

electronics today

JANUARY 1980

INTERNATIONAL

60p

10MHz

DFM *Full
Details
Inside*

**DEEP
SPACE
PROBES**

**Universal Buffer
Moving Coil Preamp
Kirlian Photography**



TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

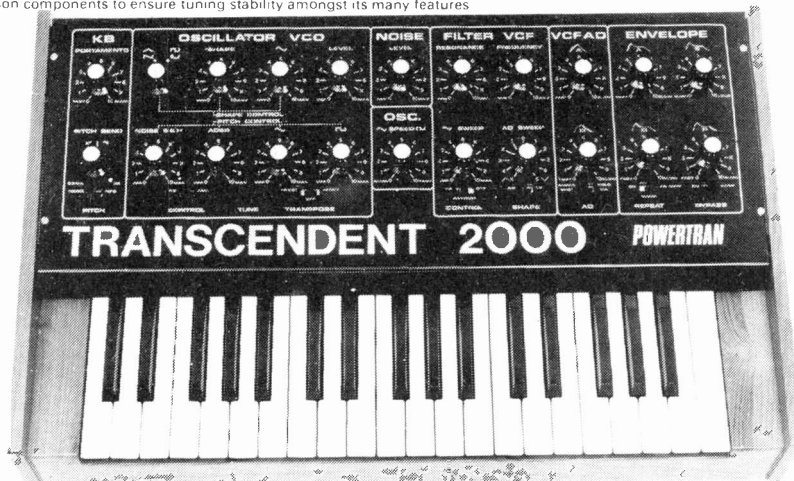
The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an affective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 1/2% metal trim) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibreglass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built easily in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready built units selling for between £500 and £700!

**COMPLETE KIT
ONLY
£168.50 + VAT!**

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer, with nothing more elaborate than a multi-meter and a pair of ears!

**WE'VE MOVED!
NEW FACTORY UP!
PRICES DOWN!**



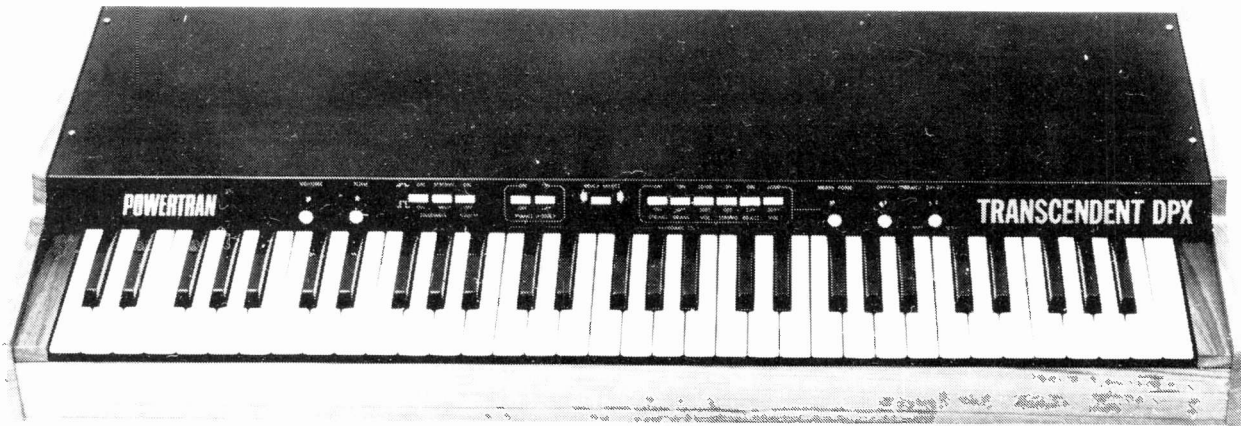
Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

**INCREASED CAPACITY AT OUR BIG NEW FACTORY
MEANS MANY PRICES DOWN! ALL OTHERS FROZEN!**

TRANSCENDENT DPX

DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER

The Transcendent DPX is a really versatile new 5 octave keyboard instrument. There are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or reed sound — fully polyphonic, i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano or a honky-tonk piano or even a mixture of the two! Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard or should you prefer — strings on the top of the keyboard and brass at the lower end (the keyboard is electronically split after the first two octaves) or vice versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive! The harder you press down a key the louder it sounds — just like an acoustic piano. The digitally controlled multiplexed system makes practical touch sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrato comes in only after waiting a short time after the note is struck for even more realistic string sounds.



Cabinet size 36.3" x 15.0" x 5.0" (rear) 3.3" (front)

COMPLETE KIT ONLY £299.00 + VAT!

Locate interest to the sounds and make the melody that it produces as it is, on the other hand, it can be used to play any system using a CCF (change of frequency) or a complex digital filter. The world's first of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with the strings or brass effects.

As the system is based on digital data, it can be easily taken to and from a computer for storing and playing back accompaniment with or without pre-recorded keyboard input, composing etc. etc. and an interface socket (25-way D type) is provided for this purpose.

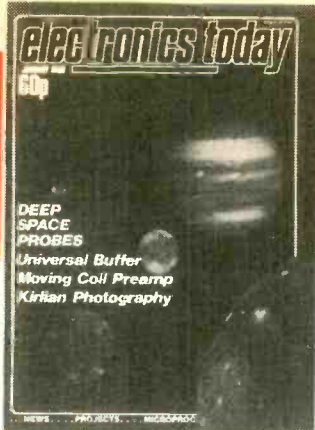
Although the DPX is an advanced design, using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple, with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the piano circuitry in the cabinet.

The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide, nuts, bolts, etc.) even a 13A plug — you need buy absolutely no more parts before plugging in and making great music! When finished you will possess an instrument comparable in performance and quality with ready built units selling for over £1,200!

POWERTRAN

**ORDERING INFORMATION
AND MORE KITS ON PAGE 8**

All kits also available as separate packs in a P.C.B. component sets, hardware sets, etc. Prices in FREE CATALOGUE

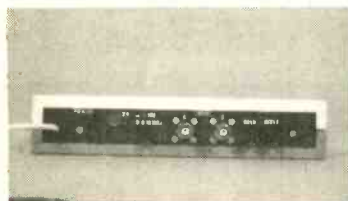


electronics today

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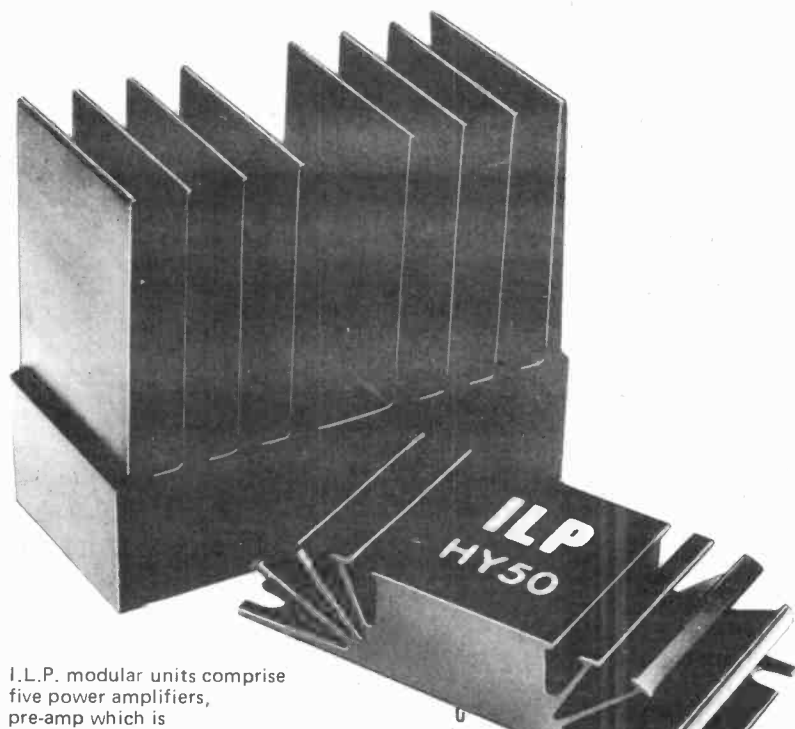
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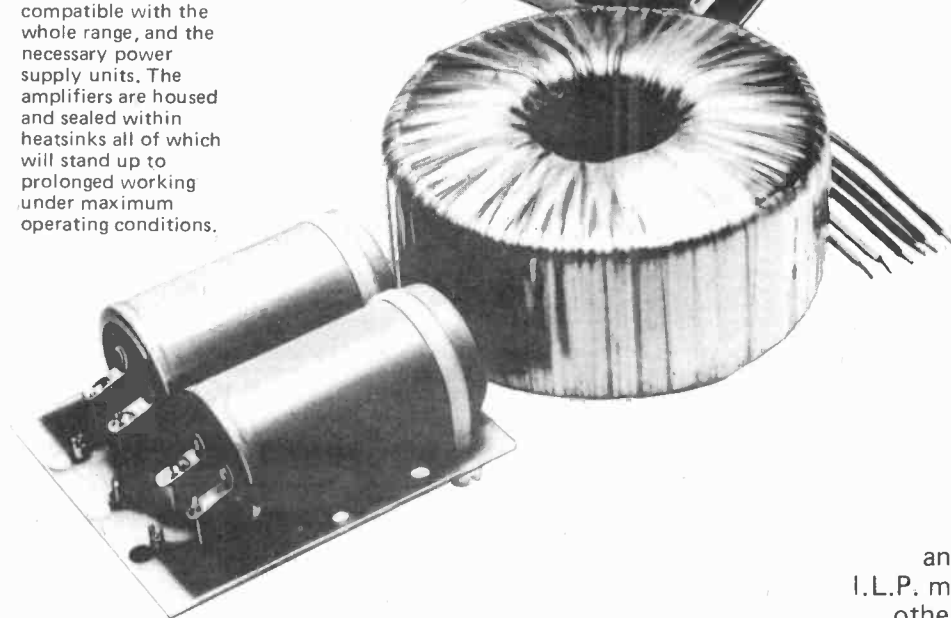
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Simply ahead . .

ILP'S NEW GENERATION OF HIGH



I.L.P. modular units comprise five power amplifiers, pre-amp which is compatible with the whole range, and the necessary power supply units. The amplifiers are housed and sealed within heatsinks all of which will stand up to prolonged working under maximum operating conditions.



With I.L.P. performance standards and quality already so well established, any advances in I.L.P. design are bound to be of outstanding importance

— and this is exactly what we have achieved in our new generation of modular units. I.L.P. professional design principles remain — the completely adequate heatsinks, protected sealed circuitry, rugged construction and excellent performance.

These have stood the test of time far longer than normally expected from

ordinary commercial modules. So we have concentrated on improvements whereby our products will meet even more stringent demands such, for example, as those revealed by vastly improved pick-ups, tuners, loudspeakers, etc., all of which can prove merciless to an indifferent amplifier system.

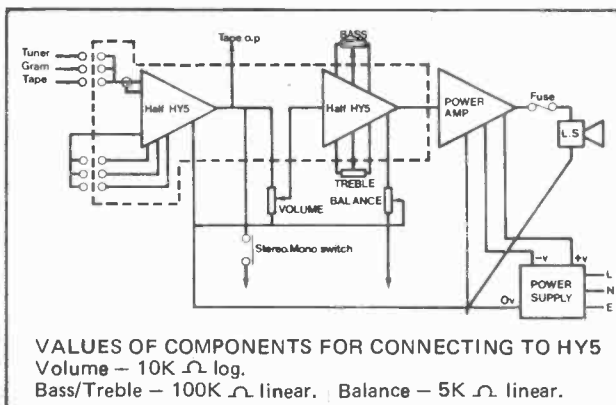
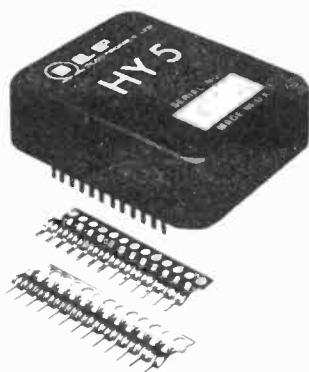
I.L.P. modules are for laboratory and other specialised applications too.

**PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS
IN ELECTRONIC MODULAR DESIGN**

and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER

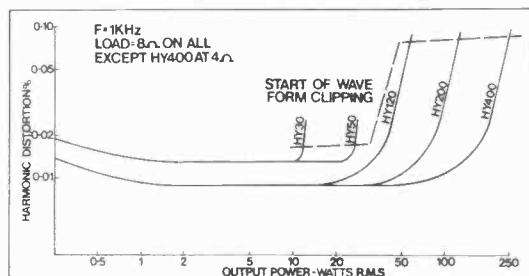


VALUES OF COMPONENTS FOR CONNECTING TO HY5
 Volume - 10K Ω log.
 Bass/Treble - 100K Ω linear. Balance - 5K Ω linear.

The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm, and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz - 0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

£4.64 + 74p VAT

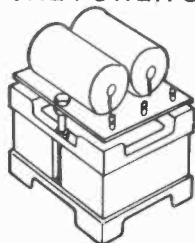
THE POWER AMPLIFIERS



Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0 +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0 +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0 +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0 +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0 +45	114x100x85	1,15Kg	£27.68 + £4.15

Load impedance - all models 4 - 16 Ω
 Input sensitivity - all models 500 mV
 Input impedance - all models 100K Ω
 Frequency response - all models 10Hz - 45Hz - 3dB

THE POWER SUPPLY UNITS



I.L.P. Power Supply Units are designed specifically for use with our power amplifiers and are in two basic forms - one with circuit panel mounted on conventionally styled transformer, the other with toroidal transformer, having half the weight and height of conventional laminated types.

PSU 30	$\pm 15V$ at 100ma to drive up to five HY5 pre-amps	£4.50 + £0.68 VAT
PSU 36	for 1 or 2 HY30's	£8.10 + £1.22 VAT
PSU 50	for 1 or 2 HY50's	£8.10 + £1.22 VAT
PSU 70	with toroidal transformer for 1 or 2 HY120's	£13.61 + £2.04 VAT
PSU 90	with toroidal transformer for 1 HY200	£13.61 + £2.04 VAT
PSU180	with toroidal transformer for 1 HY400 or 2 x HY200	£23.02 + £3.45 VAT

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CHROMATHEQUE 5000

POWERTRAN

5 CHANNEL LIGHTING EFFECTS SYSTEM



Panel size 19.0" x 3.5". Depth 7.3"

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB controls, wire, etc. — Complete right down to the last nut and bolt!

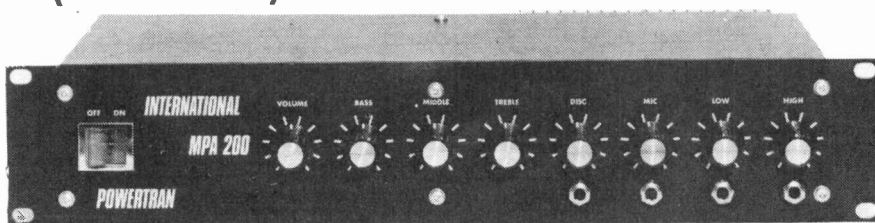
COMPLETE KIT
ONLY
£49.50 + VAT!

MPA 200 100 WATT (rms into 8Ω) MIXER / AMPLIFIER

COMPLETE KIT
ONLY

£49.90 + VAT!

MATCHES THE
CHROMATHEQUE 5000
PERFECTLY!



Panel size 19.0" x 3.5". Depth 7.3"

Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features adaptable input mixer which accepts a wider range of sources such as microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 2000 is simplicity itself with minimal wiring needed making construction very straightforward.

The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt.



DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO AMPLIFIER £99.30 + VAT

This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in H-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.



WIRELESS WORLD FM TUNER £70.20 + VAT

A pre-aligned front-end module makes this Wireless World published design very simple to construct and adjust without special instruments. Features include an excellent a.m. rejection push-button station selection as well as infinitely variable tuning and a phase locked loop stereo decoder, incorporating active filters for "birdy" suppression.



LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

This design, published in Wireless World, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco CRV with electronic speed control.

T20+20 20W STEREO AMPLIFIER £33.10 + VAT

This kit, based upon a design published in Practical Wireless, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30 watt version of this kit (T30 + 30) is also available for £38.40 + VAT.

MATCHING TUNERS — SEE OUR FREE CATALOGUE!

COMPLETE KITS: Our complete kits really are complete. All of the projects shown on this page are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet (last 4 kits on this page), or professional quality rack mounting cabinet (first 2 kits on this page), cables, nuts, bolts, etc., and full instructions — in fact everything!

All of the kits shown on this page are available as separate packs for those customers who wish to spread their purchase or perhaps make their own cabinets or metalwork. Prices are given in our FREE CATALOGUE.

PRICE STABILITY: Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until February 28th, 1980, if this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.

EXPORT ORDERS: No VAT. Postage charged at actual cost plus 50p handling and documentation.

U.K. ORDERS: Subject to 15% surcharge for VAT. No charge is made for carriage, or at current rate if changed.

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.

SALES COUNTER: If you prefer to collect kit from the factory call at Sales Counter. Open 9 a.m. - 4.30 p.m. Monday-Thursday.

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ANDOVER
(STD 0264) 64455



DIGEST



Blonde Bombshell

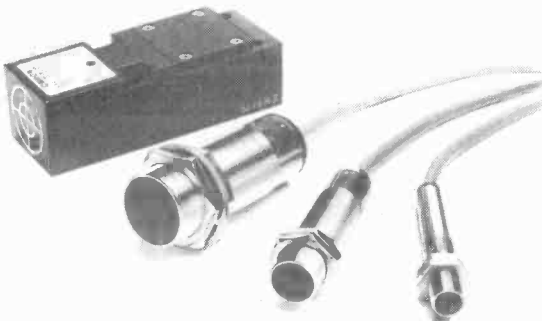
Now be honest with yourself — aren't there times during those long cold winter days when you could do with one of these in your office. No, unfortunately I don't mean Blondie in the white pants. The blonde bombshells here are the brushed aluminium boxes of ITT Terryphone's new solid state intercom units.

The intercom, which doubles as a security and alarm system, consists of a master unit and from one to nine sub-units. The system is easily installed in many configurations.

Simple press-button-to-talk operation is featured on the master and sub-units. Each sub-unit can be called independently from the master unit, or all sub-units can be called simultaneously. Pressing the self-latching security button allows noises from children, equipment, burglars, etc to be picked up and transmitted to other parts of the premises. So, the intercom can be used as a security system in small businesses of a baby alarm at home.

Each sub-unit comes complete with cable and cable fixing pads for £20 each. The master unit costs £85 and comes with a mains plug and a screwdriver. Talking of Blondie — she can install an intercom in my office any time.

Further details of this system is available from ITT Terryphone, Station Approach, London Road, Bicester, Oxon OX6 7BZ.



Near Thing

If you find yourself in one of those situations where you need to know how near the knuckle something is, arm yourself with a proximity switch.

The Omron TL series from IMO Precision Controls is a series of low cost, inductive, proximity switches, which now includes AC operation types

TL-XY 5mm and 10mm and TL-YS 10mm. All examples of the series offer reliable sensing of ferrous material. Flush-mounting and flat-mounting types are available. All the switches are available from stock and typical prices to the OEM would be under £20.

You can get further details of the Omron TL series from IMO Precision Controls Ltd, 349 Edgware Road, London W2 1BS.

SEIKO

Memory Bank Calendar Watch

TIME IS RUNNING OUT! LAST CHANCE

This is the watch offer they said even ETI could never do. SEIKO at a 40% discount! After all no-one discounts Rolls Royce do they? Well here it is. A SEIKO Memory Bank Calendar watch which retails everywhere at £138 for only £79.50 inc VAT and Registered Post charges.

The watch itself is a different league to other timepieces. It shows day, date, month, hours, minutes and seconds continuously, and switches to display the full calendar, month by month, from January 1st 1930 to December 31st 2009 at the push of a button! Twelve or twenty-four hour display can be selected and changed at will! Up to ELEVEN dates in the forthcoming year can be set as "MEMO" dates in the memory bank, and upon the allotted day the watch keeps the word MEMO flashing on the display to remind you of whatever it was you forgot. No more forgetting birthdays, anniversaries or evenings out!

Battery life is a good two years and the watch carries the full SEIKO guarantee. (Although these watches are so reliable chances are you'll never find out how good that is!) Operating the watch is simple and logical, and you don't need a pin to set it either! Even battery changing is facilitated by the 'hatch back' construction. You'll never see an offer like it again for a long long time, and even now we can't hold this price for long, so now's the time to get yourself the best there is in a watch, get a SEIKO and get it at ETI's prices! Orders can only be accepted using the coupon below, and then in order to be fair to everyone, only one watch per coupon. Supplies at this price are limited, so forgive us for being so formal!



The 'Bond' watch from Moonraker

To ETI Seiko Offer
145 Charing Cross Road
London, WC2H 0EE

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Now you can operate 120 Volts American equipment from 240 Volts! Only £9.95 complete with British type plug.

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SALE

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8 digits 5 Function 4 range to 10MHz with 0.1Hz res. time interval and period to 10 seconds with 0.1 microsecond res. units up to 10 million and ratio. A breadboarding area is provided for user to add his own input conditioning circuitry or prescalers and digital outputs are available as multiplexed as well as being displayed. Complete kit **ONLY £48 + VAT**

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1.24 25+ 100+
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2708 5.95	

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Use on car PA system, bicycle horn, or protection against would-be attackers. Invent your own sound effects. make believe you are the police or firemen. Must for DJs, pop groups and recording studios. Only £9.95 inc.

We apologise to our customers for the delay in completing orders during July/August as a result of our move. We are now back to normal.

Ordering information: For orders under £50 add 50p p.&p. Add 15% VAT to total. All items are subject to prior sale and therefore subject to availability. Prices are subject to change without notice.

All orders to:



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Please note new address:
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Telex 8953084



Casio Long Life

With the introduction of the F-8C from Casio, the age of the disposable watch is upon us. The F-8C is fitted with a lithium battery, which should last for three years. When you feel it's about time for a new watch, your battery will be on its last legs. You can strap a new F-8C on your wrist for only £12.95, complete with its three year lithium battery. If the prices of watches keep coming down and batteries become more sophisticated, more efficient and long-lived and more expensive, it can't be long before you really do throw away your watch when the battery goes to the

great recharger in the sky. Meanwhile, back to the F-8C — this new Casio ticker (with a silent tick) gives continuous LCD readout of hour, minute, second, AM (or PM), date and day of the week. It's accurate to within 20 seconds a month and has an automatic calendar, needing adjustment only once in four years — on February 29th. There's also a micro-light, of course. The stated battery life takes into account five seconds of micro-light use every day.

The F-8C is made by Casio Electronics Co Ltd, 28 Scrutton Street, London EC2A 4TY. The recommended retail price is £12.95, so you should be able to get hold of it for a little less. Moral: bargain-hunting is the best policy.

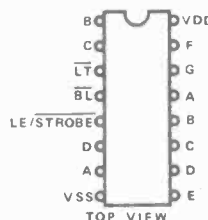
Touch Switch

This month, in our regular mistakes mention, we feature the Touch Switch (ETI December). The component overlay on page 94 looks a bit odd. To put things right, turn the foil pattern round through 180°.

Reaction Timer

We've had a few inquiries about the display used in this project. The original design was Australian and unfortunately there does not appear to be a UK equivalent for the SEL 521 displays used.

However, all is not lost. Many of you have been keen to use alternative displays, but were unable to do so, as neither the display nor the driver pin functions were identified. With the aid of the 4511 driver pin-out shown and any suitable common cathode, seven segment display, you should be able to start timing your reactions in a flash (not literally, we hope). Common cathode, seven segment displays are available from most of the major mail order component suppliers.



Romane Electronics

GRAND XMAS SALE LOW POWER SCHOTTKY TTL ICs EX-STOCK

Device	Price	Device	Price	Device	Price	Device	Price
74LS00	11p	74LS40	14p	74LS138	75p	74LS247	90p
74LS01	12p	74LS47	50p	74LS139	80p	74LS248	90p
74LS02	11p	74LS49	50p	74LS151	32p	74LS249	70p
74LS03	12p	74LS73	25p	74LS153	51p	74LS251	74p
74LS04	12p	74LS74	25p	74LS155	51p	74LS273	150p
74LS05	17p	74LS75	28p	74LS156	54p	74LS279	50p
74LS08	30p	74LS76	30p	74LS158	52p	74LS283	92p
74LS09	17p	74LS85	56p	74LS160	50p	74LS290	40p
74LS10	14p	74LS86	30p	74LS162	50p	74LS298	50p
74LS11	23p	74LS90	30p	74LS164	60p	74LS352	100p
74LS12	15p	74LS93	42p	74LS174	65p	74LS353	100p
74LS13	20p	74LS95	50p	74LS175	65p	74LS366	50p
74LS14	30p	74LS107	25p	74LS190	60p	74LS367	50p
74LS20	15p	74LS109	25p	74LS191	60p	74LS368	50p
74LS21	16p	74LS112	25p	74LS192	60p	74LS374	150p
74LS26	25p	74LS113	25p	74LS193	60p	74LS386	25p
74LS27	15p	74LS114	25p	74LS196	53p	74LS670	150p
74LS28	25p	74LS123	70p	74LS197	53p		
74LS30	14p	74LS125	30p	74LS221	65p		
74LS32	16p	74LS126	30p	74LS244	190p		
74LS37	20p	74LS132	46p	74LS245	260p		
74LS38	20p	74LS136	35p				

LOW PROFILE DIL SOCKETS BY TEXAS

8 Pin	13p	18 Pin	25p	24 Pin	33p
14 Pin	14p	20 Pin	27p	28 Pin	43p
16 Pin	16p	22 Pin	28p	40 Pin	53p

LIGHT EMITTING DIODES

	0.122"	Price		0.2"	Price
RED	TIL209	13p	RED	TIL220	15p
YELLOW	TIL212	22p	YELLOW	TIL224-1	20p
GREEN	TIL232	20p	GREEN	TIL243-1	20p

VERO PRODUCTS

Veroblock Breadboards	320p
Vero Wiring Pen	270p
2 x Spare Spools	83p
Spot Face cutters	85p
Pin Insertion tool	
for 0.052" Pins	115p
for 0.040" Pins	115p

VEROBOARD PCBs

0.1" Copper Clad	
2.5"x5"	57p
2.5"x3.75"	48p
2.5"x17"	180p
3.75"x5"	64p
3.75"x17"	220p

Terminal pins 0.052" full pin		Terminal pins 0.040" full pin	
per 100	39p	per 100	37p
per 1000	390p	per 1000	360p

CALCULATORS

Textet 1500	£3.75	Brain Wave	£7.70
Textet 1800	£6.40	Trader	£9.00
Scientific 2001	£7.25	LCD 300	£9.40

(*Phone for details)

ELECTRONIC GAMES (No TV required)

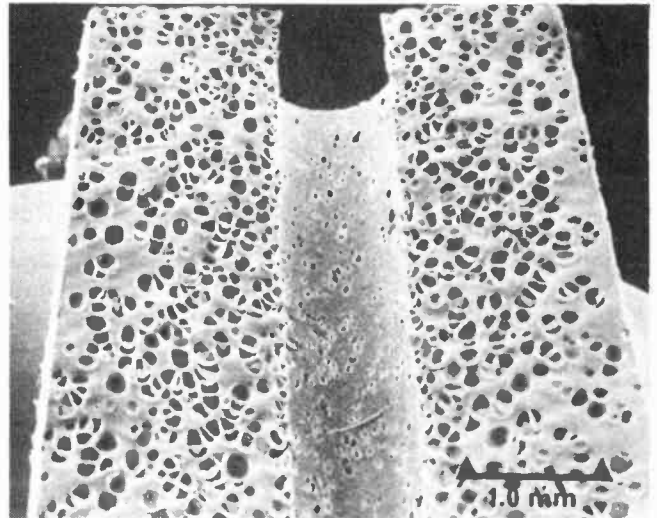
BLIP - Tennis Game	£9.00
COMPUTE-A-TUNE	£15.00
CODE NAME SECTOR - Submarine Pursuit Game	£16.95
INTERCEPT - With sounds and lights of a fighter plane attack	£15.85
DIGITS - Match your wits with a computer	£12.95
UFO MASTER BLASTER STATION - Guide you missile and destroy the UFO which may change course or even disappear!	£17.50

PLEASE NOTE:

All orders, large and small, will be dealt with IN STRICT ROTATION. Please add 15% VAT plus 30p P&P to all orders. (Games 30p P&P each). Export orders no VAT but postage at cost. Prompt delivery on all orders.

ROMANE ELECTRONICS

64 Newlyn Drive, Sale, Cheshire. M33 3LE
Tel. 061-962 2606



Holy Messages

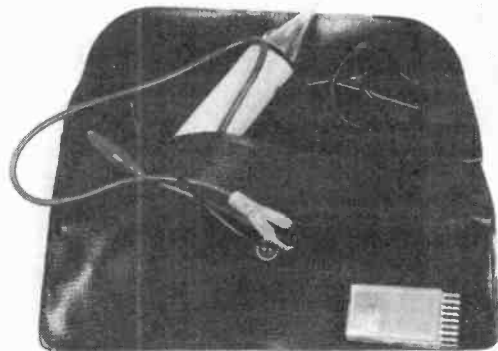
Before vicars all over the country start sending me details of forthcoming church bazaars and bring and buys, we have not started a religious corner in News Digest.

The holes are microscopic perforations in polyethylene cable insulation and the messages are telephone calls. BICC Ltd are using millions of microscopic holes in cables to improve the quality of telephone calls. For their next trick...

The holes in the insulation

help to reduce the loss of signal strength and also make the cables lighter and easier to handle. They can't be any old holes; they must be of the right size and properly distributed within an impermeable outer layer. A greater concentration of smaller holes is located next to the wire itself.

During research and development of the system and commercial production techniques, BICC have been using a stereoscan scanning electron microscope from Cambridge Instruments. The photograph shows the cell distribution in a cellular polyethylene telephone insulation.



Wat Probe

What do you give the man who has everything? If he's an electronics nut, you could solve your present problems with this month's special offer from Watford Electronics.

They are offering ETI readers the 3300A logic probe kit at the give away price of £14.50 + VAT - but only during the month of December.

As you can see, the probe, with its protective cover, comes complete with power leads, a 16 pin IC test clip and a push-on spring hook. They even supply a smart pouch to tuck the trusty tester away in.

The 3300A logic probe kit is available at the special offer price, only to ETI readers and only during December, from Watford Electronics, 30/35 Cardiff Road, Watford, Herts. Mention ETI in your order.

Now, complete your system!



Clitronic MM313 Mixer
Ideal for the DIY enthusiast building up a complete disco system 4/6 ch mono. Inc. LED indicators, connections via phono sockets at rear. Bargain price, including PSU £89.70.

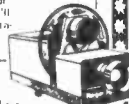
The ultimate range of speakers

We carry a good selection of high quality chassis for the DIY speaker constructor. 12" or 15" Bass speakers and Dual Concentrics. Exponential horns from £13.80, or our fabulous Plazo Horns which handle a 6K-20K frequency range in any PA system up to 100W (No X over required) and cost only £6.32 each.



Projectors

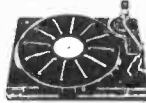
Come and see our specially selected projectors from £50.60 (Square Multifect 150) to £83.37 (Tutor IIE DDU) plus the widest array of projector attachment and effects that you'll ever see on continuous demonstration.



Ropelights Great effect at discos. 7 metres long. Multiway connectors. 4 channel £46.00 (inc. pack of spare bulbs)

Bulgin Octal plugs and sockets

There's always hundreds of Bulgin Octal multiway plugs and sockets in stock at Roger Squire's. Each pin rated 6A. Perfect for your Sound to Light System. P552 SOCKET. £0.69 P551 PLUG £1.72.



Turntables

Our unsurpassed Disc experience has enabled us to select the best turntables for your requirements. For example the new BSR P200 belt drive. ONLY £28.75

Many disco accessories

All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES

Multiway Cables
4 core (6A) 63p/metre
5 core (6A) 78p/metre
6 core (6A) 92p/metre

Roger Squire's

ALL SHOPS OPEN TUE SAT.
LATE NIGHT WED.
(UP TO 8 PM)

PERSONAL CALLERS ONLY

DISCO CENTRES
LONDON 176 Junction Road, N19. 50yds Trafal Park Tube Station. Tel: 01 272 7474
BRISTOL 125 Church Road, Bristol. Tel: 0272 550950
MANCHESTER 251 Deansgate 3, 15 mins from City Centre. Tel: 061 831 7676
GLASGOW 1 Queen Margaret Road (off Queen Margaret Drive), Kelvinside 20, just behind the BBC. Tel: 041 946 3303



Gloss in A Box

Elcometer proudly presents the Gardner Glossard II, a gloss meter to let you compare shiners with one hand-held instrument, which holds the optical system, digital display, circuitry and rechargeable battery.

The Glossard II is available in the popular geometries — 20°, 45°, 60°, 75°, and 85° — for matt to high gloss applications. Testing is to international standards. The meter has a hold

button, which, guess what, holds the last reading on the liquid crystal display until you release the button. There is also a battery recharge light to warn you that the battery is somewhat lacking in oomph.

The instrument comes in a zip-up vinyl case, which also holds the new precision, self-locating gloss standard, and comes complete with a small plug-in mains charger.

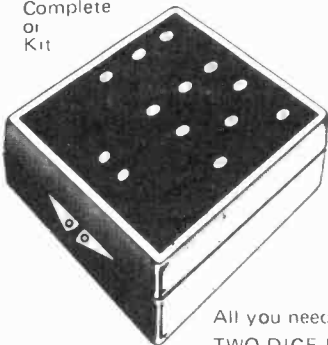
For further details of the Gardner Glossard II, get in touch with Elcometer Instruments Ltd, Edge Lane, Droylsden, Manchester M35 6BU.

Random Electronic

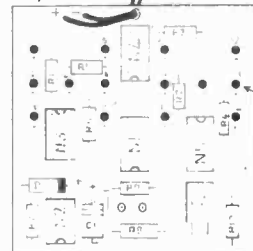
EASY DICE

Build your own 'EASY DICE' from the 5 integrated circuits and full components supplied, including box and descriptive instructions.

Complete
or
Kit



P.C.B.
Layout



All you need is a soldering iron
TWO DICE FACES TOUCH CONTROL

- a *Self Assemble Dice £3.95 plus 25p p&p
- b *Ready built Dice £4.75 plus 25p p&p

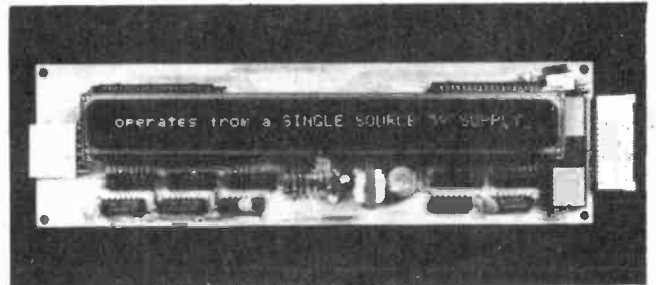
Order now from **Fringewood Electronics Ltd**
1 Hatton Court, Ipswich, Suffolk. 0473 210151

Amount enclosed £

Name

Address

please state amount required in appropriate box a b



Flip Flory

New from Perdix is the IEE "Flip" vacuum fluorescent display. It has a single line of 40 characters and needs only a single five volt supply. The high brightness, 7x5 dot matrix character is 0.2 in high and has an editing cursor.

The display is controlled by an on-board dedicated processor and interfaced via an 8-bit bi-directional data bus for parallel TTL ASC11. The unit will also accept serial data.

A unique feature is the ECMA 7 character font set that

supplements the standard 96 character ASC11-7 set to include European characters plus upper and lower case letters, numerals and symbols.

The use of an on-board processor allows useful control functions such as backspace cursor, carriage return, line feed, horizontal scroll, read data at cursor, read data at a specified address, etc.

The unit is designed for limited-space, front panel applications. In fact, the entire assembly is less than one inch deep (by 3" high and 10.6" wide).

For further information please contact Perdix Components Ltd, 98 Crofton Park Road, London SE4.

Quartz Melody Multi-Alarm Chrono For 1980 Try this 34 Function

for only £26.95

Count-down Timer



Can be used for a host of applications from boiling an egg to warning you your parking meter is expired.

The timer is presettable to 23 hours 59 mins. 00 secs. in 1 min. steps and counts down in 1 sec. steps. It operates quite independently of the other counters and the watch can be in any other mode whilst it is being used.

At the preset time the musical tone will sound for 1 minute.

Alarm



The alarm can be set at 1 minute intervals to any time within the 24 hour period.

A clear firm musical tone sounds for 1 minute at the appointed time. An automatic roll-over to the normal time is a feature after the alarm has been read. A clear indicator displays whether the alarm is set or not.

Time Zone



The time zone enables you to tell the time in two places at once. It can be useful on holiday or business trips. Just programme the second time zone and it will be permanently recorded for your easy reference.

Chronograph

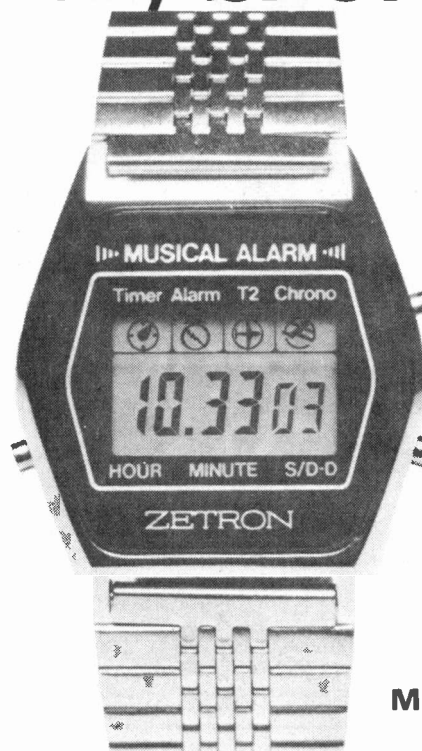


This watch incorporates a sophisticated and very accurate stop/start counter which has many applications in sporting events and timing for recordings etc.

Mode 1: Is the normal stop-watch mode. Stop-Start-Zero.

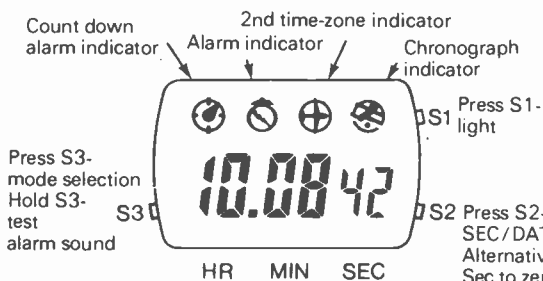
Mode 2: The lap timer enables first and second past the post times to be recorded. The display is frozen but the counter continues to count.

Mode 3: Longer timing intervals, such as journey times, can be recorded whilst the watch is reading its normal time, or the count-down is being used. The counter counts to 1 hour in 1/100 sec. steps in all its modes.



MODEL M30

Display Format (NORMAL TIME DISPLAY)



5 independent working modes

- i) Normal watch
- ii) Count down alarm
- iii) Alarm
- iv) Dual time zone
- v) 1/100 sec. chronograph

Display indicators (not all shown)

A very impressive new watch at a superbly low price from Metac. This super slim watch is only 7mm thick (that's thinner than most mechanical tick-tocks), but its micro-processor heart packs 34 different features.

In addition to those listed on the left the watch can display the day of the week in French or German or English (just select the one that suits you).

It has fast and slow setting rates for the counter and the alarm as well as the normal time setting.

There are 7 display indicators, 6 digits and a back light for night viewing. The 5 working modes are independent of each other, and the watch can be operated in all 5 modes at once.

FOR ORDERING INFORMATION PLEASE SEE OVER

Metac

**ELECTRONICS
& TIME CENTRES**

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

**QUARTZ LCD
5 Function**

Hours, mins, secs, month, date, auto calendar, back light, fully adjustable bracelet to fit all wrists.

£6.65

Guaranteed same day despatch.

Very slim, only 6mm thick.




M1

**SOLAR QUARTZ LCD
5 Function**

Genuine solar panel with battery back-up
Hours, mins, secs
Day/date
Fully adjustable bracelet
Back-light
Only 7mm thick

£8.65

Guaranteed same day despatch




M2

**QUARTZ LCD
11 Function** SLIM CHRONO

6 digit, 11 functions.
Hours, mins, secs., day, date, day of week
1/100th, 1/10th, secs.: 10X secs., mins.
Split and lap modes.
Back-light, auto calendar Only 8mm thick
Stainless steel bracelet and back
Adjustable bracelet
Metac Price

£10.65 Thousands sold!

Guaranteed same day despatch




M3

**QUARTZ LCD
ALARM 7 Function**

Alarm
Hours, mins, secs
Month, date, day
6 digits, 3 flags
plus continuous display of day and date
or seconds
Back-light
Only 9mm thick

£12.65

Guaranteed same day despatch




M4

**MULTI ALARM
6 Digits
10 Functions**

- * Hours, mins, secs
- * Month, date, day
- * Basic alarm
- * Memory date alarm
- * Timer alarm with dual time and 5 country zone
- * Back light
- * 8mm thick

£18.65



M5


**FRONT-BUTTON ALARM
Chrono Dual Time**

6 digits, 5 flags, 22 functions.
Constant display of hours and mins, plus optional seconds or date display
AM/PM indication
Month, date
Continuous display of day
Stop-watch to 12 hours 59 9 secs
in 1/10 second steps
Split and lap timing modes
Dual time zones
Only 8mm thick
Back-light

Fully adjustable open bracelet

£22.65

Guaranteed same day despatch.



M6

**SOLAR QUARTZ LCD
Chronograph with Alarm
Dual Time Zone Facility**

6 digits, 5 flags, 22 functions.
Solar panel with battery back-up
6 basic functions
stop-watch to 12 hours 59 9 secs
in 1/10 sec steps
Split and lap timing modes
Dual time zones
Alarm
9mm thick
Back-light
Fully adjustable bracelet

£27.95




M7

**ALARM CHRONO
with 9 World
Time Zones**

- * 6 digits, 5 flags.
- * 6 basic functions
- * 8 further time zones
- * Count-down alarm
- * Stop-watch to 12 hours 59 9 secs in 1/10 sec steps
- * Split and lap timing modes
- * Alarm
- * 9mm thick
- * Back-light
- * Fully adjustable bracelet

£29.65




M8

**SOLAR QUARTZ LCD
Chronograph**

Powered from solar panel with battery back-up
6 digit, 11 functions
Hours, mins, secs, day date, day of week
1/100th, 1/10th secs
10X secs, mins
Split and lap modes
Back light Auto calendar Only 8mm thick
Stainless steel bracelet and back
Adjustable bracelet
Metac Price

£13.65 Guaranteed same day despatch



M9

**LADIES DAY WATCH
QUARTZ LCD**

Ladies Day Watch only 25x20mm and 6mm thick.
Hours, minutes, seconds, day, date, backlight and auto calendar.
Elegant metal bracelet in silver or gold fully adjustable to suit very slim wrists.
State colour preference.

£9.95 Guaranteed same day despatch



M15

**LADIES FASHION WATCH
QUARTZ LCD**

Lady's Fashion Watch. Elegant bracelet in bronze/gold finish or silver colour. Hours, minutes, seconds, day, date, backlight and auto calendar. Adjustable for the slimmest of wrists.
State colour preference.

£14.95 Guaranteed same day despatch



M17

**LADIES COCKTAIL WATCH
QUARTZ LCD**

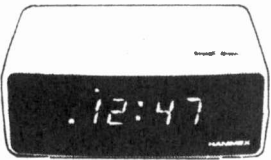
Lady's Cocktail Watch Highly functional watch which also suits those special occasions. Beautifully designed with a very thin bracelet which retains strength as well as elegance
Hours, mins., secs., day, date, backlight and autocalendar
Bracelet fully adjustable to suit slim wrists.
State gold or silver finish

£19.95 Guaranteed same day despatch



M18

**HANIMEX
Electronic
LED Alarm Clock**



Features and Specification
Hour/minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on/off control. Display flashing for power loss indication. Repeatable 9-minute snooze. Display bright/dim modes control. Size 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm)
Weight: 1.43 lbs (0.65 kg)

£10.20 Thousands sold!
Mains operated.

Guaranteed same day despatch.

M13

**EXECUTIVE
ALARM WATCH**

6 functions plus alarm
Conference signal, 5 minute snooze alarm.
Conference signal sounds 4 secs. before main alarm to give advance warning and option to cancel.
Snooze sounds 5 mins. after main alarm and is always preceded by the conference signal

£14.95



M60

**MACY QUARTZ
ANALOGUE**

Automatic calendar day and date, infinite bracelet. This man's watch has elegance as well as the robust appearance provided by a watch with traditional features
Accuracy is provided by a quartz crystal powered by a long life miniature battery

£24.95



M21

Metac price breakthrough for an Alarm Chronograph with Dual Time
Only: 16.95



OUTSTANDING FEATURES

- * **DUAL TIME.** Local time always visible and you can set and recall any other time zone (such as GMT)
- * Also has a light for night viewing
- * **CALENDAR FUNCTIONS** include the date and day in each time zone.
- * **CHRONOGRAPH/STOPWATCH** displays up to 12 hours, 59 minutes and 59 9 seconds
On command, stopwatch display freezes to show intermediate (split/lap) time while stopwatch continues to run
Can also switch to and from timekeeping and stopwatch modes without affecting either's operation
- * **ALARM** can be set to any time within a 24-hour period. At the designated time a pleasant, but effective buzzer sounds to remind or awaken you!

Guaranteed same day despatch

M16

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and order details clearly, enclose 40 pence per single item for post and packing or the amount stated in the advert. All products carry 1 year written guarantee and full money-back 10 day reassurance. Battery fitting and electronic calibration service is available to customers at any Metac shop. All prices include VAT currently at 15%

Metac Wholesale:
Trade enquiries — send for a complete list of prices for all the goods advertised plus many more not shown also minimum order details
Telephone orders Credit card customers can telephone orders direct to Daventry (03272) 76545 or Edgware Road 01-723 4753 24 hours a day

Service Enquiries: 03272-77659
CALLERS WELCOME. Shops open 9.30am-6.00pm.




Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

SEIKO MEMORY BANK

Calendar watch M354
Hours, mins., secs.
Month, day, date in
12 or 24 hour format
all indicated continuously.
Monthly calendar display
month, year and all dates
or any selected month over
80 year period.
Memory bank function.
Any desired dates up to 11
can be stored in advance.
2 year battery life.
Water resistant.



Metac Price **£79.50** **M11**

SEIKO ALARM CHRONOGRAPH

With WEEKLY Alarm.
Hours, mins, Secs,
month, date, day,
am/pm.
Weekly alarm — can
be set for every day at
designated time, e.g.
6.30am on Mon.,
Wed. and Friday.
Alarm set time
displayed above time
of day.
Full stopwatch
functions, laptime,
split, etc.



