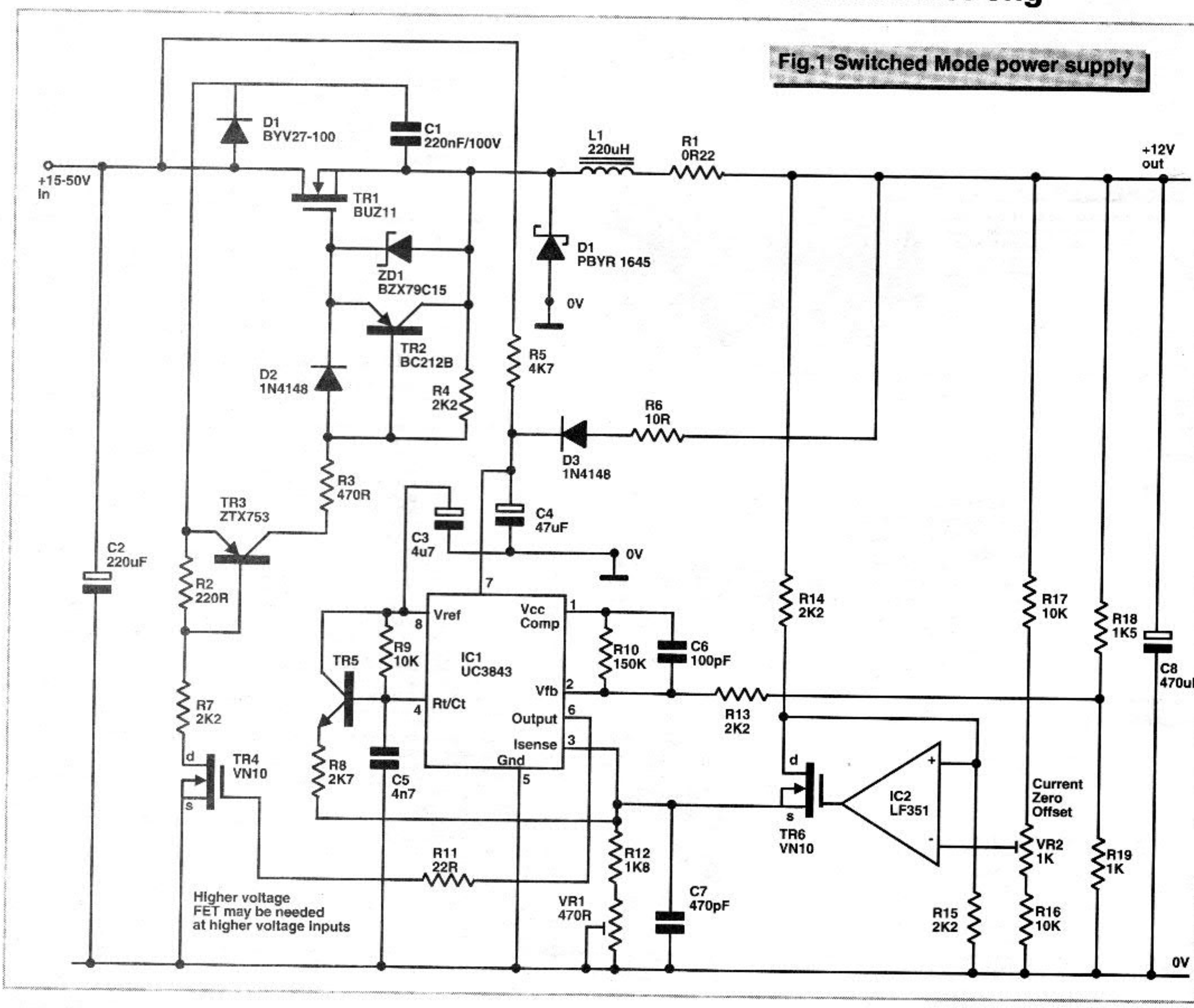


Fig.1 Switched Mode power supply

Last month I promised to show you some application circuits. You should not be surprised to see that most of these involve FETs switching, rather than operating in the linear mode. Switching is something that FETs are particularly good at.

The first application, Figure 1, is a switched mode power supply, in a topology called a buck regulator. This is a complete and workable design, but note that the values of R3, R5 and R7 may have to be recalculated according to the input voltage. Note also that for this design to work, C5 and C7 must be grounded within a few millimetres of IC1 pin 5. This circuit uses two FETs in switching mode and one in linear mode.

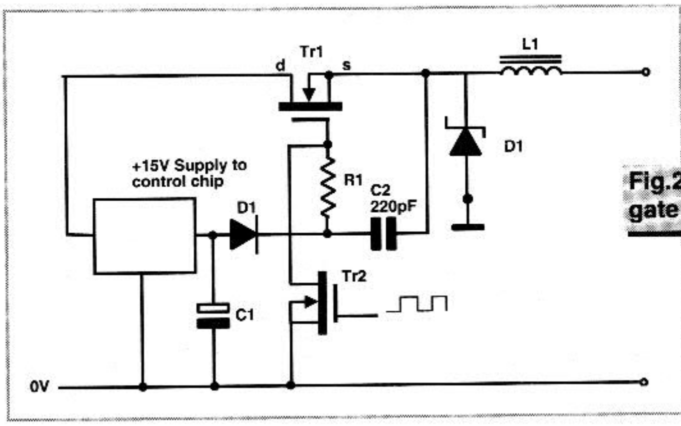


Fig.2 Providing gate drive

I will describe the circuit in detail, because it is almost identical to one which I have used in the past as a constant current battery charger, and it works well if the PCB is laid out properly, with good earth tracking.

The control chip, a UC3843, provides a constant frequency, variable mark:space ratio drive signal in response to its current and voltage feedback signals. It is a current mode controller, which means that its primary control method is to switch off the output drive when the current signal has ramped to its limiting value each cycle. The limiting value of current is set by an internal reference, and reduced as a function of the feedback voltage potted down from the output. The oscillation frequency is set by the value of R9 and C5, while the maximum on to off ratio of the output is set by C5 and the fixed discharge current inside the chip.

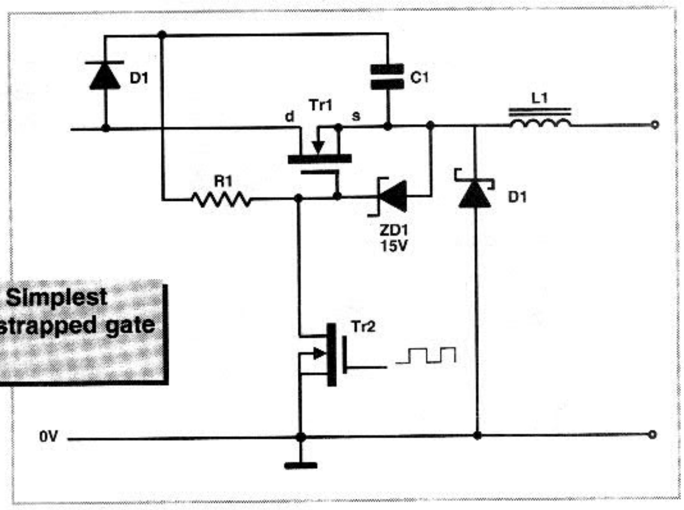


Fig.3 Simplest bootstrapped gate drive

Because this circuit can operate with greater than a 50% on-time, it is necessary to feed a proportion of the oscillator ramp into the current feedback point to prevent sub-harmonic oscillation. TR5 buffers the ramp into the relatively low impedance point, while the proportion of ramp fed back is set by the ratio of R12 in series with VR1 to R8.

The derivation of the current feedback makes interesting use of the FET. The important property of the FET in this case is that the source current is equal to the drain current (i.e. the gate current is zero). If the offset adjustment, VR2, is set so that the inverting and non-inverting inputs of IC2 are at the same voltage (with no current flowing through TR6 no current flows through R1), then any voltage drop across R1 (caused by a current through R1), will result in an extra current through R14. This must flow through TR6 in order to maintain the op-amp in balance. Note that the feedback is to the non-inverting input of IC2, because of the inversion in TR6. The net result of all this is that if R12 in series with VR1 is set to the same value as R14, then whatever voltage appears across R1 will also appear on the current sense input of IC1.

The purpose behind this apparent complexity is to avoid the necessity for a current sense resistor in the zero volt line of the supply. Such a resistor would have to be inserted directly to the right of the ground connection of IC1, and would cause incorrect voltage feedback signals.

Gate switching

The drive output of IC1 switches TR4 via a current limiting resistor, R11. This marginally slows down the switching of TR4, but is necessary to limit the peak output current of IC1 to its specified maximum value.

When TR4 switches on, TR3 also switches on. This switches off TR2, and switches on TR1. In order for TR1 to switch on fully, it is necessary for the gate voltage to be raised above the power supply's input voltage. The charge to do this is provided by C1. It is charged up to the power supply input voltage when TR1's source is at 0V, and whose top end is therefore raised to double the power supply input voltage when the source reaches the input voltage. If the input voltage is more than about 15V, then the voltage on C1 will be too high and must be limited by ZD1 and R3 to prevent damage to TR1. If the power supply input voltage exceeds about 25 volts, the dissipation in R3 and ZD1 can become significant. It is certainly necessary to calculate the value of R3 to minimise the dissipation at the expected input voltage of the supply, while maintaining adequate gate drive. However, the higher the value of R3, the slower the switching of TR1, and if the input voltage is raised, at some stage the point will be reached where if R3 is raised high enough to prevent ZD1 over-dissipating, TR1 will not switch on fast enough, and will itself dissipate heavily.

If it is so difficult to provide sufficient gate drive voltage for an N channel MOSFET, you may wonder why a P channel device should not be used instead. The reason is that, for a given die area (and hence cost and gate capacitance) an N channel device can switch on to a lower resistance. N channel devices also tend to be sturdier, cost for cost.

Control supply

When this design is running, the power for IC1 is drawn from the output. Although during power-up, C4 is charged from the input via R5, and when it reaches an adequate voltage IC1

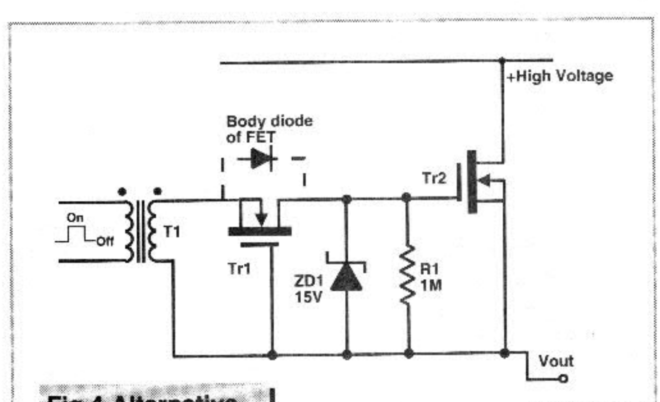


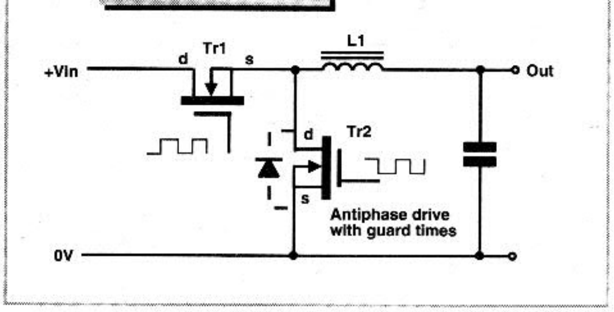
Fig.4 Alternative form of gate drive

starts to operate. R5 will not pass enough current to operate IC1 continuously, so it is necessary that the supply output is powered up before C4 has discharged.

However, there may be situations in which this means of powering the control chip is unsuitable. This supply can be used to feed the bootstrap capacitor if a separate small linear voltage regulator is used to power the control chip. So the FET gate voltage is what the FET requires without the need to dissipate power in a resistor and a zener diode. This much simpler method of providing gate drive to TR1 is illustrated in Figure 2.

In cases where the input voltage is known, does not vary much, and is not far above 15V, the even simpler arrangement of Figure 3 can be used. This arrangement works well for input voltages in the range 10-20V, and becomes increasingly inefficient at higher voltages. At input voltages lower than 10, the on-resistance of TR1 will be slightly higher, with serious inefficiency setting in at around 6V. If a lower input voltage must be used, then a special logic level FET may be used for TR1. This type of FET is more expensive than run of the mill MOSFETs, because its processing is optimised to make it switch on fully with gate drives of less than 5V.

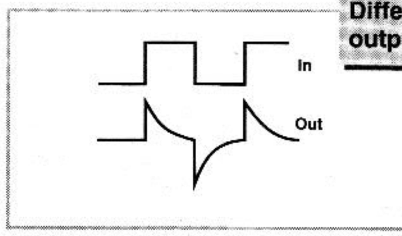
Fig.6 Catch diode replaced by an n-channel FET



Isolated drive

An alternative form of gate drive is shown in Figure 4. Because the gate drive is coupled via an isolating transformer, it does not matter at what voltage the FET is sitting relative to the voltage of the control circuit. In this design, an extra MOSFET is used to control the gate drive, so that the power FET remains switched either on or off even if the drive signal from the pulse transformer disappears. This is necessary because, if a small low-inductance pulse transformer is used, a square wave input drive may result in a differentiated output drive as illustrated in Figure 5.

Fig.5 Differentiated output drive



On a positive edge, the body diode of TR1 switches, charging up the gate capacitance of TR2, and switching that on. When there is no voltage on the output of T1, then TR1 does not conduct in either direction. A negative edge on the output of T1 turns on TR1 and discharges the gate capacitance of TR2, thus switching it off. The gate of TR2 is protected from overvoltage by ZD1, and static charge is leaked away by R1, to minimise the likelihood of damage to the circuit while it is switched off.

In some applications, it is necessary to add a fixed capacitor in parallel with R1, to hold TR2 on for longer in the absence of a drive pulse. If really long on-times are required, it may even be necessary to omit R1 altogether.

There is one particular snag to using this gate drive technique, which may render it unsuitable for use in a buck regulator. If it is possible for the control chip to stop giving drive pulses altogether, in a circumstance when the power FET should be switched off, it can happen that noise or interference causes the power FET to be left switched partly on. In the conventional buck regulator design, if the pass transistor is on when it should be off, then the control chip will not generate any drive pulses, and, with a circuit such as that of Figure 4, the pass transistor will turn off very slowly as the charge is leaked away through R1. Therefore, it is clear that this type of gate drive should only be used in designs where gate drive pulses will always be present.

There is one final buck regulator variation, in which power MOSFETs can find a further application. The circuit fragment of Figure 6 shows the catch diode (the equivalent of D1 in Figure 1), replaced by an n-channel FET. In this design, when TR1 switches off, the body diode of TR2 will start to conduct the current in L1.

After a sufficient guard time to make sure that TR1 is completely switched off, TR2 is switched on. If TR2 has been chosen correctly, it has a very low on-resistance, an so imposes a much lower voltage drop than does any normal diode, even a Schottky. This technique is called synchronous rectification, and was originally used with electromechanical power supplies using vibrating contacts instead of power transistors, to drive a step-up transformer, and vibrating contacts in phase to rectify the output. These were used in ancient valved mobile radios.

When it is time for TR1 to switch on again, TR2 must be switched off sufficiently in advance to avoid the possibility of current flowing via TR1 and TR2 directly to ground. However, for most of the diode conduction cycle the voltage drop can be arranged to be negligible. In some very critical designs, a Schottky diode will be connected in parallel with TR2 to maintain a low voltage drop while TR2 is switched off, and to avoid the problems of slow switch on associated with some MOSFET body diodes. Certain MOSFETs are specifically designed for use in this application, and the switching time of the body diode in such MOSFETs is fully specified.

This sort of design is relatively expensive and is only useful when it makes a crucial contribution to the overall efficiency of the system. In effect, the voltage drop in the catch diode, while it is on, is added in series with the output voltage. So for example, if the output voltage were 6.3V, then a diode drop of 0.7V would impose a 10% loss during the time the diode was conducting.

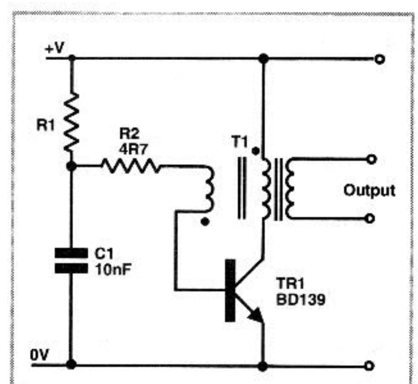


Fig.7 A blocking oscillator design

The criteria for synchronous rectification to be worthwhile are that the output voltage of the supply shall be low, efficiency is high, and the output diode is switched on for a significant fraction of the operating cycle. In particular, this is useful in high-current 5V supplies, and medium or high current 3.3V supplies (now becoming common in notebook computers). The criterion for the diode to be on for a large part of the cycle is that the input voltage is significantly higher than the output voltage. This is simple common sense, because, if the input voltage was equal to the output voltage, the pass transistor would be on all the time and the diode would be on none of the time.

Blocking oscillator

By way of contrast, Figure 7 shows an application for which, in my experience, a bipolar transistor is much better suited than a MOSFET. In this design, feedback is provided by transformer coupling between collector and base-winding, and the frequency is set (approximately!) by the time constant of R1 and C1. This is what it does: when power is first applied, C1 charges through R1 until TR1 starts to switch on. As soon as it starts to switch on, extra base drive is applied by the base winding, so it switches on harder.

It remains switched hard on with its base current supplied by the base winding on T1, until the base current demanded from C1 has discharged the capacitor to the point that there is insufficient voltage on the base winding of T1 to keep TR1 switched on. TR1 then starts to switch off, and in doing so the flow of current in the base winding is reversed which turning it off.

The operation of the circuit is based on a flow of current. A simple MOSFET implementation of this would involve the gate drive being derived from a current flow through a zener diode, with the switching device turning off when the sum of the capacitor voltage and the winding voltage fell below the gate threshold of the FET. The zener would dissipate heavily and the efficiency of the circuit would be low. For a simple and effective implementation of a blocking oscillator, a bipolar transistor seems best.

That's all for this month. In the final part next month, I shall cover high-powered analogue signal switching, reverse battery protection, a micro power voltage regulator and a transformer-coupled flyback converter. A MOSFET power amplifier project is also planned. Class A, B, or D? I haven't decided yet.

Technoshop

Electronics in Action in co-operation with The Technology Exchange Ltd, the international technology matchmaking service based in the UK, will be bringing you each month a selection of technology partnership opportunities to which you are invited to respond.

The Technology Exchange, which was formed in 1985 as a not-for-profit technology sourcing service to industry, holds a bi-annual 'Technoshop' Technology Transfer Fair at Heathrow Airport and several 'Techmart' Fairs overseas for the United Nations (UNIDO).

For this issue of Electronics in Action, we continue to present business opportunities from European firms seeking technology partners in the UK indicating on each item whether it is an offer or a request for products or technology.

If you believe that you would qualify to be the partner for any firms described in these profiles, please write to The Technology Exchange quoting the item number and code letters at the head of the entry saying how you wish to respond and enclosing information on your own organisation and its products or services.

The only cost associated with this process is a simple £10 plus VAT introduction fee for each entry to which you respond. For this we will send you the information which we hold on the entry, transmit your response to the source of the entry and invite them to send you more detailed information about themselves and their entry.

The code letters on the entry number indicate the country where the partner is located as follows:-

Code Letters

- **TO/TR** - UK
- **GOM** - Belgium
- **SOFAD** - Spain
- **GR** - Greece
- **DTO** - Denmark
- **IDA/E** - Ireland
- **PME** - Portugal
- **SG/SGT** - Italy
- **A/ANG/DP** - France
- **B** - Bulgaria
- **ZO/ZL/TVA** - Germany

Please respond directly to:
The Technology Exchange Ltd
Wrest Park
Silsoe
Bedford
MK45 4HS
or **Fax**: 0525 860664
Phone: 0525 860333
The payment of £10 plus VAT (£11.75) per item should be sent with your requests.

Offer/Request BG 14
Computer Array Processors

Bulgarian producer offers FPS-compatible Array Processors 60 x 30 x 70 (H, W, D) attached to IBM PC/AT and converting it into a minisupercomputer workstation with 60 MIPS, 12 MFLOPS, up to 1 GigaByte dynamic memory, FFT 1024 complex points - 4.75mS at a fraction of the price of RISC computers. The company looks for licences and know-how in this field.

Company Sale ANG F 1
Printed circuits

Manufacturer of printed circuits (metal and multilayer hole) generally in small quantities for industrial electronics, data processing, telephone and avionics manufacturers, seeks investment or company sale.

Offer ANG F 8
Expert system generator

New expert system generator designed for use in companies where users are not familiar with such software. Enables such users to set up programs for decision making in a couple of days instead of a few months as with traditional systems. Distributors sought.

Offer/Request ANG F 13
Position and movement sensors (Trajectory Metering)

Manufacturer of position and movement sensors used for monitoring industrial robots, human movement for medical and sports applications, mobile platforms and simiar, offers products for distribution and will consider joint-ventures with suitable companies.

Offer ANG F 24
Micro-terminals for data collection processing

Manufacturer of software and data processing terminals including portable data loggers for the control and monitoring of production processes seeks reciprocal marketing arrangements and may consider offering manufacture of their products in Europe.

Request SOF 9015
IBM Software

Spanish firm dealing in IBM medium and host systems is seeking development tools and specific software for those systems.

Offer SG 90002
Electronic systems

An Italian specialist in the development of electronic systems and general purpose automation systems for the automotive and aviation industries offers technology and know-how exchange and sub-contracting.

Offer/Request SG 911200
Component manufacture

A company producing a variety of electrical and electronic products including magnetic disk boxes, dot matrix printer leads, radio telecommunications and electronic components including circuit boards, seeks commercial and/or technical know-how exchange plus partners for CEC R & D programmes.

