

RANSCENDENT 2000 INGLE 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.

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





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!

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!

To add interest to the sounds and make them more natural there is a chorus /ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines. The overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mild effects

As the system is based on digital circuitry digital data can be easily taken to and from a computer (for storing and playing back accompaniments with or without pitch or key change, computer 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 panel circuitry from the main circuitry in the cabineti

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 not 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!

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

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



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HOLLAND

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PUBLISHED BY DISTRIBUTED BY

PRINTED BY

Modmags Ltd., 145 Charing Cross Road Argus Distribution Ltd. (British Isles) Gordon & Gotch Ltd. (Overseas) QB Limited, Colchester

Electronics Today International is normally published on the first Friday of the month prior to the cover date

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

Count-down



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

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

Alarm

used.



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

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

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

for only £ 19.95



Display Format (NORMAL TIME DISPLAY)

2nd time-zone indicator Count down Alarm indicator alarm indicator Chronograph indicator **(2) (3) (4) (8)** Press S3mode selection Hold S3-S2 Press S2-SEC/DATE alarm sound Alternative hold \$2-MIN SEC

5 independent working modes

- Normal watch
- Count down alarm (ii
- iii) Alarm
- Dual time zone
- 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 microprocessor 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



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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.



Guaranteed same day despatch.

Very slim, only 6mm thick



M1

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5 Function

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



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0.0°

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 Adjustable bracelet Metac Price

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M3

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- Memory date alarm.

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- with dual time and 5 country
- zone.

 ** Back light:

 ** 8mm thick.
- £18.65



M5

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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

Ladies Day Watch

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gold fully adjust-

able to suit very

State colour pre-

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QUARTZ LCD

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Alarm. 9mm thick. Back-light. Fully adjustable bracelet.

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10.10 od

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

29.65 £24.95

M8

0.10 ci

SOLAR QUARTZ LCD Chronograph

Powered from 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. Solit and lan modes. Solit and lap modes

Back light. Auto calendar. Only 8mm thick Stainless steel bracelet and back Adjustable bracelet

Metac Price £13.65

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M9

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slim wrists

M15

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M17

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Features and Specification Features and Specification. Hour/minute dipplay. 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).

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M13

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M21

- OUTSTANDING FEATURES

 * DUAL TIME. Local time always visible
 and you can set and recall any other
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- 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.

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!

sounds to remind or awaken you

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examples: glossarv

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Book 2 AND, OR, NOR and NAND gates and inverters, Boolean algebra and truth

Book 3 Positive ECL; De Morgans Laws; designing logic circuits using NOR gates. Book 4 R-S and J-K flip flops; binary counters, shift registers and half adders.

DESIGN OF DIGITAL SYSTEMS £11.50

Design of Digital Systems is written for the engineer seeking to learn more about digital electronics. Its six volumes - each A4 size are packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra to memories, counters and simple arithmetic circuits, and finally to a complete understanding of the design and operation of calculators and computers. Contents include:

Book 1 Octal, hexadecimal and binary number systems; conversion between systems; representation of negative numbers; complementary systems; binary

systems; representation or negative numbers; complementary systems; binary multiplication and division.

Book 2 OR and AND functions; logic gates; NOT, exclusive-OR NAND. NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; Karnaugh mapping; three state and wired logic.

Book 3 Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.

Book 4 Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive OR feedback counters: random access memories (RAMs) and read only memories (ROMs). Book 5 Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction

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ONLY

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Panel size 19.0" x 3.5". Depth 7.3"

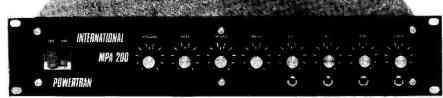
This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all 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

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

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

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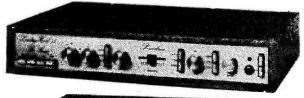
MATCHES THE CHROMATHEQUE 5000 PERFECTLY!



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 A pre-angited information mountering makes this vitteres within publishing design of the 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

PRICE STABILITY: Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until March 31st, 1980, if this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.

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WERTRAN ELECTRONICS

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ANDOVER (STD 0264) 64455



DIGEST



Open Ears

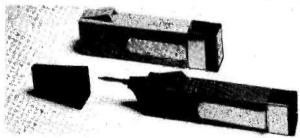
If you find earphones a pain in the neck, try this dangler from JVC. You hang it over your shell-like instead of wedging it inside.

The TP-1E weighs only 13g without its three metres of cord. It's designed for people who find conventional earphones uncomfortable. Secretaries in Readerland could

use it to listen in on Radio 1 (or music, if you prefer) without driving the boss round the twist

I would also recommend it whole-heartedly to insomniacs. While all about you are deep in dreamland, tune into your favourite middle-of-the-night music without starting a riot.

The TP-1E from JVC should be available for around £4.60 including VAT.



Combi 'n' Poly

Arm yourself with a Combi-Sensor and you're ready to detect AC or pulsating DC volttage, faulty connections to ground in electrical appliances, leakage to ungrounded metal cases or breaks in insulated conductors. Live cables laid on the surface or under plastic panels can be checked and traced without any need for stripping the cable. The Combi-Sensor has no test leads and so is safe to use. The condition of cables and connections under test is indicated by light and sound.

With the Poly-Tester you can

test continuity, neutral and ground terminals in power outlets, semiconductors and voltages. There are no test leads to connect — the Poly-Tester has only one integral test probe, with a protective cover. It can also be used as an ordinary screwdriver-type voltage tester with the added advantage of being unaffected by induction. Connection to the user's body is by a metal pocket clip. Like the combi-Sensor, test indication is by sound and light.

The Combi-Sensor and Poly-Tester are £7.60 each plus VAT from C. Lord, 61 Forknell Avenue, Wyken, Coventry CV2 3EN.

Opticom

A 96 kms experimental optical communications system has been set up by Philips Research Laboratories in Holland. It is believed to be the longest in the world.

The glass fibre connection consists of 16 reels of cable, each made of six separate strands. The reels are connected in two sections of eight kilometres each.

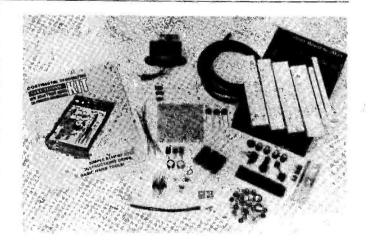
The signal is passed down one strand in the cable, through a repeater at each eight kilometre section, through the second eight kilometre section,

then through a further repeater before returning up the cable via a second strand. This sequence is repeated via all six strands and eleven repeaters

until the signal emerges at the

end of its 96 kms journey. Attenuation is a mere 4 dB/km, including the joints every kilometre. Hence the need for repeaters at only eight kilometre intervals (conventional copper cable links need repeaters every two to four kilometres).

Japan isn't far behind the Dutch achievement. The Nippon Telegraph and Telephone Corporation have succeeded in transmitting an 800 Mbit/S signal through 30 kms of fibre-optic cable with an error rate of less than 10-12. At the source wavelength (1.3 um from an indium-gallium-arsenide-phosphide laser at room temperature) the attenuation is such that the loss in the cable is only 0.73 dB/km (including losses in the splicing, every 2 kms).



Bread Power

Continental Specialties Corporation has introduced a kit of parts for a solderless breadboard system with three regulated DC power supplies.

regulated DC power supplies.
The Proto-Board PB203AK kit comes complete with all the electronic components, case and breadboard modules, nuts, bolts, connecting wire and solder. Step by step instructions are also included. The finished Proto-Board has three large breadboards plus four-long busbars and one shorter one, giving a constructional area sufficient for 24 ICs in 14 pin

packages. Terminal posts also allow connection to earth and $\pm 5A$, 1A and $\pm V$, 0.5A power supplies. The supplies are independent and fully regulated. The $\pm 15V$ supplies can be adjusted internally over 7 to 18 volts. The three supply rails allow the Proto-Board to be used with TTL and CMOS logic.

The PB203AK, supplied with a robust earthed metal case (248 × 168 × 83 mm) and designed to be powered from 240V AC mains, is available for £59 plus VAT from Continental Specialities Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

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SJ42 SJ43	5 4	24 pin 28 pin		UNCTION)
SJ44	3 3NI V 61	40 pin	2N6027 BRY56	£0.25 £0.25

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Pos	itive	No	gative
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uA7824	£0.65	uA7924	£0.70
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LM309K T	Ó3		£1.10

OPTOELECTRONICS

1510	707	LED	Display Price each	£0.70
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1512	727	LED	Display Price each (dual)	€1.55
LEDs				Price each
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SJ79	. 2	LED	Diffused RED	\$0.03
5120	.125	LED	Bright RED	€0.09
5121	. 2	LED	Bright RED	€0.09
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SJ82	2	LED	Clear illuminating RED	€0.10
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		2nd Q	UALITY LED PAKS	
1507	10	Assorte	d colours & size	€0.65
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SJ29		Texas N	PN silicon transistors 2S50	3 = BC108 TO-18

Texas NPN silicon transistors 2S503=BC108 TO-18 metal can — perfect & coded

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Type	Price				
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AC187	€0.16	. BC441	£0.25	OC72	€0.16
AC187K	£0.26	BC460	€0.28	OC75	€0.18
AC 188	€0.16	BC461	£0.28	OC81	£0.20
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	0.65/pr	BC479	€0.15	TIP29B	£0.32
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BC107	20.03	BC557	£0.10	TIP	€0.32
BC107A	\$0.03	BC558	€0.09	TIP30C	€0.34
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BC107C	£0.00	BCY 70	€0.13	TIP31A	£0.30
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BC213	€0.07	MPSA56	€0.15	2N2221A	€0.20
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			ΔR			
			$\mathbf{A}\mathbf{n}$			
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CA3089	£1.70	SN76023	N £1.60	uA 703	€0.20	
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CLTQ 4 DUDGE TO	

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0.30 0.20 0.50

SJ75 FM coax cable — plain copper conduction cellular polythene inau and plain copper braided PVC sheath — impedance 75 ohms meter

SJ76 1 Board contrining 2 x 5 pin DIN sockets 180° and 2-2 pin loudspeaker sockets

SJ76 5 pin DIN 180° chassis/normal socket incl. DPDT switch SJ83 5 Germ. OCP71 type photo transistors

SJ84 10 BD131 NPN power transistors TO-126 Hile rejects

SJ85 6 PNP Darlington power transistors TO-126 Hile rejects

SJ85 6 PNP Dorlington power transistors TO-126 Hile rejects

SJ85 2 PNP TO-3 germ. power transistors at VLTS10-20VCB

SJ87 20 Assorted types TO1, TO5, TO18, TO92 — our mix

SJ88 2 Post Office relays

SJ88 2 Post Office relays

SJ88 2 Post Office relays

SJ89 20 Mixed values 400mW zener diodes 3-10v

SJ90 20 Mixed values 400mW zener diodes 11-33v

SJ91 10 Mixed values 1W zener diodes 11-33v

SJ91 10 Mixed values 1W zener diodes 11-33v

16168 5 Assorted territe rods

16169 2 Tuning gangs, mw/lw

16170 50 Meters asst. colours single strand wire

16171 10 Red switches

16171 15 Red assorted hap striches

16172 15 Assorted ports

16173 15 Assorted ports

16181 3 Postor word chardware

16181 3 Postor word charge switches

16192 2 Relay 6-24 Min Slder switches

16193 2 Tuning sider switches

16194 25 Assorted thap striches

16194 25 Assorted thap striches

16195 2 Fore-set assorted types and values

16196 3 Pre-sets assorted types and values

SJ56 6 100K lin 40mm slider pots

SJ56 6 100K lin 40mm slider pots

SJ56 6 100K lin 40mm slider pots

SJ56 1 K lin 40mm slider pots

SJ56 1 K lin 40mm slider pots

SJ56 1 S lin 40mm slider pots

SJ56 1 S lin 40mm slider pots

SJ66 1 B strip slin 40mm slider pots

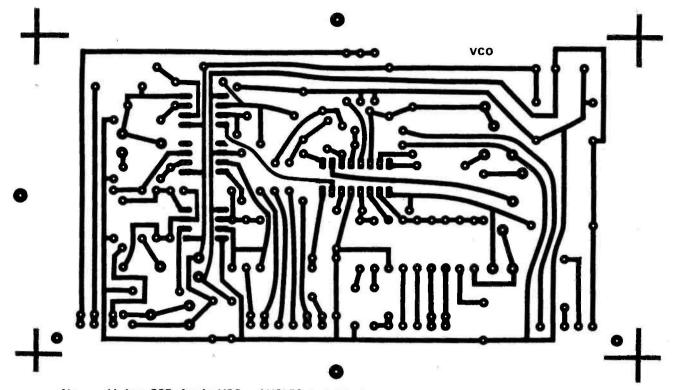
SJ66 1 B strip

METAL CASE DUAL SLIDER POTS: 45mm travel

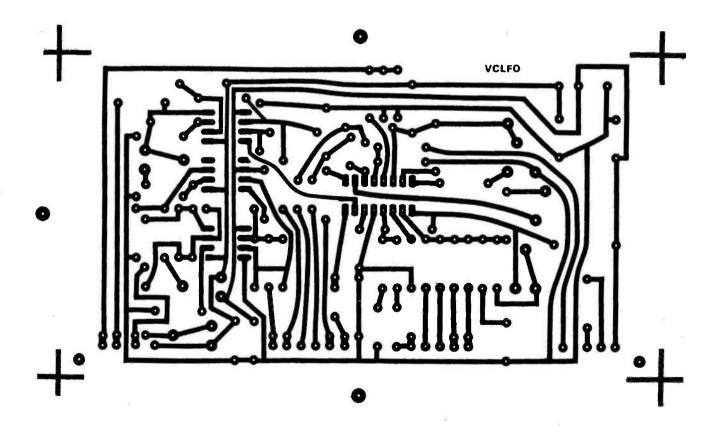
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Above and below: PCBs for the VCO and VCLFO modules. Yes we know the boards are very similar, but you'll need both — won't you?



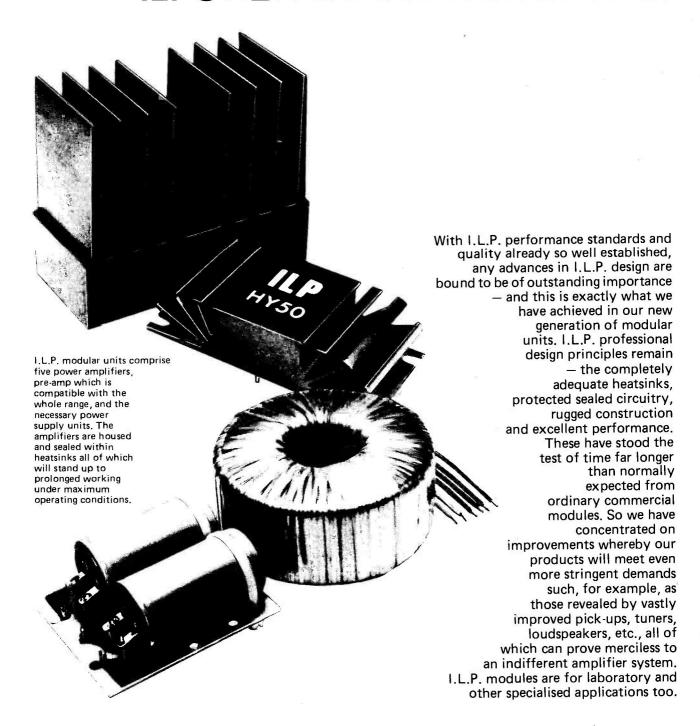
•					80	-2	VO	LTAC	E (CONTR	OLLED OS	CILLATOR		
		1	0	1			1	0	1		CONTROLS	SYNC	OUTPUTS	1
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	3		0		3	3		0		3	C1	SOFT	SAW PULSE	
	4	5		5	4	4	5		5	4	0	0	0 0	
			FINE 5				ŏc	TAV		•	C2	+HARD	SINE TRI	
	3	4	J	6	7	3	4		6	7 ON	•	•	ETI	
	2		0		8	2		0		8	PWM	-HARD		
ī	1				9	1				9	0		0 0	
•		0	PWM	10			Ö	FM	10		FM		±SINE ±TRI],

Above and below: front panel layouts for both the oscillator modules. The PSU artwork is not shown here, as this is not panel dependent — nor on show!

•				V	OLTA	AGE	СО	NTF	ROL	LED	LOW FREQUE	ENCY OSC	CILLATOR	
		4	5	6			4	5	6		CONTROLS	SYNC.	OUTPUTS	
	3				7	3				7	0	0	0 0	
	2		0		8	2		0		8	C1	SOFT	SAW PULSE	
	1				9	1				9	0	0	0 0	
		0	FINE	10			0	CTA	10 /ES)	C2	+ HARD	SINE TRI	
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	1				9	1				9				ı
0		0	PWM	10			0	FM	10		FM		±SINE ±TRI	

Simply ahead..

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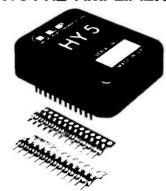
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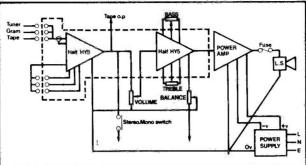
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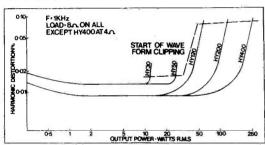
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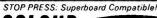
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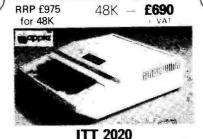


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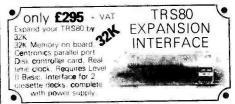
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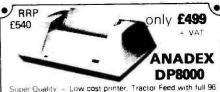
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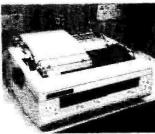
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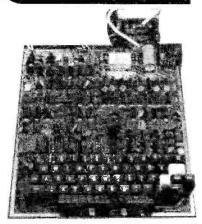
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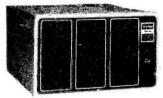
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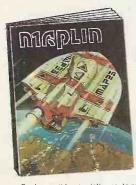


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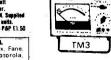
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Cat Corner

Let's kick off with the Vero contribution to Cat Corner. The new edition of the Vero Electronics Complete Packaging Catalogue is now available. The 300 page catalogue is divided into 23 separate sections covering Vero's extensive range of electronics packaging products. The product section and a copy of the latest price list are included in a smart ring binder. You can get your copy from the Sales Literature Department. Vero Electronics Ltd, Industrial Estate, Chandler's Ford, Hampshire SO5 3ZR.

Hamlin Electronics have a 24 page manual covering solid state relay applications with device specification and selection information and a guide to troubleshooting relay-based, circuits. Typical circuits are included to illustrate different applications. Each type of relay is defined and described in detail as are all the relevant elec-trical parameters. If you're a bit confused by relay lingo, don't worry, there's even a glossary of terms. This handy little relay bible is available from Hamlin Electronics Europe Ltd, Diss, Norfolk IP22 3AY,

From Cyril With Love

We know from our mail bag that the UK edition of ETI is read all over the world. Recently we received our first fan letter from Russia (a red letter day?). The demand for ETI behind the Iron Curtain is so great that the USSR National Public Library for Science and Technology have asked us to send them a copy every month. I wonder if they have an ulterior motive. Here is the news for 1999 - this morning five thousand String Things swept across the Central German Plains, dessimating Nato forces. British Centurion tanks were no match for Soviet air to ground flash triggers. Ground troops had been thoroughly trained on Ambush simulators. We believe their operations coordination computer is called Triton.' Just a joke, comrades.

In return for a monthly Moscow air-lift of ETIs, the library have kindly offered us our choice of over 500 Soviet periodicals. They are all listed in a handy handbook . . . in Russian. Now, we're not devastating decoders of Cyrillic script at the best of times, so, to put it bluntly (Anthony who?), Houston, we have a problem.

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293 128 400 298 188 400 324 200 40 325 280 40 327 288 40 327 288 40 328 40 327 288 40 348 40 353 228 40 353 322 228 40 353 365 65 40 366 65 40 367 65 40 373 180 40 377 212 40 378 184 40 378 184 40 378 184 40	15	86 4098 8 87 4099 14 88 4160 2 86 4160 2 87 4160 2 87 4161 2 88 4162 2 88 4162 2 88 4174 8 88 4174 8 88 4174 8 88 4174 8 88 4174 8 87 4174 8 88 4174 8 88 4174 8 88 4174 8 88 4174 8 89 4408 67 80 4410 67 80 4410 67 80 90 4412F 128	90 4516 52 4557 81 4517 382 4558 88 4518 63 4558 88 4518 63 4557 88 4520 63 4557 84 4521 228 4552 82 4522 149 4558 80 4527 83 4561 4568 90 4527 83 4561 4566 90 4529 145 4566 4566 90 4531 135 4572 4581 90 4534 576 4581 4572 90 4534 567 4581 4572 90 4534 576 4581 4572 90 4533 142 4582 90 4538 142 4582 90 4538 142 4582 90 4538 1456 4582 90	3 398 3 150 46 44 355 375 375 376 376 180 26 27 26 27 130 75 130 75 130 130 130 130 130 130 130 130
390 230 40 393 230 40 395 218 40 396 215 40 398 276 40 399 230 40 445 150 40 447 144 40 490 180 40 668 182 40 669 182 40	28 50 4070 29 54 4071 30 50 4072 31 150 4073 32 80 4075 34 199 4077 36 38 4078 36 325 4081 37 100 4082 39 320 4086 40 58 4089	15 4440 1221 15 4451 22 15 4452 22 15 4452 31 57 4490V 24 15 4501 1 15 4502 4 15 4503 4 15 4506 4 52 4507 3 52 4508 15	ILP MOD Full range of these fully modules available from ILP's advertised prices. AF MODULATOR	guaranteed stock at the 250p

Breadboard'79

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ETI was hard to miss. Together with Computing Today and Hobby Electronics we occupied the biggest stand in the show, much to the dismay of one of our competitors who was displaying its wares from a cupboard opposite us.

We did a brisk trade in magazines. In fact we couldn't stock up the stand quickly enough to keep pace with demand. Apologies to anyone who wasn't able to get the back number of his choice on the

Did you see the Hobby Electronics' HEBOT going through its paces? Shame on you if you didn't. Notice how Remcon (from whom you can get everything except the electronic components) killed two birds with one stone by using HEBOT to carry information leaflets round the gathered throng. In fact, there was a profusion of throngs of all shapes and sizes throughout the week at all of the stands. Throng members could be seen spending their pennies and flashing their cheque cards for bags of components, HEBOTS, radiometers (I bought one myself), breadboards and books.



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74500 60p 7401 12p 7402 12p	74278 290p 74279 110p 74283 160p 74290 150p	4020 100p 4021 110p 4022 100p 4023 22p	9302 175p 9308 316p 9310 275p 9311 275p	(copper clad) 2.5×3.75" 48p 43p 2.5×5" 57p 51p 3.75×3.75" 57p —	AC127/8 20p B AC176 25p B AC187/8 25p B	BFR40 25p TIP30C 60p BFR41 25p TIP31A 58p BFR79 25p TIP31C 62p BFR80 25p TIP32A 68p	2N3442 140p 40408 70p 2N3553 240p 40409 85p 2N3565 30p 40410 85p ZN3584 250p 40411 300p	ZENERS 2.7V-33V
7404 14p 74504 90p	74293 150p 74298 200p 74365 100p	4024 50p 4025 20p 4026 130p 4027 50p	9312 160p 9314 165p 9316 225p	3.75×5" 64p 64p 3.75×17" 222p 194p 4.75×17.9" 290p — Pkt of 100 pins 50p	AD149 70p B AD161/2 45p B AU107 200p B	BFR81 25p TIP32C 82p BFX29 30p TIP33A 90p BFX30 34p TIP33C 114p BFX84/5 40p TIP34A 115p	2N3643/4 48p 40594 97p 2N3702/3 12p 40595 105p 2N3704/5 12p 40673 75p 2N3706/7 14p 40841 90p	400mW 9p 1W 15p
	74366 100p 74367 100p 74368 100p 74390 200p	4028 84p 4029 100p 4030 55p	9321 225 p 9322 150 p 9334 360 p 9368 200 p	Spot face cutter 86p Pin insertion, tool 118p Vero Wiring Pen + 2 wire spools	BC107 /8 11p B BC117 20p B BC147 /8 9n B	BFX86/7 30p TIP34C 160p BFX88 30p , TIP35A 225p BFW10 90p TIP35C 290p	2N3708/9 12p 40871/2 90p 2N3773 300p 2N3819 25p DIODES	TRIACS PLASTIC 3A 400V 60p 3A 500V 65p
7410 15p 7411 24p 7412 20p	743o3 200p 74490 225p 74LS SERIES 74LS00 14p	4031 200 p 4033 180 p 4034 200 p 4035 110 p	9370 200 p 9374 200 p	+ combs 370p Combs 7p	BC149 10p B BC157 /8 10p B	BFY50 30p TIP36A 270p BFY51/2 30p TIP36C 340p BFY56 33p TIP41A 65p BFY90 90p TIP41C 78p	2N3823 70p BYX36-300 20p 2N3866 90p OA47 9p 2N3902 700p OA81 15p	6A 400V 70p 6A 500V 88p 8A 400V 75p
7413 30 p 7414 50 p 74C14 90 p 7416 27 p	74LS02 16p 74LS03 18p 74LS04 16p	4036 295 p 4037 115 p 4038 120 p	AY1-0212 600p AY1-1313 668p AY1-1320 320p	MM57160 620p NE531 150p NE555 22p NE556 70p	BC172 12p B BC177/8 17p B BC179 18p B	BRY39 45p TIP42A 70p BSX19/20 20p TIP42C 82p BU104 225p TIP54 160p	2N3903/4 18p OA85 15p 2N3905/6 20p OA90 9p 2N4037 65p OA91 9p 2N4058/9 12p OA95 9p	8A 500V 95p 12A 400V 85p 12A 500V 105p 16A 400V 110p
7417 27 p 7420 17 p 7421 40 p	74LS05 25p 74LS08 22p 74LS10 20p 74LS11 40p	4040 100 p 4041 80 p 4042 80 p	AY1-5050 140 p AY3-1270 840 p AY5-1224A 240 p AY5-1315 600 p	NE561B 425p NE562B 425p NE565 130p NE566 155p	BC184 11p B BC187 30p B BC212/3 11p B	BU108 250p TIP122 130p BU109 225p TIP142 180p BU205 200p TIP147 160p	2N4060 12p OA200 9p 2N4061/2 18p OA202 10p 2N4123/4 27p 1N914 4p	16A 500V 130p T2800D 130p
7423 34p 7425 30p 7426 40p	74LS13 40p 74LS14 72p 74LS15 45p	4043 90p 4044 90p 4046 110p 4047 100p	AY5-1317A 775p CA3019 80p CA3046 70p	NE567 175p NE571 425p RC4151 400p	BC214 12p B BC237 15p E BC327 16p E	BU208 200p TIP2955 78p BU406 145p TIP4055 70p E300 50p TIS43 34p E308 50p TIS93 30p	2N4125/6 27p 1N916 7p 2N4401/3 27p 1N4148 4p 2N4427 90p 1N4001/2 5p 2N4871 80p 1N4003/4 6p	THYRISTORS
7427 34p 7428 17p 7430 17p 7432 30p	74LS20 20p 74LS21 40p 74LS27 38p 74LS30 20p	4048 55 p 4049 40 p 4050 49 p	CA3048 225p CA3080E 72p CA3086 48p CA3089E 225p	SAD1024A 1250p SFF96364 £11 SN76003N 175p SN76013N 140p	BC338 16p N BC461 36p N	E310 50p ZTX108 12p MJ2501 225p ZTX300 13p MJ2955 90p ZTX500 15p MJ3001 225p ZTX502 18p	2N5087 27p 1N4005 6p 2N5089 27p 1N4006/7 7p 2N5172 27p 1N5401/3 14p 2N5179 90p 1N5404/7 19p	1A 50V 40p 1A 400V 65p 3A 400V 90p 8A 600V 140p
7433 40 p 7437 35 p 7438 35 p 7440 17 p	74LS32 27p 74LS42 70p 74LS47 90p 74LS51 24p	4052 80p 4053 80p 4054 150p	CA3090AQ 375 p CA3130E 90 p CA3140E 50 p CA3160E 100 p	SN76013ND 120p SN76023N 140p SN76023ND 120p SN76477 200p	BC547B 16p N BC548C 9p N	MJE340 50p ZTX504 30p MJE2955 100p 2N457A 250p MJE3055 70p 2N696 35p	2N5191 83p IS920 9p 2N5194 90p HEAT SINKS 2N5245 40p For TO220 Volt-	12A 400V 160p 16A 100V 160p 16A 400V 180p 16A 600V 220p
7441 70p 7442A 60p 7443 112p	74LS55 30p 74LS73 50p 74LS74 36p 74LS75 40p	4055 125p 4056 135p 4059 600p 4060 115p	CA3161E 140p CA3162E 450p CA3189E 400p	SP8515 750p TAA621 275p TBA641B11 225p	BC557B 16p N BC559C 18p N	MPF102 45p 2N697 25p MPF103/4 40p 2N698 45p MPF105/6 40p 2N706A 20p MPS6531 50p 2N708A 20p	2N5296 55p age Regs. and Transistors 22p 2N5457 /8 40p 2N5459 40p For TO5 12p	BT106 110p C106D 45p MCR101 36p
7444 112p 7445 100p 7446A 93p 7447A 50p	74LS76 45p 74LS83 110p 74LS85 100p	4063 120 p 4066 55 p 4067 450 p 4068 22 p	DAC1408-8 200 p FX209 750 p ICL7106 850 p ICL8038 340 p	TBA651 200p TBA800 90p TBA810 100p TBA820 90p	BD131/2 50p N BD135/6 54p N BD139 56p N	MPS6534 50p 2N918 45p MPSA06 30p 2N930 18p MPSA12 50p 2N1131/2 20p MPSA13 50p 2N1613 25p	2N5460 60p BRIDGE 2N5485 44p RECTIFIERS 2N5875 250p 1A 50V 19p 2N6027 48p 1A 100V 20p	2N3525 120p 2N4444 140p 2N5060 34p 2N5064 40p
7448 80 p 7450 17 p 7451 17 p 7453 17 p	74LS86 40p 74LS90 40p 74LS92 70p 74LS93 60p	4069 20p 4070 30p 4071 22p	LF356P 95p LF358P 75p LM10C 425p	TCA940 175p TDA1004 300p TDA1008 320p TDA1010 225p	BD189 60p N BD232 95p N BD233 75p N	MPSA20 50p 2N1711 25p MPSA43 50p 2N2102 70p MPSA56 32p 2N2160 350p	2N6107 66p 1A 400V 25p 2N6247 190p 1A 600V 30p 2N6254 130p 2A 50V 30p	
7454 17p 7460 17p 7470 36p 7472 30p	74LS96 110p 74LS107 45p 74LS109 80p 74LS112 100p	4072 22p 4073 22p 4075 22p 4076 107p	LM301A 30p LM311 120p LM318 200p LM319 225p	TDA1022 800p TDA1024 120p TDA1034B 250p TDA1170 250p	BD235 85 p N BD241 70 p N BD242 70 p N BDX53B 150 m N	MPSU06 63p 2N2222A 30p MPSU07 90p 2N2369A 16p MPSU45 90p 2N2484 30p	2N6292 65p 2A 400V 45p 2SC1172 150p 3A 200V 60p 3N128 120p 3A 600V 72p	LOUD- SPEAKERS Size
7473 34p 7474 30p 7475 30p	74LS113 90p 74LS114 45p 74LS122 80p	4081 22p 4082 22p 4086 72p 4089 138p	LM324 50p LM339 75p LM348 95p	TDA2002V 325p TDA2020 320p TL071 50p	BDY56 200 p O BF200 32 p O BF244B 35 p	MPSU65 78p 2N2646 46p OC28 130p 2N2904/5 25p OC35 130p 2N2906A 24p R2008B 200p 2N2907A 30p	3N140 100p 4A 100V 95p 3N141 110p 4A 400V 100p 3N201 110p 6A 50V 80p 3N204 100p 6A 100V 100p	2½" 64R 70p 2½" 8R 70p 2" 8R 80p
7476 35p 7480 50p 7481 100p 7482 84p	74LS123 70p 74LS124 180p 74LS125 60p 74LS126 60p	4093 80p 4094 250p 4095 95p	LM377 175p LM380 75p LM381AN 160p LM709 36p	TL072 95p TL074 150p TL081 45p TL082 95p	8F257/8 32p R	R2010B 200p 2N2926 9p TIP29A 40p 2N3053 30p	40290 250p 6A 400V 120p 40360 40p	
7483A 90p 7484 100p 7485 110p 7486 34p	74LS132 95p 74LS133 30p 74LS136 55p 74LS138 75p	4096 95p 4097 340p 4098 107p 4099 200p 40100 220p	LM710 50p LM725 350p LM733 100p LM741 18p	TL084 130p TL170 50p UAA170 200p UAA180 200p	2102-2L 2107B 2111-2	120p AY-3-1015P 500p 500p AY-5-1013P 400p 225p IM6402 500p 300p TMS6011NC 400p	8 pin 10p 18 pin 22p 24 14 pin 11p 20 pin 25p 28	pin 30p 3 pin 38p 3 pin 48p
7489 175 p 7490A 30 p 7491 80 p 7492A 46 p	74LS139 75p 74LS145 120p 74LS147 220p 74LS148 175p	40101 132 p 40102 180 p 40103 180 p 40104 99 p	LM747 70p LM748 36p LM2917 250p LM3900 70p	UDN6118 320 p UDN6184 320 p ULN2003 100 p XR2206 400 p	2114 2114-2L 4027	525p 600p CHARACTER 375p GENERATORS 900p 3257ADC 990p	WIRE WRAP SOCKETS BY TEXAS 8 pin 30p 18 pin 70p	24 pin 90p
7493A 30p 7494 84p 7495A 70p 7496 65p	74LS151 100p 74LS153 60p 74LS154 200p 74LS155 90p	40105 99 p 40106 60 p 40107 60 p 40108 470 p	LM3909 70p LM3911 130p LM3914 250p LM4136 120p	XR2207 400p XR2211 800p XR2216 675p XR2240 400p	5101 6810	900p MCM6576 £10 510p RO-3-2513 U.C. 600p 350p RO-3-2513 L.C. 650p 325p SN74S262AN 1350p	14 pin 40p 20 pin 75p 16 pin 55p 22 pin 80p SUBMINIATURE ANTEX SOLE	28 pin 110p 40 pin 140p DERING
7497 180p 74100 130p 74104 65p 74105 65p	74LS156 90p 74LS157 60p 74LS158 90p 74LS160 130p	40109 100p 40110 300p 40114 250p 4411 1100p	MC1310P 150p MC1458 48p MC1495L 350p MC1496 100p	ZN414 90p ZN419C POA ZN424E 135p ZN425E 400p	ROM/PROMs 71301	700p KEYBOARD ENCODER AY-5-2376 £9	SWITCHES IRONS Toggle C-15W SPST 60p CX-17W SPDT 65p CCN-15W	400p 415p 415p
74107 34p 74109 55p 74110 55p 74111 70p	74LS161 100p 74LS162 140p 74LS163 100p 74LS164 120p	4502 120 p 4503 70 p 4507 55 p	MC3340P 120p MC3360P 120p MK50398 750p	ZN1034E 200p 95H90 800p 11C90 1400p	74S287 74S387	350p 350p TRANSFÖRMERS 650p (prim 220/240V)	DPDT 70p DPDT (centre off) 85p Push to make 15p break 25p X25 SPARE BITS C/CX/CCN X25	415p 46p 50p
74116 200p 74118 130p 74119 210p	74LS165 180p 74LS166 180p 74LS173 110p 74LS174 110p	4508 290 p 4510 99 p 4511 150 p 4512 80 p	Fixed Plastic TO-220 1A +ver 5V 7805 60p	-ve 7905 70 p	74S571 82S137	650p 6-0-6 100mA 88p 650p 9-0-9 75mA 92p 750p 12-0-12 100mA 95p 400p 0-120 12500mA 280p	Push latching SPCO 60p SLIDE DPDT 18p ROCKER SPST 28p SPARE ELEM C/CX/X25 CCN	THE STATE OF THE S
74120 110p 74121 28p 74122 48p 74123 48p	74LS175 110p 74LS181 320p 74LS190 100p	4514 265 p 4515 300 p 4516 110 p 4518 100 p	12V 7812 60p 15V 7815 60p 18V 7818 60p	7912 70p 7915 70p 7918 70p 7924 70p	93436 93446	650p 0-25V (5VA) 250p 650p 9-0-9 1A 270p* 12V 2A 350p* 0-12-15	WAFER 1P/12W 45p K1000 3P/4W 45p K2000	NS 550p 550p
74125 55p 74126 60p 74128 75p 74132 75p	74LS191 100p 74LS192 100p 74LS193 100p 74LS195 140p	4520 100p 4521 250p 452b 106p	100mA TO-92 5V 78L05 30p	79L05 70 p	CPUs 1600 2650A	£12 £20 £20 (Please add 50p p&p charge	2P/6W 45p VEROBOARD DIP Breadboard 4.15 × 6.15	d 270p
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74141 50p 74142 200p 74145 90p 74147 190p	74LS241 175p 74LS242 170p 74LS243 170p	4553 450p 4556 72p 4560 250p 4569 250p	LM309K 135p LM317T 200p LM323K 550p LM723 37p	78HGKC 725p 78HO5KC 625p 78MGT2C 135p 78P05 900p	1NS8060 1 Z80 1	1400p RESISTORS High 1100p Stab 5% E12 Carbon Film 1250	3 579545MHz 200p 4MHz 350p (No track cutting	ICs 105p ng)
74148 150p 74150 100p 74151A 70p 74153 70p	74LS244 195p 74LS245 250p 74LS247 140p 74LS248 140p	4572 40p 4583 90p 4584 90p	OPTO-ELECTRONICS 2N5777 45p OCP71 130p	ORP60 90p ORP61 90p	EPROM\$	1/4W 10R-1M 7p / 5pcs one value 500p 1/2W 10R-10M 5p / 3pcs £29 one value	10 7MHz 350p 18MHz 300p 26.690MHz 210p 27.145MHz 210p S-100 Busboar	110p 110p
74154 100p 74155 90p 74156 90p 74157 70p	74LS249 140p 74LS251 140p 74LS253 140p 74LS257 120p	40014 90p 40085 200p 40097 90p	ORP12 90p OPTO-ISOLATORS ILD74 130p MCT26 100p	TIL78 70p TIL111 90p TIL112 90p		800p £29 Miniature Presets Hor/Vert 100R-1M 12p Carbon Track Pots	EDGEBOARD CONNECTORS 0.1 2 x 10 way 85p 2 x 22 wa	y 135p
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74162 100p 74163 100p 74164 120p 74165 130p	74LS279 90p 74LS298 249p 74LS324 200p	14599 290p CD22100 350p CD22101 700p CD22102 700p	TIL209 Red 13p TIL211 Gr 20p TIL212 Ye 25p	TIL222 Gr 18p TIL228 Red 22p MV5491 TS 120p	6850 8205	500p SLIDER POTS 60mm Track 500p LIN 5K, 10K 50K, 100K 320p 60p	74C925 475p TTL & MC40 74C928 600p MC40 MC40 ICM7216B £20 MC40 ICM7217A 850p 10118	24 325p 44 325p 6 70p
74166 120p 74167 200p 74170 240p 74172 450p	74LS348 200p 74LS365 100p 74LS367 100p 74LS368 100p	INTERFACE ICs DM8123 175p MC1488 100p	TIL216 Red 18p DISPLAYS 3015F 200p DL704 140p	Oips 3p NSB5881 570p TIL311 600p	8228	225p LOG 10K 60p 225p 400p 525p CDECLA	ZN1040E 700p 1023	
74173 120p 74174 90p 74175 85p 74176 90p	74LS373 180p 74LS374 195p 74LS378 200p 74LS390 160p	MC1489 100p 25S10 350p 75107 160p	DL707 Red 140p 707 Gr 140p DL747 Red 225p	TIL312 3 110p TIL321 2 130p TIL330 140p 7750 60 200p	8251 8253 1 8255	700p SPECIA 1200p 550p 555	LOFFERS TO 31.1	£5/10
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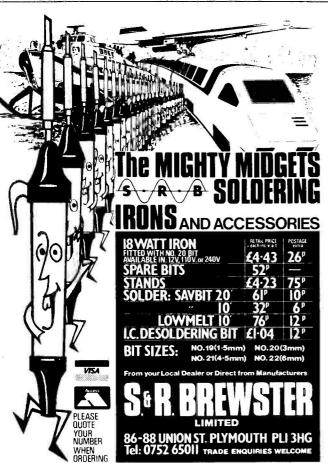
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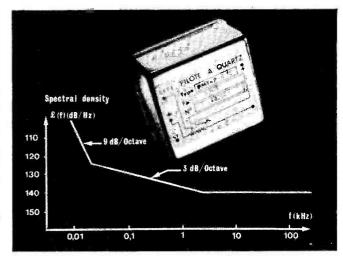
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The range of oscillators is available from Thomson-CSF Components and Materials Ltd, Ringway House, Bell Road, Daneshill, Basingstoke RG24 0OG.