Price **£89.95** **M10**

SEIKO MELODY ALARM CHRONOGRAPH

Chiming Alarm, plus
chrono. Hours, mins,
secs, date, day,
24-hour alarm, 12
hour chronograph,
1/10th secs, laptime,
back light, stainless
steel, mineral glass.

Metac Price **£92.95** **M19**

SEIKO CALCULATOR WATCH

Full specification
calculator with
memory, plus multi
function watch.
Hours, mins, secs,
day, date, backlight.
Automatic calendar.
Long-life battery.



Price **£96.20** **M27**

CASIO CHRONO 95QS-3LB

Stainless steel case,
water resistant to 66
feet. Hours, mins, secs,
am/pm, year, month,
date, day. Auto-calendar
pre-programmed until
year 2029. 12/24 hour
stopwatch function.
Range 7 hours, 1/100
sec. (Mode). Net
time/lap-time/1st-2nd
place times. Dual time
function. Accuracy
15secs. per month.
Battery life approx. 4
years.



Price **£23.95** **M22**

CASIO LADIES 86CL-23B-1

Elegant slim line stainless
steel bracelet, fully
adjustable. Hours, mins,
10 sec. symbol second by
flash, am/pm. Month,
date, day. Auto-calendar
pre-programmed for 28th
day in Feb. Accuracy per
month 15 secs., battery life
approx. 15 months.



Price **£37.95** **M23**

CASIO F-200 SPORTS CHRONO

Attractive man's watch
in black resin with
mineral glass. Hours,
mins, secs, am/pm.
Month, date,
alpha-numeric day.
Auto-calendar set 28th
Feb. Stopwatch
working range 1 hour
units 1/100 sec.
Mode, Net time/lap
time/1st-2nd place
times. Accuracy
approx. 15 secs. per
month. Battery 12
months.



Price **£15.95** **M24**

CASIO ALARM CHRONO 81CS-36B

Hours, mins, secs,
day, and also day,
month and year
perpetual automatic
calendar. 100th sec.
chronograph to 7
hours. Net time/lap
time/1st and 2nd
place times. User
optional 12/24 hr.
display. 24 Alarm.
User optional, hourly
chime. Backlight,
mineral glass, stainless
steel. Water resistant to
100ft. Battery life
approx. 4 years.



Price **£35.95** **M25**

BELTIME CHRONOGRAPH

9 Functions
Hours, mins, secs,
day, date, month,
interchange feature,
automatic calendar,
backlight, net time/lap
time. Stainless steel
bracelet. Battery life 1
year.



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29 Functions
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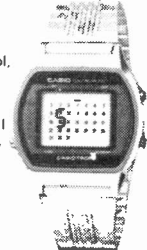
Hours, mins, secs,
am/pm, date, day.
Auto calendar set.
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function. Accuracy 15
secs. per month.
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years.



Price **£10.95** **M36**

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Month, date and day of the week. Stop-
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hours (minutes, secs, 1/100 secs up to
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measurement of two competitors. Stain-
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Price **£56.00** **M33**

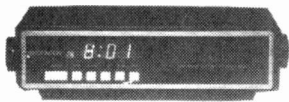
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DIGITAL CLOCK RADIO



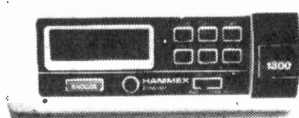
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M40

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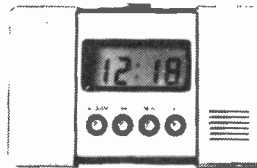


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★ Batteries supplied free.
★ Quartz crystal controlled

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M41

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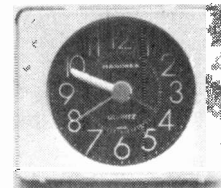
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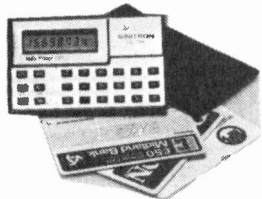


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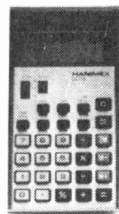


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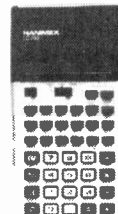


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M46

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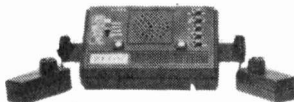


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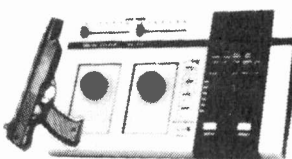
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M48

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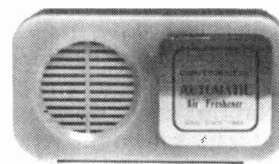
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M50

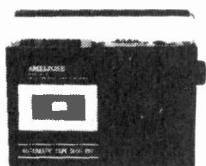
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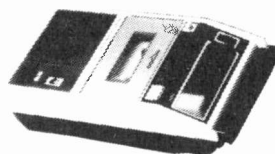
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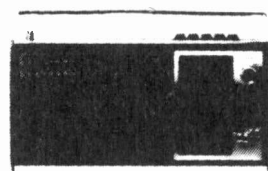
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KIRLIAN PHOTOGRAPHY

Unexplained phenomena on the fringe of established science have attracted a great deal of interest this century, but there is still no plausible theoretical framework to explain the observed events.

Two groups of phenomena that have come closer to explanation than most are first the observations and photographic records of mysterious lights and radiations around people and objects — called variously, radiation field photography, electrophotography, Kirlian effect, Human aura, St. Elmo's fire plus other names — and second acupuncture.

The Kirlian effect and acupuncture would seem as related as monkeys to stones but, as will be shown, they do seem to be complementary concepts. Belief in the existence of the human aura is very ancient. Medieval people distinguished four kinds of aura: 'Nimbus' and 'Halo' that stream from the head, 'Aureola' that issues from the whole body and 'Glory' which is both kinds combined. These were often featured in paintings. Others divide the aura into health, vital, Kharmic, aura of character and aura of spiritual nature.

Some people (clairvoyants particularly) claim to be able to see these effects without aids. The colours of the aura indicate the person's emotional and physical state.

The Old Testament bible relates how Moses was involved with a burning bush. Similar flames appeared as the "tongues of fire" that came upon the twelve apostles on the day of Pentecost.

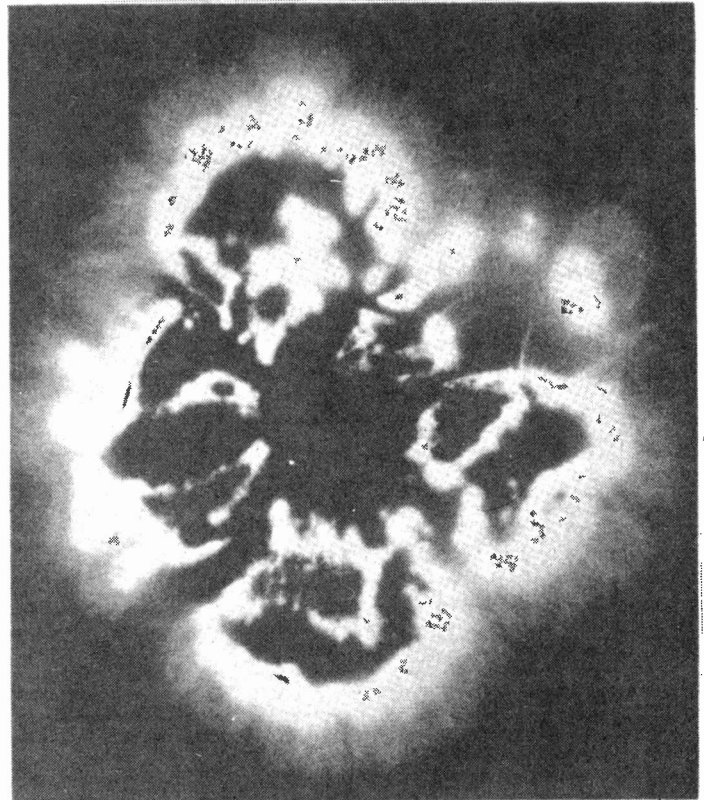
Sharp ends of extended objects — ships masts, yard-arms, church steeples, airplane wingtips — in free air often exhibit this mysterious fire. This became known as St. Elmo's Fire after the martyred Italian bishop who became patron saint of sailors. Other names used include Castor and Pollux, Dioscuri, Corpusant and Fermie's Fire.

Recently this is said to be static electric discharge — corona discharge. A bluish glow was photographed around Pete Conrad the astronaut, when he landed on the Moon from Apollo 12 in 1970.

We all have, no doubt, experienced being charged-up on dry days. There are recorded instances of people who have the ability to deliver powerful electric charges who also have electro-magnetic properties enabling them to suspend magnetic materials.

Electrical storms have been known to produce images, (a rainbow in one case and pictures of people in others) semi-permanently formed in glass window panes. This is called lightning photography.

In psychic photography, photographs of people, sometimes of people long departed, have appeared on plates. It is suggested that there exists another energy form



Kirlian photograph of an oleander flower. The flesh of the flower in contact with the photographic film is indicated by the dark portions.

to electro-magnetic radiation. It is usually called bio-energy, the name coined by Czechoslovakian parapsychologists.

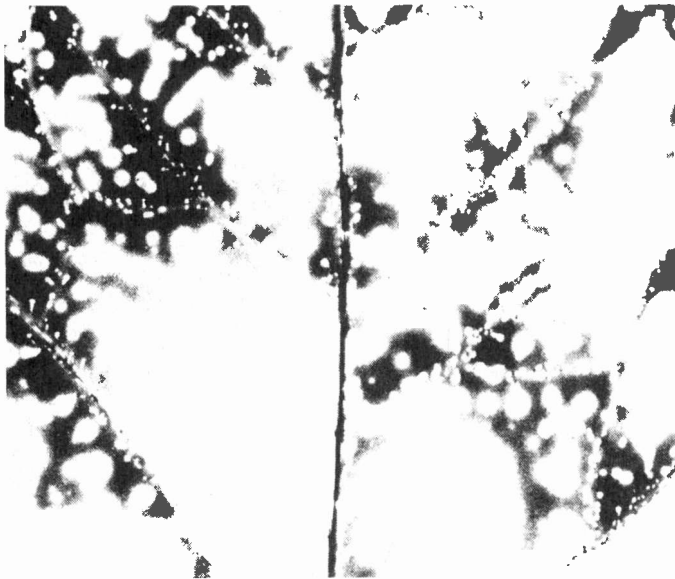
Electro-photography

Electro-photography is as old as the availability of photographic emulsions that could record the existence of radiations. A case dated 1842 is the oldest. Yakov Narkevich-Todko showed photographs taken using electrical discharges in 1898. A 1926 book by C. Hall "Triumphs of invention," contains "A photograph of the Eiffel Tower taken during the dispatch of wireless time-

signals. The ultra-violet radiations, although invisible to the naked eye, appear luminous on the photographic plate."

This kind of detection has become known as Kirlian photography after release of the work, in 1958, of the Russians Semyon and Valentina Kirlian. At first, interest in the Western World was minimal but it gained followers especially from 1970 onward.

In the West, one man responsible for assisting this interest to flourish is Kendall Johnson, who, it seems, was the dominant person in the US to obtain Kirlian pictures of objects. ("The Living Aura" by K. Johnson, Hawthorn Books, New York, 1975, is a *must* to read.) There were some earlier accounts of success in the US — one was published in 1938.



Kendall Johnson's first radiation field photograph, taken in 1971 using surplus electrical parts. The subject was a leaf.

Having accepted that there is little mysterious in Kirlian photographs, researchers are now concentrating on trying to resolve whether or not the pictures have recorded more than mere electro-magnetic radiation effects. Do they contain evidence of bio-energy? Does some new form of energy exist to be explained?

The Practice of Kirlian Photography

In the simplest form of electrophotography, an unexposed photographic film is placed on top of an electrode plate with the emulsion uppermost. Onto this is placed the subject to be photographed — a coin, leaf or person's finger or hand. High voltage is applied to the top of the object and discharged through the object and photo-emulsion to the other plate. Clearly the high voltage source must not be of lethal extent if used directly on the body.

Body-part photographs can be made using the static charge built up on a person who shuffles around on a synthetic carpet in a dry room. The use of any other active voltage source for bodypart pictures can be a most dangerous practice. It is strongly advised that you experiment with objects such as leaves, coins, flowers, metal shapes and liquid drops, unless you know about the safe use of electrical sensing equipment in electro-medical applications.

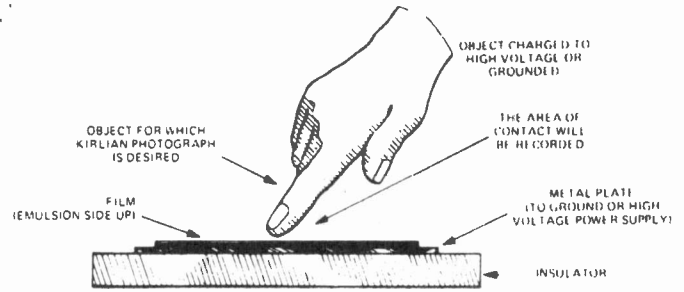


Fig. 1. A simple method for making Kirlian photographs of fingertips using static charge built up on the body.

Photographs can be obtained using DC charge, a burst of audio frequency high voltage or a single short pulse. Just about every combination appears to have been tried. Finding the right combination of film type and speed and source characteristics apparently can be time consuming as each object will need different settings. Results have been obtained using Tesla coils without and with spark-gaps (in which case RF is generated), Van de Graaf generators, charged capacitors and the charge of a person. Wei, in a paper in the Journal of Applied Physics, Volume 47, p. 4437-4441 reported using a propriety electric photography set made by Edmund Scientific. This provides voltages up to a maximum of 20W in the frequency range 3-50 kHz. The set allows the user to vary voltage, frequency, pulse width, pulse repetition frequency, and time. He also found that a spring-release piezo-electric generator, which supplies a 10 uS pulse of 19 kV, was suitable as a source for his work with metal grids. It is likely that the larger style piezo-electric gas lighters might suffice. Wei used ASA 3000 film (Polaroid 87) in his work.

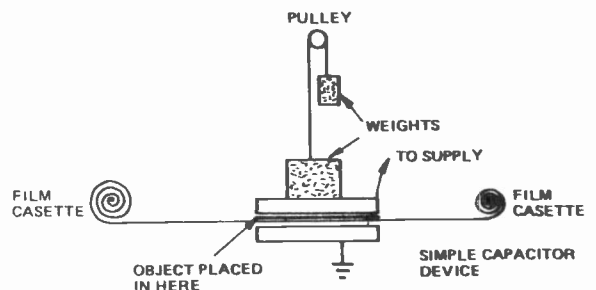


Fig. 2. Roll film can be used to record a Kirlian image. This method requires complete darkness to make the exposure.

Boyers and Tiller (J. Appl. Phys., Volume 44, 3102-3112, 1973) typically used 100 uS pulses of bipolar 1 MHz signal having amplitudes varying from 20 to 100 kV. They derived this by driving an Oudin resonator coil (details given in their book) from a modified radio transmitter. They found that each pulse produced different streamer configurations, these tending to expose the film uniformly when a string of pulses was used as excitation. They also established that the surface composition, smoothness, topography, inter-electrode spacing and parallelism of electrodes were each important factors having bearing on the results obtained. They also experimented with colour films, effects produced depending very much on the method of use and the type of film used.

A description of how to build a simple set of equipment is given in Johnson's book "The Living Aura." Another work "High voltage photography" by H. S. Dakin, ▶

published by Edmund Scientific Company, Barrington, New Jersey, USA in 1975 provides circuitry details.

Many different arrangements of film and object position have been used. The film speed number — the ASA or DIN rating — is of little value as the energy exposing the emulsion is quite different from that for which the film-speed rating is assessed. Different films produce different results.

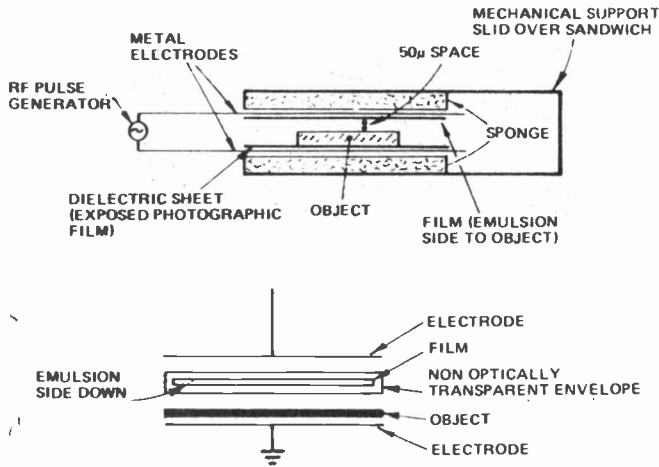


Fig. 3. Two methods of enclosing film to produce Kirlian photographs in a lighted room.

Defined Effects

Many variables exist to alter the characteristics of a Kirlian effect photograph. Even so, certain effects appear to have been established, giving electrophotography an intriguing nature.

It is said that live leaves and small animals produce a much clearer image, of higher contrast, than when they are dead — the energy image is said to reduce as the leaf loses its life.

Another claim is that a piece torn from a leaf still shows as present in a photograph of the remainder. This is termed the phantom or cut-leaf effect. (This is not to be lightly dismissed, for in the image storage method of holography the hologram plate can be broken and any piece from any position will still produce the same complete 3-D image).

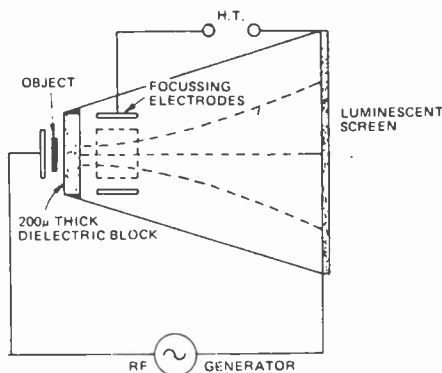
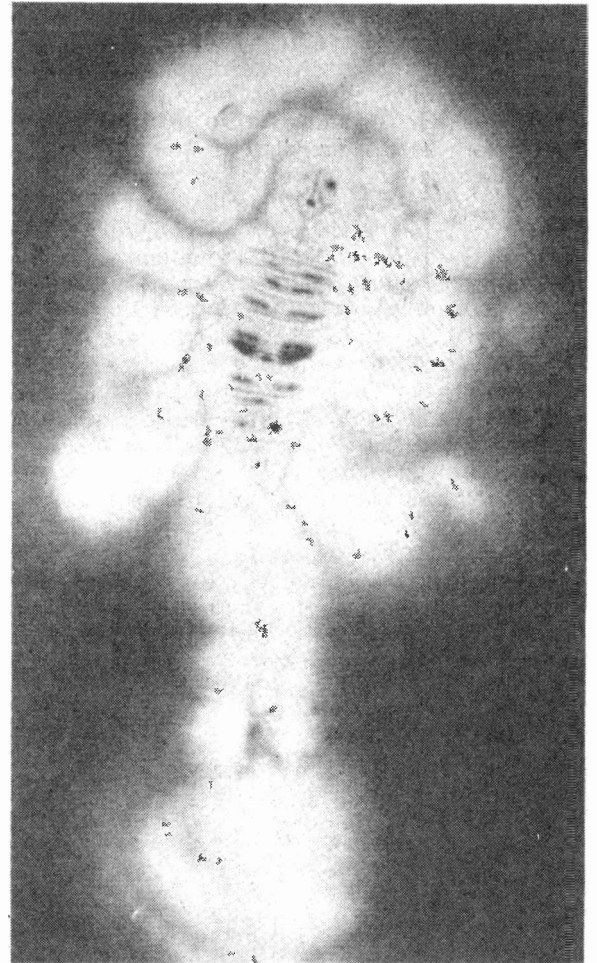


Fig. 4. A cathode ray tube arrangement for displaying a picture of the field around the object being examined.



The Kirlian aura of a live scorpion. The live parts in the centre of the outline are portions of the arachnid's abdomen in contact with the photographic plate.

It is also said that psychic healers' finger pads produce a more brilliant image when healing is in process compared with when it is not. As Johnson states: "Do the images show an energy transfer between healer and subject? Is there some informational exchange going on, resulting in the different energy representation of the finger pads?"

This also is quite plausible for we accept that information can only be transferred in a physical system when an energy (or mass) carrier exists to convey the data.

Evidence, in the form of Kirlian photographs, has been obtained implying that people with "green-thumbs" have properties that assist repairing damaged plant tissue.

Electro-photographs are certainly artistic and often pleasing to behold. Perhaps they do demonstrate some form of energy unknown to man.

Acupuncture

What in the world have electro-photography and acupuncture in common? Why stage an international conference on this joint theme? The first Western Hemisphere Conference on "Kirlian Photography, Acupuncture and the Human Aura" was held in New York City in 1972. Papers were read by authors from the Soviet Union, Canada, France,

Japan, United Kingdom, Eire and the United States. Letters were received from Czechoslovakia and other countries.

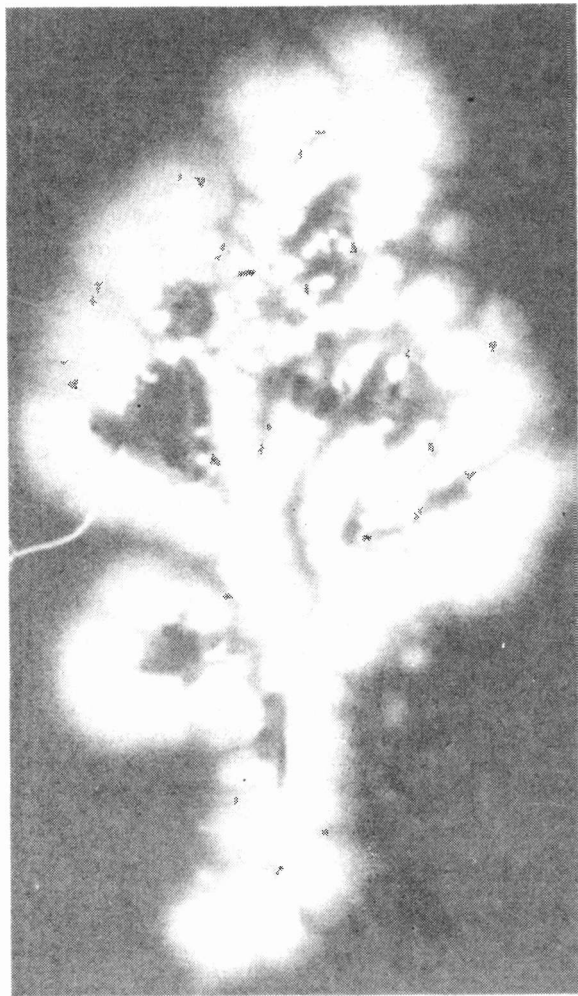
Kirlian photography is concerned with the properties of objects to modify and transmit energy fields — which are certainly of electro-magnetic kind — but may also be of some other, yet unexplained, information-linking nature.

Acupuncture is a Chinese art of healing, using needles inserted into the body at certain places called acupuncture points. It is a very ancient art and has been continuously practised, with effect, in the Asian regions.

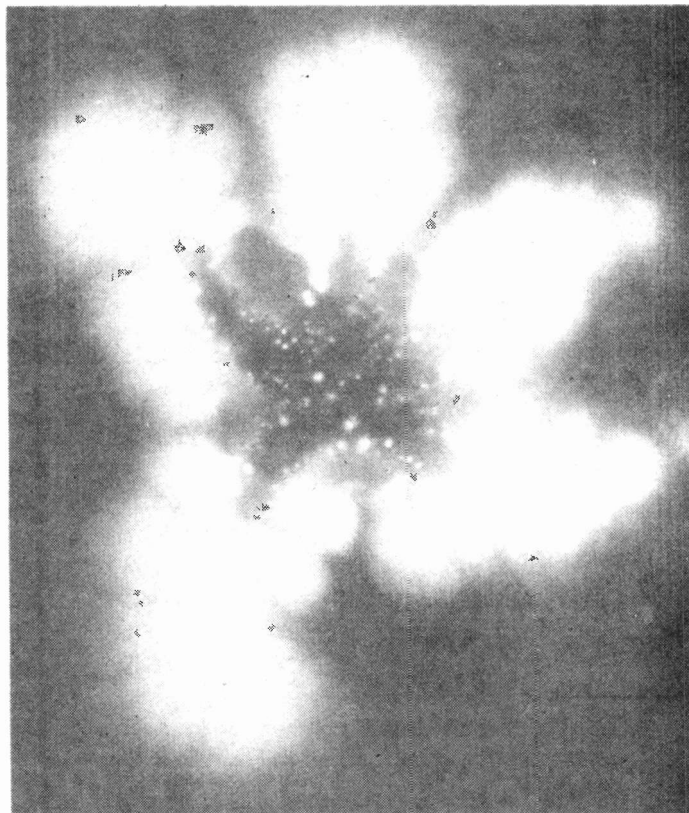
The Western attitude to medicine and healing has, until recently, been sceptical towards acupuncture because it cannot be adequately explained by Western science. Considerable evidence now proves that there is much about the body that can be controlled. Yogis are able to perform quite amazing variations of bodily function. Somehow the insertion of needles, in various numbers, places and depths can cure many ailments.

Bio-feedback is an apparently 'understandable' technology. Brendan O'Regan, of the Design Science Institute, Washington DC., wrote in 1973:

"Presumably, we in the West believe our senses only as their impressions are verified by the machines we create." It is in this light that Kirlian photography relates to acupuncture as well as to many other subjects.



The Kirlian aura of a seafern.



Radiation field of a 'Jewel of the Ocean' starfish. Fine structure of the field is evident at the extremities of the creature.

Several workers have reported that Kirlian effects are especially intense over known acupuncture points. Furthermore, some people have built probes — called tobiscopes — that indicate their position.

It is claimed that acupuncture can be established by moving electrodes over the body and observing the signal processed by an electro-physiological high-gain amplifier. The extent of the reading is said to also indicate the energy level of that particular acupuncture energy circuit. A 1971 Russian tobiscope, by Adamenko detects skin resistance changes that are claimed to drop from around the normal 1M down to 50-100 kilohm at an acupuncture point.

Related Reading

"Psychic discoveries behind the Iron Curtain" S. Ostrander and L. Schroeder, Prentice Hall, 1971.

"Galaxies of life — the Human Aura in Acupuncture and Kirlian photography" S. Krippner, Interface, New York, 1973.

"Photography records electrical phenomena." Electrical Construction and Maintenance" Volume 75, 86, 1967.

"Instant imaging of electric, radio and acoustic fields" W. G. Hyzer, Optical Engineering, Volume 17, SR-3, 1978.

"Handbook of Unusual Natural Phenomena" W. R. Corliss, Sourcebook Project, Glen Arm, USA, 1977. **ETI**

electronics today

international

What to look for in the February issue: on sale January 2nd

CMOS 555

Now you all know about the CMOS version of the 555 timer chip — because we told you about it last month in *Designers Notebook*, so no excuses in the back row please.

Only thing to do now was to get Tim Orr, the country's leading circuit man, to spend a few eons playing with the device and produce one of his superb circuit filled features all across ETI's pages next month. This is good stuff of the highest quality. Be there with your soldering irons, there are circuits for just about everything under the sun — and if we can find a heater element big enough we'll see you with a design for one of them next year.

ONE FIVE THREE SEVEN

Whatdeyer mean that you've never heard of this? Of course you have. It's a brilliant Voltage Controlled Attenuator thingy for which Keith Brindley will explain at least a million applications and designs next month. Well, not actually a million but quite a few. He also gives you a breadboard design to go away and do your own things with. What more could you possibly want? Stand up the boy in the back who said "Felicity Kendal".

MODULAR SYNTHESISER

Next month ETI presents a new series of synthesiser circuit modules which represent the forefront of modern music technology. Not only that but they're a bit new as well. And somewhat of a departure for us. The complete design will be a sophisticated machine comparable to the very best available today at any price and with more facilities than the Playboy Club.

However we are aware that not everyone has a use for such a machine, and that there are a large number of you out there who wish to experiment with sound effects circuits, without the requirement for a fully fledged synthesiser system. And So...

Our latest machine will be presented in modular form, with each separate unit mounted on a 'front panel' assembly, and housed in a common box. As the PSU requirements will be standardised, you can build as many — or as few — of these superb designs as you need when you need them.

CASIO FX502P/FA1

The best thing since sliced bread. Honest. If you don't believe us read our comprehensive report on this ten program 256 step, 100 label, cassette jumping calculator and music adaptor in next month's ETI.

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CASSETTE HEAD DEMAGNETISER

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Apart from that though this *is* a good idea — demagnetising your cassette player heads reduces all the nasty things that you don't really wanna hear anyway and makes those that you do sound even better.

Ours naturally has something a bit special about it — something that makes it both easy to use and more effective. But we're not gonna tell you what cos we want yer to buy next month's magazine instead!

VMOS 2M PA

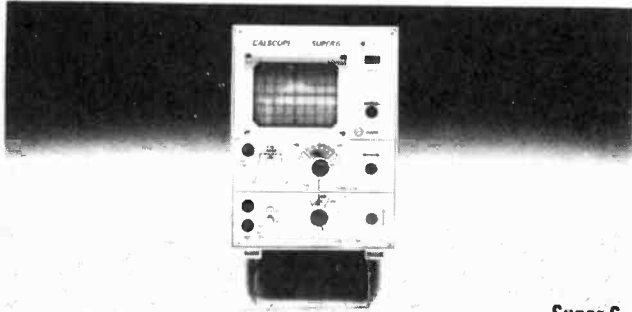
One for all the hams of this world. Put some POWER in your words with our VFET Power Amp. Based on the latest circuit techniques this is a design to burn out the receivers of the universe. Don't just broadcast — BROADCAST with ETI!

SIGNAL TRACER

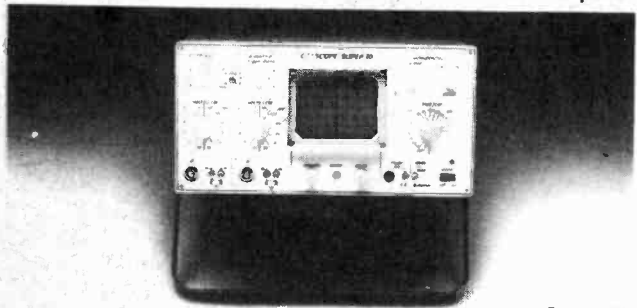
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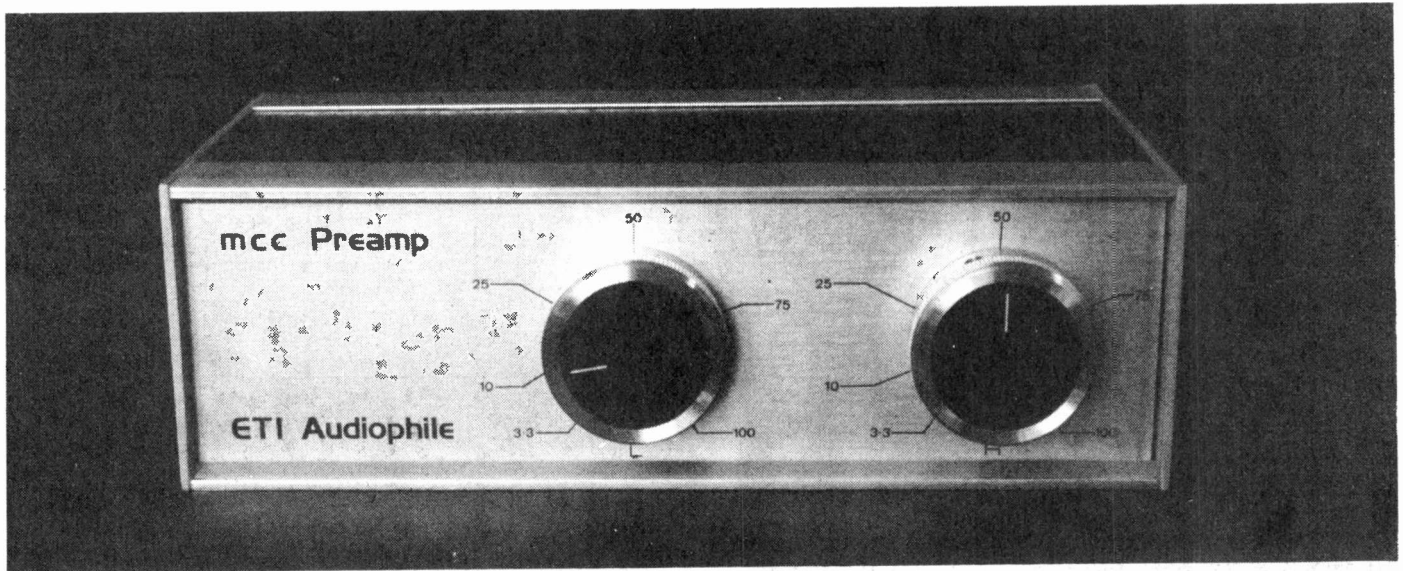
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MOVING COIL PREAMPLIFIER



A design of the highest fidelity, styled to match our amp, which is capable of bringing the best from those mobile windings.

Over the last several years there has been a dramatic increase in the number of moving coil cartridges released. The design of this type of cartridge results in a number of advantages which works on a moving magnet principle.

The pick-up coils are reduced drastically in size and weight compared to the coils used in moving magnet cartridges. This results in a total cantilever weight that is much smaller than in the typical moving magnet cartridge. Since the weight is greatly reduced the ability of the stylus to react to transients is increased and an overall improvement in signal accuracy results. Moving coil cartridges generally have superior frequency response characteristics and improved phase response at high frequencies. But they also have disadvantages.

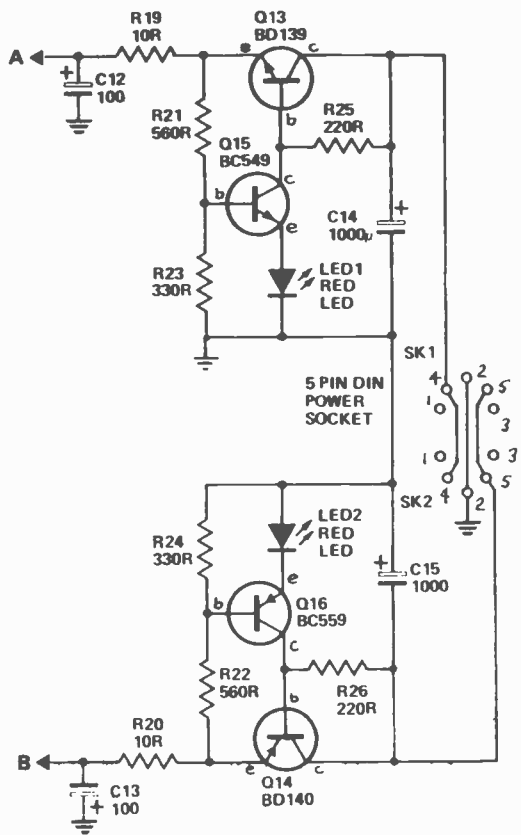
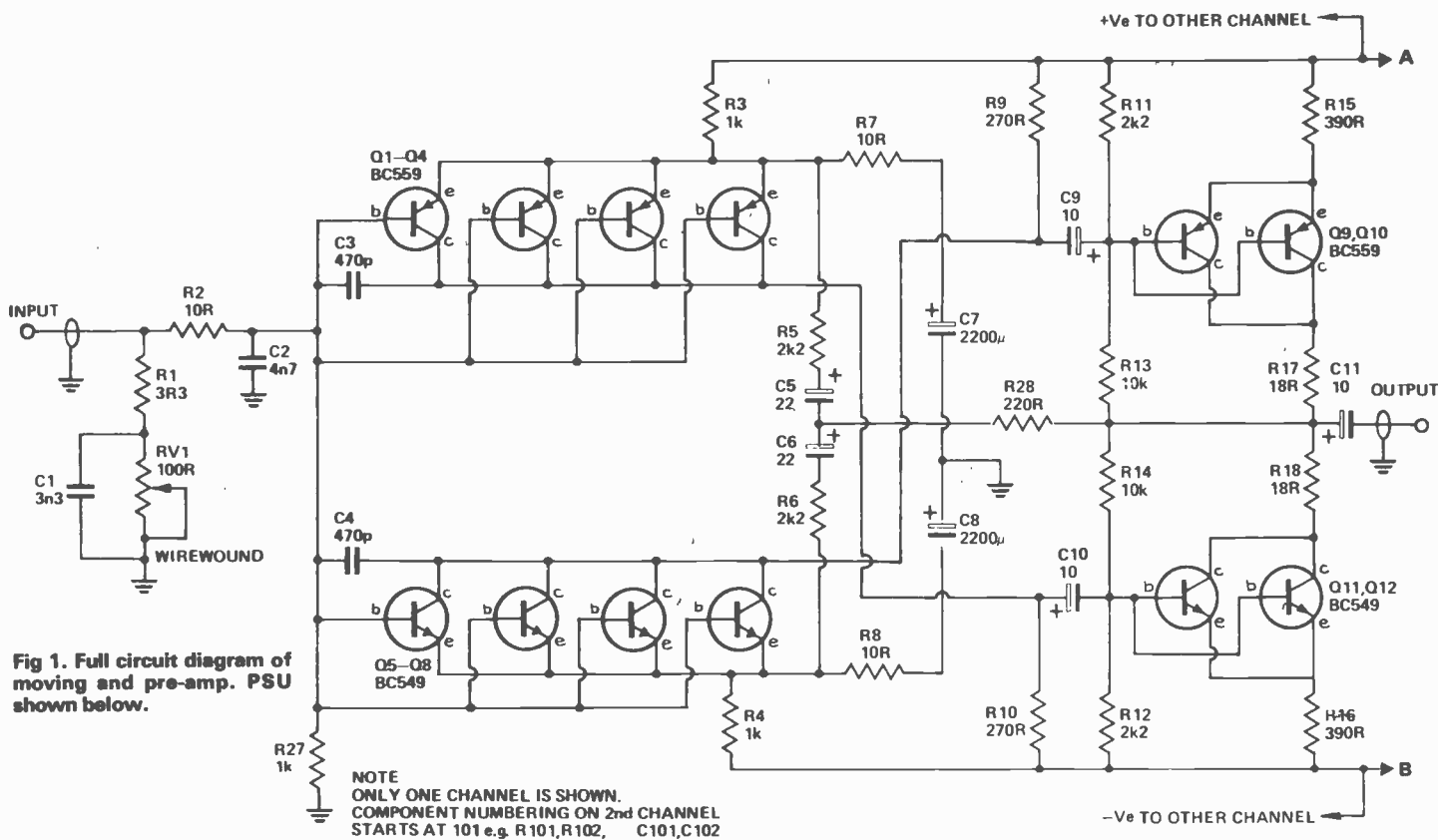
The small pick-up coils have a very low impedance resulting in much

lower signal levels than available from normal phono cartridges. In fact, the voltages present on the typical moving-coil cartridge at a recording velocity of 10 cm/sec can be in the order of $150\mu\text{V}$! This is generally insufficient to drive an amplifier to anything like full power. Furthermore, since the output level is some 30 dB below that expected by the amplifier then a great reduction in the signal-to-noise ratio will result. An amplifier with a short circuit signal to noise ratio of 80 dB for example, which is quite a good figure, will end up with a signal to noise ratio of about 50 dB — which is distinctly *bad*.

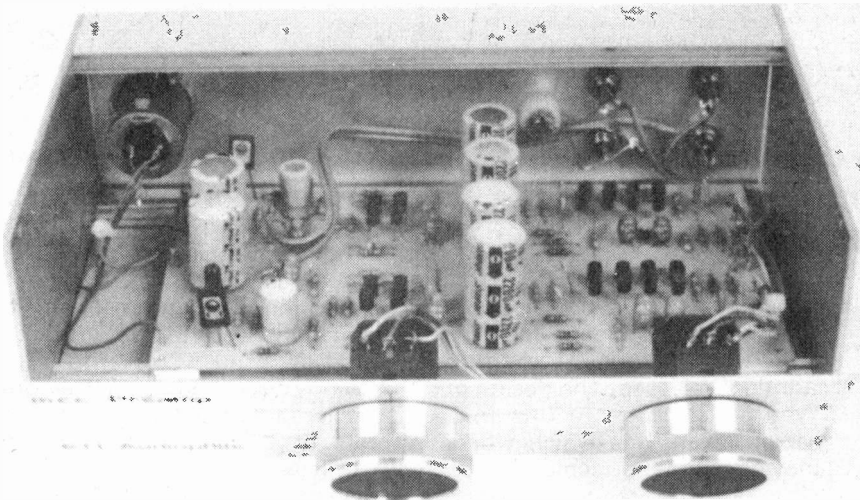
The internal impedance of moving-coil cartridges is around 5 ohms and to achieve the low recommended load impedance required it is clearly not satisfactory to simply load down the input of the average phono input with a resistor since this does nothing to overcome the signal-to-

noise ratio problems.

The solution to these problems is to insert some voltage gain between the output of the cartridge and the phono input. This can be done in two ways. Firstly, it is possible to use a transformer to boost the voltages up to the desired level and they are capable of very good results. But, transformers are still limited to transient performance and noise. To obtain the necessary voltage gain the turns ratio must be relatively high. Since the impedance ratio is related to the square of the turns ratio, the output impedance must, of necessity, be high also — usually around 30 k for a 50Ω input impedance. This is substantially higher than the output impedance of normal phono cartridges and degrades the noise figure of the phono input stage. A solution to this is to use a pre-amplifier instead of a transformer to achieve the necessary voltage gain. ►



Above right: Internal view of one of our prototype units.



SPECIFICATION

Gain	28dB (x25 approx).
Frequency response	29Hz to 48kHz ± 1dB.
Input impedance	Adjustable 3.3 to 100 ohms.
Noise	Total equivalent input noise 0.3nV/Hz. Over a 20kHz noise bandwidth —42nV. Signal-to-noise ratio, with respect to an input level of 150µV: —71dB.
Total Harmonic distortion	With respect to an input level of 0.2mV, unmeasurable (below noise). Calculated to be 0.0015% (see text). Rising to 0.015% for a 30mV input signal at 1kHz.
Channel separation	Better than 61dB.
Input overload margin	Better than 80dB.

HOW IT WORKS

The input stage consists of Q1 to Q8 plus associated circuitry. Q1 to Q4 and Q5 to Q8 are in parallel to reduce the current density providing a low input impedance stage having very low noise.

The required low input impedance can be achieved in several ways. Firstly, we can make the input stage a common base configuration. In this type of circuit the input is connected to the emitter of the transistor so that the input impedance is determined by the emitter resistor in parallel with the base-emitter junction of the input transistor, which can be quite low. However, this does not solve the problem of input stage noise.

The other possibility, and the one we elected to use in this design, is common emitter configuration. The impedance of the base-emitter junction of a bipolar transistor is a function of the amount of current flowing in the emitter of the transistor. This will be largely determined by the collector current and not by the base current, which will contribute only a small amount of the total emitter current. A study of base-emitter junction is approximately equal to:

$$\frac{26\beta}{I_e \text{ (mA)}}$$

where ' β ' is the small signal current gain of the transistor, and ' I_e ' is the current in the emitter of the transistor in mA.

So, to reduce the input impedance of the first stage it is simply necessary to increase the emitter current. But this increases the current density in the input transistors, increasing the noise generated by the input stage.

To understand why this happens it is necessary to look more closely at the causes of noise.

Noise

There are two main sources of noise in transistors: shot noise and I/f noise. Shot noise is the main cause of noise at middle and high frequencies and is generated when an electron attempts to cross a potential barrier. It is therefore directly related to the amount of charge flowing in the device. More specifically, it is given by the equation:

$$I_s^2 = 2qI_{dc}B \text{ (amps)}^2$$

(mean shot noise current) where ' q ' is the charge of an electron, in coulombs, ' I_{dc} ' is the DC current in amps, and ' B ' is the noise bandwidth in Hz.

I/f noise has a random amplitude like shot noise but its spectral density has a 1/f characteristic. This means that the noise amplitude increases as frequency decreases and becomes the dominant source of noise at low frequencies. As with shot noise, its equation reveals that it is directly related to the current flowing in the transistor.

$$I_f^2 = K \frac{(I_{dc})^2}{f} B$$

where ' I_{dc} ' is the DC current in amps ' K ' and ' a ' are constants that are a function of the particular device. ' f ' is the frequency in Hz, and ' B ' is the noise bandwidth. Notice that as I_{dc} is increased, so too is the I/f noise (I_f^2).

It is clear from this that, in order to keep noise generated by shot and I/f noise to a minimum, it is necessary to keep the current density in the input stage low. But, as we saw earlier, to obtain the necessary low input impedance we have to increase the emitter current. The solution to this is to use several transistors in parallel to form the input device. This decreases the current density in each of the transistors since the necessary emitter current can be shared by all of the input devices. It also places the impedances of the base-emitter junctions in parallel, further decreasing the input impedance of the first stage. Furthermore, since each transistor is a completely independent noise generator their noise voltage will tend to reduce each other (a process too complex to examine in detail here).

This configuration works very well and the noise levels of this preamplifier rival any of the commercially available units.

To see just how difficult it is to obtain a satisfactory signal to noise ratio at these signal levels it is necessary to look at another form of noise called 'thermal noise'. This is caused by the agitation of charged particles in any conductor due to their temperature. Every passive component will generate thermal noise and short of dunking the whole thing in liquid helium to cool it off, there is simply no way of getting rid of it. Thermal noise is given by the equation:

$$e_R^2 = 4kTRB \text{ volts}^2$$

where ' T ' is the temperature in degrees Kelvin (K).

' R ' is the value of the resistance.

' B ' is the noise bandwidth

' k ' is Boltzmann's constant, equal to 1.38×10^{-23} W-sec/K.

From this equation we can calculate the theoretical noise that will be generated by the moving coil cartridge itself. This clearly is the absolute lowest noise figure that is possible with the input stage generating no noise of its own (which is very unlikely!).

If we let the temperature of the transistor be 300 Kelvin (i.e.: mean atmospheric temperature) and the noise bandwidth be 20 kHz (the hi-fi audio band), then since the DC resistance of the cartridge is about 5 ohms the equation becomes:

$$e_R^2 = 4 \times (1.38 \times 10^{-23}) \times 300 \times 5 \times (20 \times 10^3)$$

$$\text{Therefore } e_R = 4.07 \times 10^{-6} \text{ volts or } 41 \text{ nV.}$$

So, the thermal noise of the cartridge itself is 41 nV.

Actually, this calculation is not quite right since the noise bandwidth is defined as having a 'brick wall' response. An amplifier with 3 dB point of 20 kHz that is falling at a rate of 6 dB per octave will actually have a noise bandwidth much greater than 20 kHz. Furthermore, if we want to be able to quote noise figures to enable comparison between different input stages, it is valuable to quote noise voltages independently of noise bandwidth. This can be done quite easily by dividing the noise voltage by the

square root of the bandwidth. The dimensions of this new figure will be "volts per root Hz", and our result for the thermal noise of a moving coil cartridge becomes:

$$\frac{41}{\sqrt{20000}} \text{ nV}/\sqrt{\text{Hz}}$$

or $0.29 \text{ nV}/\sqrt{\text{Hz}}$

Now, if we are aiming at a signal to noise ratio of 70 dB with respect to a signal voltage of 150 nV (0.15 mV), which is the expected signal level at a recording velocity of 10 cm/sec., then the equivalent input noise of the amplifier will be given by the equation:

$$-70 = 20 \log \left(\frac{N}{0.15 \times 10^{-3}} \right)$$

and is equal to $0.33 \text{ nV}/\sqrt{\text{Hz}}$.