Offer SG 911215
Oliodynamic motors

Manufacture of oliodynamic motors (high speed, low speed and variable speed) based on axial pistons with fixed and variable cylinders from 50 cm3 to 6,200 cm3, seeks distributors for their products. Potential partners should already be involved in the oliodynamic industry as the products are normally an integral part of the original equipment.

Offer TO 148
Data cable test equipment

This easy to use 8 channel test set is British Telecom approved and is specified for use with computer data cabling and telephone cabling installations. It is powered by a PP3 battery and gives an instant indication without manual intervention of the state of cabling terminations. Unterminated, wrongly or badly terminated conductors, inter-conductor shorts and earthed conductors are clearly shown. It will be of universal interest to installers and commissioning engineers. Investment partner sought for a 64 channel model, currently at prototype stage.

Offer TO 154
Range of high efficiency flourescent lighting units

A range of attractive fluorescent lighting units designed for ease of installation and tube replacement. High frequency electronic ballasts ensure instant start up without flicker using high efficiency tubes and special reflective films. The units are BRECON approved. Each unit is individually switched and can be changed from down lighting to architectural uplighting, either manually or by an infra-red signal. A manufacturing licence is offered for this range which is designed for low cost manufacture and assembly using aluminium extrusions.

Offer TO 163
Compact brushless DC pancake motor

This ultra slim brushless DC pancake or doughnut motor has been developed for computer peripherals and is only 12 mm thick and 100 mm in diameter. It has a hollow rotor with 40 mm through hole making it suitable for through shaft and servo applications. Especially suitable for hazardous environments with inherent electrical safety. Manufacturing licence offered.

Offer TO 215
Imaging in opaque fluids

A wide dynamic range analogue data collection system which is used with ultrasonic transducers for imaging in opaque fluids. Subsequent computer analysis prepares a two dimensional image containing three dimensional information. Manufacturing agreement/ joint venture.

Offer TO 216
Computer linking system

A patented in-house computer linking system which has virtually no memory, time, or priority overheads. The system links mini-computers, PC's and peripherals in a way which allows access to any computer or peripheral. All protocols are handled by the system for ease of interrogation and file transfer.

Offer TO 217
Video system for robot positioning

This automated equipment and control system design is used for non-contact high accuracy dimensional analysis from a video image by embedded transputer array. The information generated is used for positional control of an industrial robot - initially developed to remove fuel pins from nuclear fuel sub-assemblies, but the system may be modified for other robot assembly applications.

Offer TO 253
Computer/Perlpheral sharing and interconnection

This PC computer and peripheral sharing system is designed for the interconnection of up to 8 peripherals (printers, plotters, modems etc) with a maximum of 24 computers. The system acts as line driver, serial/parallel converter, automatic printer sharing switch, peripheral grouping system, port contention switch and multiplexer. A manufacturing agreement is offered.

Offer TO 254
Private telecomunication network services

The UK company specialises in project management of private network systems from strategic and feasibility studies to network design and cost reduction. They prepare and adjudicate ITT's, design cabling systems, troubleshoot, compile OR's and assist with training and recruitment of operators.

Offer TO 255
A hypermedia computer software mechanism for information management

WEB is a new approach to managing information based on a concept of threads which represent particular topics of interest to the user. Information can be linked to a number of relevant threads to allow users to model their ideas. The first product WEB - Information Assistant runs in a multi-window environment on IBM PC and compatibles. Information can be keyed in or imported as a text file and moved from point to point within a WEB or between WEBs providing a powerful HYPERTEXT environment for general information. Links to the users existing word processor, spreadsheet etc.

Offer TO 258
Cable coupling transformer for audio, digital and communication systems

Compact, low cost, coupler will operate round a line pair to enable insertion and/ or retrieval of digital or speech information anywhere along a cable length without any physical contact. It is the equivalent of a sliding plug and socket and can be used for telephone sharing, additional loud speakers to extend hi-fi or public address systems. It will cancel common mode noise and since it does not penetrate the cable insulation or sheathing it can be used outdoors, underwater or in hazardous or chemical environments.

Offer TO 260
Intelligent computer software desk and organisation system with hard copy binders and a computer data transfer syste and connecting cables

Filocept is an intelligent desk and organiser which integrates an automatic preset spreadsheet, database, address book, note book, calendars, diary and information sheets producing hard copy in A4 and organiser formats. Printercept enables files including pictures and text to be imported from any computer to any other computer which is made to appear like a printer.

Offer TO 262
Miniature passive inra-red motion detector

This miniature infra-red motion detector consists of a pyroelectric polymer film and an electronic circuit. The motion detector will switch on a load for a given period of time eg an external light and activate an alarm based on changes in temperature or movement and can also be incorporated into a coded radio transmitter security guard system covering six protected zones. A speech synthesis trespassing alarm version can give a pre-programmed audible warning or welcome message of up to 12 seconds in duration. The low power consumption of the sensor enables modules to operate for up to one year on a single 9 volt PP3 battery.

Offer/Request TO 272
Computer-based vision and sensor systems for the control of machine operations

A company working in the above fields have developed a flexible vision inspection system which incorporates a standard unit with flexible software which should replace the need for designing individual systems for each customer. It can be easily programmed by relatively unskilled operators and used for many purposes. The company seeks collaboration with OEMs who's products encompass vision systems but who's expertise does not extend to the vision technology.

Offer/Request TO 282
Telephone call screening device

A low cost call screening system used on an attended telephone to avoid and deter any unwelcome telephone callers. It can be operated manually by the call recipient and is suitable for use in the home or small business. This product should interest manufacturers of call answering machines and security systems. A patent sale, licence or joint-venture would be considered.

Offer/Request TO 302
Micro-code voice encryption modules for security in telephone conversations

Various implementations of a voice encryptor on a single system integrated circuit. The modules are highly reliable of low cost, and low power consumption and are easily installed to new or existing telephones or radios. Originally designed as a thick film hybrid, a single chip design is available. An investment partner is required.

Offer/Request TVA 6
Broadband communicatons

Specialist research and development company for broadband technology, cell relays, signalling software, ATM cells, etc. Company seeks R & D partners for further developments either as joint-ventures or contracts. Consultancy is offered in ATM technology and the sale of existing boards is also offered.

Offer TVA 8
Low Voltage control equipment and intelligent motor protection

Distributors or licence manufacturer required for a range of low voltage electrical control equipment including vacuum contactors, relays and circuit breakers. Also intelligent motor protection which predicts the lifetime usage of the motor aiding preventative maintenance.

Offer TVA 10
CAD-CAM Software for maximum efficiency and speed in materials usage

Software design for maximum efficiency in materials usage subject to cutting and punching. Calculates best use of materials by maximising product layout on sheet. Will maximise process for entire line in multiple products which need to be cut from sheets of varying thicknesses. Also appropriate for paper punching and construction, wood cutting and marble cutting.

Offer TVA 11
Modular satellite systems

Licensed manufacture and distribution offered for modular satellite systems used, for example, in hotels for 'pay TV'. Distributors should be able to offer technical services in satellites, TV control, data communications and installation, as well as an after sales service. Manufacturers should be working in a relevant sector and be capable of surface mounting of chips.

Offer TVA B 17
Cable system manager for large manufacturing plants

Cable system manager for all types and mixes of cable (electrical, co-axial, optical, etc) including capacity planning for cable runs and automatic monitoring and switching of telecommunications. Joint venture required to customise product for individual EEC markets.

Request TVA 17
Multimedia software

A German company seeks joint venture partner with knowledge of multimedia systems, particular for use in manufacturing industry. Company should have good knowledge of image storage and picture retrieval.

Offer TVA 26
Portable data storage device

Mobile handheld storage device with wide variety of uses from inventory stock control in warehouses to production of parking tickets for Police. Can be used in conjunction with memory cards and a light pen and will drive a separate printer. Licence offered for manufacture as well as distribution rights.

Offer TVA A 34
Portable solar powered solar cooling system

Portable cylindrical solar powered and cooled dewar vessels ideal for mobile use in laboratory, human and veterinary medicine. Particularly appropriate for vaccination campaigns in developing countries. Incorporates a temperature sensor and display, overheat protection and a power failure device.

Offer/Request ZO 7
Microelectronics

A company specialised in microelectronics covering research, production, distribution and servicing in the fields of 3-dimensional micro-structures of metal, plastic and ceramics (eg. fibre-chip couplers, micro coils, micro plugs), seeks cooperation leading to licensing-in technology, reciprocal distribution and purchase of shares in their company.

Offer/Request ZO 25
Microelectronics

Manufacturer of software tools for visualising processes on the PC, hardware and software of sensor technology based on SMD and hybrid technology, especially ultrasound and wireless data transmission, seeks distributors for above products. The company also requests contracts for the development of similar hardware and software.

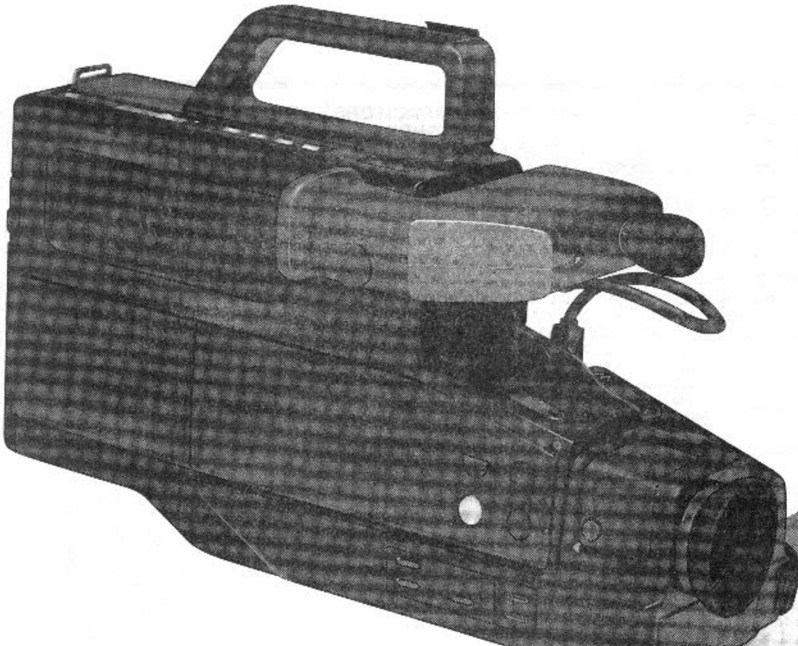
Offer ZO 34
Electronic data processing

A company who's activities include the repair of electronic assemblies (PCB's) and mechanical components (Printers only), software development and storage supervision, are seeking a distributor or wholesaler interested in Japanese spare parts and repair of Japanese EDP printers.

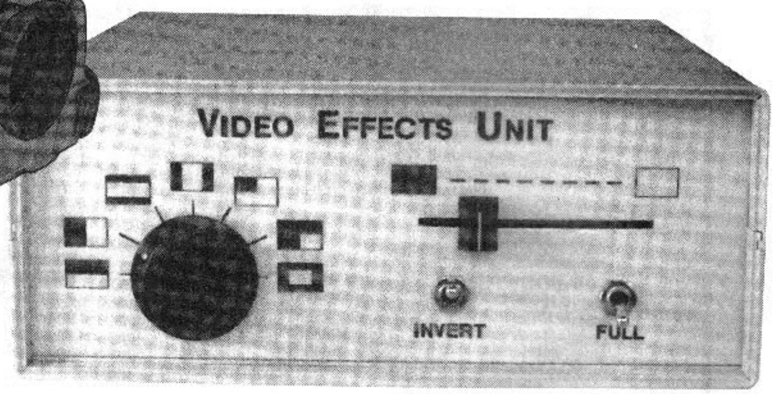
Offer/Request ZO 38
Microelectronics for communications

A company specialising in ASIC design support, training, support for object-oriented programming as well as the development of high-speed silicon bipolar circuits and with a patent pending for a switching network component in BiCMOS technology, seeks a partner for joint development of circuits for mobile communications and optical telecommunications.

MORE NEXT MONTH

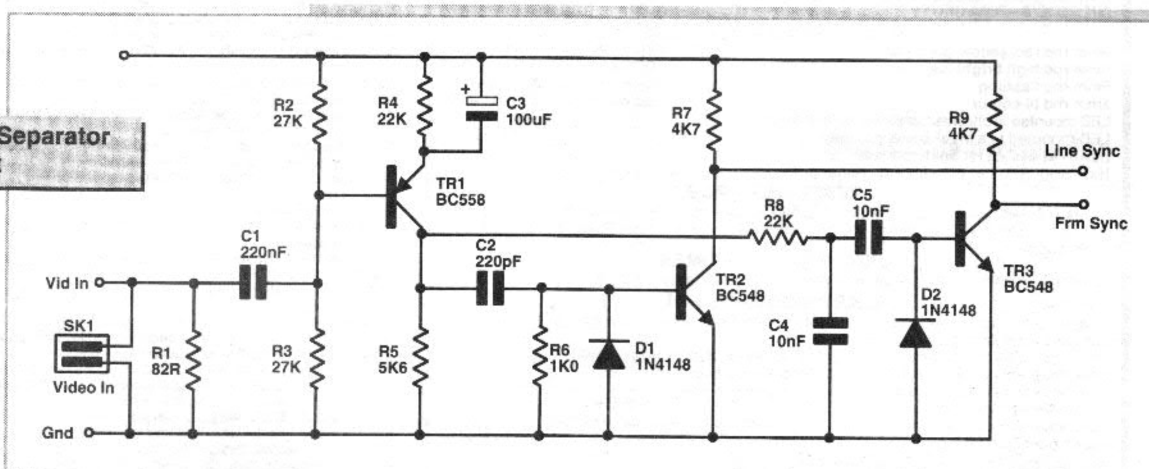


Improve your video editing with this low cost unit! Another ingenious design from Paul Stenning



Video Visuals

Fig.1 Sync Separator circuit



There are many times when I enjoy producing my own video compilations of music tracks. This normally involves recording a few hours of music videos from TV and other music programmes, then copying selected tracks onto another tape.

One problem is joining the tracks. Since the inevitable talking over the beginning and end of the track has to be removed, it results in a rather untidy continuity between tracks. A similar situation occurs when editing camcorder tapes and the like.

Digital AV mixers are available commercially, but these normally cost as much as a good video recorder, and so are rather expensive for home use.

The Works A

The complete circuit diagram is shown in Figures 1,2,3,4 and 5. Although this may initially appear complicated, the operation is reasonably straightforward.

On the circuit diagram and in the following description, a '–' after a signal name indicates that the line is active low.

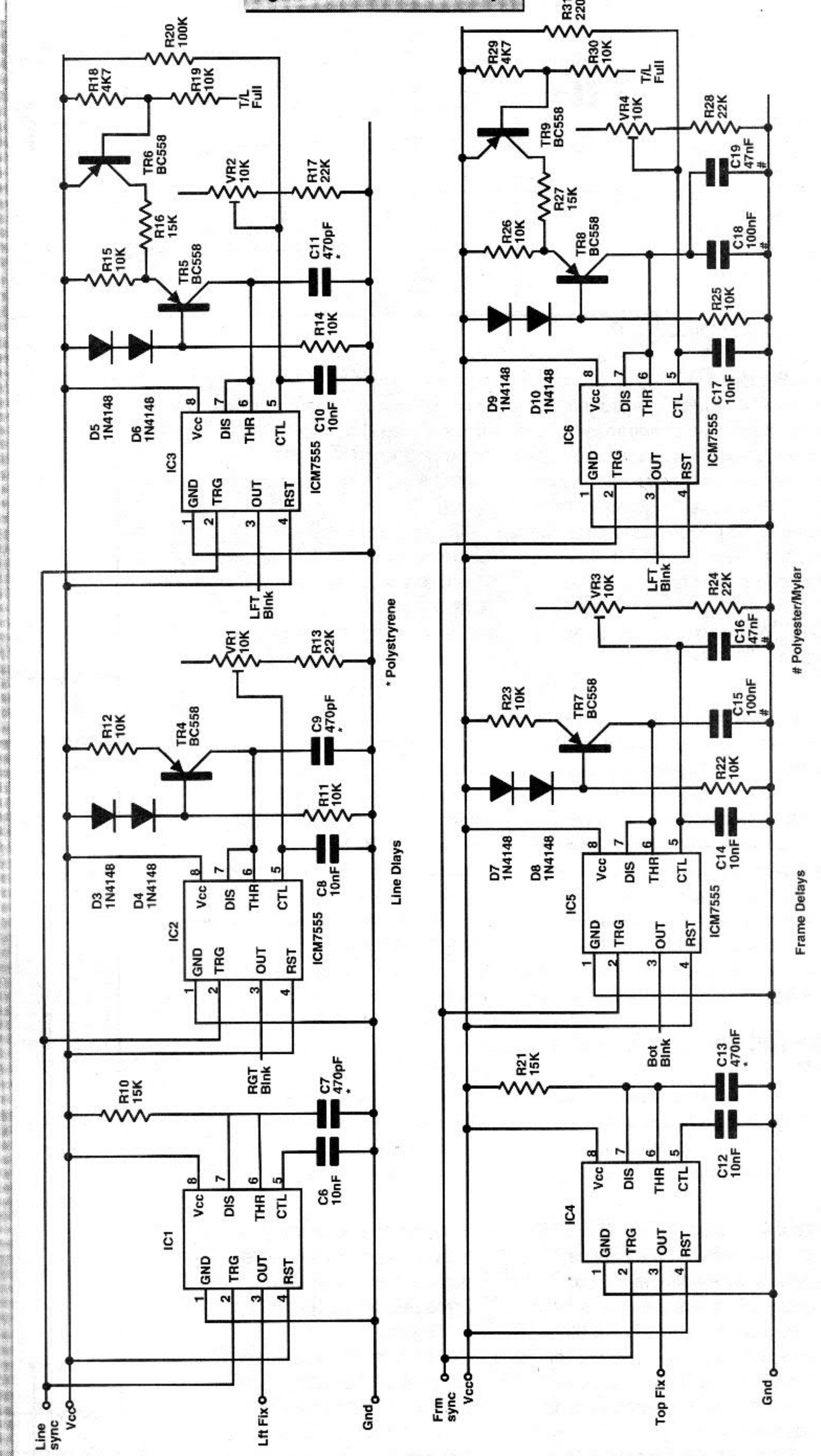
The unit works by selectively blanking the picture. To achieve this, parts of the video signal are replaced with a voltage level corresponding to black. Monostables and control logic are used to select the portions of the signal to blank.

The video signal enters the unit via SK1, and is terminated by R1. The circuit around TR1 removes the sync portion of the video signal. C2 and R5 convert this to short pulses, which are buffered by TR2. The longer frame sync pulses are able to pass through R9 and C4, and are buffered by TR3.

The Video Effects Unit presented here has a more modest specification, with a more modest price tag!

It should be possible to construct this unit for about £40 including the case. Setting up is straightforward, and no test equipment is required. Some of the companies and individuals who produce wedding videos could put this unit to good use!

Fig.2 Line and frame delays



The Works B

The two control voltages are used to control the delay of monostable ICs 2, 3, 5 & 6. These monostables are based around the 7555 IC, which is the CMOS version of the popular NE555. This device was chosen because its delay can be adjusted by an external voltage on pin 5 - this alters the threshold voltage. The level of the control voltage reaching each IC is adjustable over a limited range by the 10K preset pots to allow for component tolerances.

However since the charging waveform on the timing capacitor is exponential, the control voltage does not change the delay in a linear fashion . To overcome this, the timing capacitor is charged from a constant current source, giving a linear sawtooth waveform and therefore linear control of the delay. The constant current source, consisting of a transistor, two diodes and two resistors, gives a (reasonably) constant 60µA charging current for the timing capacitor.

The above arrangement is repeated four times. In the case of IC3 and IC6 an additional transistor can switch a second resistor in parallel with the constant current control resistor, increasing the current and hence reducing the delay. This facility is used for those patterns where the top and bottom, and/or both sides of the screen are blanked, and the delay from the left or top only has to reach the centre.

IC2 and IC5 are controlled from the reduced and reversed control voltage from the second half of IC11. This gives a control range from the right or bottom of the screen to the centre.

Two additional monostables (IC1 and IC4) give fixed delays for the left and top of the screen. These are used to ensure that the colour burst and frame sync pulses are not blanked.

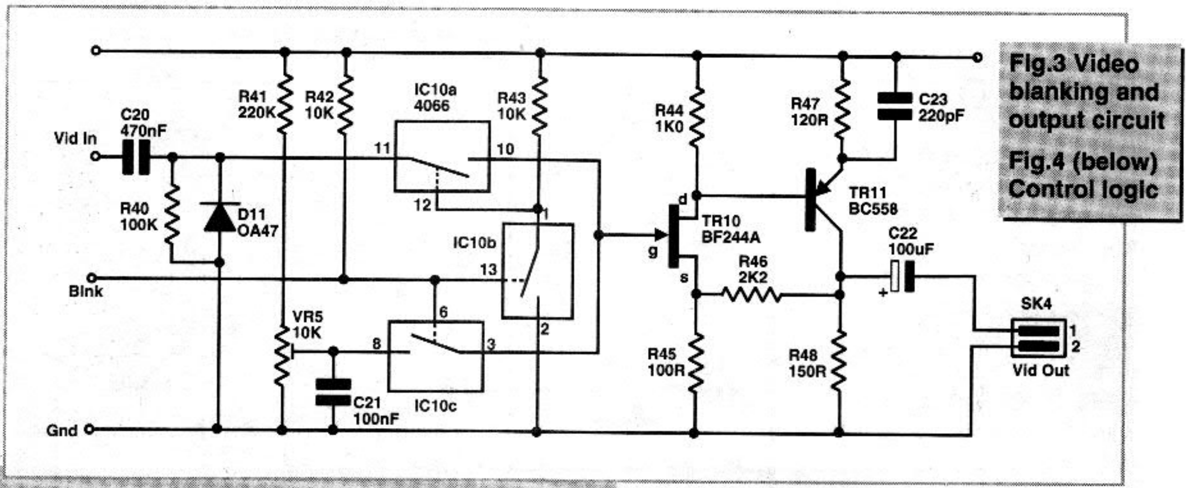


Fig.3 Video blanking and output circuit

Fig.4 (below) Control logic

The Works C

The BLANK- signal mentioned earlier controls a changeover analogue switch arrangement that switches either the complete video signal, or a DC voltage equivalent to Black level, to the output buffer amplifier. The changeover analogue switch is constructed from a pair of gates in the 4066 (IC10), by using a third gate as an invertor. The incoming video signal is held with the negative tips of the sync pulses at about 0V by D11 and C20. VR5 sets the DC level for the blanked signal.