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The PAN 2000 is availble from Precision Instrument Laboratories, Instrument House, 727 Old Kent Road, London SE15.

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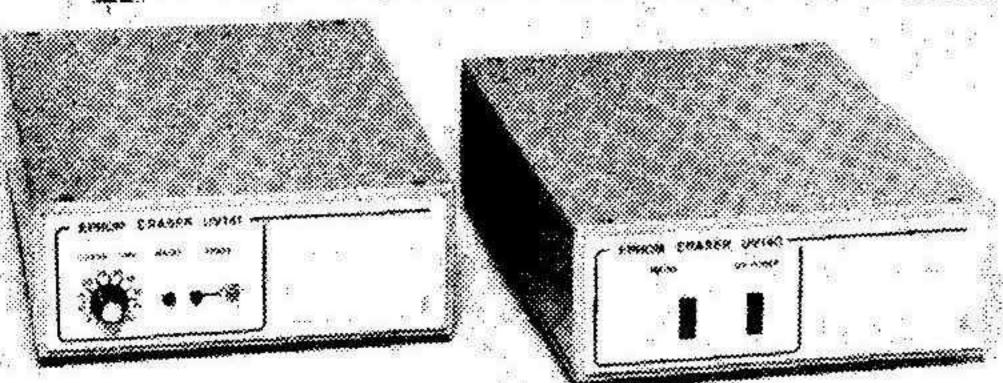
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COMPUTER BOARDS

The following is an extract from our leaflet ref. 'MP4', which is available free on request (a 9" x 6" SAE helps, but is not essential). See Microprocessor section to the right for board prices.

For many people the wide choice of micro-processors now available presents a difficult choice. To understand any particular microprocessor in depth a development system is almost essential, however in the past to understand more than one several separate development systems have had to be purchased

The reason that separate systems, one for each processor, have been necessary is due to the fact that individual microprocessors have their own individual features: in one case to access memory a separate read strobe and write strobe is required, in another a 'read/write' line is used in combination with a combined strobe called 'valid memory address and phi-2'. With some processors, the same address bus can be used for both memory and input/output ports', under the control of a 'memory request' or an 'input/output request' control line.

Naturally, if a development system takes advantage of any of the particular unique features of any particular microprocessor, this makes it more difficult to graft some other unrelated microprocessor onto the same bus at a later date. A Universal Micro System provides a basic bus structure on which any one micro-processor can be connected. The system uses a CPU (Central Processor Unit) card which is separate from the rest of the system, and this allows the same memory and interfaces to be retained when a different MPU is used.

The basic system bus consists of data and address buses together with read and write strobes. By locating the data input (Keyboard) and output (VDU) in the memory space then such chips as the 8080 / Z80 family, which normally use input/output ports, can now be used without any fundamental change to the bus (and as a bonus, users of these MPU's have all the ports entirely free for

their own purposes). The range of p.c.b.'s includes boards to implement a memory-mapped VDU. cassette interface, keyboard interface, PROM programmer, and a number of RAM and ROM cards. All the cards are of International Size 114 x 203 mm (41/2" x 8") except for the larger power PSU A power supply card. This latter card is sized so that it can be bolted to the side of a standard 4" chassis module which is then compatible with the other cards. The cards have a standard 43-way edge connector, with one position used for polarisation.

We do not propose to defend the (relatively) small number of bus connexions (42), against such standards as the 'S100' 100-position bus. The S-100 bus, as it originated in America, is bigger and better. It in nore expensive. In the Ford 'Cortina', but it same way, a Ford 'Granada' is bigger and b 10ws - it may even doesn't mean a Cortina isn't good ya!

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Input/Output Re have this facility. 15B-1 11. Of course we know .s. adding extra integrated circuits the thought of cutt. above, but it is not for these people that and bits of wire in th ...signed. We would like to think of this system as this sort of system has basis on which you can build your own personal design, perhaps as an

alternative to the use of 'Veroboard' or etching your own pcb's (Further sections give an outline of each card in turn. Although we have in mind all sorts of exotic future developments (e.g. high resolution graphics, floppy disc controllers, dynamic high-density RAM cards, programmable VDU formats, colour displays. Light pens, sound generators etc.) we prefer to keep quiet about them until they actually exist. All of the cards described actually exist, and at the time of writing (September 1979) most are in stock. (We plan it so they are all in stock, but people will insist on buying them, without caring what havoc they wreak in our stock control!))

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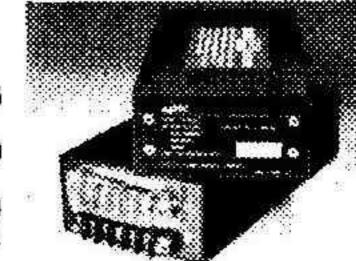
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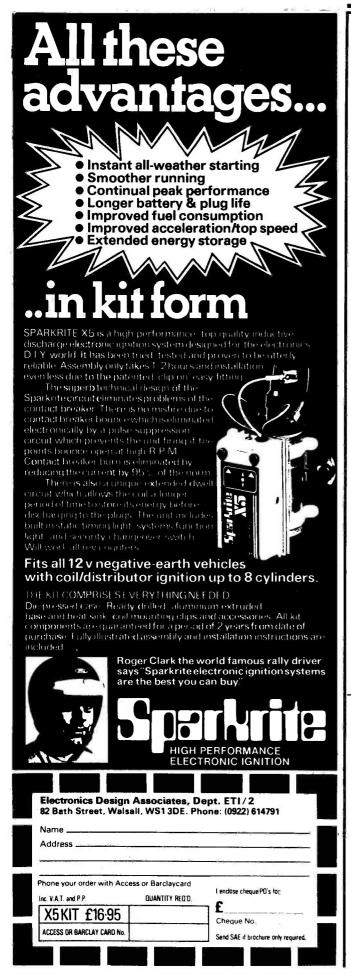
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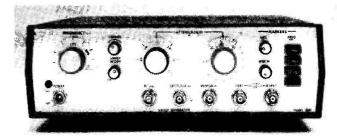
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	74LS04	16p	74LS38	39p	74LS91	£1.04	74LS145	£1.08	74LS174	£1.06	74LS247	£1.90	74LS325	£2.90	74L\$390	£2.30
	74LS05	20p	74LS40	28p	74LS92	89p	74LS147	£1.70	74LS175	£1.10	74LS248	£1.90	74LS326	€2.94	74LS393	£2.30
	74LS08	22p	74LS42	98p	74LS93	89p	74LS148	£1.73	74LS181	82.63	741.5249	£1.90	74LS327	£2.86	74LS395	£2.18
	74LS09	22p	74LS47	90p	74LS95	£1.16	74LS151	96p	74LS183	€2.98	74LS251	£1.34	74LS347	£1.48	74LS396	£2.15
	74LS 10	20p	· 74L\$48	£1.20	74LS96	£1.16	74LS153	76p	74LS190	£1.40	74LS253	£1.42	74LS348	£1.86	74LS398	€2.76
	74LS11	22p	74LS49	£1.20	74LS107	44p	74LS154	£1.70	74LS191	£1.40	74LS257	21.10	74LS352	£2.28	74LS399	£2.30
	74LS12	23p	74LS51	24p	74LS109	55p	74LS155	96p	74LS192	£1.30	74LS258	£1.46	74LS353	£2.28	74LS445	£1.50
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	74LS14	75p	74LS55	30p	74LS113	50p	74LS157	76p	74LS194	£1.66	74LS 261	£4.50	74LS366	65p	74LS490	21.80
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	74LS20	20p	74L873	46p	74LS122	70p	74LS160	£1.28	74LS196	£1.00	74LS273	€2.44	74LS368	66p	74LS669	£1.82
	74LS21	22p	74LS74	41p	74LS123	70p	74LS161	98p	74LS 197	£1.40	74LS275	£2.50	74L\$373	£1.80	74LS670	£2.48
	74LS26	48p	74LS75	48p	74LS 124	£1.80	74LS162	£1.38	74LS221	96p	74LS279	66p	74LS374	£1.95		* 1.15

regulator, or ga

74L\$240 £2.36





Mini Hertz Box

New from Electroplan, the Labgear CM7044 is a miniature frequency meter with a bandwidth of 10 MHz to 500 MHz. The portable CM7044 also has a small antenna, enabling measurement of transmissions to be made without physical connection to the transmitter. Frequency readings are presented on the seven digit LED display in two ranges, 50 MHz and 500 MHz.

The Wavetek model 1061, also from Electroplan, can be used as a carrier wave genera-

tor or can be made to sweep any part of its 1 to 400 MHz bandwidth. Crystal controlled markers are available in the sweep mode at intervals of 1, 10 or 50 MHz. Maximum output is +10~dBm from 50 ohms with a flatness of $\pm~0.25~\text{dBm}$ over the instrument's range. The 1061 also features a built-in RF detector and demodulator and a horizontal drive for an oscilloscope.

The Labgear CM7044 frequency meter and the Wavetek 1061 sweeper are both available from Electroplan Ltd, PO Box 19, Orchard Road, Royston, Herts SG8 5HH.



OOPS!

The Beast (Nov.)

Some readers have experienced difficulty in winding the required 77 primary turns on the coil of track-cleaner transformer TI when using 22 s.w.g. enamelled wire. In case of such difficulty, 24 s.w.g. wire can be used instead.

We are presently aware of no other corrections pertaining to this project.

MCC Preamp (Jan.)

In January's issue we wrongly stated that the case for the Moving Coil cartridge project was available from Boss Industries. It is, in fact, supplied by West Hyde Developments. Pease use order code Classic II AID.

Deep Space Probes (Jan.)

Due to poor printing, page 87 of the Deep Space Probes feature last month is difficult to read. If you have an unreadable copy, tear out page 87 and send it to us. We will send back a fresh copy.



ROBOT PIN~UPS

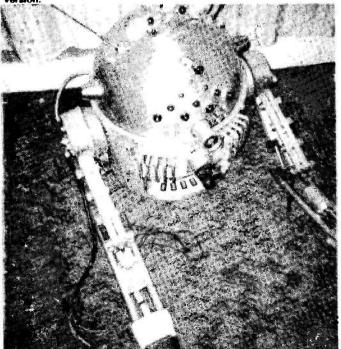
The response to our recent rallying call to the robot-makers of the UK has been truly astounding. Photos and detailed descriptions of the electronic entities have been pouring through our letterbox ever since.

Necessity, being the mother of invention, seems to have been responsible for the creation of metal men to cope with all those tedious yet absolutely essential jobs — from cutting the grass to frightening cats.

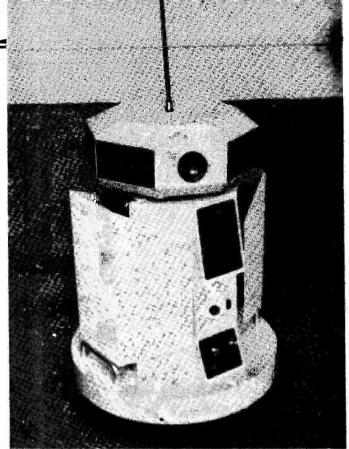
Here are a few of the ingenious creations that have come to our attention so far. Keep sending them in, with as many snaps as your Brownie can manage. Even if your system isn't finished yet, let us know what you're up to.



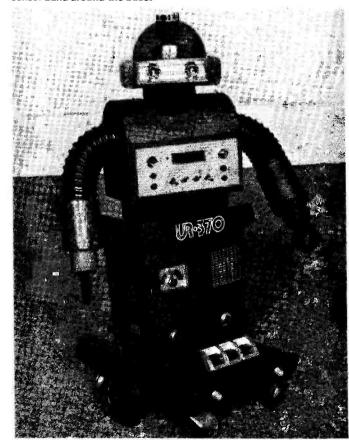
The Grass Hopper made its television debut in April on Tomorrow's World. Designed by Frank Carver, it's an admirably practical robot for armchair gardeners — it cuts grass. The design team, from Faraborough 6th form college have since produced a Mk 2 CMOS version.



ELECTRONICS TODAY INTERNATIONAL — FEBRUARY 1980



UR 700 is equipped with six channel radio and light seeking and line following functions. It can 'feel' its way around using a tactile sensor band around the base.



UR370 started life as a two channel Futaba radio and a pound of splintered balsa wood. Both the UR 700 and its brother, the UR 370 are designed by Joe Gillespie.

This car battery and lawn mower motor powered butter is built from just about everything bar the kitchen sink. It incorporates a lampshade and three huge stewpots. Cyclops 2's arms are driven by six inch hydraulic rams and his nether regions spin round and flash. Cyclops 2 was designed by Steven Brooks.

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(RS232).

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37 Way: **80p.** 25 Way: **65p** (Plastic) p & p 25p

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LED 3 Digit DIL 55p, p/p 25p
LED 4 Digit DIL HP 5082 CC
0.11" (RED), £1.50, p/p 25p. SUPERSAVER

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SUPERSAVER 7 SN74114 Dual 4 Bit latch, 75p, p & p 25p. SN74181 Arithmetic Logic Unit,

50p, p & p 25p. SN74198 8 Bit Shift Register. 75p, p & p 25p

SUPERSAVER 8 BC108b 8p each or 100 for £7.00, p & p 25p.

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CASIO FX 502/FA1

Whatever you call this Casio marvel - computer or calculator - it's an attractive little beast! Beguiled by boundless buttons, bewitched by beautious boxes, belaboured Ron Harris reports.

T is considered good form to be able to define precisely what you are reviewing, before sitting down to churn out the hackneyed prose which will enrage the manufacturer and baffle the consumer. In this case, however, I must confess that I transgress. Why?

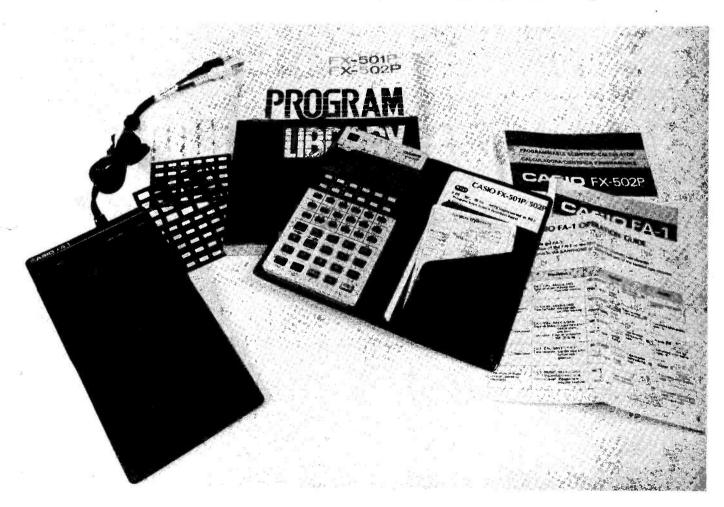
Consider this: a computing system with ten program registers, 100 user labels (10 per program), LCD alphanumeric display, cassette dumping, full conditional branching, random number generation, dynamic display control (one second 'PAUSE' delay-stackable) and an excellent number crunching facility. Sounds like whatever it describes is well on the way to being a good micro system does it not?

No, it does not. It sound exactly like the Casio FX502P/FM1, however. (Else why would it be in this

review anyway?). Apart from all that the same machine is an excellent scientific calculator and is packed and presented so superbly that I can foresee large numbers of collar and tie impulse buyers trooping home to the missus, wondering how best to explain £100 spent on this calculator set-up that they just happened to pick up.

The Casio cosmetics inspire one to heights for avarice hitherto reserved for expensive trifles such a cars, hi-fi and precious metals!

Below: the complete Casio package. The two phantom keyboards to the right of the FA1 are the overlays for programmable and music playing usage. Note that the FA1 is an optional extra and you don't get it free with the 502P (shame shame . . .)





Left: the calculator nicely settled into its FA1 tape adaptor. Two slots in the holder engage the black lugs along the calculator sides to ensure a good alignment between the (gold plated) plug and socket.

Big Steps For Man, 256 Steps For...

Before the 502P Casio used their own little FORTRAN based programming language. That is now gone to join the Dodo, and there won't be many mourners I think.

They have returned to a more straightforward assembler type approach, but have an operating system which puts them clear ahead of the opposition. The total 256 steps of program memory is divisible into ten routines, PO-P9, and each can be called as a subroutine within another program, up to four deep.

Puttig a program into memory could not be easier. Set the mode to write — display shows which programs are free — designate (choose PO-P9) and enter just as you would if carrying out the calculation via the keyboard. SINCE there is no absolute addressing, all jumps must be labelled. Most of my programs began with 'LBL 1' just in case . . . As you've got ten lables per program to play with — splash 'em all over! Correcting listings is easier than ever, the 502 can step forward and backward, single step or fast, and can delete or insert steps and automatically renumber the rest accordingly!

Whats In It For...

The 502 comes with two keyboard overlays — one for program use, one for music use (of which more later) — a program library covering such diverse topics as Surveying and Transistor Amplifier Design (but precious few games), an Operating Manual which is all one has come to expect and detest in such publications and a very smart wallet-type carrying case.

The FA1 cassette adaptor also has a carrying case, manual and short-form operating guide. The construction quality of cassette and adaptor is very high indeed. All in all eleven out of ten for presentation, Casio.

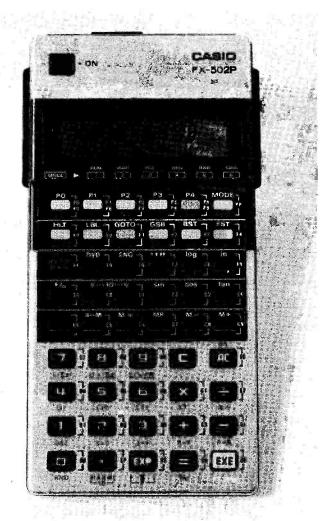
As a scientific the 502P has just about all the functions you are ever likely to consider using. Such statistical creations as standard deviation, mean square sum and data number are all hanging around beneath a key somewhere too, as are 22 non-volatile memories.

Mains operation of the 502P is not possible at all, but battery life is somewhere around 1300 hours (of operating time) and an auto switch off will turn off the calculator if you leave it on, unused, for more than a quarter of an hour. Eat your heart out Electricity Board.

The display is nothing short of superb. Normally it shows ten digits with two digit exponent, but can be rounded to any number of digits, or switched to scientific, engeering or sexaouesimal (degree) mode. Neat little alpha-numeric prompts appear in the lowest 1/3 of the display to keep you mindful of what you are doing with all this power.

Ten out of eleven as a scientific, Casio.

Right: a 502P fully dressed in its programming overlay. The little numbers beside each key are the check codes used by the machine (and you) in the compliation of a listing. The bottom half of the overlay is clear, to enable the multi-function keys to be read.



Conditional jumping is most comprehensively provided. Six tests can be made — x = 0; X > F; X < F; ISZ; DSZ — and jumps made or not as required. The last two are "increment and decrement jump if zero" commands which are particularly useful.

At each step the display gives last step-number and check code for key pushed at that point. Tis check code is alpha-numeric and corresponds to the programming overlay: After a few times through you get used to most of the codes and things (as always) improve with practise.

If the conservative 256 steps are not enough for you then the FA1 allows you to dump programs into a cassette player. Load times are pretty short so that over 100 programs could be lumped onto a C-60, PER SIDE!

Measure Of Tape

The FA1 terminates in a set of twin jacks, which should fit most portable cassette players, but will require an adaptor to fit most hi-fi decks. A few minutes with the soldering-iron might be preferable, though.

Programs are given three digit file numbers for both SAVE and LOAD operations and the machine will search the tape until it finds the required number to load. The really nice touch about this is that programs and data are stored separately, so that different data can be run through the same program, and sub-routines extracted to be added to existing listings within the calculator. Frighteningly flexible.

This brings me on to the music playing facility of the 502/FA1 combination. I cannot ignore it any longer, I suppose. All I shall say is that I consider it an insult to the intelligence of anyone buying such a calculator. What does it sound like, you may ask. Horrendous I might say. Is it

entertaining, you might ask. Boring, I might say.

Thus we could deal with the thing in one paragraph. Yeuk!

I found no problems loading and saving programs from the FA1 at all, and consider it a good system. Keep the volume turned up full on the tape through.

Summing It All Up

Overall then the new Casio has a lot going for it. A beautifully elegant programming system and a good scientific ability. Coupled to a tape through the FA1 it becomes an unequalleld way to get some real computing power into your life at a reasonable price. Also an excellent way to earn basic programming techniques, as the machine steers you toward modular programming almost instinctively.

Against it stands the monument to ineptitude that is the Instruction Manual. Please Casio, you sell yourselves short here. The 502P is a magnificent piece of work but why why why make it rise against a manual like this?

Other minor quibbles — although the display has alpha-numeric capability (it shows the check codes doesn't it) the user is denied access to anything but numbers. Why not let us loose upon the full ASCII set, eh? Make for much more interesting programs. And since we have a *little* brother (FX501P) with 128 steps, can I request a world conquering FX-503P with 1000 steps and absolute addressing please?

Our thanks to TEMPUS of Cambridge for supplying the review machines to us. Prices for the FX502P and FA1 are £74.95 and £19.95 respectively, although for a limited time TEMPUS will sell you the pair plus a Masterpack — a software pack of 150 programs on cassette — for £99.90 all inc. Tempus, Beaumont Centre, 164-167 East Road, Cambridge CB1 1DB.

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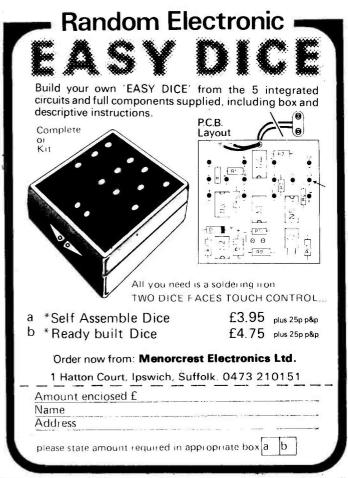
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- 5. They are, by virtue of their construction, protected against infinite VSWR problems.
- 6. They have a high source-drain breakdown voltage.
- 7. They have low gate-drain feedback capacitance. This characteris-

SPECIFICATION

Saturated output power:

Vd of 24 volts - 16 watts (13,5 watts specified)

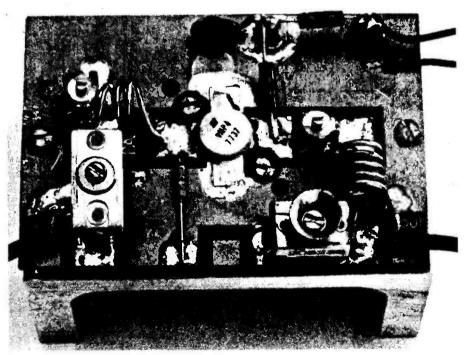
Power Gain:

Vd of 36 volts - 22 watts (21 watts specified) Vd of 24 volts - 11.2 dB at 10 watts output (10 dB @ 200 MHz specified).
Vd of 36 volts - 11 dB at 18 watts output

Efficiency: Imput VSWR:

less than 1.5:1.

The prototype was unconditionally stable without neutralisation.



tic particularly suits VHF/UHF operation.

- 8. Low noise figure: 2.5dB is typical. A power amplifier can be used as a low-level amp as well.
- 9. Wide bandwidth and uniformity of characteristics across frequency
- 10. Higher gain than bipolars of equivalent power dissipation rating.

HOW IT WORKS

amplifier described here will produce watts output on the amateur two-metre and from a drive of less than one watting a 24 volt de power supply It can be crated in either class AB or C modes for a poly voltage of volts (recommended maximum) the crotype delivered 22 watts of RF power n by around two watts.

The amplifier was unconditionally stable of required no neutralisation, although the sanufacturer recommended it. Typical diciency should be greater than 50%, a parable to bipolar designs for this power

The device used is a Siliconix VMP-4 circuit is shown in Figure 1. Convenal matching was employed with values uslated from data given in reference I. ut and output impedances of the VMP4, and S22 respectively, were taken from manufacturer's data sheet.

manufacturer's data sheet.

It is utralisation circuit, as recommeny Siliconia, shown in the circuit, was
it to be unnecessary on the prototype
could probably be left out in many
if your amplifier proves to be unit your amplifier proves to be untesting as it is quite a simple matter.

or class AB operation, bias in applied
a simple zener regulator through a potresistor to the base (no metay base
cash.

n class C operation, the 4k7 base for is simply earthed. RF Chokes 1-RFC2 are 1 uH miniature moulded

e VMP-4 is an SOE (stripline opposed r) package device with flange rather stud, mounting.