The necessary equivalent input noise is in the same order of magnitude as the noise being generated by the cartridge itself!

The total equivalent input noise of this unit was measured at $0.3 \text{ nV}/\sqrt{\text{Hz}}$. With respect to a noise bandwidth of 20 kHz, this corresponds to an input noise of 42 nV, giving a signal to noise ratio with respect to an input signal of 150 nV (0.15 mV) of 71 dB. At this level, the noise generated by the cartridge itself will be one of the dominant noise sources.

Capacitor C1 and C2 fix the upper frequency roll-off characteristics as well as shunting the input with the desired load capacitance for the moving-coil cartridge. The configuration of R1 and R2, C1 and C2 was found to give the best loading for a variety of moving-coil cartridges.

The potentiometer RV1 allows the input impedance to be varied over the range most commonly recommended by cartridge manufacturers.

Negative feedback is applied via the network consisting of R28, capacitors C5 and C6 and resistors R5 and R6. Some degenerative feedback for the input stage is applied to the first stage by the emitter resistors R7 and R8. Capacitors C9 and C10 are coupling capacitors to the second stage while bias for this stage is determined by R11, R12, R13 and R14.

The power supply consists of a series regulator Q13 and Q14. The potential dividers R21/R23 and R22/R24 divide the voltage present at the output of the regulator and drive the transistors Q15 and Q16, and the LEDs. The transistor base-emitter junction in series with the LED will drop 0V6 + 1V65. Therefore, whenever the voltage present at the centre of the potential divider tries to increase above 2V3 the transistor increasingly, conducts decreasing drive to the pass transistors Q13 and Q14.

This is a relatively low noise regulator since the voltage reference is LED and not a zener diode which is a noisy device. Resistors R19 and R20, together with capacitors C12 and C13 form 6 dB per octave low-pass filters on the supply rails to further reduce noise that may be generated by the regulated supply. . .

PARTS LIST

Resistors All 1/2W, 5%

R1,101 3R3
 R2,102,7, 10R
 107,8,108,19,
 20.
 R3,103,4, 1k0
 104,27,127.
 R5,105,6, 2k2
 106,11,112,12,
 111.
 R9,10,109, 270R
 110.
 R13,113,14, 10k
 114.
 R15,115,16, 390R
 116.
 R17,117,18, 18R
 118.
 R21,22 560R
 R23,24 330R
 R25,26,28,
 128. 220R

Capacitors

C1,101 3n3 ceramic
 C2,102 4n7 ceramic
 C3,4,103,104 470p ceramic
 C5,6,105,106 22u 16V tantalum
 C7,8,107,108 2200u 25V electrolytic
 C9,11,109. 10u 16V tantalum
 111.
 C12,13 100u 25V electrolytic
 C14,15 1000u 25V electrolytic

Semiconductors

Q1-4,101-104, BC559
 9,10,109,110,
 16.
 Q5-8,105-108, BC549
 11,12,111,112,
 15.
 Q13 BD139
 Q14 BD140
 LED1,2 TIL209

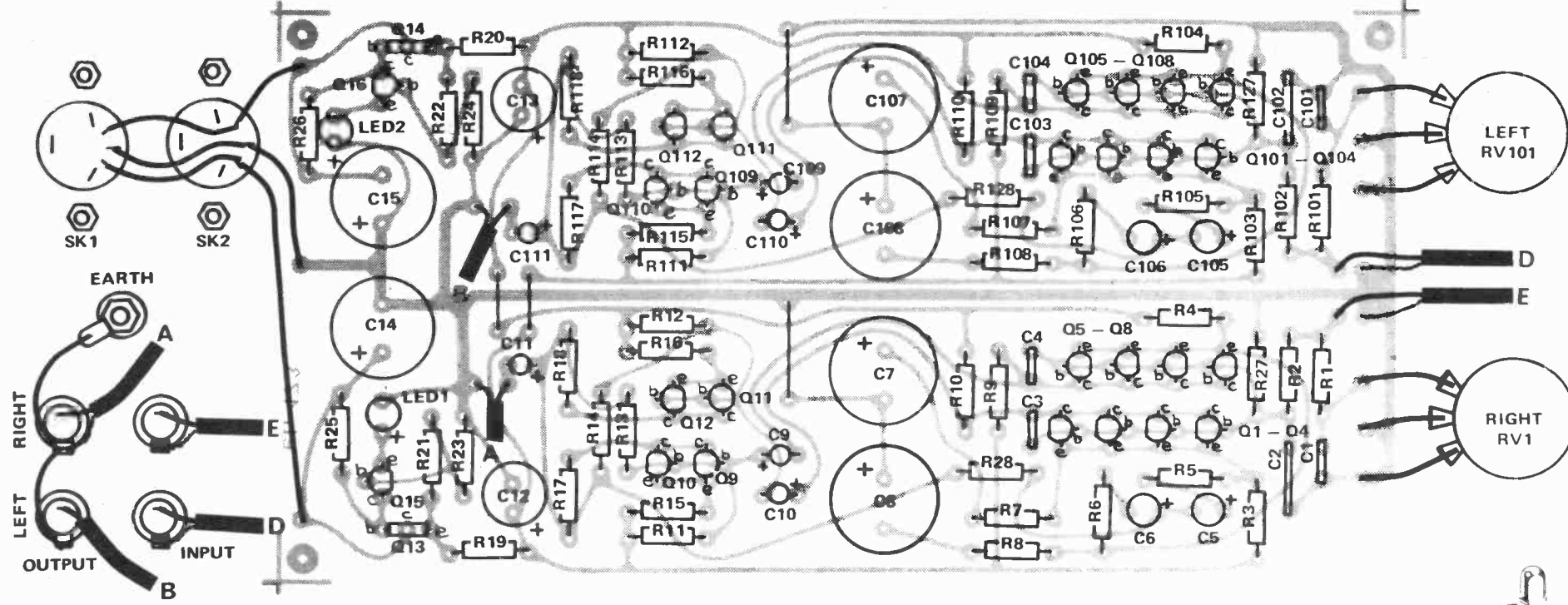
Potentiometers

RV1,101 100R linear
 (wirewound).

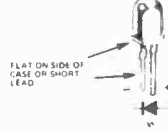
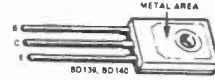
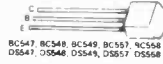
Fig 2. (Right). Component Overlay.

BUYLINES

The transistor types specified should not be substituted at all. In order to maintain performance keep to the parts list. The case used is in a matching style to our Audiophile amp, but probably a steel case would provide better screening. In practice ours worked well if properly sited (away from mains wiring). None of the components should prove troublesome to find. Case available from Boss Industries.



NOTE - SHIELD IS NOT CONNECTED FROM CABLE 'B' TO LEFT OUTPUT SOCKET



Preamp Requirements

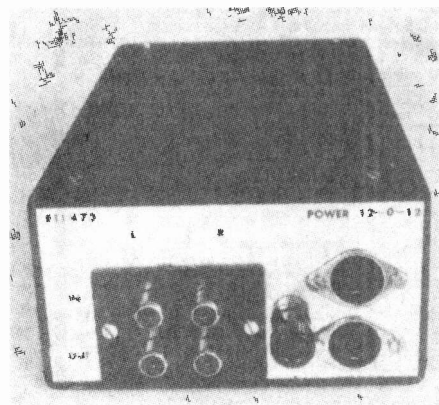
Preamplifiers have their disadvantages also. The biggest problem by far is the design of an extremely low noise input stage with the correct input impedance to load the cartridge according to the manufacturers' recommendations. The distortion must be kept to a minimum and the frequency response should be as flat as possible. These design goals are not unique to a moving coil cartridge preamplifier but they are difficult to achieve owing to the very low output voltage of the moving coil cartridge.

The required low input impedance can be achieved in several ways. Firstly, we can make the input stage a common base configuration. In this type of circuit the input is connected to the emitter of the transistor so that the input impedance is determined by the emitter resistor in parallel with the base-emitter junction of the input transistor, which can be quite low. However, this does not solve the problem of input stage noise.

The other possibility, and the one we elected to use in this design, is common emitter configuration. The impedance of the base-emitter junction of bipolar transistor is a function of the amount of current flowing in the emitter of the transistor. This will be largely determined by the collector current and not by the base current, which will contribute only a small amount of the total emitter current. A study of base-emitter turn-on characteristics shows that the impedance of the base-emitter junction is approximately equal to:

$$\frac{26\beta}{I_e \text{ (mA)}}$$

where ' β ' is the small signal current gain of the transistor and ' I_e ' is the current in the emitter of the transistor in mA.



Performance Features

The total equivalent input noise of this unit was measured at $0.3\text{nV}/\sqrt{\text{Hz}}$. With respect to a noise bandwidth of 20kHz, this corresponds to an input noise of 42nV, giving a signal to noise ratio with respect to an input signal of 150nV (0.15mV) of 71dB. At this level, the noise generated by the cartridge itself will be one of the dominant noise sources.

The circuit uses a symmetrical configuration with NPN and PNP transistors set up in such a way that asymmetrical distortions tend to cancel. Normally distortion products are generated differently for positive and negative signal excursions and this tends to produce second harmonic distortion products. The configuration used in this circuit results in very low second and third harmonic distortion. This has enabled a total harmonic distortion figure of around 0.0015% to be obtained.

The problem with quoting distortion figures of this order is that they are too low to be measured directly, being well hidden under the noise level. The only way a figure can be obtained is to remove the overall negative feedback, measure the distortion and then divide by the gain difference when the feedback is reapplied. Unfortunately, feedback does not affect all the distortion products equally, but the figure is still meaningful.

Another advantage of the symmetrical design of the input stage is that it does away with the need for an input capacitor. This is a definite advantage when dealing with low input impedances since the value of the capacitor would have had to be very large to obtain a flat frequency response at low frequencies.

The signal voltages present in the preamplifier are naturally extremely low and for this reason the power supply has been kept as a separate unit to reduce the possibility of 50Hz induction from the power transformer.

A voltage regulator supplies the necessary $\pm 6\text{V}$. As it is critical to achieve low noise it is important that the regulator does not put noise onto the supply rails which would degrade the noise performance of the unit. Normally the voltage reference used for regulators of this type is a zener diode but, as the zener is reverse biased, it generates a comparatively large amount of noise. In this design an LED was used as the voltage

reference. A red LED operated in the forward-biased mode drops a constant 1V65 and generates very little noise.

Construction

Construction is relatively straightforward since most components are mounted on the board. Other construction methods are possible but performance will not match that of our prototype.

Mount the resistors and capacitors first, followed by the transistors. Cut the necessary lengths of shielded cables and solder them onto the board keeping the ends as short as possible. Solder the necessary lengths of hook-up cable to the board and after checking all components mount the board in the chassis.

Use a steel box if you can, if not, just be careful where it is placed.

Once the board is mounted in the chassis, the pots and rear panel hardware can be mounted and the wiring completed according to the wiring layout diagram shown. The shielded cables coming from the outputs on the board have only one of their shields connected to the output sockets which are wired together and connected to the chassis at the ground terminal.

It is important that the sockets be insulated from the case and that the ground connection made to them is according to the wiring diagram. If the unit is going to be used with the recommended power supply there should be no hum problems. It is wired so that the 0 volt line is not connected to the chassis of the power supply. This is important, otherwise a hum loop around the units' mains grounds will result. Do not 'cure' the problem by disconnecting the ground wire at the 240 volt plug, as this will remove any ground connection from the power supply chassis. This is dangerous.

Powering Up

Before turning the unit on make a final check of the board. Check the orientation of the transistors, electrolytic and tantalum capacitors and the LEDs. If all is right, turn down the volume control completely and switch the power supply on. The LEDs in the preamp's regulator should come on immediately.

Perhaps we are biased, but the sound quality of this preamp is extremely good!

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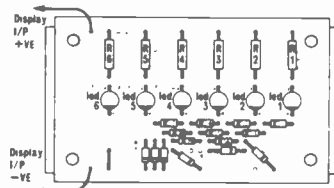
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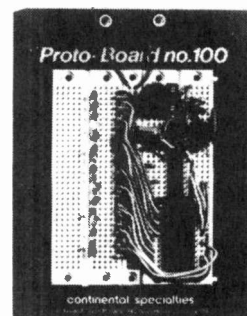
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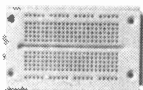
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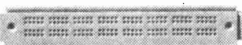
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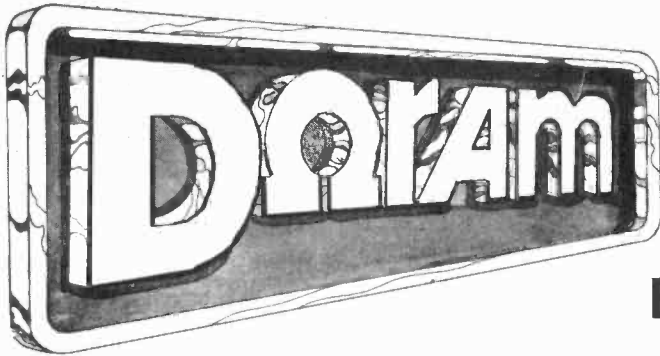
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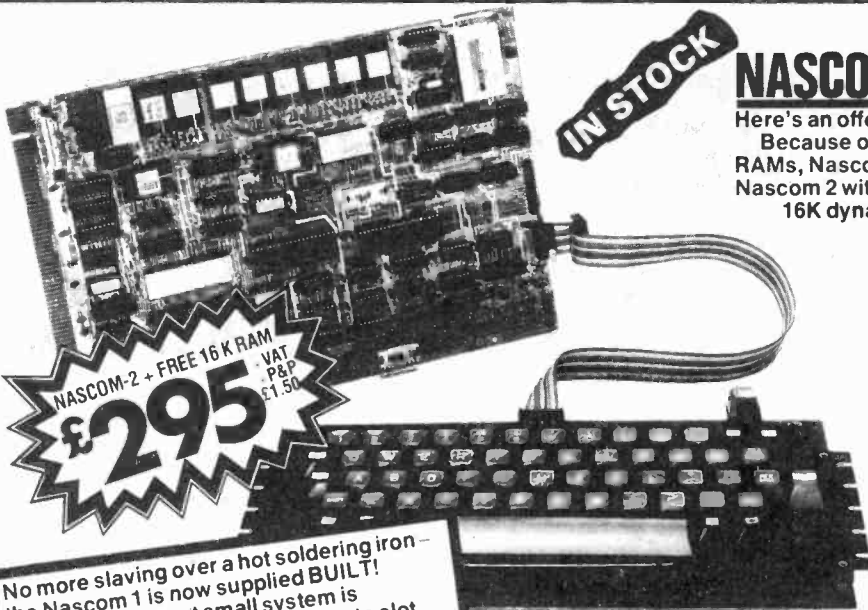
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DESIGNER'S NOTEBOOK

In this month's 'Notebook' Ray Marston looks at applications of the ubiquitous CD4093B CMOS IC.

Regular readers of ETI and our sister magazine Hobby Electronics will have noticed that the project design team have a special affection for the CD4093B CMOS IC. This device is a quad 2-input NAND Schmitt trigger. It is a highly versatile package that can be used in a wide variety of wave-shaping, timing, logic and waveform generating applications. This month's 'Notebook' is devoted exclusively to describing applications of this ubiquitous device.

Schmitt Applications

Figure 1 shows the functional diagram and truth table of the CD4093B. Each of the four gates is individually accessible and can be used as either a normal NAND gate or

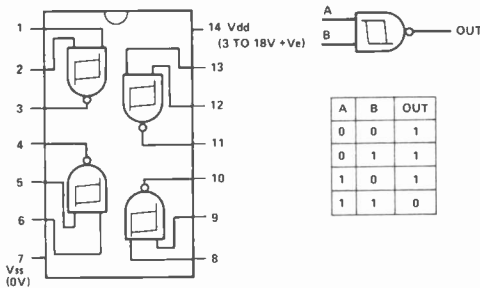


Fig 1. Functional diagram and truth table.

an inverting Schmitt trigger by using the connections shown in Fig. 2. All unused inputs of the package must be tied to the positive or negative supply rails, as appropriate. ▶

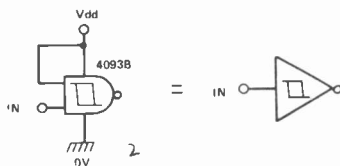


Fig 2. Method of connecting a NOR gate for inverting Schmitt use.

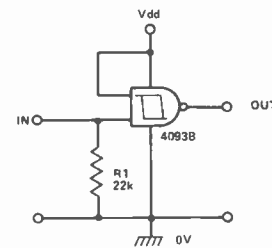


Fig 3. Simple Schmitt trigger with DC input.

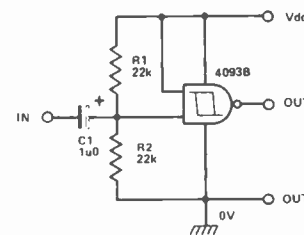


Fig 4. Simple Schmitt sine/square converter.

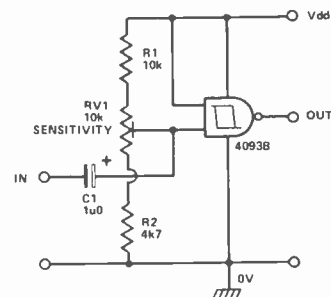


Fig 5. Improved sine/square converter.

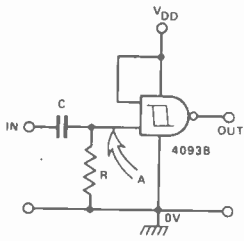


Fig 6. Connecting the 4093 as a rising edge detector.

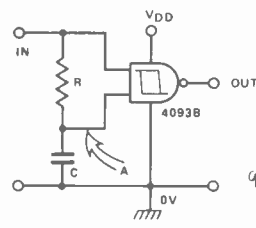


Fig 9. Leading edge delay circuit for the 4093.

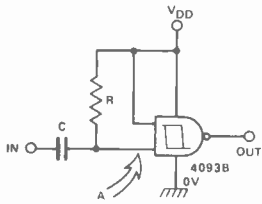


Fig 7. Rewiring Figure 6 to produce falling edge detection.

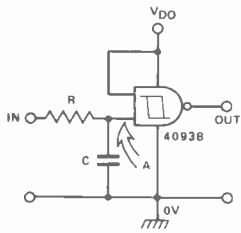


Fig 8. Pulse delay using a 4093.

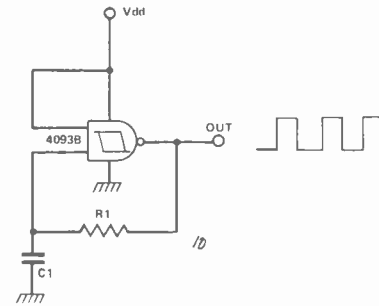
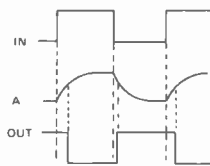
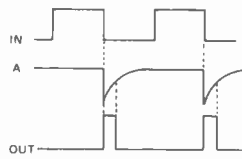


Fig 10. A basic astable multivibrator circuit.

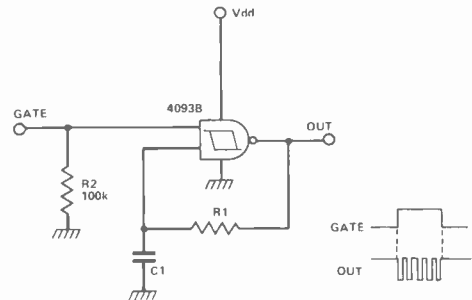


Fig 11. A variation giving gated astable multivibrator operation.

Figs. 3 to 5 show basic ways of using a CD4093B gate as a Schmitt trigger. Each gate has a typical hysteresis voltage (difference between the upper and lower trigger threshold voltages) of 2 V when powered from a 10 volt supply. In Fig. 3 the input signal is direct coupled to the gate input. In the Fig. 4 sine/square converter circuit the input signal is AC coupled and the input pin is biased at half-supply via R1 and R2. In the improved sine/square converter circuit of Fig. 5, the input pin bias can be adjusted to mid-way between the upper and lower threshold values, to give maximum sensitivity.

Edge Detection

Figs. 6 to 9 show a variety of ways of using the 4093 to detect or delay the edges of input pulse waveforms. The Fig. 6 circuit gives an output pulse on the arrival of the rising or 'leading' edge of an input pulse. The duration of

the output pulse is determined by the C—R values. The Fig. 7 circuit produces an output pulse on the arrival of the falling or 'trailing' edge of an input pulse. The Fig. 8 circuit delays the entire input pulse by a period determined by the C—R values. The Fig. 9 circuit delays the leading edge only.

Clock Circuits

Figure 10 shows how a single CD4093B gate can be used as an astable multivibrator or 'clock' generator. This circuit gives excellent performance with very clean output edges that are unaffected by supply line ripple and other nasties. The operating frequency is determined by the C—R values and can be varied from a few cycles per minute to 1 MHz or so. The circuit action is such that C1 alternately charges and discharges via R1. C1 can be a polarized component.

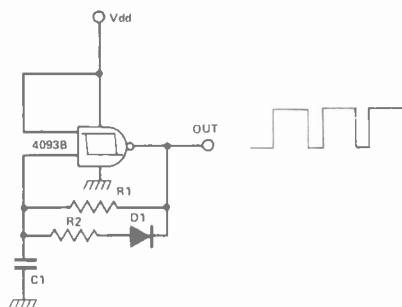


Fig 12. An astable with a non-symmetrical mark-to-space ratio.

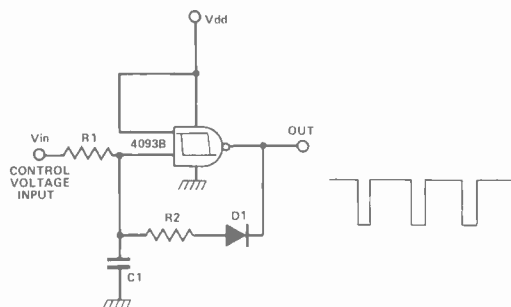


Fig 13. A special purpose astable. The voltage V_{in} has to rise above Schmitt (upper) threshold for operation. Frequency increases with V_{in} .

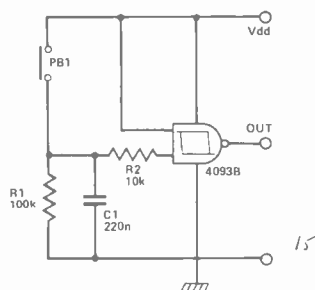


Fig 14. Using a 4093 to obtain a 'noiseless' push button switch.

Figure 11 shows how the basic astable can be gated on and off via an external signal. Note that the circuit is gated ON by a high input, but gives a high output when it is in the OFF state.

The basic astable circuit of Fig. 10 produces an inherently symmetrical output waveform. The circuit can be made to produce a non-symmetrical output by providing the timing capacitor with alternate charge and discharge paths, as shown in the circuits of Fig. 12. The Fig. 12 circuit produces a fixed M/S (mark-space) ratio output.

Figure 13 shows a special-purpose voltage-controlled astable which operates only when V_{in} rises above the upper Schmitt threshold: the operating frequency then rises as V_{in} is further increased.

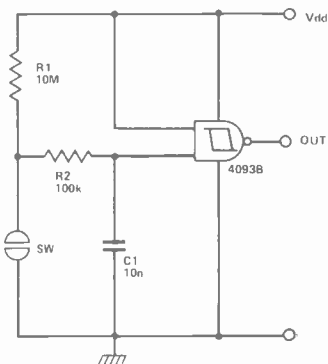


Fig 15. Touch switch giving output HIGH on operation. Reversing R1 and SW gives output LOW on operation.

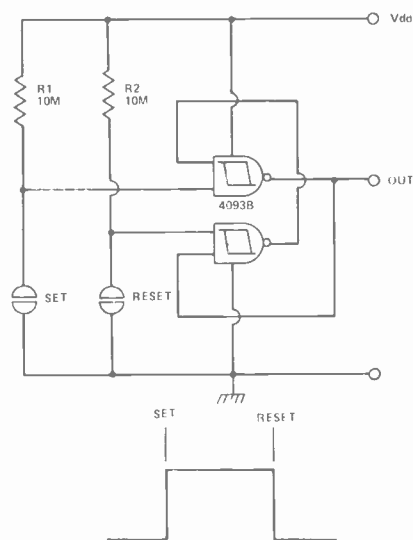


Fig 16. A latching or bistable touch switch circuit using two CD4093B ICs.

Miscellaneous

Fig. 14 is the circuit of a 'noiseless' push button switch, which produces a clean output pulse each time PB1 is operated. C1 charges up rapidly when PB1 is closed but discharges slowly (with a period that is long relative to normal noise spikes) via R1 when PB1 is released.

The output of the Fig. 15 circuit goes high when the input contacts are touched. Fig. 16 shows the circuit of a latching or bistable touch-activated switch.

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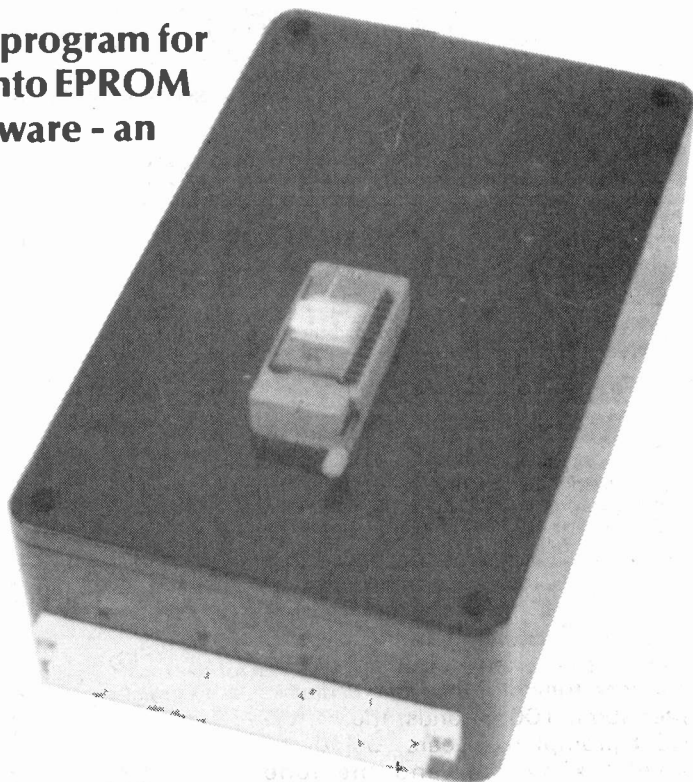
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EPROM PROGRAMMER

Once you've developed and debugged a program for your trusty Triton, transfer it to tape or into EPROM using the latest addition to Triton's hardware - an EPROM Programmer.

THE EPROM programmer is constructed on a single sided PCB. As there are not many components on the board construction is quite straightforward. Start by inserting the wire links into their respective holes. There are five of these. Bare tinned copper wire can be used. Then insert pins for all of the connections to Triton and for the transformer outputs. Now solder the normal IC sockets into position (leave the zero insertion force socket for now). Solder one socket to the board at a time in order to ensure that all of the pins are connected. As usual, start with the largest socket and work down to the smallest. You can now solder the resistors, capacitors, diodes and transistors into position. Take care to insert the correct value component into each position and to ensure that the transistors, diodes and electrolytic capacitors are the right way round. Lastly insert the socket for the EPROM and solder it. The control lever is adjacent to pin 1.

It is now time to make up the connecting cable for the board. The programmer is intended to be plugged into the end of the Triton motherboard and derives most of its power from here. However, it could be run directly from the extender socket on the main board with some care. More on this later. Using the wiring diagram of figure 5, attach the wires to the 64 way socket and to the PCB. If you are using a cover on the socket, remember to pass the wire through it before soldering both ends! Take care when connecting the wires to ensure that none of them become crossed on their journey from the socket to the circuit board or you will end up with a data encrypter! When the job is complete and checked, insert all of the ICs into their relevant sockets and check their orientation.



The unit can now be mounted into a box and the transformer connected. Firstly, cut a hole in the lid of the box for the zero insertion force socket. Also cut a slot at the join of the lid and base of the box for the cable entry. The board should be mounted with stand-off pillars to the box lid so that the programming socket is flush with the front panel. The connecting cable emerges via the slot cut between the lid and base of the box.

Firm Commitment

The programmer is now ready for use. Connect the 64 way socket to the end of your motherboard and switch the Triton system on. Now apply 240V to the programmer. If you are using the Level Six firmware, you are ready to go. Otherwise it is necessary to key in the program given. Having keyed it in, save it on tape. Now enter the program that you want to burn into EPROM. This can either be done using the monitor or TRAP. Normally

the program is loaded from a cassette tape having been previously developed and debugged in RAM. When an object code form of the program is ready in RAM, you can start to program the EPROM with Level Six type Z. With other monitors, load the tape which you dumped earlier into RAM and type G1600. In response to the START: prompt type the address in RAM where the 1K byte block of data for the EPROM starts. After typing the carriage return, the program will start to load the data into the EPROM. Before each programming pulse occurs, the data is read from the EPROM and checked against the new data for the location to ensure that a 0 bit is not trying to be programmed to a 1. If this test fails a PROGRAM ERROR is reported on the VDU and programming is halted. On the last programming cycle, the data in the EPROM is read again and tested to see if it is the same as the data being programmed into that location. This test is used to verify that the data has been correctly

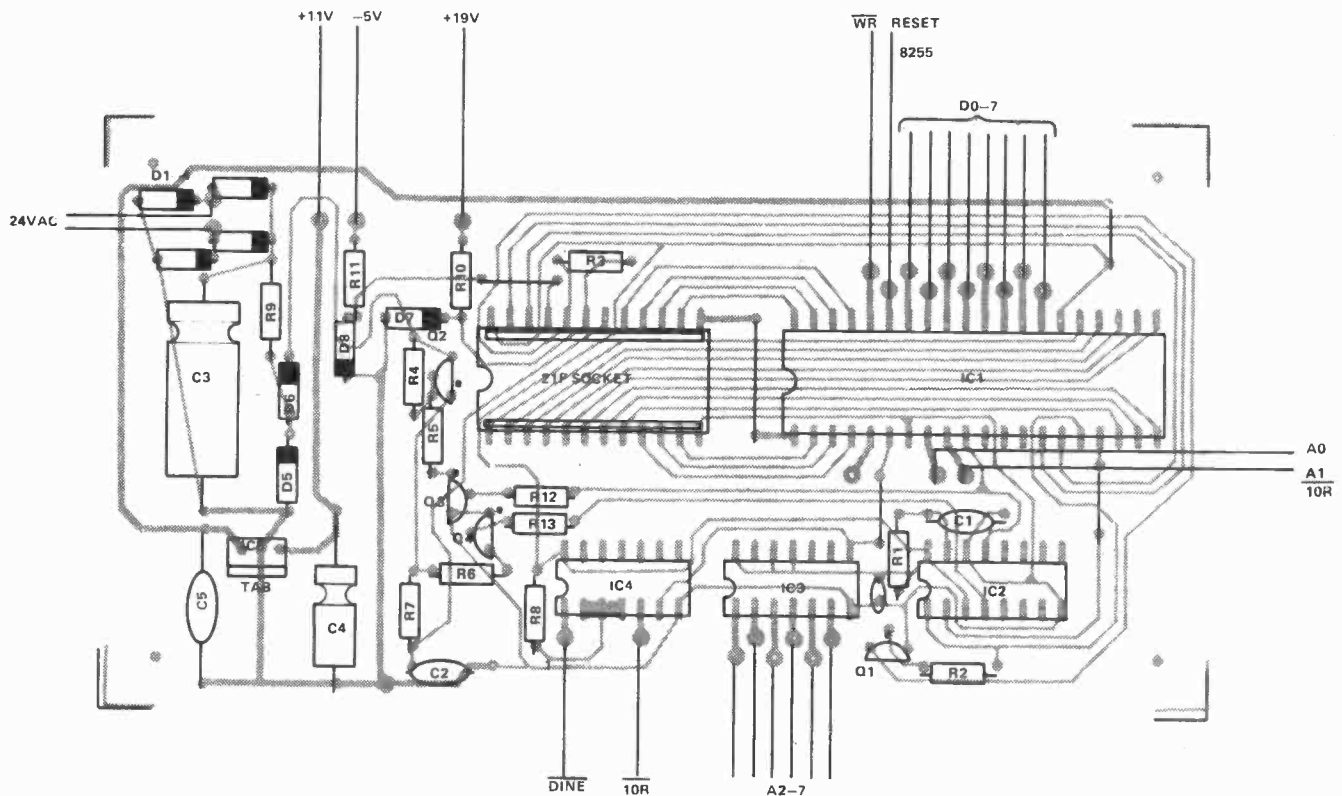


Fig 1. Component overlay for the Triton EPROM programmer

PARTS LIST

RESISTORS all 1/4W 5%

R1	22k
R2,8	4k7
R3,4	10k
R5	33k
R6	47R
R7	180R
R9	560R
R10	100R
R11	130R

CAPACITORS

C1	100n ceramic
C2	10n ceramic
C3	220u 63V electrolytic
C4	47u 25V electrolytic
C5	470n ceramic

SEMICONDUCTORS

IC1	8255
IC2	74LS123
IC3	74LS30
IC4	74LS33
IC5	7805
Q1,3,4	BC548
Q2	BC558
D1-4,6	1N4001
D5	27V 1W zener
D7	12V 400 mW zener
D8	5V1 400 mW zener

MISCELLANEOUS

12-0-12 V 50 mA transformer, 100 mA fuse and holder, 64 pin Euro Socket (straight), 40 pin IC socket, 16 pin IC socket, 14 pin IC socket (2 off), 24 pin zero insertion force socket, case to suit, PCB (Transam Components Ltd).

transferred and if it fails, a READ ERROR is reported. When an EPROM is successfully programmed, typically after about 100 seconds, the FUNCTION prompt reappears. Using the Level Six monitor and the tone oscillator facility will cause a bleep to be sounded.

Banishing The Bug

Having successfully programmed an EPROM and plugged it into the Triton, some new bug in your program may well decide to rear its head! Fortunately with EPROMS this is no problem. Having traced the bug and decided how to correct it, turn your Triton off and remove the offending EPROM. Place it in an eraser for about 30 minutes. The eraser is just a source of ultraviolet light so if you do not own one of these (relatively expensive) machines do not worry. If you have a sun lamp, it is a good source of UV light. Put the EPROM on a piece of conductive foam or aluminium foil and place it under the lamp. Remember — DO NOT LOOK DIRECTLY AT THE SOURCE OF ULTRAVIOLET LIGHT — IT WILL DAMAGE YOUR EYES. If you do not possess a sun lamp, a UV tube can be

purchased for a few pounds. Connect it up with a choke and fit it into the lid of a small lightproof box. Place the EPROM in the box about one inch from the tube, close the lid and switch on. After about half an hour you have an erased EPROM. While waiting for the EPROM to clear, load the program back into RAM from tape and modify it. When the EPROM and program are ready, reprogram the EPROM.

If you do not have a motherboard it will be necessary to wire up the 64

way connector to suit the expansion socket on the Triton main board. This has different connections and these can be obtained from the Triton manual. It is also necessary to provide the power supply voltages. This can be done with a small transformer or from the existing Triton power supply rails. In the latter case do not use the -5V rail directly. Instead use the -12V rail and a Zener diode and resistor so as not to overload the existing circuit. ▶

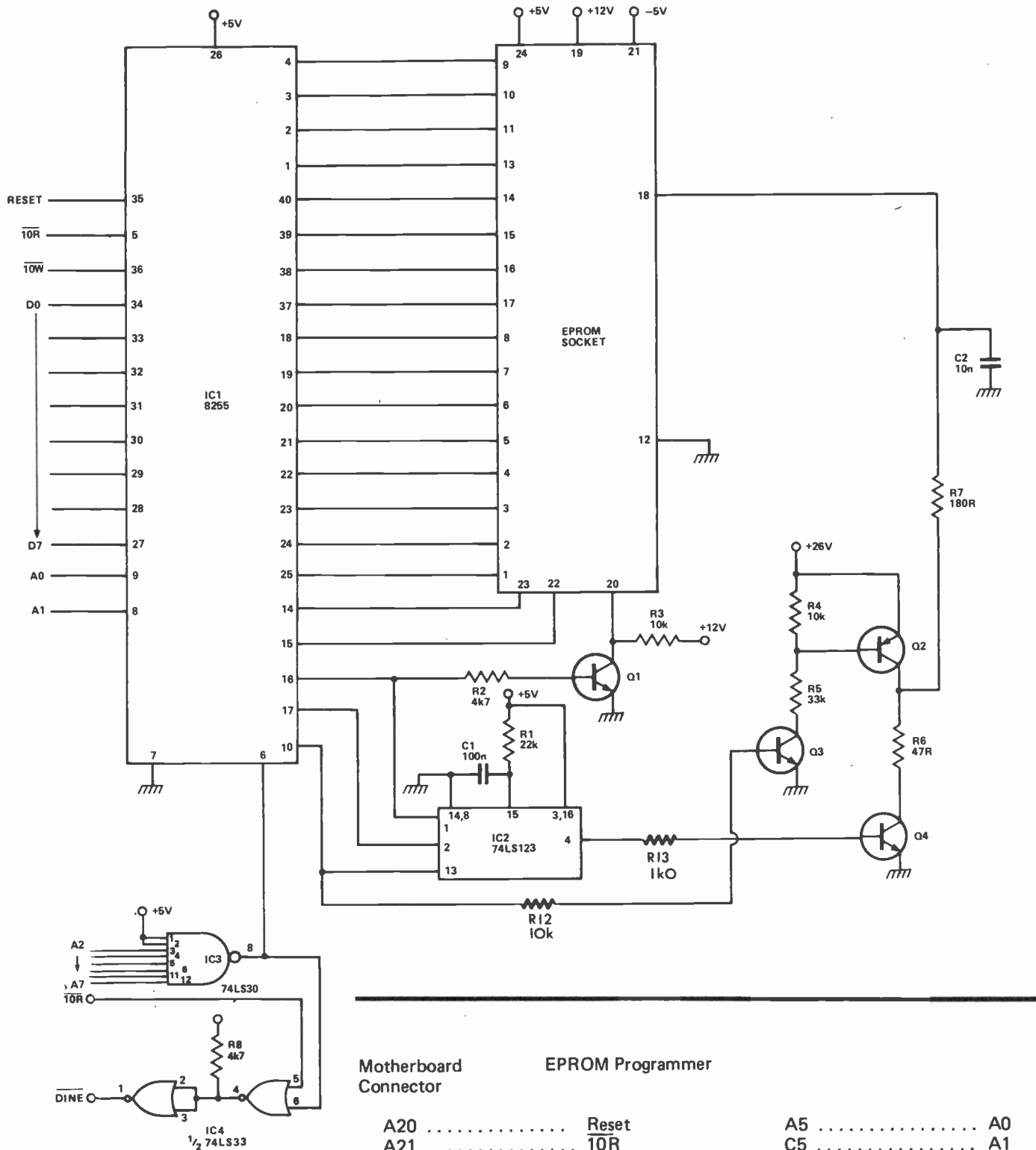


Fig 2. (Above) Main current diagram for the EPROM programmer.

Fig 3. (Right) Connection table for hooking into Triton.

Motherboard Connector

EPROM Programmer

A20	Reset	A5	A0
A21	<u>10R</u>	C5	A1
A18	<u>10W</u>	A6	A2
A22	DINE	C6	A3
A23	D0	A7	A4
C23	D1	C7	A5
A24	D2	A8	A6
C24	D3	C8	A7
A25	D4	A1,2, C1,2	0V
C25	D5	A32, C32	+11V
A26	D6	A31, C31	-11V
C26	D7	A3, C3	+19V

HOW IT WORKS

When an EPROM is fully erased all of the bits are set to a one so that each location reads FFH. Programming the EPROM sets selected bits to a zero level. To program the device, the address has to be set up on the address pins and the data for that location has to be set up on the data output pins. Then a 20 V pulse is applied to the program pin. Each location has to be programmed for 100 mS. As there are 1024 locations, the programming operation should take about 103 seconds. However life is not as simple as applying one 100 mS pulse for each location to be programmed. The programming pulse duration must be between 0.1 mS and 1 mS. In this design a pulse of 1 mS is used. Hence each byte must be programmed 100 times. We are using Triton to carry out all of the work so this is not a cause of concern.

The main work in the programmer is done by IC1 and IC2. IC2 is a TTL monostable producing pulses with a 1 mS duration. This pulse could have been generated directly on one of the output port pins using a software timing loop. However, this approach has two disadvantages. Firstly, if the Triton's clock speed is altered, the software must be changed to compensate for this. Secondly,

and more importantly, if an interrupt or reset occurred whilst the programming pulse is in an active state, it will remain active for longer than the maximum permissible time, 1 mS and damage the EPROM. The Q and Q outputs are used to drive Q2-4 which generate the 20 V pulse at pin 18 of the EPROM. Q4 is used to provide an active pull down, since the EPROM sources a few mA of current when the program pulse is low. If a resistive pull down were used then the pulse would not reach 0V. R8 and C2 provide the necessary shaping of the pulse. The communication between the Triton and the EPROM is provided by an 8255. This is a device with three programmable eight bit I/O ports. Pin 6 is the CS and this is enabled by IC3 for port addresses FC-FFH. The CS signal is Nanded with IOR to provide the DINE signal required by the motherboard during port read operations. The 8255 contains four registers which are selected by A0 and A1. Three of these are the port data registers and the other is a control register. The 8255 is used in mode 1. In this mode it provides three simple I/O ports and port C can be used as two four bit ports. For circuit port A is used as the data bus to

read data from the EPROM or to send data to it. Port B is used as an output port for the lower eight address bits. The lower half of port C is used as an output port. The bottom two bits are used for the remainder of the address bus and the upper two bits are used to control the generation of the program pulse. The upper half of port C is used as an input port to monitor the state of the program pulse so that Triton can keep a track of the programmer's operations.

While the data and address information is being set up, port C bits 2 and 3 are set to 1 and 0 respectively. This inhibits the monostable and holds the CS of the EPROM active (at 0V). When the busses are ready, bits 2 and 3 of port C are toggled. Now the CS is set to +12V to enable programming and the monostable is triggered to generate the program pulse. This sequence of events is repeated for each program cycle.

No buffering was provided on the busses as it is felt that the programmer will not be connected to the bus for much of the time and it does not present a load of more than one gate on any of the address or data lines. This has allowed the cost to be reduced.

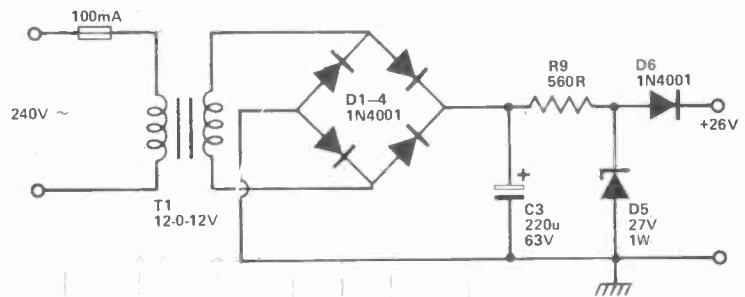
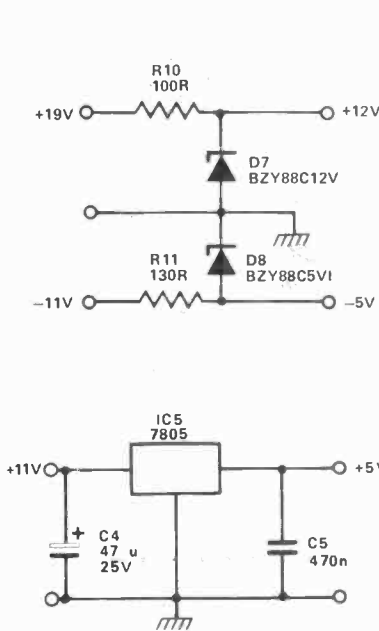
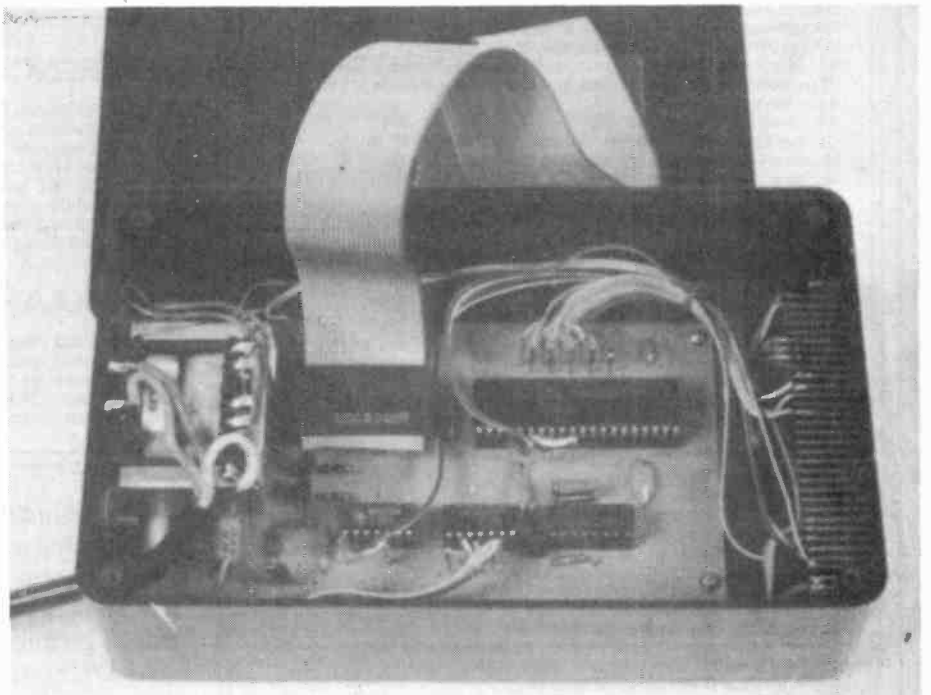


Fig 4. (Above) PSU circuits for the TRITON EPROM card.

BUYLINES

Transam Components are producing a kit for the Triton EPROM programmer for £29.50 excluding the case. Another £2.50 brings you the case as well. Transam Components Ltd, 12 Chapel Street, London NW1 5DH.