The circuit requires a regulated supply of 12V DC at 50mA, this is derived from a 7812 regulator circuit. C29-C33 are decoupling capacitors that are distributed around the PCB.

The unit enables the picture to be wiped to black at the end of a track, and then restored at the beginning of the next track. The recording video recorder would be paused once the picture is black, and the pause released just before fading in the next section.

A 'Full' switch is provided to show the picture when the unit is faded - this is useful for finding the beginning of the next section once the recording machine is paused.

The full wipe or just the half!

The unit offers seven wiping effects, all of which are also available in inverted form giving a total of fourteen, these are illustrated in Figure 8.

As described this unit does not fade the sound, however, it would be a simple matter to add a second slider control next to the existing one, and operate both simultaneously. Further comments on this option are given later.

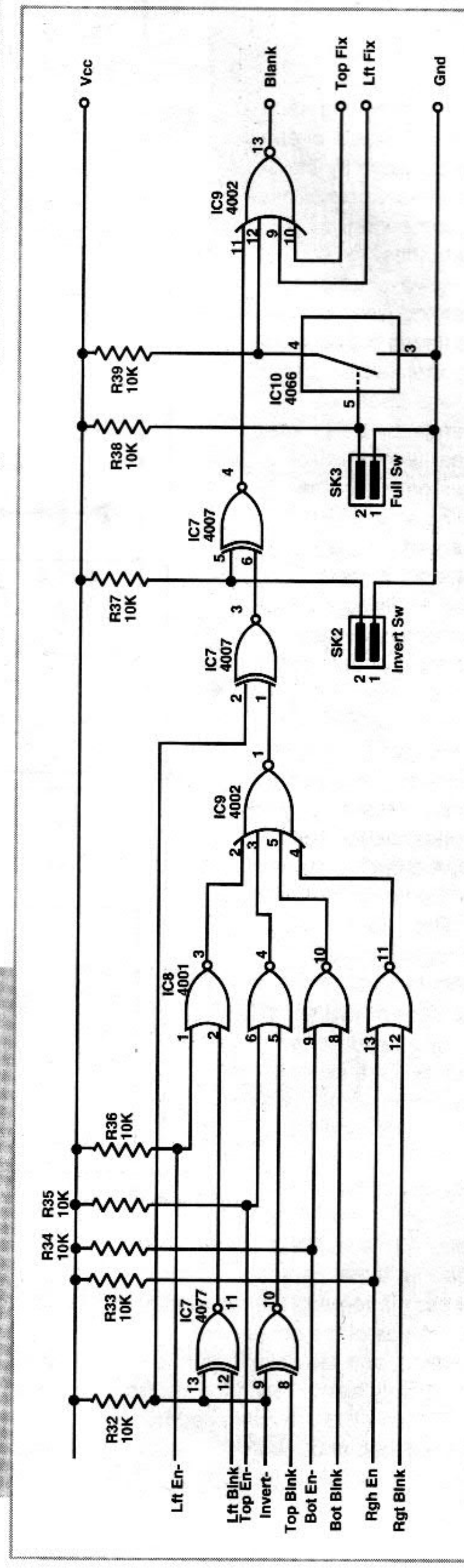
The unit only allows the wiping of one video input to black. Due to sync problems it is not possible to mix two video signals without incorporating the expensive digital techniques contained in commercial products. Broadcasters and professionals use a gen-lock system where all equipment is controlled by one external sync generator, however, domestic video equipment

The Works D

We now have all the control signals. The next stage is to select which are used, and how they are used, to achieve the selected blanking pattern. This is the job of the Control Logic, which is in turn controlled by the Control Switching.

The first two gates in IC7 (an exclusive NOR gate) are controlled by an INVERT- line from the control switching, and allow the signals from the top and left delay monostables to be inverted. The four gates of IC8 (NOR) allow each of the outputs from the monostables to be individually selected. The outputs from these are combined with a four input NOR gate, IC9.

The output of this passes to the third gate in IC7, which is controlled by the INVERT- signal. This is followed by the last gate in IC7, which is controlled by the front panel Invert switch. IC9 combines the output from this with the fixed delay signals from IC1 and IC7, and the inverted signal from the Full switch, to form the BLANK- signal.



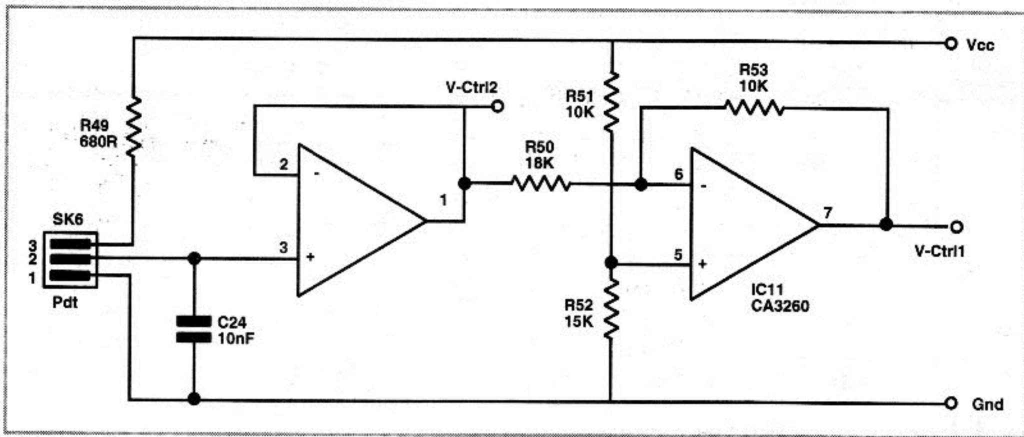
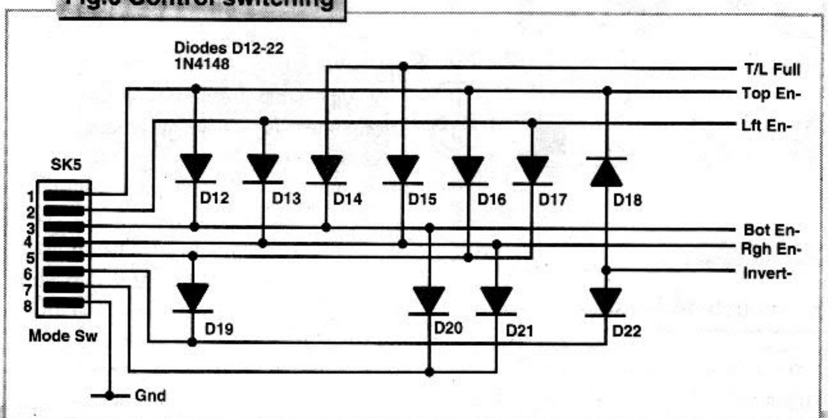


Fig.5 Control amp

The Works E

The voltage from the control pot is buffered by half of IC11. This is then inverted by the second part of IC11, and the level reduced to give an output range of 11V to 5V for an input range of 0V to 11V. Note that the pot is a dual device with the tracks wired in anti-parallel. The front panel Invert switch selects which wiper is connected to IC11.

Fig.6 Control switching



The Works F

The operation of the above logic is controlled by the mode switch, via D12-D22 which act as basic logic. The truth table of switch position against control logic levels is shown in table 1. Note that the control lines are pulled high (1) by resistors, the diode logic and switch pull the appropriate lines low (0).

	Mode Switch Position						
	1	2	3	4	5	6	7
TOP EN–	0	1	0	1	0	0	0
BOT EN–	1	1	0	1	1	1	0
CONTROL LFT EN–	1	0	1	0	0	0	0
LINE RGH EN–	1	1	1	0	1	1	0
T/L FULL	1	1	0	0	1	1	0
INVERT–	1	1	0	0	1	0	0

does not support this system. In any case mixing two signals would require three video recorders, which is probably excessive by domestic standards!

Construction.

The circuit is constructed on a single sided PCB, 157mm x 134mm, which is available from the EIA PCB service. Component positioning is shown in Figure 6. Before commencing construction, the three PCB mounting holes and the fixing hole for IC12 should be enlarged to 3mm.

The 31 link wires should be fitted first, followed by the other components in the usual size order. D11 is a germanium device and extra care should be taken to ensure it does not get too hot. The holes for the off-board connections (shown as SK1 to SK7) should be fitted with terminal pins or suitable 0.1" pitch connectors.

The PCB was originally designed for low cost ceramic disc capacitors. However when testing the prototype, it was found that these were not suitable for the monostable timing components. C7, C9 and C11 should be polystyrene types - the leads of these may need to be formed to fit the PCB. C13, C15, C16, C18 and C19 must be polyester or mylar types; polyester types are available in 0.2" pitch to suit the PCB.

IC sockets may be used for the ICs, however the ICs are fairly cheap and could be soldered directly into the PCB if preferred. In this case they should be fitted last and due care taken to avoid static damage.

The prototype was constructed in a plastic case, 190mm x 165mm x 68mm. A suitable overlay for the front panel is shown in Figure 9. This may be photocopied and fixed to the front panel with clear self-adhesive vinyl ('sticky-backed-plastic' as Blue Peter call it!).

The interwiring is shown in Figure 7. Screened wire should ideally be used for the video signals, but since the cable runs are short this is not essential. Normal hookup wire or coloured ribbon cable may be used for the remainder of the low voltage connections. Take care when soldering to the slider pot as the connection pins are not very tough!

No mains power switch or fuse is necessary, however, a three-amp fuse must be fitted in the mains plug. A suitable cable clamp should be fitted to the case where the mains lead enters. The mains cable may then be connected directly to the transformer tails with a choc-block connector. Since the unit is not earthed, the transformer must be fitted with nylon screws.

Testing.

Initially set VR1-VR4 fully clockwise, and VR5 to the centre position. Set the slide control fully to the left, the Effect switch to position one, the Full switch to the off (upper) position and the Invert switch to the lower position. Connect the unit between two video recorders and connect a television or monitor to the second video recorder.

Switch the unit on. If a test meter is available check the regulated supply

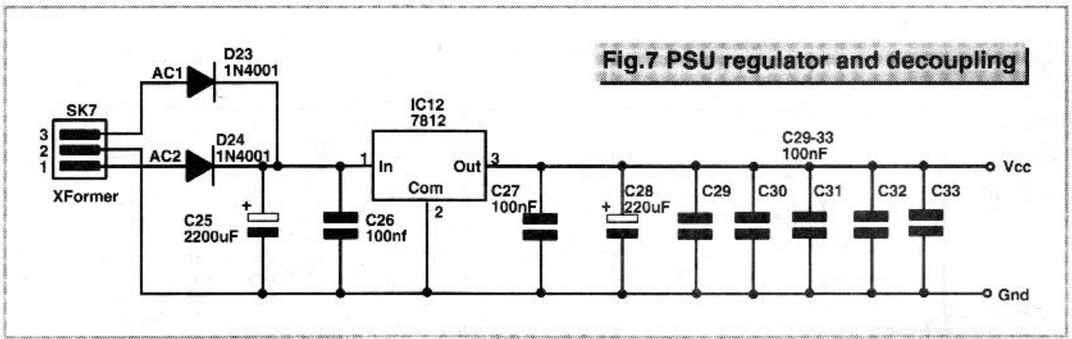


Fig.7 PSU regulator and decoupling

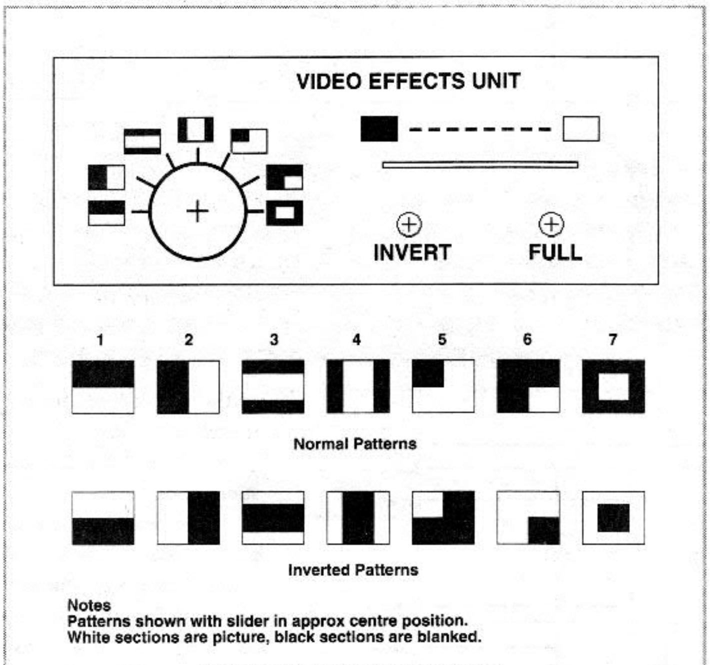


Fig.8 Front panel details

is indeed 12V. The picture on the TV should be blank. Move the slider to the right, and more of the picture should appear as it is moved.

With the slider fully to the right, adjust VR4 to remove the whole black section at the bottom of the screen. If the control is adjusted too far the picture will flicker and may roll. Set the control just before the onset of the flickering.

Now set the Effect switch to position two, and adjust VR2 for no blanking on the right side of the screen. If this control is adjusted too far alternate lines on the screen will be blank; adjust to the point just before this occurs. Check that with the slider fully to the left the whole picture is blank. Careful adjustment of VR2 should give the desired results at both ends of the slider's range.

Set the Invert switch to the upper position and the Effect switch to position three and adjust VR3 as described previously. Set the Effect switch to position four and adjust VR1. In both cases check the operation of the slider control.

With the screen partially blanked, adjust VR5 so that the blanked portion is black. If a testcard is available (try unused satellite channels) this will provide a suitable black reference. If VR5 is set too far anti-clockwise the picture may roll or pull on some settings of the controls.

Finally check the operation of all the controls. If the unit was constructed with care no problems should occur.

Options.

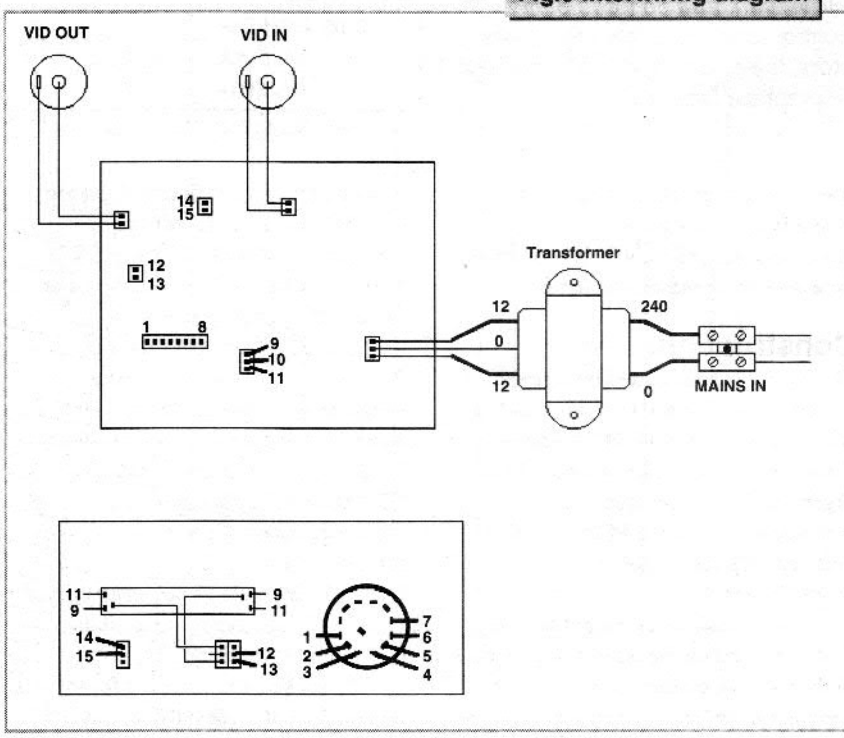
The following suggestions are aimed at experienced constructors, and have not been tested by the author.

This unit does not fade the sound. However if a second dual slide pot (10K Log) is placed next to the existing one on the front panel, the two controls may then be operated simultaneously. This second control is then wired as a passive attenuator in the audio line(s) between the two video recorders. Some constructors may like to construct a mechanical linkage between the two, and have only one control knob.

A possible problem with this arrangement is that the automatic recording level system in the video recorder might try to raise the volume while it is faded. This point should be checked with the equipment being used.

Many people will want to carry out their video editing from the sofa with the aid of the remote controls. The front panel controls on this unit may be mounted separately from the remainder of the circuit, and connected by a length of thin 12 core cable. Not true remote control perhaps, but better than lying on a cold floor for hours!

Fig.9 Interwiring diagram



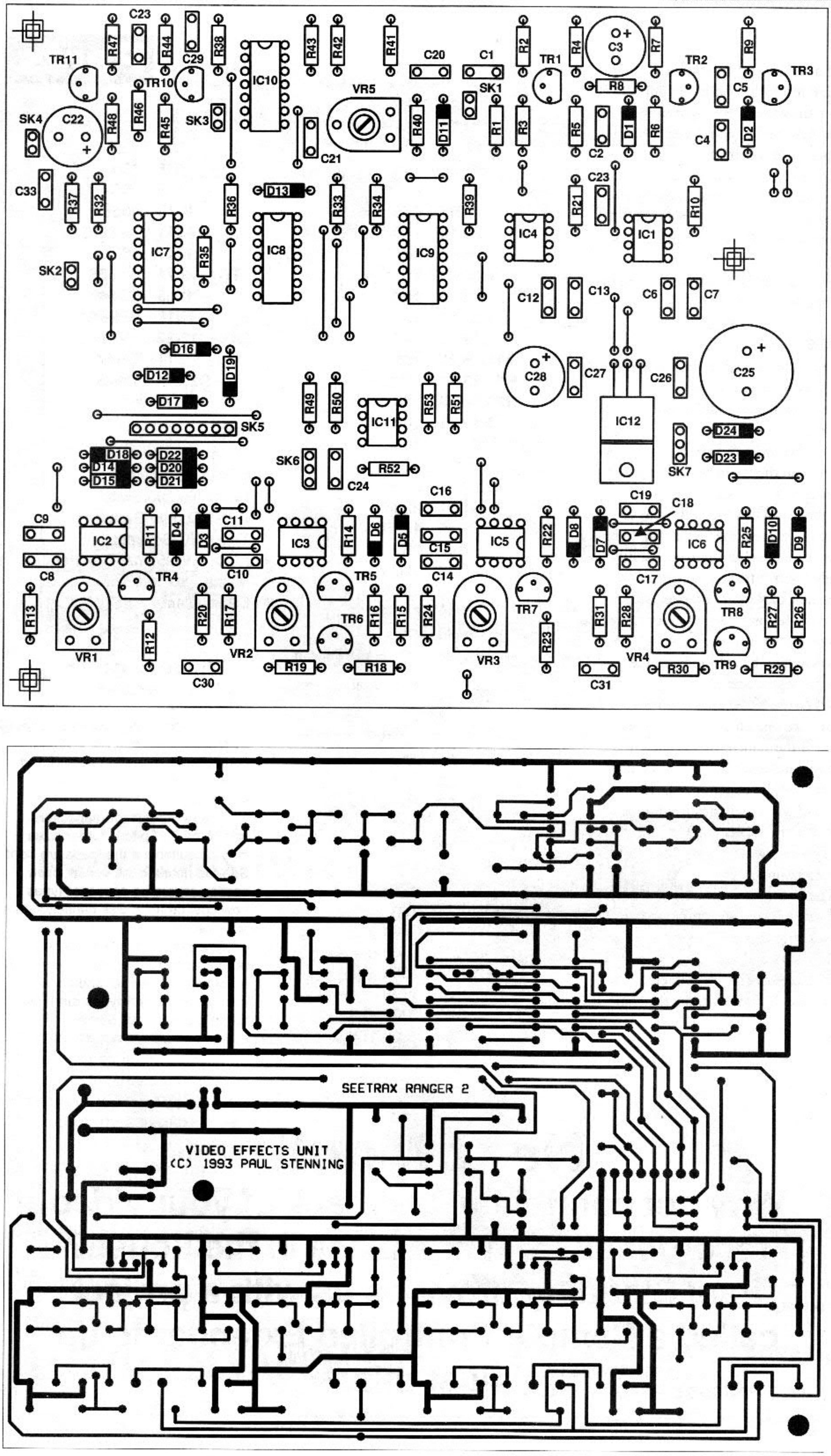


Fig.10 Component positioning and foil

If a second video monitor is available it may be useful to connect this in parallel with the input to this unit, so that the input and output can be monitored independently. In this case R1 should be omitted since the line will be terminated by the input impedance of the monitor. The input impedance if this unit without R1 will be about 10K. This does not apply if the second monitor is a television connected via the aerial socket.

In Use

The unit is connected in the video link between two video recorders, or between a camcorder and a video recorder.

In normal use the effect required is selected, and the slider is set to the left. The recording unit is set to Record/ Pause mode. When the section to be recorded is played, the pause should be released and the slider moved steadily to the right. When the end of the section approaches, the slider is moved steadily back to the left and then the recording machine can be paused again. A new effect may then be selected and the whole process repeated.

When the Effect and Invert switches are operated the picture may flicker. If the same effect is used at the beginning and end of a section then no problems will be experienced. However if either of these switches need to be operated while recording, the Full switch should be turned on first, and off again afterwards.

The Full switch may also be useful for monitoring and searching on the playback machine, while the recording machine is paused.

With your editing complete, your holiday videos may never be the same again!