C10 10₄ 35V 1n0 feedthrough used as a standoff RFC1 1₄H R4 22R C6 20₀ OUTPUT *to suit supply oltage R3 DRAIN

Fig. 1	. Circuit	diagram	of the	VMOS	Power	Amplifier.
--------	-----------	---------	--------	------	-------	------------

BV _{DSS}	Characteristic Drain-Source Breakdown	Min 60	Тур	Max	Unit	. 11
i _{D(on)}	ON-State Drain Current	400	600		mA	<u> </u>
g _{fs}	Forward Transconductance	170	240		υw	
Coss	Common-Source Output Capacit			34	37	SOURCE 1 3 SOURCE
C _{iss}	Common-Source Input Capacita	nce	32	35	pF	
C_{rss}	Reverse Transfer Capacitance		4.8	6.5		
G _{ps} NF	Common-Source Power Gain	10			4D	2
ŊF	Small Signal Spot Noise Figure		25		dB	
						GATE

11. Input and output impedances generally higher than equivalent bipolar devices making matching easier.

High power MOS devices were pioneered in the mid-1960's by RCA laboratories who managed to produce an amplifier that delivered up to 14 watts at 10 MHz. The Russians next achieved 1 watt at frequencies up to 100 MHz.

Recently DMOS (double-diffused MOS) was developed in Japan and commercially produced by Signetics.

The performance of these early types of MOS technology has been surpassed by VMOS which can offer higher power levels by virtue of its inherent improved thermal transfer in the chip construction.

Several companies have developed VMOS devices for communications applications. These are: Westinghouse, Siliconix and the Communications Transistor Corporation. Other companies, such as Fairchild, have confined their interests to fast switching devices.

Construction

Commence construction by drilling two holes diagonally opposite the transistor mounting hole, as shown in figure 2 and the photograph, to clear the mounting bolts for the transistor flange. A small file should be used to elongate the holes.

DRAIN

SOURCE

Drill two holes in the heatsink toaccommodate the transistor flange securing bolts.

Next, carefully solder the VMP-4 to the copper side of the PC board taking care that the orientation is correct:

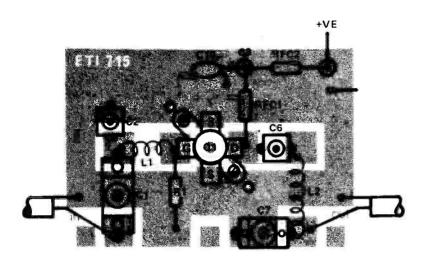


Fig. 2. Component Overlay.

NOTE: The bias and neutralisation components are not shown on the overlay. Neutralisation was not found to be necessary on the prototype.

If bias is required for linear operation R1 should be fed to the bias supply and this point by-passed through C3.

PARTS LIST

Service and About	THE CONTRACT OF THE PARTY OF TH
Resistant	All ¼W, 5% unless stated
	1110
HI .	to suit supply voltage
84	22 R
Petention	eter -
AVI **	5k linear
Capacitors	
	60p mica compression
	trimmer, or miniature film
	trimmer
6.1	20p miniature film
	trimmer
C3	1n0 ceramiç
C4,5	10u tantalum
C6,7	20p mica compression
	trimmer or miniature film
	trimmer
cal William	1n0 feedthrough, used as
	standoff
C9	120p ceramic
Semicond	notal.
	VMP4 (Silicontx)
Q1	A ML - (Officolity)
Miscellane	
RFC1,2	• Turminiature moulded RF • Turminiature m
a negative	chokes
heatsink t	o dissipate 20W nuts, bolts,
wire, etc.	
	THE RESERVE OF THE PERSON AND ADDRESS AND

gate to the input side, drain to the output side.

All the minor components may then be soldered to the board. Wind and mount the two coils L1 and L2 last.

Take care when mounting the board assembly to the heatsink. Secure the VFET flange-mounting bolts first. These could be tapped into the heatsink (as we did with the prototype) or secured by nuts through the other side of the heatsink.

The board should be secured, and at the same time grounded to, the heatsink by two bolts. These were placed at each end of the board, simply for convenience, and a suitable number of washers placed between the board and the heatsink so that the board was firmly secured without placing strain on the VFET leads.

Input and output switching, if required, may be effected by diode switching or a carrier-operated-relay circuit.

Tune Up And Test

Once construction is completed, and

Coil Winding Details

L1 5 turns 18 B+S (19 SWG) tinned copper wire 6mm inside dia. 10mm long.

L2 3 turns 18 B+S (19 SWG) tinned copper wire 6mm inside dia. 6mm long.

L3 4 turns 26 B+S (27 SWG) enamelled wire wound on Neoside L1010 former with

BUYLINES

F29 slug.

The only component liable to tax the intending constructor is the VMPA. All the rest are fairly standard stuff, and people like Catronics, for example, will have stocks.

The VFET itself is available from P. Rimmer at 367 Green Lane, N4 10 Y or Ambit International. Check with them for prices before ordering.

you have checked that all is correct, testing can commence.

A variable supply with a current limiting facility is suggested for initial test and tune up. Bias is not necessary at this stage.

Connect the output to a dummy load and some RF power measuring device. Apply supply voltage and then drive power. Tune for maximum RF output! This should correspond with a peak in drain current. If 'funny' things happen here then suspect positive feedback and install neutralisation.

It's dead simple. However, take care not to grossly overdrive the device — VFETS do not take kindly to this sort of abuse. Becoming the owner of a four-legged stripline fuse can be a chastening experience!

For class AB linear operation, bias should be set to provide about 100 mA quiescent drain current, subsequently adjusted for best performance.

Some adjustment of the input network was required on the prototype suggesting that the input impedance, S₁₁, of the particular VMP-4 was lower than indicated on the data sheet.

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BUGGED BY INTERFERENCE?

You can banish the demon hum from your sounds if you know what you're looking for.

he most common irritant in hi-fi systems of any performance or cost standard is almost certainly hum, that horrible, low pitched noise which strikes almost every system at least once in its life. In fact, the only good thing that can be said about hum is that it is not selective; it will strike both amateur and professional equally.

And the most aggravating thing about hum is the trouble that it may cause — not that it will normally damage components unless extremely bad, but because it may sometimes take hours of concentrated searching to track it down. Until the cause is located and the problem corrected, satisfying listening is impossible.

What is Hum?

Once hum has been heard it is unmistakable. It is also difficult to describe. Typical textbook descriptions run pretty much as follows: 'HUM — an unwanted low-pitched sound produced in reproduction by an interference from the AC mains. It usually occurs at the mains frequency of 50 Hz, or at its second harmonic, 100 Hz. Can be caused by . . . ", and then follows a list of about a dozen typical causes.

In spite of the rather open-ended descriptions, hum is immediately recognisable.

Its causes are not so easily pinpointed, although the sources of hum found in hi-fi systems can usually be traced back to any one of three chief sources — loops, screening and induction.

Hum generally affects low level signals with high circuit impedances — so the pickup cartridge and its associated signal connections are the prime offenders. The high gain of this circuit, and the large amount of bass boost applied in the RIAA equalisation, make it exceptionally prone to hum from any of the various causes.

In Britain, the AC mains power supply is a nominal 240 volts, alternating with a frequency of 50 Hz. Wherever these voltages occur, the mains conductors are surrounded by electrostatic and magnetic fields which fluctuate at the same frequency. With a voltage as high as 240 volts, these fields are fairly intense and can produce hum by inducing tiny AC currents in surrounding wiring and components.

Occasionally hum may arise from a faulty component in some piece of equipment, but most problems come from the linking and positioning of the hi-fi components.



Hum-bugs can strike ANY system, with no regard to make or quality!

Loops

Earth loops are possibly the most common cause of hum, and are the most annoying in that they are frequently caused by taking too much care! They are formed by duplicating earth links between components — a real trap for beginners attempting to set up a foolproof system.

The problem arises when the earthed screen of a signal carrying lead is correctly earthed, but an additional earth link is formed between the two components. The separate earth link may be redundant, in which case it forms an electrical loop.

If there are slight potential differences at the earth points, or if the loop falls within a stray magnetic field, a tiny circulating AC current will start to flow within the loop. This current affects the audio signal carried in the central core of the conductor by adding unwanted components to it, and hum results



Sometimes the loop may be formed through no fault of the person assembling the system. When the earthy sides of the signal connectors on the amplifier (or other component) are linked internally to form a common ground, a loop is very easily completed.

Troublesome loops are known as 'earth' or 'hum' loops, and although they are the common cause of a great many problems, their source may well be different in each case, and their cure may take considerable time and careful thought.

The ideal interconnecting system between any two components conveys the signal and the earthy (signal return) conductors for each channel by only one path — via a live and an earthed conductor. Separate earth connections should be used only to earthed metalwork which is not connected to the signal carrying circuits. Because of this pickup arm on a turntable is earthed separately without causing hum loop problems.

In these cases earthing may be essential to draw off any leaked voltages or static build-up directly to the mains earthing point. If these spurious voltages were carried via the signal earth leads, they too could cause interference with the audio signal.

Curing Earth Loops

As hum loops are set up when there is a redundant earth connection, they can be cured by breaking the loop — that is, by removing the redundant earth.

The process of tracking down a hum loop problem is rather long and laborious. If the majority of connections are made by RCA-phono plugs and sockets, it is rather more simple than when DIN connectors are used.

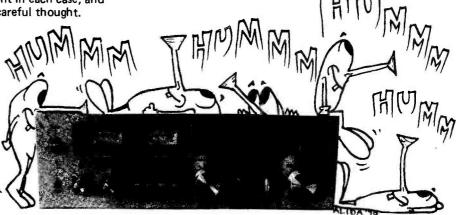
Start by disconnecting all inputs to the amplifier except for the separate earth link between the turntable frame and the amplifier's chassis. Connect one channel of the turntable and note the hum level. Try pulling the plug slightly out of the socket so that the outer rim doesn't still make contact. If the hum is now worse, push the plug fully home — excessive hum indicates that the rim contact is not redundant but is needed for shielding. If, however, the hum is reduced with partial connection, leave the plug as it is — this earth is redundant.

Now check the second channel from the turntable in the same way. If the hum is still present in spite of these checks, try removing the separate earth link from the frame of the turntable to the amp. It is unlikely that this will be redundant, as ideally it should be isolated from the signal carrying components. In rare cases, however, its removal may help.

Continue this checking process in the same way for all inputs, until you are sure which earth links are redundant and may be disconnected permanently.

DIN connectors pose more of a problem, and unless you are sure of your ability with a soldering iron it will be better to check only the auxilliary earth connections, and then investigate to see if the problem lies elsewhere.

When working through the checking procedure, make sure that the amplifier's volume control is turned down whenever making or breaking contacts. High level transients are easily generated, especially when checking for loops in the vicinity of the turntable.



As the amplifier is the control centre of a system, central earthing is best carried out at this point to avoid loops. Only use single earth wherever possible

Electrostatic Hum...

Because of the fairly intense electrostatic fields surrounding mains supply cables, any signal-carrying leads within such a field may be affected, because of the capacitance across the space between the cables. The higher the circuit impedance, and the lower the audio signal level, the more likely the occurrence of hum breakthrough.

This problem is generally overcome by the use of an earthed shield around the signal carrying conductors — hence the almost universal use of shielded leads for connections between components.

The screen must be arranged so that the live conductors are shielded by some earthed metal at all times — it will be seen when looking at RCA or DIN plugs and their appropriate sockets, that this requirement is fulfilled. It is to prevent this type of hum that almost all signal carrying leads between components in a hi-fi system use a shielded cable.

The shield, or braid, should itself be insulated so that it doesn't inadvertantly contact any other earthed metalwork. If this happens, the earth bypass created will form an earth loop to bring even more hum.

The only components which do not require shielded connecting leads for the audio signals are loudspeakers, which are fed by high level signals via a low impedance circuit.

...And The Cure

The most obvious cure for hum of this sort is prevention. Any signal-carrying lead should be kept well clear of all mains supply cables, and should also be kept as short as practicable. However, as electric fields are coupled by capacitance, and the effects diminish as distance increases, length should not be sacrificed unnecessarily. Never lengthen the connecting cables supplied with a turntable, however, as this will degrade the unit's performance.

Mains cables should consist of twisted conductors or, when using two core mains leads, parallelled conductors so that the fields are reduced by cancellation.

If it can be established that hum is caused by some form of electrostatic breakthrough, but it is not practicable to move the offending cables, a form of shielding may be required between the mains cables and the signal leads. Any earthed metal should service the purpose — provided any signal leads and thus set up an earth loop.

When turntable hum is the problem, a trick of the trade which works in a surprising number of cases (with turntables fitted with two pin mains plugs) is simply to reverse the two pin mains plug in the power outlet — whether at the mains or at the amplifier's mains outlet. By transposing the active and neutral conductors in this way, it is sometimes possible to reduce the field that may occur around a switch, or some

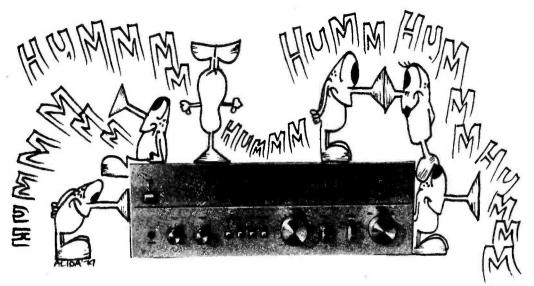


Turntables and associated equipment are particularly prone to hum in all its infuriating forms. This is due to the high impedances in this part of the circuitry and the bass boost applied by RIAA correction. Make sure for starters that the turntable is not earthed twice through the signal leads and its own leads. Some cartridge manufacturers earth the metal of the body to one channel of the system and if you get mono hum in one speaker have a look at the back of your head! (cartridge wires therein)

While it may be an advantage to use earthed metal equipment cabinets as a shield against induced electrical hum, this is not possible when the cabinet is electrically connected to the equipment's chassis. In this situation, any separate earthing of the cabinet will form a hum loop — the cure may be worse than the original sympton.

other internal device which is sufficiently close to the pickup, or to signal leads, to cause problems.

It is also worth experimenting with different routes for the signal cables — keeping them well clear of any cables carrying mains voltages. Make sure that any mains conductors are kept well away from the pickup cartridge.



Hum fields exist around mains transformers and AC mains wiring in general. If senaitive equipment — unscreened — is placed near enough humbugs will immediately surround it making life unbearable

Magnetic Induction

Transformers and electric motors operate within powerful magnetic fields which are generated by passing the mains current through the windings of a coil. It is very difficult to contain that magnetic fields that occur around transformers or turntable motors, and they tend to spread out beyond the immediate vicinity of the device. Any coils (including earth loops) or windings used in signal carrying components which do fall within the stray magnetic field, are very prone to hum pickup of this type;

The earthed shield used to prevent hum from electrostatic fields is unfortunately no barrier to a magnetic field, and special metallic shielding — such as mu metal — must be used.

The components which are most susceptible to magnetic hum induction are the pickup cartridge and the magnetic heads on a tape recorder — low level devices which rely on magnetic coupling for their operation.

Generally tape heads are shielded by the internal design and layout of the recorder's electronics. However, the pickup cartridge by its very design and performance requirements must be close to the turntable's motor. While most good turntable motors do not give trouble, cartridges do vary in their sensitivity to magnetic fields, and troubles may occur when least expected.

In spite of any design features or in-built shielding included to prevent the breakthrough of magnetically induced hum in turntables and tape decks, these units should be kept as far as possible from the power transformers of amplifiers, tuners and other components.

Curing Magnetic Hum

The most common problem with magnetically induced hum is found around the pickup cartridge. To cure this hum it is necessary first to establish the cause.

If you suspect that the turntable motor is the cause of the problem, try switching the motor on when the arm is at different points across the turntable. If the hum appears and disappears as the motor is turned on and off, then the motor is the culprit.

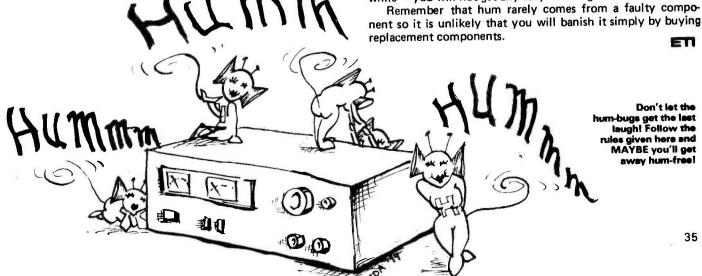
It will be possible to tell where the problem is worst, and the only cure in some cases will be to relocate the arm. If this is impossible, as it would generally be with automatic and semi-automatic arms, it is necessary to look to some form of magnetic shielding.

If hum levels change with the position of the arm across the platter — even with the motor switched off — it is probable that some nearby component is the cause — possibly a power transformer in the amplifier or some other component nearby. Try changing the position of the turntable relative to the other components — sometimes a slight change in orientation is all that is needed.

Similar experiments will be required if the hum occurs in a tape deck, although this is only likely to occur when the equipment is mounted in a confined space such as an equipment cabinet.

Halting Hum

The search for the source of a hum may take a great deal of your time and when hum problems do arise, you must be prepared to devote several hours to the hunt. It is certainly worthwhile — you will not get any easy listening until it is found.





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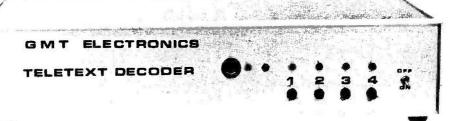
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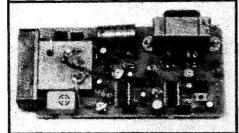
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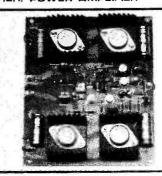
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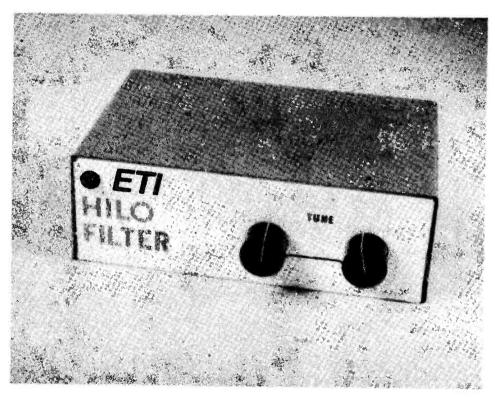
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4050 (200ns)	2.50	8255	5.08	ICL7038A	3.57	01	IIY E TO	OTVAL		74LS26	0.18	74LS163	0.69	74LS668	0.6
4050 (350ns)	2.35	Baud Rate	0.00	ICL803BBC	8.82	MC1350P	1,20	1 TBA800	0.83	74LS27	0.18	74LS164	1.06		1.1
4060 (300ns)	2.39	Generators	- 1	ICL8038CC	3.40	MC1351P	1.20	TBA810S	1.10	74LS28	0.18	74LS165	0.72	74LS670 74500	1.7 0.5
4116	6.74	MC14411	5.87	ITT7120	1.90	MC1352P	1.35	TBA810AS	0.80	74LS30	0.18	74LS166	1.65	745262	
Static RAMS		MM5307	9.38	LF351N	0.40	MC1375P	1.73	TBA820	0.70	74LS32	0.26	74LS168	1.71	745374	15.8
2102A	1.16		0.00	LF356N	0.80	MC1445L	2.95	TBA9200	1.75	74LS33	0.26	74LS169	1.71	745374	12.8
2102A-2	1.16	UARTS		LM301AH	0.38	MC1456CG	1.75	TBA990Q	1.50	74LS37	0.23	74LS170	1.72	745472	2.3
2111A-1	1.70	AY-5-1013	3.65	LM301AN	0.25	MC1458CP1	0.45	TCA270Q	1.00	74LS38	0.23	74LS173	0.81	745472	14.3 11.2
2112A-2	1.83	MM5303	5.04	LM307H	0.66	MC1495L	5.98	TCA730	3.97	74LS40	0.18	74LS174	0.97	75107AJ	
21102	1.16	TMS6011NC	4.30	LM307N	0.43	MC1496P	0.75	TCA740	3.97	74LS42	0.65	74LS175	0.97	75107BJ	1.5 1.5
2114	5.17	Integrated Circ		LM308N	0.95	MC3302P	0.65			74LS47	0.81	74LS181	2.77	75108AN	1.3
4035 (1000ns)		703 (8 pin)	0.95	LM308	0.55	MC3340P	1.20	Integrated C TCA940		74LS48	0.81	*74LS188	0.44	75182	1.5
4045 (250ns)	6.15	709 (8 pin)	0.35	LM318N	1.95	MEM 780	2.48	TDA 1054	1.60	74LS49	0.81	74LS189	2.08	75452A	0.4
5257 (TMS4	0441	709 (14 pin)	0.38	LM319H	2.25	NE531N	1.00	TDA 1327	1.20	74LS51	0.18	74LS190	0.86	75452A 75L90J	
6.93	/	709 (1099)	0.45	LM322N	3.87	NE540L	2.97	TDA1352	0.95	74LS54	0.18	74LS191	0.86		2.2
6810	3.03	710 (8 pin)	0.36	LM324N	0.50	NESSSN	0.22	TDA1352	1.35	74LS55	0.18	74LS192	1.04	TTL	
ROMS		710 (14 pin)	0.38	LM339N	0.50	NE556N	0.60	TL072CP	3.20	74LS73	0.33	74LS193	1.04	7400	0.10
2513 (U.C.)	8.25	710 (T099)	0.45	LM348N	0.90	NESSON	3.25		0.95	74LS74	0.27	74LS194	0.86	7401	0.10
2513 (L.C.)	6.25	711 (14 pin)	0.40	LM370N	2.90	NES61N	3.25	TL074CN TL081CP	1.50	74LS75	0.40	74LS195	0.97	7402	0.10
MM5230	4.62	711 (TO99)	0.87	LM371H	2.05	NE562N	3.95		0.45	74LS76	0.27	74LS196	0.97	7403	0.11
CPU		739 (14 pin)	1.80	LM373N	2.90	NE565N	1.10	TL082CP TL083CP	0.95	74LS78	0.27	74LS197	0.97	7404	0.12
6800	6.01	741 (8 pin)	0.18	LM374N	2.90	NE566N	1.20		1.05	74LS83	0.78	74LS221	0.92	7405	0.13
8080	5.08	741 (14 pin)	0.35	LM377N	1.75 -	NES67N	1.35	TLOB4CN	1.15	74LS85	0.81	74LS240	2.08	7406	0.21
	26.05	741 (TO99)	0.42	LM378N	2.05	SAA 1024	3.40	UAA170	1.98	74LS86	0.27	74LS241	2.08	7407	0.21
280	9.00	747 (14 pin)	0.70	LM379S	3.75	SAA1025	4.85	UAA180 2N404	1.98	74LS90	0.57	74LS242	2.08	7408	0.12
6502	9.50	748 (8 pin)	0.33	LM380N8	0.85	SL414A	1.90		0.80	74LS91	0.97	74LS243	2.08	7409	0.13
E-PROMS	5.50	748 (14 pin)	0.45	LM380N	0.75	SL440	2.90	2N414	0.80	74LS92	0.69	74LS245	2.50	7410	0.11
1702AQ	5.16	748 (TO99)	0.48	LM381N	1.45	SD6000V	2.98	2N417E	1.90	74LS93	0.60	74LS247	1.09	7411	0.17
2708	8.26	753 (8 pin)	1.50	LM381AN	2.50	SN75491N	0.75	2N423T	1.05	74LS95	0.81	74LS248	1.09	7412	0.13
	24.00	AY-10212	5.80	LM382N	1.20	SN75492N	0.75	2N424E	1.15	74LS96	1.16	74LS249	1.09	7413	0.19
T.V. Controller	24.00	AY-1-5050	1.90	LM386N	0.78	SN76001N	0.95	2N424P	0.80	74LS107	0.32	74LS251	0.96	7414	0.40
		AY-1-5051	1.45	LM387N	0.95	SN76003N	1.98	2N425E	3.75	74LS109	0.32	74LS253	0.92	7416	0.19
	14.59	AY-16721/6	1.95	LM389N	0.95	SN76008K	1.60	2N458A	1.35	74LS112	0.32	74LS257	0.92	7417	0.28
Buffers	}	AY-3-8500	5.00	LM725CN	2.25	SN76013N	1.40	2N459CP	2.73	74LS113	0.32	74LS258	0.92	7420	0.10
74365	0.52	AY-5-1224	2.40	LM1303N	1.00	SN76013ND	1.40	2N1034E 2N1040E	1.90	74LS114	0.32	74LS259	1.39	7423	0.18
74366	0.52	AY-5-3507	4.15	LM1808N	1.95	SN76018K	1.50		6.85	74LS122	0.69	74LS261	4.50	7425	0.18
74367	0.52	AY-5-4007	1.10	LM1812N	5.40	SN76023ND	1.30	2N1066E	5.85	74LS123	0.72	74LS266	0.37	7426	0.18
	0.52	CA3036	1.10	LM1820N	1.00	SN76033N	2.00	2NA116E	4.95	74LS124	1.39	74LS273	1.70	7427	0.25
	0.86	CA3045F	1.40	LM1830N	1.98	SN76532N	1.55	2NA134J	26.95	74LS125	0.36	74L\$279	0.57	7428	0.29
	0.70	CA3046	0.65	LM3065N	1.50	SN76544N	1.25	LS series	0.40	74LS126	0.36	74LS283	1.09	7430	0.10
	0.86	CA3053	0.72	LM3900N	0.50	SN 76660N	0.75	74LS00	0.12	74LS132	0.60	74LS289	4.50	7432	0.18
B1LS98	0.70	CA3075	2.00	Integrated circ		SN76666N	0.75	74LS01	0.12	74LS133	0.39	74LS290	0.91	7437	0,19
	1.90	CA3078S	1.90	LM3905N	1.00	TAA263		74LS02	0.14	74LS136		74LS293	0.91	7438	0.19
	1.90	CA3080	0.67	LM3909N	0.68		2.20	74LS03	0.14	74LS138		74LS295		7440	0.16
8T95	1.57	CA3080E	0.67	LM3911N	1.10	TAA320A	0.50	74LS04	0.16	74LS138			1.30	7441	0.46
8T96	1.57	CA3081	1.30	M252 B1 AA	7.50	TBA120S	0.70	74LS05	0.19	74LS139		74LS298	1.16	7442	0.35
8T97	1.57	CA3082	1.30	M253 B1 AA	7.95	TBA231	1.00	74LS08	0.18	74LS145		74LS348	1.39	7445	0.58
	1.57	CA3086	0.45	MC1310P	1.00	TBA520Q	1.00	74LS09	0.18	74LS151		74LS352	1.04	7446A	0.56
Interface		CA3089	1.75	MC1312P	1.85	TBA530Ω	1.50	74LS10	0.18	74LS153		74LS353	0.92	7447A	0.40
	3.00	CA3090Q	3.95	MC1314P	3.35	TBA540Q	1.50	74LS11	0.16	74LS154		74LS362	4.21	7448	0.49
	2.00	CA3097E	1.85	MC1315P	5.50	TBA550Q	1.50	74LS12	V. 10	74LS155		74LS365	0.47	7450	0.10
	2.08	CA3123E	1.70	MC1327P	0.95	T8A560Q	3.75	74LS13	0.37			74LS366	0.47	7451	0.10
		CA3130E		MC1327P		TBA651	1.80	74LS14	0.00	74LS157 74LS158		74LS367	0.47	7453	0.10
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HI-LO PASS FILTER

Are you in the depths of despair because your highs are hissy, or because your laws are rumbly? Then you need the ETI Hilo Filter to remove your extremities - without anaesthetic.



e can hear you all now, saying to yourselves in unison simultaneously and all together — GOSH, is there no end to the ETI Project Team's ingenuity? Whatever will they come up with next? Well this really is the ultimate in audio gadgetry — a rumble and scratch filter that one can tune to suit an individual rumble or a personal scratch. Speaking for ourselves, we only scratch when there is no-one around anyway, it's bad manners to do otherwise.

The ETI HILO FILTER essentially consists of two separate filtera, a variable high pass and a variable low pass filter in series, which together form a tunable bandpass filter, whose cutoff frequencies at each end of the audio spectrum can be adjusted by varying the cutoff frequencies of the individual filters.

The cutoff point of the high pass

filter is variable between about 235 Hz and 2.8 kHz depending on the setting of RV1. At all frequencies above this the filter operates as a unity gain buffer. The effect of this part of the whole circuit is to quite adequately filter out all low frequency oscillations and tremors which go under the heading "rumbles".

The low pass filter functions in just the opposite mode, in that it filters out all frequencies above its cutoff point variable between about 2.2 kHz and 24 kHz dependent on RV2).

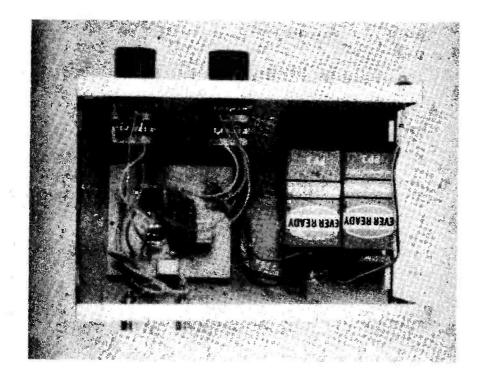
Unwanted tape hiss and record scratches can be filtered out with this part of the circuit. Frequencies below the cutoff point are buffered with unity gain.

For the technically minded we can say that both filters are second order filters giving a cutoff rate of 12 dB/octave below or above the consecutive filter points.

Construction

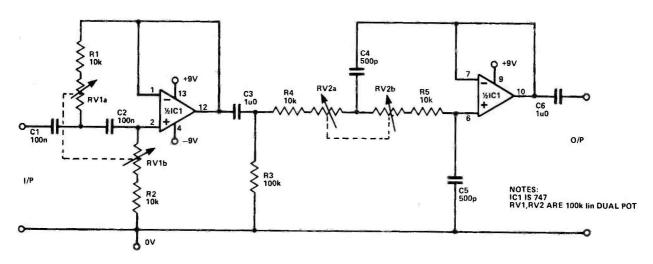
The circuit really is so simple that very little need be said on construction techniques. The only area of possible difficulty might be encountered in the wiring up of the two potentiometers R/V1 and RV2. Both are dual ganged types and obviously require to be wired correctly for proper function. Work from the circuit diagram and follow the wiring carefully. If the circuit does not work first time, it is more than likely that this is the area of fault.

We build our filter into a box but this is not strictly necessary. You can build the board into your own system and run the filter from a mains/DC power supply (up to ± 15 V), which will save the expense of batteries, if you wish.



The internal photograph (left) shows the completed PCB installed in its case and the connectors to the batteries and front panel controls. Two PP3s will give sufficient power for satisfactory operation. We have taken the outputs to two phono sockets on the back panel.

Fig. 1 (below) shows the circuit diagram. RV1 and RV2 are both ganged potentiometers.







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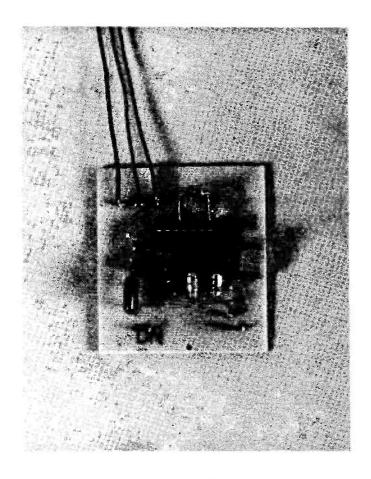
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HOW IT WORKS

The high pass filter gives a frequency response as in the graph of Fig. 1. The response of the circuit can be seen to fall off below about 235 Hz. Adjustment of RV1 can alter the response to that of the broken line or any position in between.

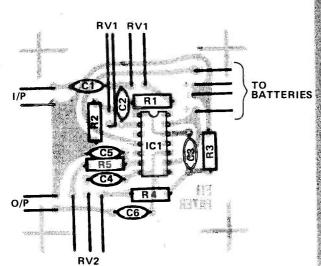
Similarly, the low pass filter shows a frequency response as in the graph of Fig. 2. Adjustment of RV2 alters the cutoff frequency 2.2 kHz and 24 kHz as shown by the broken and full lines of the graph.

When the two filters follow each other; as in, our circuit the overall response curve is simply a combination of the two diagrams of Figs. 1 and 2.



You shouldn't find this PCB (above) very taxing to construct. It may be small, but the mighty mica morsel banishes hiss and rumble a treat.

Fig. 2 (below) shows the Hi-Lo Filter component overlay. The capacitors go in two by two — two polyester, two polycarbonate and two polystyrene.