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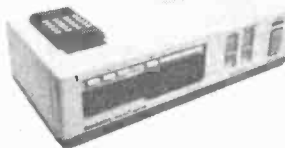
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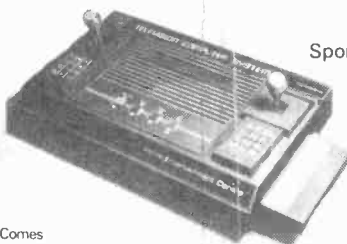


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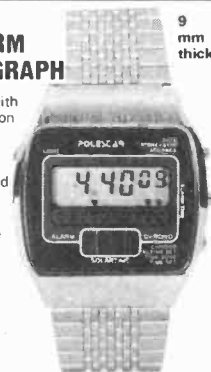
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Tim Orr - the man of a thousand circuits - takes us on a tour around the cables of a recording studio.

The last decade has seen an enormous growth in the quantity of electronic hardware that is used in recording studios. The list of equipment now available includes 24 track tape recorders, 48 channel mixers, computer assisted mixing, spectrum analysers and a whole host of electronics effects gadgetry. These high technology solutions have made the job of producing recordings much easier but the tasks now demanded of the studio engineer have increased.

It is sobering to remember that the early Beatles' albums were produced in one day on a four track recorder. No matter how hard we try, technology cannot produce music; it can only provide the 'tools for the job'. In fact technology has in some ways, had a detrimental effect on music production with the idea that if you have sufficient recording tracks to spare you can get it right on the final mix down.

A Typical Studio

A typical recording studio is split up into two working areas: the performance area and the control room — containing all the electronics and associated hardware. The performance area is soundproofed to provide about 80dB's of acoustic isolation from the outside world. The walls, floor and ceiling are all made from very dense materials to absorb sound. The room itself is usually acoustically flat, having little or no reverberance or resonances. Often there are mobile acoustic baffles, (vertical sheets of board), that can be positioned in between musicians to provide some amount of acoustic isolation between them. These are often used for drums. There is a studio talk back system so that the control room can talk to the musicians or play them recordings. The microphones plug into floor or wall sockets and are connected directly to microphone amplifiers in the control room. A large double glass window separates the two halves of the studio.

The control room houses all the electronic equipment needed to produce the recording. All signals pass through a multi-channel mixer which is used to provide control over the volume, tone and any special treatments that need to be performed on a particular sound. The usual approach for producing a recording is to build it up track by track so that the music is broken down into its basic ingredients, (i.e. bass line, melody, vocals, strings, drums), which are stored



on a multi-track tape. This can then be mixed down by the producer to get the required overall balance. The mixer can be used to fade in and out various tracks and to provide equalisation.

Graphic Equaliser

A Graphic equaliser is a very flexible tone control operating over the audio spectrum. This spectrum is broken up into segments, each being controlled by a slider which can provide up to 12dB of cut or lift. Thus it is possible to draw out, using the sliders, an overall frequency response which

will be imposed upon the audio signal. The position of the sliders graphically display the frequency response curve.

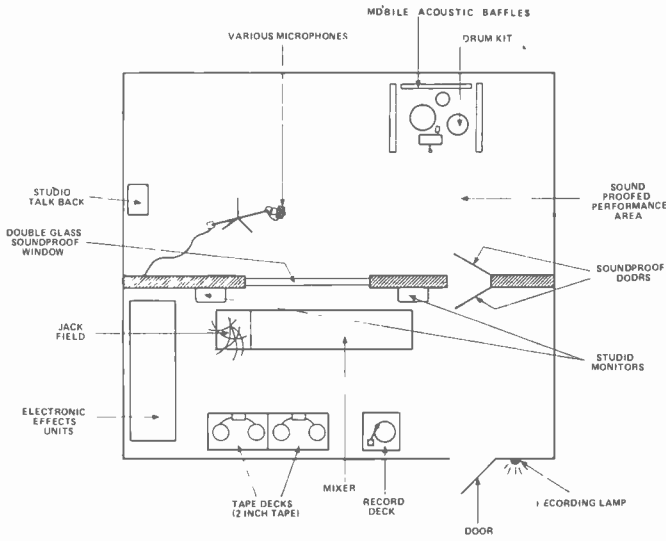


Fig 1. A typical studio layout.

Compressor/Expander

Two problems that are ever present are noise and overloading. To prevent overloading of equipment you can simply operate at a low signal level but this results in a poor signal to noise ratio. To obtain a good signal to noise ratio you should operate at a higher signal level but this will probably result in overloading and distortion!

An enormous amount of programme material is listened to on radio sets which typically have a reception signal to noise ratio of between 40 to 55dB and which are used in noisy environments. Thus the programme sound level must be very tightly controlled. If the signal level is too large then the radio transmitter will be over modulated causing gross distortion; if it is too small the signal will be lost in noise. Generally broadcasting companies try to limit their programme material to a range of about 16dB. Also when records are cut the dynamic range must be tightly controlled as a disc can only provide 60dB (usually less) signal to noise ratio.

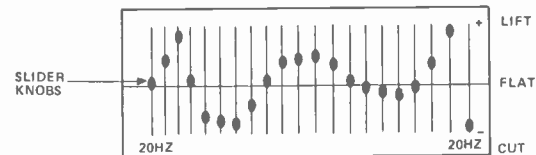
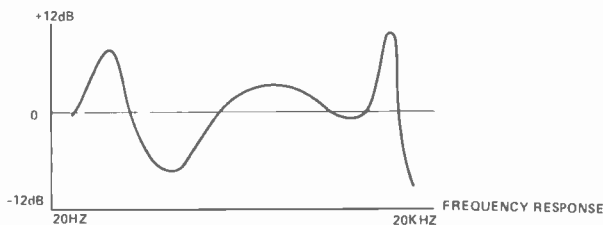


Fig 2. A graphic equaliser and response.



If the signal level is too large the cutting will break through into its neighbouring grooves. Even if it doesn't actually break through it can cause a material deformation of the master disc that produces a noticeable pre and post echo. When a disc is cut the general brief for the disc cutter is to get as large a cut as is possible without producing any cross talk and to do this the recorded material should not have any nasty signal peaks.

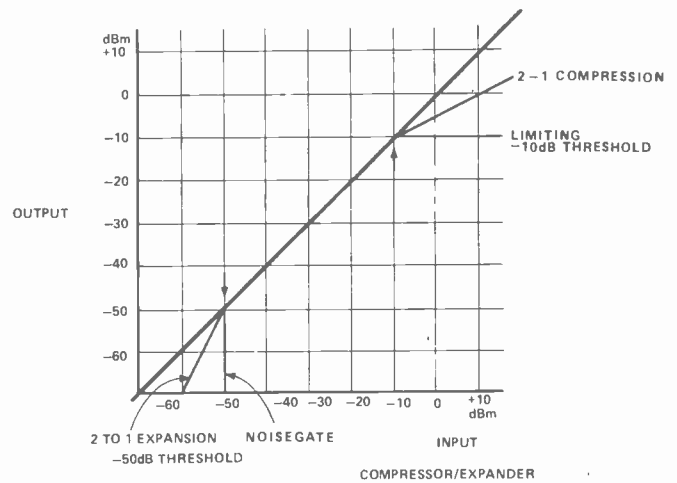


Fig 3. Compressor limits and response

Level Control

There is a large selection of equipment available to control the signal level of programme material and these are known as compressors, limiters and expanders.

A typical device will have controls that set the threshold points, the compression and expansion ratios and the response times.

A limiter is a device that prevents the output signal from rising above a set threshold. As the input signal attempts to do this, a voltage controlled attenuator turns the signal level down. The effects of limiting are rather harsh and are usually only used to prevent overloading in some other piece of equipment. Compression is also used to reduce overloading but it is more subtle.

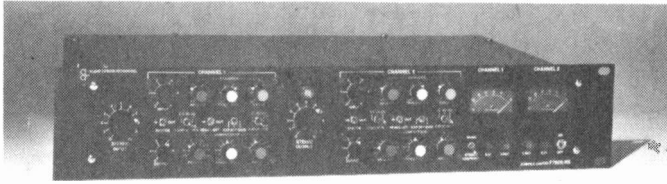
If say, a two to one ratio has been selected then as the signal level exceeds the threshold the output will increase by only 3dB for every 6dB increase of the input. By using both a compressor and a limiter at once it is possible to run at 6dB below the maximum operating signal level for a system and still handle signal excursions of a further 18dB without noticeable distortion.

When the input signal is very noisy as for example, a telephone news report, or an old film sound track, an expander can be used to clean up the sound quality. An expander is a device that attenuates the signal when it falls below a pre-set threshold. A two to one expansion ratio reduces the output signal by 12dB when the input signal falls by 6dB. A more dramatic effect is a noise gate which has an expansion ratio of about 20:1 or even more.

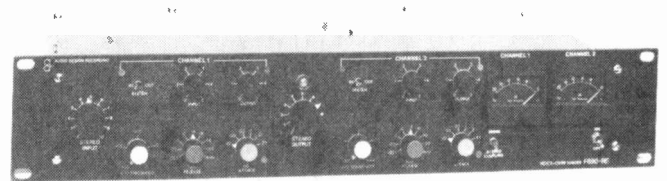
The speed with which compression or expansion occurs is controlled with switchable attack and decay times. This allows the user to select the best time constants for the job in hand.

Another but more specialised type of signal level controller is the voice over or ducking unit. This enables a DJ to automatically fade the music down to a preset level every time he speaks. When he stops the music rises back to its

original level. The attack and decay times for the ducking are adjustable.



Above: an Audio Design compander.



Above: an Audio Design voice over unit.

Noise Reduction

The signal to noise ratio of a professional tape recorder is about 60dB, which is mainly due to the limitations of the tape. This is not good enough for professional recordings, particularly when many sound tracks have to be mixed together. What is needed is a system for improving the perceived signal to noise ratio. An expander does this but it distorts the natural dynamics of the signal in that the signal dies away abruptly after it falls below the threshold. A system that overcomes this problem and which is widely used in studios is the Dolby A system. The signal to be recorded is pre-processed with a low level compression. That is, low level signals are selectively made larger whilst the high level signals are unaffected. The signal is then recorded on tape and in doing so tape noise is added.

When the tape is replayed a low level of expansion exactly complimentary to the compression previously mentioned is performed. This reduces the effect of the tape noise in the periods of silence but does not corrupt the signal dynamics because of the complimentary compression and expansion.

Also, the process is performed in four independent frequency bands so that "breathing" effects are reduced. The advantage of using low level compansion is that the distortion caused by it appears only on low level signals and is thus not very noticeable. Also low level compression makes very little difference to the maximum signal level. An improvement of 10dB is obtainable using the Dolby A system.

Echo And A D T

Electronic delay lines are often used to produce a wide range of effects such as flanging, chorus, automatic double

tracking and echoes. There are two methods of implementing time delays, one is with bucket brigade delay lines which are useful for short delay (1 to 40 mS.) low cost units, and the second is with digital delay lines. These are best used for 10 mS to 1 S. delay times in high quality units, (usually costing £500 upwards).

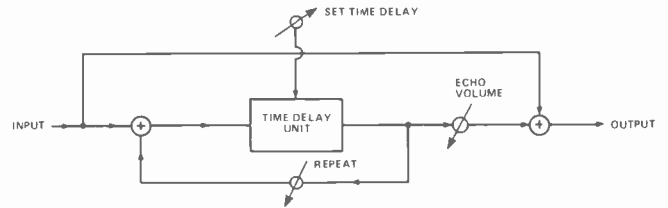
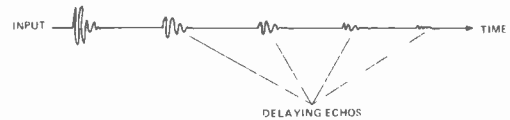


Fig 4. (Above) Block diagram of an echo unit.

(Below) The resulting outputs.

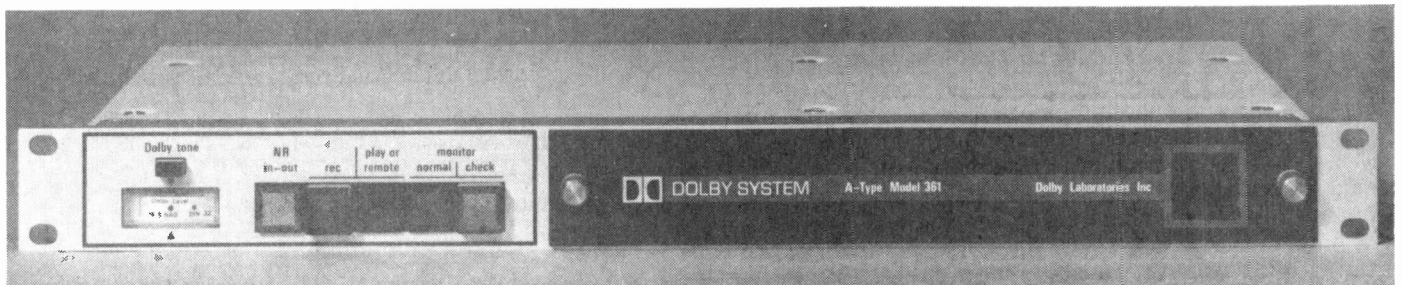


Automatic double tracking (ADT) simulates the sound of a second instrument playing along with the original. A time delay of 10 to 40 mS is generally used and the delayed voice is mixed in with the original so you effectively get two musicians or singers for the price of one. To improve the naturalness of ADT the time delay is slowly modulated, thus generating very slight timing errors. Another effect similar to ADT is 'chorus' where one or more delay lines are used with a slightly shorter delay time, (5 to 10 mS) thus creating a richer, more complex sound structure.

Echo is often obtained using a digital delay line. The input sound is converted into a binary word with an ADC, stored in a large RAM and then converted back sometime later into an analogue voltage using a DAC. The memory size is often very large. Take, for example, an echo unit which has to have a 60 dB dynamic range, a 10 kHz bandwidth and an echo length of 1 second. The system must be 10 bits wide and have a clock speed of 25 kHz, thus the number of bits of memory needed is $25K \times 10 = 250,000$ bits, which would be 250 1K RAMs costing about £1 each!

Flanging

Flanging is a popular effect that is implemented using a comb filter. The comb filter response is produced with a short delay line, (1 to 10 mS) where the original and delayed signal are mixed together. This generates a frequency response which has a series of linearly spaced notches, the spacing of these being inversely proportional



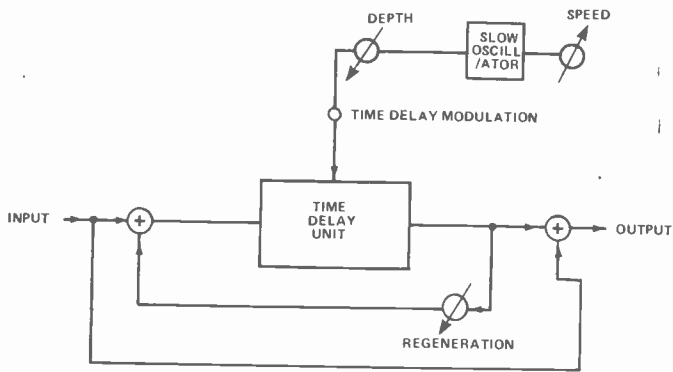
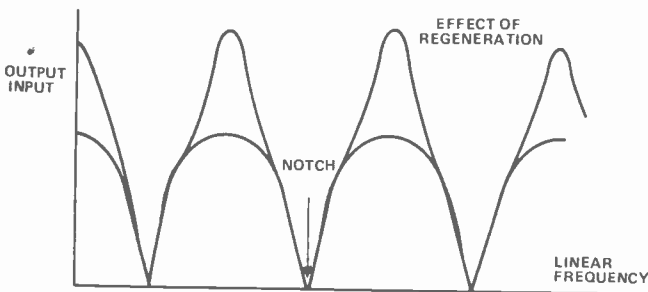


Fig 5. (Above): Flanging and how it is obtained. Below is shown the frequency response of a comb filter.



to the delay time. By applying feedback around the delay line, the comb becomes more peaky and so provides more colouration of the sound. The delay time is slowly modulated and this produces an interesting mobile colouration of the sound. Flanging and phasing are often confused as they are both produced by comb filtering. Flanging uses a time delay and generally has lots of notches, sometimes as many as 50, whereas phasing uses phase delay and usually has only 2 or 3 notches.

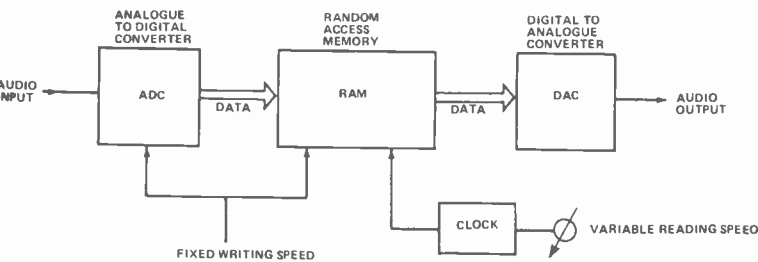


Fig 6. Digital pitch shifting techniques.

Pitch Shifting

It is now possible to transport the pitch of an instrument using a pitch shifting device. The shifting is not perfect, but it is good enough to produce useable harmonies. The operation is as follows. The input signal is converted into a binary code and written into memory. At the same time the memory is read, but at a different speed and this data is converted into the audio output using a DAC. If, say, the reading speed is twice that of the writing speed then the output will be transposed up an octave in pitch. There are many problems to be overcome. First, the output must not be significantly delayed. Second, the time varying information of the output must rapidly track the input, that is,

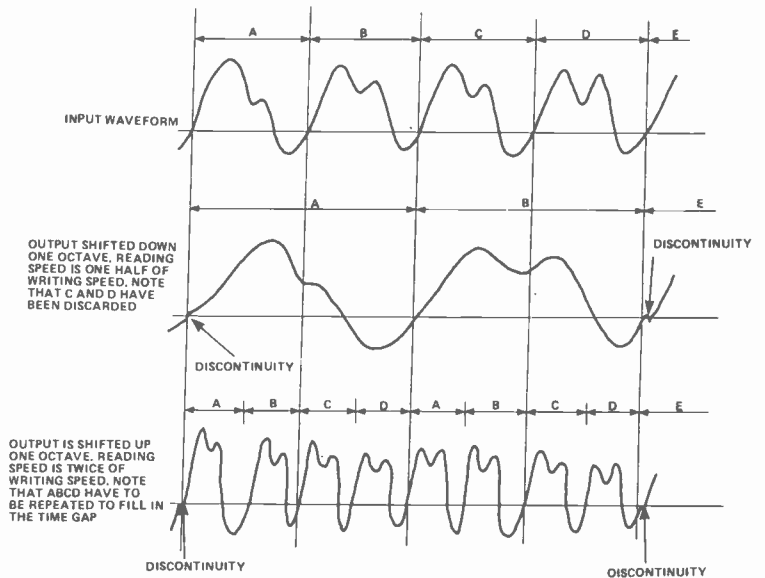


Fig 7. Pitch shifting in practise.

the melody should be the same, but the pitch transposed. To satisfy these conditions the memory size should be relatively small (20 to 40 mS). Take the case of the up transposition of one octave. If the reading speed is twice as fast as the writing speed then each segment of sound will have to be played twice, otherwise gaps would appear. However, when the transposition is down by one octave,

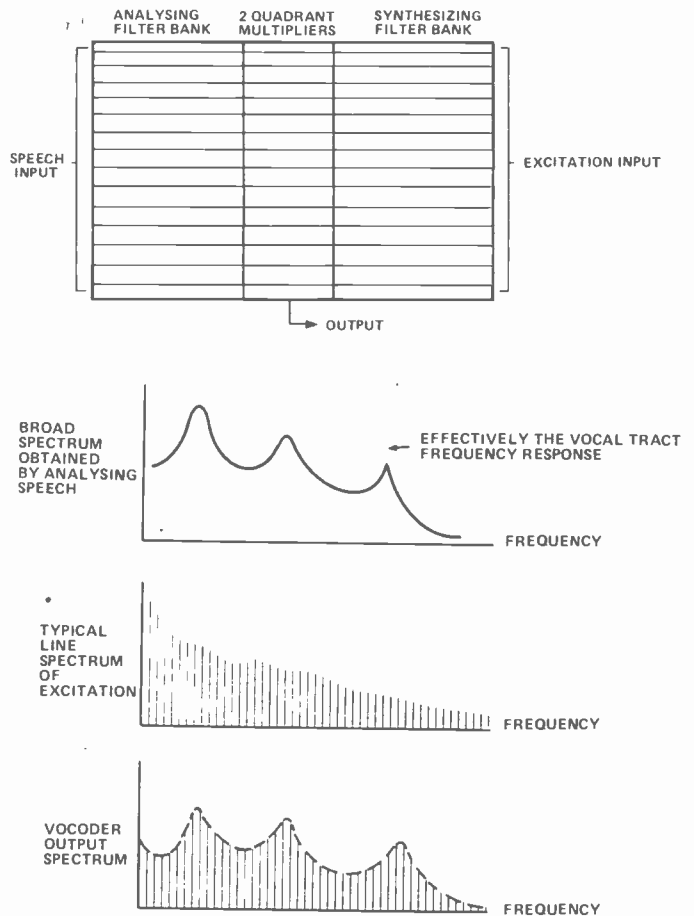
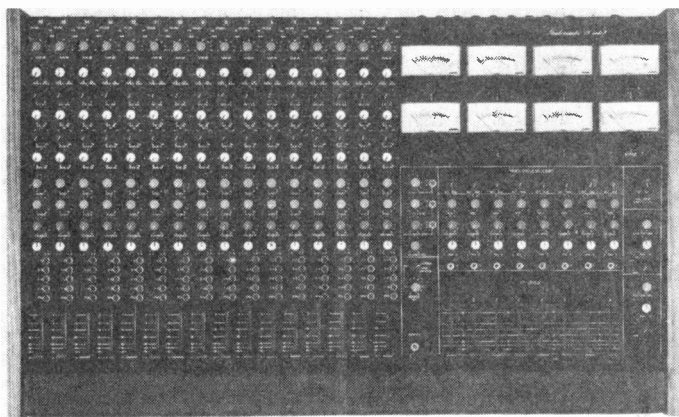


Fig 8. A representation of the Vocoder principle and waveforms expected.

then half of the information cannot be read in time and so has to be discarded. Pitch shifting units are usually continuously variable over the range of plus or minus one octave.

Vocoders

A vocoder is a device for producing a cross product of two sounds. If the two sounds are speech and an electric organ, then the resultant sound output is a talking organ. When we speak we produce a buzz in our vocal chords that is acoustically filtered by our vocal tract. The buzz becomes articulate, it speaks. The vocoder uses a filter bank to analyse the speech so it can determine the time varying frequency response of the vocal tract. It then synthesises a model of this frequency response using a second filter bank plus some multipliers. The excitation signal (the electric organ), is then filtered by this model and so becomes articulate. The vocoder output has the melody and harmonics of the excitation signal, but the time varying broad spectrum (the articulation) of the speech.

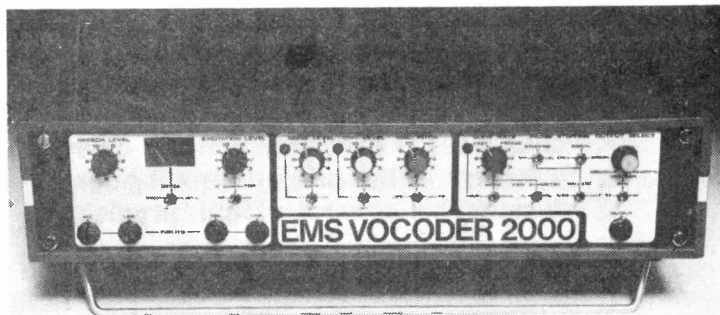


Above: a typical portable mixing unit. This one is produced by Studiomaster and will mix sixteen channels into eight.

Mixers

There is a wide variety of mixers on the market today, ranging in price from £20 to £20,000. Basically, the more you pay, the better the product. A mixer is composed of input and output channels; for example a 16 into 8 device has 16 inputs and 8 outputs. A typical input channel has the following controls. An input gain switch so that low level signals from microphone sources up to high level studio signals can be accommodated. An overload lamp or a VU or PPM is usually provided so that the signal level may be monitored. Next is a tone control section, perhaps consisting of Bass, Middle, Treble and sometimes a few parametric control functions. Many mixers also have an echo send control so that reverb may be added to that channel. A foldback control is often included. This is an internal mixing system so that a few tracks can be grouped together and fed back via headphones to the musicians.

A pan control enables that channel to be sent to either of the left and right output groups. Routing switches are used to connect a particular channel to any output group. A level slider, always at the bottom of the channel allows the operator to fade in and out the sound from that channel?



Above: the EMS Vocoder 2000, a very popular unit and one which the author helped to design in his days at EMS.

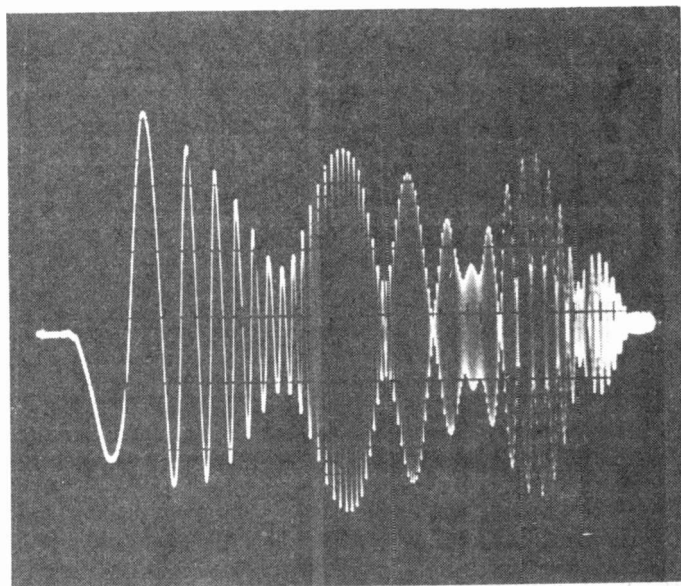


Fig 9. The frequency response of a chorus unit which employs three flanging units without regeneration. The scope picture was obtained using a swept sine wave oscillator set to run the audio band.

You might get a nasty surprise! You won't if you have got a pefade listen switch. This connects the signal at the top of the slider to some monitoring device, so that the operator can have a sneak listen to a channel before fading it up and perhaps ruining the output.

To produce a controlled mix down the operator will need to be very skilled and possibly he will need ten pairs of hands!

Computer Mixdown

To ease the burden of mixing down 32 channels, Neve Electronics has produced the NECAM computer assisted mixdown system. The computer can remember several mixdowns and replay them. The sliders are servo driven and so they provide a visual indication of what is actually happening. The slider knobs have proximity switches so that the operator merely has to touch them to regain control.

This system is however, 'slightly expensive'!

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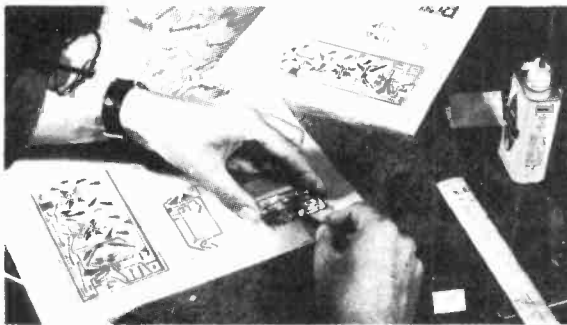
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HOW IT WORKS



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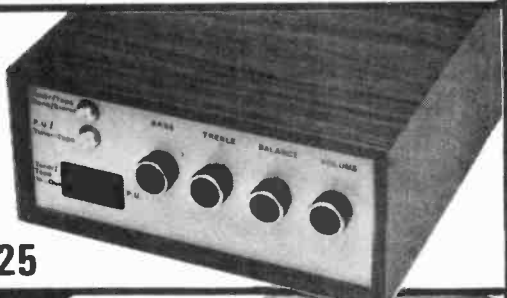
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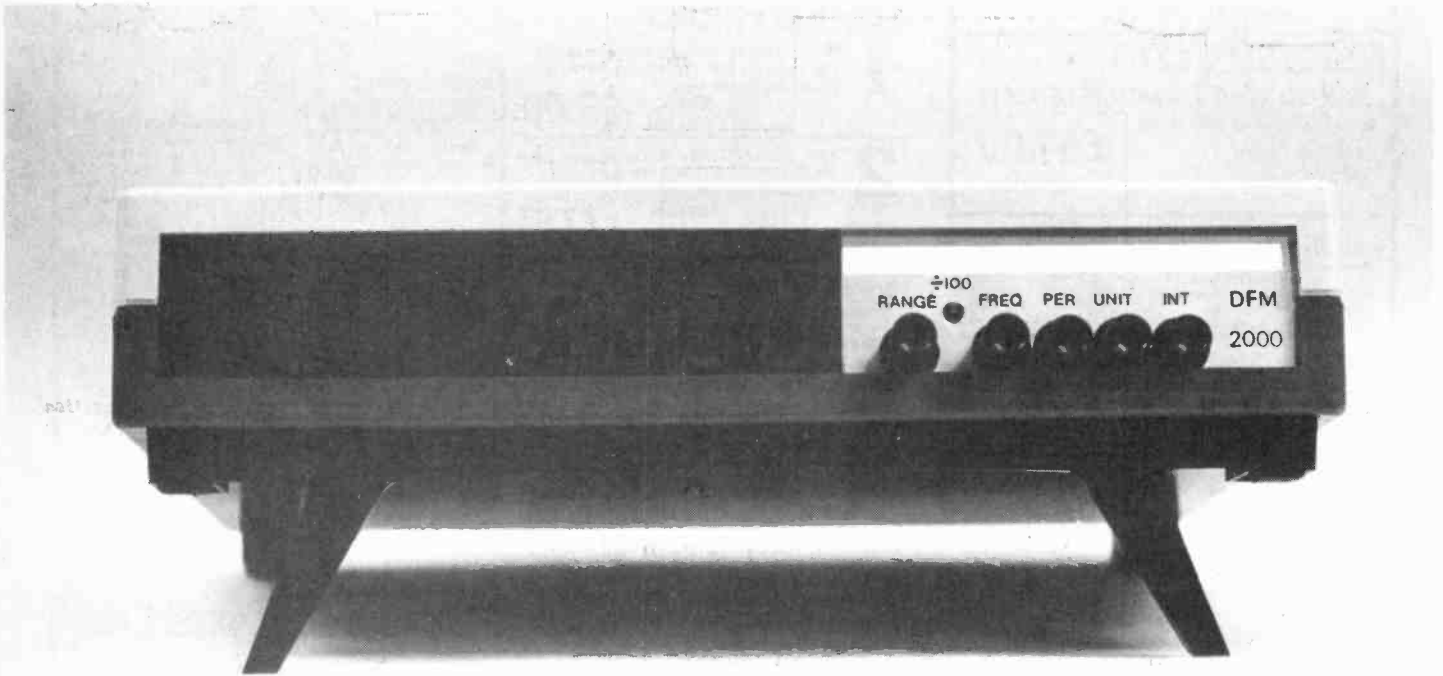
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DIGITAL FREQUENCY METER



This 0-150 MHz DFM design from Watford Electronics features frequency, period, unit counter and time interval functions. A highly stable crystal timebase ensures accurate measurement.

The heart of this instrument is the Intersil ICM7216A, which contains all the timing, timebase oscillator and control circuitry. Input A is the main signal input. Input B is used with the time interval function and has a five volt TTL input characteristic. Pressing the $\div 100$ button switches in a prescaler. To obtain the correct result the display reading should be multiplied by 100.

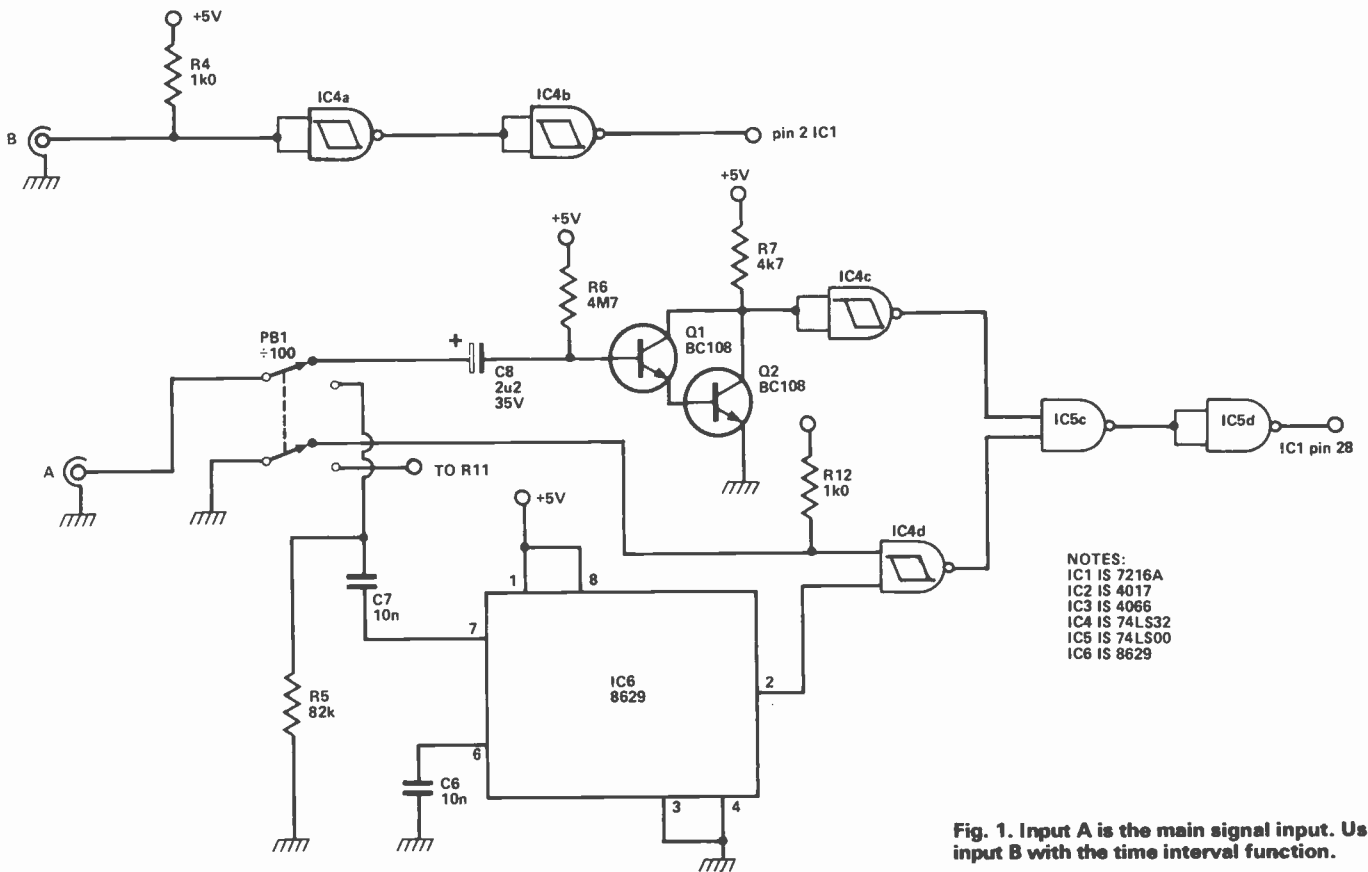
A double-sided PCB is used. To save the cost of plated through holes, pins are used to connect the two sides. Start by soldering in the pins, resistors and capacitors, but do not insert the power supply test link yet. The PCB is fixed to the rear panel with right angle

brackets. When all the components are mounted on the board, clean it with meths or thinners. Check that

diodes, electrolytics, etc, are the right way round and that there are no solder bridges between tracks.

SPECIFICATION

Input A	0.3 to 20 Volts 0-10 MHz (20-150 MHz $\div 100$ in)
Input B	5 V TTL
Sample Rate	5 Hz (all ranges)
Supply	240 V AC
Accuracy	± 1 digit
Overflow indicator	Left hand digit decimal point.



NOTES:
 IC1 IS 7216A
 IC2 IS 4017
 IC3 IS 4066
 IC4 IS 74LS32
 IC5 IS 74LS00
 IC6 IS 8629

Fig. 1. Input A is the main signal input. Use input B with the time interval function.

HOW IT WORKS

IC1 does most of the work. The two displays are driven directly by IC1, so they require no additional drive circuitry. The timebase is formed by the crystal with C8, 9 using the onboard oscillator.

When the $\div 100$ switch is pressed, input A is connected to the input of IC6 via C7. IC6 is a Plessey emitter coupled logic (ECL) frequency divider with an onboard pre-amp. R5 is used to reduce the input sensitivity in order to increase stability.

When PB1 is in the 0-10 MHz position, input A is connected to the pre-amp formed by Q1,2 with C8, R6 and R7. Input B is a Schmitt TTL gate. Why TTL? TTL is used in preference to CMOS because the maximum input frequency for the CMOS equivalent is around 2 MHz.

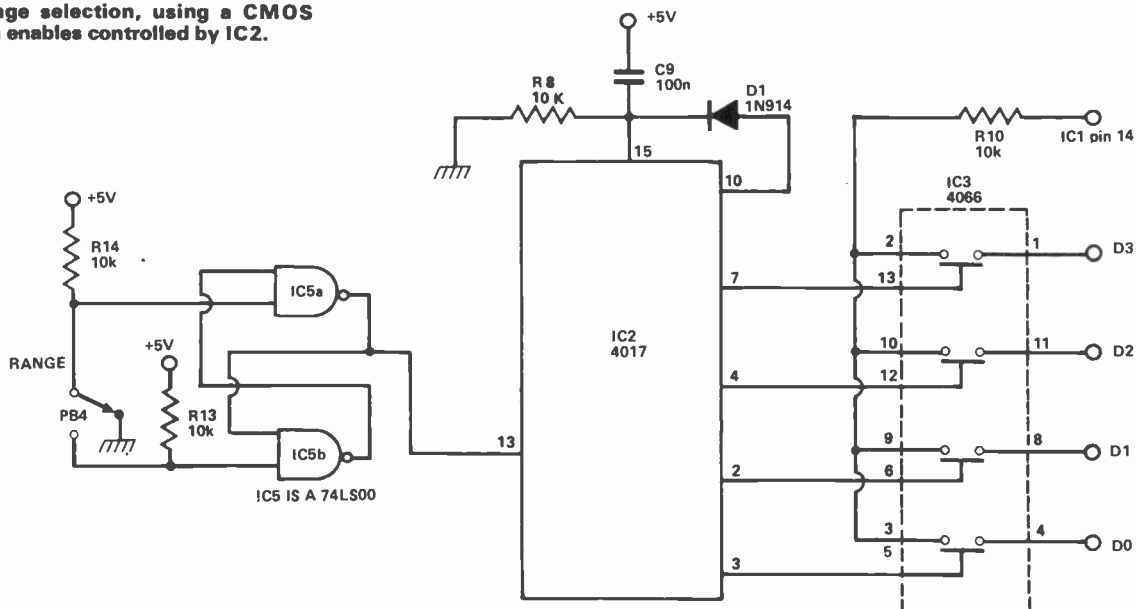
The range selection pin (pin 14) of IC1 is switched to the appropriate strobe line (D0-D3) by the CMOS switch, IC3, with the enables controlled by IC2. PB4 is

debounced by IC5 and cycles the four position ring counter IC2. C9 resets the counter when power is applied.

For function selection, pin 3 of IC1 is connected to the appropriate strobe line (D0, D3, D4, D7) by switches 6, 9, R9, 10 are used to increase noise immunity in the multiplexed inputs, pins 3 and 14.

The Hold switch 'freezes' the display to make it easier to take a reading from a rapidly changing input.

Fig. 2. Range selection, using a CMOS switch with enables controlled by IC2.



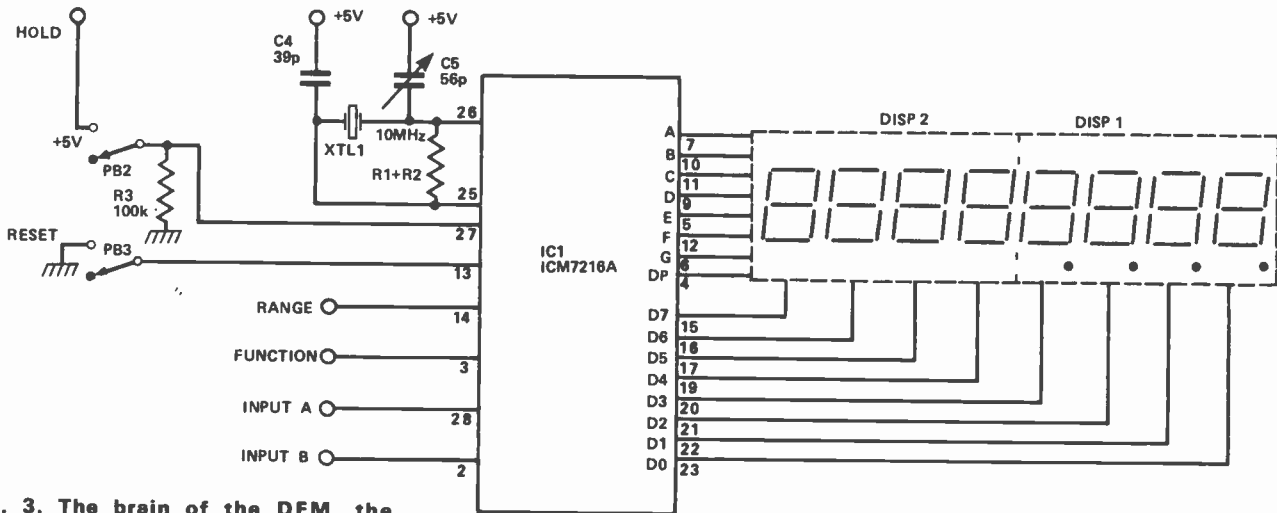


Fig. 3. The brain of the DFM, the ICM7216A chip. It even drives the displays.

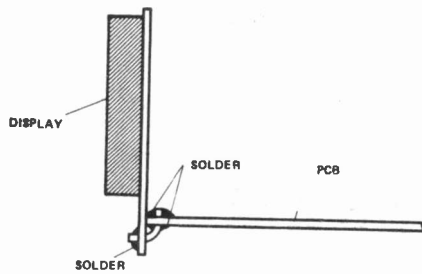


Fig. 4. Fixing the display board to the main PCB.

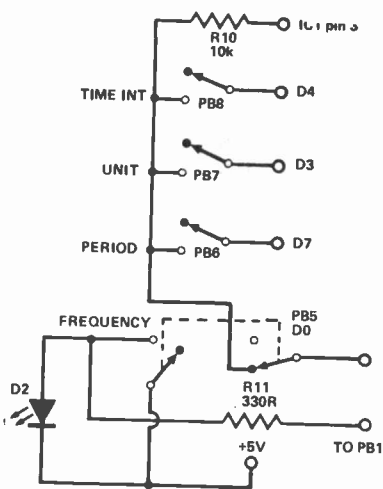


Fig. 5. Switch wiring for the time interval, unit, period and frequency functions.

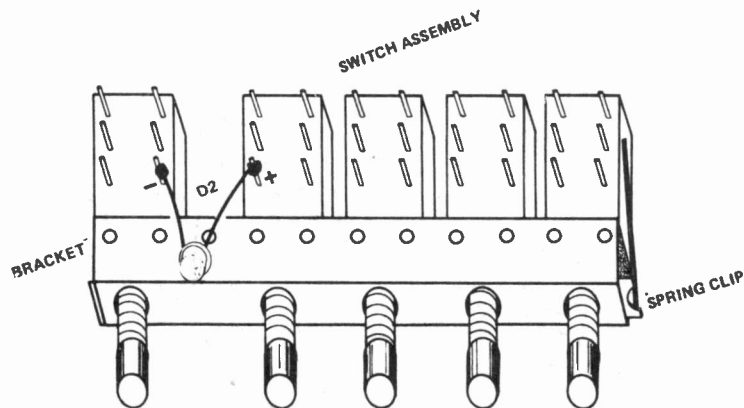


Fig. 6. Make sure you get the polarity of the frequency switch LED right.

off, check the mains switch, C1, C2, C3 and IC7. Have a look at the transformer and check the fuse.

With the link in place and the power on, a zero should appear on the right hand digit (unless unit counter mode has been selected, when the right hand decimal point will light). With the +100 button out, connect a signal of known frequency to input A. Note: to obtain a reliable reading the signal should be at least 300 mV. To test the prescaler, a frequency of at least 10 MHz is needed.

Final Assembly

The plastic mounting pillars in the bottom of the case should be removed with a hot knife blade or cutters. Slot the PCB with panel into the case bottom and drill out the fixing holes (6 BA clearance). Bolt the board into

place. The red perspex display filter (113x28½ mm) is held in place by the two halves of the case when closed.

In Use

With the time interval mode selected, input A starts the count and B stops it. A must go low before B to stop the count. On repetitious signals this occurs automatically.

The instrument can be used to count items on a moving conveyor belt or to measure the speed of a model plane prop. The prop can be made to interrupt a beam of light.

The speed is then given by:

$$\frac{\text{No of pulses (Hz)}}{\text{No of blades}} \times 60 = \text{RPM}$$

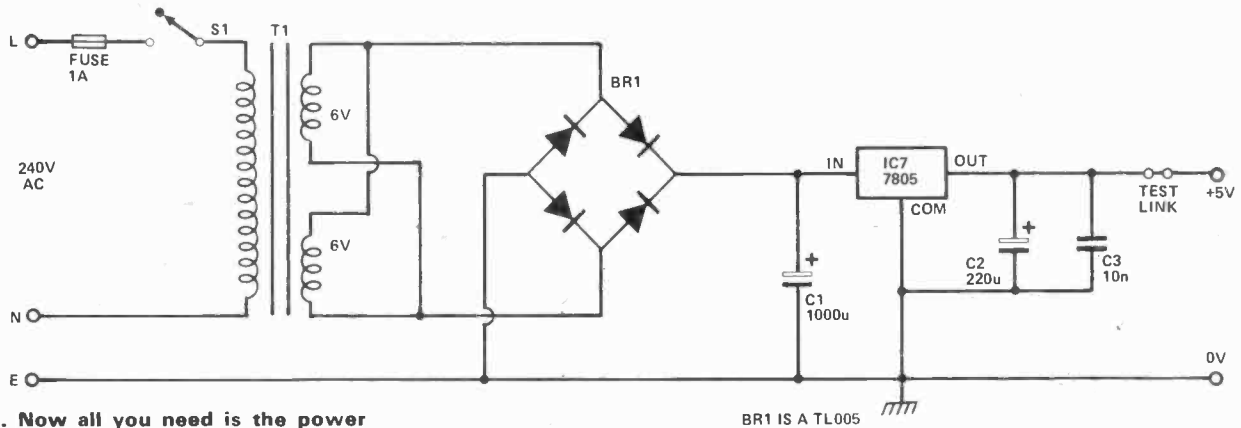


Fig. 7. Now all you need is the power supply to start DFMing. See text for details of the test link.