Parts

Resistors (all 0.25W 5%)

R1	82R
R2,3	27K
R4,8,13	22K
R17,20	22K
R24,28	22K
R5	5K6
R6,44	1K0
R7,9	4K7
R18,29	4K7
R10,16	15K
R21,52	15K
R11,12,14	10K
R15,19,22	10K
R23,25,26	10K
R30,32-39	10K
R42,43	10K
R51,53	10K
R27	12K
R20,40	100K
R31,41	220K
R45	100R
R46	2K2
R47	120R
R48	150R
R49	680R
R50	18K
VR1-5	10K Horiz Preset
Slide Control	10K Dual Lin Pot

Capacitors

C1	220n
C2,23	220p
C3,22	100µ/16V
C4-6,8	10n
C10,12,14	10n
C17,24	10n
C7,9,11	470p
C13,16,19	47n
C15,18,21	100n
C26,27,29	100n
C30-33	100n
C20	470n
C25	2200µ/25V
C28	220µ/16V

Semiconductors

IC1-6	ICM7555
IC7	4077
IC8	4001
IC9	4002
IC10	4066
IC11	CA3260
IC12	7812
TR1,4-9,11	BC558
TR2,3	BC548
TR10	BF244A
D1-10,12-22	1N4148
D11	OA47
D23,24	1N4001

Additional Items

PCB
Case
1 Pole 12 Way switch
DPDT Toggle Switch
SPST Toggle Switch
Two BNC Sockets
12-0-12V 250mA Transformer
Mains Flex
Cable Clamp

Where to get things

The PCB is available from the EIA PCB service.

The slide control pot was supplied by Maplin. Note that M2 x 12mm countersunk mounting screws and 6mm spacers must be purchased separately.

The non-polarised capacitors should be 0.2" pitch. Other sizes may be suitable if the leads are bent. See the notes in the construction section regarding capacitor types. Low cost ceramic disk capacitors are suitable.

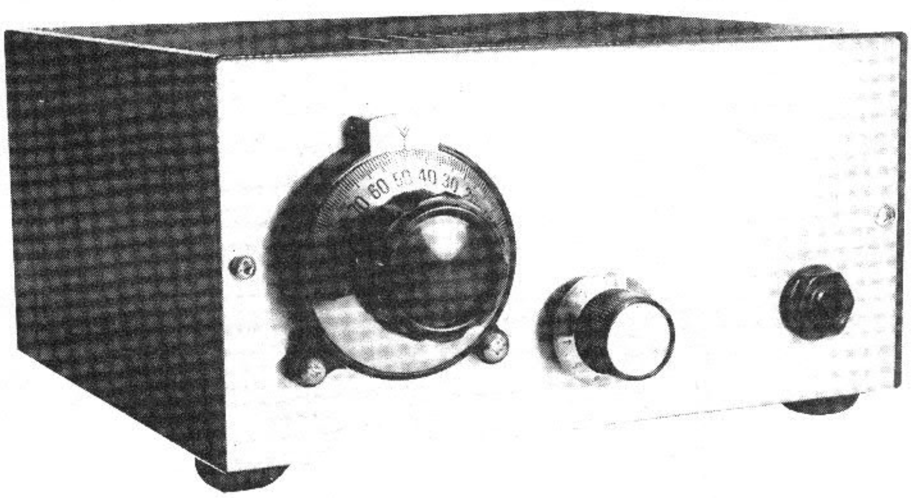
Since the unit is likely to be permanently connected to the mains, a 250mA transformer should be used. The 100mA types run fairly hot at a continuous 50mA.

Next Month

Why not control the playback of your video recorder all from one place in the house? Paul Stenning provides us with a project called a Remote Controlled Extender to do just this.

Listening on 15 metres

A direct conversion receiver by David Silvester G4TJG



Amateur radio receivers are expensive, or should I say the ones that you can buy are expensive, and this will put off people who are interested in radio but cannot afford a commercial receiver. The reason is shown Figure 1. After the RF input stage, the oscillator and mixer convert the incoming frequency to another radio frequency. This intermediate frequency is amplified before conversion to an audio signal in the detector. The last stage is the power amplifier that drives the receiver's loudspeaker. This is the layout of a very simple single conversion superhet receiver. Many commercial receivers use dual conversion, dual oscillators and two intermediate stages. There will also be a range of RF input filters for the bands of interest. It is little wonder that commercial communications receivers are expensive. Setting up the receiver would be impossible without the necessary test gear to inject the intermediate frequencies for alignment of the tuned frequency amplifier stages.

By accepting a number of limitations I was able to use the direct conversion principal to allow a receiver to be built at home, since the design substantially reduces the alignment difficulties. The saving in complexity of the communications receiver, building for a single frequency band, and constructing at home brings the cost of the receiver to around £70.

Figure 2 shows the basic layout of a direct conversion receiver. There is now only a single oscillator running at the incoming 'received' frequency to which all of the other RF circuits are tuned. Other than the first RF stage that mainly provides isolation of the antenna from any oscillator feedback in the mixer, all the gain occurs at audio frequencies. For the AF gain we use a number of op-amp circuits and a power IC to drive either headphones or a small loudspeaker. Tuning can be performed without any test gear, although it is advisable to try to use a frequency counter to set up the oscillator scanning range. At a later date I plan to add a digital frequency display to the design, providing that the performance is not degraded by the addition.

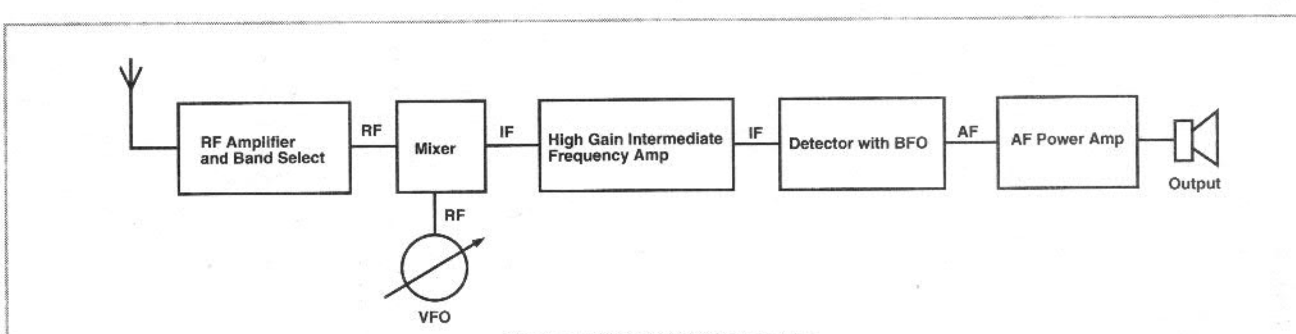


Fig.1 Superhet Principal

Mode of Operation

The receiver has been built on two PCBs separating the oscillator from the rest of the receiver. The oscillator is contained in a separate aluminium box within the receiver's main case to both provide a stable environment for the oscillator and prevent spurious inputs to the main PCB. Output has been set up for headphones as this allows the constructor to use the receiver without annoying the other members of the family, although a loudspeaker can be used if a single resistor is shorted out. I have used all the circuits myself previously, and they have proved to be reliable and easy to set up. Many have been adapted from articles in either 'Solid State Design for the Radio Amateur' or 'QRP Classics', both published by the ARRL.

Circuit Description

The VFO

The oscillator is of the standard series-tuned Clapp type, named as are all oscillator designs after the man who first proposed the circuit. Oscillator stability is vital in the receiver if the radio is to fulfil its function. While common in the valve era, the Clapp oscillator has been forgotten in semiconductor designs. The advantage of the Clapp circuit over the Colpitts or the Hartley is that the inductance of the coil in the Clapp oscillator is around twice that in the alternatives, which eases the physical design problems in this area at higher frequencies. Also the stability of the circuit is increased with the higher inductance. This circuit in Figure 3 was designed to allow other frequencies of operation and therefore contains a few component spaces that are not used in the 15 metre (21MHz) receiver but may be required in other frequency bands. L1 with the series capacitance of C1 and C2 forms the tuned circuit. The tuning capacitor is connected across 'Conn1' to 'Conn2' and may be either of two values. Using a 25pF capacitor results in a tuning range slightly less than the full 15 metre amateur band but makes tuning easy as the tuning control is less sensitive. This may be suitable for those constructors interested in either the SSB or CW portion of the band. For the full band a 50pF tuning capacitor should be used, but this will result in coarser tuning control. Final adjustment of the range is carried out with C1 and C2. Two variable capacitors have been used to distribute the RF current for oscillator stability and allow ease of tuning. The full oscillator range can be set from around 15MHz to about 26MHz. With the two capacitors set around the half meshed position, 21MHz is achieved.

The upper section with ZD1 and IC1 provides highly stable supply voltages, essential if the oscillator is to have an output frequency that remains stable enough for SSB or CW listening. The circuit around Q2 is a buffer stage with enough amplification to allow the correct drive level at the output.

The final stage of Q3 to Q6 is a high impedance to 50 ohm B class RF buffer, designed so that the double balanced mixer SBL-1 on the main PCB gets the correct drive impedance level.

The Main PCB

The rest of the circuit is constructed on a single PCB on which the upper layer acts as a groundplane with the signal

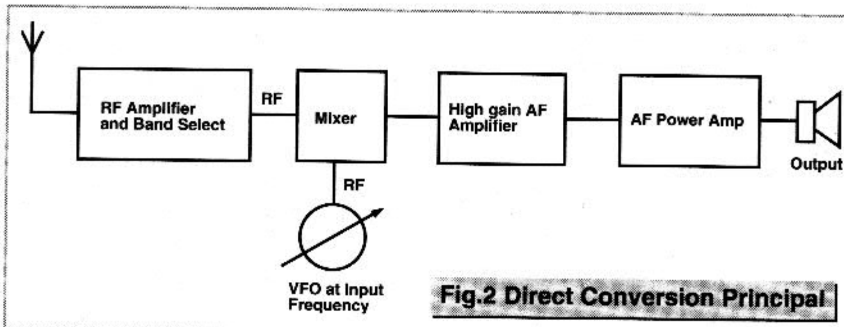


Fig.2 Direct Conversion Principal

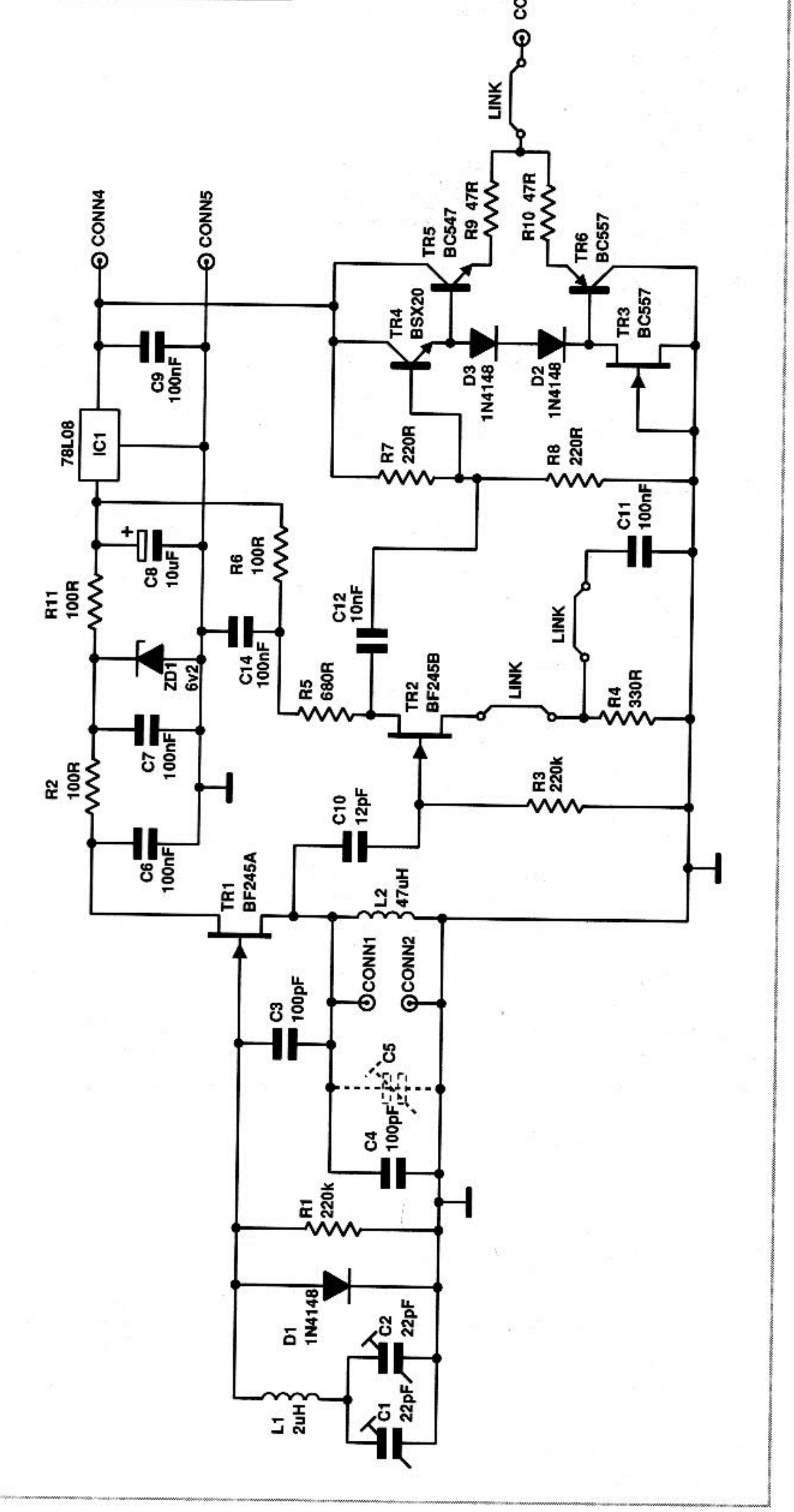


Fig.3 Oscillator section

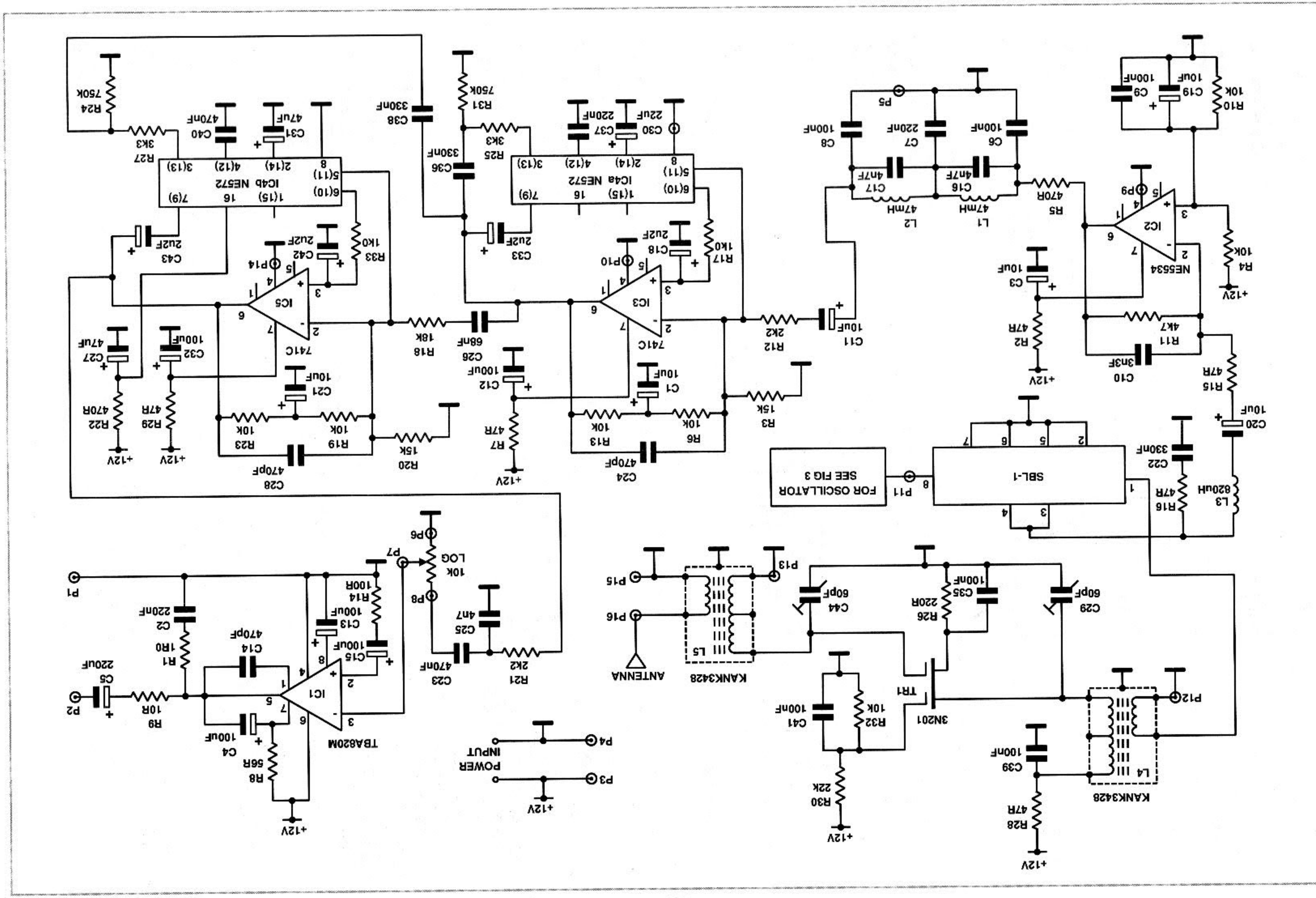


Fig.4 15m Receiver Circuit

tracks on the lower layer. Again, this PCB has been designed for use with several different frequency bands, so that in the RF section some components may be missing. These are noted in the parts list. Figure 4 is the schematic for the main PCB.

There are 17 pins on this PCB, some of which connect the lower PCB track to the upper groundplane. Others are for off-board connections. The rest connect both the lower tracks and the upper groundplane, or go to off-board wires. The circuit around L5, L4 and Tr1 is the RF input amplifier buffer stage. This feeds the RF input of the Double Balanced Mixer SBL-1 where the sum and difference frequencies are generated. The difference is an audio frequency and is selected out by the circuit of L3, C20 and R15 (the input to the first op-amp stage). All the rest of the signals are shorted to a 50 ohm 'waste' line of R16 and C22. As the 3dB cut-off of the two circuits is the same, the mixer should see the fixed 50 ohm impedance that it needs for correct operation. IC2 is a very low noise op-amp circuit with an inverting input layout and a gain of times 100. For this device, you can substitute a slightly noisier LF351 or TL071 op-amp.

L1, L2 and the associated circuit form a high cutoff low pass AF filter to attenuate any signals outside the 3.3kHz SSB band. The final stage around IC1 is the power amplifier driving the head-phones or loudspeaker. For loudspeaker operation R9 should be shorted out.

This leaves the circuit around the two halves of IC4 with the op-amps IC3 and IC5. This is an AF gain-controlled amplifier in which IC4 provides a variable feedback resistance to the inverting op-amp circuits of IC3 and IC5. This circuit was originally proposed by DF4SQ in the Autumn 1991 issue of SPRAT. (This magazine, which comes with membership of the G-QRP club, is a mine of information for designing simple radio circuits). These circuit units give an automatic gain control action that prevents the variability of the incoming signals resulting in the listener tearing off the headphones in pain when a strong signal is received.

Construction

The VFO

The VFO is built on a single sided PCB, as stray capacitances between an upper groundplane and signal tracks on the lower layer are very variable, causing oscillator frequency instability. Locate the five off-board connections 'Conn1 to Conn5' and solder in the terminal pins. Drill holes for the PCB stand-offs where the large pads are shown.

The main inductor L1 is wound on a T50-6 torroidal core. Take about 2ft (60cm) of 26SWG (0.018 inch or 0.045mm) enamelled copper wire. Gently pull this straight and place the toroid on the wire leaving about 4 inches (10cm) for one of the connections. With this short end pointing away from you, take the longer end and wind this around the toroid and through the hole again from below keeping the second winding to the right of the first. This is the natural way for a right handed person to wind the core. Left handed persons should start with the short wire towards them and wind keeping the long end to the left. Continue for the full 22 turns, so that the wire passes through the toroid centre 22 times. Distribute the turns evenly around the core. If the winding is correct, when you look at the core with the wires pointing away from you, the upper wire should be to the right of the lower. See L1 on Figure 5. If the wires need to cross over to fit in the holes, or the core does not fit exactly with the position in Figure 5, then you will need to start the coil winding again from scratch. If all is OK then scrape back the insulation on the wire and solder L1 to the VFO PCB. There should be no difficulties with the rest of the building of the VFO PCB. Note that C5 and C13 are not used in this design as the PCB was laid out for use at other frequencies as well as the 15 metre amateur band shown here. Equally L3 is not used, but a shorting wire is installed in its place. Should the constructor desire, pads are available to scale the VFO for many frequency bands without modification. The only criteria for the double balanced mixer is that it receives 5mW of power at 50 ohms, equivalent to around 2V peak to peak at the output pin 'Conn3'. Put this board aside for the mechanical construction stage.