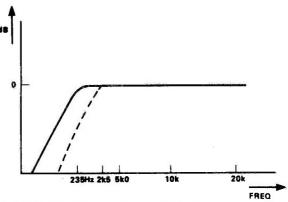


Fig. 1. The frequency response of the high pass filter. The response falls off below about 235 Hz.

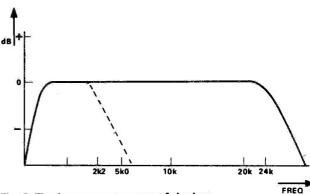
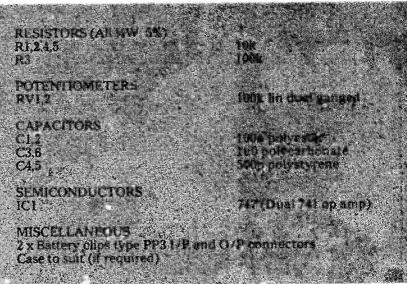


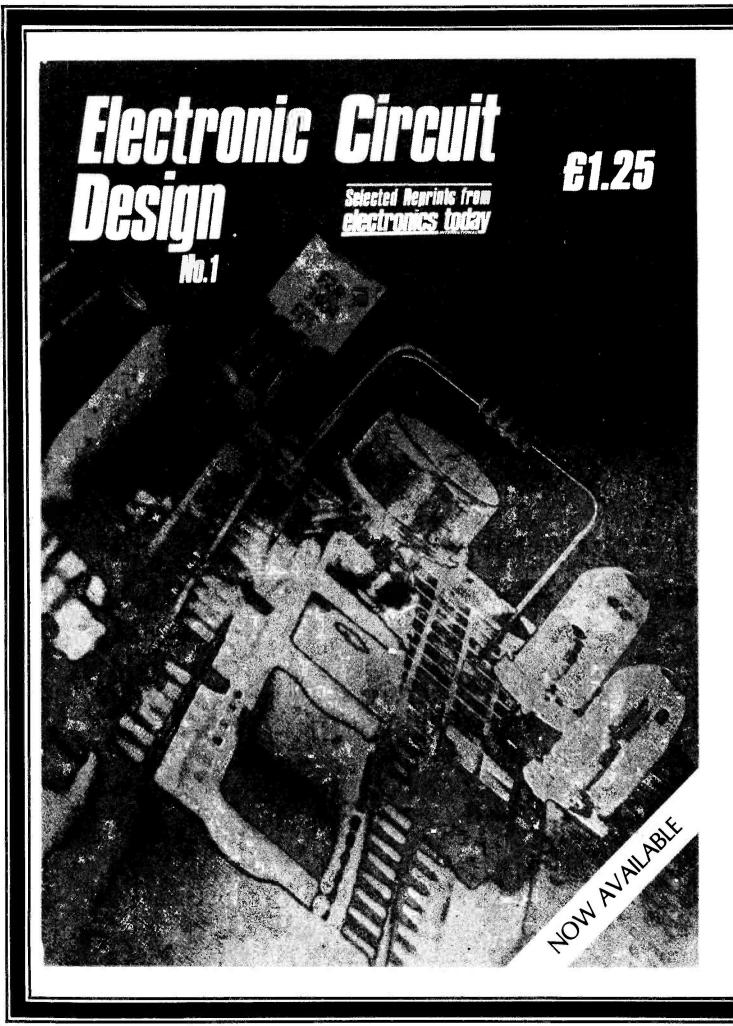
Fig. 2. The frequency response of the low pass filter.

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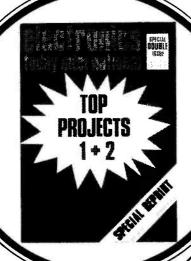
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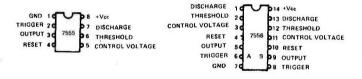
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CMOS 555 APPLICATIONS

Tim Orr brings you the result of bipolar versus CMOS in the 555 league

he bipolar 555 timer chip has been around for many years, but there is now a CMOS version that has some very significant design improvements. The two devices are functionally very similar, being interchangeable in most applications. The operation of the 555 is very simple, (Fig. 1). It consists of a pair of comparators that operate at ½ and ½ of the supply voltage, this being set up by a resistor chain. These comparators set and reset a flip flop which in turn drives the output stage. A second output is available which is an electronic switch, (Discharge) to ground. Other features include access to the resistor chain via the control voltage pin and an extra reset input to the flip flop. This simple network readily lends itself to all sorts of oscillators and timer circuits.



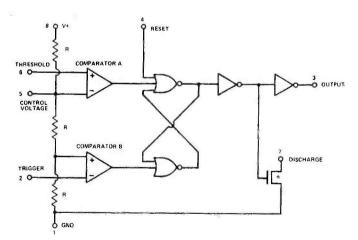


Fig. 1. The pin-out and internal configuration of the CMOS 555.

The bipolar 555 has a few parameters that can make it difficult to use, but which have been improved in the CMOS version, (Fig.2.). The bipolar quiescent supply current is generally about 10 mA which negates their use in small battery units. The CMOS version consumes a mere 120 uA.

PARAMETER	ICM 7555	BIPOLAR 555C
QUIESCENT CURRENT Vcc +15V	TYPICAL 120uA	TYPICAL 10mA
INPUT CURRENT TRIGGER THRESHOLD RESET	50pA 50pA 100pA	0u5A 0u1A 0m1A
MAX. OPERATING FREQUENCY	500kHz	500kHz
POWER SUPPLY RANGE	2 → 18V	4VS → 16V
PEAK SUPPLY CURRENT TRANSIENT	10mA	370mA
RISE AND FALL TIME	40nS	100nS

Fig. 2. A comparison between the Bipolar and CMOS version of the $555. \,$

Also the CMOS inputs are very high impedance having input currents down in the pico amp region. Another major improvement is the reduction in the power supply current transient during an output transmission. The bipolar is very noisy in this respect and can often be the cause of lots of 'funnies' in nearby circuits.

The CMOS 555 is a low power high input impedance device that should be used where low current consumption is at a premium. The following circuits illustrate some possible uses of the device.

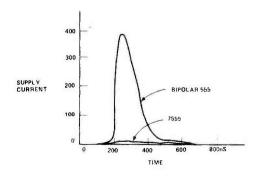


Fig. 3. The CMOS 555 displays an impressive reduction in supply current transient during an output transmission.

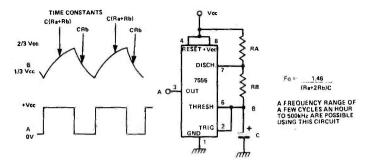


Fig. 4 (above) A simple oscillator can be constructed using two resistors and a capacitor. Due to the high input impedance of the CMOS device, resistor values up to 100M may be used. The operation is as follows. Capacitor C is charged up via Ra and Rb and so rises with a time constant of C(Ra+Rb). When the voltage B reaches ½ Vcc, the threshold hold comparator goes high causing the output (pin 3) to be set low. Also the discharge FET (pin 7) is turned on. This discharges the capacitor via Rb with a time constant of CRb, until the voltage B reaches ½ Vcc.

This causes the trigger comparator to go low which sets the output high and turns off the discharge FET. Thus, the voltage B oscillates between ½ and ½ Vcc. The waveform is asymmetric but due to the nature of its generation its frequency is virtually invarient with regards to supply voltage changes. It is possible to generate a sawtooth waveform by reducing Rb to a short circuit. This causes the reset time to be very fast, of the order of a few microseconds. However, there is a propagation delay through the device from the trigger comparator to the output which causes the discharging waveform to overshoot the ½ Vcc limit, thus making the waveform at B larger. This will cause the oscillation frequency to be lower than calculated. To maintain the calculated frequency, the discharge period should be 5 uS seconds or longer.

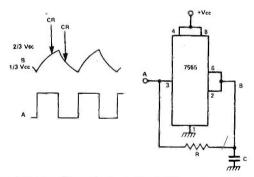


Fig. 5 (above) This oscillator has a symmetrical output because the charge and discharge paths are the same and the portion of the exponential cruve that is used is symmetrical. Note that in this circuit, the discharge pin (7) is available to do other jobs, such as drive a LED or some other device. The timing resistor R should be kept relatively high (above 10k) to prevent loading of the output.

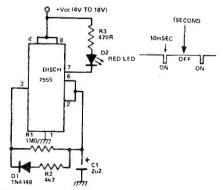


Fig. 6 (above) This circuit is an oscillator that has a wide mark to space ratio. It is OFF for approximately 1 second and then turns ON for about 10 mS. During this latter period the LED is turned on by the discharge FET. The long OFF period is generated by the R1, C1

time constant, whereas the short ON period is produced by D1 (which is forward biased) and R2, C1. The average current consumption is relatively low. If the unit were powered from a 9 V bettery, then the current would be 120 uA for the ICM 7555 and an average of 140 uA for the LED, making 260 uA total. This would give a lifetime of a few months for a PP3 which would be extended by lengthening the OFF period (increase R1) and reducing the LED current (increase R3).

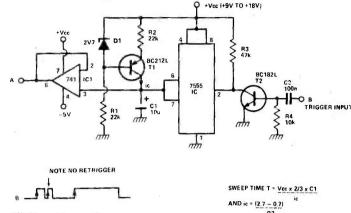
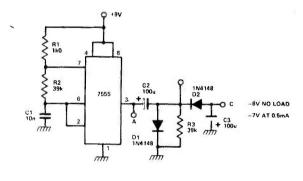


Fig. 7 (above) The 7555 is used to initiate and terminiate a triggered sweep. Normally the discharge FET (pin 7) is ON and so C1 is shorted to ground. When a trigger is applied to the input, the collector of Q2 momentarily goes low which sets pin 7 of the 7555 in its OFF condition. Q1, R1, R2 and D1 form a current generator that drives C1. Once the discharge FET has been turned OFF, the voltage on C1 rises linearly. When this voltage reaches + 2/3 Vcc, the threshold comparator sets the discharge FET into its ON state and so C1 is shorted to ground. IC1 is used to buffer the voltage on C1. The sweep generator is not retriggerable and is only initiated on fast positive going inputs. To vary the sweep rate, alter C1 and or R2.



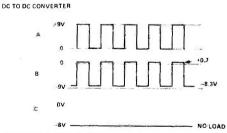
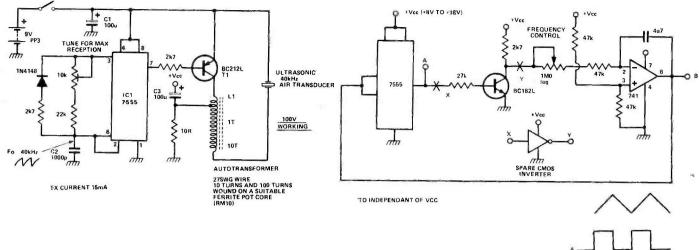


Fig. 8 (above) A DC to DC converter can be constructed from an oscillator and a diode charge pump. The 7555 forms a high frequency square wave oscillator. The squarewave from pin 3 is AC coupled via C2 to the charge pump. The voltage on the negative side of C2 is prevented from going more than 0V7 positive by D1 and so the square wave on this side of the capacitor biases itself so that it moves from +0V7 to -8V3. D2 charges up C3 on the negative excursion of this waveform and so a negative rail of about -8 V is generated. The current that can be taken from this rail is rahter low, being determined by the oscillation frequency and C2. Generally DC to DC converters have a poor transfer efficiency.



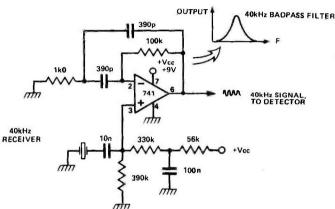


Fig. 9 (above) The 7555 can be used as the driving oscillator in an ultrasonic remote control system. The oscillator generates a thin pulse about 2.5 uS long at the natural resonant frequency of the transducer. This short pulse is used to turn on a transistor (Q1) which drives an auto transformer with a 10 to 1 step up ratio. The output of the transformer is connected to the transducer and when the oscillation frequency is correct a 100 V peak to peak sine wave will be produced at this point. The transducer is usually a crystal with a high impedance and so a high operating voltage is required to produce any power output. The receiver is a 40 kHz bandpass filter. This will amplify any audio signals at this frequency, which can then be sent to a detector circuit.

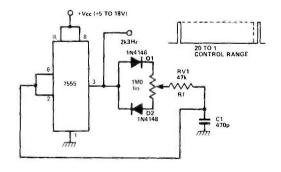


Fig. 10 (above) This oscillator allows the mark space ratio at pin 3 to be varied from 1 to 20, to 20 to 1, by using two feedback routes. When pin 3 is high, C1 is charged via D1, part of RV1 and R1. When it is low, C1 is charged via D2, the other part of RV1 and R1. Thus the position of the RV1 wiper determines the ratio of the charge and discharge periods. The oscillation frequency is slightly dependent on this ratio.

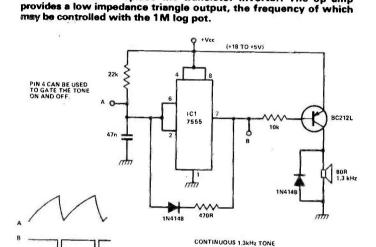


Fig. 11 (above) By making a loop out of a 7555, an inverter and an

integrator, a triangle/square wave oscillator is produced. To operate well at high frequencies (up to 40 kHz) a CMOS inverter

should be used to replace the transistor inverter. The op amp

Fig. 12 (above) The 7555 can be used to generate an acoustic tone. The oscillator is set to run at 1k3Hz which has a low period of about 15 nS and a high period of about 755 nS. During the low period the transistor is turned ON and so the loudspeaker is connected across the power supply and sinks at about 100 mA (for a 9 V supply). This gives it a 'kick' on every cycle of the oscillation. As the transistor is only on for 15 out of every 770 nS the average current through the speaker is quite small, being about 1.95 mA. Therefore, the total current consumed by the whole system is only about 2.5 mA (at 9 V), and yet the 20 mW output signal is quite audible.

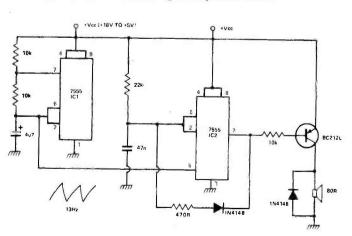


Fig. 13. A warbling tone can be generated by using two oscillators. The warble is produced by IC1 which generates a 13 Hz wave form that is used to frequency modulate the tone generator as described in the previous example. Pin 5 of a 7555 is connected to the $\pm \frac{2}{3}$ Vcc tap on the resistor ladder. By tying it to a 'warble' waveform, frequency modulation of the final output tone is produced. A 7556 could be used instead of two 7555's.

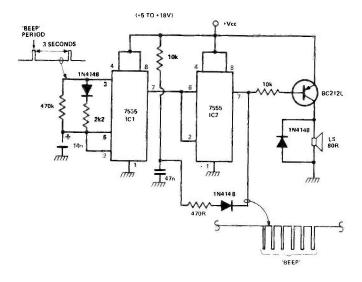


Fig. 14 (above) The police and other emergency services use a repeating high frequency 'beep' on their radio networks. This doesn't interfere with the normal radio traffic and allows the listener to be certain that he is still tuned in correctly to that channel. The circuit generates a similar 'beep' and yet consumes only a couple of milliamps. IC 1 is a slow oscillator (3 second period) with a large mark/space ratio. The discharge FET is on for most of the time and only goes OFF for about 15 milliseconds in every 3 seconds. This FET is connected to the tone generator in such a manner that when the FET is ON the tone generator is inhibited. When the FET goes OFF the generator produces a burst of 3 kHz oscillations which are heard as a 'beep'.

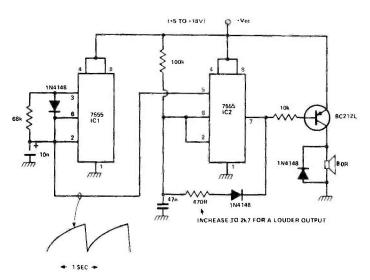


Fig. 15 (above) The last type of sound generator to be described is a simple siren. IC1 generates a sewtooth waveform which is used to frequency modulate, via pin 5, the tone generator (IC2). As the sawtooth voltage rises (with a period of 1 S) so does the tone generator frequency.

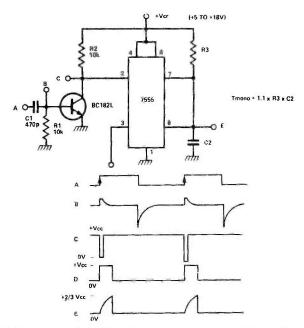


Fig. 16 (above) The 7555 can be made into a monostable, although some problems may occur in its use. A negative going pulse on the trigger input (pin 2) can be used to start the monostable period. It is important that this pulse goes high again before the end of the monostable period, or else it may prolong the period. To this end an AC coupled transistor inverter has been used so that a rising positive signal will initiate the event. Initially C2 is discharged to ground. When pin 2 is taken low, the discharge FET is set to be OFF and so the voltage at E rises with a time constant of C2, R3. When this voltage reaches + ½ Vcc, the discharge FET is turned ON, C2 is discharged to ground and the monostable period is finished. During this period the 7555 produces a high output at pin 3.

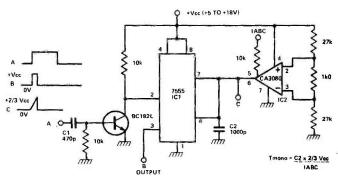
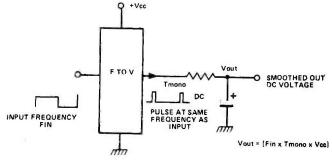


Fig. 17 (above) The previous circuit has been modified. The timing resistor has been replaced with a programmed current source, IC2. Whatever current is put into pin 5 of the CA 3080 (the $I_{\rm ABC}$ current) will appear at its output. This will linearly charge up C2 when the FET switch is turned OFF. The monostable action will be the same as in the previous example. The monostable period is linearly proportional to the $I_{\rm ABC}$ current so by programming this current the period is controlled.



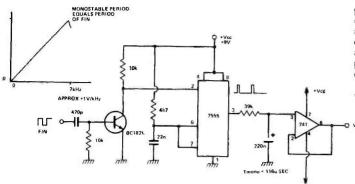
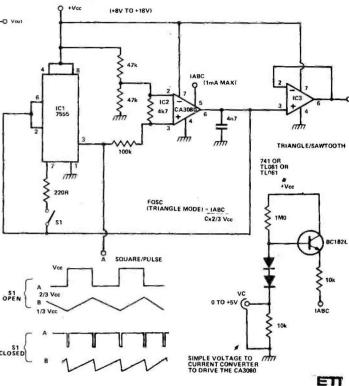


Fig. 18 (above) The monostable can be used to linearly convert a frequency into a voltage. The pulses at the output pin of the 7555 in this circuit are fixed in length but occur at the fundamental frequency of the input signal. Thus the average equivalent DC voltage of these pulses will be linearly proportional to their frequency. This averaging can be performed very simply with a CR low pass filter. This filter determines the response time of the circuit and the ripple. A long time constant will have little ripple and respond slowly and vice verse. Care must be taken to not exceed the range of the monostable. When the period of monostable exceeds that of the input signal, the circuit will miss every other period and will drop its apparent output by an octave.

Fig. 19 (right) IC1 and 2 form a triangle/squarewave oscillator. IC2 is a non-inverting, programmable rate integrator and its output ramps up and down between the V_3 and $^2/_3$ Vcc limits set by IC1. The rate at which the integrator ramps up and down and hence the oscillation frequency, is determined by the I_{ABC} current. Because the input impedance of IC1 is so high, it is possible to directly connect the timing capacitor to it, without any unwanted loading effects. This circuit has excellent high frequency performance producing good quality triangle wave forms at 40 kHz. The circuit can also produce very low frequency signals by making C a 100n tantalum and I_{ABC} a current of say, 1 nA. This oscillator would then have a

period of 800 seconds. IC3 is used to buffer the triangle to the outside world. If a 741 is used, then the waveform will become asymmetrical at low I_{ABC} currents (below 1 uA) due to the input bies current needed to run a 741. A TL081 has very little input current and so could be used for both low I_{ABC} currents and high frequency performance. If low power is needed, then a TL061 (200 uA quiescent) could be used.

By closing switch S1, the oscillator will produce a sawtooth waveform and a pulse.





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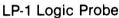
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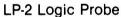
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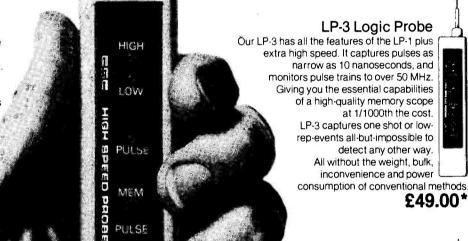
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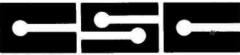
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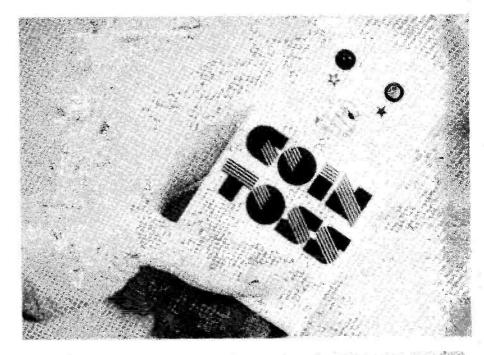
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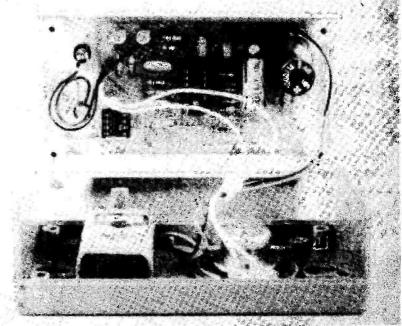
ou know how it is. Someone flips a coin, it spins wildly in the air, you all call and the coin lands... on the floor and rolls under the sideboard. Frustrating, isn't it? Well, now you can banish the problem at a stroke with our great new circuit. Featuring illuminated indicators, single push-button control and exciting sound effects, the whole unit is powered from a single nine volt battery and switches itself off aitomatically after about twenty seconds.

Only a couple of cheap chips are used along with three transistors and a scattering of discrete passive components. Depressing the push-button causes the unit to emit a 'whooping' siren sound. Also the LEDs flash alternately, gradually slowing down until one remains illuminated. A further depression of the push-button starts the process again. If the unit is left undisturbed it will turn itself off, emitting a couple of quiet squeaks. Once the flashing display has settled and one LED is illuminated continuously, the display will remain stable until both LEDs are extinguished. This avoids any troublesome arguments!

Construction

The unit is assembled on a single PCB with the battery, push-button switch, LEDs and loudspeaker connected via flying leads. There are two links to make on the board; from IC1 (pin 4) to IC2 (pin 4) and from IC1 (pin 3) to the junction of diodes D6, 7. Note that this is a straight wire link which





The finished coin machine (right) installed in a standard Verobox.

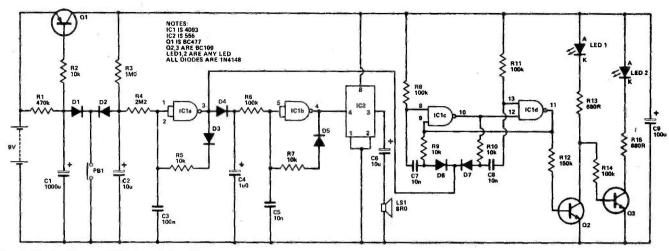


Fig. 1 Circuit diagram. We found that the circuit operated more reliably if D1 was made a 1N4001.

PARTS LIST

Resistors
##############################
10 R3 1M6 R4 2M2 R5.8.11, 100k R12 150k R13,15 680R Capacitors C1 1600u electrolytic C2,6 10u tentalum C3 100n polyester
R6.6.11. 100k 14. R12. 150k R13.15. 680R Capacitors C1. 1990u electrolytic C2.6. 10u tentalum C3. 100n polyester
R6.8.11. 100k 14 R12. 159k R13.15. 680R Capacitors C1. 1000u electrolytic C2.6. 10u tentalum C3. 100in polyester
R12 159k R13,15 680R Capacitors C1 1690u electrolytic C2,6 10u tentalum C3 100n polyester
RTS,15 680R Cipecitors C1 1990u electrolytic C2,6 10u tentalum C3 100n polyester
Capacitors C1 1990u electrolytic C2,6 10u tentalum C3 100n polyester
C1 1000u electrolytic C20 10u tantalum C3 100n polyester
C1 1000u electrolytic C20 10u tantalum C3 100n polyester
C3 100n polyester
1u0 tantalum
C5.7,8 10n polyester
C9 100u electrolytic
Temiconductors
4083
1C2 555 O1 BC477
02.3 BC109
LED C2 ANY LED
01 to 7 \$N4148
Miscellaneous
PB1 SPST, LS1 8 ohm loudspeaker,
PCB, PPS OV bettery.

BUYLINES

The Coin Toss project uses standard components. You should have no difficulty in obtaining them from your favourite mail order supplier.

passes under R11 and D6. The flying lead link is most easily made on the underside of the board after construction is complete.

Assembly is quite simple. As usual, pay attention to the orientation of the diodes, transistors, ICs and capacitors. C9 may have to be bent to one side to accommodate C1. However, there is plenty of space for the other components. As IC1 is a CMOS chip, use a socket if you are worried about damage from static electricity. There are no problems with IC2 or the other components.

Layout of the unit is uncritical and any construction technique may be employed. You need two different coloured LEDs. Any size or colour of LED will do. The unit should work as soon as power is applied and again upon depressing PB1. Build one now and try your luck!

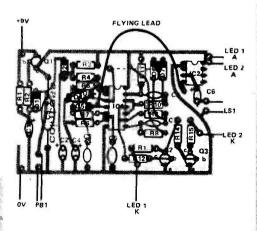


Fig. 2. Component overlay.

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0-8-9, 0		1A 1A		
		200 200		
0-20, 0-		300 300		
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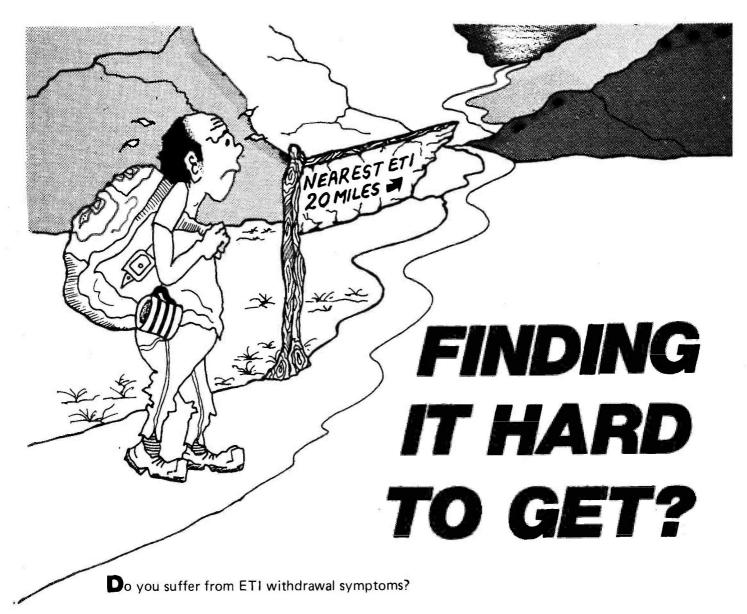
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RAVEN ON...

This month Dave Raven of Metac Electronics goes computer shopping and casts doubts on lie detectors.

Starting a new year is not only necessary but can be quite enjoyable since it now possible to reflect on the previous year as history. Errors of judgment, success and missed opportunities are all behind us and cannot be brought back. The only positive thing you can do is cast all thoughts and aspirations forward. In the words of G. B. Shaw "Man can climb to the highest summits but he cannot dwell there long".

If electronics is your chosen career then 1980 is to be another exciting year of challenge and new opportunities. Behind clouds of doom and gloom painted for us by the Press and politicians, not forgetting those great British patriots, the government and business spokesmen, who roam the world speaking out, never failing to tell the world how bad things are in Britain or how bad they are going to be, there are still signs of the continuing revolution in the electronics industry. Difficult decisions have to be taken, since, to remain in the industry, it will be necessary to spot the trends. An interest in small computing systems must be formed since organisations that wish to remain competitive and efficient have to make the change from mechanical to computerised systems. Fewer jobs, even for school-leavers, will be available to those who have not had sight of a computer keyboard. These new tools for industry and commerce are being pushed out onto the market at an alarming pace. It is already possible to buy a small system with 4K of memory for half the price of a modern shop cash register. My own company is introducing a mixture of small systems for general purpose operations backed by larger units for the mail order centre. This philosophy of decentralising computers away from one large system gives maximum flexibility and enables a company to match the computer system to the job.

In America it is not uncommon for solicitors to sit at their word processor and prepare complex company merger documents in a fraction of the time previously required. So watch out ladies, this is just as important for you too. Secretaries and office juniors will all need the ability to change from typing pool mentalities to the new 'smart' methods.

Computers In The High Street

Major efforts have been made in the UK during 1979 to bring small computers onto the High Street. However, my own impression is that most of the retailers have ended up selling mainly to established businesses. The consumer will

not be rushed into these things and it does appear that home computers have still to take off. I would also hazard a guess that video recorder specialists are finding a similar pattern of sales. Currys, the electrical retail chain, is to establish a subsidiary company to market small computers and provide computer programs. Operations are expected to start next year with outlets being opened at Currys established premises. They are aiming for the small to medium size business market, also industrial and commercial outlets. Figures quoted in the Press suggested that they aim to take a whole 10% of the domestic market in their first year which doesn't leave a lot for the rest of us. Coincidently, news that the president of the electronics giant Fairchild Camera and Instrument Corporation had resigned reminded me of an announcement he made several years ago predicting that their range of Time Band LED watches were going to take some huge percentage of the world's market, I think it was about 40%. Not all that long after this they announced getting out of watches completely and promptly moved their entire UK service facility to somewhere in West Germany.

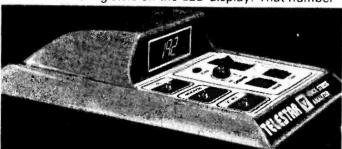
Confusion In The Shops

An interesting article on Computing Today describes the experiences of the author when shopping in London's Tottenham Court Road for a small computer. I mention this since it provides a classic story of the current state of immaturity and confusion that exists in the High Street. His experience when buying a computer may not be dissimilar to those buying electronic watches, video recorders, etc, mainly a bewildering choice of different systems, functions and, of course, prices. It is quite possible to spend £3,000 on a computer and find that the system is totally unsuitable for your requirements. Shortage of software for particular systems is a common complaint and the price of the add-ons.

Honest Truth Machines

A sinister new electronic product is being sold in America, called the Truth Machine. I have not seen these advertised in the UK yet, but when they come I can imagine a similar reaction to the one created in the States. Doubts have been cast on their accuracy. However, this has not prevented these solid state, voice stress analysers being used in personnel offices and other areas where people may stray from the truth. One leading professor of psychiatry and psychology at the University of Minnesota claimed that

lie detectors are about as accurate as flipping a coin. Professor Lykken goes on to say that you cannot discriminate with a stress analyser between a stress and a non-stress situation. Even if tests could detect stress, one could not assume that stress indicates lying. Speaking the truth under stressful circumstances would typically show up as stress in these machines. A more traditional machine used for lie detection, the polygraph, was compared for accuracy with one of the new stress analysers. Results showed that the stress analyser detected lies 38% and 20% of the time compared to the polygraph machines record of 92% and 76% assuming of course that stress indicates lying. The companies marketing the products will not disclose the identity of the integrated circuits used. saying that patent rights are still being sorted out. To use one particular model of stress analyser the operator first adjusts the circuitry to recognise the fundamental frequency range of the voice of the person under test. While talking to that person under non-stress conditions, the user tunes the analyser with a one-knob control, until the number 20 registers on the LED display. That number



The Truth Machine — currently being sold in America for about £75 each. Doubts are cast on the accuracy of its results.

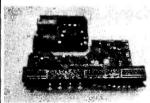
signifies that the machine is locked into the fundamental voice frequency range. The claim then made by the manufacturers is that when a person experiences stress, normal harmonics disappear from the voice and they shift so that they are no longer integral multiples of the fundamental. A sensor which also doubles as a filter and may be a tuned circuit, is programmed to anticipate harmonic changes, and measure their duration and intensity. The LED display indicates stress by a rise in the numerical value at displays. The model described has a built in microphone. or it can be connected to an external mike or to a telephone. On the drawing board is another model which I hope my company will be cautious about handling. It incorporates a stress analyser in a digital watch. Just think of the reaction when you're told "The time is 9.30 and you're already lying through your teeth."