PARTS LIST

RESISTORS all 1/4W 5%

R1,2	10M
R3	100k
R4,12	1k0
R5	82k
R6	4M7
R7	4k7
R8,9,10,13,	
14	10k
R11	330R

CAPACITORS

C1	1000u 16V PC electrolytic
C2	220u 25V PC electrolytic
C3,8,9	100n polycarbonate
C4	560p polystyrene
C5	56p trimmer
C6,7	10n ceramic
C8	2u2 10V tantalum
C9,10	100n polycarbonate
C11,12	10u 35V electrolytic

SEMICONDUCTORS

IC1	ICM7216A
IC2	4017
IC3	4066
IC4	74LS32
IC5	74LS00
IC6	SP8629
IC7	78M05
Q1,2	BC108
D1	1N914
D2	TIL211
BR1	TL005
Disp 1,2	4 digit common anode display

MISCELLANEOUS

DPDT push button switches (PC mounting) and buttons (8 off), 6way mounting bracket, one way mounting bracket, SPST toggle switch, BNC sockets (2 off), 1 A fuse (20 mm) and PC clips, 6-0-6 3VA PCB mains transformer, 10 MHz crystal, case, cable clip, PCB.

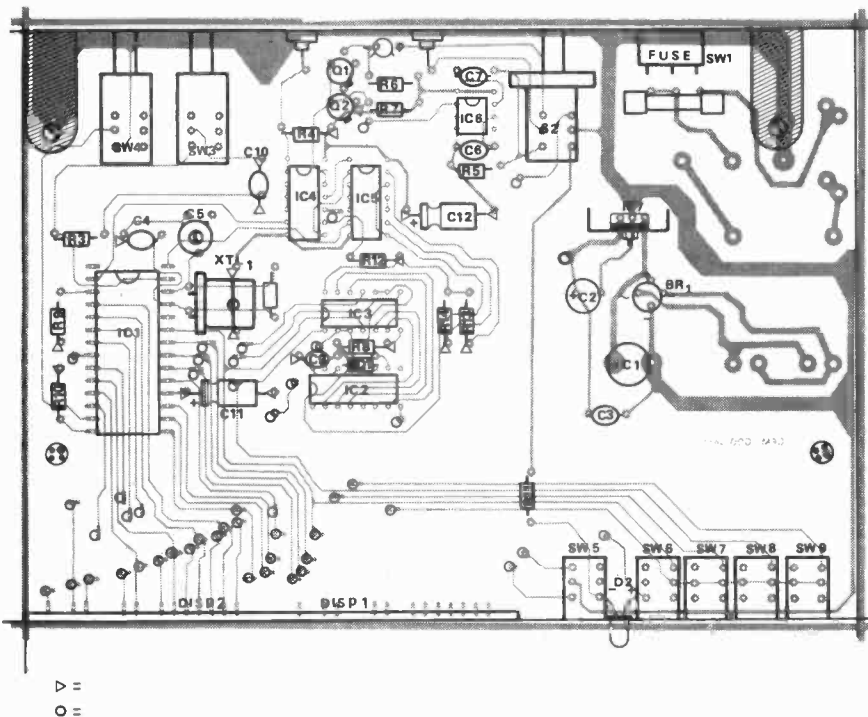
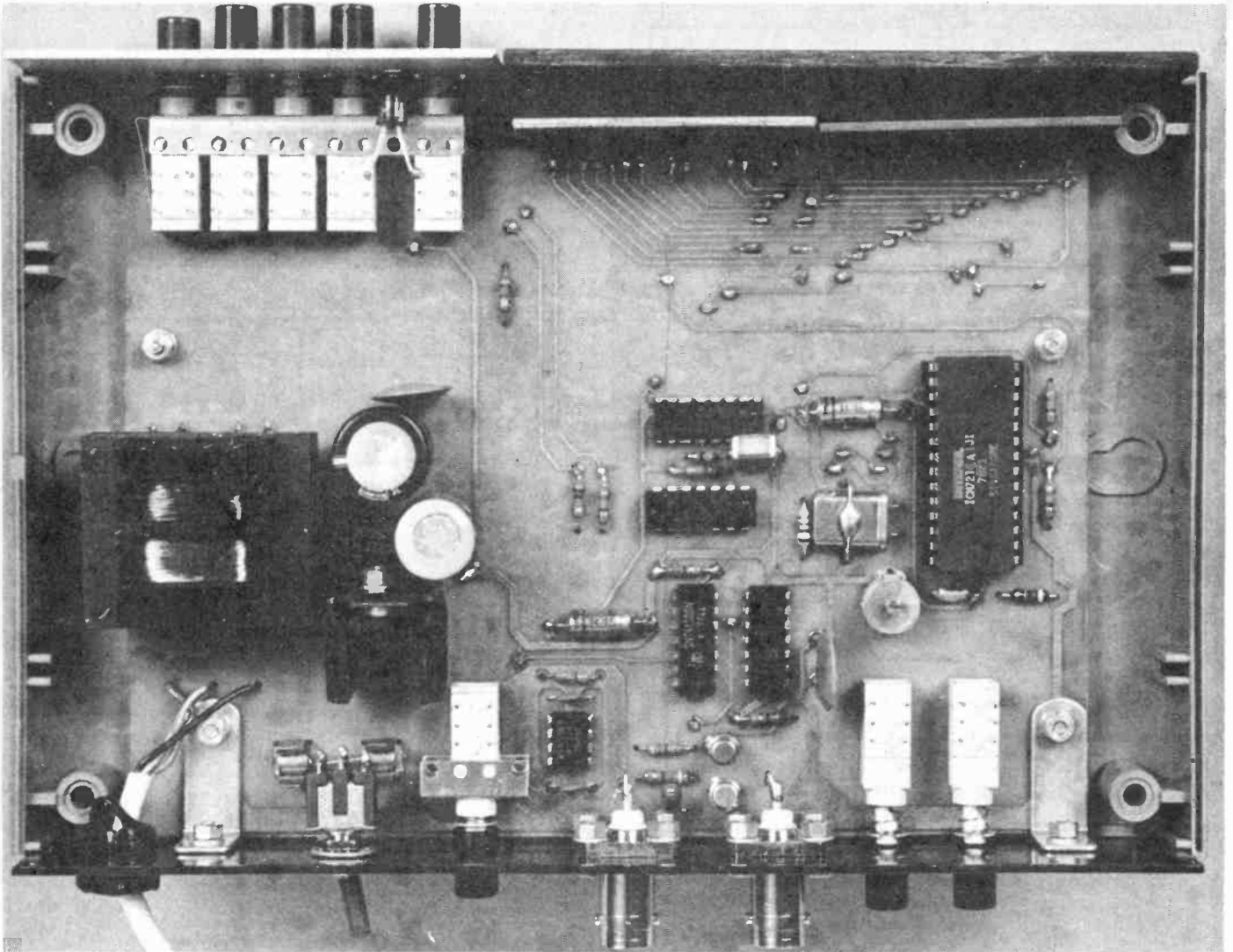


Fig. 8. Component overlay.



PROJECT: Digital Frequency Meter



... And when you put it all together, this is what you get. Nice innit! This photo shows the completed prototype PCB, installed in the case.

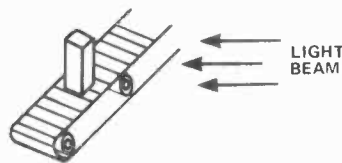
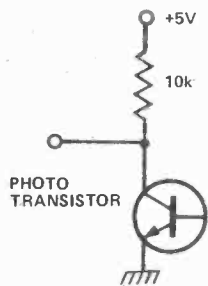
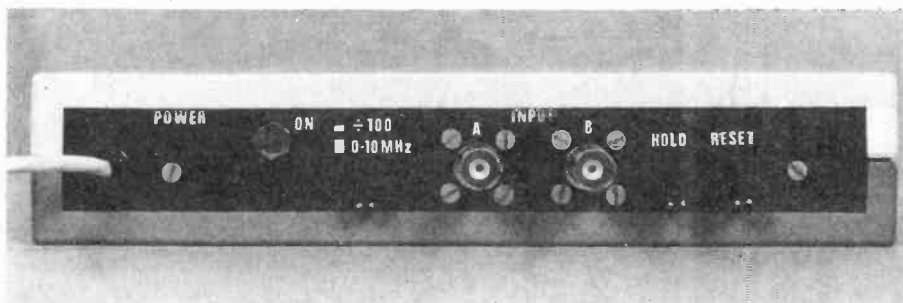


Fig. 9. If you have a conveyor belt handy, you can count things running along it (gremlins, etc.) with this arrangement.

BUYLINES

Watford Electronics are producing a complete kit of parts for this project, with everything you need down to the last nut and knob.

Your Watford Electronics Digital Frequency Meter kit will cost £64.50 + VAT.



The back panel, which carries the inputs, input attenuator and hold and reset buttons ... and power switch, of course.

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0.9-0.9	330 330	235	1.90	.60
0.8-9-0.8-9	500 500	207	2.50	.65
0.8-9-0.8-9	1A 1A	208	3.60	.65
0-15-0-15	200 200	236	1.90	.60
0-20-0-20	300 300	214	2.50	.80
20-12-0-12-20	700(DC)	221	3.25	.80
0-15-20, 0-15-20	1A 1A	206	4.35	.95
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0-15-27, 0-15-27	1A 1A	204	5.85	.95

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2	1	71	3.00	.80
4	2	18	3.80	.80
6	3	70	5.35	.85
8	4	108	7.20	1.10
10	5	72	8.00	1.10
12	6	116	8.60	1.10
16	8	17	10.60	1.20
20	10	115	13.60	1.40
30	15	187	16.60	1.40
60	30	226	33.10	1.70

30 VOLT (Pri: 220-240V)

Amps	Ref. No.	Price £	P&P
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1.0	79	3.35	.80
2.0	3	5.35	.95
3.0	20	6.05	1.10
4.0	21	6.35	1.10
5.0	51	9.35	1.10
6.0	117	10.85	1.10
8.0	88	14.10	1.40
10.0	89	16.35	1.40

50 VOLT (Pri: 220-240V)

Amps	Ref. No.	Price £	P&P
0.5	102	3.35	.80
1.0	103	4.35	.95
2.0	104	7.05	1.10
3.0	105	8.35	1.10
4.0	106	10.60	1.20
6.0	107	14.85	1.40
8.0	118	19.95	1.60
10.0	119	23.85	2.10

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Amps	Ref. No.	Price £	P&P
0.5	124	3.60	.80
1.0	126	5.35	.95
2.0	127	7.30	1.10
3.0	125	10.85	1.20
4.0	123	12.10	1.40
5.0	40	13.90	1.50
6.0	120	17.35	1.50

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INDEX 79

THIS month's alphabetical extravaganza brings you up to date with the past year of excellent ETI projects and features. Index 79 follows roughly the same game plan as Index 78. All articles except Tech-Tips and News Digest are included.

Projects are listed in alphabetical order. Features have been divided into categories for ease of reference. For simplicity's sake each project or

feature has only been entered once, in the most relevant category. Although Readers' Designs are constructional articles, they are listed under Features, because they are not ETI projects.

Computing Today is now a separate publication and is no longer featured as an ETI supplement. Its contents have, therefore, not been included here.

See you next year for Index 80.

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MICROFILE

This month Henry Budgett takes the plunge into the language war and brings you the latest Triton news.

A strange month this one and no mistake. There have been lots of little snippets of information drifting in on the wind, varying from general interest to specific details, but with the proliferation of trade shows that always occurs at this time of year much has tended to be "come and see". As I have mentioned in the past, the majority of Personal Computer shows in this country have tended to become carbon copies of each other so I hope to bring a little difference to this month's proceedings by not mentioning any!

Television's Epitaph

It was with a great deal of personal sadness that I learnt of Dr Chris Evans' death last month. The return of ITV with their series "The Mighty Micro", taken from his recently published book and presented by him, will probably be a fitting epitaph. I was fortunate enough to work with him for over four years prior to joining Computing Today and, from the first couple of the episodes that have been shown so far, I think that his prime skill of presenting complex information simply is going to make the series a great success.

Although the series will break no new ground with anyone familiar with the micro as a tool, it already has the appearance of being the "Working Man's Guide to New Technology". If it succeeds in getting over the fact that the microprocessor is by no means the weapon that certain areas of the popular Press tend to scream about then it will have achieved what I believe is its main aim.

Chris had not been in the best of health for nearly a year, but his sudden and untimely death has removed a great source of energy and interest from the computer world. I hope that the rest of the series maintains the level of interest that it has already set.

Program Or Language

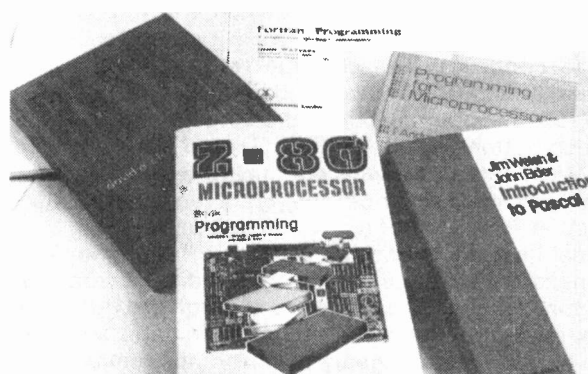
A raging controversy is taking place at the moment in the personal computer pages of many publications. The subject under the spotlight is what will replace BASIC as the next computer language for the home computer.

Claims have been made in support of everything from Pascal via LISP to FORTH. In fact the vast majority of these claims reveal one simple fact — not too many people in the home computer market know as much as they would like us to think!

Before you think that my head is expanding at an alarming rate, let me explain.

Your average computer doesn't really give a proverbial monkey's about what language you use because all it knows about is a series of binary digits that conform to either its internal instruction set or are data for it to process. The only reason that computer languages were invented was to save us mere mortals from going mad over vast quantities of binary. The next logical stage up from the actual binary language, machine code as it is generally called, is Assembly Language. This consists of mnemonics, or short groups of letters, that remind one of what the binary code does. It is obviously easier for someone who talks in a complicated language like English to understand something written in letters than as a string of ones and zeroes. Most assembly languages follow roughly the same format and it is not too difficult to convert from say SCMP to Z80.

At this stage in the game we find what are called High Level languages, or as I prefer to call them Specialist Languages. These become more like the language that is spoken by the people who use them and this is the real point of this little discourse. It is a strange fact that this country is about the only one to have any expertise at machine code level in the home environment. The Americans, who are supposed to have invented everything from the wheel up, and indeed did produce the micro, seem to disappear whenever the words Machine Code are mentioned. Why we are happy with it is a total mystery to me (answers on the back of a blank cheque please) but there must be some reason. I wasn't allowed near BASIC until I had some knowledge of machine code and I suspect that there are many others like me. ▶



Any bets for the next home computer bingo.

The reason for the popularity of BASIC at the moment is because it is a well proven language, easy to write, many systems support it and, above all, it is easy to understand. Try taking a program written in say Z80 assembler, another in BASIC and a third in APL. It is fairly certain that the BASIC program will be the easiest to understand, the easiest to convert to your system and the easiest to change. I well remember being asked at an interview which I would prefer to alter, a program in BASIC or one in machine code, I replied "BASIC, because I'm more familiar with it." My interviewer replied "Right answer, wrong reason." I'll leave you to work out why!

The language which most people are touting to replace BASIC is Pascal, and this is in my opinion similar to buying a two litre car where a one litre one would do. The point to be made here is that both perform exactly the same job but in a different way. If you were offered a choice of BASIC or FORTRAN you would look at the problem in a different way, say, as a choice between a car and a lorry. Why, because they do different jobs. So the prime objective in the choice is to select the right language for the task that you wish to perform and, without any doubt in my mind, the choice for the general purpose user is BASIC.

As a final parting shot in this argument I would further endorse the suggestion that any microcomputer sold without decent access to it's machine code isn't worth much. Whilst being harder to write it does give such a vast speed improvement that it can be the only way to solve some programming problems.

Try It On

A couple items of interest to those who have Tritons. You can now get a Pascal compiler for the system. It's a 20K version that plugs into the motherboard but it was developed from a CP/M original which will also become available soon, so those of you with a CP/M system can have it too. I'm digging my fingers in at the moment and will let you have a report as soon as I can.

The second item is that disks are on the way very soon, again with the CP/M operating system. Both 5 1/2 and 8 inch will be available and you can have up to four in double sided, double density format, which is a tidy number of bytes of store. Keep your ears on for more details soon.

And finally two items, again both concerning Triton. The first is just about the dirtiest trick in the book and I take the blame for it. I wanted to hang our printer on our Trion (we have 5.1 so it's really easy), but I was a trifle worried about speed problems. The fact was that our printer uns at 300 Baud. I'm too lazy to change the switch and it looked as though the delay in the software wasn't going to belong enough to cope with the carriage return. Well, being hardware biased I looked around for a solution, and I found it! On the original Triton drawings you will see a dotted push-button on IC4, that's the master clock, labelled PAUSE. Well, I thought, why not stick the printer's busy signal on there, after all it does the job. Even so sorry Mike and all you at Transam but it does the job perfectly!

The final item this month before I go off to a couple of exhibitions, drat I gave the game away, again concerns our little machine. Having been dragged through the rigours of the disco, as seen in the papers, it has been banished of all places to Mount Etna, allegedly to control the temperature of the police chief's bath water.

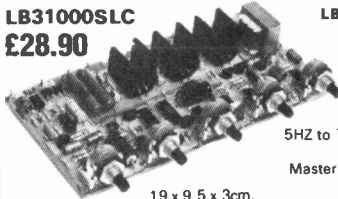
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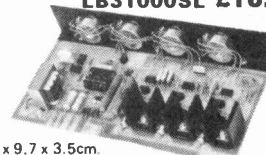
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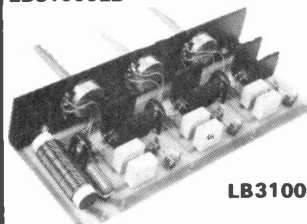
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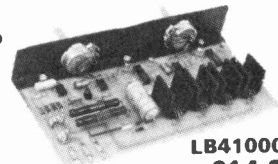
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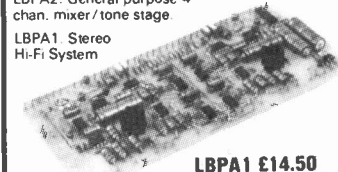
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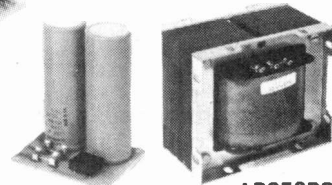
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WHAT TO LOOK FOR IN
THE JANUARY ISSUE.
ON SALE DECEMBER 14TH.

LOSING YOURSELF IS FUN

Next month we present what we hope is the ultimate maze game. The program designs a maze in plan and then projects it in 3D so you actually walk through it, hopefully finding the way out! Written in BASIC for the Triton it is fully documented for conversion to other systems. Once you get into your micro you may never get out so beware.

The famous game of Pontoon has been written in BASIC and we present it in next month's issue. A better way to spend Christmas afternoon than watching repeats, on telly that is. Gamble your 50p on next month's issue for hours of fun.

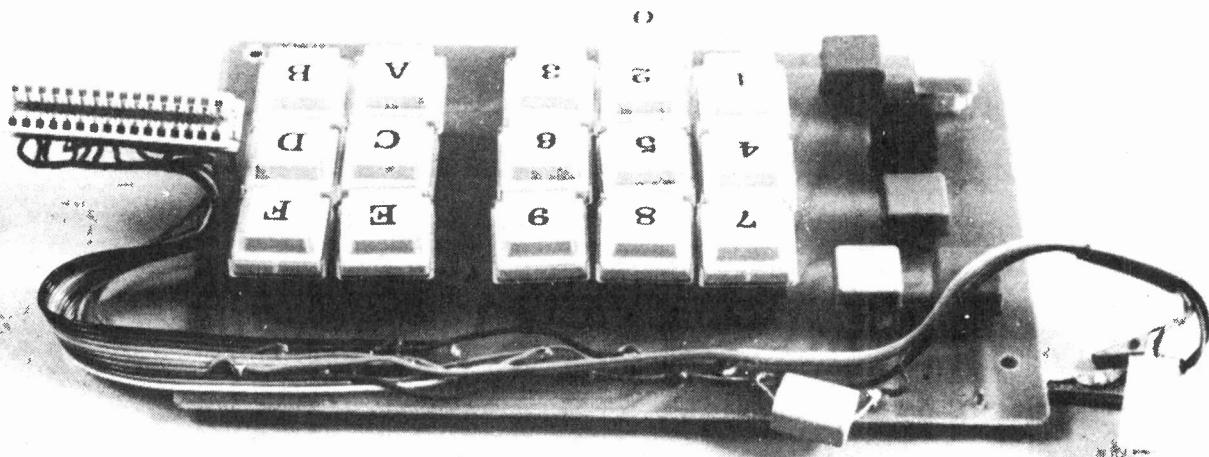
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A brand new game of naval strategy combining air to sea operations with conventional submarine attacks. You will have to guide your submarine through the Pacific avoiding submarine hunters and sinking ships. A must for the sea-dogs amongst you.

If you are following our MPU's by Experiment series this project is for you. A simple add-on keyboard to replace the one on the Mk 14 is a must for easy programming, and this simple project will save those stubbed fingers.

KEY TO SUCCESS



PROCESS CONTROLLER

This controller has myriad applications in electronic and photographic work. It features an LED display which 'counts down' and is easily visible in darkroom or daylight.

Various processes in fabricating electronic projects require timing a chemical reaction or process — developing photoresist in making printed circuit boards being a prime example.

The Technique

The easiest way of producing a time delay is by using a 555 timer IC, but a glance at the data sheets shows that it should not be used for periods in excess of 100 seconds. By using the 555 as an oscillator and feeding its output into a 4017 counter/decoder IC the maximum timing period can be increased ten fold. The unused decoded outputs can then be connected to a column of LEDs which will give an indication of elapsed time.

Each pulse from a 555 clocks the 4017, moving a high level along its ten decoder outputs, lighting each of the LEDs in turn. When the high level reaches the last output it is used to operate the relay and thus the time delay has been multiplied by ten.

A permanently-lit LED has been included at the bottom of the row to show when the unit is on. This also gives a better indication of elapsed

time in a darkroom, as the LEDs can be seen to step towards a reference light.

Four time ranges have been provided with a trim pot on each one for easy adjustment. The table gives the values for each trim pot and C1, for a variety of times. The minimum time is limited by the time taken for the relay to operate, maximum time by the limitation of the 555. In practice, times from 100 mS to twenty minutes can be achieved. For very short times the time elapsed indication will not be much use and the LEDs can be left off the board.

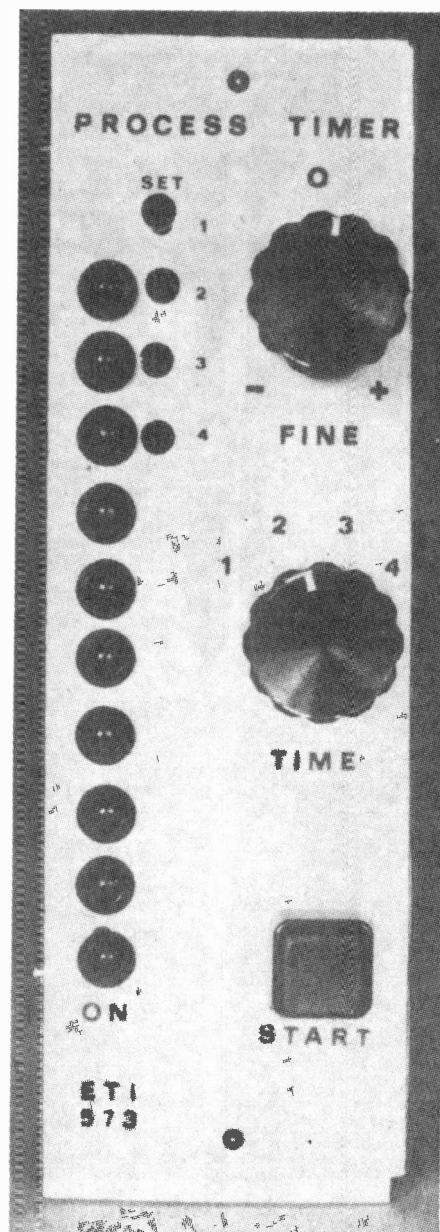
Fine adjustment of the timing is achieved by adjusting the threshold voltage on pin 5 of the 555. When the voltage on pin 5 reaches a set value, the output (pin 3) of the 555 goes 'low' (i.e. the 555 triggers). This voltage is normally set at two-thirds the value of the supply rail, fixing the time during the charging cycle of C1 when the 555 triggers.

If the threshold voltage is increased, the time taken for C1 to charge to the required value increases, and the frequency of oscilla-

SPECIFICATION

Maximum time delay	1 sec	10 sec	100 sec	1000 sec
value of C1	1uF	1uF	10uF	100uF
value of RV (1-4)	200 k	2 M	2 M	2 M

Table of values for C1 and RV1-RV4 required for differing time delays.



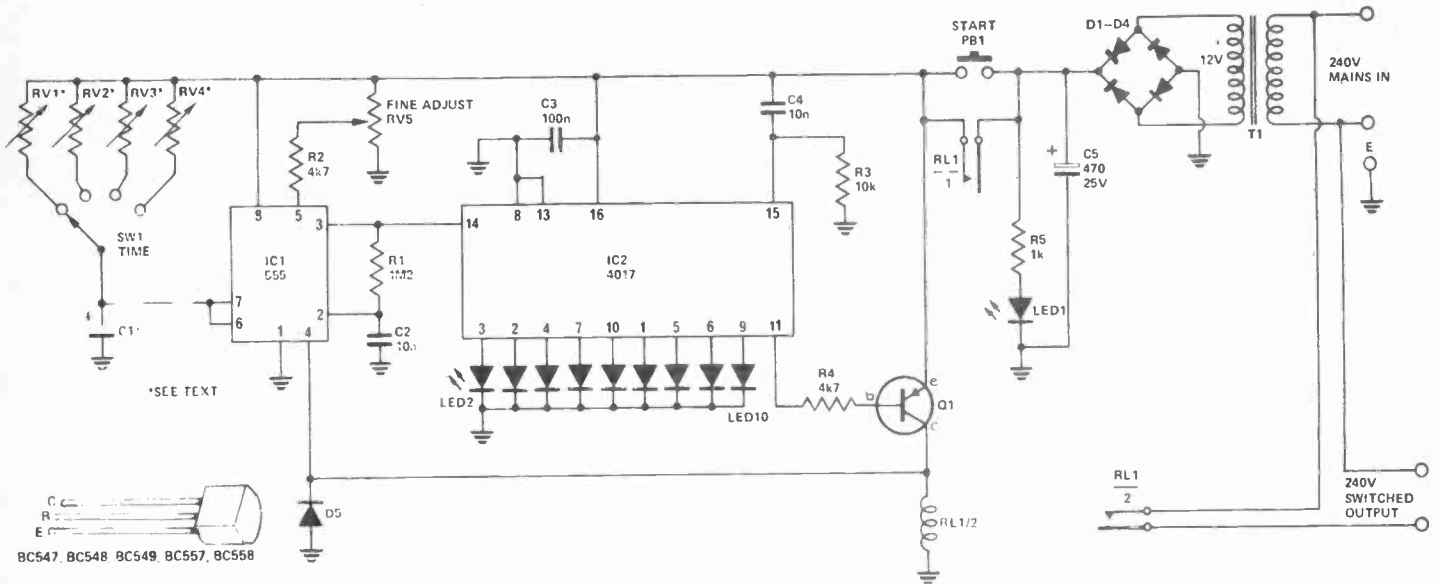
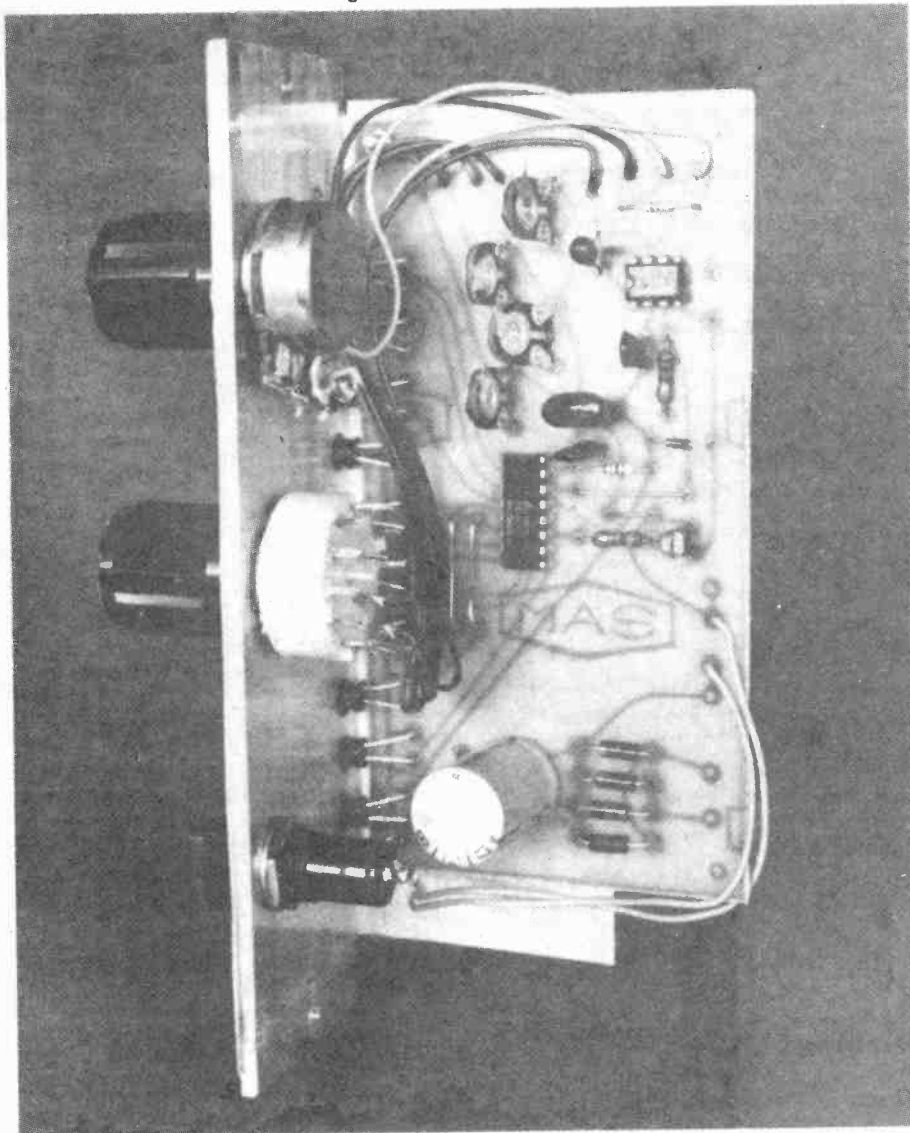


Fig 1. Full circuit diagram of the controller



HOW IT WORKS

The timer consists of a 555 timer IC used as an oscillator driving a 4017 counter/decoder IC, the decoded outputs being used to drive a row of LEDs and switch a relay.

The timing period is set by the frequency of oscillation of IC1. This is dependent on the time constant of RV1-RV4 and C1. As either of these components are increased in value the time constant will increase and the frequency adjustment is provided by RV5 which adjusts the threshold voltage on pin 5 of the 555. This voltage is normally set at two thirds of the supply voltage, but here it is adjusted varying the required voltage across C1 to the 555.

Output from the 555 is fed to the clock input of the 4017. After each pulse a different decoded output of the 4017 goes high, lighting each LED in turn. After the tenth clock pulse the output on pin 11 of the 4017 goes high. We shall come to what that does shortly.

When power is first applied, the relay contacts RL1/1 are open and the bottom LED (LED 1) is lit. When the 'start' button is pressed the 4017 is reset to zero by a positive pulse applied to pin 15. This pulse is provided from R3 and C4. Pin 11 goes low, turning on the PNP transistor Q1, and the relay operates. The now closed relay contacts (RL1/1) short out the start button and sustain the power after the start button has been released. The transistor also drives the reset line of the 555 (pin 4) which commences to oscillate. This ensures accurate timing of the first cycle.

On the tenth pulse from the 555 pin 11 of the 4017 goes high, turning off Q1, stopping the oscillator, and the relay is de-energised. The contacts RL1/1 open removing the supply to the timer returning it to its original condition, ready for the next sequence.

During the timing period, the second set of contacts RL1/2 close and can be used to switch up to 5 A using the relay specified.

tion decreases. Thus, the total timing period is increased.

What device you want to control with the timer will determine the type of relay you use. This unit is capable of driving quite large relays, however, we used a commonly available type having contacts rated at 10A.

Construction

First, you will have to determine from the table the correct values of RV1-RV4 and C1 to provide the times you want for your application.

Next, mount all the components taking care to correctly orientate the semiconductors. The LEDs are best mounted by inserting them into their holes and bending them over flush

with the edge of the PCB. The photo shows the way we mounted the LEDs.

The completed unit can be mounted in a variety of ways to suit individual applications. Either in a box, together with its relay and a mains female output socket for the switched output, or on a panel with a remote transformer and relay.

To mount the unit against a front panel, drill a row of ten holes for the LEDs and four holes to line up with the trim pots for screwdriver adjustment of the timing. The start button, timing switch and fine adjustment pot can be mounted anywhere convenient. The board should be mounted against the panel so the LEDs protrude through the holes.

Setting Up

Having assembled the unit, all that remains is to calibrate the ranges. This is easily done with the aid of the second hand of a watch. For shorter times, say under five seconds an oscilloscope is best.

Monitor the positive supply after the relay contacts RL1/1 and measure the time the contacts operate. For other purposes it may be best to set the ranges by trial and error, such as when the it is being used for a PCB development timer. In either case, the fine adjustment control should be set in its mid position when calibrating.

ETI

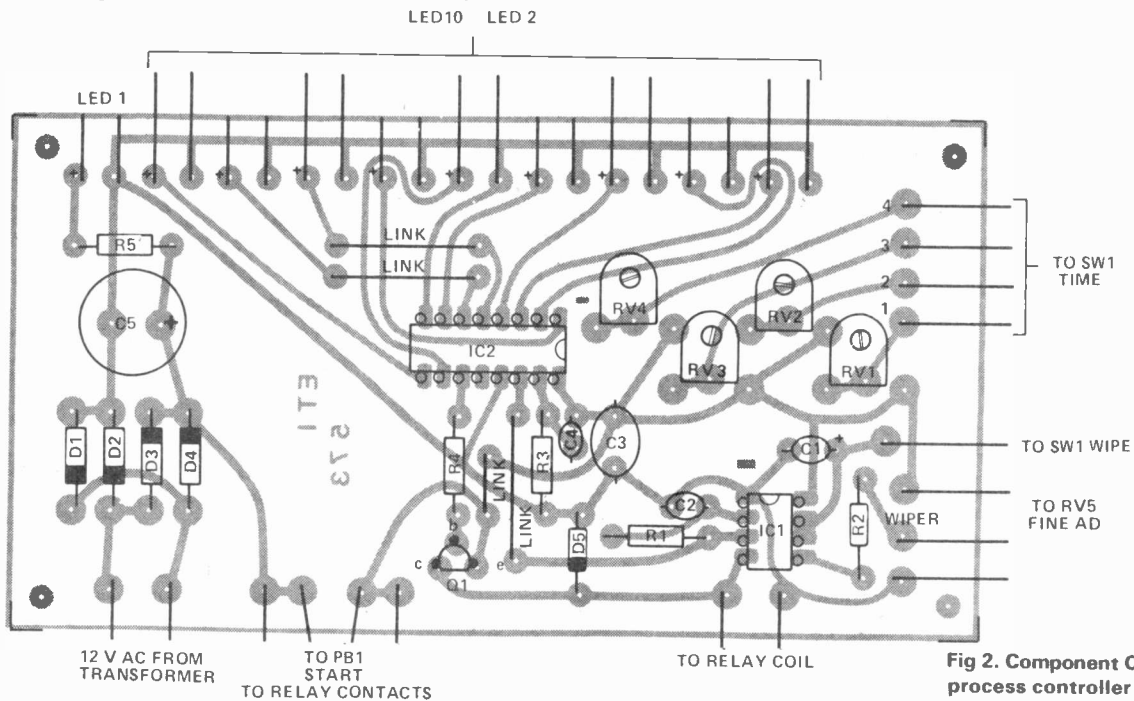


Fig 2. Component Overlay for the process controller unit

PARTS LIST

Resistors All ½W, 5%

R1	1M2
R2,4	4k7
R3	10k
R4	4k7
R5	1k0

Potentiometers

RV1-RV4	See text
RV5	10k lin pot

Capacitors

C1	See text
C2,4	10n polyester
C3	100n polyester
C5	470u 25V electrolytic

Semiconductors

D1-D4	1N4004
D5	1N914
Q1	BC558, BC178
IC1	555
IC2	4017
LED1-10	TIL220R or similar

Miscellaneous

SW1	One pole, four position switch
PB1	Momentary Push Button
T1	12V, one amp transformer
RL1	12V relay with two changeover contacts

BUYLINES

The switch SW1 can be any 'break before make' rotary type. Suitable units are sold by Watford and Maplin. The 12 V relay is not a critical type and so readers should experience no difficulty in obtaining one suitable from their local component shop.

ETI MARKET PLACE



1 CLOCK RADIO

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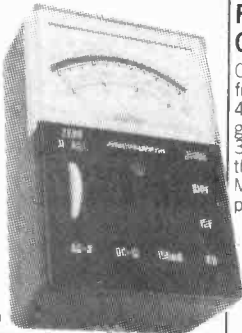
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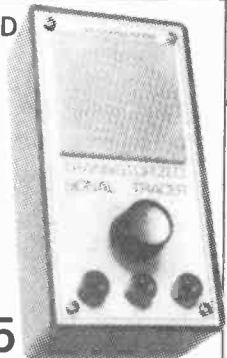
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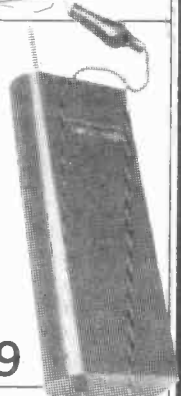
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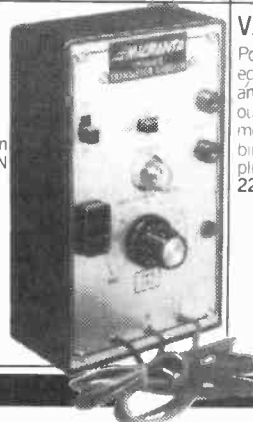


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AUDIOPHILE

This month Ron Harris has news of a vanishing thump, a speaker which comes with ribbons on and a cartridge which has a golden future. Videotone, Goodmans, JVC and Goldring get themselves involved.

IT is 6.30 am Monday morning and it is cold and dark on Charing Cross Road. ETI's editor walks through the still air, ignorant of the frost gathering on his extremities and the shuffling uncertain glares of the tramps in the doorways.

Far away a burglar alarm rings unheeded, disturbing no one not even the rat munching happily on a crisp bag which skips away with a snarl as the editor passes, eyes unseeingly fixed on infinity.

Dawn was gathering its strength behind Centrepont (and the rubbish piles) as he reaches the office doors. He stops suddenly and a mugger swinging an iron bar down at where the editorial head would have been, misses his mark, stumbles and falls down a flight of stairs into a cellar, stunning himself.

Head still in clouds, musing on the ill fortunes of life, ETI Ed turned the key and meandered into the building, closing the door just as a hungry cat leapt at him from the hall, catching it in mid-flight with the door.

"Rotten. That's what is is. Rotten. Everything has a flaw in it," he mused to the ringing walls. "Rotten luck is what we got. Rotten. Take for example that Coral H 300 headamp I reviewed last month. Lovely sound, neat construction and well matched to the excellent MC81. But is it perfect? Alas no. Rotten luck. Rotten. The de-thump relay doesn't work on switch off. Sends the speaker cones heading for the far wall with no regard for any ear-drums that may be in the way. Rotten luck."

By now he was entering the offices, edging in as the semi-sentient cleaning staff pushed out, demolishing a wall fitting on the way. As their communicative grunts echoed away down the stairs the editor walked to his office passing the Art Director slumped unconscious across his desk on the way. Cause unknown.

Just as he takes his place in the Editor's Throne, but before he can doze off, the phone rings. It is Coral. They put the designer of the H300 on the line. The unit is no longer possessed of a thumping switch-off. The relay has been rewired on all current models so that no nasties escape. All thumps are de-thumped good and proper. The flaw is rectified. All is well. . . . Perfection at last.

The Editor flings the phone high in the air and runs yelling from the room, awakening some of the staff in his uncaring unbounded joy.

Life is good after all. Nice one Coral.



Heed ye all the vision before thine eyes. Felicity Kendal. You must have been expecting this for a long time. Mr N. Ashford of Leicester had the good sense to point out that although I have continually referred to the beautiful lady, I have never actually published a photograph of her to prove the point to heathens like him.

Well Mr Ashford, my thanks for the idea (excuse?) and I only hope you are suitably repentant. Ignorance is no excuse.

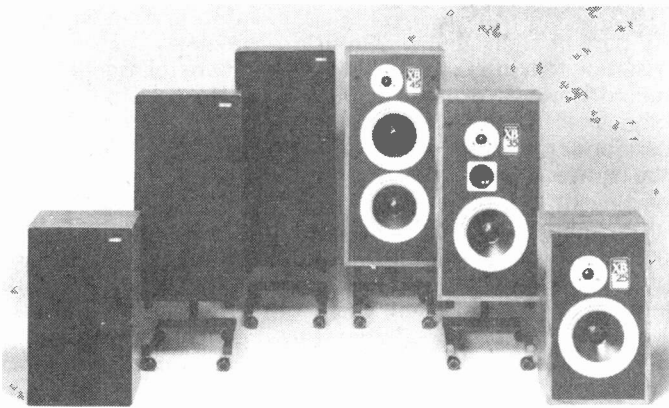


Corals H300 head amplifier which can now be wholeheartedly endorsed because the one fault — a de-thump relay which didn't work on switch-off — has been dealt with by the manufacturer and all is now well.

Apart From All That

Yes, well, I'm back from unbounded joy — all too soon. It would take Felicity Kendal's smile to keep this cynical soul in Nirvana longer than a brief moment or two. All else is but dross after all. 'Music to sooth the savage editor', etc, etc.

Some nice things have happened this month in the realms of things hi-fi. Two new sets of loudspeakers are worth a mention for starters. Goodmans launched the XB



The entire Goodmans XB range — all three of them! Prices vary from £95 for the 25 up to £139 for the considerably larger XB45 lurking away at the back of the photo. Stands are considered essential by Goodmans and are always a good thing anyway. All three are specified for 10-60W RMS and a sensitivity of 9W (DIN).

range shown in the photo and on the initial listen in they have a crisp sound to them with a particularly clear upper bass. Good value for your diminishing pound.

JVC also have some new speakers to follow last month's tuners, and their claim to fame and notice is the use of a ribbon tweeter unit, the principle of which is of interest. For once even my own stubborn nature does not tell me I could improve on the company's own explanatory verbiage. So

Getting Ribbed

In the ribbon tweeter the diaphragm is a piece of thin film (12u — poly resin) of which the voice coil (18u — aluminium foil) is an integral part. This single unit has a moving mass of 0.048g — which is between 5% and 20% of the moving mass of a conventional tweeter.

The diaphragm is stressed to ensure constant surface tension and sandwiched between two sets of magnets of high efficiency and linearity.

Current entering the tweeter flows through the coil bonded onto the resin film and, with minimal transmission loss in the coil, the diaphragm can produce movement with high efficiency.

Transient response is excellent, since the entire surface of the driver is driven to displace air and a (cast aluminium) horn is used to aid sound dispersion.

Intriguing, eh?

There are three models in the new Zero range, a Three, Five, and Nine floor standing version which I would very much like to get a listen to somehow. I will have to hope JVC can help. At £375 each they are a little over the top to stop a shop and try one.



JVCs new Zero-5 loudspeaker incorporating the new ribbon tweeter unit of which they are so proud. Sounds Isodynamic to me.

If you're about to buy a pair of headphones for anything under £35 — then don't. Instead, hang onto your money until you've read next month's Audiophile. A little box with MDR-3 written on it, which arrived here very recently, could make you regret doing anything rash. Let me be sneaky and refuse to reveal anything other than that if you want your phones to be comfortable, compatible with any amp, have an excellent transient response and cost £17 then anything you do now might be a mistake.

It is a safe prediction for me to make that the MDR-3 will completely change the headphone market place upon their release. You have been warned! ▶

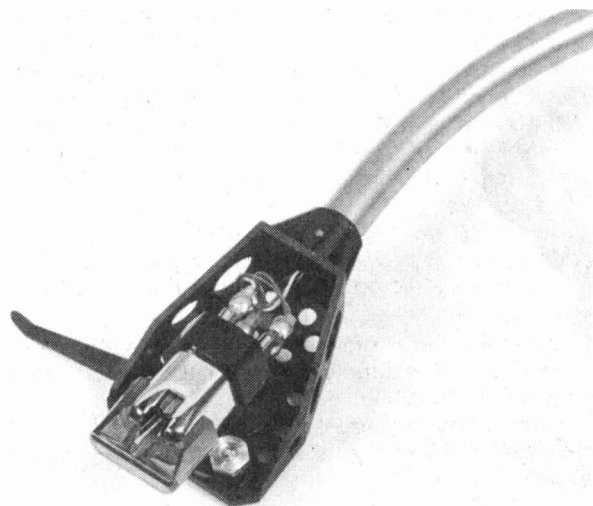
Goldring G900IGC

Whatever next. Gold plated ABS plastic boxes, containing gold plated cartridges. How to make an impression in one easy lesson and lots of pounds sterling.

The precious metal approach was adopted by Goldring to enhance the presentation of their new IGC (Improved Groove Contact) cartridge. This is basically a G900SE II body with a whole new, highly expensive, stylus assembly.

Called a Van den Hul point, the stylus is of the 'Gothic Arch' type such as employed in the Shibata type, but with a completely redesigned profile to further improve groove contact and better recreate the cutter head profile.

Goldring have taken an amazing amount of time, trouble and money out of the bank over this stylus. The shape itself is computer designed, the work having been done by the Dutch physicist after whom it is named, and the company spent a long long time searching for a supplier for the very high grade of diamond employed.



technically but that don't quiet the vague rumblings of discontent somewhere south of what passes for my conscious mind.

I ran the cartridge through a series of response and distortion tests which only went to prove how pointless it is to publish a graph which is to all intents and purposes a straight line and from which not one jot of information about the cartridge's performance — other than that it has a textbook frequency response — is to be gleaned.

At 1.3g it passed every tracking test I could put in its way and sailed unconcerned over 99% of the 'murder music' I fed it later. An almost incomparable tracking ability then (good improvement here). As a guideline I'd say the IGC is a better tracker than the VI5 IV — but only just!