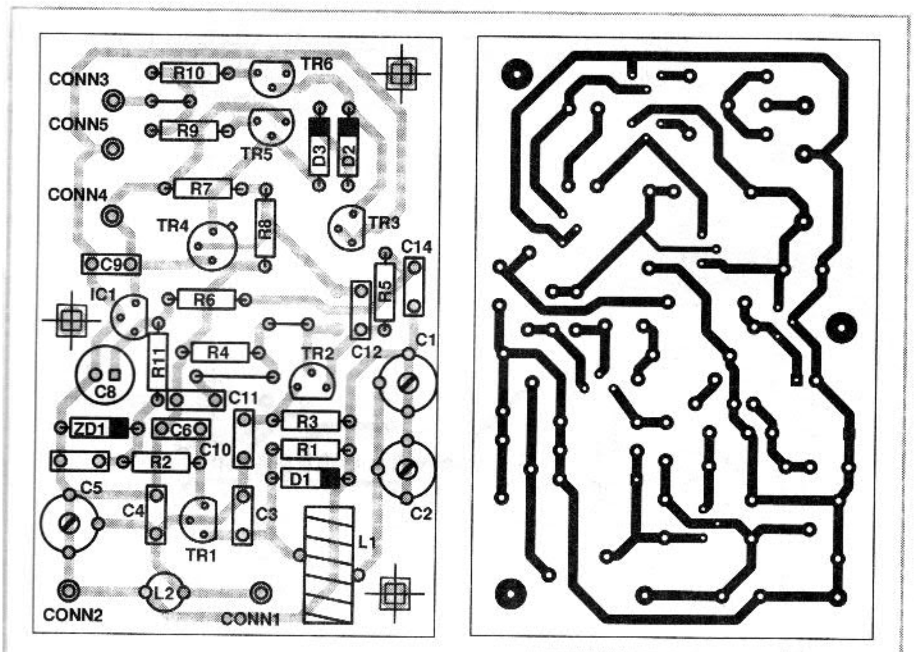


Fig.5 Oscillator component overlay and foil

The Main Receiver PCB

The main PCB is a double sided board in which the upper layer is used solely as a groundplane. During construction you will need to cut back the holes around most of the components to prevent shorting to ground. The kit PCB will be cut back during processing. However, the main PCB has 17 connections, labelled P1 to P17. The separate table lists the types, and the solder connections that the three types need. In some cases the upper ground-plane MUST NOT BE CUT BACK or a faulty connection will result.

Let us start from a home constructed PCB. In this case it is only necessary to etch the lower surface while protecting the other side as a full groundplane. Drill all the holes at 0.8mm except the connectors which are 1mm. Locate the position of the five ICs and cut back the groundplane around the holes for all of them. Insert and solder down IC sockets for each IC. These provide a good reference point for the rest of the layout. Using the separate table fit and solder the connections, being extremely careful over those that have the upper groundplane cut back. I have used a 1/8 inch (3mm) drill mounted in a file handle to cut back the groundplane. The upper groundplane acts as a good thermal heatsink as well as a good electrical conductor, so that you need a large soldering iron to prevent cold joints. A better option is to invest in a temperature controlled soldering iron. With a large bit they have enough power to get a good solder joint to the groundplane but the bit can be changed to a small one to protect the semiconductors that have to be soldered in at a later stage. It is unlikely that the amateur will need to buy another iron, for many years, such is the reliability of the temperature controlled unit.

Having got to this stage the rest of the holes can have the groundplane cut back from them. Drill holes for the PCB stand-offs. Now we come to the PCB construction proper. Of the components shown in Figure 6 only C34 and C45 are missing as they are not needed in the 15 metre receiver. Space has been left for them should the receiver be built for other frequency bands.

Due to the crowded nature of the PCB and since the semiconductors can be plugged in at the final stage it is best to start from the centre near P10. By taking care to select components, it is possible to build the PCB without ending in a position where it is very difficult to solder a component blocked by others. In Figure 6 many of the components are shown with a stub wire, such as C3 in the upper left corner. This is a radial electrolytic capacitor which has the negative wire pulled to the side for soldering to the upper groundplane, while the positive terminal passes through the PCB to a pad on the lower surface. Figure 7 shows the side view.

When connecting the coils L4 and L5 the case sides are pulled out and soldered to the upper surface. Take your time over construction, as a lot of care is needed. When complete hold the PCB for final construction.

Final Assembly

Take the main case and remove all the panels. The slow motion drive should be fitted to the left of the front panel so that the outside ring is about 1/4 inch (5mm) from the left fixing screw. Drill the necessary holes and fix the drive to the front panel. There is a small screw to prevent rotation of the drive on the inside of the front panel and two screws

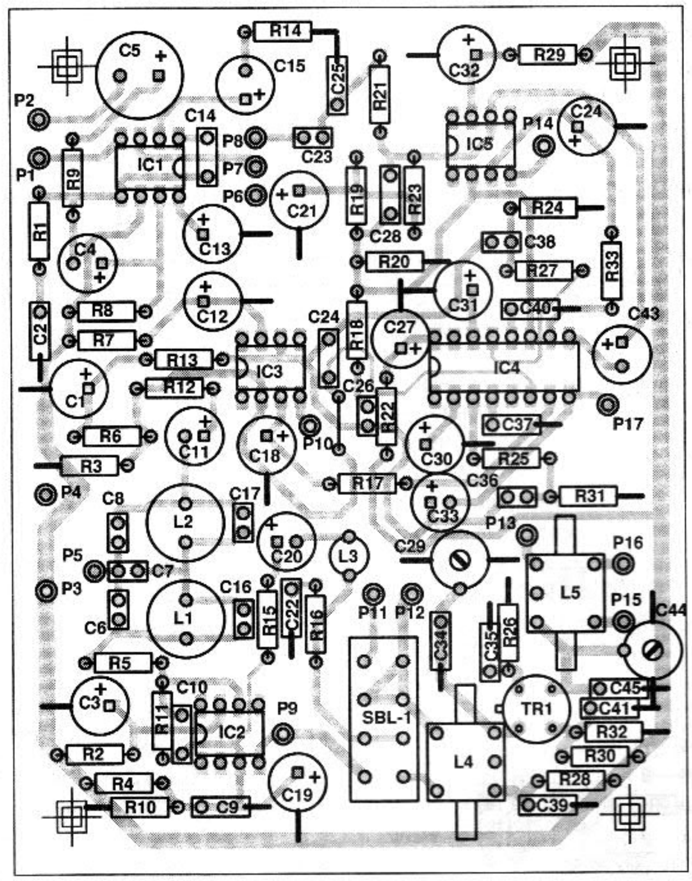
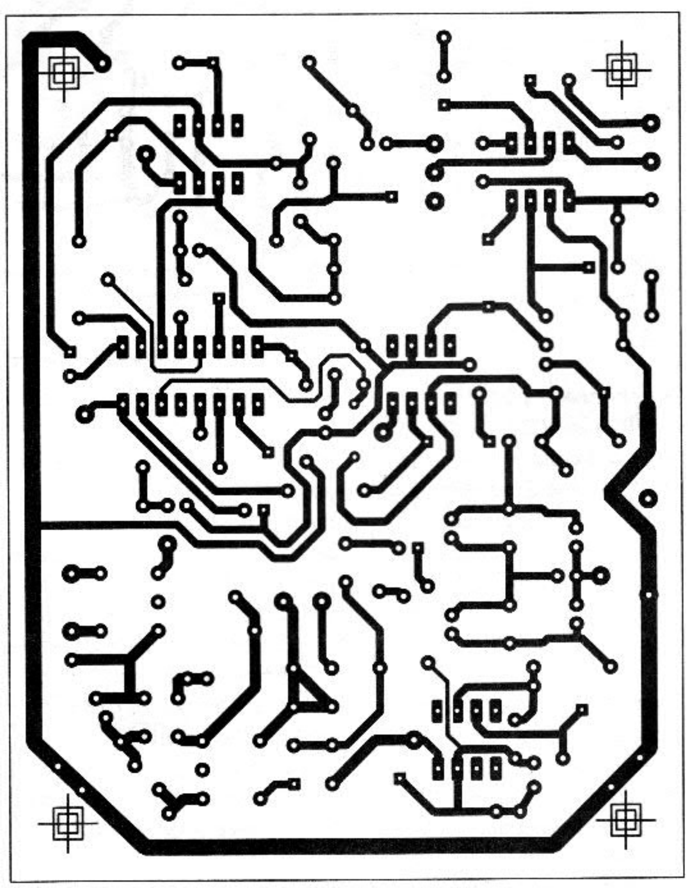


Fig.6 Main board component overlay and foil
Note connections to ground plane on top surface



Parts

Oscillator Section

Resistors

(all 0.25w metal film)

R1,3	220K
R2,6,11	100R
R4	330R
R5	680R
R7,8	22R
R12	shorted out

Capacitors

(All with 15V rating or greater) Lead spacing in brackets is in inches. ***THIS SPACING IS VITAL IF COMPONENTS ARE TO FIT IN THE ALLOTTED SPACES.***

C1,2	22pF Variable
C3,4	100pF (0.2) polystryrene
C5, C13	Not used
C6,7,9,11,14	100nF (0.2)
C8	10µF (0.1)
C10	12pF
C12	10n

Semiconductors

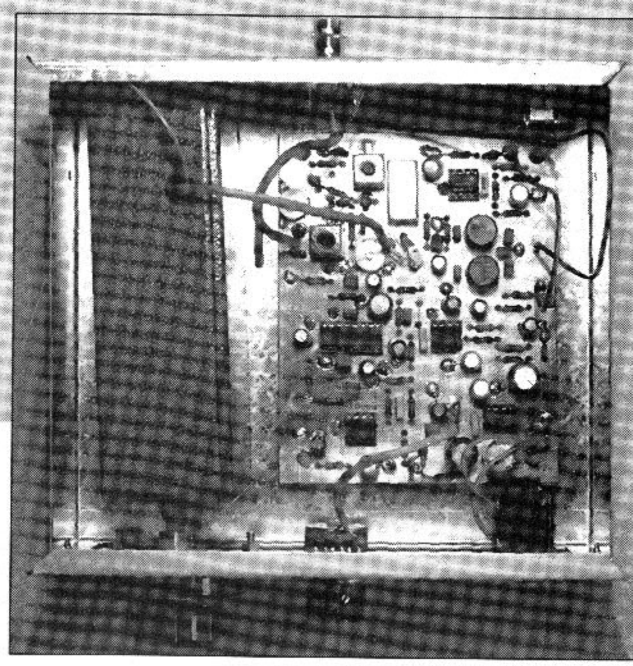
Tr1	BF245A. Other BF245 Idss groups may be substituted but with modified gain and stability.
Tr2,3	BF245B. Note for Tr1 applies
Tr4	BSX20 or 2N2222
Tr5	BC547 or equivalent
Tr6	BC557 or equivalent
D1,2,3	1N4148
ZD1	6.2V 400mW zener diode
IC1	78L08 8 volt regulator

Inductors

L1	22 turns of 26SWG enamelled copper wire wound on a T50-6 core [Cirkit Part No.T50-6] approx. 2µH
L2	47µH Toko 7BS series Part No. 283AS-470J [Cirkit]
L3	Shorted out, not used in the 21MHz oscillator

Additional Items

Case – See component list of main receiver
Grommet
Small Coax – I could not source the preferred 50ohm
Tuning capacitor: See text for value required by the constructor. Either 25pF or 50pF
PCB as in Figure 5
Terminal Pins (5 needed) see text for important note on use
PCB Stand-offs (4 needed) [Cirkit LCBSB401A]
Hookup wire



through the panel from the front. The external screws will be M3, needing 3mm holes in the panel. With the front panel in place, mark and drill holes for the volume control and the PO pack plug that is the headphone connector. Ream out as necessary, then remove all of the items from the front panel, but screw the front panel onto the main case bottom for the next stage.

Take the aluminium box, and on the short side nearest the front panel (see photo of the inside for orientation) draw a line on the outside down the centre, with the box lid towards the right. Place the aluminium box in the main case and align this line with the hole for the slow motion drive; then draw a horizontal line at the centre, making sure that the aluminium box is pushed squarely against the main case's base. Due to the way that the aluminium box is made, the sides are not perpendicular to the top and bottom so that the rear end of the box will lean closer to the main case's left-hand panel. Where the two lines cross on the aluminium box drill a hole for the tuning capacitor and fit it into the aluminium box. Now refit the slow motion drive to the front panel. Fit the tuning capacitor with the vanes towards the bottom of the main case. This eases the wiring of the VFO PCB to the tuning capacitor. Connect the drive shaft from the tuning capacitor to the hole on the shaft from the slow motion drive and fasten the locknut. If all has gone well, the aluminium box will rest against the bottom of the main case. Carefully measure a distance from the left hand edge of the main case to the centre of the aluminium box and drill two holes through the base of the main case and the aluminium box. The two may now be secured together. I used a pop riveter in the prototype although screws are acceptable. When done, check that the zero position of the slow motion drive corresponds to the fully meshed plates of the tuning capacitor, as this results ina higher read-out number corresponding to a higher frequency. Final wiring is very simple. Glue the VFO PCB onto the aluminium box with the terminal pins 'Conn1' and 'Conn2' closest to the tuning capacitor. Connect 'Conn1' to the grounded rotating plates of the capacitor and 'Conn2' to the fixed plates with tinned copper wire. A small hole in the top of the aluminium box and a protecting grommet takes the power supply (+12v to 'Conn4' and ground to 'Conn5' and a piece of the small 75ohm coax connected to 'Conn5' and 'Conn3' with the centre wire going to 'Conn3'. If a frequency counter is available, it is advisable to set the scanning range of the VFO by setting C1 and C2. Without this aid the vanes on both should be set to half meshed, with final tuning done from off air signals.

Stick the main PCB into the main case on the stand-offs. Drill holes in the back panel of the main box for the BNC connector that connects to the antenna and the power socket. Power is supplied to the PCB via P3 (+12V) and P4 (Ground). The VFO coax wire connects to P11 (central signal wire) and P12 (screen). The headphone connector goes to P1 and P2 with P1 as the ground and therefore the connection on the PO jack closest to the panel. The aerial connects from the BNC to P15 and P16 with P15 being the ground connection to the screen. Finally, plug in the ICs.

The Aerial

The aerial I used is a very simple affair. My back garden is just long enough to take a 20 metre dipole on the diagonal, so for the 15 metre receiver I set up a dipole antenna with longer guy wires. The aerial is made from strong PVC-covered copper wire available from a local radio shop and has an insulating unit in the centre to which the feeder is connected. This is a section of 75ohm twin feeder that can fit through the window seal without damage. Between the feeder and the coax to the radio itself is a simple balun. This consists of a toroidal ferrite core, T72-26, wound with a pair of 26SWG wires that have been twisted together. One end is connected to the balanced feeder and the other end with coax to the receiver. Everything should now be ready. Grit your teeth and apply power to the radio. There should be a noticeable difference in output volume of the background hash with and without the aerial. This is a good sign as it shows the receiver noise is below the background which forms the limit for the reception. None of the components should become warm at any time. Try tuning for a signal. If one can be heard, use this to set the positions of C29 and C44 for the loudest signal. If nothing is available then a rough guide to the settings of these variable capacitors can be made by tuning for the largest difference in noise with and without the aerial connected. The 15 metre band is subject to strong propagation variations and may be silent on occasions. However, its saving grace is that it is open for long distance communications at some time in the day. If the band is open, then signals will be strong. In southern England contact with South America is not unusual. I used an American station in New York to tune up the receiver at around 18:00 GMT.

The construction of amateur radio equipment is addictive, you may end up with your own call sign and a low power (QRP) transmitter/receiver rig of your own.

Main PCB Connections

P1, P4, P6, P12, P15
These are terminal pins. In all cases the groundplane MUST NOT be cut away from the upper surface. During soldering both the lower and the upper groundplane are soldered to the pin to allow both a ground connection to the lower track and a grounded pin for an off board connection.

P2, P3, P7, P8, P11, P16
These terminal pins carry live signals to or from the PCB. They are only connected to the lower layer, so it is important to cut back the groundplane around the pin to give isolation from ground.

P5, P9, P10, P13, P14, P17
These are by PCB connector pins. They connect the upper groundplane to the lower layer in situations where it is difficult to arrange direct connection from the component. They are pushed well home, then soldered onto the lower pad and the upper groundplane.

G-QRP Club and SPRAT magazine
Rev. George Dobbs G3RJV
St. Aidan's Vicarage
498 Manchester Road
ROCHDALE
Lancs OL11 3HE

Parts

The Main Receiver

Resistors

(all 0.25w metal film)

R1	1R0
R2,7,15	47R
R16,28,29	47R
R3,20	15K
R4,6,10	10k
R13,19	10k
R23,32	10K
R5,22	470R
R8	56R
R9	10R
R11	4K7
R12,21	2K2
R14	100R
R18	18K
R26	220R
R17,33	1K
R24,31	750K
R25,27	3K3
R30	22K
RV1	10K log volume pot

Capacitors

(All with 15V rating or greater) Lead spacing in brackets is in inches. ***THIS SPACING IS VITAL IF COMPONENTS ARE TO FIT IN THE ALLOTTED SPACES***

C1,3,11,19,20,21	10µF (0.1)
C2,7,37	220nF (0.1)
C4,12,13,15,32	100µF elect (0.15)
C5	220µF elect (0.2)
C6,8,9,35,39,41	100nF (0.1)
C10	3n3F (0.2)
C14,24,28	470pF (0.2)
C16,17,25	4n7F (0.1)
C18,33,42,43	2u2F elect (0.1)
C23,40	470nF (0.1)
C26	68nF (0.1)
C27,31	47µF elect (0.1)
C29,44	60pF variable
C30	22µF elect (0.1)
C34,45	unused See text
C36,38,22	330nF (0.1)

Additional Items

- Through PCB connector pins (6 off)
- Terminal Pins (11 off) see text for important note on use
- 4 by 8 pin IC sockets
- 1 by 14 pin IC socket
- PCB as Figure 6
- PCB Stand-offs (4 off) [Cirkit LCBSB401A]
- Small 75 ohm coax – I could not source the preferred 50 ohm coax.
- BNC Chassis socket and Free plug. For lower cost a TV connector may be used
- Aluminium box, Main Case
- Slow motion Dial Drive
- Hookup wire
- Stereo headphones as used on a Sony Walkman type stereo system
- Small socket to fit the above headphones
- Power connector for the 12V supply

Inductors

L1,2	47mH Toko 10RB series Part No.181LY-473J
L3	820µH Toko 7BS Series Part No.283MS-821J
L4,5	Toko MKANK3428R
SBL-1	Double Balanced Mixer SBL-1

Semiconductors

Tr1	3N201, 3SK85 or most dual gate RF FET
IC1	TBA820M
IC2	NE5534 low noise op-amp See Text
IC3,5	741C op-amp
IC4	NE572

At last, a fully functional upgradeable PCB CAD system to suit any budget. Substantial trade-in discounts are available against other "professional" PCB design packages ...

... call now for details.

BoardCapture

Schematic Capture Design Tool

- Direct netlist link to BoardMaker2
- Forward annotation with part values
- Full undo/redo facility (50 operations)
- Single-sheet, multi-paged and hierarchical designs
- Smooth scrolling
- Intelligent wires (automatic junctions)

- Dynamic connectivity information
- Automatic on-line annotation
- Integrated on-the-fly library editor
- Context sensitive editing
- Extensive component-based power control
- Back annotation from BoardMaker2

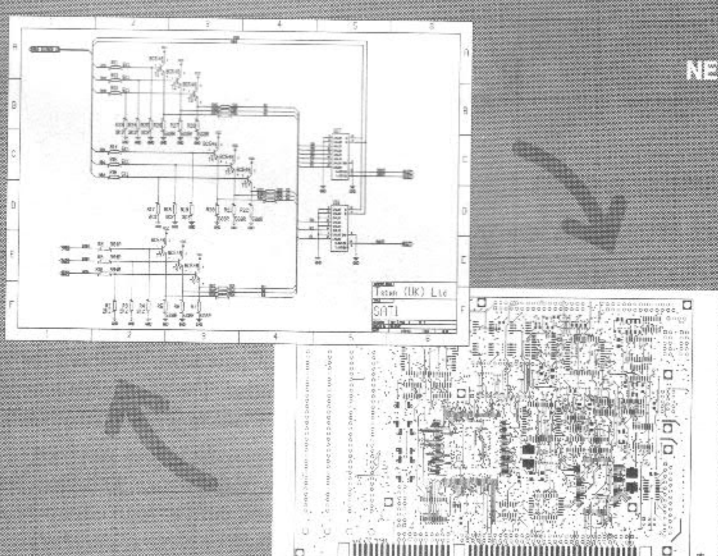
BoardMaker

BoardMaker1 - Entry level

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

BoardMaker2 - Advanced level

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



BoardRouter

Gridless re-entrant autorouter

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

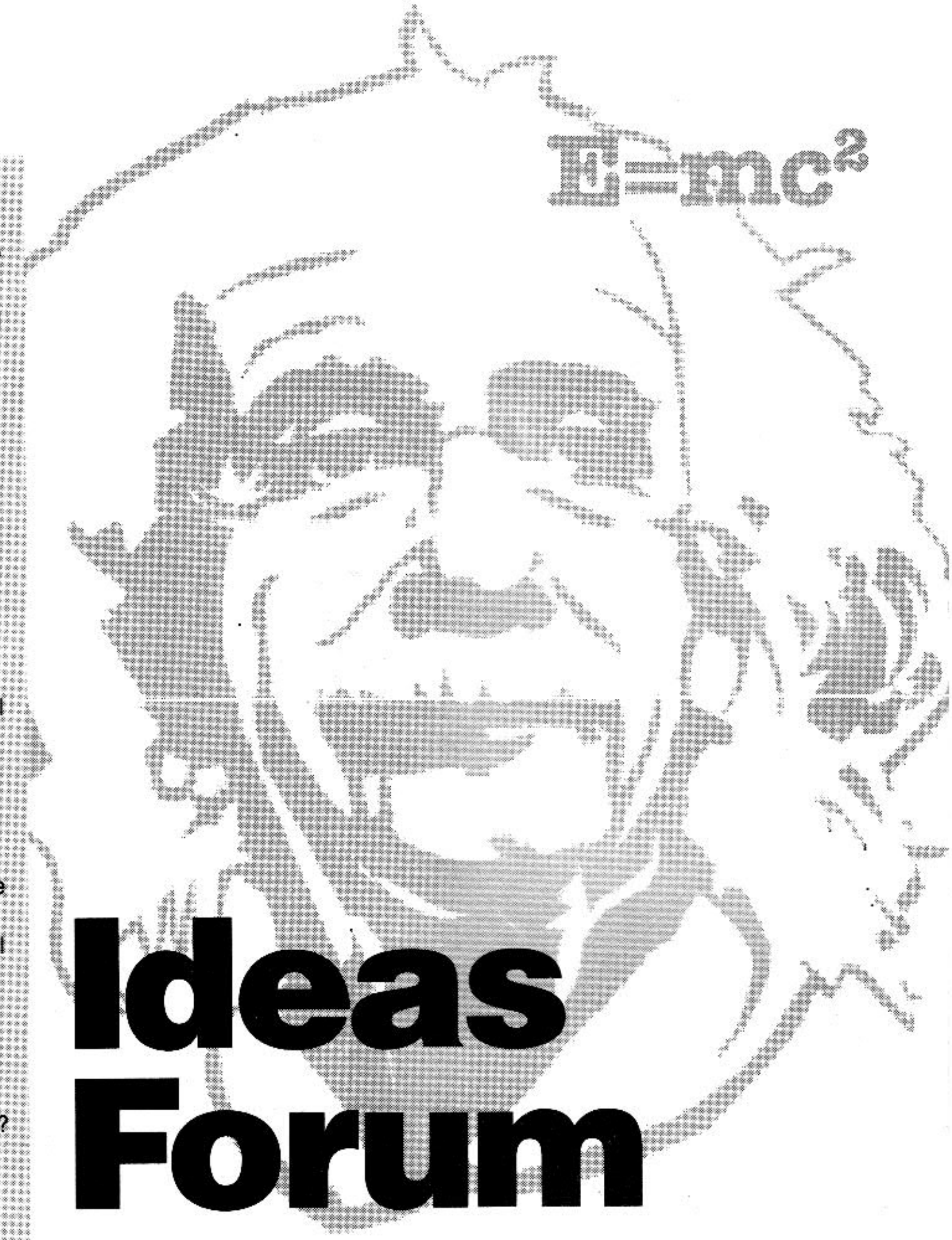
Output drivers - Included as standard

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

Call, write or fax for more information
or a full evaluation kit

Tsien (UK) Limited
Aylesby House
Wenny Road, Chatteris
Cambridge
PE16 6UT
Tel (0354) 695959
Fax (0354) 695957

tsien



Ideas Forum

Time once again to expand these ideas and put some thoughts to paper. This is Electronics in Actions' monthly brainstorm column.