New SAW Devices

One old saying which regularly comes to mind is that "there ain't nothing new" especially in science. Acoustic surface wave devices are becoming more familiar and I was interested to see an article recently describing a new high speed SAW device on gallium arsenide material. The material used is the same as that required for producing Field Effect Transistors and, by making use of the properties of gallium arsenide, strain-sensitive FET heterodyne mixers can be fabricated in the epitaxial layer grown on the surface of the bulk gallium arsenide compound, producing a useful programmable tapped delay line.

Well, my news for the researchers is that a research programme I worked on ten years ago at Birmingham University developed working devices as described above. Ah well, back to the drawing board.

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Power Output 7 walls RMS per channel, at betler than 2° .
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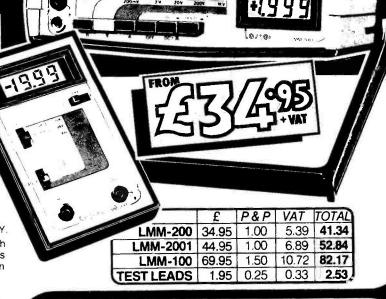
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BARGAIN OFF

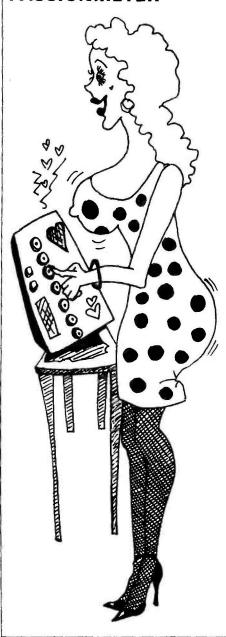
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Hobby Electronics

PASSIONMETER



Months of fearless research (mainly on calibration) have led to the design we hope to be publishing next month. It is primarily intended to visually display (via a column of LEDs) the degree of passion being experienced by the

Measurement of passion is made by inserting the subject's finger into an orifice in the case to contact with a sensor array. Use of CMOS circuitry enables the unit to function for many months without being switched off. This project, whilst a little tongue-in-cheek should prove a great success at parties and may just provide a few surprises!

KEZY DOES IT



Unless you've heard it you will find it almost impossible to believe, American radio that is. Rick Maybury hot foot from Los Angeles brings back a report of one particular AM / FM station, KEZY. In a city that has over 80 other stations catering for just about every taste KEZY manages to capture a very large audience. Find out about this and the American radio scene in general in next month's issue.

INTO CONSTRUCTIONAL ELECTRONICS

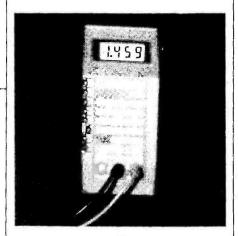
Are you thinking about taking that first step into the wonderful world of electronics? Ian Sinclair begins a major new series just for you.

Many newcomers are often daunted by the thought of building that first project. This series is designed to take you gently by the hand, through the jungle of jargon and coloured bits and pieces and hopefully leave you with the confidence and expertise to tackle just about anything. Much of the series is centred around the Eurobreadboard so why not drop a few hints to Father Christmas so you can be ready.

KIT REVIEW SPECIAL

Two kits this month. Even though we've delayed the Radio Control system for a few months we will still be presenting the review of the Servo Kit we hope to be using with the system.

Our second kit comes from THE kitmakers — Heathkit. They may be a bit pricey but they are the best. The one we're reviewing is probably one of the finest pieces of test equipment we've ever seen. It's the Digital Multimeter with an LCD readout. If you think a price tag of around £80 is a bit steep then see what we think next month.



INFRA RED CONTROL

Look out for a new remote control system using Infra Red techniques. Coming next month.

The February issue will be on sale January 11th

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

MODULAR SYNTHESISER

The synthesiser you've been waiting for. Presented as either a full spec., rack mounting, stage instrument or as a set of stand-alone modules, ETI's Project 80 gives you the options. Circuit designs by R. C. Blakey.

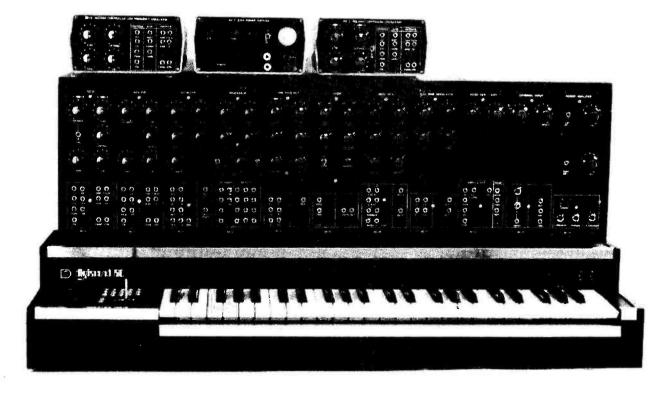
ne of the fascinating, and sometimes irritating, aspects of electronics is its rate of technological growth. It is the recent development of customised integrated circuits for music applications which justifies another synthesiser project. The use of these devices greatly simplifies construction of stable, accurate and reliable modules, which will be of particular benefit to constructors. These new integrated circuits are equally useful to the musician since they allow greater control of many of the complex 'music-making' parameters.

Design Philosophy

The popular conception of a synthesiser is a musical instrument which can produce all manner of wondrous sounds. In fact a synthesiser is a multi-function machine having sound generators, modifiers and mixers which are electrically compatible with one another. It is the designer who connects the various modules together in a particular manner to produce an integrated musical instrument. He (she) has certain targets of portability, ease of playing and cost —

and inevitably these result in compromises in terms of the capabilities of the instrument.

The basis of the current project is that for hobby application and greater exploration of musical expression there is no substitute for a truly modular system inter-connected by patchcords. Of course, patchboards or switches are alternatives to lots of drooping cords, but sooner or later the compromises begin as the cost, or the trouble, of adding more switches or boards arises. Furthermore a patchcord synthesiser is just as easy to play as a pre-set machine.



SPECIFICATION

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Ganaral Specification

The design features of the modules follow the principles adopted by many of the major manufacturers of synthesisers. These are:

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1. Exponential voltage control. For the basic signal and treatment units (oscillators and filters) this will be the widely used one volt per octave relationship. For some modules the response level may be variable, as with the voltage controlled amplifier.

2. 10 V minimum control range providing a span of 10 octaves without mixed signals. switching.

3, 10 V peak to peak signals.

Signal and control inputs via a ing op-amp stage. This allows

multiple inputs. It is also a simple matter to alter the inputs to make the modules compatible with existing equipment.

5. Normally all inputs will have an input impedance of 100k or a minimum trol of filters, pulse width modulation, of 47k. This allows a single control signal to drive several modules without adverse loading effects.

6. Output impedance will be 1k wherever practical, that is, without adding significantly to cost. These outputs may be mixed by shorting them together which results in an average of the

7. DC coupling, except for a few instances where it is essential to avoid errors which may arise from any DC drift and when the use of AC coupling

does not result in loss of flexibility.

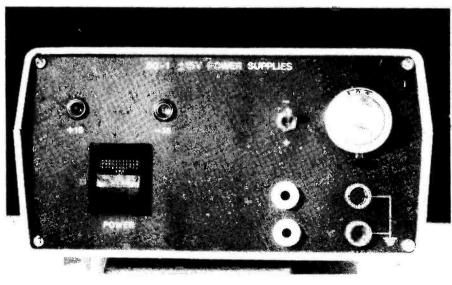
8. ±15 V supplies, common to all modules. Single PSU required.

9. All major features to have voltage control capability, for example, Q conenvelope generation and so on.

An important feature of the above is that it allows anything to be plugged anywhere without fear of causing damage. Where modules are interfaced with external equipment then kinch jack sockets are used to avoid problems which may arise from incompatibility. Another aspect that should be noted is that because one signal can control several modules any attenuation of the signal should be made at the input to the modules.



Above and below: the VCO and PSU modules as they appear in their free standing cases. Note the vernier drive on the PSU. This is for calibration of oscillators etc. This case will be standard throughout the series.



Modules To Come

The modules to be described in this series are as follows:-

- 1. Power Supply: ±15 V regulated and trimmed supplies which, as described, are sufficient to drive all of the proposed modules.
- 2. Voltage Controlled Oscillator. Good exponential response over a range from 10 Hz to over 16 kHz. Triangle, sawtooth, pulse and sine outputs of 0 to 10 V amplitude and triangle and sine outputs of ±5 V amplitude. Manual and voltage control of pulse width duty cycle from 0 to 100%. Linear frequency modulation input. Three techniques for synchronising oscillators.
- 3. Voltage Controlled Low Frequency Oscillator. Same features as the VCO but with a frequency range of 0.2 Hz to 205 Hz with a 10 V control input. The frequency range extends to over 5 kHz with higher control voltage or by manual adjustment of initial frequency. The lower frequency limit is easily altered to suit individual requirements.
- 4. Processor. The flexibility of the input-output structure described above has one main disadvantage, namely, that to take full advantage of it one should have several output jacks for each control source and an attenuating potentiometer on each control and signal input. This can be overcome by having a pane!

(or panels) which only contain attenuating potentiometers and/or sets of commoned jack sockets for distribution purposes. Such panels are not powered and do not require further description. On the 'processor' module facilities have been incorporated for inverting two of the inputs and also for slowing down control signals by means of a lag circuit. The latter circuit may also be used as a control source by using a foot pedal.

- 5. Voltage Controlled Mixer. Four input mixer with manual and external voltage control of mix together with a single control for manual and external voltage control of pan.
- 6. Voltage Controlled Filters. A state variable filter with low pass, high pass, band pass and notch outputs will be described. Also a 24dB/octave low pass filter which is the most widely used type for music applications. Voltage control of Q provided.
- 7. Voltage Controlled Envelope Shaper. Voltage control over the attack, initial decay and final decay responses of the envelope generator provides opportunity for more realistic envelopes, for example, a change in envelope with pitch. A third generation IC will be used which has many other features allowing control over the formant of the sound.
- 8. Dual Voltage Controlled Amplifier. Exponential and linear control for increased flexibility and variable gain of both. Ability to partially bury the envelope so as to reduce the exponential final decay of the envelope which in imitative synthesis can be a problem. Provision for stopping the VCA so that when used in conjunction with other instruments it does not continue playing when the rest of the group has finished.
- 9. Dual Ring Modulator. Based on a single IC and having a wide dynamic range and high signal to noise ratio.
- 10. Noise Generator and Sample & Hold Module. White, pink and red (random) noise sources. The sample and hold unit allows creation of sounds from a variety of sources.
- 11. External Input. Pre-amplifier to increase external signals to a level compatible with the other synthesiser modules. Includes an envelope follower with a variable threshold level to generate trigger pulses.

- 12. Power Amplifier. Two speaker channels and headphone output. It is not advisable to use the domestic Hi-Fi for synthesisers since the tweeters can be destroyed by continuous tones at an output above a few watts. A pair of good quality speakers is a worthwhile investment. A separate power supply is used for the power amplifier.
- 13. Keyboard Controller. Digitally scanned keyboard capable of controlling a five octave keyboard. Sample and hold with portamento. Precise octave shift over range of -2 to +3 octaves. Gate and trigger pulses. Pitch bend with variable bend level. Suitable for standard monophonic synthesiser and microprocessor compatible for polyphonic capability.

Construction

Each module is designed for both panel mounting or for housing within a standard low cost plastic case. The use of a case serves a number of purposes, one of these being a neat packaging of the modules for those who wish to construct them for other applications. The cased units are also appropriate for teaching and learning purposes, for example, the beginner should start by thoroughly exploring the functions and capabilities of each module. If electronic music is approached in this systematic way it becomes a relatively simple matter to create specific sounds at a later date. Furthermore one should not have any pre-conceived notions on the format of a synthesiser and a methodical study will enable the user to determine his approach to electronic music.

The panels are 228 x 76 mms. (9 x 3 inches). This size is widely used by commercial manufacturers of patchcord synthesisers. Such a panel will comfortably accommodate at least six control potentiometers or rotary switches with control knobs of an easily manipulated size. Standard quarter inch jack sockets are used on most of the professional equipment but their physical size limits the number of inputs and outputs per panel and it is back to compromises again. This project uses 3.5 mm jack sockets and up to twenty may be fitted onto the panel along with the six rotary controls. These miniature lack sockets should be of good quality. Screened patchcords are used to reduce the likelihood of crosstalk or noise. A major



advantage of panels is their ease of construction which also applies to the case to house the panels. 1.2 mm aluminium sheet provides adequate strength and a professional appearance can be obtained by spraying and the use of transfers for the markings. The cabinet can be constructed from a proprietary laminated blockboard assembled with 'Lok-Joint' fasteners. With this type of shelving a maximum of twelve modules per row is advised unless intermediate supports are used. 9.5 mm hardwood beading along the edges of the shelves allows the panels to be mounted using small woodscrews and if only a small pilot hole is made then the panels can be repeatedly removed without refilling the holes. The panel approach provides flexibility in lay-out and virtually unlimited scope for expansion.



Above: both versions of the VCO, panel mounted for rack fixing. Note that all inputs/outputs are at the bottom of the panel to prevent wiring fouling the con-

MODULE 1: POWER SUPPLY

±15 V power supply is used for the modules except for the power amplifier which has its own supply. A design based on the 723 regulator is used and the circuit is shown in Figure 1. The circuit incorporates the recommended features for stability and both rails can be adjusted to a precise 15 V output.

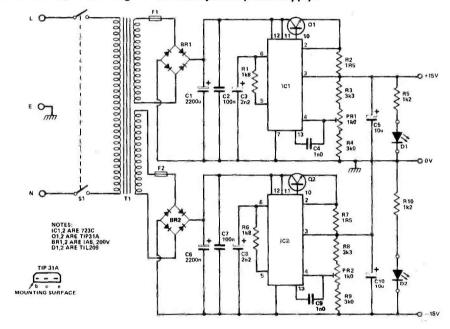
Construction

The PCB has been designed to suit the mounting holes in the recommended case and these same holes can be used

for vertical mounting of the power supply in the keyboard housing by means of L brackets. A 100 mm x 65 mm heatsink provides generous heat dissipation from the plastic box and this is secured to the outside of the rear panel. The transformer should be bolted onto a small piece of aluminium plate which is screwed down to mounting lugs moulded into the box. Addition of plastic feet to the box will ensure adequate ventilation through the grills.

Before connecting to the mains supply ensure that all mains connections

Fig 1 (below). Circuit diagram for the Project 80 power supply.



HOW IT WORKS - PSU

Power Supply

A synthesiser requires very stable power supplies because in most designs the voltage is used to establish reference currents in the exponential generators. It is also desirable that the voltages are set at the precise 15 V levels. The ±15 V power supply for this project is based on the 723 voltage regulator. The circuit comprises two identical positive 15 V supplies with one of the outputs tied to the ground rail of the other to generate the ±15 V required.

The circuit will supply up to 300 mA per rail at full voltage and the current sensing resistor R2 (R7) limits output to about 450 mA under overload or short circuit conditions, R3, TP 1 and R4 allow precise adjust-

ment of output voltages; RI improves temperature stability; C3 increases ripple rejection; C4 is for compensation; and C5 reduces noise on the output which originates from the voltage reference diode in the IC.

The output is adequate for the basic project but if extension is envisaged then the same circuit board can be used for much greater outputs. The only changes required are, increased power rating of the transformer, appropriate increase in value of fuses; adjusting R2 (R7), i.e. halving this resistor will double the current limit and the PCB has provision for two resistors in parallel to facilitate obtaining the correct value. Wirewound 2W5 resistors are also used since low

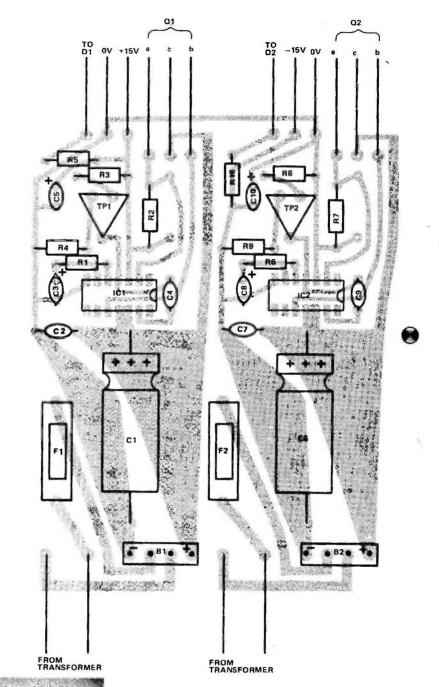
ohmic values are more easily obtained and the resistors are physically smaller than 1 W carbon types; increasing power rating of transistors and when more than 1 A per rail is required the latter should be mounted on separate heatsinks.

Setting up voltage controlled synthesiser modules requires a voltage source that can be quickly adjusted to a precise value. A ten turn potentiometer which can be switched to positive or negative voltage is an asset. This is shown on the boxed module. Two commoned outputs are provided, one for the output to the unit being calibrated while the other may be used for direct connection to a voltmeter. Installation of this variable voltage source is optional and components are not listed.

to plug, switch and transformer are properly insulated. The calibration consists of setting TP 1 and TP 2 to obtain, as accurately as possible, +15 V and -15 V respectively.

PARTS LIST - PSU

	AND THE RESERVE OF THE PARTY OF
RESIST	ORS All 4W, 5%
R1.6	
	1R5, 2.5W wirewound
R3,8	3k3, metal film, 100ppm T.C.
R4.9	3k0, metal film, 100ppm T.C.
R5,10	1k2
TP 1.2	1k0 cermet trimmer
CAPACI	TORS
	2200uF, 35V electrolytic
C2.7	100nF: polvester
C3.8	2u2. 25V tantalum
C4.9	InF. polvester
C5.10	2u2, 25V tantalum 1nF, polyester 10uF, 25V tantalum
SEMICO	NDUCTORS A
BR1.2	1A6 200 V
IC1.2	LM 723CN
	TIP 31A
D1.2	Red LED
7	
MISCEL	LANEOUS *
7 T1	
	secondaries, 20 VA
	transformer.
F1,2	1 A fuses with PCB holders.
S 1	DPST rocker switch.
Heatsink	(4°C/W); mains connector;
output se	ocket.
The above	re will fit into a Teko Alba A23
case.	
Torrible M. C	A CONTRACTOR OF THE CONTRACTOR



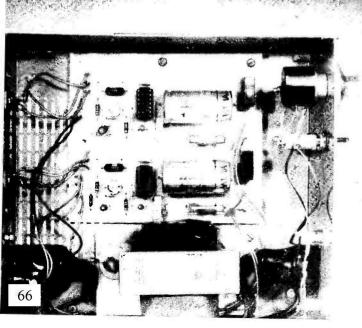


Fig. 2 (above). Component overlay for the PSU project.

Left: the inside story on the PSU project. The heatsink is mounted on the rear panel of the case.

ELECTRONICS TODAY INTERNATIONAL — FEBRUARY 1980

The VCO is based on the CEM 3340 IC produced by Curtis Electromusic Specialities and specifically designed for music applications. Figure 3 shows the block diagram of the device which is packaged in standard 16-pin DIL form. It provides the exponential law required for music, that is, a doubling of the frequency for a fixed increment of input control voltage, which for this project has been set at one volt per octave. The design provides excellent conformity to the exponential response from less than 10 Hz to over 16 kHz.

The CEM 3340 has triangle, sawtooth and pulse outputs. In the design presented a sine wave has been generated from the triangle output. The outputs are 0 to 10 V in amplitude which facilitates their use as control signals. Additionally, the triangle and sine waveforms are provided at ±5 V amplitude and are directly suitable for modulation applications. The duty cycle of the pulse output can be varied from 0 to 100%, either manually or by external voltage control. A linear frequency modulation input with a 10% change in frequency per volt is also included.

The IC allows three methods of synchronising the oscillator which provides an exceptional range of modulation and harmonic locking effects.

The circuit is shown in Figure 4.

Construction

Construction is straightforward and the component layout on the printed circuit board is shown in Figure . It is essential to use the components specified if the accuracy and stability of the design is to be realised. All lack sockets and potentiometers should be wired up except for the wiper of the fine control (RV2). Neat and short wiring reduces the likelihood of crosstalk and all inputs and outputs are provided at the front edge of the PCB to avoid excessive wire length. The PCB will fit the mounting lugs in a Teko Alba A23 case. It may also be mounted to the 228 x 76 mm panel with proprietary brackets or Lbrackets. If the latter are used a 12.5 mm spacer between the panel and the bracket is recommended since this provides adequate space for the wires.

When all components have been installed carefully check their placement and orientation and also inspect the underside of the board to ensure that no solder bridges have been made. Before

MODULE 2: VCO



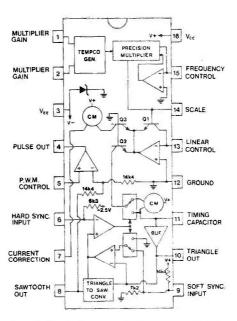


Fig. 3. Block diagram of CEM 3340 VCO chip.

inserting the IC it is good practice to connect the board to the power supply and check that power is available at the correct points in the circuit and this is simplified by using IC sockets. If this step is satisfactory then disconnect power before inserting the IC.

A final check before calibration is to ensure that all outputs are functioning. Connect the 0 – 10 V triangle to an oscilloscope or amplifier (turn volume control nearly off) and then power up the circuit. If there is no response then switch off immediately and repeat the checking procedure. If functioning then check the other outputs although remember that the sine waveform has not been trimmed at this time.

Calibration

Set all trimmers to their mid positon. The first step is to adjust the sinewave output. With an oscilloscope, or by ear via an amplifier, adjust TP 4 then TP 5 for purest sine output. These adjustments may have to be repeated a few times to obtain the best results. Next adjust TP 6 to get the 10 V output referenced to ground. The simplest method is using an oscilloscope, but it can be trimmed using another VCO. If the latter technique is used, set the other VCO to about 1 kHz and the frequency of the VCO being calibrated at a low frequency (coarse control switch on and RV1 fully anti-clockwise). The sinewave output is then plugged into the other VCO and TP 6 adjusted until there is no discernible jump in frequency.

The last and most important step is to calibrate the oscillator to the 1V/octave relationship. The easiest method requires a variable voltage source (from a potentiometer or a calibrated keyboard), an accurate voltmeter and a digital frequency meter.

Alternatively, if a previously calibrated oscillator is available then the beat frequency technique may be employed. Another approach is to build two stable fixed frequency oscillators and use these in conjunction with an oscilloscope to calibrate the VCO by generating Lissajous figures. Whichever method is chosen the calibration proceeds as follows. With the coarse control switch, SW1 in the OFF position apply a positive voltage to Control Input 1 (R5) until the frequency is about 200 Hz.

Increase voltage by one volt (as accurately as the measuring equipment allows) and adjust TP 1 until the frequency is doubled. This step is repeated until a doubling of frequency for a one volt change in input is achieved. Next increase the frequency to about 5 kHz, increase voltage by one volt and adjust TP 3 to obtain doubling of frequency. Finally, re-check the first step and if a DFM is available check the VCO over its full range.

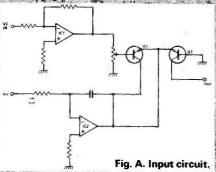
Note that the oscillator has been (accurately) calibrated for Control Input 1. This input should be used for the keyboard, if fitted, since there may be a slight difference between Control Inputs 1 and 2 even though 1% resistors are

The oscillator may now be adjusted so that with no input voltages it will be tuned to the lowest frequency of a four octave C - C keyboard, Adjust TP 2 to 65.4 Hz, or if connected to a keyboard press note A and adjust to 440 Hz. This step is not essential until the VCO is connected to a keyboard, Also R4 and TP 2 may be changed to suit other keyboard requrements.

The wire to the wiper of the fine control potentiometer (RV2) may now. be connected.

HOW IT WORKS - VCO

Voltage Controlled Oscillator
The VCO utilises an integrated circuit which has been specifically designed for music applications. Understanding the IC and how it overcomes the many problems associated with building exponential converters from tilecrets components is best approached by considering the latter circuits. A transistor design makes use of the fact that in an ordinary transistor the collector current is an exponential function of the base-emitter voltage and, the current can then be used for asy. hential function of the base emitter voltage and the current can then be used for say, charging a capacitor. The emitter saturation current, however, doubles for every 10 C change in temperature and so to employ a single transistor necessitates use of techniques such as 'ovening' that is, maintaining the transistor at an elevated temperature. A better approach is to use a well matched transistor nair meterality on the same thin and to pair, preferably on the same chip, and to arrange them so as to cancel out this particular temperature dependent term. A simplified oscillator input stage using two transistors is shown in Figure A below.



ICL and associated resistors and trimmer provide a means of scaling and ranging the input. voltages and for the standard IV/octave response the components are chosen to give approximately 18 mV increase at the base of Q 1 for an increase of 1 V at Vin Next the control range is adjusted by applying a reference current to the collector of Q 1. Ideally this would be in the middle of the exponential range of the transistor, about 1uA, but considerations of bias current from IC2 usually dictate that Ired is 10uA, or more IC2 usually dictate that Iret is 10uA, or more IC2 also serves to sink the excess current from the emitters of Q 1 and Q 2. Thus the current from the output transistor Q 2 becomes:-

so that with Vin = 0, lout = Iref. There to mains, however, a temperature dependent term, 1/T, which changes the exponent by

about 0.33% for every degree Centigrade change in temperature. To compensate for this the usual practice is to use a semigrature componenting registor, having a similar temperature coefficient, in the input stage so that Vin also changes by 0.33% per °C.

This project is based on the CEM 3340 Voltage Controlled Oscillators, produced by Curtis Electromusic Specialities Reference to the simplified block diagram (Figure 3) shows that the whole of the input stage described above has been incorporated within the C. Pin 15 is the input amaning stage while Fin 14 determines the scale. Since the current gain of the multiplier is set shift unity a 100k input resistor (R5, R6) and a like scaling registor (R3) provide the standard IV/octave response and about 18mV/volt at the base of Q 1. Components R4 and TP2 set the initial frequency of the oscillator and have been chosen so that with no external voltage inputs the frequency cast be adjusted to 65 406 Hz, het the lowest note of a 4 octave C — C layboard, R7 and RVI allow manual adjustment of the oscillator by 25 octaves. Switch 31 has been fitted between RVI and R7 so that is normal use; is keyboard, precise octaye shift; and external voltage controls, slight variations in RV7 will not cause the oscillator to go out of tune. R8 and RV2 provide a fine adjustment of approximately 10.5 octaves. The other components (R5, C5) on the summing input are for compensation and are always required. The sum of the input voltages should always remain positive for proper operation of the oscillator.

For greatest multiplier, accuracy the current flowing out of Pin 1 (22Vr/R2, where

For greatest multiplier, accuracy the current flowing out of Pin 3 (22VT/R2, where VT = 26 mV at 20°C) should be close to the current flowing out of Pin 1 (3.0/R1 + TP1). TP 1 is used to adjust the oscillator to a pre-

TP 1 is used to adjust the oscillator to a precise LV/octave response.

The exponential substrator is capable of
delivering a current, leg. for charging and
discharging the timing capacitor; from greater
than 500 uA to less than the input bias
current of the buffer which gives a typical
frequency range of 500,000: For synthesizer applications one should use the most
accurate portion of this range; which is from
50 nA to 100 uA. These current limits are
used to determine the value of the signing used to determine the value of the timing capacitor, CT (C7). The oscillation frequency is given by fo = 3leg/2VecCT and therefore to keep within the above current limits and to maintain an accurate frequency range of 5 Hz to 10 kHz, the capacitor will be 1000p with a Vec of +15 V

An tref of 10 aA is produced by R11 connected to the +15 V supply. This input (Pin 13) is also used for linear frequency modulation of the oscillator, R12 adjusts the FM

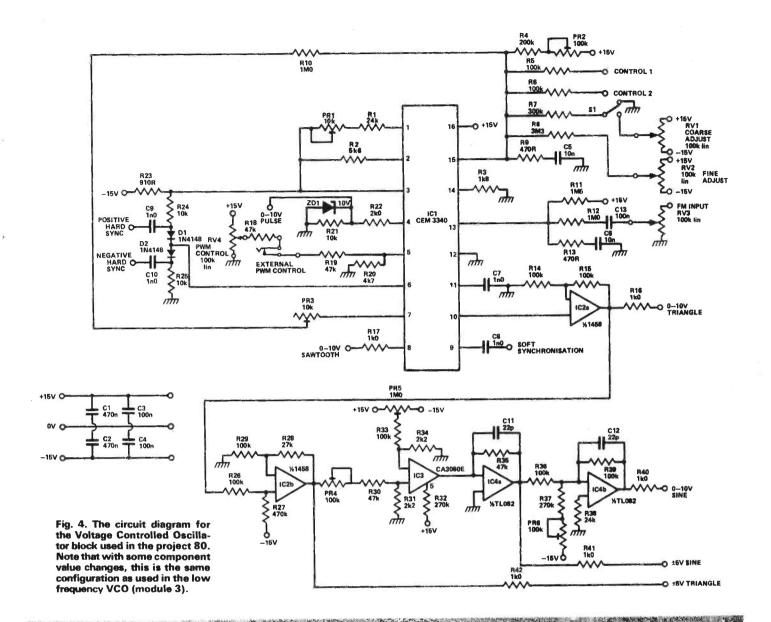
range to a 10% change in frequency per volt and an attenuating potentiometer (RV3) allows manual adjustment of this range. The PM laput has been AC coupled so as to avoid errors from any DC drift although it may be DC coupled if required. A negative voltage at Pin 13 will gate the oscillator off.

Reference was made earlier o the need to provide temperature compensation. One of the many novel features of the CEM 3340 is the incorporation of temperature compen-sation within the device. This is achieved by multiplying the current sourced into the con-trol pin (Pin 5) by a coefficient directly proportional to the absolute temperature. This coefficient is produced by the Tempco enerator using the same mechanism as in-

lation is hearly perfect.

A further problem that occurs with transsistor exponential converters is their bulk emitter resistance which becomes a significant factor as current is increased and will cause the oscillator to go that With the CEM 3340 this struction applies when current from C.Z. is greater than 50 u.A. Means of correcting for this effect have been included since Pin outputs a current which is a quarter of the exponential generator current. The current is converted to a voltage across TP-3 and a proportion can be fed back into the control input

via R10. Waveform Outputs, All waveform outputs from the IC are short circuit protected and may be shorted continuously to any supply without damaging the device. A 0 - 10 V sawtooth waveform is available at Pin 8 which sawtooth waveform is available at Pin 8 which can sink at least 0.6 mA and source over everal milliamps without any effect on oscillator performance and only a negligible effect on waveshape. The pulse output from Pin 4 is an open NPN emitter and therefore requires a pull down resistor to ground or a negative voltage. This output has been clamped with a 10 V zener diode (ZD 1) to give a 0 - 10 V pulse output. Pin 5 allows pulse width modulation and 0 to 5 V applied to this pin will vary the pulse width from 0 to 100%. Attenuvary the pulse width from 0 to 100%. Attenurange to our standard 0 to 10 V. P4 connected to +15 V provides manual control of pulse width and this control voltage is further attenuated by R18. RV4 input is connected via a jack socket so that it is disabled when an external voltage control source is used. Pin 10 outputs a 0 - 5. V triangle waveform. Although the sink and source capabilities approach those of the sawtooth this output has a finite impedance and also drives the comparator with the result that loading of this output into 100k impedance may lower frequency by 0.15%, in the worst case, This



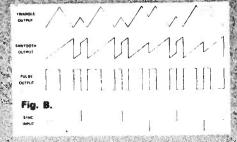
output has therefore been buffered by 102a

1 30 300

and addition of R14, R15 increases gain by two to give a 0 - 10 V triangle output. The triangle output is converted to 25 V at IC2b (this output is made available from the VCO) and attenuated to about ±100 mV by TP 4, R30 and R31 prior to IC3 which is a CA 3080E. Use is made of the non linear characteristics of the OTA at high input levels to convert the triangle into a sine wave. TP 4 adjusts the 3rd harmonic content and TP 5 and associated components at the inverting input of IC3 trim the 2nd harmonic. IC4a and provides a ±5 V sinewave. This output is 180° out of phase compared to all other outputs but this is not detrimental in most applications of this output. Finally the sine wave is shifted to a $0-10~\rm V$ input by IC4b with R37 and TP 6 as the level shifter.