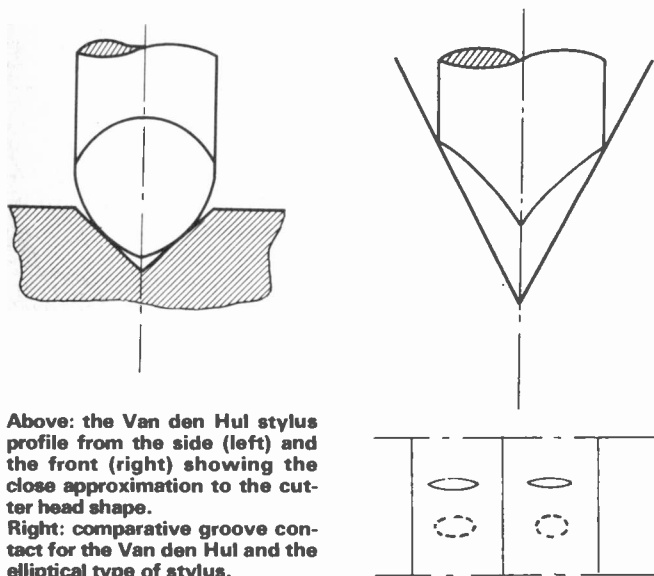
What A Set-Up

As part of their 'blurb' Goldring make the astounding assertion that 'due to the IGC's inherent ability to follow the record grooves exactly it will obviously pick up record blemishes also. In order to extract the best from the cartridge, therefore, we recommend that ONLY records of the highest quality (such as Enigma Supercut series) should be played.

Include that ONLY and discount nine-tenths of your market, Goldring. I must say that I found the IGC as tolerant of bad software as any top quality cartridge. It did not emphasise 'blemishes' in the slightest, much as that text would have led me to expect it to. I can see what they're getting at but instead of giving the impression of a superb performance, fit for Superdiscs, in my opinion they are needlessly accusing their own product of a touchiness it does not possess.

Detail,Detail

To be able to form a valid opinion of any piece of hi-fi, one needs a reference against which to compare performance and in this case that role was filled by the Coral MC81 moving coil cartridge. In addition I was interested to see how the new 900IGC gared against its predecessor, the G900SE II.



Above: the Van den Hul stylus profile from the side (left) and the front (right) showing the close approximation to the cutter head shape.

Right: comparative groove contact for the Van den Hul and the elliptical type of stylus.

Finally it has all come together at once, and here we have the result — a cartridge with claimed attributes of reduced intermodulation distortion due to its line of contact with the groove being straight and perpendicular, better detail (especially at HF) due to its minor radius of 4.5 microns as compared to 7 microns for an elliptical point and reduced record and stylus wear due to reduced friction between the two.

As my one faithful reader may well recall I value the G900SE II as one of the best examples of a moving magnet cartridge around and here they've been and gone and changed it. It's enough to drive a man to bacon butties and bromide in his tea (almost).

It is with trepidation and wonder that one should open a golden (Pandora's?) box. Beware of Greek postmen bearing gifts and all that.

Making An Entrance

It certainly entranced *me* seeing that bright gold body clasped firmly to the bosom of the SME. Setting up the unit proved to be no trouble at all, but that mounting bracket looks as wrong now as it did on the first G900 I tried. Alright, so I know it only looks that way and I cannot fault it

In a direct comparison with the Super-E, the IGC was at first listen little different. However, the two were *at once* distinguishable and as the minutes ticked by the virtues of this new point began to make themselves apparent.

The sound is a beguiling one which leads you deeper into the music the more you listen. It has a considerable ability to portray that elusive thing called detail, and the treble is a good deal better than either the G900SE II or that Decca device, being smoother and more accurate. Cymbals sound more like cymbals (rather than a burst of metallic white noise).

The difference is not one which leaps from the loudspeakers but is of the kind that makes hi-fi livable with for a long long time as opposed to until the gloss wears off the power switch.

It will also build a following devoted to the IGC I think.

Bass quality is simply very very good and little changed over the two models.

Having stayed ahead of the competition this far the Coral beckoned confidently, and the SMEs were appropriately armed.

Coral In Deep Water

Let me say now that the Coral is a more expensive cartridge and one which I feel gives a performance which is worth a great deal more than its purchase price. It was no disgrace therefore for the 900IGC to fail to better it subjectively. Indeed the comparison did it proud indeed.

The main difference is one of those things difficult to explain but immediately audible. The MC81 sounded at ease with whatever music it was playing and somehow less like a hi-fi cartridge. I avoid the word colouration deliberately as being inappropriate.

One area where the IGC did take the decision, and all but unanimously too, was the bass. It just goes down further — reaching the parts which moving coils cannot refresh, and with good control to boot. To put it bluntly windows rattled more with the Goldring!

The only thing we could find to criticise was that the IGC is on the bright side of neutral, being characteristically very clinical in its approach. The rendition is excellent although I fear some of the "valve brigade" may find it a little cold. A small thing to hold against such radiance.

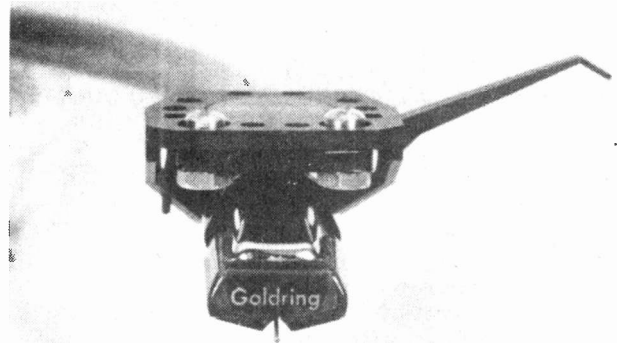
Summary

Overall then the Goldring is a very fine moving magnet device and one which many people — including me — preferred to such moving coils as the 777EX and even (shock horror) the Entré 1. It easily bears comparison with the best of current moving magnet cartridges and indeed, in my opinion, has no peer in this realm.

It is difficult to find anything remotely detrimental to say about the cartridge and very easy indeed to go on praising it I shall thus refrain from both and finish by congratulating Goldring for improving an already worthy product.

All they have to do now is to convince people to listen to something other than the 'revered few' repeatedly fawned over by the more 'partisan' press.

ETI



The 900 descends. Even the stylus assembly is push! The carrier is in a translucent green if you please. If this lot doesn't get in the Design Centre they must be all mad blind twisted and dead.

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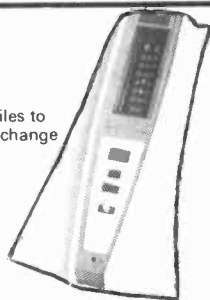
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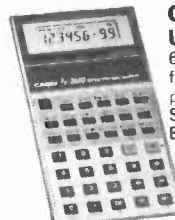
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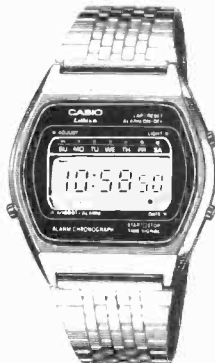


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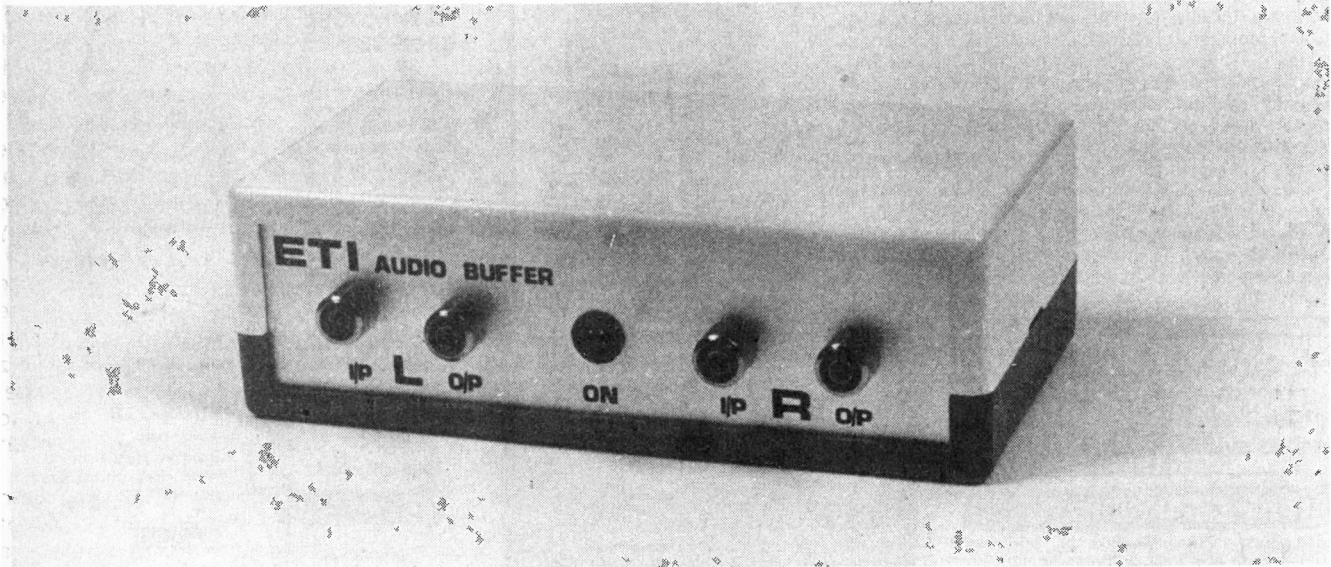
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AUDIO MATCHING CIRCUIT



Make sure you and your hi-fi are well matched with ETI's universal buffer.

A FAIR proportion of problems in audio set-ups can be due to mismatched output and input impedances, when connecting equipment. If a relatively high output impedance source is fed to a low impedance receiver, distortion can occur mainly because of the overloading of the output stages of the source. We can understand how this can occur by looking at Ohm's Law (this is a simplification of the situation, but nevertheless a useful analogy can be drawn). Ohm's Law states that the current through a resistor is proportional to the voltage across it and inversely proportional to its own resistance.

$$\text{ie. } I = V/R$$

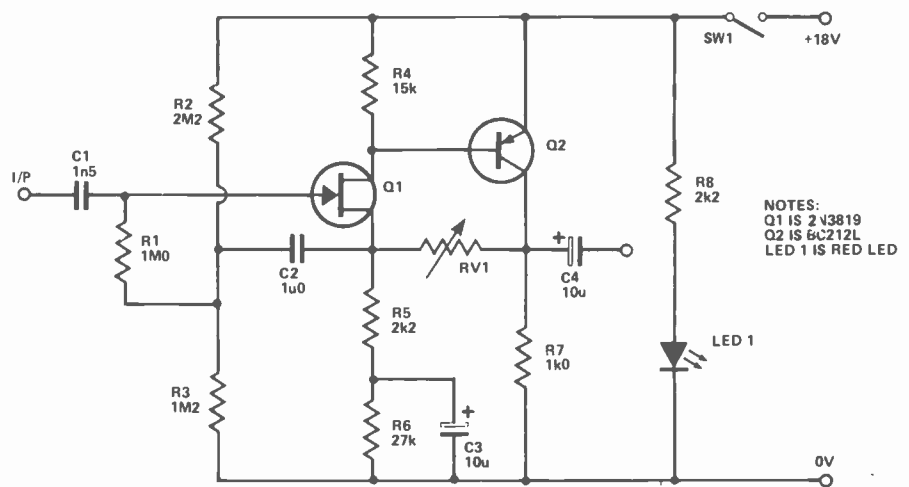
Impedance

It can be appreciated that if the resistance is lowered with the same voltage, then the current must increase. Likewise if the I/P impedance of a

receiver of a signal falls below that of the O/P impedance of the source then more and more current will be drawn from the source. The O/P stages can

become overloaded, distorting the signal and, if the impedance is too low the O/P stages can be permanently damaged.

Fig. 1. Circuit diagram of the buffer.



SECOND CHANNEL COMPONENTS DENOTED BY PREFIX 1 e.g. Q11, R17 ETC.

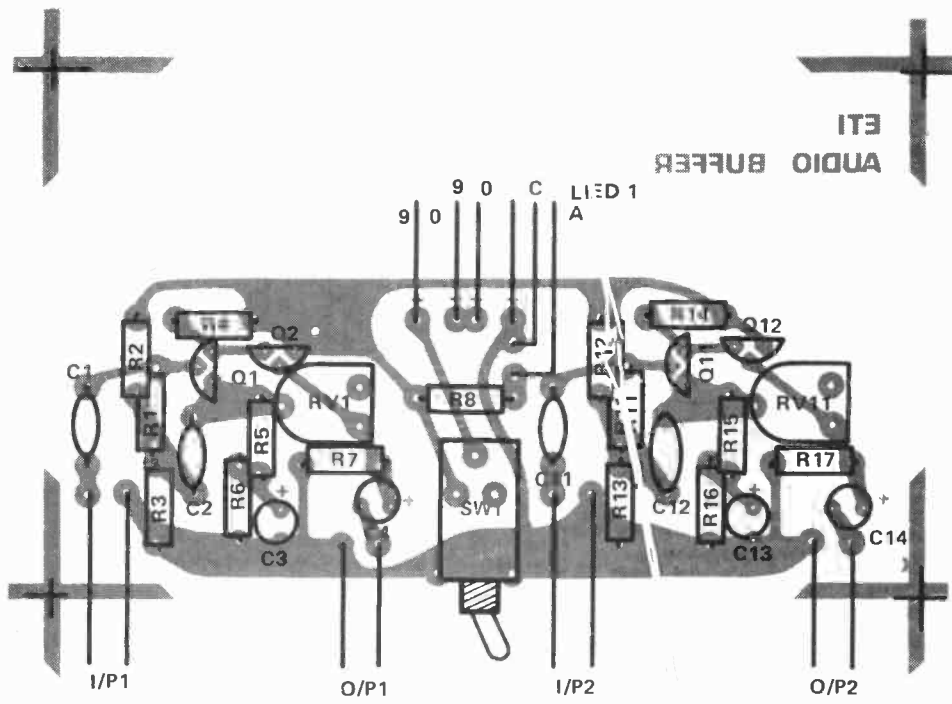


Fig. 2. Component overlay.

PARTS LIST

RESISTORS All 1/4W, 5%		SEMICONDUCTORS	
R1,11	1M0	Q1,11	2N3819
R2,12	2M2	Q2,12	BC212L
R3,13	1M2	LED 1	TIL220
R4,14	15k		
R5,8,15	2k2		
R6,16	27k		
R7,17	1k0		
POTENTIOMETERS		MISCELLANEOUS	
RV1	20k preset	SW1	SPDT PC mounting switch.
CAPACITORS		Phono sockets	4 off
C1,11	1n5 polystyrene	Box	Vero type 202-21048D.
C2,12	1uF polycarbonate	Battery clips	2 off type 6PP3
C3,4,13,14	10uF tantalum 16V		

HOW IT WORKS

The high input impedance of a field effect transistor is utilised in the input stage of the buffer. This is further increased by "bootstrapping" the amplifier, by inserting C2 (referring to the circuit diagram) between the source and R1. The capacitor is chosen to be large enough to act as a virtual short circuit at the lowest frequency under consideration. This gives the effect that if one end of R1 changes in voltage, the other end of R1 moves through the same voltage change. R1 is "pulled up by its bootstraps".

(A typical American term). RV1 allows a certain amount of gain because the overall voltage gain is given approximately by the equation

$$A_v = \frac{R_5 + RV1}{R_5}$$

In our circuit R5 = 2k2 and RV1 = 20k, allowing a gain of approximately 10. RV1 can be further increased if required.

The opposite, however is not the case — if the receiver stage has a higher impedance than the source, no distortion will occur.

Currently In

The ETI Audio Input Buffer provides the facility of an impedance converter. Because of the inherently high input impedance (in the order of Megohms) the buffer is basically a high impedance source follower (ie. whatever signal is connected to the I/P will appear at the O/P). The O/P impedance is low and therefore will drive virtually any amplifier.

The ideal buffer should give the outward appearance that there is nothing there, ie. it should introduce no distortion, no matter what frequency or amplitude of signal is being buffered, the only effect should be impedance matching. To this end the frequency response of the ETI buffer is quite wide, 20 to 200KHz (adequately covering the audio range) and it can accommodate signals up to about 10 volts pk. to pk. without clipping.

Although essentially a unity gain device we have included a preset resistor whose adjustment will give a maximum gain up to approximately 10: overall making it a most useful and versatile device (we hope).

Construction

Construction is straightforward if our PCB design is used. Both channel components are mounted on the printed circuit board along with the ON/OFF switch SW1, to reduce interwiring. Use screened lead for all I/Ps and O/Ps and keep them as short as possible.

C2 must be non-electrolytic — we used polycarbonate for size restrictions, and would recommend that you do likewise.

Although a Verobox such as employed here is perfectly adequate, in hum fields such as are found next to mains transformers etc, a steel box might improve noise performance.

In use ours gave no problems at all if sited sensibly.

BUYLINES

All parts used in this design are standard types which should be available at your local stockist, without much ado.

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

CAPACITORS

Electrolytic Axial Leads -10% to +50% Tol.

µF	16	25	40	63
1.0	9	9	9	9
1.5	9	9	9	9
2.2	9	9	9	9
3.3	9	9	9	9
4.7	9	9	9	9
6.8	9	9	9	9
10	9	9	9	9
15	8	8	9	11
22	8	8	9	13
33	8	8	9	13
58	9	8	11	13
100	9	9	13	13
150	9	10	31	
220	13		26	36
330			30	40
470		23	32	47
680	21	30	39	54
1000	25	30	59	
1500	35	39		
2200	42			

Order Code Cap 015 + µF + V.d.c.

Electrolytic Radial Leads

-10% to +50% Tol.

µF	6.3	10	15	25	35	40	50	63
47								7
68								7
100								7
150								7
220								7
330								7
470								7
680								7
1000								7
1500								7
2200								7

Order Code Cap 034 + µF + Volts

Electrolytic Can Type

High Ripple, IEC Grade 1, Low E.S.R. Cap HR + µF + Volts

Cap	16V	25V	35V	40V	50V
10000µF	16V	8.8A	13.7A	21.5	29.7
22000µF	16V	8.8A	13.7A	21.5	29.7
47000µF	25V	4.8A	6.4A	8.4	11.1
100000µF	25V	8.0A	11.2A	28.2	36.8
220000µF	25V	15.8A	17.9A	46.9	60.8
470000µF	40V	5.2A	7.8A	11.1	14.3
1000000µF	40V	9.2A	12.8A	29.3	37.8
47000µF	70V	7.5A	10.5A	40.3	51.8

Order Code Cap HR + µF + Volts

Miniature Low Value

Polymer Resistor, Axial, ±1% Tol., >63V DC Wkg. Ceramic Plate, Radial, Low K, 100V DC Wkg. Ceramic Plate, Radial, High K, 63V DC Wkg.

Value	424	632	832	630	629
10	1	1	1	1	1
1.2	10	18	7	12	29
1.5	12	18	9	15	29
1.8	6	180	18	9	31
2.2	6	220	18	9	31
2.7	6	270	20	9	33
3.3	6	330	20	9	33
3.9	6	390	20	6	39
4.7	6	470	20	6	39
5.6	6	560	20	6	39
6.8	6	680	20	6	39
8.2	6	820	20	6	39
10	6	1000	20	6	39
12	6	1200	20	6	39
15	6	1500	20	7	39
18	6	1800	20	7	39
22	6	2200	20	7	39
27	6	2700	20	7	39
33	6	3300	20	7	39
39	6	3900	20	7	39
47	6	4700	20	7	39
56	7	5600	25		
68	7	6800	25		
82	7	8200	25		

Order Code Cap 624, 630, 629 + Value

Polyester Radial Leads

Dipped Type, C280/352 Style Moulded Type, 10.2mm Pitch

Value	352	360	362	369	390
001	7	7	7	7	7
0015	7	15	8	10	10
0022	6	7	22	9	11
0033	6	7	33	11	11
0047	6	7	47	14	11
0068	6	7	68	17	11
01	6	8	1.0	21	21
015	6	8	1.5	30	30
022	6	8	2.2	35	35
033	6	8			
047	6	8			
068	7	8			

Order Code Cap 352 + Value

Tantalum Bead

20% Tol.

Value	10	16	26	35
0.1				11
0.22				11
0.47				11
1				11
2.2				11
4.7				11
10				11
22				11
47				11

Order Code Cap PR + µF + Volts

TRIMMERS

250V D.C. Wkg. Film Dielectric, Miniature

Value	20	22	31
1.4 - 4.1pF	20		
7 - 80F	20		
2 - 20pF	22		
5.5 - 59.5pF	31		

Order Code Cap 808 A, B, D

INTEGRATED CIRCUITS

4000 Buffered C.MOS - High Speed

Part No.	Code	Part No.	Code	Part No.	Code
HEF4000	17	HEF4044	84	HEF4512	110
HEF4001	17	HEF4046	106	HEF4514	250
HEF4002	17	HEF4047	87	HEF4515	299
HEF4006	95	HEF4049	45	HEF4516	101
HEF4007	82	HEF4050	45	HEF4517	382
HEF4008	80	HEF4051	89	HEF4518	94
HEF4011	17	HEF4052	72	HEF4519	55
HEF4012	17	HEF4053	72	HEF4520	94
HEF4013	45	HEF4517	382	HEF4521	188
HEF4014	84	HEF4067	380	HEF4528	99
HEF4015	80	HEF4068	17	HEF4532	120
HEF4016	45	HEF4069	17	HEF4534	510
HEF4017	30	HEF4070	17	HEF4535	110
HEF4018	80	HEF4071	18	HEF4543	155
HEF4019	46	HEF4072	18	HEF4555	78
HEF4020	89	HEF4073	18	HEF4556	78
HEF4021	85	HEF4075	18	HEF4557	386
HEF4022	82	HEF4076	104	HEF4585	97
HEF4023	17	HEF4077	17	HEF4724	171
HEF4024	62	HEF4078	18	HEF40097	80
HEF4025	17	HEF4081	18	HEF4098	73
HEF4026	195	HEF4082	18	HEF40106	62
HEF4027	45	HEF4085	64	HEF4160	119
HEF4028	71	HEF4086	64	HEF4161	119
HEF4029	90	HEF4093	50	HEF4162	119
HEF4030	46	HEF4094	175	HEF4163	119
HEF4031	200	HEF4104	166	HEF4174	119
HEF4035	110	HEF4502	91	HEF4175	119
HEF4040	85	HEF4505	571	HEF4192	140
HEF4041	75	HEF4508	184	HEF4193	140
HEF4042	56	HEF4514	106	HEF4194	119
HEF4043	80	HEF4511	125	HEF4195	119

7400 T.T.L.

LINEAR Voltage Regulators

Part No.	Code	Part No.	Code
CA3046	84	LM309DA(K)	118
CA3090E	77	LM333CN	42
CA3102E	99	LM339CN	42
CA3140E	48	UA7805CU	78
CA3189E	293	UA7812CU	78
LM301AN	34	UA7815CU	78
LM339N	78	UA7912CU	97
LM385N	104	UA7915CU	97
LM388AN	198	UA78L05CS	38
LM3900N	75	UA78L12CS	38
NC4303P	156	UA78L15CS	38
NE531	131		
NE538T	259		
NE555N	28		
NE560N	86		
NE568N	171		
NE570N	485		
NE571N	505		
RC4136	146		
TBA1208	95		
TDA1022	713		
TDA1034B	239		
TL081CP	84		
TL084CN	156		
UA741CN	20		
UA741CT	47		
UA748CN	39		

PLESSEY I/C'S

SL440	331
SL445	182
SL4510	245
SL620	359
SL621	369
SL622	910
SL624	342
SL630	232
SL640	409
SL680	245
SL1610	177
SL1611	177
SL1626	267
SL1631	177
SL1640	206
SL1641	206
SL6640	270
SP8629	475

CASES - Boss Industrial Mouldings

Small Desk Console - Boss Industrial Mouldings

Part No.	Code	Part No.	Code
W161_096_H391571	214	Case B1M1005 OR	
W215_D130_H471731	308	Case B1M1008 OR	

Plastic Boxes - Boss Industrial Mouldings

Part No.	Code	Part No.	Code
L112 WB2 D31	99	Case B1M5003 OR	
L150 WB2 D50	131	Case B1M5005 NA	
L190 W110 D60	223	Case B1M2008 OR	

Plastic Boxes with Metal Lids

Part No.	Code	Part No.	Code
L85 W56 D29	112	Case B1M4003 OR	
L111 W31 D42	150	Case B1M4004 OR	
L181 W96 D53	208	Case B1M4005 OR	

Diecast Boxes

Part No.	Code	Part No.	Code
L13 WB3 D31	124	Case B1M5003 NA	
L152 WB2 D50	215	Case B1M5005 NA	
L192 W113 D61	334	Case B1M5006 NA	

Small Desk Consoles

Part No.	Code	Part No.	Code
W105 D143 H321581	236	Case B1M6005 OR	
W170 D143 H321581	312	Case B1M6006 OR	
W170 D214 H321821	431	Case B1M6007 OR	

OPTO ELECTRONICS

Light Emitting Diodes, Individual

Value	Code
125" (3mm) Red	16 COY54
Green	16 COY95
Yellow	20 COY97

Panel Mounting Clip to suit:

2" (5mm) Red	16 COY2-A Jip
Green	16 COY9-A Jip
Yellow	20 COY4-K Jip

Photoreistors

ORP12	95	ORP 1 2
ORP81	95	ORP 8 1

Phototransistors

OC971	220	OC P 71
BPX25	195	BP P 25
BPX29	195	BP P 29

Photocoupler

FC0820	165	FC 0820
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HARDWARE

D.I.L. Sockets

8 Pin Low Profile Socket Tin	12	E JIL SKT B
14 Pin Low Profile Socket Tin	14	E JIL SKT 14
16 Pin Low Profile Socket Tin	16	E JIL SKT 16

Heatsinks

Individual Type for 1 x T05 50°C/W	12	Sink 5F
Individual Type for 1 x T066 105°C/W	26	Sink TV2
Individual Type for 1 x T03 72°C/W	26	Sink TV3
Individual Type for 1 x T016 27°C/W	26	Sink TV4
Individual Type for 1 x T0220 17°C/W	26	Sink TV5

P.C.B. Components

Dalo Pen. Blue Ink, Slow Drying	98	Pen 33PC
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SWITCHES

Miniature Toggle - Honeywell

SPDT	87	SW 8A1011
SPDT C/OH	81	SW 8A1021
SPDT Double Bias To Centre	90	SW 8A1041
SPDT Single Bias To Centre	90	SW 8A1051
SPDT Bias	84	SW 8A1061
DPDT	99	SW 8A2011
DPDT C/OH	111	SW 8A2021
DPDT Double Bias To Centre	123	SW 8A2041
DPDT Single Bias To Centre	123	SW 8A2051
DPDT Bias	116	SW 8A2061

Miniature Push - C & K

SP Push To Make, Momentary	62	SW 8531
SP Push To Break, Momentary	62	SW 8533

MAINS TRANSFORMERS

0.4-5V, 0.4-5V Secondaries	Trans BVA	45
0.5V, 0.6V		80
0.12V, 0.12V		120
0.15V, 0.15V		150
0.20V, 0.20V		200

20VA - Clamp Type Construction

0.4-5V, 0.4-5V Secondaries	Trans 20VA	45
0.6V, 0.6V		80
0.12V, 0.12V		120
0.15V, 0.15V		150
0.17.5V, 0.17.5V		175
0.20V, 0.20V		200

SEMICONDUCTORS

IN914	5	BC182L	12
1N4001	5	BC184	11
1N4002	6	BC184L	12
1N4004	7	BC212	12
1N4007	8	BC212L	12
1N4148	4	BC214	11
1N5402	15	BC214L	12
2N218A	51	BC547	13
2N2369	21	BC548	11
2N2646	46	BC549	12
2N2926B	13	BC557	15
2N3053	19	BC558	15
2N3054	55	BC560	15
2N3055	55	BCY71	15
2N3055 -		BD131	39
Full IBS Test	95	BD132	39
2N3442	155	BD138	39
2N3702	9	BD140	39
2N3704	9	BF890	333
2N3705	10	BF895	26
2N3773	297	BFY50	17
2N3819	22	BFY51	17
2N3820	39	BFY52	20
2N3904	9	BLK65	262
2N5457	39	BLY93A	2977
2N5459	35	BRY39	50
40673	88	BSX20	21
AC188	24	CLB960	2850
AO161	42	MF102	36
AO162	42	OA81	8
BAW95D	1200	CAC28	118

GMT
ELECTRONICS

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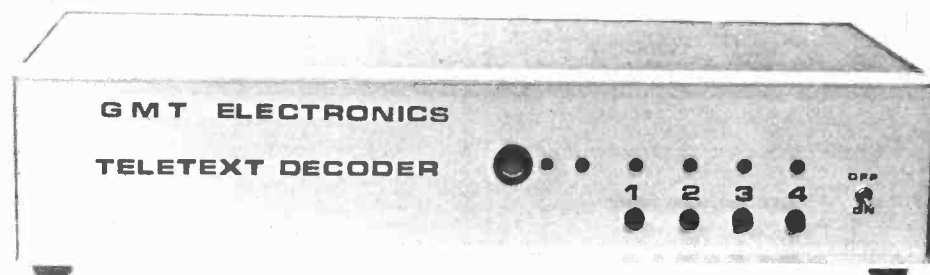
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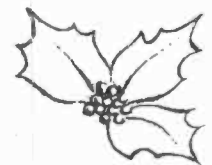
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DEEP SPACE PROBES

This month Ian Graham tracks down the interplanetary superstars - Viking, Voyager and Pioneer.

Until recently, unmanned spaceflights have been overshadowed by the glamour of manned missions, especially the Apollo series. However, in the hiatus between the last Apollo flight in December 1972 (hard to believe it's almost seven years ago) and the long-awaited re-useable shuttle, unmanned space probes have come into their own.

In the foreseeable future men are likely to visit only Mars, so any on-the-spot study of the planets must be done by unmanned probes. Our first close-up view of the surface of another world came from the Soviet Luna-9 in January 1966. Since then, spacecraft have crashed into, soft landed on or flown by Mercury, Venus, Mars, Jupiter and Saturn. Soviet motorised 'wheelbarrows' have even trundled across the Moon's surface, picked up rocks and returned them to Earth.

The recent stars of stage, screen and now ETI are Viking, Voyager and Pioneer. Although the Mariner spacecraft sent

back impressive photographs of Mars, Viking made the headlines. Viking was special, because it was sent to look for evidence of life on Mars, the most Earth-like planet in the Solar System. In addition, it would study the atmosphere and geology of the whole planet. Each of the two Vikings launched in 1975 was a double spacecraft. While the Orbiter circled Mars, photographing the surface and studying the atmosphere, the Lander carried its payload of instruments down to the surface.

The Lander, although less than ten feet across, contained the equivalent of two power stations, two computer centres, a TV studio, a weather station, two chemical labs, three incubators, a scoop and hoe to dig trenches and collect soil samples, an Earthquake (Marsquake?) detector and miniature railway wagons to deliver the samples to the labs and incubators.

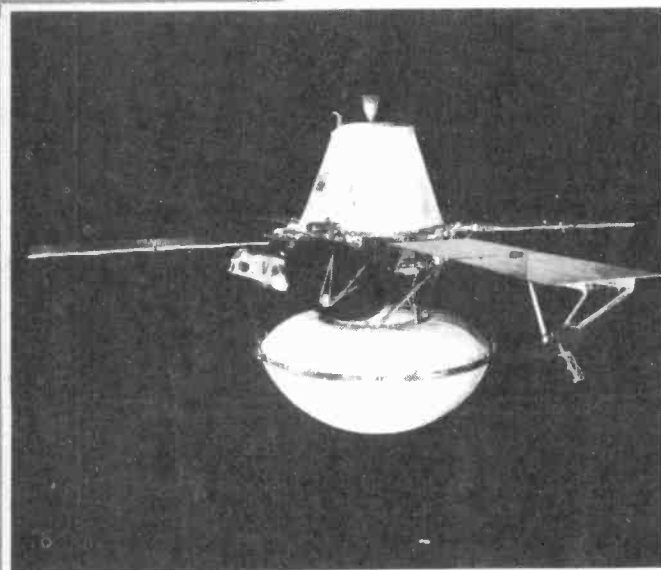
Landing Snaps

Viking-1 orbited Mars for a month while the Orbiter carried out a detailed photographic reconnaissance of the proposed landing sites. Apparently smooth sites, photographed by Mariner-9 showed up as cratered, rocky spacecraft killers under Viking's cameras. Finally, the Lander was committed to a landing at a site in the Plains of Chryse. A month later, Viking-2 came down to a successful touchdown in the Plain of Utopia.

The two sites were found to be quite different in nature. Chryse featured exposed bedrock, a large variety of rock types and sand dunes. Utopia featured more abundant, more uniform, generally vesicular rocks, but no sand dunes.

Viking-1 was not the first spacecraft to stand on the Martian surface. As in so many space activities, the Soviet Union did it first, but did not follow up its lead. Mars-3 successfully soft-landed in 1971, but stopped sending back data after only 20 seconds.

The most striking feature of the first photos received from Viking was the colour of the Martian landscape and sky. The first colour pictures showed a pink sky. As scientists had expected to see a blue sky, a few knobs on Earth were twiddled to make the sky blue. However, we



The Viking spacecraft weighs over three tons and consists of an Orbiter and Lander (here shown encapsulated in its bioshield). When the Lander is sitting on the surface of Mars, it radios data back to earth via an aerial on one of the Orbiter's four solar panels.

now know that Mars has a pink sky, caused by particles of the red surface dust being carried into the atmosphere by strong winds.

Even though the Martian atmosphere is less than a hundredth of the density of the Earth's atmosphere, Viking found several similarities in the weather of the two planets. On one day in 1976, the atmospheres of both planets reached their maximum temperatures at 3 pm local time, although the terrestrial maximum temperature was some 150° F higher than that on Mars. (The daily Martian temperature ranges from -122° F just after dawn to -22° F in the middle of the afternoon). Even the wind behaviour over the Plains of Chryse matched winds blowing over the Great Plains of midwest U.S.

Although the Martian air has only a thousandth the water content of terrestrial air, cloud and fog are to be found on the Red Planet. In the valleys and deep in craters, atmospheric water freezes during the cold night, appearing as white fog in the early morning. It vaporises again, however, in the low atmospheric pressure (about 8 millibars) when the Sun climbs high in the sky.

One meteorological feature not found on Earth is an enormous seasonal variation in atmospheric pressure. In one month, the Viking Lander recorded a drop of 5%. It may be that, in winter, carbon dioxide, which forms 95% of the atmosphere (compared to 0.03% on Earth), was freezing out onto the southern polar cap.

The second most common element (by weight) found in the Martian soil, silicon being the most common, was iron. However, only a small fraction of the soil was found to be magnetic, suggesting that there must be more than one mineral of iron, not all of which are magnetic. In general, the soil was similar to terrestrial and Lunar basalt lava. Weathering and contact with the water-rich atmosphere make it more Earth-like than the dry, unweathered Lunar soil.

Look Lively

Before you can design instruments to look for life on an alien world, you must decide what you're looking for. Viking's experiments were based on two assumptions — that life on Mars would be Earthlike (ie carbon-based) and secondly, that as on Earth, some form of bacteria life would exist almost everywhere on the planet.

The Lander's incubators provided a warm, nourishing environment for the sought-after organisms. Instruments studied the samples for any chemical activity. One experiment provided a radioactive carbon dioxide atmosphere and looked for radioactive compounds produced by any organism present. In another experiment, the gas above the soil sample was analysed for anything which might result from biological activity. A third experiment added radioactive nutrients to the soil, while instruments looked for radioactive carbon dioxide exhaled by any organisms in the sample.

After processing several samples in each Lander's laboratories, the results are inconclusive. The experiments did, indeed, record some form of chemical activity in the soil, but it's not clear if this was due to living organisms or the unusual chemical make-up of the soil itself. Despite the positive results from these experiments, no trace of the carbon molecules that make up terrestrial living organisms were found. The depth of analysis necessary to find out what is going on in the Martian soil is beyond the capabil-

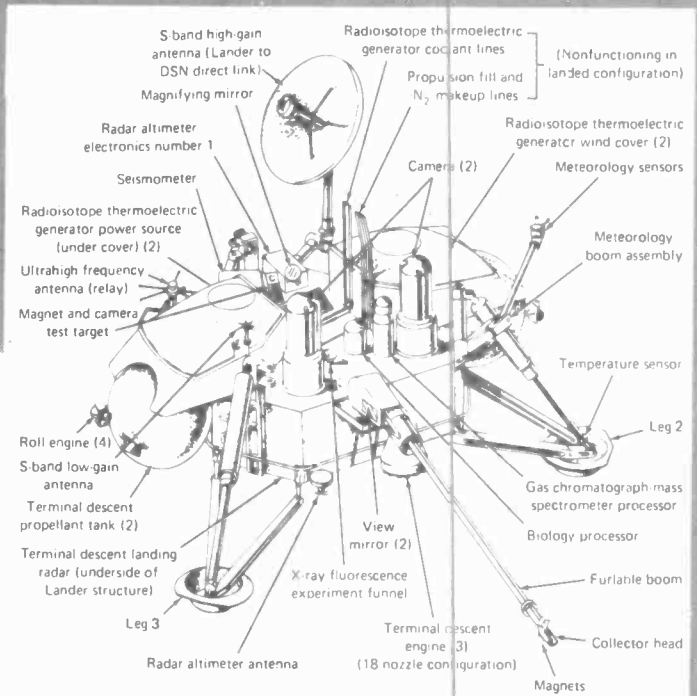
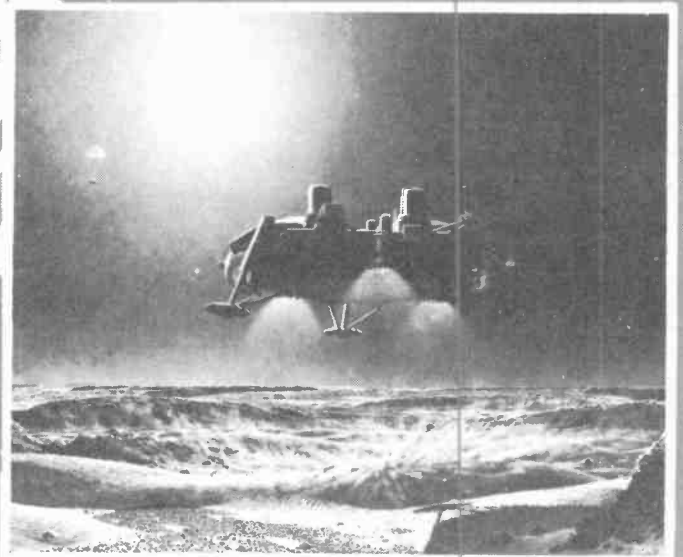


Fig. 1. The Viking Lander is an automatic laboratory designed to study the structure, surface and atmosphere of Mars and to look for life forms.

ities of Viking, so the question of life on Mars is unlikely to be resolved until samples can be returned to Earth by an automatic probe or until man lands on the planet. Although the latter is technically possible, there remains the question of the so-far unknown effects of deep space missions on the human body. It is by no means clear yet whether manned spaceflights as we know them today, but lasting several years, are possible.



This artist's impression shows the Viking Lander heading for touchdown after a year in space. The aeroshell is descending on a parachute in the distance.

By Jove!

Jupiter is a strange, massive and totally un-Earthlike world. The Earth would comfortably fit inside Jupiter more than 1300 times. The main constituents of the atmosphere are hydrogen and helium. The planet itself is largely composed of liquid hydrogen. Its core is six times hotter than the surface of the Sun. Although a very distant world, a mean distance from the Sun of 800 million kilometres, one prominent feature seen from Earth as early as 1664 is the Great Red Spot — the biggest storm in the Solar system. It constantly blows its way over 40 000 square kilometres and reaches 8 kms above the surrounding clouds.

Bon Voyage

Two Voyager spacecraft left Cape Canaveral in August and September of 1977 on their way to the outer planets. Voyager-1, launched after Voyager-2, flew a faster, shorter route to Jupiter, to arrive ahead of Voyager-2.

The spacecraft receded from Earth at nearly nine miles a second. They took ten hours to cross the Moon's orbit (Apollo took three days). Voyager-1, while testing its optical navigation and video systems, captured both mother Earth and the solitary Moon in one picture from more than 7½ million miles away, the first time it had ever been done.

Between them, the two Voyagers were designed to investigate the atmosphere and magnetospheres of Jupiter and Saturn and survey in detail five Jovian and six Saturnian satellites. At 60 million kilometres from Jupiter, the spacecraft's narrow angle camera turned to face the planet. During the 80 days until closest approach, the narrow angle and then the wide angle camera took hundreds of colour photographs of the disc. Closer to the planet, the narrow angle camera was used to pick out individual features, like the Great Red Spot. In addition to the white light photography, ultraviolet, infrared and polarimetric observations were made to provide more information on the structure and composition of the planet. A radio astronomy experiment monitored powerful radio bursts from the planet's surface and spectrometers scanned the atmosphere and brilliant cloud bands to determine their composition.

Exciting as the Viking photographs of Mars were, the detailed photographs of the brilliant red, swirling storms on the surface of Jupiter have, I believe, been the most beautiful images received from space to date.



Tiny red Amalthea orbits Jupiter every twelve hours. Voyager-1 took this photograph of Amalthea only 100 kms a cross, from over a quarter of a million miles.



IO



EUROPA



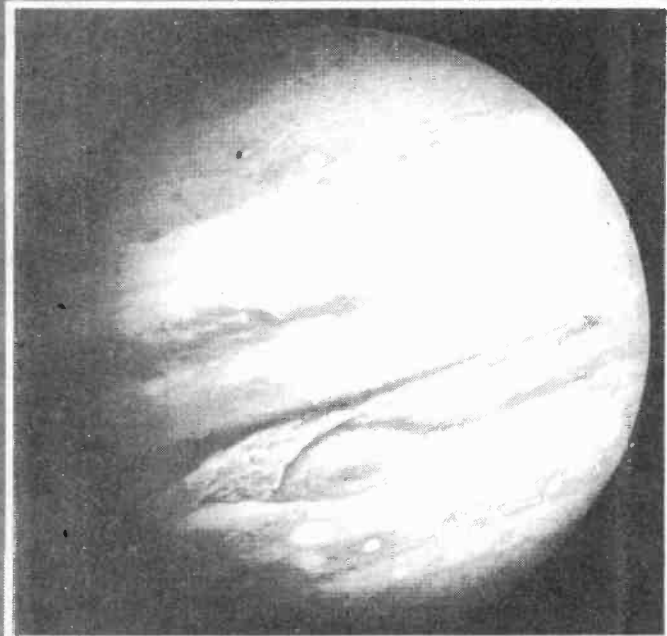
GANYMEDE



CALLISTO

In March 1979, Voyager-1 took these photographs of the four large Galilean satellites of Jupiter. Ganymede and Callisto are bigger than Mercury. Io and Europa are about the same size as Earth's Moon. The reflectivity of the satellites varies according to the nature of their surfaces. Io may be covered with sulphur and salts (63% reflectivity), Europa with water ice (46%), Ganymede with ice and rock (43%) and Callisto with rock-covered ice (17%).

The interiors of the satellites showed similar diversity. Io and Europa have rocky interiors, while Ganymede and Callisto contain a lot of water or ice.



Voyager-1 took this photograph while still 20 million miles from Jupiter. Bright cloud in the equatorial region north of the Great Red Spot appears to be where bright clouds originate from, then move westward. However, the bright ovals south of the Great Red Spot appeared about 40 years ago and have remained relatively unchanged ever since.

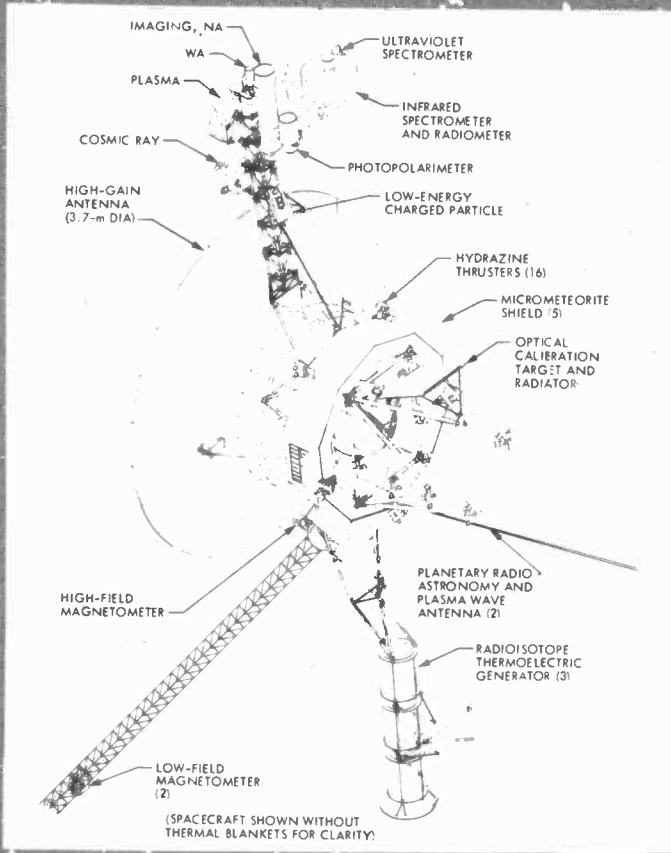
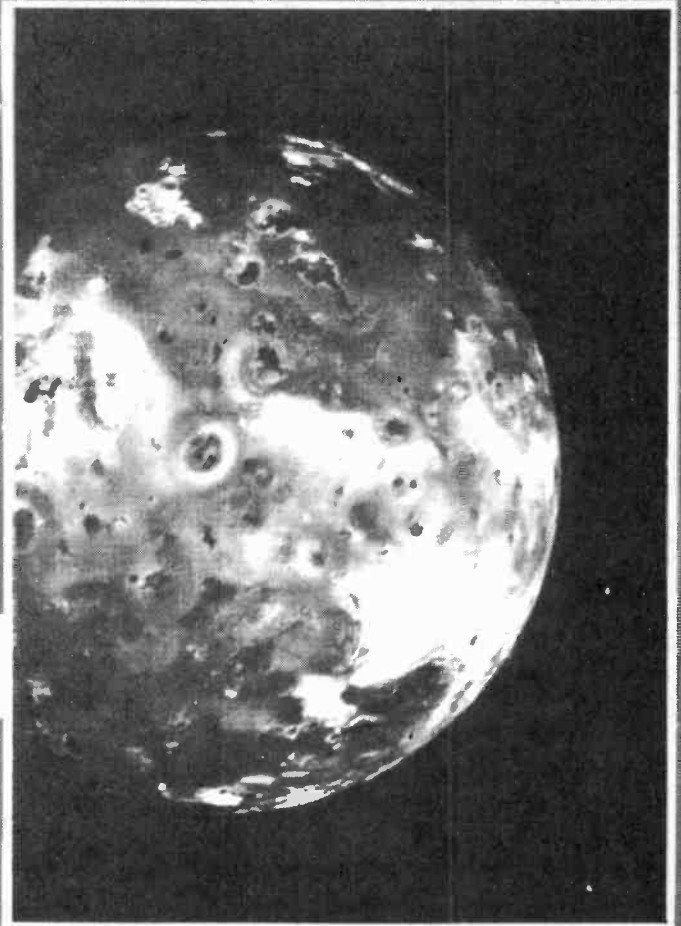
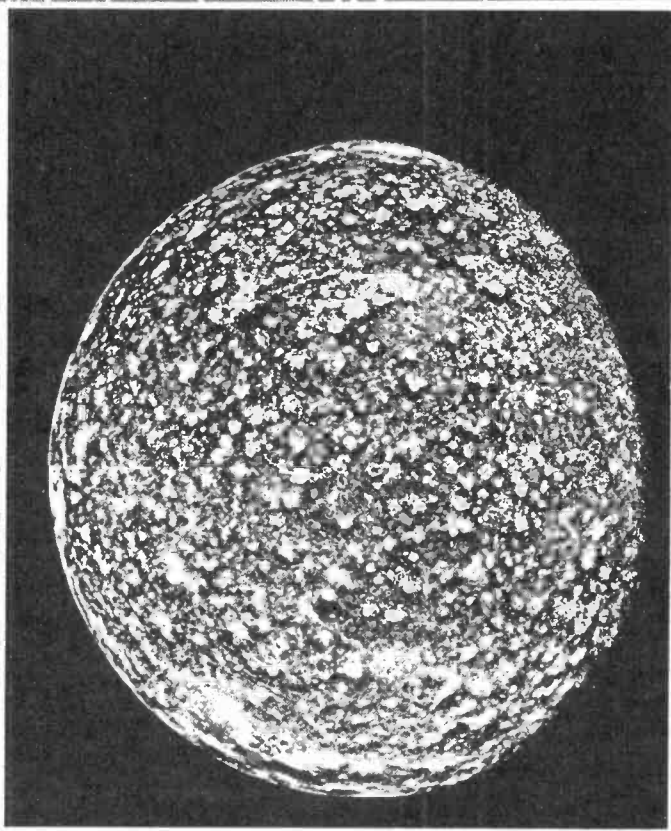


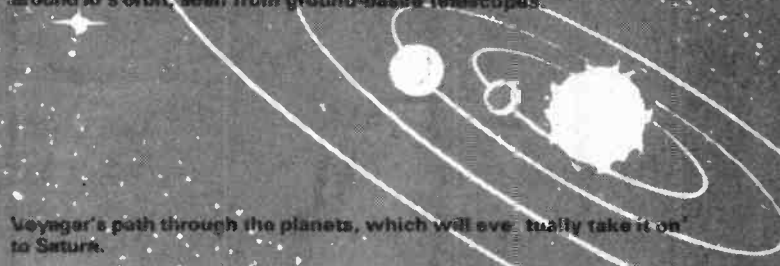
Fig. 2. The Voyager spacecraft.