Ever wondered what to do with your spare time? Why not examine the ideas to the left and see if they can provide a spark of an idea that you can develop into something worthwhile. It could be that you are at home, school, college or university and have to make an electronic or allied project for your coursework and you are wondering what to do.

This is an ideas page and is intended to be a regular feature. As soon as you think or know the idea can be achieved by yourself, and it might be a variation on these themes, get a working prototype together. If you think others might like to see your efforts in print, send it in with the details to us and we will seriously consider publishing it. You will of-course be rewarded for your efforts in print. The ideas seen here may even be a cause to write in to our letters page to discuss the ideas you have.

Some of them may well have been designed and built at high commercial level and high cost but it may be you have thought of a quick and easy route to achieving the same end and at much lower cost. The exercise here could also lead to other less costly innovative ideas.

The ideas do not appear in any particular order so keep a look out every month. Very soon Electronics in Action could be printing lists of 'Centres of Excellence' where it would be the place to be for an informal chat and to openly discuss these and other ideas in a sort of brainstorming session.

December

How Green is your city?

Public transport

Are your buses electric or diesel powered? Of the few electric buses around, can we improve upon their efficiency with better electronic control systems, better electrical storage or further ways of reducing friction to give a longer range?.

Is there a better way at converting electrical energy into motion rather than using electromagnetic repulsion?

If the main problem is one of running out of portable electrical energy ie dead batteries, can the supply be remote and without connecting wires (remember trams and trolley buses used wires and rails). Is there a method of picking up the energy from under or by the side of the road without physical contact?

Reducing Pollution

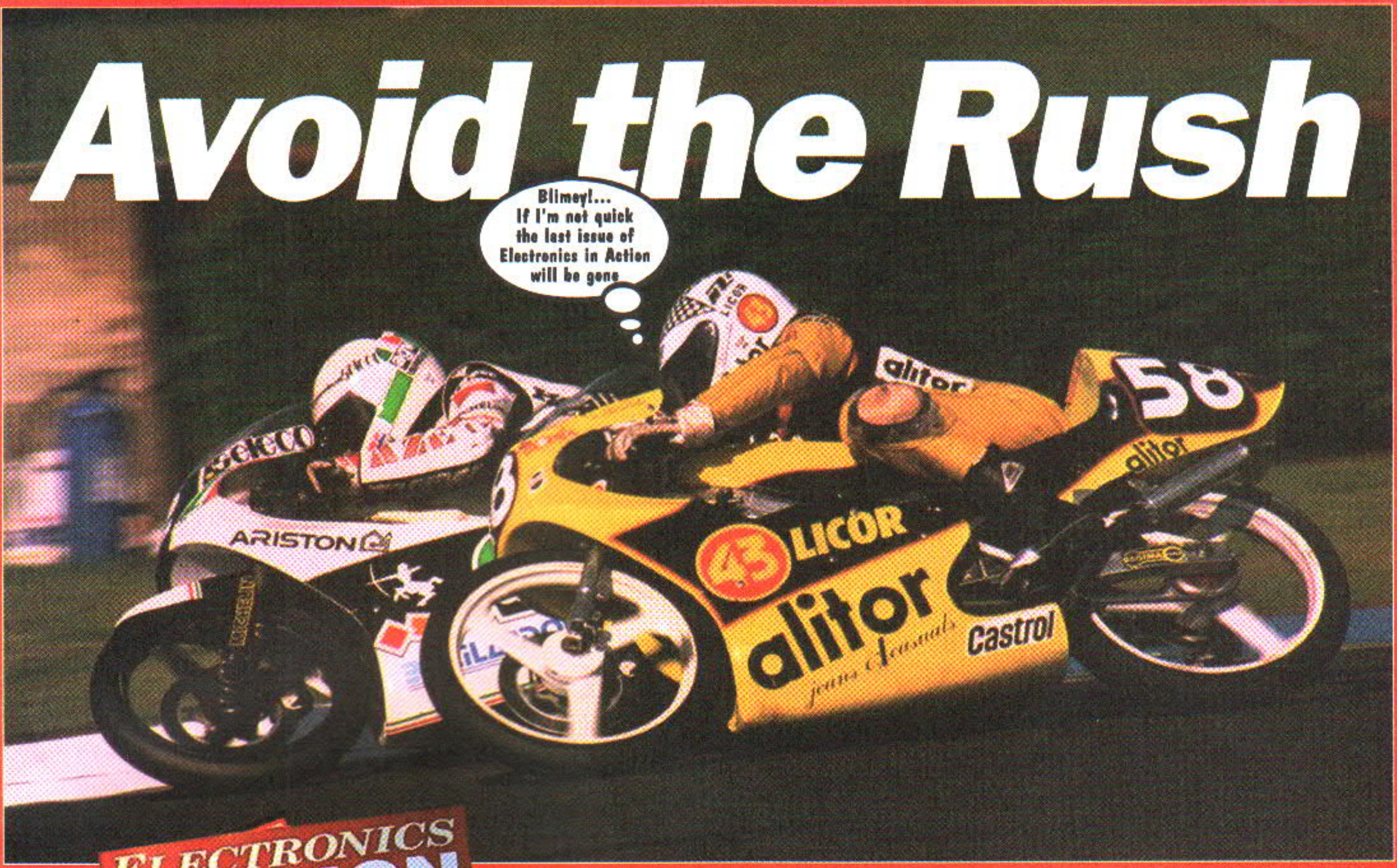
Can electrostatic dust precipitators be converted for use in removing particulates from conventional car exhausts?

Noise pollution

Traffic and engine noise is a problem. Many cars are now quiet inside, but can we apply the same noise reduction to external sound emissions. Is there a way to reduce the high/low alternating gas pressure from moving cylinders that creates the engine sound before it leaves the exhaust?

Can the oscillations be down or up converted to sub or supersonic frequencies? A more radical approach - why have an oscillatory reciprocating motion engine anyway - Is there a way of producing an automobile engine from a continuous force rather than impulses as in a four cylinder engine? Can the rocket or Jet engine be tamed to run on normal roads? What about using high velocity air for thrust? Air in-air out giving no pollution? Could Noise cancelling electronics be used to deaden sound?.

Avoid the Rush



Subscribe to Electronics in Action for 12 months and receive each issue at 25% discount without having to leave your armchair

Just think... no queuing up at the newsagent for ages only to find the person in front is paying for their christmas shopping with one pence pieces. All you need do is fill in the coupon, and send it, with a cheque for **£20.25** (that's 25% less than the news–stand price). Then we will send you 12 issues full of news, views, features, and projects from the world of electronics and technology.

SUBSCRIPTIONS

I would like a 12 month subscription to **Electronics in Action** starting from the............................ cover dated issue

I enclose a cheque/postal order (payable to Electronics in Action) for **£20.25** (inc. p+p)

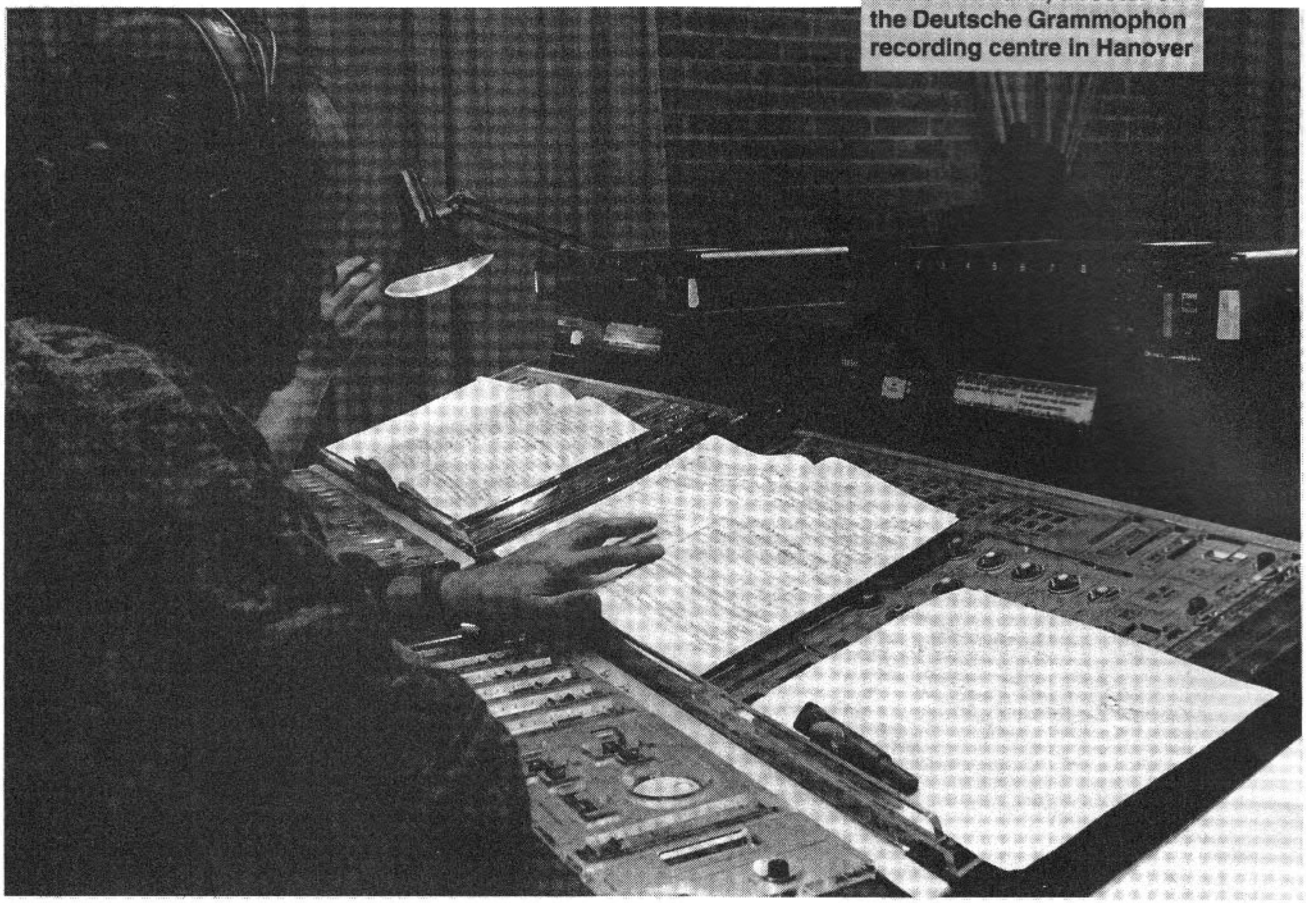
Please print your name and address in **BLOCK CAPITALS**

Name ....

Address ....

.... Postcode ....

Please send to: **Subscriptions Dept.**
Electronics in Action, PO Box 600
Berkhamsted, Herts. HP4 1NL



Klaus Hiemann, director of the Deutsche Grammophon recording centre in Hanover

Welcome to the fourth dimension

4D Audio Recording is the world's first fully digital mobile profesional recording system. Keith Grant reports from Hamburg.

For an engineer, even a sound engineer, to declare that the aim of recording technology should be that it should become inaudible, might seem incomprehensible. But listen to the sound of a group of players while they are being recorded and then listen to the recording and you will realise that the degrading effect of the recording technology is indeed audible.

When Klaus Hiemann, Director of the Deutsche Grammophon Recording Centre in Hannover, therefore declares that the technology used to make a recording should be inaudible, he means that its effect should not be to audibly degrade the musical signal that first enters the microphone. Sadly however it is so often the case that, even with digital recording, metres of microphone cable, recording console signal paths and multiple conversions, of analogue signal to digital audio and digital audio back to analogue signal, throughout the recording, mixing and mastering processes, do just that.

The development of a recording system that could offer freedom from the effects of the recording process itself was a dream that Klaus Hiemann held for many years, convinced that the digital recording medium would eventually evolve beyond the simple development of a storage system for the same analogue recording signal chain. 4D Audio Recording is the materialization of that dream and although much publicity has surrounded the claims for its technical achievements it is The Recording Centre's principals of acoustic engineering, under Hiemann's Directorship, that has shaped the development of the world's most sophisticated mobile location recording system, transferring laboratory standards of system performance into the field.

"It has always been my goal as director of The Recording Centre to make the recording process as imperceptible as possible, but the less noticeable the technology is to the listener, the more complex it has to be on the inside," explains Hiemann.

The shift to digital technology was a worldwide phenomenon. We were suddenly confronted with a recording process we scarcely knew.

"In the beginning we found it very 'cold' and later, that view proved to be correct because the equipment was not advanced enough. Almost immediately we discovered flaws in the analogue-to-digital and digital-to-analogue converters, so we sought to improve them, so the analogue musical signal could be shifted to the digital level with a greatly reduced distortion."

Along with the rest of the classical recording companies, Deutsche Grammophon continued to record digitally while constantly seeking to refine the available equipment. What became increasingly clear to the company's Audio Development team, from the early 80s onward, was the scale of improvement that was going to be required. The years following the rush into digital recording also saw a break with the tradition of developing in-house technology.

The Recording Centre (like Decca in the UK) had always striven, to develop its own equipment, believing that the technology required could not be found commercially."

The development of dedicated analogue recording equipment was an entirely different proposition to the R & D investment required to produce the fully digital recording signal chain that DG had identified as a primary requirement of the next generation classical recording systems. A development partner was found in Yamaha. Their research department in Japan was already tackling the development of the powerful digital processing technologyt.

In Yamaha we found a real willingness to create technology with our particular needs in mind.

In co-operation with Yamaha, we were able to develop new improved analogue-to-digital converters which led us into high-bit technology, shifting the analogue music signal to the digital level with much greater than 16-bit precision, with greatly reduced levels of distortion. The next objective was to be able to mix the microphone signals as cleanly as possible. We worked with Yamaha to develop a new generation of completely digital mixing consoles.

Around the same time Hiemann appointed a young digital audio communications engineer, Stefan Shibata, to head the Audio Development team charged with replacing the entire audio signal chain with a completely integrated digital processing system, incorporating the new Yamaha converter and console technology. The 4D Audio Recording programme was officially under way.

Yamaha Digital mixing desk used in 4D recording

A 21-bit variant of Yamaha's Delta-Sigma floating digital D/A converter system, offered both a technical and a musical performance exceeding anything previously possible. Extensive listening tests and technical measurements were made before the system was selected. The high bit resolution allowed a signal to noise and performance dynamic range far in excess of 16-bit technology but more important still to Hiemann it enabled the elimination of so much of the distortion inherent in the 16-bit standard, regarded as woefully inadequate, almost from the outset, by so many engineers. The resolution with 21 bit conversion is much higher and far closer to the original waveform of the music.

Replacing the analogue signal chain meant they had to be sited on the recording stage, as opposed to in the control room along with the mixing console and digital recorder. Siting the converters on the stage would allow short microphone cable runs.

"Experience has shown us that it is much better to convert the analogue signal, almost as soon as the microphone has picked it up. This ensures a cleaner mix, and above all, one free from technical interference and from other sounds bouncing around theatres and concert halls. Since the signal is converted into digital, it is no longer subject to undesired interference."

High bit converters of this quality made new demands on microphone head amplifier design, to ensure that what remained in the way of analogue processing did not impose a bottle neck on the digital signal chain. Given that the converters were assembled in an eight channel arrangement an eight channel head amp was suggested. A remote facility was also required but with no compromise on quality. An extensive search found no suitably spec'd devices on the market and the decision was taken to design and manufacture one in-house.

Design criteria included external power supply (maximum signal to noise performance), transformerless input, distortion-free gain switching with relays, gain setting and display and channel group indication, remote protocol with extensive acknowledgment and error reporting features, asynchronous serial communication on RS422 (midi/4 Baud default) and interface with PC based remote control software for up to six eight channel units to a system. Signal path components were selected on the basis of extensive measurement and listening tests. "We have developed our pre-amplifiers to satisfy the ears subjective expectations. They have been designed, above all, with the goal of 24 bit recording in mind."

The eight channel configuration of both the converters and head amps allowed an eight channel 'stagebox' to be devised, housing both devices as well as the required electronics to allow these stageboxes to operate in synchronization with the digital consoles and control room based computer aided control systems. The demands of location recording mean that the stagebox may have to be placed anywhere up to 200 yards from the control room. A critically engineered error-free transmission system was designed and built by DG's engineers to ensure that the kind of system performance obtained under laboratory conditions could also be realised.

The 'Digital Network', a galvanically separated, multicore transmission line, carrying bi-directional 24 bit AES/EBU audio channel, digital transfer data, remote control data for the microphone head amplifiers, and other communication data, took two years to engineer and construct.

The DMC1000 digital consoles are usually configured three to a system, although larger systems of up to six consoles are possible and occasionally required. These operate with extremely sophisticated operational software, developed specially for Deutsche Grammophon by Yamaha.

Recording with a high bit signal, i.e. one greater than 16 bit, of course raises the problem of incompatibility with all the digital consumer playback formats which all adhere to the 16 bit standard. In order to master such high bit signals for consumer release it is however possible to employ requantizing noise shaping techniques, in order to redither the signal down to 16 bit. While it will never completely mirror the quality of a 21 bit master tape, noise shaping a high bit signal can result in acheiving a better sound performance than that of the standard 16 bit medium. The resultant improvement in the sound of a standard CD, played back on a standard CD player, can represent a readily perceived quantum leap in sound quality.

In employing noise-shaping techniques (termed Authentic Bit Imaging), an extensive program of experimentation and empirical testing has led to refinements that build on the pure mathematical precepts of noise-shaping, as defined in the pioneering work of Dr. Stanley Lipshitz. This has produced interesting and often surprising results which have led Deutsche Grammophon to conclude that no single noise-shaping curve is appropriate to all types of program material. In the course of their analysis of requantizing techniques Deutsche Grammophon have experimented with changing filter techniques, the varying of different parameters and the use of correlated and non-correlated noise generation. Consequently Deutsche Grammophon have developed curves appropriate to particular types of music.

The improvement in the sound of a standard CD can represent a readily perceived quantum leap in sound quality

After five years of development, Hiemann took the prototype 4D Audio Recording system out to record a session. "As the man responsible for pushing through the development of the system, it was only fair that I should take the responsibility and possible risk of trying it out." In fact the system worked first time, as it has done so ever since; a level of reliability not necessarily associated with the implementation of digital audio even in the 'fixed' studio environment. The first officially badged 4D Audio Recording was released in March this year although several had already been released onto the market using the system. Now all recordings used the new technology.

Initially it was not possible to store the high bit signal as DG awaited the availability of 24 bit capable recorders, requantizing therefore having to occur before the signal hit tape. Operation is now with 24 bit Nagra D recorders with evaluation of Sony's new 24 bit MOD magneto-optical drive) system due to commence. By November a propriety 'scrambler' developed by the DG engineering team will also allow full 24 bit recording with conventional Sony digital multitrack recorders. The use of 24 bit recording allows for the future development of 24 bit A/D conversion and the implementation of 4D as a fully 24 bit system. 24 bit is recognised as representing the limit of human hearing.

There are now six fully operational 4D mobile recording rigs traversing the globe and all inhouse digital editing and mastering suites are all fully 4D compatible. Future system development revolves around the continued push towards a fully 24 bit recording chain and the problems inherent in current microphone technology that this will require to be solved; but that's another story, to be told at a later date.

At Your Service

In order to build some of the creations appearing in this magazine, you may wish to fabricate them on a printed circuit board. It just so happens that Electronics in Action can provide these at very reasonable cost if the need arises. Just simply fill in your details in the box, send in your payment and we'll do the rest. You may photocopy the form if you wish as we know some of you do not like destroying the magazine.

Payment must be received with order, either postal-order or cheque made payable to: **Electronics in Action.**

Please print your name and address in **BLOCK CAPITALS**

Name ....

Address ....

.... Postcode ....