Power supply to IC: The CEM 3340 will operate directly from positive supplies of between 10 and 18 V (although the amplitude of the waveforms as given above will decrease and increase respectively) and negative supplies

Synchroniseti Synchronisment of war-sation of oscillators is of a unpleasant beating effects tors are set to ratios to pr waveform. Synchronization can, also be used to produce some plans effects. The CEM 3340 has a wid offects. The CEM 3340 has a wider maps a synchronising effects than found on our winter that the synchronised oscillators. Solve the chronisation by negative pulses to Fin 5 causes the triangle upper peak to reverse direction prematurely with the result that the oscillation period is an integral multiple of the pulse period. If this input will not be used a should be by-passed to ground with a 180 capacitor (provision for this has been unde as the PCB). Alternatively, the 100s capacitor (CSA) may be connected to ground via a jath



PARTS LIST - VCO

		全工等的体 宝宝	
RESISTO	RS All WW	5%.	3
R8	3M3		P) A
R9,13		260	
R12			a la
R14,15,26		COLUMN TO A TOTAL Y	
29,33,36,3	39		2
R16,17,40), 1k0	1 1 1	
41,42	78L		d
R18,19,20	,47k	744 */}	
30,35		· · · · · · · · · · · · · · · · · · ·	· ·
R21,24,25	10k	3	
R22	2k0		
R23	'910R		
R27	470k	2 - A	The state of the s
R28	27k		
R31,34	2k2		der
R32,37	270k		
R38	24k		
S. D. D. C. C. C.			
RESISTO	KS All WW.	1%, 100ppm	T.C.
DOTE THE RESERVE AND ADDRESS OF THE PARTY OF			7 O 600
RI	24k		ı
• R2	24k 5k6		
R2 R3	24k 5k6 1k8		
R2 R3 R4	24k 5k6 1k8 200k		
R2 R3 R4 R5,6	24k 5k6 1k8 200k 100k		
R2 R3 R4 R5,6	24k 5k6 1k8 200k 100k 300k		
R2 R3 R4 R5,6 R7 R10	24k 5k6 1k8 200k 100k 300k 1M0		
R2 R3 R4 R5,6	24k 5k6 1k8 200k 100k 300k		
R2 R3 R4 R5,6 R7 R10 R11	24k 5k6 1k8 200k 100k 300k 1M0 1M5		
R2 R3 R4 R5,6 R7 R10 R11	24k 5k6 1k8 200k 100k 300k 1M0 1M5		
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO	24k 5k6 1k8 200k 100k 300k 1M0 1M5	ester	
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO C1,2 C3,4,13	24k 5k6 1k8 200k 100k 300k 1M0 1M5 ORS 470n poly 100n poly	ester ester	
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO C1,2 C3,4,13 C5,6	24k 5k6 1k8 200k 100k 300k 1M0 1M5 ORS 470n poly 100n polye	ester ester ster	
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO C1,2 C3,4,13 C5,6 C7	24k 5k6 1k8 200k 100k 300k 1M0 1M5 ORS 470n poly 100n polye 1n0 polye	ester ester ster tyrene	
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO C1,2 C3,4,13 C5,6 C7 C8,9,10	24k 5k6 1k8 200k 100k 300k 1M0 1M5 ORS 470n poly 100n polye 100 polye 1 n0 polye	ester ester ster tyrene ster	
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO C1,2 C3,4,13 C5,6 C7 C8,9,10 C8A (see	24k 5k6 1k8 200k 100k 300k 1M0 1M5 ORS 470n poly 100n polye 1n0 polye	ester ester ster tyrene ster	
R2 R3 R4 R5,6 R7 R10 R11 CAPACITO C1,2 C3,4,13 C5,6 C7 C8,9,10	24k 5k6 1k8 200k 100k 300k 1M0 1M5 ORS 470n poly 100n polye 100 polye 1 n0 polye	ester ester ster tyrene ster ester	1000年の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の

TRIMMERS

TP 1 10k cermet multitum
TP 2 100k cermet
TP 3 10k cermet multifum
TP 4,6 100k carbon
TP 5 1M carbon

POTENTIOMETERS RV1,2,3,4 100k lin.

SEMICONDUCTORS
IC1 CEM 3340
IC2 LM 1458
IC3 CA 3080E
IC4 TL 082
D1,2 1N4148
ZD1 BZY 8810V

MISCELLANEOUS

SPDT miniature switch; 3.5mm jack sockets (13)

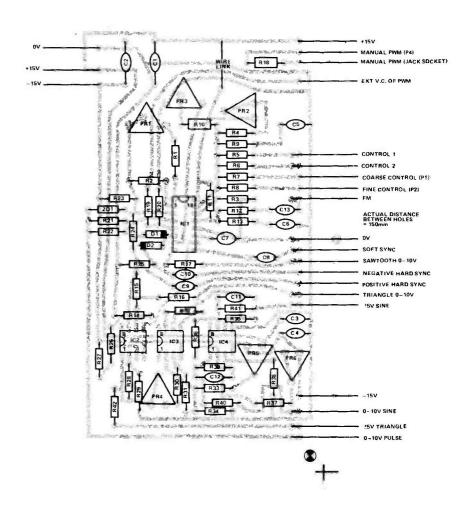
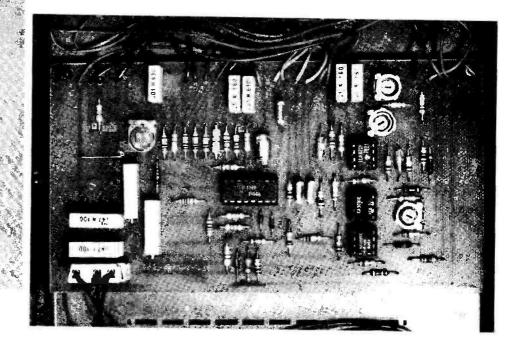


Fig. 5 (above). Component overlay for the VCO/VCLFO modules. The parts list to the left is for a standard VCO circuit. Use the changes given to the far right of page facing to convert to a low frequency oscillator. Below: A made up PCB sat sitting in its box.



he VCLFO is identical in design to the VCO described above. It is designed to operate in the range of 0.2 to 205 Hz with a 10 V control input. It is, however, capable of about 5 kHz. Alternatively a lower minimum frequency may be obtained by using a higher value timing capacitor, C7, provided that the capacitor is a very low leakage type.

Note the component changes listed. Construction and initial setting up follows the same procedure as the VCO except that the fine control potentiometer can be wired up prior to calibration.

Calibration

Set all trimmers to their mid position. Adjust sinewave output as described for VCO.

Turn both coarse and fine controls fully anti-clockwise (zero input) and apply a voltage to Control Input 1 to obtain doubling 100 Hz. Increase voltage by one volt and adjust TP 1 to obtain doubling of initial frequency. Repeat step until the one volt per octave response is achieved. Next increase frequency to about 1500 Hz, increase voltage by one volt and adjust TP 3 to obtain doubling of frequency. After adjusting TP 3 re-check setting of TP 1. Finally with 10 V applied to Control Input 1 adjust TP 2 to give a frequency of 205 Hz which will result in a frequency of 0.2 Hz with no external input voltages applied.

BUYLINES

The power supply PCB and components, including the heatsink and illuminated rocker switch but not the projectors, are available from Digistant for £19.55 incl. postage and VAT.

The PCB and components (including pots) for each voltage controlled conflictor are available from Digisound for £18.86 incl. postage and VAT.

Digital Ltd 13 The Brooklands Wree Green

Lancashire PR4 2NO
The modules are case in Teko Alba
A23G cases, available from
West Hyde Developments Ltd
Unit 9

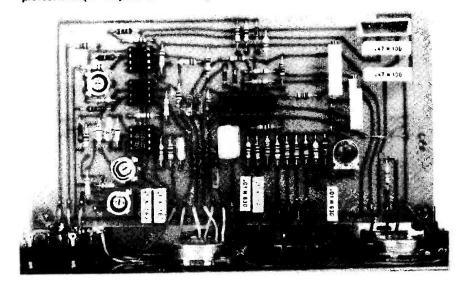
Perk Street Industrial Estate
Aylesbury
Sucks HP20 1ET

They cost £4,43 each incl. postage and VAT Please use order code TEK A23G.

MODULE 3: VCLFO



Above and below: the inside and outsides of a low frequency VCO. The PCB is panel mounted just to show we did both ways! This method of construction is best suited to professional (or *very* serious amateur) use.



HOW IT WORKS - VCLFO

Voltage Controlled Low Frequency Oscillator The LFO is identical in design to the VCO described above. A larger timing capacitor (C7) is used to give a frequency range of between 0.2 and 200 Hz with a 0 to 10 V control voltage. R4 and TP 4 are used to set the lower limit; RV2 provides an adjustment of one octave; and RV1 a range of 10 octaves. A switch is not required between RV1 and R7 in this instance. One reason is that both RV1 and RV2 are connected between +15 V and ground and so when the controls are fully anti-clockwise the oscillator is at the pre-set frequency (0,2 Hz). Secondly minor variations in frequency arising from RV1 and RV2 are of little importance for low frequency applications.

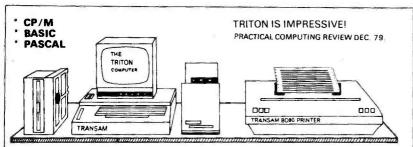
PARTS LIST - VCLFO

Component changes from VCO parts list.

R7 150k, 1% R4 470k, 1%

C7 10n polycarbonate R8 1M5,5%

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•	17 1 with	2k monitor 8k extended	hacia

•	LY. I WILL ZK INDINION OK EXICITIES	Dasic
		£409
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	3N74LS019	.18	\$N74L854N	.21 .21	\$874L\$1386 \$874L\$1386	.75	SN74L81960	1.20	SN74L8329N	2.55	SUPPORT		2101	2.32
											6212	2.20	21.02L-4	1.20
	SN74LSQ211	.22	3874L863N	1.50	SN74L3145A	1.20	SN74L8197N	1.20	SN74L3327N	2.95	8216	2.00	2111	2.32
	SH74L803M	.26	\$M74L\$73H	.35	3M74L3 148M	1.75	SN74L8221N	1.25	SN74LS352N	1.35	8224	2.80	2112	2.46
	3N74L8D4N	.25	\$1741.3740	.40	8M74L8 151M	.85	8N74L824DN	2.20	SN74L8353N	1.50	3853 (FB)	10.00	5610	4.00
	831.741. 385 31	.26	\$N74L875K	.46	\$874LS 53N	.00	8N74L8241N	1.99	SN74L8365N	.85	8228	4.20	8154	11.50
	SN74L808N	.20	81174L876H	.35	SN74L8154M	1.00	8N74L8242N	1.90	\$M74LS365M	.05	8T26A	1.75	21141-450	5.50
	841748LD6H	.22	3874L5788	.35	SN74L8156N	1.25	-M174L32430	1.95	SN74L8367N	.85	8T28	1.90		7.60
	80174LS1001	.18	SN74L883AN	1.15	\$1174L8 58M	1.25	3N74L3244N	2.10	SN74L8368N	.65	6522	8.75	R114L-250	
	8874LS118	.26	8074L385H	1.10	SN74LS157N	.00	8N74L8245N	3.00	SN74LS373M	1.75	8251	5.00	740920	11.00
	SN74L312N	.25	\$9174L\$86H	.40	8M74LS150M	. 50	SM74L8247W	1.25	SN74L8374N	1.70	8253	11.00	740921	11.00
	8874L813H	.56	8N74LS90N	.85	\$31,74L\$ 160H	1.15	\$1174L\$2480	1.98	SN74LS375#	.72	6255	5.00	740929	11.00
	SN74LS14N		20174L20 IN	.90	SN74LS181N	1.15	SN74LS24901	1.30	SN74L\$377N	1.75	8257	11.00	4027	5.00
	8N74LS15N	25	SN74LS92N	.90	311741.516211	1.15	SN74L82519	1.45	SN74LS37991	1.32	8259	12.50	4044	7.98
	\$87415200	.20	SN74L3938H	.85	SN74LS163N	.90	SN74L3253N	1.25	SN74L8379H	1.40	6155	12.50	4045	7.00
	SH74L221N	.26	8N74LE95AN	1.20	SN74LS1640	1.50	8N74L\$257N	1.40	SN74LS361N	3.65	6402	5.00	4060	7.00
	SN74L3229	.26	\$8741,5966	1.75	SN74LS165N	1.70	\$8(74,\$258)	.95	SN74LS388N	.57	6821P	4.50	2107	7,86
	8M74L\$26M	.29	\$M74L\$1079	.30	SN74LS106M	1.75	SN74L8259N	1.45	SN74L839DN	1.90	6850P	4.60	4116 (58 for 8)	8.00
	SN74L\$270	.35	SM74LS10000	.30	\$N74L\$1880	1.95	SN74L8280H	.30	SN74LS393N	1.50	6852P	5.50	4118	20.00
	SN74L328M	.35	\$874131129	.30	SN74LS1600	1.95	SN74LS261N	3.50	SN74LS395N	1.80	AY-5-2376	11.50	Z\$0P10	8.00
	38741.8309	.25	3874.31139	.44	SN74LS1700	2.50	SN74L\$266N	.30	SN74LS396N	1.70	MC14411	12.00	ZBOCTC	6.00
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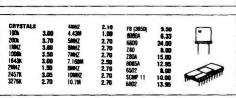
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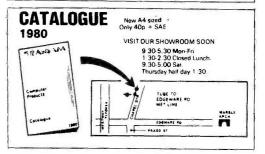
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ECCTONICS LOCAL International

What to look for in the March issue: on sale February 1st



TV SOUNDS GOOD?

Tired of tinny tunes from your telly? The melodic meanderings start out from the transmitter in super-duper hi-fi, but the cost cutting sounds section of your set takes care of that, lowering the fi at the speed of light. Next month Richard Maybury explores the world of TV sound and comes up with a few ideas on improving it.

ELECTROMYOGRAM

The ETI Muscle Meter senses the tiny electrical impulses associated with muscle activity. As Superman flexes his biceps you can hear it all happening and see the activity building up on a meter.

THE ULTIMATE METAL LOCATOR

Calling all treasure hunters. How many times has your metal detector gone ping or buzz or hello sailor and you've shifted half a ton of Surrey only to find a non-biodegradable ring pull tab? Well, next month we have a discriminating metal locator for you.

The magic machine rejects nails, bottle caps, aluminium foil and ring pull tabs. The design also features full ground effect exclusion over normal or high permeability soils. Search for your pot of gold with deepseeking VLF plus three TR discriminating ranges. Instant tuning recall is made possible by a push button memory circuit.

BLACK HOLES

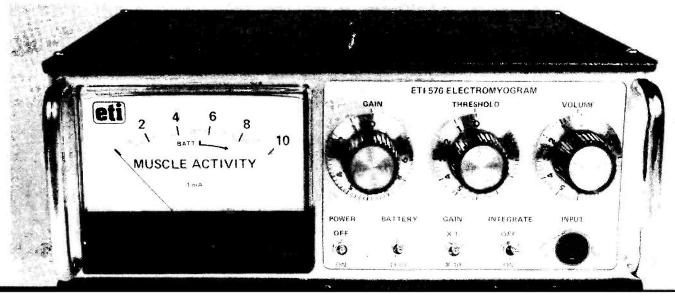
When a massive star reaches the end of its life, uses the last of its nuclear fuel and explodes as a supernova, one of three things can happen. The supernova explosion may destroy the core, or, if a small core remains, it may become a neutron star, or, if it is large enough, it may collapse to form a black hole.

Next month Ian Graham has a bash at explaining that most enigmatic of astronomical propositions — the black hole.

HEATER POWER CONTROLLER

With most heater controllers, your heater is either on or off and the room temperature fluctuates several degrees either side of 'comfy'. Our design will keep your room temperature stable to within half a degree. In addition, by using zero voltage switching, RF interference is avoided.

If you're into Biofeedback you can use the ETI Muscle Meter to learn to relax more effectively. On the other hand, if you're into having fun, there's plenty of scope for doing your own thing. Watch this space (give or take a few pages) to find out how the miracle machine picks out the fractions of a microvolt of relaxed muscles from the volts of 50 Hz hum present in the body — induced from power and light wiring.





DESIGNER'S NOTEBOOK

Project editor Ray Marston makes an in-depth review of the revolutionary mini-robot, HEBOT.

he basic electronic concept of the Hobby Electronics HEBOT is brilliantly innovative and uses the priority encoding principle illustrated in Fig 1. Each drive motor is energised fron an analogue driver circuit. Each driver has a high input impedance and can drive its motor forward or backward at a speed proportional to the input voltage. The motor drive 'instructions' (analogue voltages) can be selected from any one of (up to) eight independent sources (or circuit boards) via a motor instruction selector or 'multi-way electronic switch', which has its position controlled by an (up to) eight-level priority encoder. This encoder causes the motor to take its instructions from the source or circuit board with the highest active priority coding at any given moment of time and is analogous to a human central nervous system.

Suppose that we connect just four independent circuit boards to the HEBOT's central nervous system and assign each board a priority number as shown in Fig 1. Board 1, with the lowest coding, simply instructs the motors to drive HEBOT in a 'search' pattern. Board 2 is a light-sensing

circuit that gives a 'high' output to the priority encoder only in the presence of bright light and then produces motor instructions that steer the HEBOT towards the light source.

Board 3 is designed to detect the presence of, and guide the motors along, an inductively-coded wire loop. This board produces a 'high' priority output only in the presence of the loop. Finally, board 4 (with the highest priority coding) handles the tactile sensor logic and produces a 'high' priority output in the event of a collision and then instructs the motors to execute a suitable avoidance manoeuvre.

A Sequence Of Actions

A possible sequence of HEBOT actions may in this case be as follows.

At switch-on, all priority outputs except '1' may be low, so HEBOT accepts instructions from board 1 and goes into a 'search' or rotary-movement mode. During this move-

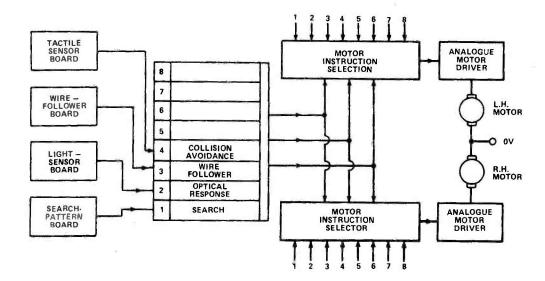


Fig 1. The priority encoding principle used in HEBOT has revolutionary implications in Robotics.

ment the light-sensing board may detect a powerful light source some distance away and so set its priority output high and start generating the motor instructions necessary to steer the HEBOT towards the light source. Since '2' is a higher priority number than '1', the priority encoder will automatically turn the motor instruction selectors to board 2 and HEBOT will start moving towards the light source. Note that under this condition the 'search mode' instructions may still be generated but will be ignored by HEBOT.

Suppose now that, as HEBOT moves towards the light source, board 3 detects the presence of an inductively coded wire loop. In this case the priority-3 output of the board will go high and HEBOT will lock on to the motor drive instructions of board 3, ignoring the instructions of boards 1 and 2. While following the inductive wire, HEBOT may collide with an object. The collision will be detected by board 4 (the highest priority board) and the mini-robot will then execute an avoidance manoeuvre based on instructions from board 4, ignoring all instructions from boards with lower priority numbers.

On completion of the avoidance manoeuvre, HEBOT may have lost contact with both the inductive wire (priority 3) and the light source (priority 2), in which it will revert to the priority-1 'search' mode until a higher priority number is generated.

A Revolutionary Concept

This 'priority coding' system has enormously important and revolutionary implications in robotics. First, it means that robots no longer have to be designed as single complex entities, but can be built as highly versatile devices containing a number of quite independent control/sensing modules, all feeding ino a simple central nervous system or priority encoder.

The simple (?) version of HEBOT published in the recent editions of Hobby Electronics uses only the four priority levels already described. The experimenter can, however,

and the same of th	Colored Colore
8	RADIO CONTROL
7	COLLISION AVOIDANCE, (TACTILE)
6	COLLISION AVOIDANCE, (ULTRA–SONIC)
5	HUNGER AVOIDANCE
4	WIRE FOLLOWER MODE [SEARCH AND LOCK]
3	OPTICAL RESPONSE
2	ACOUSTIC RESPONSE
1	'SLEEP' MODE

Fig 2. A possible sequence of priority coding for an advanced version of HEBOT.

design additional control boards and add them to the HEBOT at will. Figure 2 shows a possible way of connecting a number of independent circuits into the HEBOT central nervous system to give eight levels of priority encoding.

Individual boards can even incorporate their own priority-coded response conditioners, in which case they can be regarded as NERVOUS SUB-SYSTEMS

Human Behaviour

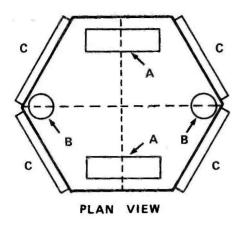
The second important implication of the HEBOT priority coding system is that it can give a very close analogy of animal/human behaviour. Figure 3 is a provisional table of human behavioural priority levels. The table shows six main priority levels, with COMFORT/PLEASURE (into which work ethic is entwined) having the lowest priority level and CONFORMANCE (conditioned resposes) having the highest priority level (even higher than survival). If a page 1.

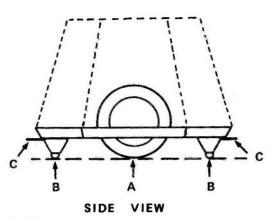
1000		_
6	CONFORMANCE (CONDITIONED RESPONSES)	
5	SURVIVAL	
4	PAIN AVOIDANCE	
3	SLEEP (RECOUPERATION)	
2	HUNGER SATISFACTION	
1	COMFORT WORK ETHIC PLEASURE	
MAIN	PRIORITY LEVELS	-

Fig 3. Provisional chart of human behavioural priority levels and survival sub-levels. Behavioural patterns are predictable and can be simulated by a HEBOT-type robot.

	A
7	DESTRUCTION AVOIDANCE
6	EXHAUSTION AVOIDANCE
5	STARVATION AVOIDANCE
4	DAMAGE AVOIDANCE
3	ATTACK AVOIDANCE
2	THREAT AVOIDANCE
1	SPECIES SURVIVAL

SURVIVAL PRIORITY SUB-LEVELS





A = MOTOR DRIVE UNIT B = BALL CASTOR C = TACTILE SENSOR

number of these priority levels are stimulated simultaneously, the highest priority will override the lower ones.

The really fascinating feature of human/animal behaviour is that each of the main priority levels consists of a number of sub-levels. In Fig 3 seven main sub-levels of the survival priority are shown. Each of these sub-levels can in turn contain priority sub-levels. Each level and sub-level is fed with sensor information which itself has a number of basic levels: peckishness, hunger and starvation are, for example, three levels of the same basic sense which, when connected to the appropriate levels and sub-levels, produce highly complex but predictable behavioural patterns.

Similarly, work ethic normally has a low rating in the main priority levels but may, under certain circumstances, attain very high priority ratings as discrete sub-levels of a survival (level 5) or conformance (level 6) main priority level.

These complex behavioural patterns can easily be electronically simulated, or modified and improved upon, by using HEBOT's basic and revolutionary 'priority encoding' concept.

Fig. 4. (Above) The HEBOT chassis. Although outwardly very simple, a great deal of thought and effort went into the final design of this. Anyone who saw HEBOT trotting around at Breadboard exhibition recently will realise that this configuration is in no way a limiting factor on HEBOTS performance.

The shape of the chassis helped us to determine several important factors for HEBOT and helped in finalising the tactile sensor arrangements.

highly sophisticated super-robot. At the other end of the scale, it is feasible that a highly sophisticated HEBOT-type robot could (like a living animal) have 90% of its circuitry blasted to shreds by machine-gun fire yet still be able to perform useful function (stay alive). In this latter case, the 'vital organs' of the HEBOT are the central nervous system, the motor drive system and the power supply unit.

You can see, then, why we are so proud of HEBOT. Superficially, it does not look very impressive, but it in fact incorporates the most far reaching design concept yet devised in the field of robotics. It represents a major breakthrough in robot technology and places the off-the-shelf commercial/domestic robot of 'science fiction' within the reach of all of us. And, by jove, it's British!

Indestructible

The final important implication of the HEBOT 'priority encoding' system is that, since most priority levels and sub-levels are normally low or inactive,, it follows that total obliteration of an individual priority level will resull in a mere degradation of the total performance of, rather than the total disabling of, a priority encoded robot system. Compare this concept with that of a television or computer, where every individual component is vital to the functioning of the total system! An alternative way of stating the same point is to say that the performance sophistication of a priority-encoded robot can be enhanced at any time by merely adding extra priority levels or sub-levels to its existing 'nervous system'.

Thus, at one end of the complexity scale, our simple little HEBOT project can (in principle) easily be expanded into a

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		4023	13p	4066	30p
		4024	40p	4068	13p
4001	130	4025	13p	4069	13p
4002	13p	4026	90p	4070	13p
4007	13p	4027	28p	4071	13p
4009	30p	4028	45p	4072	13:
4011	13p	4029	50p	4081	13p
4012	13p	4040	550	4093	36p
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4015	50p	4042	55p	4511	60p
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П	BC148	7p	TIP30C	70p	2N3820	44p	
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MYLAR F 0.001, 0.01, 0.068, 0.1	0.02	2, 0.0				27	e e	e).	3p 4p
POLYESTI Mullard C28	0 seri			•	047	^	000	^	
0.01, 0.015, 0.15, 0.22	0.02	2, U.C	J33,	Ų.	047,	U.	U68,	U.	
	55.0		2.7	- 1		4.			7p
0.33, 0.47	¥	14	3	4	*	1	4	4	10p
0.68			13		ě.		2		14p
1.0uF									1.7p
CERAMIC									
Plata tura El									

ITT Full spec. product 1N4148 £1.40-100

22pF to 1000pF and E6 series from 1500pF to 0.047uF

RADIAL LEAD ELECTROLYTIC 63V 0.47 1.0 2.2 4.7 10

			22	33	47	7p
	100	,				13p
			220			20p
25V	10	22	33	47		5p
	100					8p
		220			-	10p
				470		15p
	1000					23p

CONNECTORS

JACK	PLUGS	AND	SOCK	ΕT	
------	-------	-----	------	----	--

	unscreened	screened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8 p
Standard	16p	30p	15p
Stereo	23p	36p	18p
DIN PLUC	S AND SOCK	ETS	
	plug	chassis	line

	plug	chassis	line		
		socket	socket		
2pin	7p	7p	7p		
3pin	11p	9p	14p		
5pin 180°	11p	10p	14p		
5pin 240°	1 3 p	10p	16p		
1mm PLUG	S AND SOC	KETS			

Suitable for low voltage circuits, Red & black. Plugs: 6p each — Sockets: 7p each.

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Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each

PHONO PLUGS	ANDS	OCKETS		
Insulated plug in	red or	black	skr	9p
Screened plug		1 10 (F F)	+	13p
Single socket.	7 p	Double socket	×	10p

Electronic Components

JANUARY SPECIALS

A range of special offer items valid during January. All orders placed for these items <u>must</u> be received during January



during January.						_		
Pack of 3 x LM380 .	b 1 1						225p	200p
Pack of 30 x 1N4001	Ac 9 4			Table 1	,		120p	100p
Pack of 4 x FND500	Ar a d	tr.	4		8		400p	350p
Pack of 15 x 2N3702	2 2 2	- 4		4.			120p	100p
Pack of 15 x BC107					15		120p	100p
Special pack of nuts + over 600 4BA + 6BA					g			
washers		f		W.	3		330 p	250p
Pack of 4 red + 4 blac	k croco	odile	e cl	ips	;	ä	_64p	50p
Mixer control knobs, i	per 100	n) C	nix	ed))			
colours to suit					7		1400p	1300p

MULTIMETERS

A really smart looking multimeter with an impressive specification for such a small size. The very clean scale in white and green on a black background makes this meter very easy to read. The D.C. Impedance of this meter is 4K ohms per volt which is exceptionally good compared with the vast majority of multimeters of a similar size £5.95 each.

SPECIFICATION

DC Volts AC Volts DC Current Resistance

5V 25V 250V 500V (4K ohms/V) 10V 50V 500V 1000V (2K ohms/V) 250uA 250mA 0 - 600K (7K ohms centre)

PANEL METERS



5p

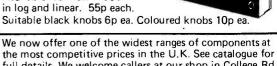
High quality 2" wide view meters. Zero adjustment. Back illumination

Available in 50 uA, 100 uA, 500 uA, 1mA, 100mA, 500mA, 1A. £4.95 ea. VU meter similar style. £1.50 ea.

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Available from 5k - 500K in log and linear. 55p each.



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BY RETURN

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☆ THIS YEAR'S STAR BUY ☆

THE NEW 83QS — 27B ALARM CHRONOGRAPH

Optional display of hours, minutes, seconds, date, am/pm; or alternatively: Hours, minutes, alpha day, date, am/pm. The automatic calendar is set for 28 days in February. Casio's new Lithium battery lasts up to 4 YEARS or more. The chronograph times in 1/10 second units up to 12 hours, measuring net, lap and first and second place times. An indicator shows the chronograph is running when normal time is displayed. The 24 hour alarm can be set very easily to 1 minute intervals with an indicator to show the alarm is set.

In addition the watch can be set to chime every hour, on the hour, with a separate indicator to show this function is

A micro light illuminates the display at night time. This superb watch is stainless steel encased, has a mineral glass face and is guaranteed water resistant to 66 feet (2 atmospheres)



RRP £27.95



F-200 SPORTS CHRONO

Day, date, month, 1/100 sec. chrono to 1 hour. Net, lap and 1st and 2nd place times. Backlight. Resin case/strap. Mineral glass. W.R. to 66 feet. Silver oxide

(0:58s

(£17.95) £15.95

3 YEAR BATTERY Hours, minutes, seconds, date, day, am/pm. Auto 28, 30, 31 day calendar. Backlight, Resin case strap. Mineral glass. W.R. to 66 feet

(£12.95) £10.95

NB. This watch does not have a



Scientifics with volatile memory: FX-310 £17.85. FX-510 £19.95. FX-2600 £19.95. FX-3200 £21.96.

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4 digit ultra slim watch with four year calendar and 24 hour

59CS-33B Stainless steel (£49.95)

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wieksto repail
Adubious or non-existent spares service
If you want a watch that the manufacturer doesn't
put his namic on
THEN DON'T BUY A CASIO

ALARM CHRONOGRAPHS

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(£31.95)

£27.95

1/100 second chrono to seven hours. Net, lap and 1st and second place



ctable hourly chime facility.

Mineral glass face.

81CS - 36B As above but

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TUNING FORK

You don't have to bash this tuning fork on its head and sit it on the sideboard to get a note. Just flick a switch and get a constant frequency tuning tone.

usical instruments are generally a clever and harmonious blend of physics and aesthetics (both aural and visual). But, underlying all this wonderful harmony and human cleverness is the law of 'the cussedness of nature'. This law, simply explained, says that through all the consistency and harmony we find in nature runs a streak of cussedness always causing something to be out of place. It is this very streak of cussedness that has thwarted attempts to date to develop a 'unified field' theory that would link gravity, electricity and magnetism.

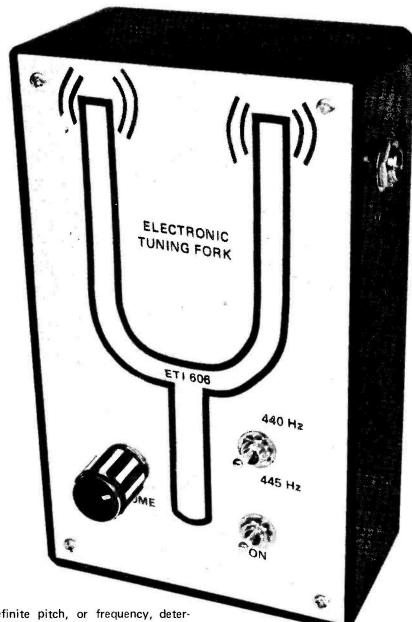
It doesn't seem, at this stage, that gravity, electricity and magnetism have much to do with musical instruments and tuning forks, but we'll get around to it!

For one musical instrument to be played with another requires both to be tuned to the same fundamental pitch (or frequency). If not, the sound will be unpleasant — generally described as discordant,

Fork Lore

Over the centuries there were various ideas as to what basic 'standard' pitch would be adopted. After some considerable squabbling a 'standard concert pitch' was settled upon in 1929. This gave the note 'A' a pitch of 440 Hz. That standard remains to this day. Of course, it means that modern orchestras playing the music of Hadyn, Mozart and Bach, for example, will not be playing in the pitch in which the music was originally composed.

The traditional tuning fork consists of two cantilevered bars attached to a common base — it resembles that common eating utensil, hence the name. When the tines are struck (or one tine) they will vibrate, producing a sound of



a definite pitch, or frequency, determined by the length of the tines. The pitch is largely unaffected by temperature, except by gross variations, and accuracy can be maintained within about 0.1%.

They are portable and relatively inexpensive but suffer from low sound

level output and do not give a sustained note — it 'dies away'. What's more, as many modern groups use electrically amplified instruments and sound reinforcement, a failing of tuning forks is lack of a pick-up.