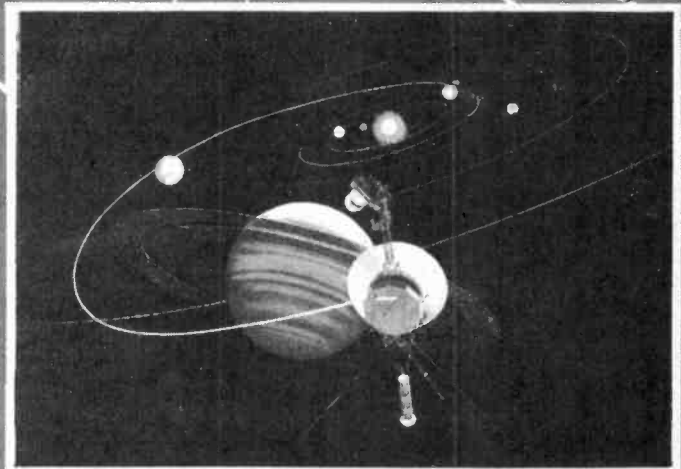
This view of Io, taken by Voyager-1 from half a million miles, shows circular surface features, which may be meteorite impact craters or features of internal origin. The bright, irregular patches seem to be younger deposits masking surface detail. The surface is thought to be the source of material for the clouds of neutral and ionized atoms around Io's orbit, seen from ground-based telescopes.



This photomosaic of Callisto was taken by Voyager-2 from a quarter of a million miles away.



Voyager's path through the planets, which will eventually take it on to Saturn.



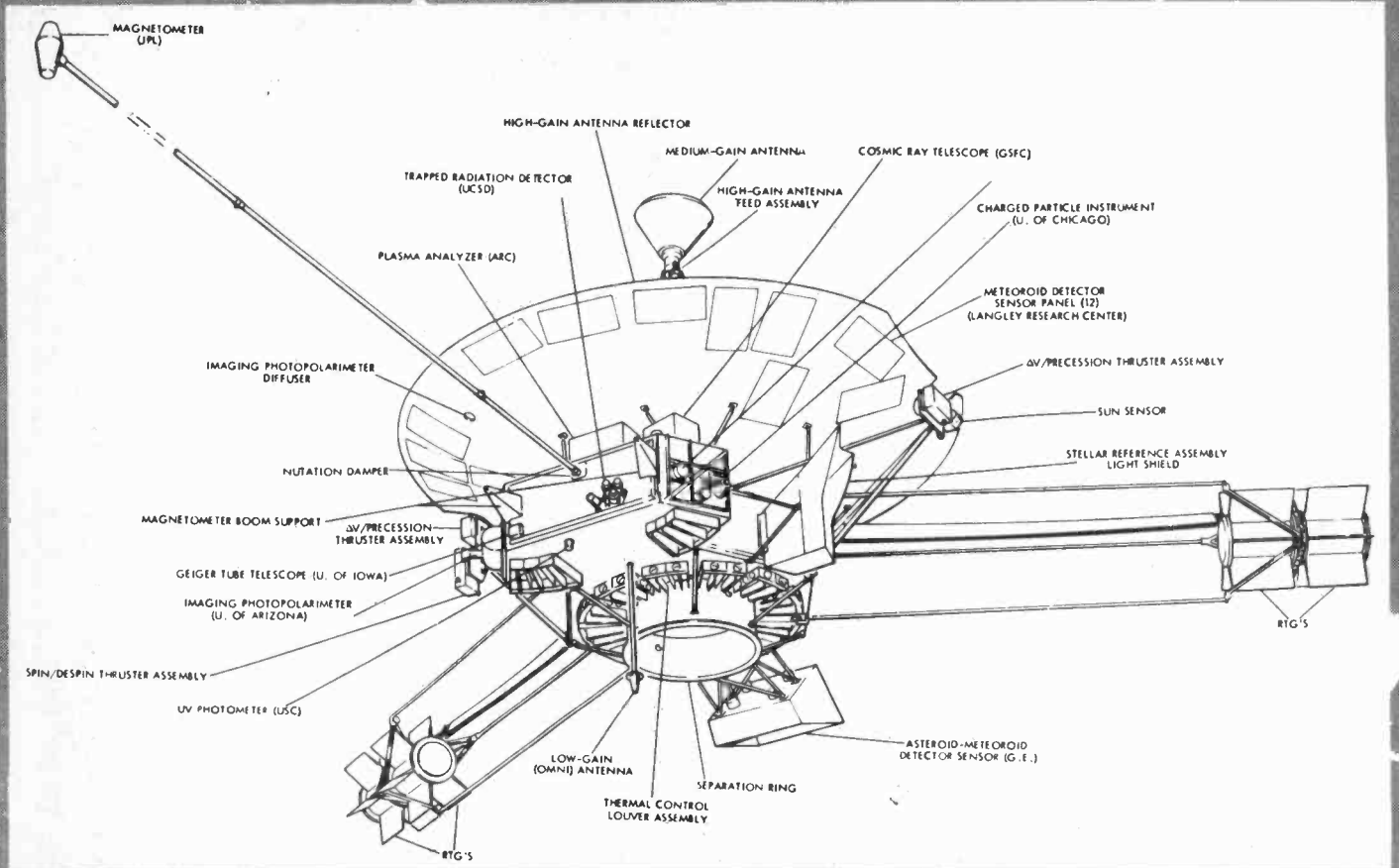


Fig. 3. The Pioneer spacecraft. Power is derived from four Radioisotope Thermal Generators (RTGs). Pioneers-10 and 11 were each launched by an Atlas Centaur vehicle fitted with a solid fuel third stage. Launch from the Cape was on a direct ascent trajectory. At third stage cut-off the Pioneers had a velocity of about 32,400 mph — the fastest a man-made object had ever travelled in space.

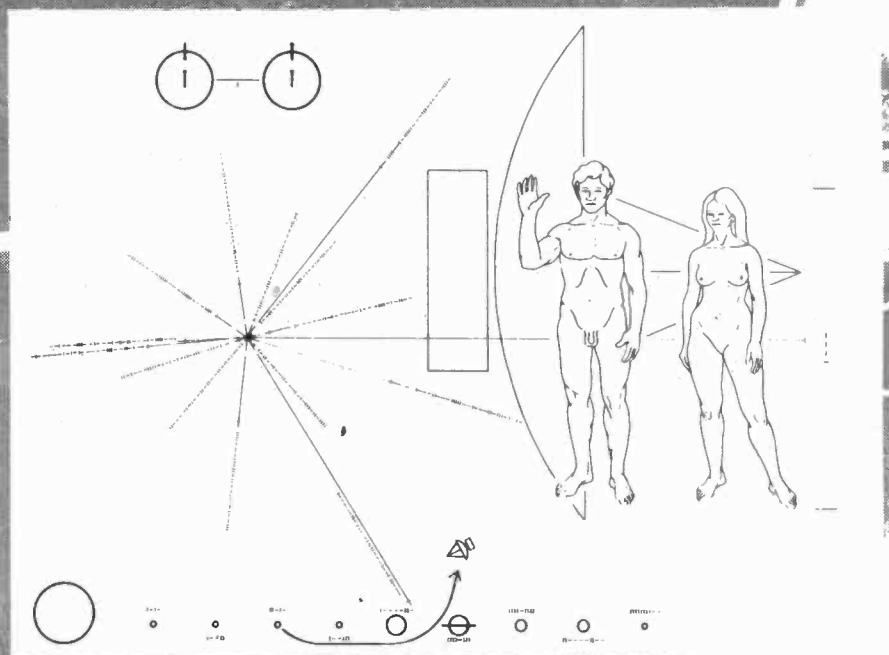


Fig. 4. Each Pioneer spacecraft carried one of these plaques on its way to the outer planets. The diagram should show scientifically educated inhabitants of another solar system, who might intercept the spacecraft millions of years from now, from where and by what kind of beings.

Past It?

Having passed Jupiter, Voyager-1's work isn't finished yet. It will carry on to encounter Saturn at the end of August 1981. Although Voyager-2 was launched 16 days before Voyager-1, it will not reach Jupiter until June 1981. In contrast with Voyager-1's mission, which was carefully preplanned, Voyager-2's flight-plan has been deliberately left very flexible to respond to the progress and results received from Voyager-1. If Voyager-1's Saturn fly-by goes according to plan, Voyager-2 may be sent out to encounter Uranus in 1986, using Saturn's gravity to help it on its way.

At such huge distances from the Sun solar panels cannot be used to produce power. Instead, the twin Voyagers carried their own Radioisotope Thermal Generators (RTGs), generating 1800 watts of heat, which was converted by thermocouples into 400 watts of useable electric power.

The Voyagers were not the first spacecraft to fly by Jupiter. Five years ago the Pioneer spacecraft photographed the giant planet. They made headlines again this year as they approached the ringed planet, Saturn.

Pioneer 11, launched in 1973, weighs 258 kg and carries a 2.74 m diameter high gain dish aerial to send data back to Earth. Small hydrazine thrusters around the rim of the dish are used to keep it pointing towards Earth, make minor course adjustments and adjust the spin rate of the spacecraft. Electrical power is provided by four RTGs.

Pioneer 10, launched in 1972, carried a helium vector magnetometer, a cosmic ray telescope, an infrared radiometer, a charged particle instrument, a trapped radiation detector, an ultraviolet photometer, a Geiger tube telescope, an imaging photopolarimeter, a plasma analyser, meteoroid detector sensor panels, and an asteroid-meteoroid detector sensor. Pioneer 11 was identical with the addition of a flux-gate magnetometer.

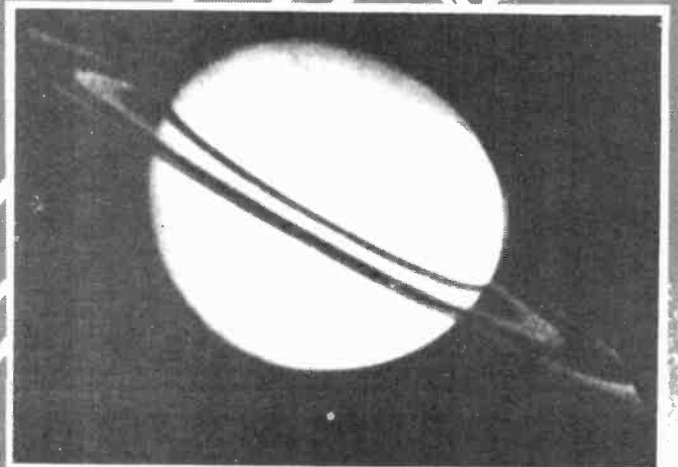
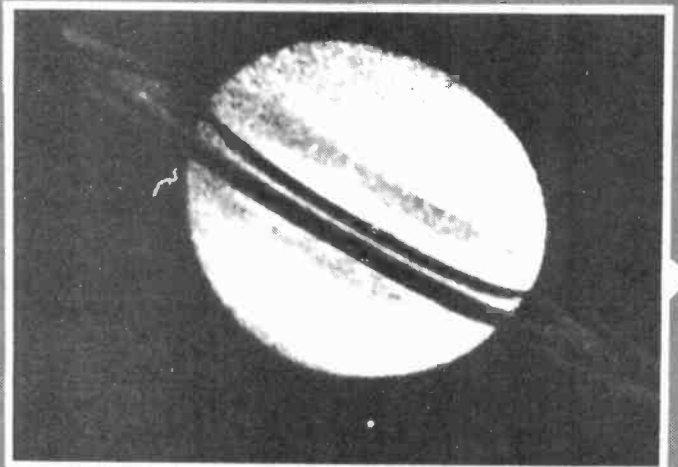
Intergalactic Telegram

The Pioneer spacecraft will be the first spacecraft to leave the Solar System. A plaque on each craft shows where it was launched from and what sort of life form sent it on its way. I hope the little green men who find Pioneer are friendly little green men.

Pioneer 10 was the first spacecraft to probe the secrets of the outer planets by investigating Jupiter. Pioneer 11 followed a year later and, in addition to visiting Jupiter, it was put on course for a Saturn encounter in September 1979. The scientists among you may be familiar with the principle of conservation of energy — energy cannot be created or destroyed. So, if the spacecraft uses Jupiter's gravitational field to accelerate it on towards Saturn, something must lose energy, to uphold one of the cornerstones of modern physics. But what loses energy? — Jupiter. However, the planet is so massive that the loss in energy equivalent to the spacecraft's gain is imperceptible.

After six years in flight Pioneer 11, now called Pioneer Saturn, passed only 21,000 kms from the Saturnian cloud tops and gave us the first ever close-up photographs of the planet. It is now heading out of the Solar System in the opposite direction to Pioneer 10.

What did Pioneer Saturn find? It discovered that Saturn has a magnetic field and trapped radiation belts. The magnetic field at the cloud tops is slightly weaker than that at the Earth's surface, yet Saturn is almost 100 times as



Pioneer Saturn took these photographs of Saturn only hours before closest approach. The imaging photopolarimeter gathers data using the red and blue components of reflected light from the planet. The blue component is shown top and red above.

massive as Earth. Saturn was also found to have a hot interior. Pioneer came close enough to the planet to pass through the outermost E-ring and, in doing so, discovered new rings. Throughout the mission Pioneer was tracked by NASA's Deep Space Network in California, Spain and Australia. The 10,000 commands sent to the spacecraft in the fortnight before closest approach each took 85 minutes to get there. Good communications are expected to continue into the mid-1980s.

Gas Ball

Saturn's core of molten heavy elements seems to be about the same size as the Earth, but three times more massive. Hot liquid methane, ammonia and water surround the core, but most of the planet is composed of very light gases — hydrogen and helium. In the intense pressure of the lower gas levels, the hydrogen is in a liquid metal state. Above this, there is a layer of liquid molecular hydrogen. **ETI**

I would like to express my thanks to the following for their assistance in the preparation of this article:
Jet Propulsion Laboratories, California.
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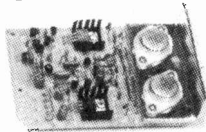
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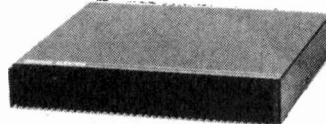
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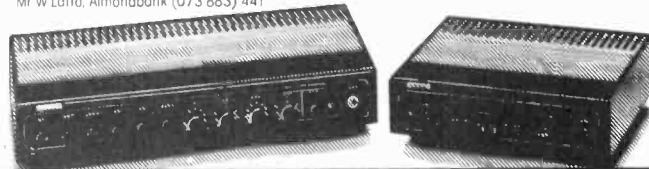
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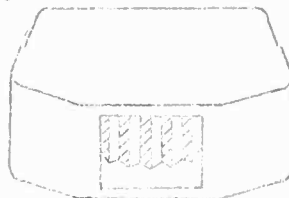
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LOUDSPEAKER DESIGN PROPOSAL

Following up his *Audiophile* contribution, H. Lipschutz is back again with an ingenious method of increasing both efficiency and bass linearity.

In my first article (*Audiophile*) about the need to improve speakers, I showed that three areas of improvement existed, and concentrated on the first: — reduction in size, showing how this could be achieved without loss of quality or bass response. At the end of the article I then mentioned a patent which dealt with the second area of improvement, namely efficiency.

In the meantime the complete patent has been applied for, and in this article I will now show how to go about the reduction of size and increase efficiency (at least ten fold)! But before talking about the solution, let's first consider the problem. This is that at low frequencies the travel required of the diaphragm has to be much further than at higher frequencies. This can easily be seen when looking at a gramophone record groove, where the bass frequency dominates the groove spacing, and can easily be recognized. Now a cone in free air, when driven with a bass note, would automatically take up the distance required. When the speaker is mounted in a sealed enclosure however, the air behind the cone gets compressed every time the cone moves inwards.

Efficiently Up!

The enclosed air resists that movement and tries to return the cone to centre. Reducing the size of the box has the same effect as changing a petrol engine into a very high compression diesel, i.e. a much bigger starter motor is now required to turn the engine over. Similarly, with the speaker, we need 12 dB more power per octave from the amplifier, — not for playing louder, but only for compressing and rarefying the enclosed air, and heating it up.

Obviously it is a great waste of good amplifier sound to use it for just that. Previously I have showed that by raising the acoustical efficiency of the speaker, it is possible to manage with normal amplifier powers as used with conventional bass speakers, and still reduce the size of the box. However, the difference of 12 dB/oct is still there, and I can produce all the bass needed with, say, 40W. Without the hindrance of the enclosed air, however, the same bass level could be produced with 3W!

It would be nice if that could be done. Well, it can be, that is what this patent is all about.

For every position of the cone there is a corresponding compression or rarefaction of the enclosed air, which acts as a restoring or excess centring force. The force needed to overcome this is the same for every cycle, and is therefore

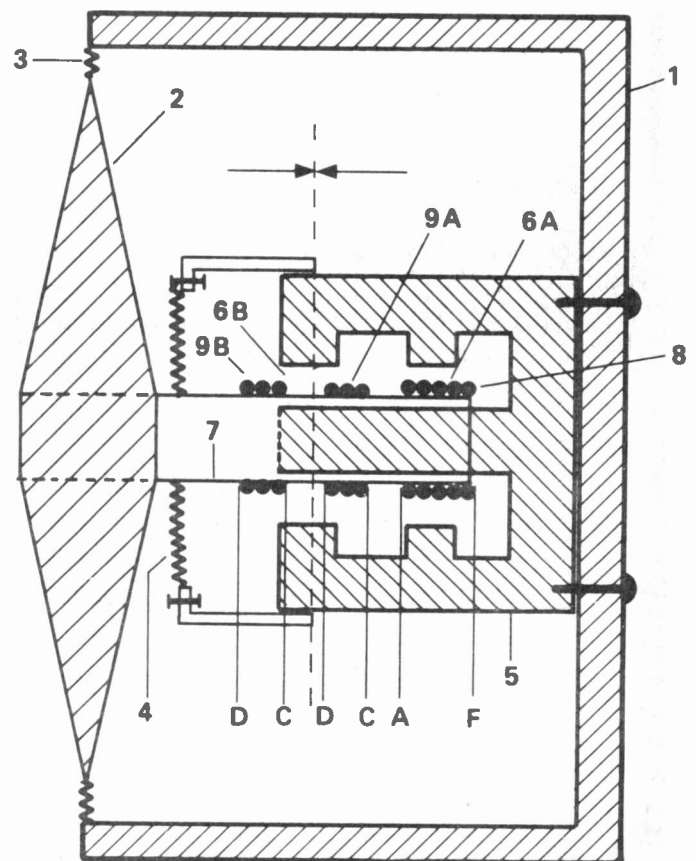


Fig 1. The first version of the speaker design with a common magnet but which uses individual Air Flux Gaps. The letters mark the beginning and end of the windings. Audio is present on coil AF and coils DC carry the centering current. The numbers stand for: (1) Speaker chassis; (2) Diaphragm; (3) Roll surround; (4) Suspension or spider; (5) Magnet; (6a) Voice Coil air gap; (6b) Balancing coil air gap; (7) Coil Former; (8) Voice coil; (9) Balancing coils.

predictable. It can therefore be overcome by a force acting in the opposite direction, and by so balancing it cancelled.

Thus, all that is necessary is to add two more coils, i.e. one to each end of the voice coil, and connect these two 'balancing coils' to a DC supply. When the cone now is moved off-centre by the voice coil, the balancing coil at one end moves closer towards and into the magnetic flux gap, which then produces a force pulling it further, and assisting the voice coil to overcome the excess centering force of the

enclosed air. Naturally the balancing coils have to be wound with suitable shape, and the DC supply has to be adjusted so that the force produced is just enough to overcome the resistance of the enclosed air to the movement of the cone. If too much DC is applied, then the cone would tend to be unstable and possibly move on its own, and with not enough DC we would be back to square one, and most of the work would have to be done by the voice coil, i.e. the amplifier, and bass would be lost unless especially boosted.

By adjustment of the DC supply therefore, the balancing forces can be adjusted to compensate for just the right proportion of work to be done, and thereby relieve the amplifier of this pump load represented by the enclosed air. Furthermore, by the simple expedient of limiting the length of the balancing coils, their effectiveness is limited to normal excursions of the cone, thereby preventing excessive swing.

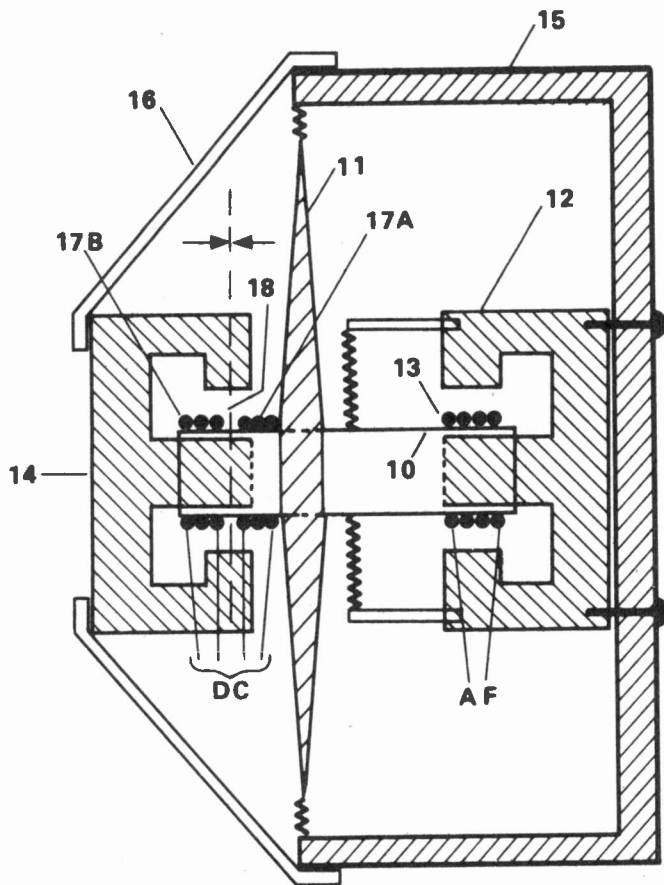


Fig 2. A version of the design which uses an independent flux balancing system. Key:— (10) Coil former: (11) Diaphragm: (12) Voice coil magnet: (13) Voice coil: (14) Balance coil magnets: (15) Chassis: (16) Spider frame: (17) Balancing coils: (18) Air gap.

Brake To A Stop

Practically every modern car has servo-assisted brakes, and this is taken for granted. I therefore see no reason why not to apply the same sort of solution to bass speaker work load. There is no difficulty in supplying DC, which, for car speakers, can be taken from the car battery without trouble, and from rectified mains for home equipment. The alternative is and remains the solution indicated in my first article, or the conventional approach of the big box, with

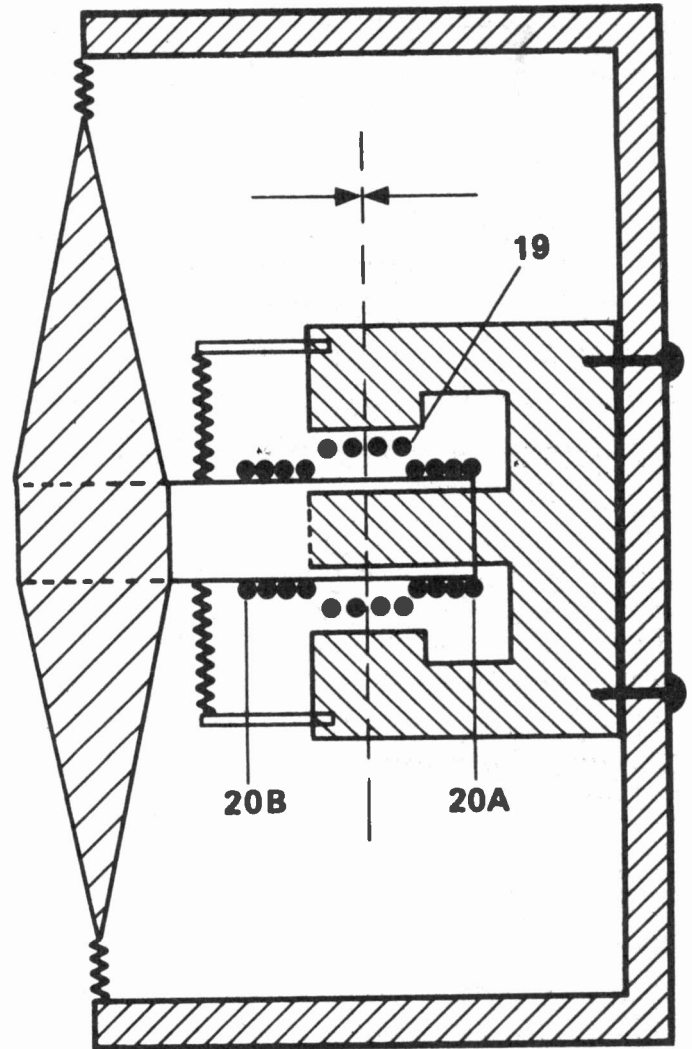


Fig 3. Here the balancing coils and the audio carrying voice coils share a common air gap and magnet system. The dotted line represents the point about which the centering force acts. (19) Voice coil (20) Balancing coils.

walls that are difficult to prevent from vibrating and thereby colouring the sound, and paying for the woodwork and room space required. But in the mobile field, there really is no choice.

DC For Dead Centre?

Remains the last area of improvement, — quality of reproduction. That too can be improved, with designs which retain small size and high efficiency, and solutions are known to me. But I would have to find more support before going for more patents. These cost money and cause a lot of work, and are wasted unless something is done with them. I am sure the market for improved speakers exist, but who will fill the demand remains to be seen. I am a designer, and I like solving problems; but I am not a producer with a company supplying the market. It is up to those to make the next step.

However, even in the version just described there is an improvement in quality too, due to the fact that when a proportion of the centering force is cancelled, any non-linearity of the suspension is cancelled as well, resulting in a lowering of distortion.

FEATURE: Loudspeaker Design

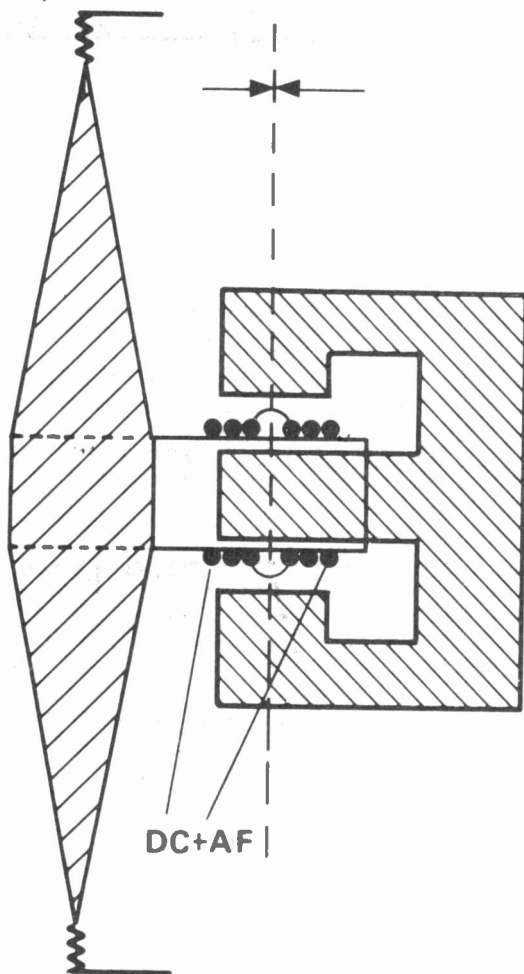


Fig 4. A much simplified and improved version with utilising virtually a standard loudspeaker chassis, but where the coil is much much longer and carries both DC and AF signals.

In Summary

A transducer with electro-magnetically extended bass response, with a vibratory diaphragm, incorporating adjustable means to oppose the centering force exerted upon the said diaphragm by the enclosed air of the transducer's sealed enclosure, said means comprising a magnet assembly defining a gap across which a magnetic flux extends to form a magnetic field, two coils secured to said diaphragm and movable axially in said gap, said coils' operative length limited to the designed travel distance of said diaphragm, and a DC supply for said coils, adjustable for balancing the air stiffness of differently sized enclosures, and lowering of 'main system resonance' to that exhibited by conventional, normally much larger enclosures.

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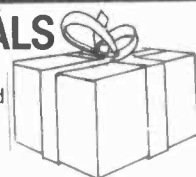
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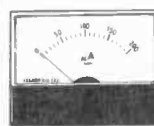
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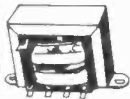
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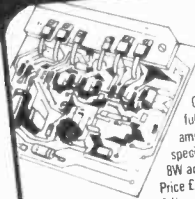
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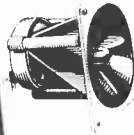
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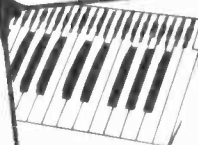
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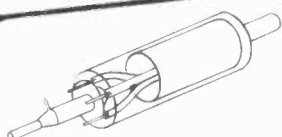
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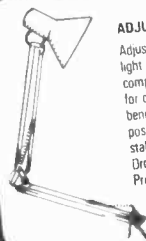
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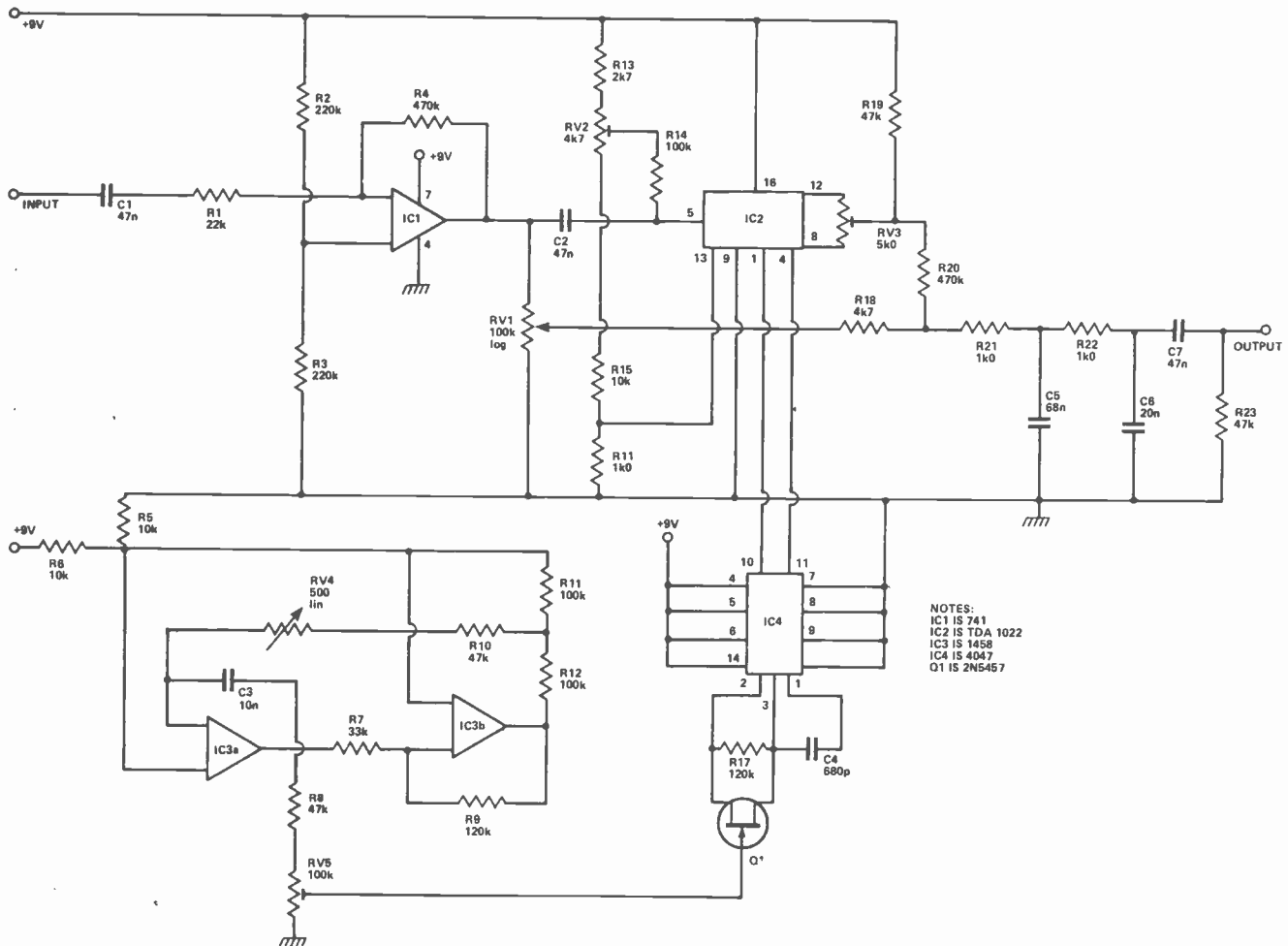
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TECH TIPS



NOTES:
 IC1 IS 741
 IC2 IS TDA 1022
 IC3 IS 1458
 IC4 IS 4047
 Q1 IS 2N5457

A Simple Sequencer

S. Giles

This is an example of how not to use a bucket brigade IC (according to the manufacturer's specifications). The circuit shown is basically that of a normal flanger but with two important differences

1. The clock modulation oscillator operates within the audio range.
2. There is no input filtering and

output filtering is kept to a minimum.

The usual precautions should be taken when handling the TDA 1022 (in other words — don't use an IC insertion clip).

The setting up procedure is as follows

RV2 should be at its mid-point, although this is not too critical. Turn RV5 full on and the clock modulation oscillator should be heard at the out-

put. Tune this with RV4 to the open 6th string on the guitar and then turn RV5 until the oscillator is barely audible. If the guitar is now played with RV1 fully on, both the guitar note and the oscillator will appear at the output, with the oscillator tending to follow the guitar's change in frequency. For best results the oscillator should be turned to the key being used. Finally, clock breakthrough can be minimised by use of RV3, which should preferably be a 20 turn preset.

Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H 0EE.

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22.5KV 110MA £50 ea.
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0.5 mfd 7.5KV £4 ea.
8 mfd 2.5KV £4 ea.

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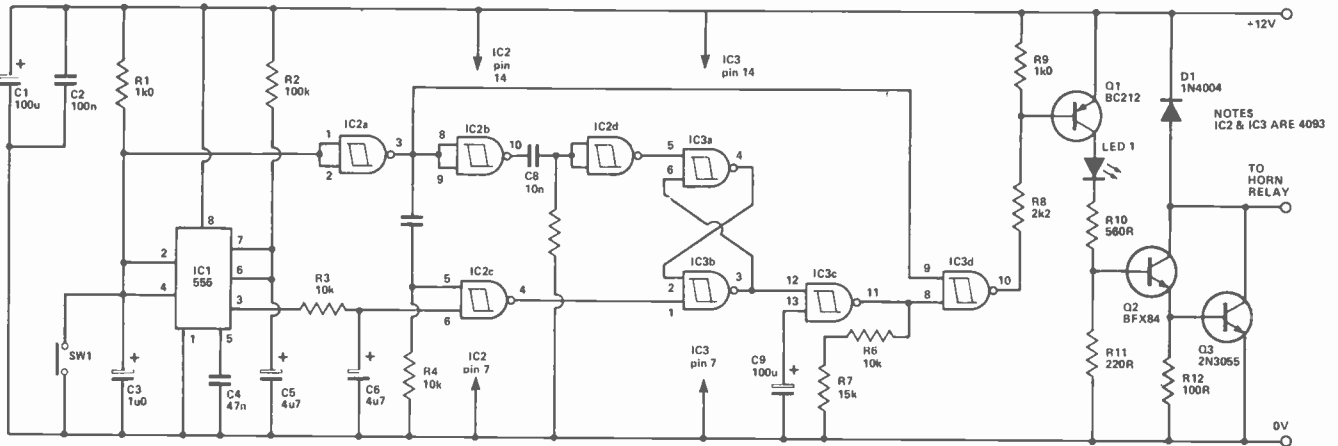
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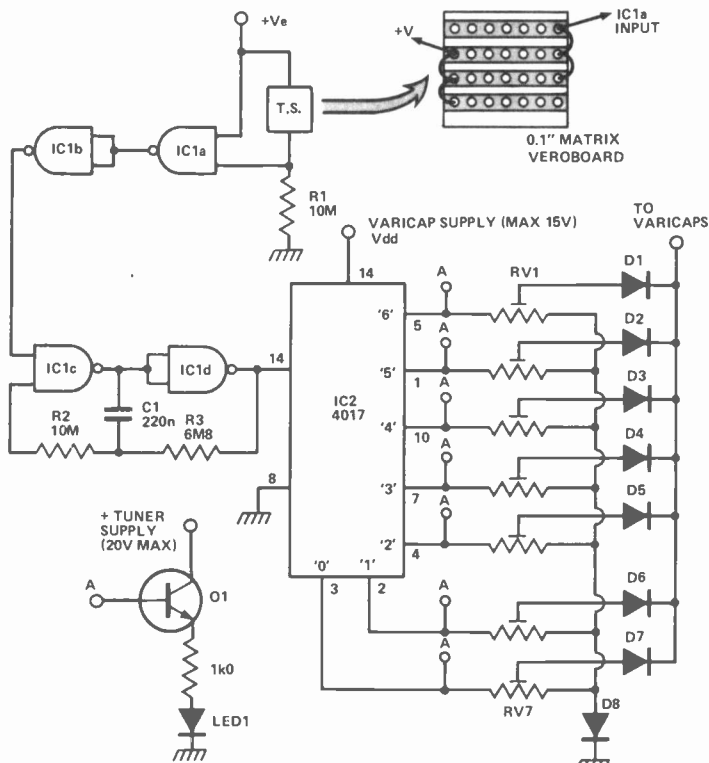
I. Hopkins

This circuit allows the horn to sound either continuously or repetitively while the horn switch is pressed. The second option is activated by pressing the horn button twice in quick succession.

When SW1 is pressed initially, gates IC2a and IC3d propagate the signal, turning on transistors Q1-Q3 and sounding the horn in the conventional manner. Releasing SW1 triggers the monostable IC1 (a 555 timer). If SW1 is pressed again while IC1 is active, flip-flop IC3a/b is set, enabling oscillator IC3c and causing the horn to operate intermittently as

long as the switch is closed.

LED 1 is optional and monitors the operation of the horn — very useful during testing. The oscillator frequency can be varied by altering C9, while the monostable period is adjusted using R2 and C5. C3 and C6 suppress the effects of switch bounce and R7 sets the mark/space ratio of the oscillator to approx 3:1.



Touch Station Selector

J. P. Macaulay

This circuit, used in conjunction with an FM tuner, will enable stations to be selected by means of a single touch pad.

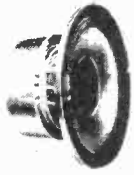
Under quiescent conditions the output of IC1a is high. In consequence the output of IC1b is low and the astable formed around IC1c/d is

disabled. The astable produces an output square wave of 0.5 Hz, when enabled. When a finger is applied to the touch pad IC1a's output goes low sending IC1b's output high, enabling the astable whose output is loaded into the decade counter, IC2. The ten outputs go high sequentially with the leading edge of the square waves provided by the astable. When the finger is removed the counter will 'freeze' retaining the last count.

Tuning is accomplished by the presets attached to the outputs of IC2. As shown, the circuit caters for seven stations but this can be extended to ten by making similar connections to all the outputs. Diodes D1-7 ensure that the individual tuning voltages don't interfere with one another whilst D8 helps to stop drift due to temperature variations. In order to know which station has been selected the display and driver transistor is fitted to the outputs.

In this manner a LED corresponding to the chosen station is displayed. The touch switch used in the prototype is simply a small piece of 0.1 inch vero with alternative strips connected together.

If the outputs of the decade counter were to be connected to CMOS transmission gates the circuit could also be used as a multiway switch for audio signals.



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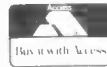
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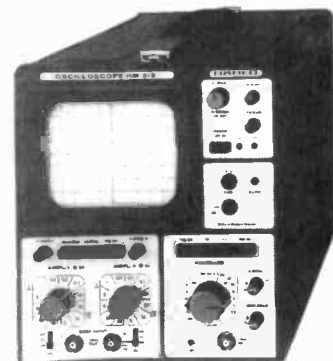
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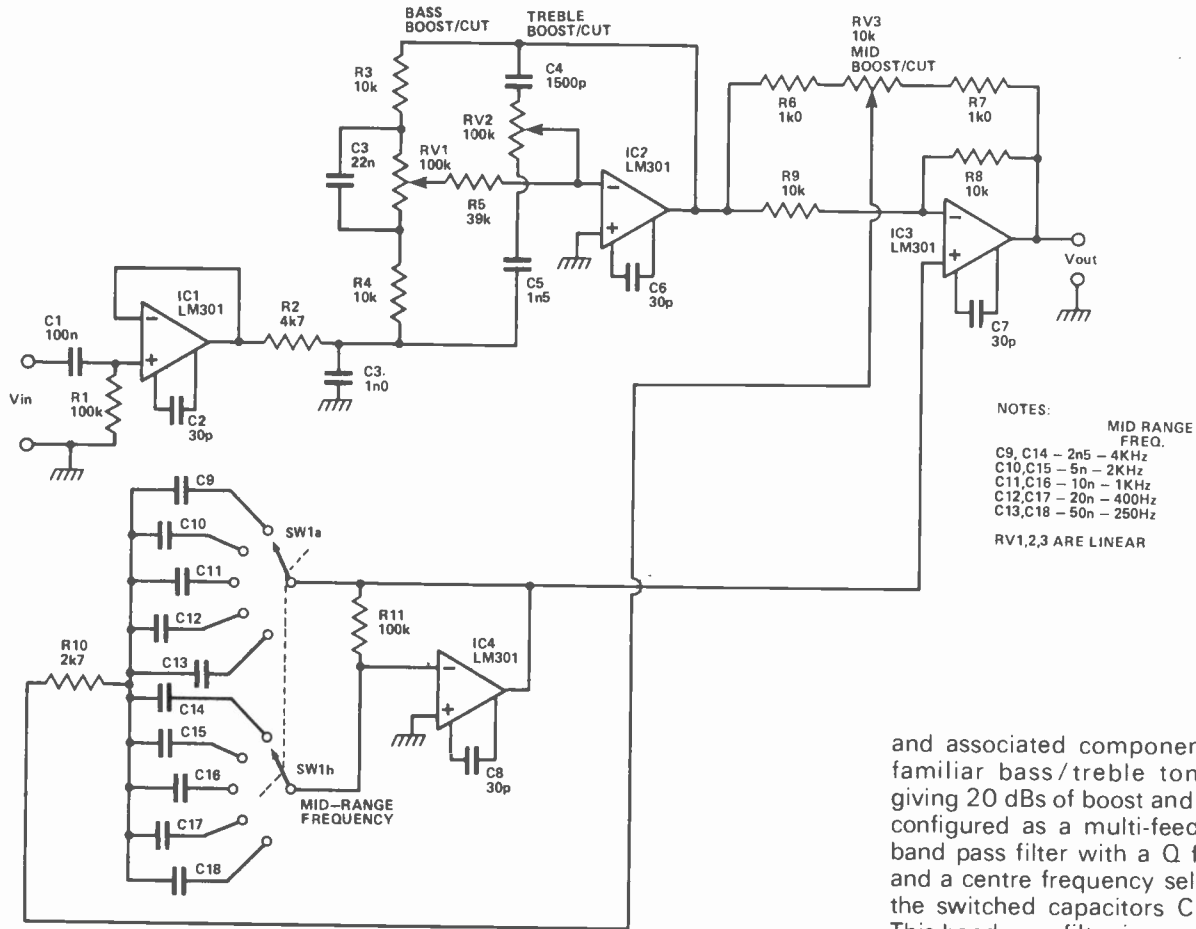
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Audio Equaliser

J. Collins

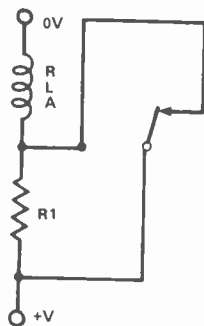
The circuit is a versatile line level audio equaliser providing many of the useful functions of a multi-channel

equaliser but using only one band pass filter and, therefore, far fewer components.