Send the completed coupon (include 80p for postage and packing) to:

At Your Service, Electronics in Action
PO Box 600, Berkhamsted, Herts. HP4 1NL

Please enter amount required in appropriate box

☐	QH1293-1	Guitar Tremolo	£5.00
☐	QH1293-2	Switcher Main board	£10.00
☐	QH1293-3	Switcher Front panel	£6.00
☐	QH1293-4	Video Editing Unit	£8.00
☐	QH1293-5	15m receiver (double sided)	£5.00

November issue

☐	QH1193-1	Power Supply (double sided)	£6.00
☐	QH1193-2	Telescope Input board	£5.50
☐	QH1193-3	Drainpipe Seismometer	£5.50

October issue

☐	QH1093-1	Telescope Main Board	£12.00
☐	QH1093-2	Hi-fi Preamp	£4.50
☐	QH1093-3	Laser Zone	£5.00
☐	QH1093-4	Anti-howler (double sided)	£5.50
☐	QH1093-5	Sig Gen board	£4.50
☐	QH1093-6	Crossover unit	£3.00

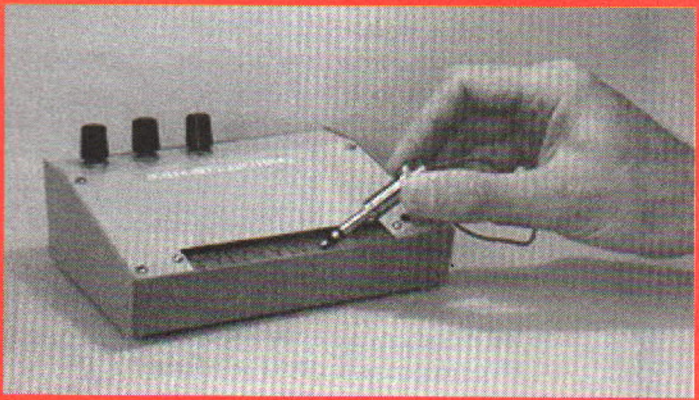
Total remittance including P&P £ ______ .

Allow 28 days for delivery

ADVERTISERS' INDEX

NEXT MONTH

With the festive season just round the corner, the office party looming and Christmas spirit flowing, we suggest you construct our novel Harmonizer.



You just sing into it and change the pitch of your voice by running the probe along the touch pad and hey presto! Instant vocal accompaniment. A real competition winner for the Christmas karoke

On Sale 16th December

Back to the Sixties...

...Using 90s technology. Bathe your audience in nostalgia with an auto panning stereo tremolo unit. Music to our ears from Dan Coggins

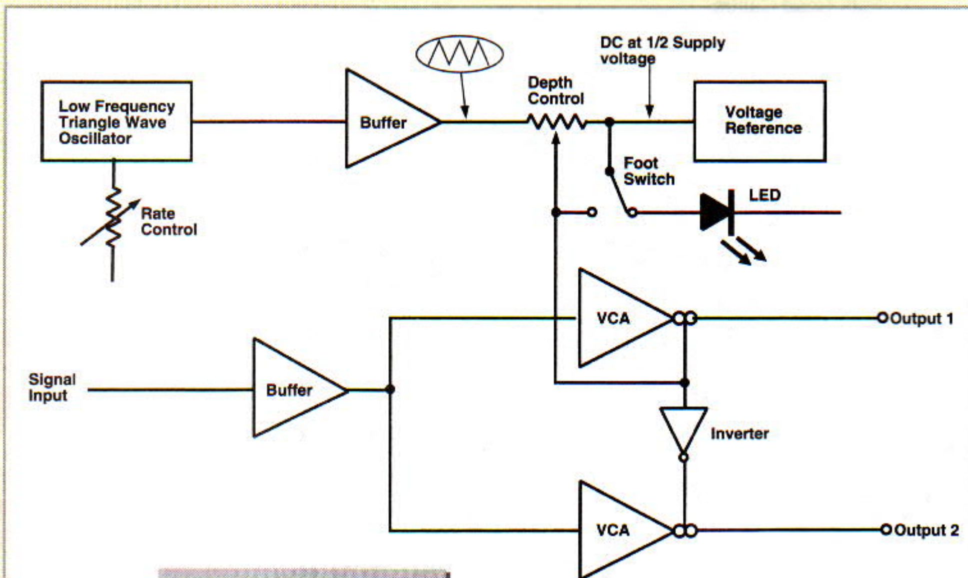


Fig.1 Block diagram of the stereo tremolo unit

I have been asked countless times by my guitar-toting friends where they can buy a 'tremolo pedal' for their instrument.

Oddly, these are hard to find - which seems strange when it is enjoying a new-found popularity, especially with 'indie' groups.

Tremolo is an old-fashioned effect, found originally on late 1950s guitar amplifiers of the valve variety. It can best be described as a 'stuttering' effect (or used more discreetly, a 'shimmering' effect.) However, only vintage-style amplifiers feature it (as a rule), and designs for tremolo circuits have been absent from the pages of electronic magazines for some years. Hence this design.

I might be accused of taking 'money for old rope' here, but this design has a difference - it's stereo! It can also work in mono, of course, giving the classic sound that many a sixties' hit was built on. The design uses modern ICs to capture these sounds in a compact pedal with low battery consumption.

Design Considerations

As with any musical effect pedal, a small portable sturdy box, containing a substantial footswitch and having low-current battery operation is the general requirement. This pedal has those very features and is simple to use.

Although chiefly associated with guitars, tremolo effects can be used on most signal sources with interesting results. Indeed, I tested the prototype by feeding Radio One through the input - a vast improvement!

To this end, a high input impedance and a reasonably flat

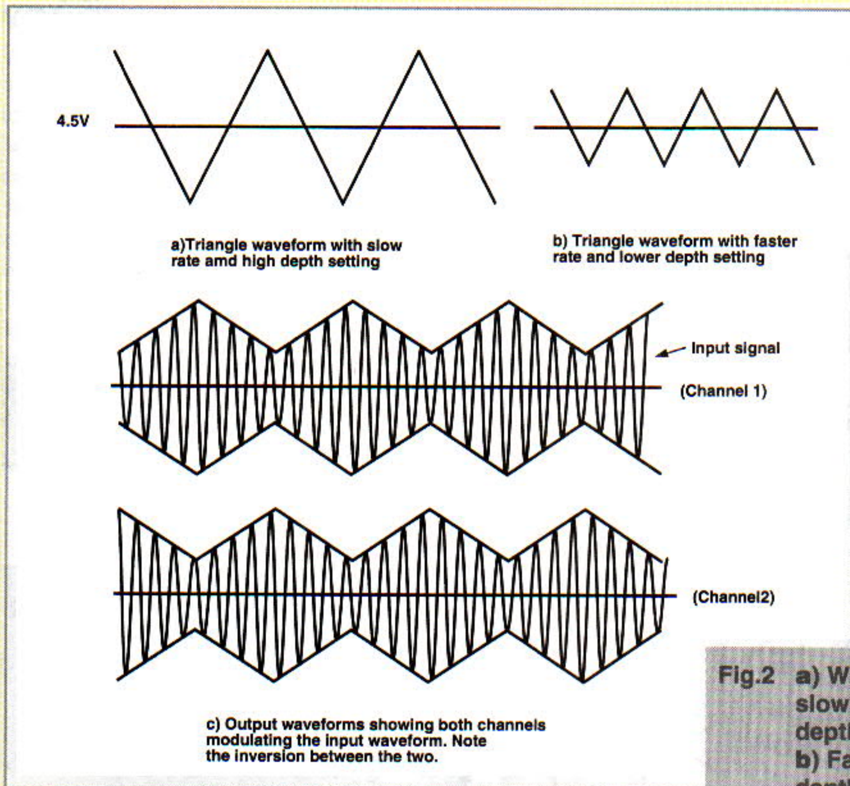


Fig.2 a) Waveform with slow rate and high depth setting b) Faster rate and low depth setting c) Output showing both channels modulating the input waveform. Note inversion

frequency response are important features to have. This is achieved by buffering the input signal as it enters the circuit.

Low current consumption is achieved by using JFET op-amps which use only hundreds of microamps, typically. The overall design uses about 3mA, and so is kind to a PP3 battery. Of course, a power supply may be used and a socket wired in to accommodate this, if so desired.

A substantial die-cast case is used to screen and protect the circuit, in the arduous conditions it is likely to endure between a stage and someone's pounding foot! A lot of time was spent agonising over a suitable switching arrangement to bypass the effect.

The arrangement chosen gives very noise-free operation from a mechanical switch, as well as switching on an LED when the effect is in operation to alleviate confusion and to show up a dying battery.

Many methods of coupling oscillators to audio signal paths were investigated in this design - it's difficult to be successful in reconciling good performance with low noise. Having abandoned the use of opto-isolators, a design utilising voltage controlled attenuators was implemented.

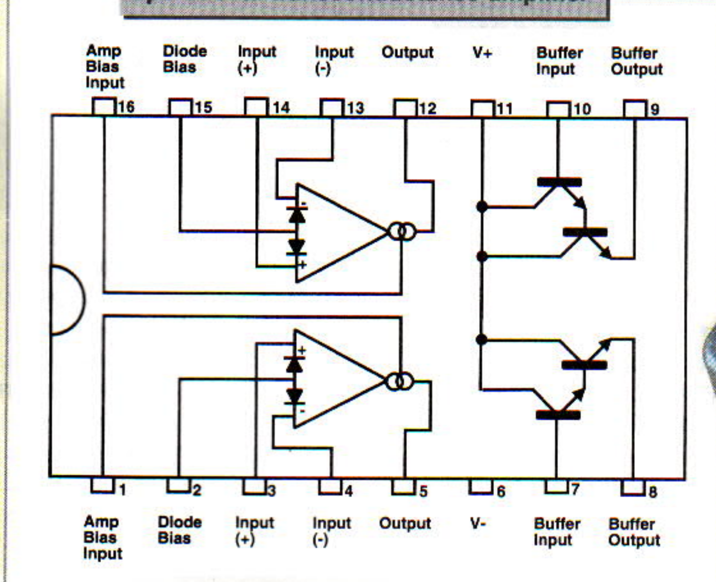
The Circuit

For convenience, I shall refer to the circuit in two halves, namely the Low Frequency Oscillator (LFO) and the Voltage Controlled Attenuator (VCA) circuit. In the LFO circuit:- IC1 is a TL064 quad JFET op-amp package, giving low current consumption and good performance at low cost. Here, all four of its op-amps are used in the LFO circuit only, which is good practice from a noise viewpoint.

First, we require a split supply for the LFO (and the VCA circuit, too). IC1a buffers the 4.5V produced by R1 and R2, both acting as a potential divider. This voltage is decoupled 'fore and aft' by capacitors C1 and C2. This provides a low impedance 4.5V rail necessary to run the LFO and VCAs. Good decoupling is essential to prevent breakthrough of the LFO control waveform to the signal path.

IC1b is configured as a simple triangular wave oscillator, with C3 as its timing capacitor. C3 charges and discharges alternately through the resistance set by RV1. With series resistor R6 assigning a maximum rate of oscillation of 5Hz approximately, the rate control RV1 will vary this rate down to around 0.3Hz. The voltage appearing across C3 is a triangle wave, buffered by IC1c to feed the control

Fig.3 The LM13700 (LM13600) dual operational transconductance amplifier



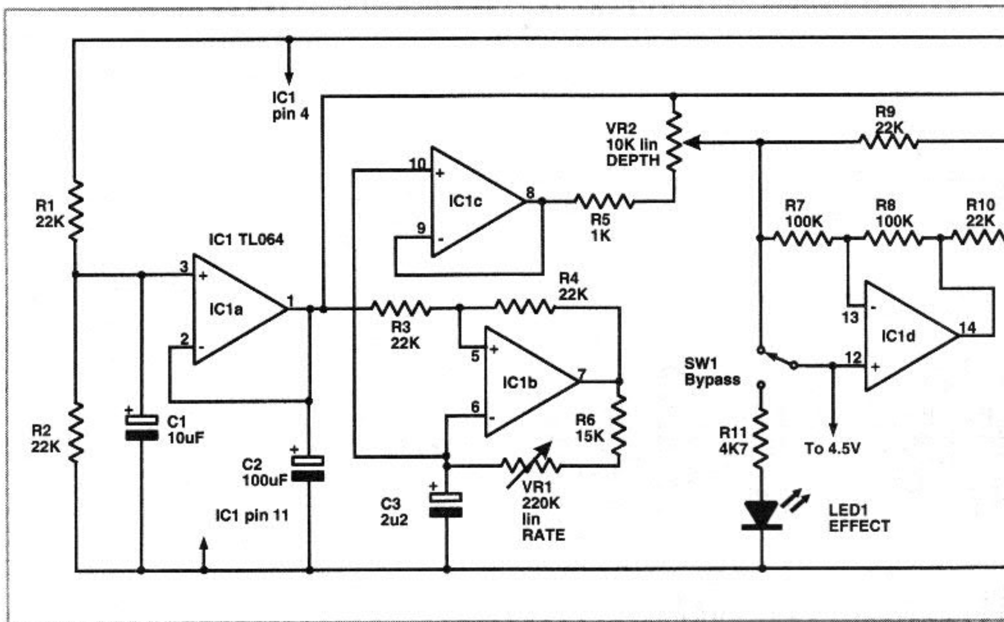


Fig.4a Stereo tremolo LFO circuit

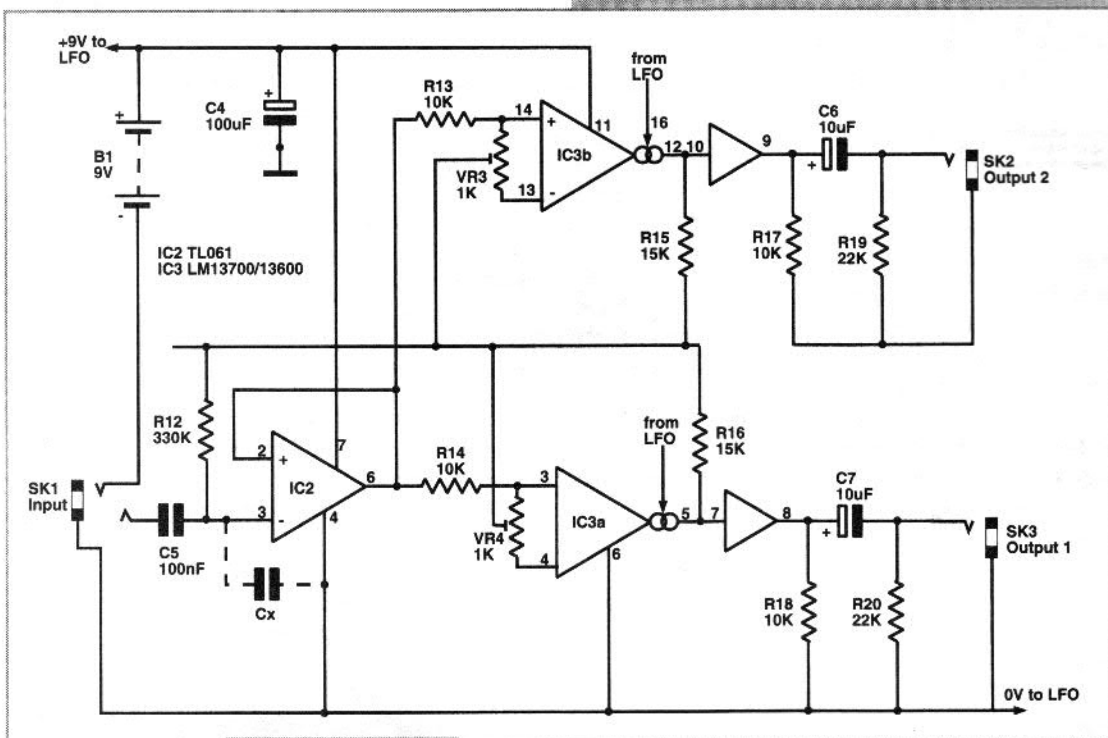


Fig.4b VCA circuit

The Works

Refer to Figure 1. An input signal from a musical instrument, such as a guitar, bass or keyboard is buffered and fed to two identical electronic attenuators. When an adjustable waveform is fed to these, as a control voltage, the amplitude of the instruments' signal is modified. A triangle waveform will give us a 'tremolo' effect. With just one of the two outputs connected, a tremolo sound will be heard. With both outputs connected to separate amplifiers a stereo 'panning' effect is heard. This stereo effect is achieved by feeding opposite phase waveforms to either attenuator. When the footswitch is pressed to cancel the effect, both attenuators are fixed to the same 'zero' DC control voltage, giving identical outputs of the original input signal at the same level, without any audible effects.

This unit is useful for buffering high impedance sources, such as electric guitar pick-ups, as the buffer stage is always in the signal path (with unity gain), preventing undesirable treble-losses in the signal, due to cable length. And it provides a convenient means of running two amplifiers or signal chains from a common source.

inputs of the VCAs (see Figure 2a & 2b).

R5 is included to protect the output of IC1c from excessive loading when the footswitch is closed across RV2 on its higher settings. RV2 is the 'depth' control which varies the amount of modulating waveform fed to the VCAs. The penalty of including R5 is to limit the maximum depth of modulation, but the effect will still sound quite powerful despite this.

At RV2's minimum setting (or when it is effectively shorted by the footswitch) the VCAs are held at half-supply with zero applied modulation. This allows the original signal from the instrument to pass through to the output unmodified, and the unit is therefore 'bypassed'.

With the effect 'on', the LED (D1) is lit when the other contact of the footswitch is closed. It runs from 4.5V via current limiting resistor R11,which passes only 0.5mA through the LED , yet giving reasonable visibility in ambient light. IC1d is an inverting buffer, which reverses the phase of the waveform applied to the second VCA - this gives the stereo effect when two separate amplifiers are used (when one output gets louder, the other gets quieter and vice-versa, according to control settings). See Figure 2c. When the effect is bypassed (or depth is zero) both VCAs will have the same half-rail control voltage, hence giving identical in-phase unmodified outputs to both amplifiers.

VCA Circuit

In the VCA, the input signal is buffered by IC2, a TL061 - again chosen for it's low current consumption and reasonable noise level (the TL071 is superior for audio, but will use more current; in this design, the LM13700 IC produces most of the noise - the S/N ratio of this design is 60dB, approximately - (so the use of a TL061 is justifiable). R12 sets the input impedance, suitably high for musical instruments, with no treble loss. Cx is shown dotted in the event that the unit may pick up radio signals after dark.

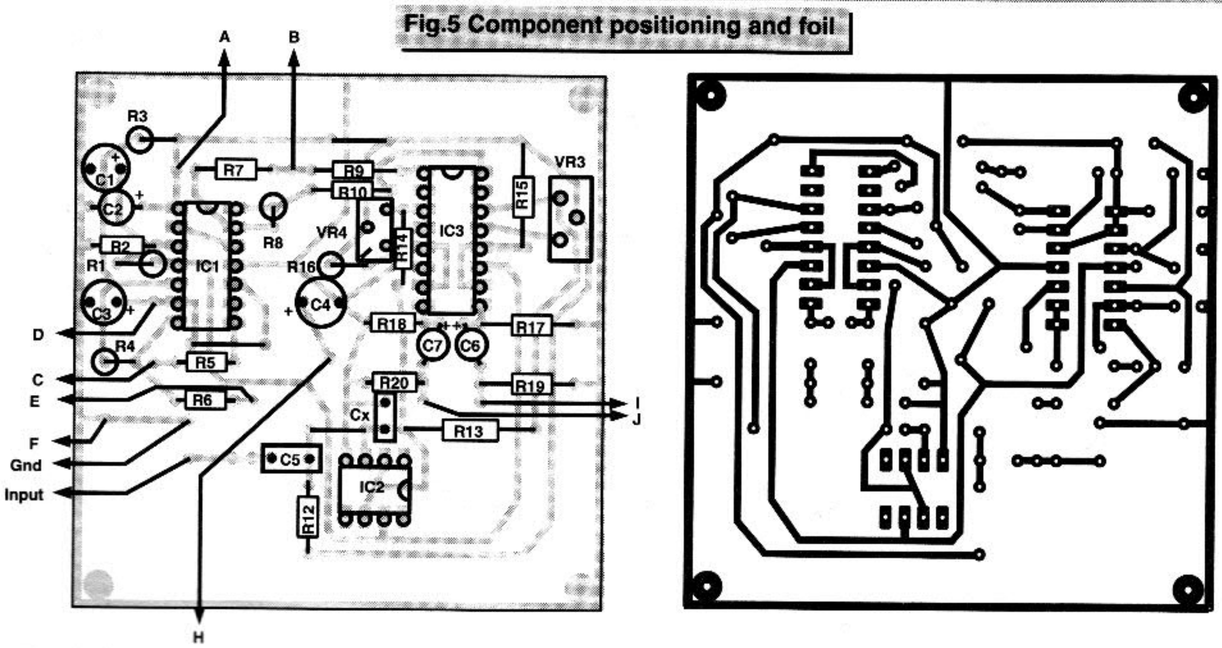
output buffer, which is internally matched to the characteristics of its op-amps. Pins 9 and 8 are loaded by the resistors R17 and R18 and the audio signals coupled to the output sockets by C6 and C7. Resistors R19 and R20 provide a charging path for these capacitors, thus eliminating 'thump' when connecting up to an amplifier. The trimmer resistors RV3 and RV4 are used to null out any control signal breakthrough, by balancing the input stages of each transconductance op-amp.

diameters. Drill out the other holes to size, as shown in Figure 6. The PCB can be mounted on the inside of the lid. Once all the holes have been checked to fit their respective components, rub-down letters can be used to label the controls and sockets. Several coats of clear lacquer (as found in motor factors) may now be applied to protect it.

Setting Up and Testing

When you are content with your wiring and everything has been checked over carefully, connect the battery with an

Fig.5 Component positioning and foil



If this problem arises, try using a polystyrene capacitor of around 470pF. If this fails, increase the value until the RF is eradicated, but remember that too high a value may cause treble loss with high impedance sources - experimentation is the best way to solve this!