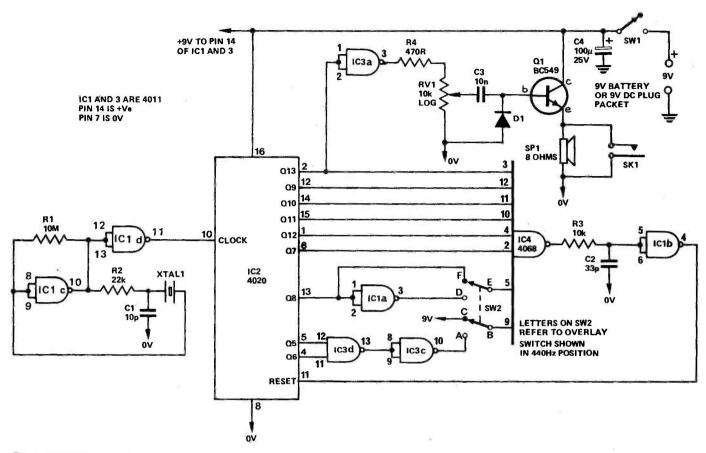
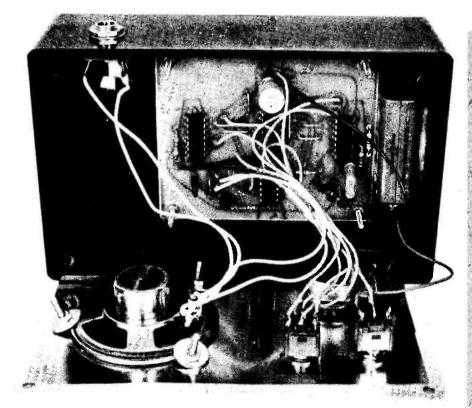


Fig. 1. Circuit diagram.



When you get all your bits bolted down into box, it should look like this.

HOW IT WORKS

The signal is generated at a high frequency (about 3.6 MHz) by a crystal oscillator and then divided down to the output frequency by a counting circuit. ICIc is the oscillator, — gates biased into their linear region by RI and R2. Capacitor C1 forms a phase shift network with the bias components, providing a shift of 180 degrees at the crystal frequency. As the crystal is in series with the feedback path, the circuit will oscillate at the crystal frequency.

at the crystal frequency.

IC1d forms a buffer between the occillator and the clock input of IC2, a 14 stage counter.

As the required division is not a power of two, decoding of the counter (IC2) outputs is necessary. This is provided in three gates — IC1a, IC3c and IC3d. These modify the counts of IC2ato obtain the required division by resetting IC2 after the appropriate count priate count.

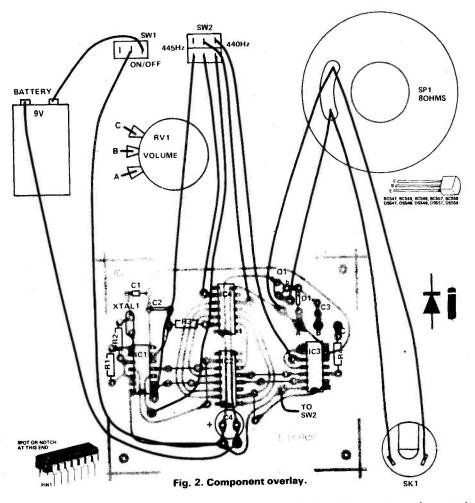
priate count.

Switch SW2 changes the decoding for either a division by 8128 for a 440 Hz output or 8048 for a 445 Hz output or 8048 for a 445 Hz output.

When all the input of IC4, an eight input NOR gate, go high its output goes low and drives IC1b via a network to remove noise pulses (R3, C2). IC1d then provides a reset signal to the divider, ready for the next count.

The Q13 output from the divider provides a signal at the required frequency and, after buffering provided by IC3a is fed to the volume control. The pulses are then fed to an emitter follower (Q1) and thence to the speaker.

The William Land Comment of the Comm



PARTS LIST

P/	AKIS LISI
Resistor	All 4W, 5%
RI	10M
R2	22k
R3	10k
- R4	470R
Capacito	
C1	10p ceramic
C2	33p ceramic
_C3	10n polyester
C4	100u 25V electrolytic
Semicon	
3C14C3	4011B or C
IC2	4020
IC4	4068
Q1	BC548,BC108 or similar
D1	1N914 or similar
Miscella	
RVI	10k log poten kometer * 3.579545 Mars Atal
SP1 SW1	8 ohm speaker SPST miniature toggle
301	- switch
SW2	DPDT miniature toggle
	switch
BSK1	mono jack socket
9 V bat	tery or Plug Pack (Ferguson
type PP	A9 - DC or similar), PCB,
box to	suit (155 mm x 105 mm x
	knob, plug for jack socket
(if need	ea).

Again, the cussedness of nature raises its head. Remember too, the popularity of the electric guitar. They have magnetic pickups and require plugging into an amplifier. Now you see what electricity and magnetism have to do with musical instruments! Gravity? Oh, most instruments will go out of tune when dropped from a height!

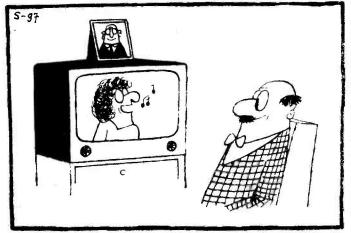
Construction

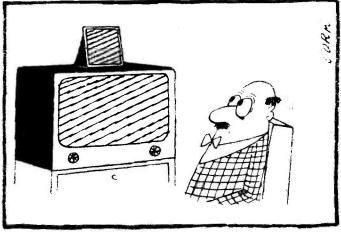
We strongly recommend you use the pc board specified for this project. For a start, it simplifies construction, and secondly it reduces the possibility of wiring errors. With digital circuitry, bugs created by wiring errors can prove most frustrating to track down — particularly if you haven't had much experience with digital equipment. The project is not a difficult one; if you have had a small amount of experience constructing projects and finding your way around circuits and layout diagrams, then it should not prove too challenging.

It is best to commence construction

by assembling the components on the printed board. Leave the ICs till last. Solder the crystal, the BC547 transistor, diode, resistors and capacitors in first. Watch the orientation of the diode, D1. Then do all the links using, say 22 gauge, tinned copper wire. There are six in all. Take care here, and refer to the overlay.

The last thing to do is check that you have the switches wired correctly. Make sure that when you switch from 440 Hz to 445 Hz the output goes a little sharp in pitch.





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21053	125×65×40mm	£1.40

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	1-99	100-499	500+
8 pin	.095	.075	.065
14 pin	.105	.085	.075
16 pin	.12	.095	.085
18 pin	.155	.125	10
20 pin	.19	.15	.12
22 pin	.21	.17	.14
24 pin	.24	.19	.15
28 pin	.26	.21	.16
40 pin	.32	.26	21

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100 of on	e type at the	ese low price	s!!)
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BC147	€5	BFY52	£14
BC148	£5	BSY95A	£10
BC149	£5	BU205	£65
BC159	£5	BU206	€65
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BC1828	€4.50	2N2369	£12
1k	£35	2N2894	£12
1.0k	€310	2N2926Y	£5
BC1B3B	£5	2N2926R	£5
BC184L	£5	2N3053	£13
BC212	£5	2N3054	€34
BC213L	£5	2N3055	€34
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BC238B	£5	2N3583	£45
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BC230	£7	2N3708	
BC238	€8	2N4401	£5
BC337	€8	2N4403	66
BC348	£5	2N5401	£19
BC351	£14		
BC557A	£5	DIOD	ES
BCX33	€5.	1N4001	£3.50
BD131	£19	1k	£28
BD132	€20	1N4004	£4.50
BD181	€50	1 k	€39
BD184	€60	1N4006	£5.50
BD246	€25	1 k	£46
BD525	£25	1N4148	£2.30
BD526	£25	1 k	£17
B0173	£13		
BF181	£17	ICs	
8F195	€5	741 8dit £	13.50
8F197	£5		21.75
BF198	£5	723 14dil	£32
BF241	£5	723 TO99	€30

Resistors — 1/4W 5% carbon film, these values only: 220R, 470R, 1k, 3k9, 4k7, 33k, 47k, 220k, 18R, All at £4 per 1,000 (min qty of one value) or £35 per 10,000

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atlogether for £5.07. 8.022. 0.33. 0.47 µ. 110 ach altogether for £5.07. ROO4 Mylar capacitors. min 100V type 10 each all values from 1.000pf to 10.000pf Total 130 for £4.05. ROO7. Electrolytic capacitors 25V working small physical size. 10 each of these popular values 1.2. 4.7. 10. 22. 4.7. 100.4. Total 70 for £3.59 ROO8 Extended range, as above, also including 220, 470 and 1000 µ.F. Total 510 for £6.05. RO21 Miniature carbon film 5% resistors £8.25 cmillar. 10 d each value from 10R to 1M. £12 series. Total 610 resistors £6.15. RO22 Extended range. Total 850 resistors from 1R to 10M £8.50. RO41 Zene doddes 400mW 5% 82Y88, etc. 10

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and driver board, supplied with circuit and connection data, £3.50.

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19p	2N2906	38p	BD135	8p	BC159	10p	BCY72	7p	BC109
19p	2N2907	38p	BD136	16p	BC327	8p	BC212	7p	BC147
49p	2N3054	34p	BD139	14p	BC328	8p	BC213	7p	BC148
40p	2N3055	34p	B 0140	15p	BC337	8p	BC214	7p	BC149
38p	TIP30	17p	BFY50	14p	BC338	8p	BC557	7p	BC182
•		17p	BFY51	15p	DC71	20p	BC143	18p	BC117
25p			555 Time	18p		plastic	741 8 pin	4p	1N4001
55p		CA3046 trans array			oil				1N4004
95p		TBA810 7W amp				10	709 op an		1N4005
110p	ck	stereo de		40p			MC1458 c	5p	1N4007
100p			7805 5V i	50p		uad amp	LM3900 c	2p	1N4148
30p	3	DOV bridge	W04 1A 4	12p	.2in	or yell 0	LEG green	3p	1N914
	ck	17p ans array W amp stereo de	BFY51 555 Time CA3046 to TBA810 7 MC1310P 7805 5V i	15p 18p 14p 29p 40p 50p	DC71 ail	20p plastic can spin tp ual 741 uad amp	741 8 pin 741 metal 709 op an MC1458 c LM3900 q	4p 4p 4p 4p 5p 2p	BC117 1N4001 1N4004 1N4005 1N4007 1N4148

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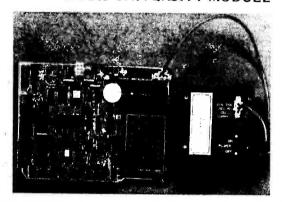
LOGIC EMULATOR

Does your logic lie to you? Do you doubt the truth of your tables? Next month we present a solution to your logic design problems with a software logic emulator for the Nascom. The design caters for the usual range of logic gates and will allow you to try out various input combinations. A must for all who are not up to Mr. Spock's logical capabilities!

We start a new occasional series on connections you can make with your micro. In the first part we show you how to get your Mk14 or Acorn to flash lights on and off, a vital step for micro-mankind.

MICROLINK

TEXAS UNIVERSITY MODULE



There have been evaluation kits and there have been teaching aids. Now there are teaching aids which can double as an evaluation kit! What Texas have produced, however, is a one board education system (TM990/189) which is also an excellent evaluation and to the TMS 9980 16-bit MPU!

A 300 page course comes with the board—along with a hell of a lot else. But is it good value? Can it teach machine code programming as promised? Could it really educate cavement and Spurs supporters? Can it make good tea?

Don't miss next month's stunning inside information when CT reveals all on the TM990/189. The Wews of the Norld will envy us.

It has been the most (and longest) awaited home computing system for a considerable time. Everyone we spoke to had heard of it — and knew a great deal about it — but no-one had actually seen it!!!

Well we can put you out of the state of suspense because CT has been examining a Nascom 2 in great detail and will report all that there is to be reported in our next issue.

Whatever you were expecting we can guarantee you that the Nascom is a surprise!

NASCOM 2





Ron Harris takes time off returning noisy records for a chat with the record industry and a word about mini headphones with a mighty performance.

am appalled. Totally and utterly appalled. Apart from that I'm not even happy. In the past month I have attempted in vain to buy myself some LPs with which to exercise all this hi-fi stuff our hobby is based upon.

I was particularly looking forward to 'Tusk'. After all, it, cost a large fortune to produce — digital mixing and all — and the music promised to be worth all the effort. Six copies later I still cannot comment on how good the production finally turned out. Six copies and six doses of snap crackle and pop made me give up on the idea completely. Sorry Warner Bros but I do like some music with my surface noise. Silly, I know, but I'm old-fashioned that way.

The new Pink Floyd double LP led me a similar dance, wearing out the carpet in the record shop in the process. No-fi 2 me 0, and so it continued all month. Final score? LPs purchased — five; LPs kept — one; copies returned twelve.

Now admittedly this has been the worst ever month for duff records, but it is not unfortunately actually unique. Most records these days have to go back at least once — the record shop next to our office (Our Price Records — and very helpful they are too, thank God) is thinking of giving me a job. After all 1 spend more time at the exchange counter than the staff.

Other people I've talked to about this seem to suffer from a similar malaise, so I'm not gonna feel too paranoid just yet. Besides, you meet a nice class of person exchanging LPs. Beats discos anytime.

Trouble is — what is the point of all this ultra-fi that some of us are addicted to, if record companies go on churning out pure unadulterated garbage for us to play on it? Digital LPs may be on the way but in the meanwhile we have got to live with the surfaces upon which our music is recorded. Please please please Mr Record Executive Sir take your quality control a bit more seriously. No wonder record sales continue to fall, so does the quality of the product.

If there is anyone out there involved in the industry, engineers, technicians, producers, mixers, or even artists themselves, HELP. It's about time we all stood up and got counted. It seems everyone from us poor consumers back down the line wants something done, but no-one is actually doing it!

Well, having added one more small voice to all those already crying into the wind I'll cease and desist — after a quick wave of the fist in the appropriate direction.

MDR-3 Headphones

Open headphones seem to have continued to gain popularity steadily in recent years and it is never a surprise to see a new pair released. Some years ago Sony had a pair on the market, entitled DR-15s, which I thought to be excellent value for my money. About three weeks ago I was very interested, therefore, to see the new MDR-3 open headphones from the very same Sony.

These units are incredibly small and light, and thus comfortable. At first glance they look just *too* small to complete. At first *listen*, however, the universal reaction so far has been dropping of chins onto chests. My first thought was to go scrambling through the accompanying paper to find the price. I had expected somewhere in the region of £30-£40.

It came as a shock to read only £16 in the blurb.

The MDR-3 is a revolution at that price. The sound quality is truly amazing and will satisfy most types of listener. Rock followers who are made a little uneasy by the slightly 'light' balance can apply bass boost all they want with little or no complaints from the MDR-3.

Compared against Koss ESP-10 electrostatics, the transducers are shown to be adding a certain amount of 'warmth' to the sound, especially in the midrange, but this is no bad thing on headphones, I feel, and is certainly preferable to a hard, colder approach with no room effects to temper it. The treble is well extended and smooth and showed no tendency to harshness or a brittle nature.

The bass is obviously going to be less plentiful than on the much heavier 'can' type of phone but that diaphragm must be moving a long way indeed to produce bass as well as it does.

I have no complaints to make of the bass overall.

Cryptic Comments

Fitting the phones to the head is simple enough, the cups are angled back so they naturally lie in the same direction as your ears on your head (statement only valid for human subjects. Aliens can figure it out themselves) and have a certain degree of freedom to move and thus align themselves better.



The MDR-3s really are *small*. We tried several young ladies heads, in an attempt to convey just how small — but each time the headphones got lost! Those earpieces are about the size of a 50p piece. But no-one at ETI had one of those either.

As Sony say in their little leaflet, positioning is vital for best performance, so it is advisable to bend the headband to get the best fit with the pads exactly over the ears. Once set, they'll stay there until the moon falls, if necessary, although I doubt if you'll find an LP that long.

The chord is supposed to be oxygen-free copper — a chemical impossibility I would have thought — and is not of the usual coiled spring variety. This I found an absolute pest, as, oxygen free or not, it is pretty good at getting tangled and twisted around the most unlikely of objects.

Cobalt magnets are used to achieve the very high field density required to get the sound out of such a small diaphragm, although the leaflet insists that cobalt is used *instead* of magnets. The diaphragm itself is 12 um thick (so don't go trying to tap it!) and this very small mass undoubtedly confers upon the MDR-3 their quite incredible transient reponse.

Overall, the headphone market at anywhere from £17 to around £35 should take quite a beating from the MDR-3 if there is *any* justice in the world at all, and I stand by my

comment last month that you'd be mad to buy a pair of headphones in this price range unless you had at least given the MDR-3 a chance to impress you as much as it impressed us.

Quick Summary

- Small and lightweight (40g)
- Open type do not exclude surroundings totally.
- Good extended treble, warm mid-range, good bass for type.
- Will take bass boost without deterioration of sound.
- Impedance 32R, thus needs to be driven hard.
- Cord not usual type inconvenient.
- Excellent value for money, highly recommended.

Guest Moaner

Help! I'm being invaded by people. Ian Graham, ETI's new Celtic Assistant Editor, has cajouled his way into an Audiophile in order to have a moan about racking systems with no racks. Seems a valid point and besides he bribed me with a picture of Felicity Kendal.

So here you go Mr Graham, take it easy at first lad

Put yourself in my position — you're building up your first decent hi-fi system. You save up your pennies, raid your little brother's piggy bank, collect the deposits on every lemonade bottle in sight and generally economise until friends start counting your ribs through your duffle coat. Unit by unit budget lo-fi gradually gives way to higher-fi than you've ever had.

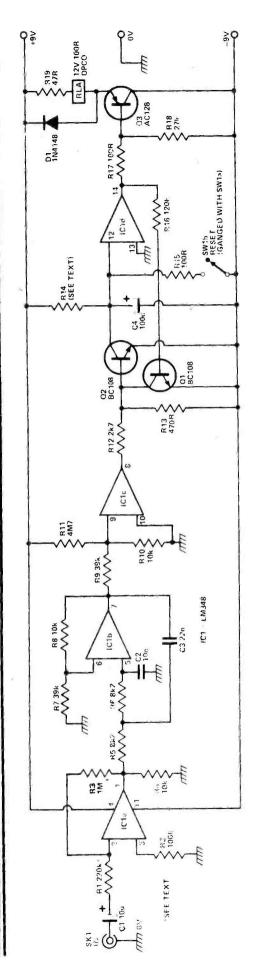
Now, the system looks a bit out of place piled up on the coffee table and, besides, it's beginning to sag a bit under all the watts. What about a rack to put it all in — like the one you saw your very own system in in the shop. A quick phone call brings the answer — no, we only supply a rack when you shell out £400 or so on a complete system. Another call to the UK importer brings the same response.

How much nicer and dust-free my Pioneer system would be in the smart, glass-fronted rack where I first saw it. I wonder how many other hi-fiers there are, who must now remain rackless and didn't find out until it was too late? For Pioneer-lovers, at least, I can bring news of a light at the end of the tunnel. Shriro (UK), the importers of Pioneer equipment, have told me that Pioneer racks will be available as separate units in about five months.

Keeping the Homeleds Burning

Battery powered equipment is a nuisance. More than that is a guilty-of-incestuous behaviour nuisance. Mainly because I keep leaving it on and flattening the batteries — and on my headlamp that means two days without moving-coil type music — leading to withdrawal symptoms such as shortened tempers and kicked cats.

What is needed is a machine which knows when you're using the box and when you're not — and makes an appropriate fuss if you leave it on. After several periods of non-musical evenings I finally overcame my inertia and DID SOMETHING ABOUT IT. Some moons ago ETI ran a project called the Watchdog which was designed to prevent you leaving on teles, hi-fis and other (mains driven) equipment. This was also born of my desire to be lazy electronically.



me many a long evenings 'turning off'! The relay contacts can be wired easily enough to switch on an audible alarm, or even to de-power the equipment in question if need be, although this is Above: the faithful old Watchdog circuit. Rover here has saved less applicable to battery powered devices.

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HOW IT WORKS

feeds the input audio of around 50mV minimum to the buffer amp formed by ICIa and associated components. The gain of this sitivity. ICIb is a second order Bessel low pass filer with break frequency set around 800Hz (when loaded). This is to cut the response to high frequencies such that continuous white and may be changed to vary the unit's senstage is determined by the ratio of R3 to R1 noise will not keep the unit switched on.

op-amp working at its full open-loop gain such that it will 'clip' any intput into a as long as audio is present at SKI. ICle is an square-wave.

audible 'bleeper' or the like 'twould be better to wire up one

options open - except on cold days.

This means that rather than replacing the relay with an set of contacts to power said device once the relay tripped Keeps open your options too. And I'm all for keeping me

relay is under power as long as the equipment is operating.

ICIc and the potential divider R12, R13, square the incoming audio signal and feed this to the base of Q2, keeping if switched on

sient audio, such as switch off thumps' etc. re-triggering the Watchdog and keeping it from closing down. While O2 is turned on, C4 cannot charge up consideration. DI is protection against back no longer present at the base of Q2, C4 begins and after the time-delay has elapsed, the output swings high, turning off the relay driver (3, and disabiling the relay which way that as soon s the output goes high, this above earth potential. Once the pulse train is controls the mains to the equipment under O2 as a 'Shut-down' component, in such a to charge via R14. ICld acts as a comparator, EMF generated in the coil. Ol is wired across turns on Q1 which then prevents any

With a little modification Watchdog can be amended to sound an audible alarm. The circuit is given below, and note that, in order that the box is 'fail-safe', the switching

Above: a possible PSU for use with the Watchdog circuit, which will supply the needed 9-0-9 volts. A 500 mA in the mains rail

will improve safety!

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RESISTORS (1/4W E12)		OPTO/DIS		LM308N	60p	4049	35p	7460	13p	74195	57p	BF196	12p	ZTX503	17
10 phm to 10 Mohm	1.5p	2N5777	55p	LM318N	200p	4050	35p	7470	28p	74196	100p	BF197	12p	ZTX504	28
PRESETS (.15W Horizontal)	1.00	OCP71	65p	LM324N	740	4066	38p	7472	21p	74197	100p	BF244B	35p	2N696	35
100 ohms to 2 Mohms	8p	ORP12	60p	LM339N	60p	4069	18p	7473	28p	74198	135p	BF259	40p	2N697	25
POTENTIOMETERS (Carbon)	×μ	MAN72	110p	LM348N	90p	4070	18p	7474	24p	74199	120p	8FR39	32p	2N698	35
Log and Linear		MAN74	110p	LM377N	175p	4071	18p	7475	34p	74133	120p	BFR79	32p	2N706	14
4.7 Kohm to 2.2 Mohms	28p	.125" &	.2"	LM380N	90p	4072	18p	7476	30p	TRANSIST	TOPE	BFX29	25p	2N914	20
VERO BOARDS (0.1" Copper)	LOP	LEDs		LM381N	140p	4073	18p	7480	32p	AC126/7	23p	BFX84	25p	2N918	35
2.5 ×5	52p	Red	10p	LM382N	130p	4081	18p	7485	80p	AC128	23p	BFX87	25p	2N1131	20
3.75 ×5	62p	Green	14p	LM1310N		4082	18p	7486	25p	AC128/17		BFX88	25p	2N1302	35
ZENER DIODES (400mW)		Yellow	14p	LM3900N		4086	80p	7490	36p	Mt. pr.	42p	BFY50	22p	2N1303	401
2V7 to 33V	8р	125" clip	3р	LM3909N	70p	4510	73p	7491	55p	AC176	23p	BFY51	22p	2N1304	501
TRANSFORMERS (240V)	-	.2" clip	4p	MC1496P		4511	99p	7492	40p	AC187/8	23p	BFY52	22p	2N1613	25
9-0-9V, 100mA	13 0 p	DIODES		NE531	140p	4516	95p	7493	35p	AD149	70p	8RY39	60p	2N2222A	
0-15V, 0-15V, 200mA	150p	BY127	10p	NE555	25p	4518	72p	7494	57p	AD161/2	40p	BSX20	22p	2N2369	171
CERAMIC CAP (50V)	1 Jop	OA47	8p	NE556	60p	4520	94p	7495	46p	AF124	45p	8U205	150p	2N2484	30
22pF to 50nF	2p	OA91	8p	NE566	140p	4528	99p	7496	56p	AF139	40p	BU208	210p	2N2646	55 _F
POLYSTYRENE CAP (50V)		OA200	6p	TBA641A	200p	4520	aab	7497	200p	AF239	47p	MJ2955	110p	2N2904	23
10pF to 1.000pF	E-	OA202	9p	TBA641B	200p	TTL		74100	90p	BC107	10p	MJE340		2N2905	23
POLYESTER CAP (100V)	5р	1N916	5p	TBA800	75p	7400	13p	74105	43p	BC108/9	10p	MJE2955	70p	2N2906	20
1nF to 100nF	E	1N4148	4p	TBA810S	110p	7400		74103	26p	BC147	10p	MJE3055	110p	2N2907	20
15, .22, .33, 39µF	5p 6p	1N4001	4p	ZN414	100p	7402	13p	74107	44o	BC148	10p	MPF102	85p	2N2926G	
.47, .68µF	10p	1N4002	4p	ZN1034	200p	7403	13p 13p	74110	40p	BC149	10p	MPF102	40p	2N3053	20
1μF 12p 2.2μF		1N4003	5p			7404		74118	90p	BC157	12p	MPF103	40p	2N3054	50
3.3µF 26p 4.7µF	20p	1N4004	5р 6р	CMOS		7404	13p	74110	26p	BC158/9	12p	MPF104	40p	2N3055	50
ELECTROLYTIC CAP (µF/V)	28p	1N4005	6р	4000	18p	7406	13p	74122	40p	BC167	14p	MPF105	40p	2N3442	140
1/25 to 47/25	e	1N4006	8p	4001	18p	7401	24p 24p	74123	45p	BC169C	13p		50p	2N3702 to	
68/50, 100/35	6р	1N4007	8p	4002	18p	7407		74125	37p	BC173	8p	MPSA06 MPSA56	26p	2N3711	115
150/25, 200/12	8p 9p	1N5400	13p	4006	70p	7409	13p 13p	74126	37p	BC177/8	18p	MPSU06	26p	2N3772	150p
220/25, 250/12		1N5401	140	4007	18p	7410		74132	48p	BC179	20p	OC35	61p	2N3773	250
470/25, 500/30	10p	1N5401	15p	4008	84p	7410	13p 18p	74141	60p	BC1B2/3	12p	TIP29	92p	2N3819	22 _F
1000/10		1N5404	16p	4009	34p	7412		74145	55p	BC184	12p	TIP29B	40p	2N3820	40
1000/10	14p			4010	42p	7412	15p	74145	78p	BC209	13p	TIP29B	48p	2N3823	70
500/25	22p	DIL SOCKI		4011	18p	7413	27p	74150	48p	BC212/3	12p	TIP30B	40p	2N3866	90
2200/6 3	26p	8 pin	11p	4012	18p	7414	31p	74153	43p	BC214	12p	TIP31	48p	2N3903	10
20070 3	20p	14 pin	13p	4013	40p	7417	25p 25p	74154	90p	BC214L	14p	TIP32	40p	2N3904	10
	A	16 pin	14p	4014	85p	7417		74154	56p	BC261B	14p	TIP32	40p	2N3905	10
RIDGE VOLTAGE		18 pin	18p	4015	70p	7420	14p	74156		BC461	40p	TIP33	60p	2N3906	10
ECTIFIERS REGULATION		22 pin	22p	4016	40p	7421	17p	74156	46p	BC477	40p 27p	TIP34A	80p	2N4037	45
.75/200V 25p 320H-05	40p	24 pin	24p	4017	57p	7422	17p	74160		BC477	27p 27p	TIP34A	90p	2N4058	14
75/600V 30p 320H-24	40p	28 pin	28p	4018	68p	7427	20p	74160	64p	BC547/8		TIP35B	240p	2N4059	14
A/50V 22p 7805	70p	40 pin	40p	4019	45p	7428	25p	74162	64p	BC549	14p 14p		280p	2N4060	14
A/100V 27p 7812	70p	LINEAR		4020	90p	7430	14p	74162	64p	BC557/8		TIP41A	60p	2N4061	14
A/200V 32p ,7815	70p	CIRCUITS		4021	85p	7432	20p		64p		15p	TIP42A	60p	2N5457	40
A/400V 34p 7818	70p	709	40p	4022	82p	7433	24p	74164	78p	BC559	15p	TIP2955	70p	2N5458	40
A/50V 40p 7824	70p	710-14	33p	4023	18p		20p	74165	78p	BCY70	18p	TIP3055	55p	2N5459	35
A/100V 42p 7905	90p	741-8	22p	4024	58p	7 438 7 44 0	20p	74166	85p	BCY71	18p	ZTX107	13p	2N6027	40
A/200V 48p 7912	90p	747-14	48p	4025	18p		13p	74173	77p	BCY72	18p	ZTX108	13p		
2A/400V 55p 7915	90p	748-8	44p.	4027	35p	7441	56p	74174	75p	BD115	58p	ZTX109	13p		
7918	90p	CA3018	70p	4028	60p	7442	51p	74175	60p	BD131/2	42p	ZTX300	16p		
7924	90p	CA3028A	85p	4029	75p	7443 7444	80p	74176	64p	BD135/6	42p	ZTX301	18p		
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MICROFILE

Henry Budgett has news of the long-awaited Nascom 2, a pretty potent Petsoft program party and an expensive Communicator.

F micros are the food of life eat on would be a fair description of this month's ramblings through the world of small systems. The spirit of Christmas also seemed to take quite a bashing as well! The old adage about it being human to err has struck again. Yours truly has made a box-up. Having rambled extensively on the subject of standards in the November offering, Mr Henry Law has raised the valid point about the usage of the word Baud. I tend to use both Baud and bits per second to mean the same thing and he points out quite rightly that they don't. The term "bits per second" means exactly what it says, but the term Baud is defined as being "a unit of signalling speed equal to the number of code elements transmitted per second." Some transmission systems such as phase modulation actually carry more than one bit in each signal element so in Mr Law's case his 9600 bps transmission runs at 2400 Baud. In future I'll stick to bps unless the actual Baud rate is defined, honest.

The Long Wait (Is Over)

The first gastronomic offering of the month was digested after the delivery of our Nascom 2. Not bad really, we have been waiting since June along with the rest of you for the machine. The hardware is certainly impressive. There are options galore for both memory and I/O and the packing density of chips is almost unbelievable. The lack of 4118 memory chips has caused Nascom to offer the 16K RAM board with the "2" but if you wish to use it in a dedicated system the missing 4118s can be replaced with 2708 EPROMs holding your own software. The BASIC is the 'standard' Microsoft version, but it has one or two added extras to make periperheal handling easier.

The other interesting feature is that the BASIC is blown in a 64K ROM chip, one of the first uses for this device, and is actually removable so you can use the memory space for something else. Both the new NAS-SYS monitor and the BASIC can be used on the "1" and I feel that the NAS-SYS should become the standard operating system for the "1" rather than the T2 or T4.

The instruction manual is a loose leaf binder making it easy to alter or insert new information. There are one or two poor areas, but Nascom have promised to change these if demand is sufficient. The price may seem high but you are getting a very high quality product that makes certain other "single board computers" look rather like toys.

A very strong whisper on the Nascom front is that the price of the "1" may well be coming down, look out for bargains. The lunch was very good but it's the first time I've had to pay for doing someone a review of their own product!



Would you buy 50,000 programs from this man?

The Second Belch

The second gastronomic wonder was given by Petsoft to celebrate, among other things, the sale of the 50,000th program. They have even had it gold plated and presented to the author. I rather suspect that the dreaded LOAD ERROR message may come up if it is ever used. Gathered at the lunch were many of the editors and publishers of the Computing Press and after the dinner discussions ranged far and wide on the subject of machines and languages. As usual in these meetings nobody managed to agree on anything apart from the excellence of the wine and the quality of the food!

The fact that Petsoft has become a part of the giant ACT doesn't seem to have detracted from the quality of their product. If anything, it has dramatically improved. The achievement of selling 50,000 programs has only left them with one slight problem, do they go for platinum plating on the 100,000th?

Fresh Air

We have had a small box called the Communicator, in the office for review. The device hangs on the parallel user port of the PET and provides eight user accessible input or output lines. The voltage of the power supply that you connect determines the output swing. The box derives five volts internally for the input lines. The circuit is based around two Darlington transistor arrays, each containing seven transistors that are connected to provide two channels with a drive capability of 500 mA and six channels that can drive 1 A. The box can be directly called from BASIC

using either POKE for output or PEEK for input. The manual is not too specific, but interrogation of the PET manual, the one with the blue writing on the cover, reveals that there are a few extra things that you can do. Unfortunately the unit has no handshaking capability at all so most of your program will be taken up with loops to interrogate the device.