IC1 acts as a buffer, providing an input impedance of 100 k. R2 and C3 give HF roll-off at around 30 kHz. IC2

and associated components form a familiar bass/treble tone control giving 20 dBs of boost and cut. IC3 is configured as a multi-feedback type band pass filter with a Q factor of 3 and a centre frequency selectable by the switched capacitors C9 to C18. This band pass filter is connected in a feedback path of IC3, giving up to 20 dBs of boost or cut at the centre frequency by varying RV3.

All three potentiometers give no boost or cut at their centre (midway) positions and give a smooth increase in boost or cut on rotation to the right or left respectively.



Relay Power Saver

L. Goodfriend

When power is at a premium (usually in battery circuits), this circuit can be used to save 20% or more of the power used by a relay.

Since the pull-in voltage of a relay is several volts more than its drop-out voltage, there will be no noticeable effect if a resistor is switched into circuit when the relay pulls in. This is very simple to achieve. Any contact which carries the coil voltage of the relay can be used to bypass current

limit resistor R1 until the relay is energised. When power is applied to the relay, all the necessary current flows through this contact, but when the relay pulls in, the current has to flow through R1, which reduces the power drain.

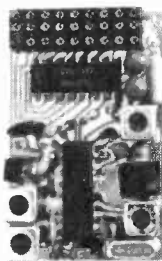
The value of R1 must be determined by experimentation; try about a quarter to a fifth of the relay's coil resistance. Bear in mind that the on-load voltage of a battery decreases with use, so while a resistor may seem to be suitable with a new battery, the relay may start to drop out when the battery ages.

IT'S HAPPENED AGAIN!

THE PART THREE CATALOGUE IS PUBLISHED & WE HAVE MOVED TO BIGGER PREMISES.

Yes, it's here at last - the all new Part Three Catalogue. Fun for all the family, and the usual update on all that is new, worthwhile and exciting in the world of Radio and Communications. A big section on frequency synthesis techniques covering broadcast tuners, to communication quality transmitter systems. More new products than ever - RADIO CONTROL parts, crystal filters, ceramic filters for 455kHz and the new range of TOKO CF5H low temperature coefficient types for 10.7MHz. Details on new radio ICs, including the new HA11225, the CA3189E lookalike with 84dB signal to noise, and adjustable muting threshold. Radio control ICs - and an updated version of the RCM&E 8 channel FM receiver - now with an Ambit designed screened front end, with 27MHz ceramic bandpass filter, LCD panel clock timer modules - the neatest and best LCD panel DVM yet (only £19.45 each + VAT), the new 5 decade resolution DFM3 for LW/HF/VHF with LCD readout. The DFM6 with fluorescent display to 10kHz resolution on VHF, 1kHz on SW. A 1kHz HF synthesiser with five ICs - the list is endless. Get your copy of the catalogue now. Post publication price is 60p (inc PP etc). The previous two sections are also required for a complete picture: Parts 1 & 2 £1 the pair, All 3 £1.50. And don't miss our spot the gibbon contest, together with a quiz to see if you can spot the differences between a neolithic cave drawing and a circuit diagram of one of our competitor's tuners. (* Yes, we still haven't learnt how to spell.)

Updated RCME FM radio control RX kit



- 8 Channel RC receiver (FM)
- Single IC RF/IF/Detector
- Single IC decoder
- 27MHz ceramic filter input
- FET RF stage with double tuned bandpass filter
- Dual ceramic filter IF
- Based on RCM&E FM system
- Best quality SLM servo connector block
- ONLY £16.10 inc VAT (kit) (includes new SLM case)

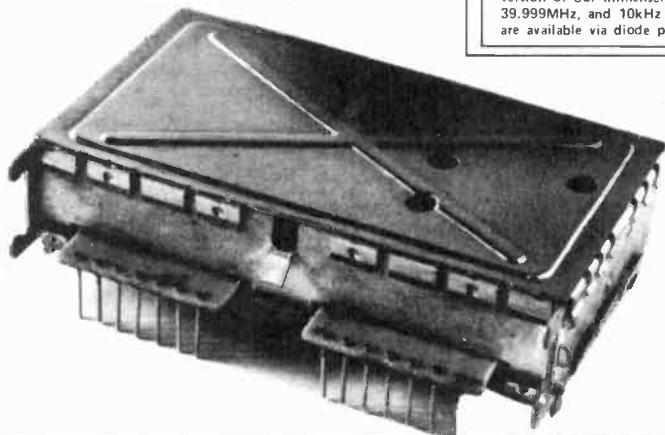
DOES YOUR ONE GLOW GREEN IN THE DARK ??

Our DFM4 does, since it uses a vacuum fluorescent display for direct readout of MW/LW/FM. Basically the same as the DFM2, (LCD Version). £24.45 kit (inc VAT) Transformer with all necessary windings for DFM4 - £2.50 inc VAT.



Not illustrated here - but also now available is the DFM6. This is a vacuum fluorescent display version of our immensely popular DFM3 (LCD). Resolution is 100Hz to 3.9999MHz, 1kHz to 39.999MHz, and 10kHz to 200.00MHz; all standard IF offsets (inc. 10.7MHz on shortwave) are available via diode programming.

New series of radio modules in fully screened cans:



UM1181 VHF band 2 VARICAP TUNERHEAD

5 tuned circuit, with image/spuri better than -80dB, buffered LO output, MOSFET RF stage, FET IF preamp, tunes with only 1% to 8v, -9dBm 3rd order Intercept. 1off price £12.00 inc VAT. (1000off) OA)

911225 FM IF strip with all mod cons for the HiFi tuner: All types use 80+dB S/N Hitachi IC, with muting, AFC, AGC, meter outputs for signal level and centre zero. IF preamp stage.

- 'A' Dual linear phase ceramic filters, with MOSFET (AGC'd) IF preamp and a 3rd narrow filter with DC filter selection. Dual tuned FM detector stage. £23.95 inc VAT (5off)
- 'B' Dual ceramic filters, single tuned detector stage £14.95 inc VAT
- (All 'A' series units are set up with a spectrum analyzer for best THD)

91072 AM RADIO TUNER MODULES - DC TUNED and DC SWITCHED Available February '80

All include buffered LO output, mechanical IF filter (TOKO CFMQ) 1-10v tuning bias, switching by a single pole to earth
A MW/LW (150 to 350kHz LW range) with ferrite rod antenna
B As 'A' but also including SW1 or SW2 (specify.)
SW1 = 1.8 to 4MHz SW2 = 5 to 10MHz
C With both SW ranges

Prices one off-INC VAT
'A' £14.43 'B' £15.90 'C' £17.50 (Custom types OA)

There is a danger - when advertizing in some magazines - that because we do not find space to list everything we sell in every ad., that some readers forget about half the ranges we stock. So to summarize the general ranges:

- TOKO Chokes, coils for AM/FM/SW/MPX. Audio filters etc.
Filters: Ceramic for AM/FM, LC for FM, MPX etc.
Polyvaricons
ICs for radio, clock LSI, radio control MPX decoders etc
- Micrometals Dust iron cores for toroids for resonant and EMI filters
Toroid mounts
- Hitachi Radio/audio/mpx linear ICs
100W MOSFETs, small signal FETs, MOSFETs and bipolar

And the following groups of products from a broad range of sources:

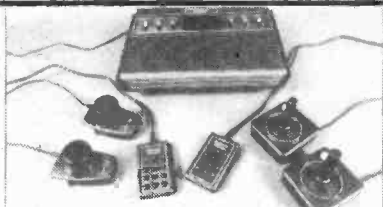
Semiconductors -specializing in radio devices, Plessey SL1600, EUROPE's best selection of AM/FM and communications devices. Power MOSFETs, WORLD's LOWEST NOISE AUDIO small signal transistors, BAR graph LED drivers for linear and log.
CD4000 series CMOS, TTL/LPSNTTL, standard linears (741, 301, 3080 etc). MPUs, memories. Small signal transistors from AEG BC237/8/9 families etc. (1000 off BC239C : 5.2p ea)
LEDs: AEG 3mm/5mm round, 2.5x5mm flat, red, green, orange, yellow. The best prices you will find for quality products.
MOSFETs for RF signal processing, including the BF960 UHF device, and 3SK51 for VHF.
Varicap diodes for 17:1 capacity ratio tuning

FREQUENCY READOUT LSI from OKI with a one-chip answer to most digital frequency display needs (and various modules).
Crystal and ceramic ladder filters from leading manufacturers, ferrite rods, various ferrite beads and a range of crystals for 'standard' frequencies and both AM and FM radio control at 27MHz. Trimmer capacitors.

METERS - a new range of linear movement types, plus many 'indicator' types for VU, all types of tuning indicators etc.
SOCKETS - a new range that are better quality than Texas low profile, yet better priced.
Modules for AM/FM/STEREO, complete kits for tuners, audio amplifiers from Larsholt.
SWITCHES - complete low cost DIY systems for push button arrays, keyboard switches.
DOUBLE BALANCED MIXERS - MCL SBL1, replacement for MD108 etc. And cheaper.

OUR LATEST MOVING EXPERIENCE :: At last, we have moved to the address below. There is car parking for customers approaching via North Service Road (an extension of North Road Avenue, entrance opposite the Brentwood Fire Station.) Pedestrian access from the High Street (alongside 117 High Street). The new building is six times bigger than our Gresham Road offices, and we will be installing a much expanded sales counter in the fullness of time. NEW TELEPHONE NUMBER (0277) 230909, TELEX NUMBER (as before) 995194 AMBIT G. See you there!

200 North Service Road, Brentwood, Essex.



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complete with combat cartridge mains transformer and aerial switch over box, extra cartridges include — Air Sea Battle, Space War, Outlaw, Video Olympics, Breakout, Basket Ball, Surround, Blackjack, Basic Maths, Bowling, Street Racer, Codebreaker, Hunt and Score, Brain Games, Golf, Skydiver, Superman, Basic Programming, Video Chess and Backgammon.

**EXTRA CARTRIDGES: Most at £14.95
CHESS £45: Backgammon £34.50**



PHILIPS G7000 VIDEOPAC COMPUTER

PAC 1 — Motor Race, Spin-out, Cryptogram, PAC 2 — Paris, Space Rendezvous, Logic, PAC 3 — American Football, PAC 4 — Air-Sea and Tank Battle, PAC 5 — Blackjack, PAC 6 — Ten Pin Bowling, Basketball, PAC 7 — Maths, Echo, PAC 8 — Baseball, PAC 9 — Computer (Assembler and Machine code) PAC 10 — Golf, PAC 11 — Space Conflict.

G7000 — **£149.95** inc. VIDEOPACS
most each — **£12.95** inc



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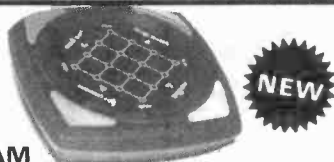
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RADIO/GAS LIGHTER

RADIO SPECIFICATIONS
Power Source: DC 1.5V
One "AA" size UM-3) battery.
Frequency Range: AM
525-1605 KHz.
Transistors: 6 transistors.
Speaker: 5 cm.
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Computer controlled electronic game selectable for four games and each game has variations all explained in the instruction booklet.

★ **Bounce** is a game of skill & reaction played with a "ball" which progressively speeds up until only one player remains the winner.

★ **Ditto**. Adam challenges you to outwit its own memory by repeating a sequence of lights & tones.

★ **Pathfinder** is a maze game — but beware a wrong turning returns you to your starting place and to progress you must retrace your path correctly.

★ **Memory Tune** allows you to program the Adam with up to 30 notes and patterns on the 4x4 display and replay your tune as many times as you wish. A tune book with 30 tunes to play is included.

★ All the games include visual display on the playing board and sound effects.

GRANSTAND ADAM £19.95



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Vocabulary of 1500 words/module.
Modules available:

German, French, Italian, English

Translator £149.95

Modules **£18.95** each



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3 waveband radio alarm clock. Green display.

£19.95

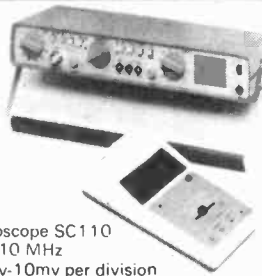
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6 Language module included. **£158.70**

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- Portable oscilloscope SC110
Frequency to 10 MHz
Sensitivity 50v-10mv per division
Timebase from 0.1 μsecs to .5 secs per division. Weighs only 1lb 12oz.

£159.85

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- 5 meg 3106C **£159.85**
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COMPUTER BOARD GAMES

Voice Chess Challenger **£229.90**
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Computer Bridge **£275.00**

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high performance electronic ignition, to add power, economy, reliability, sustained smooth peak performance, instant all weather starting, to your car.

Surefire has sold in its thousands in ready made form from big name accessory firms, but it is now available in quality kit form to fit all vehicles with coil ignition up to 8 cylinders.

ES200. A high performance inductive discharge ignition incorporating a power integrated circuit (special selection) electronic variable dwell circuit (maximises spark energy at all speeds); pulse processor (overcomes contact breaker problems). Coil governor (protects coil). Long burn output. Negative earth only. Compatible with all rev. counters.

C300. In it's ready built form (C3000) it came top of all systems tested by an independent national authority July '79. A high energy capacitive discharge ignition incorporating a high output short circuit proof inverter, top grade Swedish output capacitor, pulse processor circuit, transient overload protection. Fast rise bidirectional output ideal for fuel injection, sports carburation, oily engines. Compatible with most rev. counters (Low cost adaptors available for rare cases). Application list enclosed with each kit. Note: Vehicles with Smiths/Jaeger rev. counters code RVI on dial will require adaptor type TCI).

What's in the kits. Surefire's own precision anodised aluminium extruded case. P.C. mounted security changeover switch, static timing light. Special selection Motorola semi-conductors. Capacitors, resistors etc. selected after 5 years experience. Glass fibre pcb, solder, complete down to last washer.

Fully illustrated comprehensive instructions and full technical back up service.

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Phone order with Access Barclaycard Quantity
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ES200: Neg	£13.95	£11.95	
C300: Pos	£17.95	£15.95	
C300: Neg	£17.95	£15.95	
Tacho Adapt. TCI		£3.90	

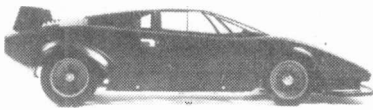
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**Next
Month**

Hobby Electronics

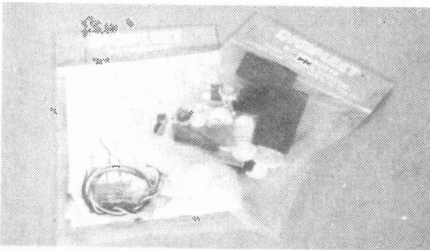
How do we do it? Next month at great expense to life, limb and sanity we hope to present you, the loyal readers, with an issue yet to be surpassed in the history of magazine publishing. Extravagant claims? We think not, just feast your eyes on this little lot.

RADIO CONTROL



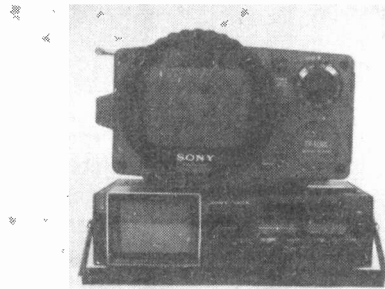
Do-it-yourself radio control systems always tend to be less attractive to build when confronted with hundreds of components, so for everyone that has ever promised themselves a system HE proudly present a Multi-Function digital R/C system using the latest 'dedicated' state-of-the-art ICs in both the decoder and encoder to make this system possibly the easiest and cheapest system yet published anywhere!

KIT REVIEW



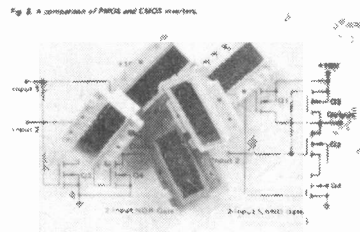
Next month in conjunction with the Radio Control project we are reviewing a new servo kit. This easy to build kit is ideal for use in our project car and will not leave you broke. Before you start though it would be as well to arm yourself with a fine-point soldering iron and a new pair of glasses as this kit calls for some pretty accurate soldering.

MINIATURE TV SURVEY



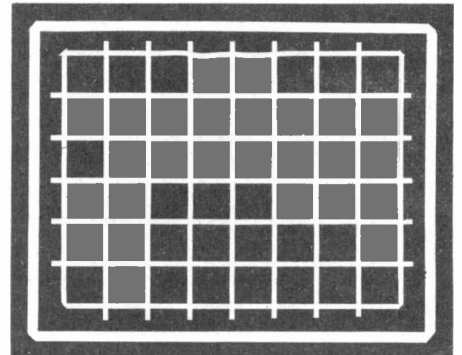
For people with very small eyes from people with very small brains (no offence meant) we have great pleasure in presenting this review of all of the latest titchy tellies on sale at the moment, from the miniscule Sinclair to the somewhat larger offerings from our Oriental cousins. We have drawn a limit at anything exceeding a screen size of five inches, you would be surprised what you can cram in such a small box, one model combines a TV with a FM/AM radio cassette recorder. The kitchen sink is an optional extra.

CMOS SPECIAL



Next month we present another in our very popular series highlighting a particular component or device. This time it's the turn of the CMOS IC. As usual we show lots of practical, buildable circuits with the accent on the functional and novel side of our hobby.

CROSSHATCH GENERATOR



To make this something of a TV special we have decided to include in this month's projects one of the most useful pieces of test gear available to the TV engineer. It will produce a grid pattern onto the screen of a TV set, this is particularly useful if you happen to be setting up the convergence on a colour set or the picture size and shape on a black and white set.

If you're very clever it can also be used as a TV game, how does multi-layer noughts and crosses sound?

SPACELAB

Look out for a major feature on one of the proposed payloads for the Shuttle, this new orbiting laboratory will enable scientists, rather than astronauts, to carry out their experiments in a near-Earth environment.

DIGITAL DICE

Grasn, not another dice project, but wait, our researches have shown that dice projects are amongst the most popular electronic systems to build. Why? Simply because they are easy to build, ideal for a newcomer to electronics, easy to understand, and they work. They actually do something. Our project next month uses a rather novel circuit that will be of interest to beginners and 'old hands' alike.

The January issue will be on sale December 14th

The items mentioned here are those planned but circumstances may affect the actual contents

8K ON BOARD MEMORY!

5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

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56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

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64 character graphics option — includes transistor symbols! Only £18.20 extra!

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high resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

KANSAS CITY

low error rate tape interface.

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Z80 the powerful CPU with 158 instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, -, /, squares, roots, logs, exponentials, trig functions, inverses etc. Range 10^{-99} to 9×10^{99} to 8 figures plus 2 exponent digits.

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Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

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with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

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resident in EPROM.

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Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCB.

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Cabinet size 19.0" x 15.7" x 3.3". Television by courtesy of Rumblelows Ltd., price £58.62

Kit also available as separate packs: e.g. PCB, Keyboards, Cabinet, etc.

POWERTRAN

PSI Comp 80. Z80 Based powerful scientific computer Design as published in Wireless World, April-September, 1979.

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete!

Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board. 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer. 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.

PSI COMP 80 Memory Expansion System

Expansion up to 32K all inside the computer's own cabinet!

By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computer's transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

Mother board:

Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug
£39.90

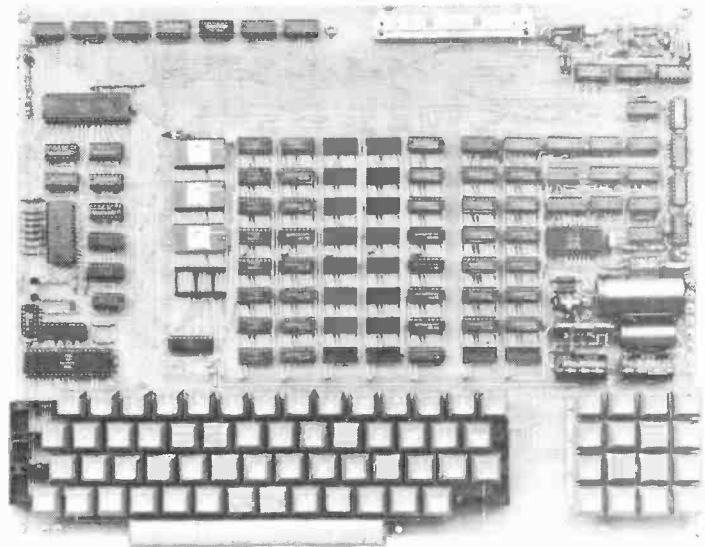
8K Static RAM board

Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8" £12.50
Set of components including IC sockets, plug and socket but excluding RAMs £11.20
2114L RAM (16 required) £5.00
Complete set of board, components, 16 RAMS £89.50

8K ROM board

Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8" £12.40
Set of components including IC sockets, plug and socket but excluding ROMs £10.70
2708 ROM (8 required) £8.00
Complete set of board, components, 8 ROMs £78.50

Floppy Disk, PROM programmer and printer interface coming shortly!



Value Added Tax not included in prices

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(a division of POWERTRAN ELECTRONICS)

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PROGRAMMABLE £29.50 + VAT. COLOUR CARTRIDGE T.V. GAME.

The TV game can be compared to an audio cassette deck and is programmed to play a multitude of different games in COLOUR, using various plug-in cartridges. At long last a TV game is available which will keep pace with improving technology by allowing you to extend your library of games with the purchase of additional cartridges as new games are developed. Each cartridge contains up to ten different action games and the first cartridge containing ten sports games is included free with the console. Other cartridges are currently available to enable you to play such games as Grand Prix Motor Racing, Super Wipeout and Stunt Rider. Further cartridges are to be released later this year, including Tank Battle, Hunt the Sub and Target. The console comes complete with two removable joystick player controls to enable you to move in all four directions (up/down/left/right) and built into these joystick controls are ball serve and target fire buttons. Other features include several difficulty option switches, automatic on screen digital scoring and colour coding on scores and balls. Lifelike sounds are transmitted through the TV's speaker, simulating the actual game being played.



EXTRA CARTRIDGES

ROAD RACE — £8.87 + VAT.

Grand Prix motor racing with gear changes, crash noises

SUPER WIPEOUT — £9.17 + VAT.

10 different games of blasting obstacles off the screen.

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6 Game — COLOURSCORE II — £13.50 + VAT.

10 Game COLOUR SPORTSWORLD £22.50 + VAT.

Manufactured by Waddington's Videomaster and guaranteed for one year.

CHESS COMPUTERS

STAR CHESS — £55.09 + VAT. PLAY CHESS AGAINST YOUR PARTNER.

using your own TV to display the board and pieces. Star Chess is a new absorbing game for two players, which will interest and excite all ages. The unit plugs into the aerial socket of your TV set and displays the board and pieces in full colour (or black and white) on your TV screen. Based on the moves of chess. It adds even more excitement and interest to the game. For those who have never played, Star Chess is a novel introduction to the classic game of chess. For the experienced chess player, there are whole new dimensions of unpredictability and chance added to the strategy of the game. Not only can pieces be taken in conventional chess type moves, but each piece can also exchange rocket fire with its opponents. The unit comes complete with a free 18V mains adaptor, full instructions and twelve months guarantee.



CHESS CHALLENGER — £85.65 + VAT. PLAY CHESS AGAINST THE COMPUTER.

The stylish, compact, portable console can be set to play at seven different levels of ability from beginner to expert including "Mate in two" and "Chess by mail". The computer will only make responses which obey international chess rules. Castling, on passant, and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given problem from magazines or newspapers or alternatively establish your own board position and watch the computer react. The positions of all pieces can be verified by using the computer memory recall button.



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£17.17 + VAT

A special bulk purchase of these amazing chess teaching machines enables us to offer them at only £19.75 less than half recommended retail price. The electronic chess tutor is a simple battery operated machine that can actually teach anyone to play chess and improve their game right up to championship level. This machine is not only for total beginners but also for established players wanting to play better chess. Unit contains the electronic chessboard with 32 chess pieces, a 64 page explanatory booklet and a set of 32 progressive programme cards including 6 beginners cards, 16 check mate positions, 9 miniature games, 5 openings, 3 end games, 28 chess problems and 2 master games.

Price includes unit with wood grained housing, and Staunton design chess pieces. Computer plays black or white and against itself and comes complete with a mains adaptor and 12 months guarantee.

OTHER CHESS COMPUTERS IN OUR RANGE INCLUDE

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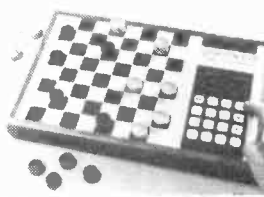
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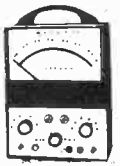
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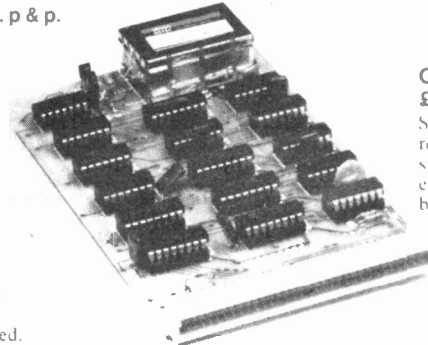
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Now, the complete MK 14 micro-computer system from Science of Cambridge

VDU MODULE. £33.75

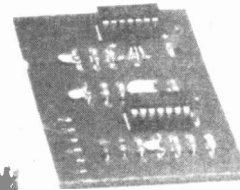
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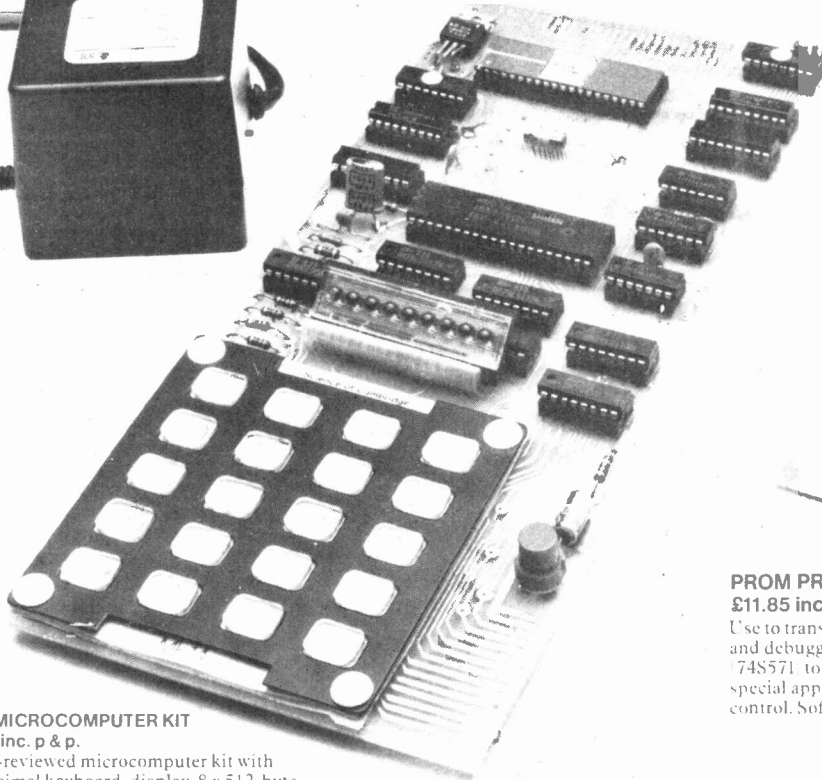
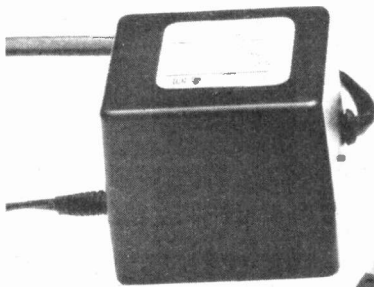
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MK 14 MICROCOMPUTER KIT £46.55 inc. p & p.

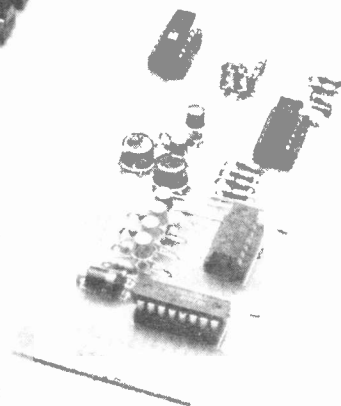
Widely-reviewed microcomputer kit with hexadecimal keyboard, display, 8 x 512-byte PROM, 256-byte RAM, and optional 16-lines I/O plus further 128 bytes of RAM.

Supplied with free manual to cover operations of all types - from games to basic maths to electronics design. Manual contains programs plus instructions for creating valuable personal programs. Also a superb education and training aid - an ideal introduction to computer technology.

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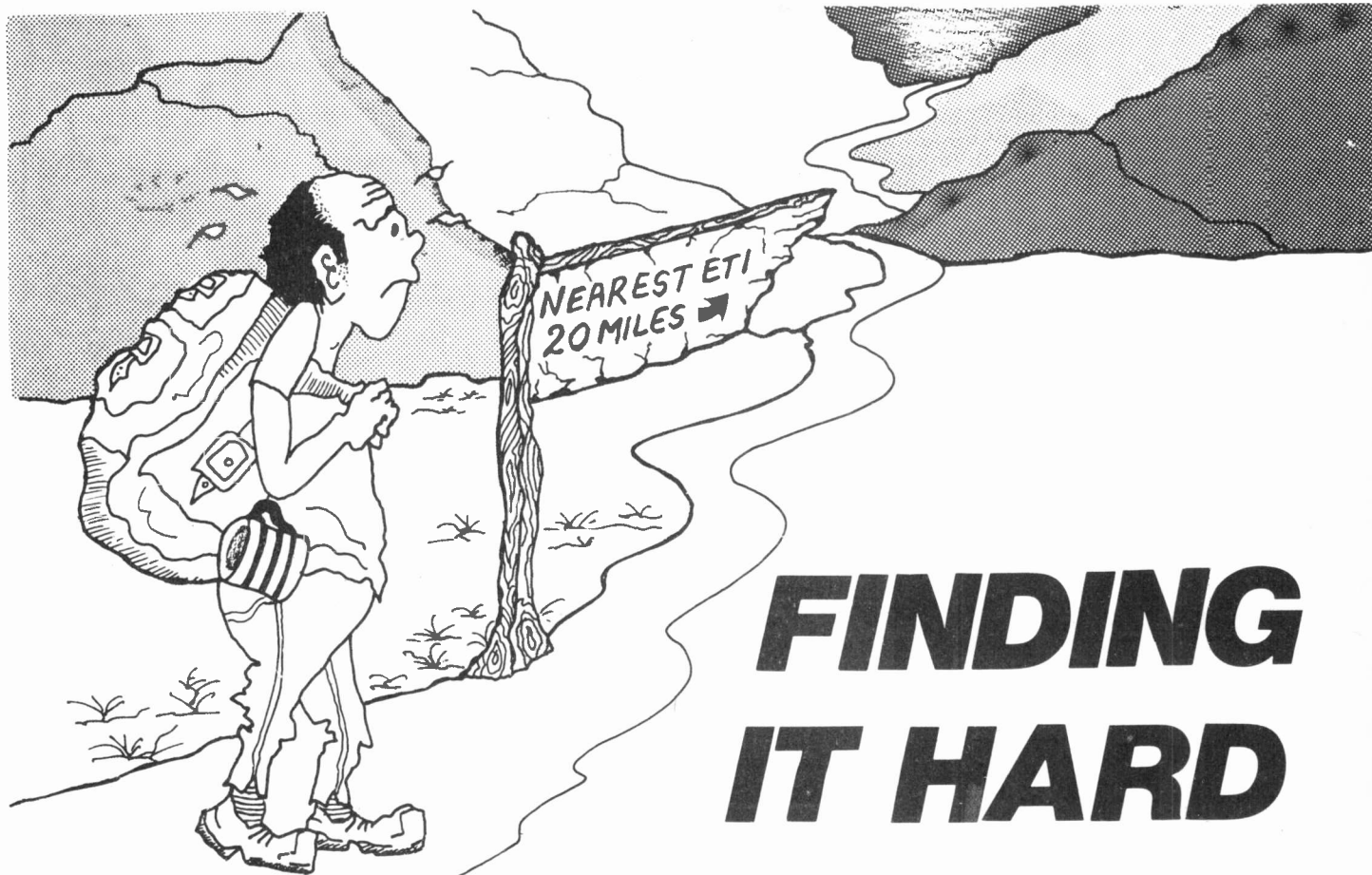
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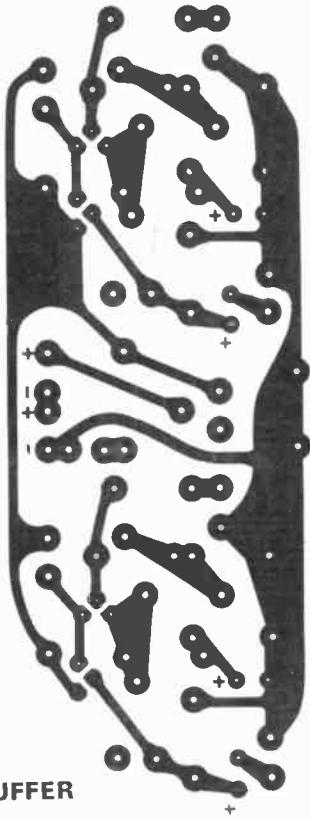
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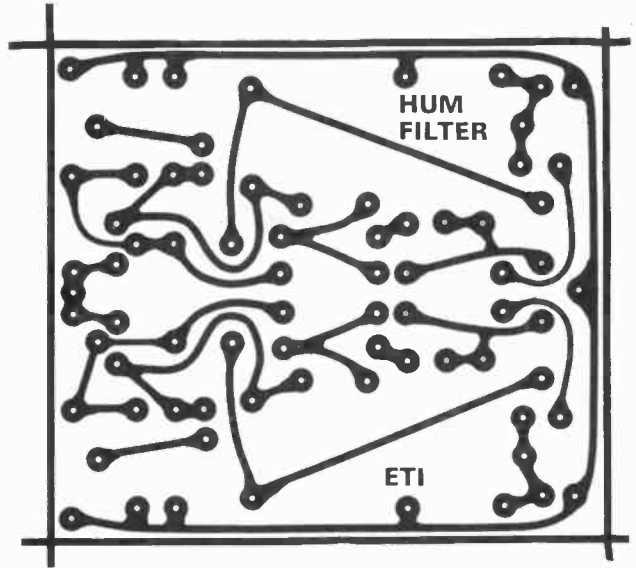
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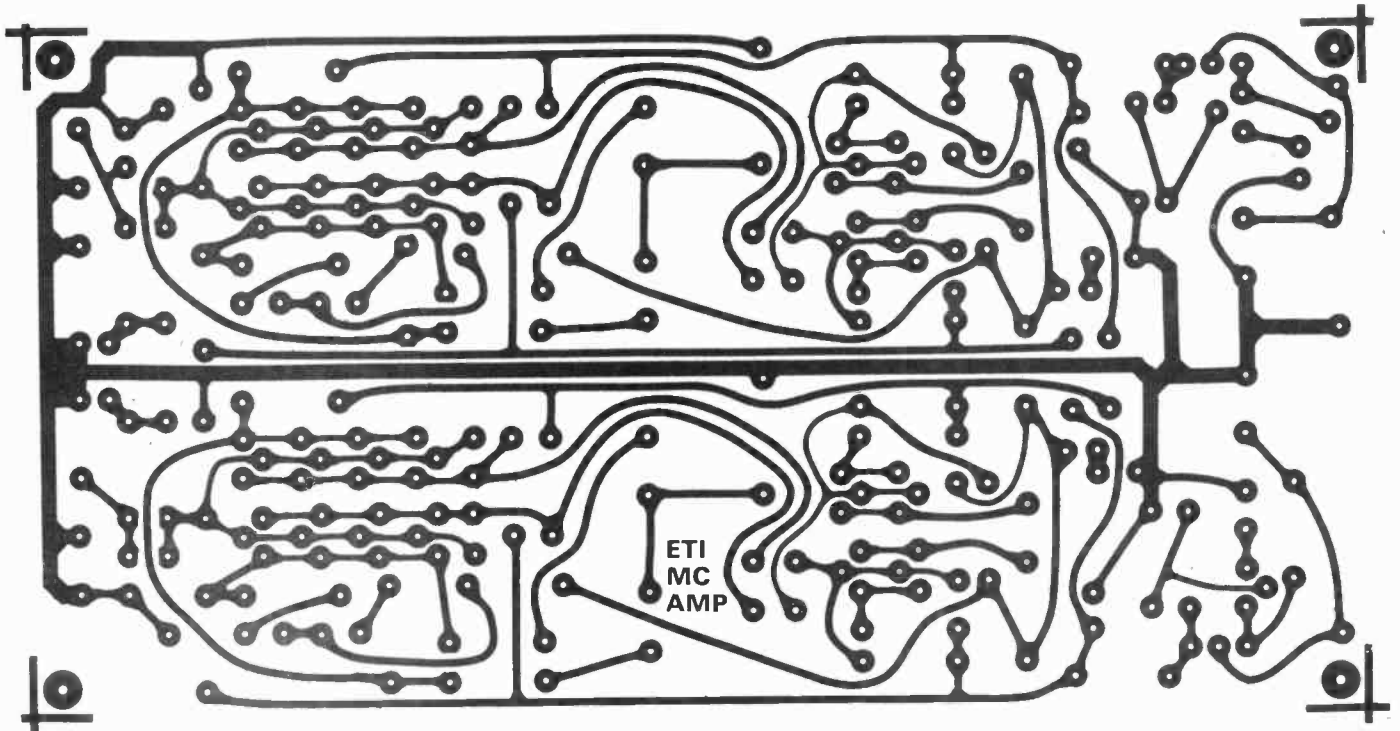
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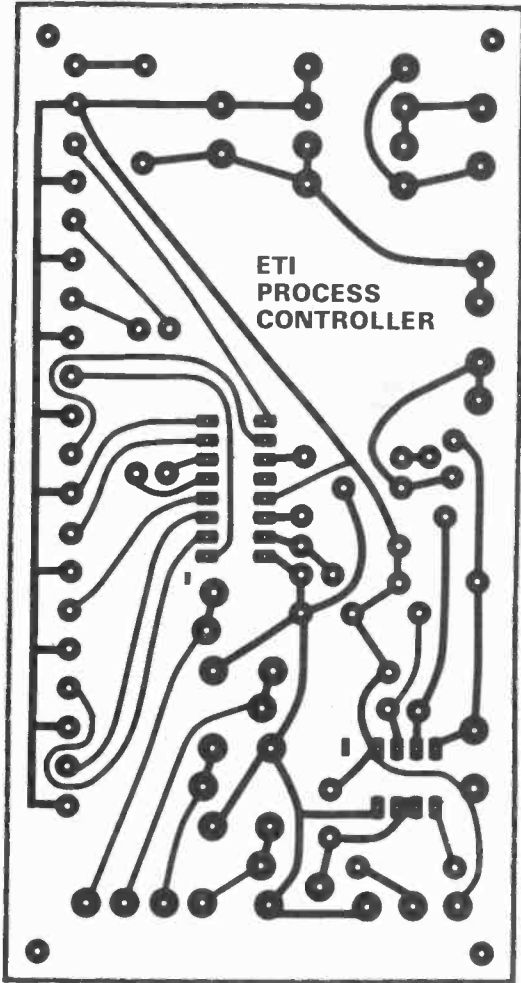


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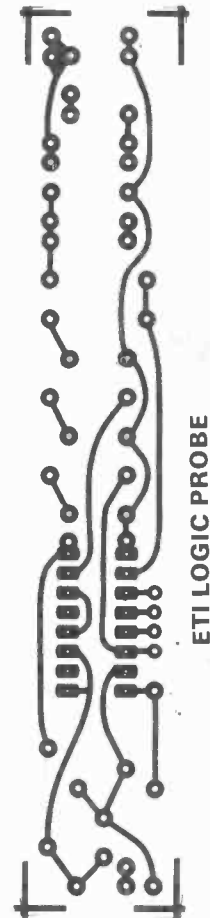
Herein this months PCB patterns (minus the DFM which is double sided and copyright Watford). Also shown are the two we missed from last issue, namely the hum filter and logic probe.



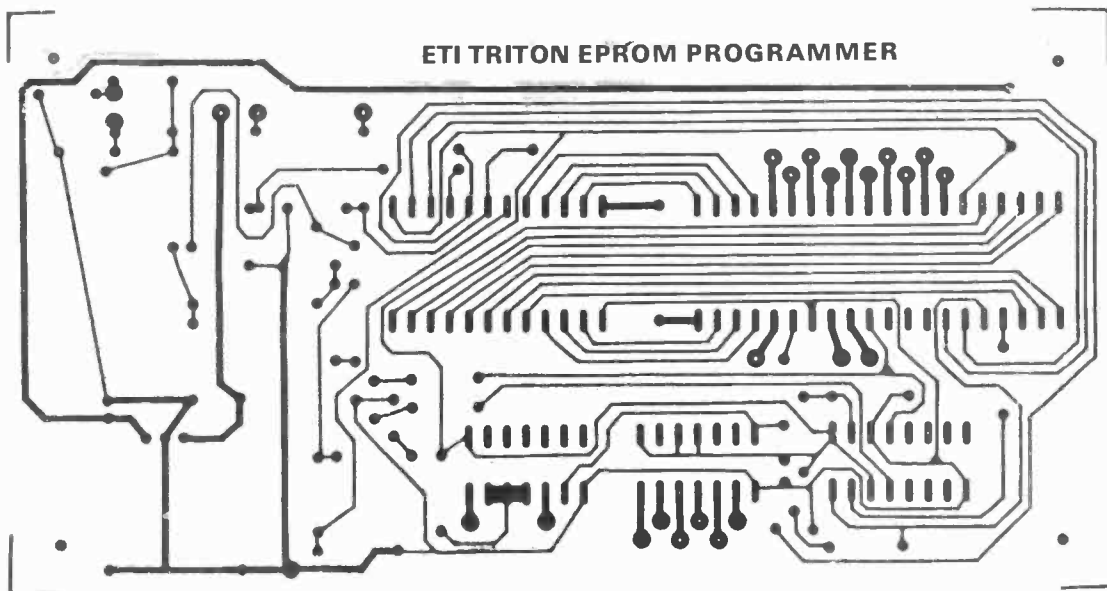


Left: process controller board.

Right: last months logic probe PCB. Apologies for the delay!



Below: the Triton EPROM programmer PCB. Companies note Transam hold copyright.



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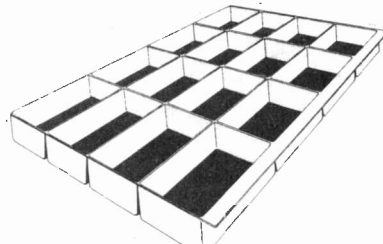
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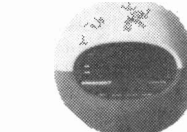
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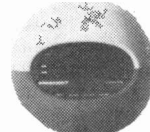
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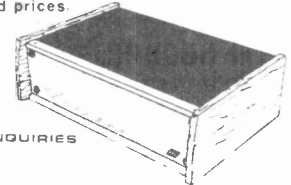
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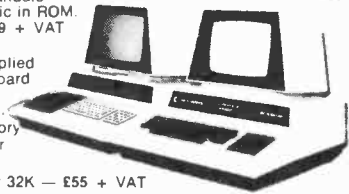
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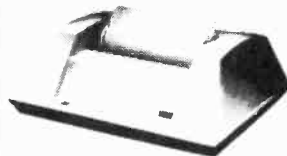
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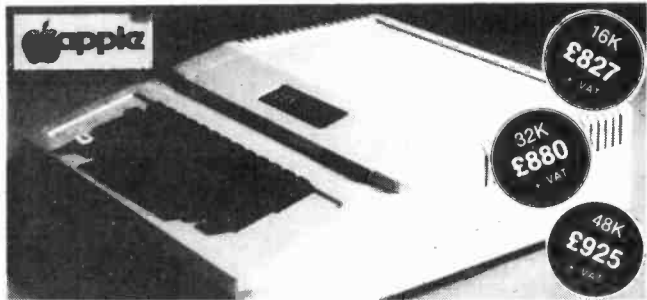
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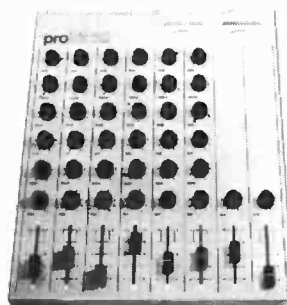


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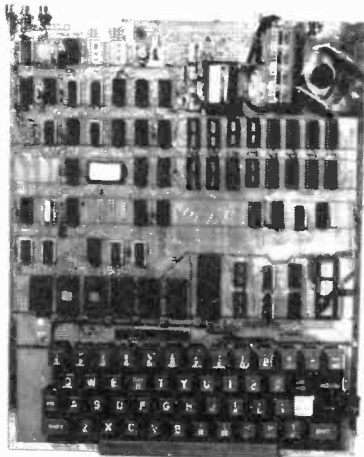
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*8K Microsoft Basic means conversion to and from Pet, Apple and Sorcerer easy. Many compatible programs already in print.

- SPECIAL CHARACTERS**
- @ Erases line being typed, then provides carriage return, line feed
 - Erases last character typed
 - CR Carriage Return — must be at the end of each line
 - Separates statements on a line
 - CONTROL/C Execution or printing of a list is interrupted at the end of a line
 - "BREAK IN LINE XXXX" is printed, indicating line number of next statement to be executed or printed
 - CONTROL/O No outputs occur until return made to command mode. If an input statement is encountered, either another CONTROL/O is typed, or an error occurs
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COMMANDS

CONT LIST	NEW	NULL	RUN		
STATEMENTS					
CLEAR DATA	DEF	DIM	END	FOR	
GOTO GOSUB	IF GOTO	IF THEN	INPUT	LET	
NEXT ON GOTO	ON GOSUB	POKE	PRINT	REAC	
REM	RESTORE	RETURN	STOP		

EXPRESSIONS

OPERATORS

* ↑ NOT AND OR >> << > < = <= RANGE 10 32 to 10 + 32

VARIABLES

A B C Z and two letter variables
The above can all be subscripted when used in an array. String variables use above names plus \$ e.g. \$A

FUNCTIONS

ABS(X)	ATN(X)	COS(X)	EXP(X)
LOG(X)	PEEK(I)	POS(I)	RND(X)
SPC(I)	SQR(X)	TAB(I)	TAN(X)
FRE(X)	INT(X)		
SGN(X)	SIN(X)		
USR(I)			

STRING FUNCTIONS

ASC(X\$)	CHR\$(I)	FRE(X\$)	LEFT\$(X\$, I)
RIGHT\$(X\$, I)		STR\$(X)	
LEN(X\$)	MID\$(X\$, I, J)		
VAL(X\$)			

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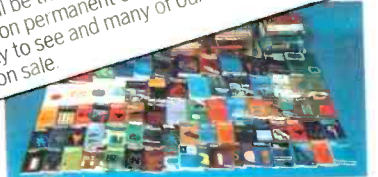
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