The buffered signal is coupled by R13 and R14 to each VCA IC3 is an LM13700 dual Operational Transconductance Amplifier. It has many uses (filters, pulse width modulators, electronic stereo volume controls, etc.) and here both of its op-amps are configured as voltage controlled amplifiers (or more correctly, voltage controlled attenuators).
By applying a varying voltage to the control pins (1 or 16) the amount of attenuation applied to the audio signal can be controlled. As this is a transconductance op-amp, an output current is produced which in turn develops a voltage across resistors R15 or R16. This voltage is buffered by the LM13700's own internal darlington

Construction

Start by assembling the PCB. Begin with the resistors - double checking their values with a multimeter will help to prevent any inexplicable faults later on! Next fit the capacitors - be sure to fit them the correct way round. Solder in the ICs - again, checking for orientation. Refer to the overlay diagram (Figure 5) for assistance.

Connect all the flying leads to the PCB and use colour-coding if possible, to pre-empt any possible wiring nightmares! Ensure that screened cable is employed for the input socket connection. This piece of wire makes the difference between a quiet pedal and a noisy one. It is only necessary to solder the screen at the PCB end. If moulded plastic sockets are used, then connect the nearest contact of the case to one of the potentiometer housings for a suitable ground.

Using the case specified, mark out the holes using a centre punch and use the 3mm drill for the LED hole (D) to make pilot holes for the larger

ammeter in series. Plug a 1/4 inch mono jack into the input and observe that the current reading should be between 2 and 3mA approximately. If your reading differs much from these figures, disconnect the battery and check your wiring and assembly again, especially the ICs and capacitors. Always unplug the input jack when not using the unit - it doubles as the on-off switch, and will eventually drain the battery if neglected. With both controls set fully clockwise, connect a cable between one of the output sockets and your amplifier. Ideally, short the terminals on your mono input jack to effectively ground the input stage (alternatively, turn down the volume control on your instrument). Press the footswitch so that the LED is lit, then turn up the volume on your amplifier until it registers a 'thumping' noise. Depending on which output socket you have connected your amplifier to, adjust RV3 or RV4 until this noise disappears. Repeat the process for the other output - there is a critical point on both trimmers where the

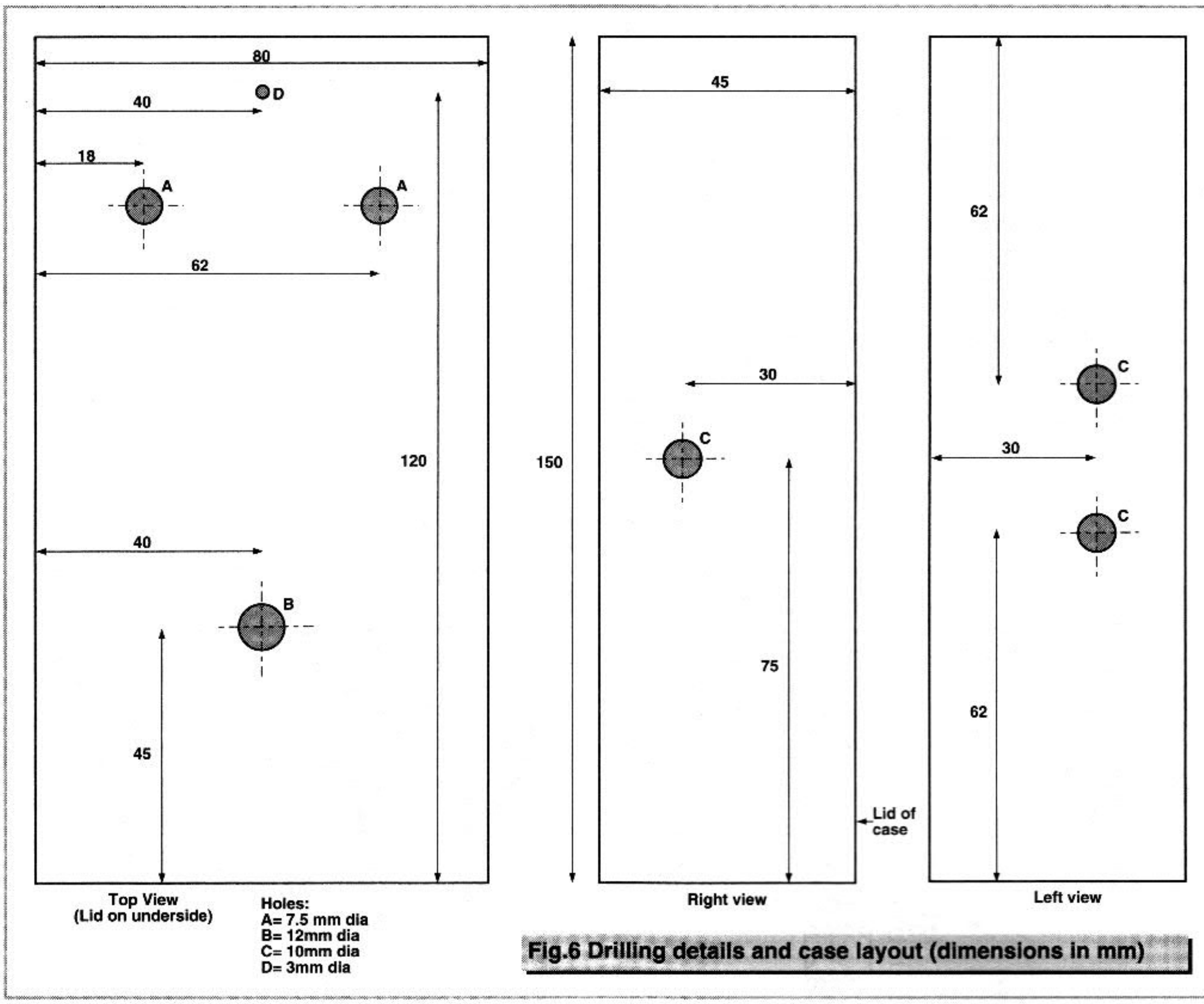


Fig.6 Drilling details and case layout (dimensions in mm)

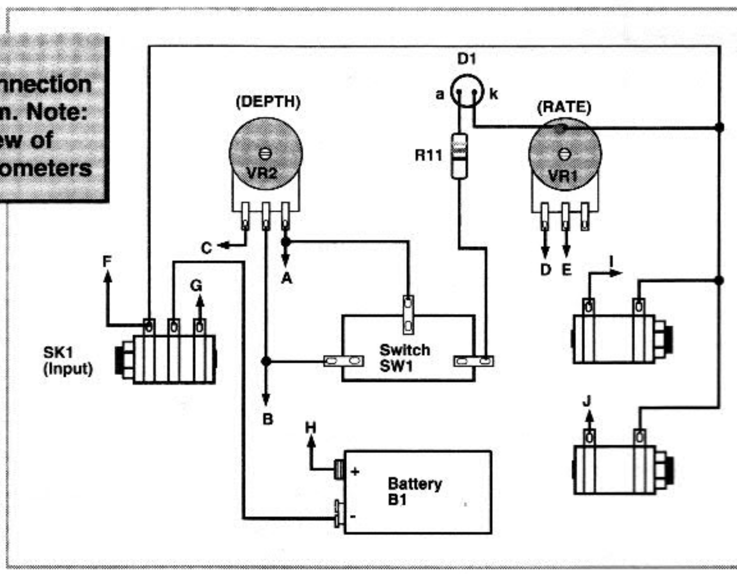


Fig.7 Interconnection diagram. Note: rear view of potentiometers

cancellation occurs, so adjust slowly. If the oscillator can still be heard, check the layout of your wiring and the grounding of the input connections. A low level of hiss may be noticeable on either setting of the footswitch, and this should not be confused with oscillator noise.

The stereo tremolo unit is now ready for use

The Twang's the Thang

Hopefully, the stereo tremolo effect should be self-explanatory. The rate control adjusts the speed of the effect, and the depth control adjusts the intensity of it. With an amplifier connected to each output (it's an expensive game) the most dramatic 'panning' effect will be heard at low rate settings, with full depth. Stereo imaging can be produced by using a high rate with the depth control set to about ¾. Experiment to find the sounds that please you the most.

When used in mono (as a standard tremolo) the rate control may seem a bit 'cramped' at one end. Ideally an anti-log potentiometer would be employed, but these are scarce and costly. A log pot could be used instead, with the opposite track connection used to provide smoother rate control, albeit back-to-front. This appears to be counter-intuitive, but is worth consideration. If you only intend to use the tremolo in mono (one amplifier) then change the value of the rate pot to 100K. A 220K pot is specified to accommodate lower rates for stereo 'panning' effects, and would be worth changing to improve its 'sweep'.

Afterthoughts

Other effects may be obtained from this circuit by modifying the VCAs to operate as VCFs which could give 'auto-wah' effects, or as a dynamic filter to simulate the sound of a rotating 'Leslie' speaker.

If the unit is to be used at line level (0dBu/775mV) or greater, then some modifications must be made. IC3 has optional linearising diodes at its inputs to facilitate greater headroom and lower distortion figures. This is at the expense of available gain and has not been used in this design. If you wish to modify the unit, tie pins 2 and 15 to 9V with 15K resistors and increase the values of R15 and R16 to compensate for gain loss.

If the LED is considered to be too dim try reducing the value of R11 to 3K3 or less. Do remember the pay off will be a substantial increase in current consumption when the effect is switched on. Generally, the smaller the LED the greater the perceived intensity of light - large LED's appear to diffuse low light levels to a greater extent. Connecting a second oscillator producing an even slower triangle wave will give interesting effects, if it too is connected to the control pins of the VCAs. By skewing the triangle waveform it is possible to achieve 'backwards guitar' simulation, by offsetting the voltage to the oscillator. It's tricky to implement, as it causes erratic rate control if it is altered and can be difficult to interface with the VCAs to give a consistent overall gain, but it sounds good.

REFERENCES

National Semiconductor data sheet for the LM13700.

Parts

Resistors (all 5%, 1/4W):

R1,2,3,4	22K
R5	1K
R6	15K
R7,8	100K
R9,10	22K
R11	4K7
R12	330K
R13,14	10K
R15,16	15K
R17,18	10K
R19,20	22K
RV1	220K linear potentiometer
RV2	10K linear potentiometer
RV3,4	1K miniature vertical preset

Capacitors

C1,6,7	10u/16V PCB type electrolytic
C2,4	100u/16V PCB type electrolytic
C3	2u2/16V PCB type electrolytic
C5	100n polyester or similar
Cx	see text

Semiconductors

IC1	TL064 quad JFET op-amp
IC2	TL061 JFET op-amp
IC3	LM13700 (or LM13600) dual transconductance op-amp
D1	3mm miniature red LED

Additional Items

S1	SPST heavy duty footswitch SK1 stereo 1/4" jack socket
SK2,3	mono 1/4" jack socket
B1	9 volt (type PP3)

Battery clip
Case (150 x 80 x 45mm - BIMBOX type 5005)
Rub down letters, Knobs, Wire, Screened cable, Solder
Spray lacquer, PCB (This can be ordered through EIA)
Most parts should be readily available.

Future View

Robin Saxby, Managing Director of Advanced RISC Machines Ltd. talks about the emerging market for portable products at the cross roads of communications, computing and consumer electronics

Historical Background

Following on from the pioneering work by Charles Babbage on computer architecture, the first practical computers were produced in the UK and USA during the second world war. The invention of the transistor in 1948 by William Shockley, Walter Brattain and John Bardeen at US Bell labs and the integrated circuit (IC) by Robert Noyce and Jack Kilby independently in the USA in 1959, fuelled the start of the mainframe digital revolution in the early 60's. IBM introduced the 360 mainframe computer (so called because it was intended to turn the world through 360 degrees) in 1964 and quickly became one of the world's largest corporations. At the same time and through the mini skirt era of the sixties the mini computer companies started to be successful with the emergence of DEC.

The microprocessor, invented in 1971 by Ted Hoff was originally designed for calculators. In 1975 Intel thought that their microprocessors were only suitable for controllers such as those used in traffic lights. But in parallel with this hardware activity, Paul Allen and his friend Bill Gates were working away in Albuquerque to write a version of BASIC that could run on a microprocessor. This work demonstrated that Intel's new invention had the potential to be the brain of a truly serious computer. In 1976 on April Fools day, Steve Jobs and Steve Wozniak who had written a BASIC for another microprocessor from MOS Technologies, founded Apple Computer and launched the Apple I. This computer had characteristics of good performance and low cost as it consisted of a circuit board which connected to an ordinary TV set. Apple's sales accelerated when Visicalc, the first spread sheet, invented by Dan Bricklin, was coded to run on the Apple II by his friend Bob Frankston. Then IBM entered the PC business in the mid 70s and along with all the clone companies fuelled the explosive growth of Microsoft and Intel.

Meanwhile...

In Cambridge UK at 3pm on the 26th April 1985 a couple of British computer scientists, Steve Furber (Now ICL Professor of Computer Engineering at Manchester University) and Roger Wilson (now Chief Scientist at Acorn Computers) with a small team of engineers;- Mike Muller, Robert Heaton, Tudor Brown, Jamie Urquhart, Dave Flynn, Dave Howard and Jim Sutton received samples of the world's first commercially exploited RISC chip which was manufactured by VLSI technology and called the ARM.

Unlike later RISC chips of Sun SPARC and MIPS which were designed for the highest performance, the ARM was designed to squeeze the maximum performance possible within the constraints of a tight cost budget. In semiconductor terms manufacturing cost is directly proportional to chip size. The ARM was used in Acorn's award winning Archimedes computers which in world terms were not well known except within a small techno-cult community. This cult community extended into California's silicon valley in the USA and the engineering laboratories of some major Japanese electronics corporations.

Foundation of Advanced RISC Machines Ltd.

On November 28th 1990, twelve engineers from the original chip and software design team of Acorn were spun out into the independent company

Advanced RISC Machines (ARM) Limited. ARM Ltd's strategic goal is to establish the ARM as the leading processor for new emerging markets at the cross roads of computing, communications and consumer electronics. I was fortunate in being recruited to lead this outstanding team and to develop the International business of ARM. ARM Ltd's founders were Acorn Computers, Apple Computer and VLSI Technology Inc. Latterly NIF (Nippon Investment and Finance) which is Japan's second largest venture company became ARM's fourth investor.

New Market Opportunities

The Electronics Industry is currently undergoing rapid change with an increasing number and breadth of products being introduced that will change the way we live, work, learn and play. This transformation is occurring to improve the way that humans interact with machines and each other. Faced with the environmental challenges to reduce pollution, save fuel and costs, people are moving into an era where working effectively and remotely from home is now possible with the help of electronic mail, remote computer access, portable computers, mobile phones and fax machines. Distance learning with full media availability (sources of books, newspapers and films on CD and via cable) is extremely straight forward and fun to use. Leisure media products offer high quality sound and 3D graphics capability. Dial up of information available in the best reference libraries of the world will be available at the touch of a button and at a low cost.

Product Needs

New classes of intelligent products share common themes of being cost effective, light weight, highly intuitive to use, very powerful and yet running from batteries for a long time, making them fully portable.

New products-New markets

So, what are these products which are going to change our lives? Mentioned here as examples are a few examples which are entering the market today and will be totally pervasive by the year 2000.

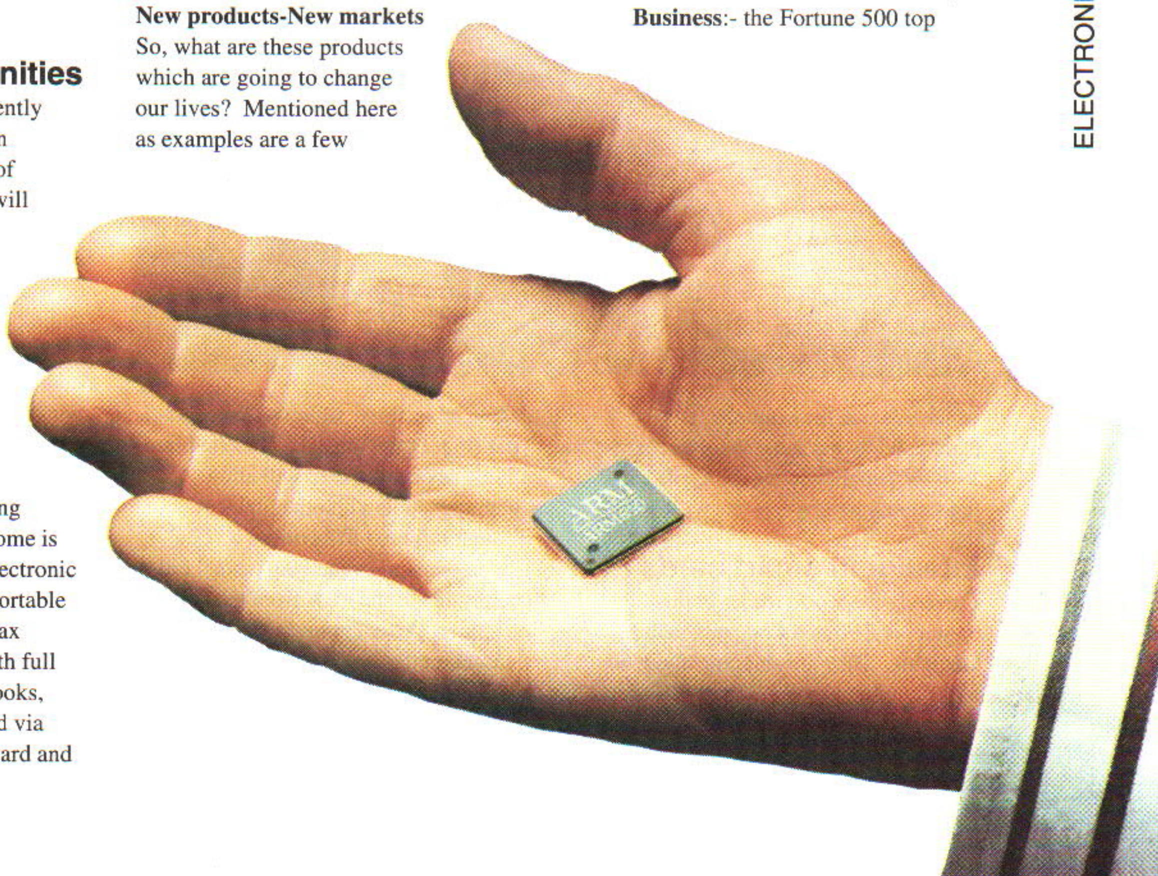
Personal Digital Assistants (PDAs)

The first volume product in this category known as Newton™ was launched by Apple in Boston USA at the beginning of August 1993. Today it is an "intelligent organiser" with address book, diary, calculator, to do list and note taker built in. I will briefly describe how you use it and its benefits;

Fitting into the palm of your hand you write onto a liquid crystal display (LCD) screen 80mm by 120mm with a plastic pen, as Newton™ converts your scrawl into readable text. Faxes and electronic mail can be sent from it and Newton keeps a good track of your personal priorities and actions. Because writing with a pen is so natural and as Newton is light weight, you use it everywhere and continually, ensuring that the most current data is stored in Newton's memory. As you meet people who have changed their job or phone number, you immediately up date your information and put new appointments in your calendar. Newton also helps you to make new friends who are very keen to see how the hand writing recognition works. I find waitresses in restaurants I visit are most fascinated by the device. Application programmes are supplied on 85mm by 55mm flash memory cards. Examples are:-

Leisure:- Time Out Guide to London,

Business:- the Fortune 500 top



businesses in the world, spread sheets, financial calculations
Education:- scientific calculators, the periodic table of the elements. foreign languages
Personal:- talking and moving pictures of your family
These application programmes can also be down loaded from central computers through telephone or radio links. Newton™ also has an infra red link by which you can for example electronically exchange business cards with the people you meet. Apple call this beamimg.

Intelligent smart cards

Currently the world leader in this product is a French Company called Gemplus. They are shipping about 60 million units per year globally. Today's cards consist of an 8 bit microprocessor and memory mounted on a thin flexible card. The information stored in memory is equivalent to monetary units and their main application is for public telephone booths especially in France. After use of say 50 units, they expire and can be thrown away.

The intelligent card of the future will store all your personal information, such as passport, current bank account balance and health details. It will be a personal smart card with a very high degree of security, which will recognise your finger print or voice. Inserted into a PDA device, the card will allow communication with other devices through infra red links or radio. For example imagine receiving a hotel bill transmitted to the PDA from the hotel's computer. After approving the transaction through, applying your signature on the PDA, the card would transfer money from your bank account to the hotel proprietor's account.

New multi media games and education machines

In October 1993, Matsushita (National Panasonic) started shipping in the USA, an Interactive Multiplayer™ designed by "The 3DO Company" of California. This is an advanced CDROM device which can play audio and photo CD, movies, games and education programmes through your television set. By attaching a camcorder to the machine, you can input a picture of yourself so that you become the cartoon animation character in the game you are playing. It is the high quality sound, 3D graphics and interactive capability that makes this product different from other entertainment machines on the market today. When this device is attached through cable to a central station it may also be used for home shopping and interactive TV applications.

Complete mobile phone capability

The GSM (global system mobile) and PCN (personal communication network) phone systems have recently started service in central London and Germany. These systems offer light weight and potentially lower cost portable voice and data global telephone capability. Eventually these systems will work anywhere in the world making communication easy wherever you are.

Product vision for the year 2000

I imagine a product integrating all of the above capabilities being available by the year 2000.It would be light-weight and portable, be interactive with its users and have a high resolution colour LCD screen. It would also provide smart card security features and have PDA type intelligence (also with voice recognition)to be able to communicate globally by having access to the cable and satellite television network and access to data services through radio links.

This device becomes your TV set, note book, games machine, phone, fax, computer, organiser, language tutor , cinema rolled into one. Technologically this is possible, the only question, is how much will it cost? With the rate of progress of technology, and mans ingenuity, I think that such a device will be a high volume consumer product in this time frame. Most probably there will be families of devices for different applications.