The other contention that I have with the device is that for a grand total of £92.85 including VAT and p&p you don't really get value for money. The Communicator is available from Mektronic Consultants, Linden House, 116 Rectory Lane, Prestwich, Manchester M25 5DB.



The Communicator performs well, but does it represent value for

Exhibitionitis Strikes Again

There was one ray of sunshine in the gloom of computer shows this month, no it wasn't Compec. The Professional Viewdata Exhibition held at the West Centre Hotel last month was the one that rates high on my list for a visit next time. A grand total of 28 exhibitors, all doing their utmost to be helpful, plenty of space to move around, comfortable seats for tired journalists - in fact everything you could wish for. Among the notable were Tecnalogics who are doing very well with their TECS system, Logic Box with their screen treatments - amber is the IN colour - and Video Electronics with their intriguing real time graphics display system.

Make a note in your diaries to go to this one next year, it's well worth it. The same cannot be said of Compec which was incredibly hot, crowded and boring. A companion of mine, who was there to check out some hardware, reckoned the pub was less crowded at lunchtime, so we all went there instead. About the only points of interest were the new Sharp machine, but no-one seemed to be very impressed, and the Texas machine which is expensive. One day someone will organise a true home computer show with no big business computers, lots of room to walk around and a friendly atmosphere in which one can actually talk to the people you've gone to see. Surely it's not too much to ask.

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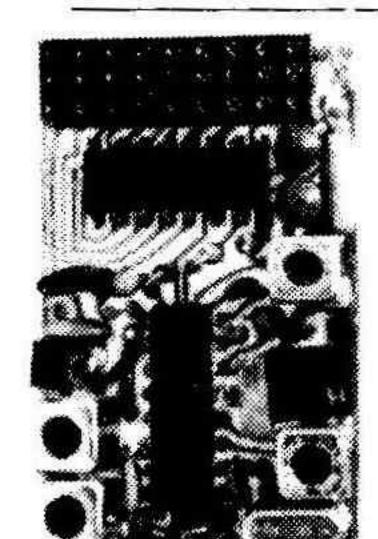
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Yes, it's here at last - the all new Part Three Catalogue. Fun for all the family, and the usual update on all that is new, worthwhile and exciting in the world of Radio and Communications. A big section on frequency synthesis techniques covering broadcast 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 CFSH 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 synthe siser 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

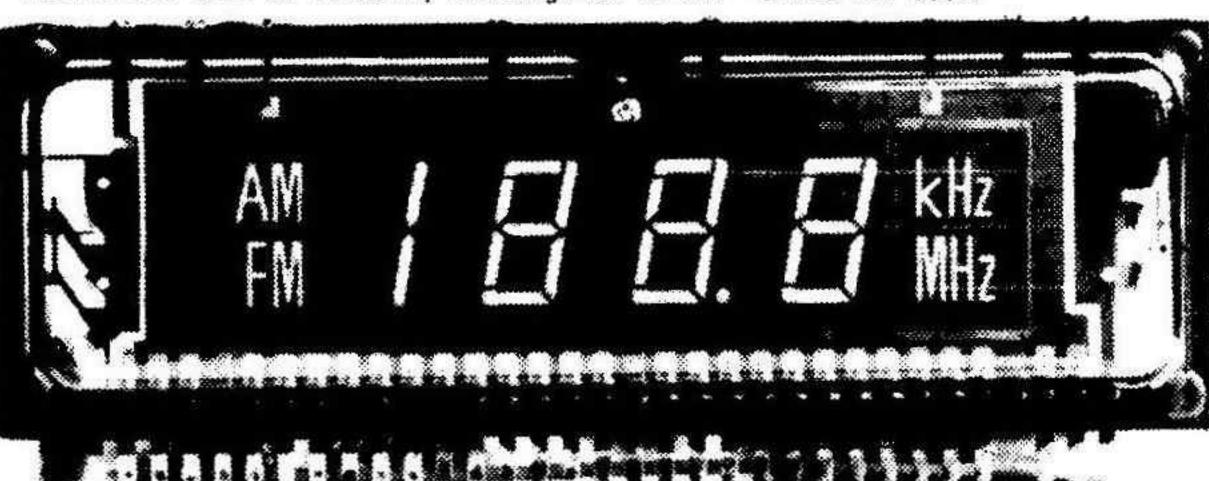
New series of radio modules in fully screened cans:



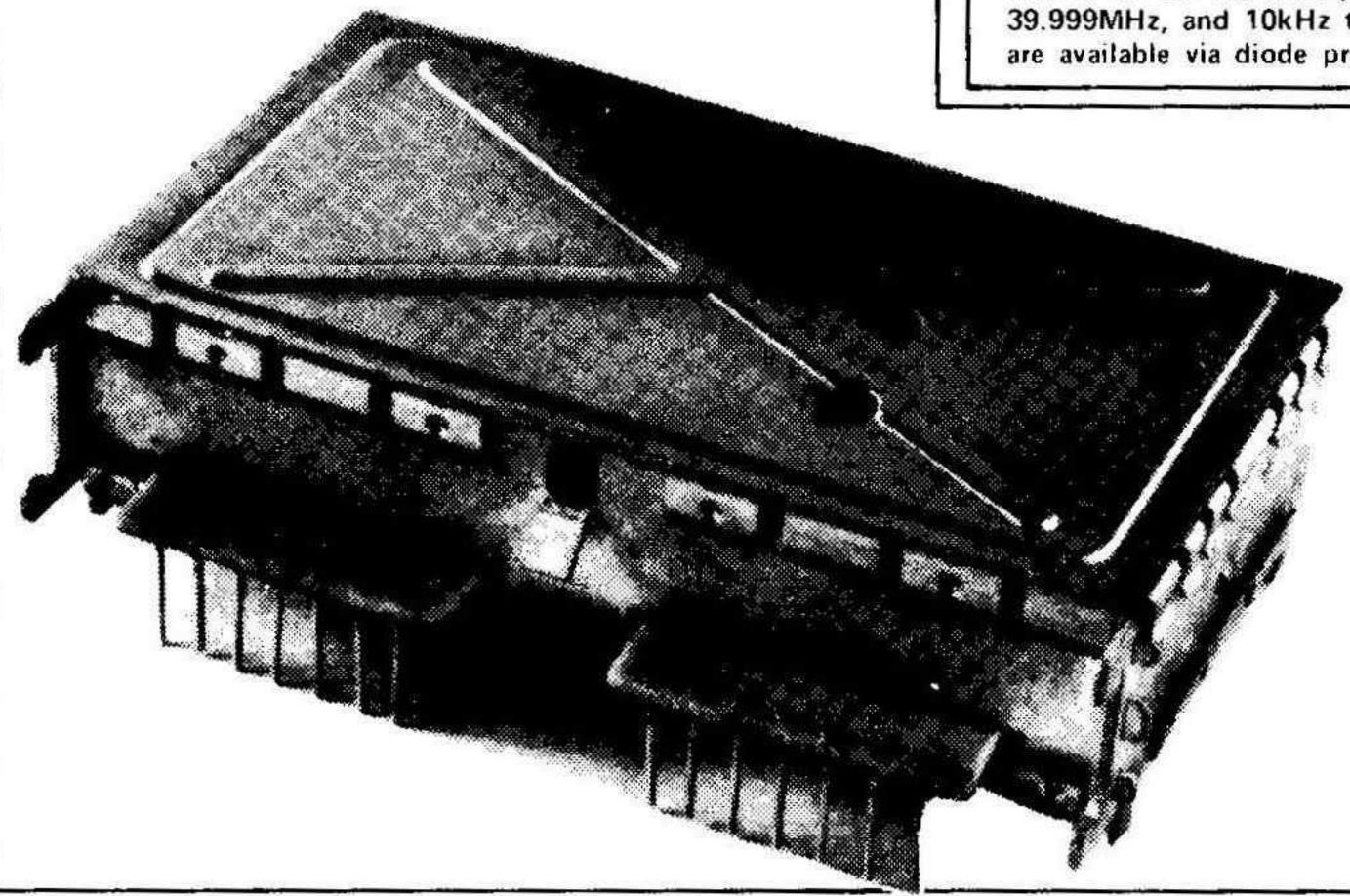
- 8 Channel RC receiver (FM)
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- Dual ceramic filter IF Based on RCM&E FM system
- Best quality SLM servo
- connector block
- * ONLY £16.10 inc VAT (kit) (includes new SLM case)

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.



UM1181 VHF band 2 VARICAP TUNERHEAD

5 tuned circuit, with image/spuril 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. (100off/ 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. 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 (built) 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 £17.50 (Custom types OA) £14.43 'B' £15.90 ,C,

There is a danger - when advertizing in some magazines - that because we do not find space to list everything we sell in every ad., 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, that some readers forget about half the ranges Plessey SL1600, EUROPE's best selection of AM/FM and communications devices. Power small signal transistors, BAR graph LED drivers Trimmer capacitors. for linear and log.

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, greem, orange, yellow. The best prices you will find for quality products.

MOSFETs for RF signal processing, including Varicap diodes for 17:1 capacity ratio tuning replacement for MD108 etc. And cheaper.

FREQUENCY READOUT LSI from OKL 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 MOSFETs, WORLD's LOWEST NOISE AUDIO and both AM and FM radio control at 27MHz.

METERS - a new range of linear movement CD4000 series CMOS, TTL/LPSNTTL, standard types, plus many 'indicator' types for VU, all types of tuning indicators etc.

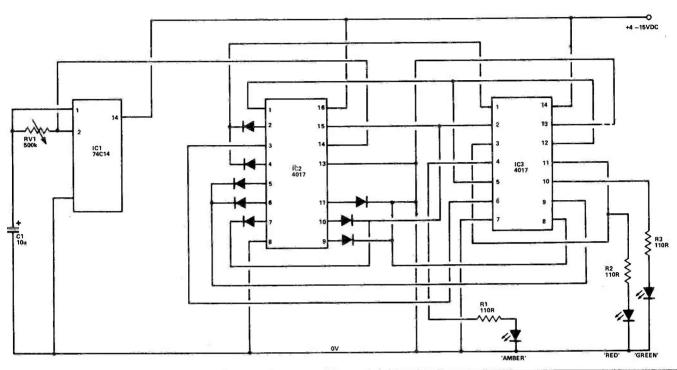
SOCKETS - a new range that are better quality than Texas low profile, yet better priced. Modules for AM/FM/STEREQ, complete kits for tuners, audio amplifiers from Larsholt. SWITCHES complete low cost DIY systems for push button arrays, keyboard switches. the BF960 UHF device, and 3SK51 for VHF. DOUBLE BALANCED MIXERS - MCL SBL1,

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. –



TECH TIPS

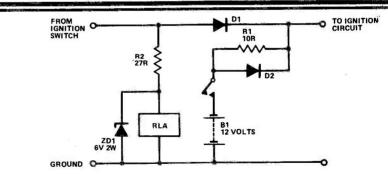


Traffic Light Controller

Michael Miller

This circuit is relatively simple and gives a realistic timing sequence. IC1 sets the timing clock pulse and can be adjusted by RV1. IC2 is a decade counter, whose output pulses are mainly fed through diode buffers (any small cheap diodes will do), to IC3, a quad OR gate, which sorts the consecutive decade pulses into three groups, monitored by the three coloured LEDs.

To couple this circuit to a similar one, for the other intersection of the crossroads, the pulse from pin 1 of IC2 should be taken to pin 15 of the IC2 of the other circuit. This second circuit should have pin 15 biased to OV via a 100 k resistor. When the first circuit is showing red, the second circuit will be showing green.



Cold Start Ignition

M. C. Polgreen

The heart of the circuit is a small auxiliary battery with a capacity of one or two amp hours. If a nickel cadmium battery is used then R1 should be increased in value so that the maximum trickle charge current is not exceeded. R2, ZD1, and RLA connect B1 into circuit when the ignition is switched on, thereby reducing the amount of additional wiring. Any small 6 volt relay with a;

contact rating of 5 amps will do, and ZD1, R2 ensure that the relay will remain energised when the starter motor causes the main battery voltage to drop. When the main battery voltage falls, D1 becomes reverse biased and D2 forward biased, therefore allowing B1 to supply current to the ignition circuit. When the engine is running, the main battery voltage rises, forward biases D1 and reverse biases D2. Therefore the ignition current comes from the main battery, and B1 is trickle charged via R1. The two diodes D1, D2 should be rated at 50 V, 10 A.

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 DFF.

OLIVETTI PRINTER & KEYBOARD type Te 300

with PUNCH & READER. Upper case ASCII with V24 Interface. 240 volt operation.

£125 each

TELETYPES KSR33

Upper case ASCII with 20MA Loop. This is a printer with Keyboard (no Punch or Reader on this model).

£225 each

BRUEL & KJOER EQUIPMENT

AUDIO FREQUENCY SPECTOMETER type 2112 £175 ea.
BEAT FREQUENCY OSCILLATOR type 1013 £140
BEAT FREQUENCY OSCILLATOR type 1014 £140
BEAT FREQUENCY OSCILLATOR type 1022 £140
AUTOMATIC VIBRATION EXCITER CONTROL type 1018 £90
AUTOMATIC VIBRATION EXCITER CONTROL type 1019 £90
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TRANSISTOR INVERTOR 115V 50/60 HZ INPUT

These run at 20KHZ. They can be modified to be a switching power supply or to provide EHT for VDU, Oscilloscopes, etc. or the output core could be rewound to provide any voltage/current within the units rating. As supplied they have multiple outputs. A schematic is provided. Size $3\frac{1}{2}\times4\times8\frac{1}{9}$. All units are tested before dispatch. £3.25. P&P £1.50.

INFRA RED IMAGE CONVERTER type 9606 (CV 144)

13/4x2" diameter. Requires single low current 3KV to 6KV supply. Individually boxed. With data.

£12.50 each P&P 75p.

Infra Red Lamps also advertised

HONEYWELL VDU

1920 Character Upper Case ASCII. With edit and block transmission.
Limited quantity with data.

NEW LOW PRICE £200 each

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5" Display. These are supplied with STU 2 plug-in. 1 to 4.5GHZ £125 each.

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This gigantic but superb analyser covers from 100HZ to 30MHZ with a 6HZ resolution. 5" display. Complete with trolley. £75 each.

CROWN replacement MOTOR for IBM GOLF-BALL TYPEWRITERS.

115 volt 50HZ 1350 rpm.

£4.50 each P&P £1.50.

STEPPING MOTORS

6/12 position with additional where the rotor is coils. Device can be used as a tacho. Diagram supplied. Will actually work on 5 volts. 12/24 recommended.

£1.50 each P&P 75p or 5 for £5 P&P £1.50.

R&S GEN BN 41026 SCR 1000-19000MHZ	£120
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R&S GEN BN 1524 USVU 0.9-2.7 GHZ	£180
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R&S GEN BN 2412/50 NRD 0 3200MHZ	£120
R&S GEN BN 4242 SWH 50KHZ-12MHZ	£120
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R&S GEN BN1523 USVD 280-940 MHZ	£120 ea.
R&S GEN BN422 WID 30-300MHZ	£120
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AVO Precision meter	£75 es.
PYE pH Meter Model 79	£120
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FLUKE RMS Voltmeter type 910A	£120
TELONIC SWEEPER SM2000 0-1800MHZ in 3 plu	£60
TELESTIC GITTELT CIT SINT 2000 OF TOO ON THE RES PIC	AND DESCRIPTION OF THE PROPERTY OF THE PROPERT
WAYNE VEDD Dade - CT FOO THE	£150

WAYNE KERR Bridge CT 530 with adaptor £150 ea. TELONIC SWEEPER SD-3 450-900MHZ with markers £65 ea. TWENTY MILLION Megohm meter Bby E.1. £40 ... SCOPEX oscilloscope type 4D10 £190 es. AVO 8 Mk 3 or similar from £50 HEWLETT PACKARD Oscilloscope type 140A with Reflectometer plug-in £250 MARCONI Gen type TF801D/1 £150 COSSOR CDU130 small, compact main/battery Oscilloscope. Batteries supplied £240 MARCONI GEN type TF144H £150 LABGEAR UHF/VHF PAL Colour Bar Gen. CM6052/CB F90 as

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MARCONI GEN TF1066B	€350
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20 AMPS	£35 ea.
Some 3 phase available. Please enquire	LOU OR.
CARRIAGE ALL UNITS £4	
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CRYSTALS 19.2KHZ FLAT METAL CASE — 50p each. 10 MHZ B7G 50p each.

EX-NAVAL 4ft dia STEEL DISHES. NEW CRATED 1 ft deep at centre. These are plain steel dishes with holes for various aerial options £22.50 ea. Carriage £4

LISTS AVAILABLE - WRITE OR PHONE.

Secondary outputs. 6KV 0 125A £15 ea. 3440V 0.66A with matching 40H Choke £30 the pair. 8V 600 Amps £25. 5V 0-20-30-40-50-60V 40 Amps £20. 5KV 300MA £15. 12KV 30MA **£20**. 3KV 50MA £8 ea. 4 Volts 250 Amps £10 ea. 18KV 30MA £60. 22.5KV 110MA £50 ea. 60KV 0.0273 £150. Input 200V 50HZ Sec 100KV 0.05 £150. MULTI PURPOSE MAINS TRANSFORMER 4 windings each winding 0-10-110-125 at 4 8A £15 ea. 425V 50HZ 2 Wire Input. Output 8 5KV 2.55KVA. Could be run on 240V at 1/2 rating £15 ea. STEP DOWN ISOLATING TRANSFORMER. Input 220, 250V 50HZ Output 115V 1.8KVA BRAND NEW. These are very conservatively rated £20 ea. CAPACITORS 10mfd 10KV DC Working £4 ea. 2mfd 5KV £4 ea. 0.5 mfd 5KV £4 ea. 200mfd 4KV Rapid discharge £10 ea. 0.5 mfd 10KV £4 ea. 8 mfd 2.5KV £4 ea.

TRANSFORMERS - Standard Mains input.

INFRA RED QUARTZ LAMPS. 230V 620 Watts. Size 13½" × ½" dia. £1.50. P&P 50p.
BRIDGE RECTIFIER. 2 Amp 50p ea.

PHOTODIODE DETECTOR 4" fly leads, 25p ea.

A SUPERIOR KEYBOARD. Size 3 × 2½ × 2" high with 12 Alma Reed Switches. Blue keys marked in green 0-9 and a star with one black. NOW £4 ea. P&P 75p.

AMPHENOL. 17-way chassis mount edge connectors 0.1

CARRIAGE on these units will be charged at cost.

spacing. 15p ea.

I.E.C. Standard MAINS LEAD. Moulded (3 vertical flat pins centre offset) 60p ea. P&P 50p.

FANS, 115V 13 Watts. Size 3¼ × 3¼ × 1½" BRAND NEW.

£4.50 ea. Secondhand £2.50 ea. P&P 75p.

MOTOROLA REGULATORS, type 7812 12V 1 amp 65p ea.

Miniature MOTORS 12V with geared wheel (8 teeth 3 / 16" dia).

Size 1¼ × ½" dia. New 30p ea.

MOTOR 12V DC with pulley and integral semiconductor Speed Control. New £1 ea. P&P 50p.

LEDEX ROTARY SOLENOIDS. 115V DC. No switch assembly.

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DIAMOND H CONTROLS ROTARY SWITCH. Single pole
10-way. Printed Circuit Mount. New 10p ea.

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MOTOR by Inland Motor Corp. DC High Torque Reversible.

Usable torque at 5V. Max voltage 24V £2.50 ea. P&P £1.50.

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75p en. Box of 12 £5.50 P&P £1.50.

Decoupling CAPACITORS 0.05mfd 10V. Size 0.25" between

leads ¼" height. 100 for £1. P&P 50p.

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MYSTERY IC PACK. Some 40 pin — good mixture — all new

devices. 25 ICs for £1. P&P 50p. You find out what they are and we will buy the information from you

SUPERS 19" RACK CABINET. Approx 4' 6" high × 33" deep

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10-Way Multi-Colour Ribbon Cable New 40p per metre. P&P

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RAPID DISCHARGE capacitors 8mfd 4kV. £5 each. P&P £1.50.
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BIG INCH Motor 1 10V AC 3 rpm 50 cycle. Very small 50p each.
P&P 50p.

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RANCO 250V 18A THERMOSTATS with Control knobs calibrated 50-200 degree F. £2.50 each. P&P £1.

SOLID STATE UHF TUNERS. 30 acs £1 each. P&P 75p.

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5in SOLID RUBBER RINGS (1" dia. rubber). Keep the kids for

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115V input. 8ac. 5V 250MA. Size 1 11/16 × 1.5/16 × 1½" 2

115V input. 8ac. 5V 250MA. Size 1 11/16 × 1.5/16 × 1½ for 50p. P&P 75p.

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SEMICONDUCTORS At 2p each. 1M3063 1344.

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Regulator TBA635 8 to 20V in — 5V out 180MA TD5 Con. 50p.

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7451	5p	74H74	12p	SN15862	4p
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7495	350	74154	70m	Senior Core	TOP

MOTOROLA DUAL in Line 6 pin Opto Coupler 30p each. Gold plate tester version 50p each.
AM9140 4K RAMS STATIC 5 Volt ceramic £4 each.

2708 £5.50 each. P&P 25p.

TELEPHONES. 706 style Black or Grey £5.50 each. 746 style Black of Grey £7.50 each. Older style Black £2.50 each. Postage £1 each.

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plastic relay case. Standard 7 pin base. Series delay 50p each. P&P 85p.

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DIGITAL TO ANALOGUE CONVERTER & bit will fit standard

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Minimum order £3 value of goods. P&P or Carriage and VAT at 15% on total must be added to all orders. CALLERS VERY WELCOME STRICTLY BETWEEN 9am-1pm and 2-5pm Monday to Saturday inc. BARCLAYCARD (VISA) and ACCESS taken. Official orders welcome

CHILTMEADLT

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TELEPHONE NO. READING 669656

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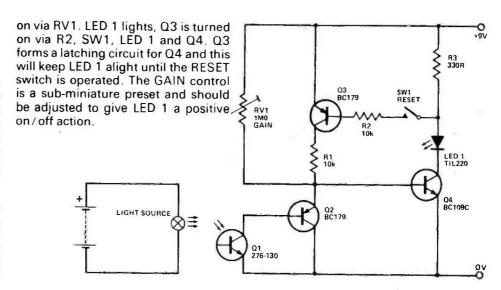
(2nd turning left past Reading Technical College in King's Road then first right — look on right for door with "Spoked Wheel")

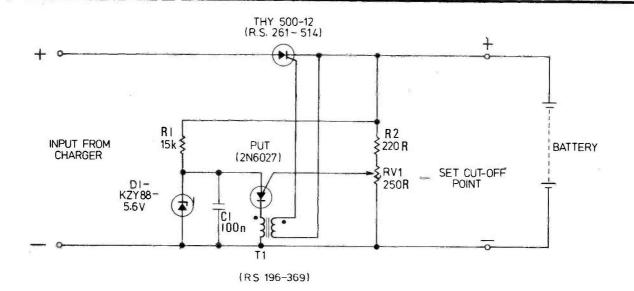
Silent Sentry

B. J. Lowery

The 'Silent Sentry' is a form of intrusion alarm. It will indicate the breaking of a light beam by means of lighting a Light Emitting Diode, which will remain lit until the RESET switch is activated. Q1 may be any suitable NPN photo-transistor available, eg 276-130 (Tandy) and BPX 25 (Maplin).

When light from the light source is falling on Q1, Q2 is turned on, causing both Q3 and Q4 to be turned off, therefore LED1 will not light. As soon as the light beam is broken Q2 is turned off, allowing Q4 to be turned





Battery Charger Controller

D. Wedlake

The battery charger circuit illustrated was designed to be incorporated in any conventional battery charger rated up to 10 amps, where the output is full-wave rectified and unsmoothed. It is fully protected as it cannot be damaged by short circuit or reverse battery connection. Furthermore, charging ceases when the battery voltage reaches a pre-set voltage (normally 13V8 for a fully charged battery).

The design is based on the Programmable Unijunction Transistor (PUT) oscillator which senses the

battery voltage to determine when charging should cease. The battery being charged provides the power for the oscillator which, in turn, triggers the thyristor via the pulse transformer T1. As the anode of the PUT is clamped to 5V6 by the Zener Diode, ZD1, it follows that the circuit will not oscillate if the potential at the slider of RV1 is correspondingly higher. Therefore, RV1 controls the cut-off point which should be set to 13V8. This is best set under actual operating conditions and the charging current will gradually reduce as this voltage is approached.

The charger is fully protected as the circuit cannot oscillate under short circuit conditions or reverse battery connections. However, as the power for the oscillator is derived

from the battery, the circuit will naturally not be self starting if the battery is completely flat or charged to less than about 7 volts. This problem could be overcome by providing a push-button shorting switch across the thyristor to initiate charging. In a short while the battery voltage should have risen sufficiently to maintain normal operation. However, one should bear in mind that the charger will not be protected when the start push button is pressed, so if included, one should provide a fuse as additional protection.

If used at full load current, the thyristor should be mounted on a suitable heat sink having a thermal dissipation of 4 C/W (eg RS 401-497).

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.

2 KEYBOARDS!

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

GRAPHICS!

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

MEMORY MAPPED

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.

NEW LOW PRICE!



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

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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!

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Set of components including IC sockets, plug and socket but excluding RAMs

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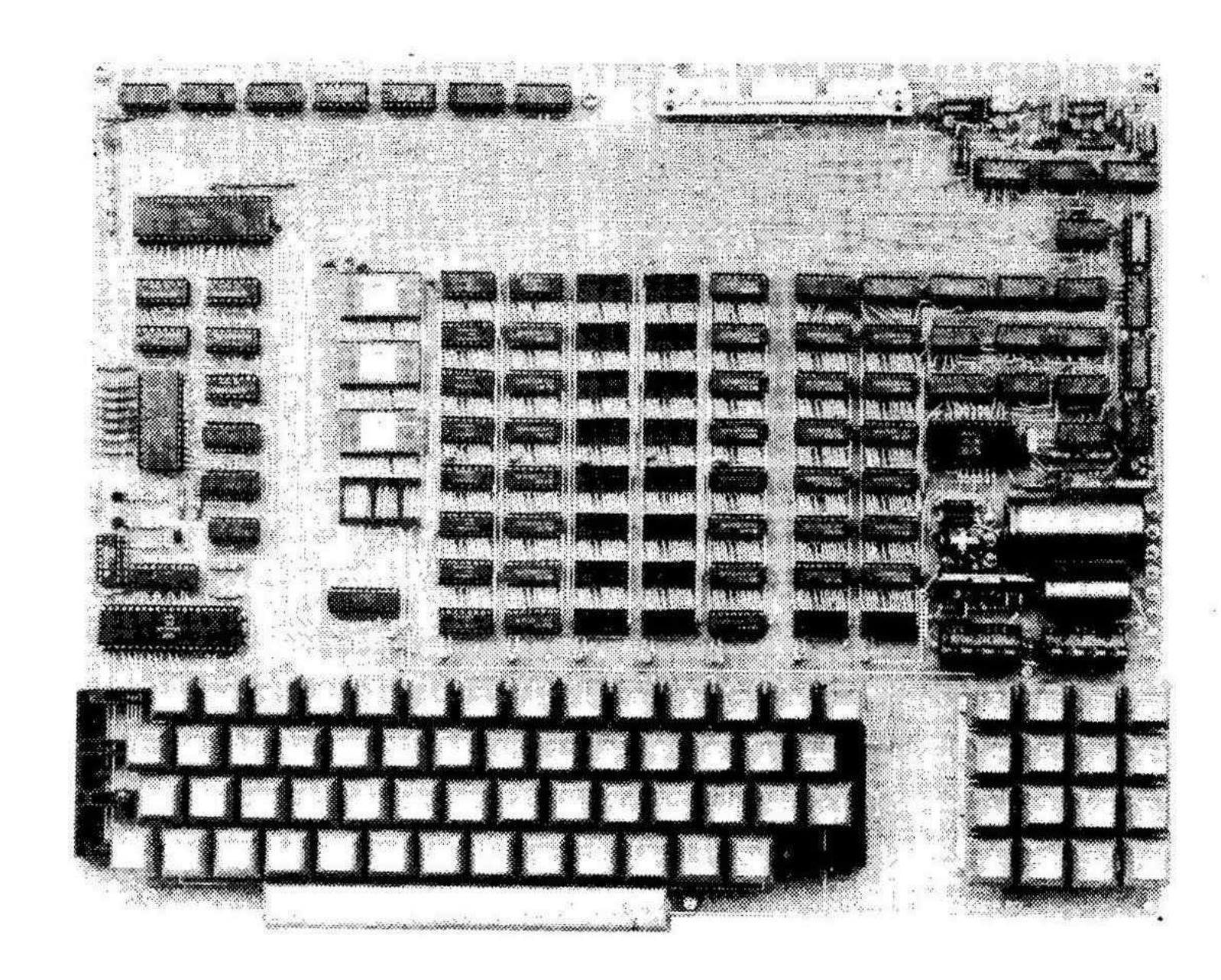
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Stereo VCA

J. Macaulay

The circuit shown is of a stereo VCA whose gain can be varied over a 90 dB range by the application of a control voltage between 0-15V.

Maximum gain is limited to 20 dB and occurs when the control voltage is 0V. Minimum gain occurs with the application of +15V at the control input.

The circuit works as follows. IC1/2 are 741 op amps operated in the virtual earth mode with R1, R5 determining the input impedance at 1M, regardless of gain. The feedback loop from the output of the IC's are completed by the resistors R4, R6. A pair of MOSFETs, internal to IC3, are connected in parallel with these resistors and the control voltage is applied to their gates, pins 3 and 10.

When zero volts are applied to the gates the resistance across the feedback loop is some 109 ohms in all with R4-6. In consequence these latter components determine the gain of the stage. When the control voltage is increased in a positive direction the impedance across the

FETs decreases and the gain of the amplifier decreases in sympathy. Once the voltage is increased to 15V the impedance across the FETs lowers to roughly 300R.

The frequency response of the amplifier extends from approximately 5 Hz-100 kHz at the

-3 dB points whilst the distortion at maximum gain is about 0.1% at 1 kHz. If the feedback resistors are close tolerance types, 2%, the gain will be found to be within ± 1 dB between channels due to the closely matched characteristics of the FETs within IC3.

LED Chaser

P. Davidson

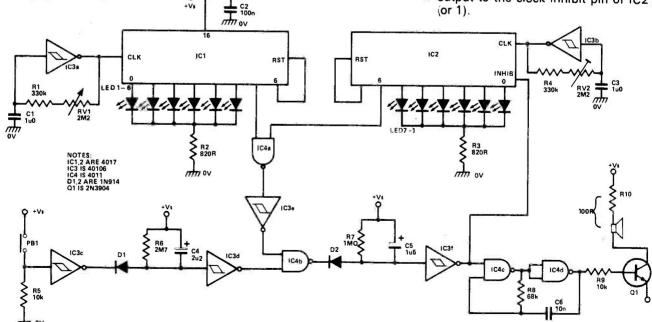
This game is a test of skill and patience. The aim is to align a LED chaser (under your control), with another preset chaser.

A matching pair of outputs are fed

to an AND gate (IC4a, IC3e). This gate feeds the NAND gate IC4b, its other output taken from the monostable formed around IC3d. This has a duration of about 6 seconds to ensure the display is fully counted.

When you think you've matched

the displays up PB1 is pressed. IC3d output goes high and if, while this is high, the two matching outputs both go high, the monostable formed around IC3f is triggered. This enables the astable formed by IC4c,d, to signal success. The unit can also be automatically reset by feeding IC3f's output to the clock inhibit pin of IC2 (or 1).



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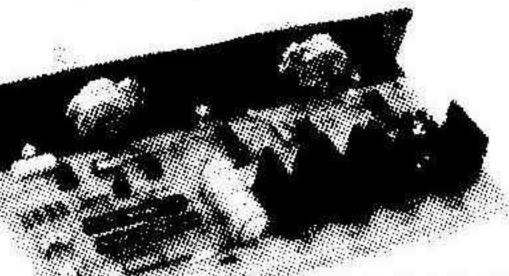
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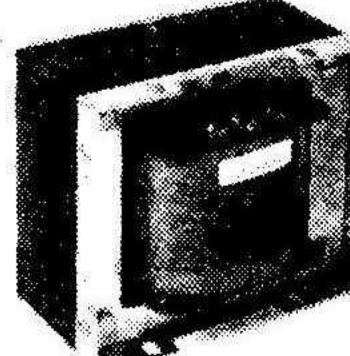
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