

electronics today

JULY 1979
50p

INTERNATIONAL

CEEPAX 181 Thu 3 May 16 40/43 1/2

Weather

Today

Heavy showers, wintry in places, especially on hills.

Some sunny intervals

ORACLE 616 Thu 3 May 16 40/43 1/2

THE L. E. PHANT

CAN AN ELEPHANT JUMP HIGHER THAN A LAMP-POST?

YES. LAMP-POSTS CAN'T JUMP.

PRESS REVEAL FOR ANSWER.

ORACLE 102 Thu 3 May ITV 1620.87

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LONDON

FULL SPEC TELETEXT DESIGN

Plugs In To The Aerial Socket!

POLYPHONIC KEYBOARD

40 CMOS CLOCKS!

LIFE ON OTHER WORLDS

SOIL MOISTURE INDICATOR

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WIN OK'S NEW BADGE.

BE NICE TO PLANTS. 618

ORACLE KIDS

ORACLE 605 Thu 3 May ITV 1621.92

CINEMA

CENTRAL W/B 20TH. APRIL A B C

FAMILY FILMS

BATTLESTAR GALACTICA (U) Empire
THE WIZ (U) Dominion
ABC, Bayswater (U) ABC, Bayswater
Odeon, Marble Arch (U) Odeon, Marble Arch
BACK (U) Odeon, St. Martin's Lane
Odeon, Maymarket (U) Odeon, Maymarket
Filaments 3 (U) Filaments 3
Warner U.E. 2 (U) Warner U.E. 2
Class C Oxford St. (U) Class C Oxford St.

read p617

more follows++

Thu 3 May 16.31/16

DATA ON 2

PLY TO MID-MARCH

DCE (12-month running total)

45
Ebn mamjjasondjfm Ebn mamjjasondjfm

Sterling M3 Supply Mid-March: 250.6bn (down by 2410m or 0.9pc in the month).

Domestic Credit Expansion Down by 2262m for a 12-month total of 26.6bn.

CHROMATHEQUE 5000

5 CHANNEL LIGHTING EFFECTS SYSTEM

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



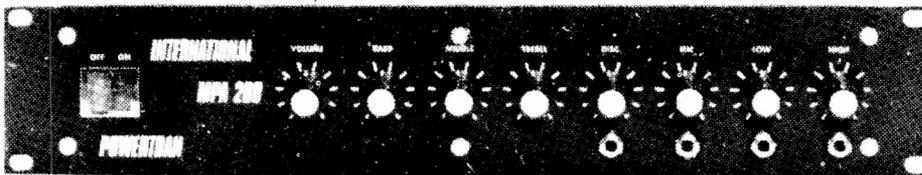
**COMPLETE KIT
ONLY
£49.50 + VAT!**

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

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

MPA 200

100 WATT (rms into 8 Ω) MIXER / AMPLIFIER



**COMPLETE KIT
ONLY
£49.90 + VAT!**

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

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

Parts to build power amp module (inc. PCB, res., caps., s/c etc) **£10.60 + VAT.**

Custom designed toroidal transformer with mounting clamp **£10.50 + VAT.**

Parts for power supply only (caps., rects., fuses, F. holders) **£3.40 + VAT.**

TRANSCENDENT 2000

SINGLE BOARD SYNTHESIZER

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

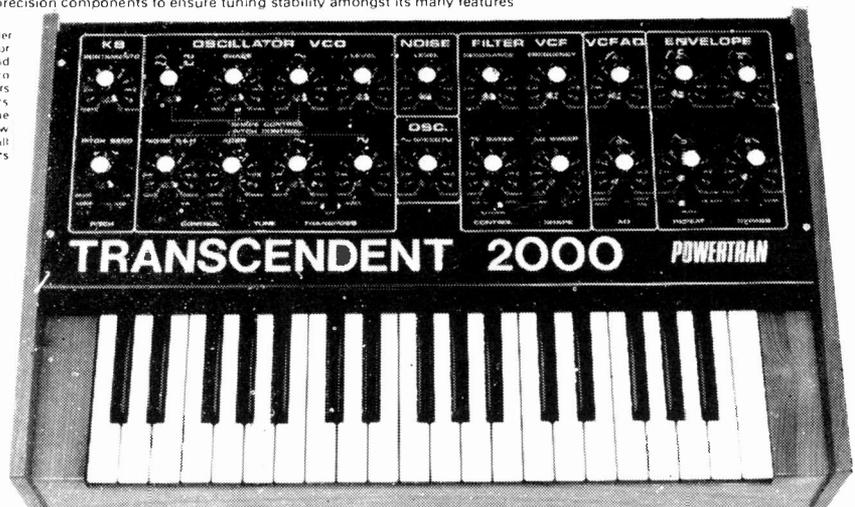
The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, a noise generator and an ADSR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

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

**COMPLETE KIT
ONLY
£172.00 + 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!

POWERTRAN



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

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



electronics today

JULY 1979 VOL 8 NO 7 INTERNATIONAL

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- TECH TIPS **99** Son of readers circuits.

PROJECTS

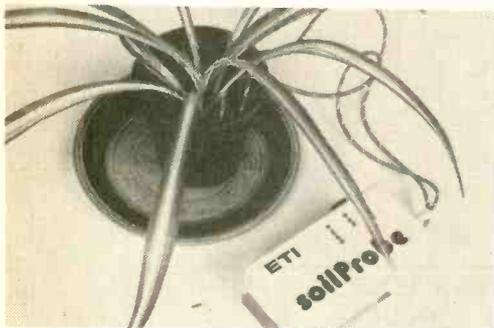
- TELETEXT **20** A quick newsflash on your telly.
- POLYPHONIC KEYBOARD **36** Multi-note organs to you.
- MOTOR SPEED CONTROLLER **47** Gear down your movements.
- SOIL MOISTURE INDICATOR **67** Wet or dry ETI gives you it straight.
- TUNER AMP 2 **79** The final part of System 8000.
- BATTERY INDICATOR **92** State of charge flashed for your convenience.

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Quality audio modules and accessories for

S450

STEREO FM TUNER
Fitted with phase lock-loop

£26.14
+40p p&p



FREQUENCY RANGE	88-108 MHz
SENSITIVITY	3.0 µV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (22.5 kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm · 110mm · 32mm

The S450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage, Vari-Cap diode tuning, Switched AFC LED Stereo Indicator.

Stereo 30

COMPLETE AUDIO CHASSIS

£21.57
+35p p&p



7 + 7w R.M.S.

OUTPUT POWER	7 Watts RMS
LOAD IMPEDANCE	8 ohms
TOTAL HARMONIC DISTORTION	Less than 5% (Typically 3%)
FREQUENCY RESPONSE	50 Hz to 20 kHz ± 3dB
TONE CONTROL RANGE	± 12 dB at 100Hz and 10kHz
SENSITIVITY	190 mV for full output
INPUT IMPEDANCE	1 M ohms
TRANSFORMER REQUIREMENTS	22 V A.C. rated at 1A
DIMENSIONS (Less controls and panel)	200mm · 130mm · 33mm

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, main switch, fuse and fuse holder and universal mounting brackets.

AL60

AUDIO AMPLIFIER MODULE
25 Watts RMS

£5.27 +35p p&p



25w R.M.S.

OUTPUT POWER	25 Watts RMS
SUPPLY	30-50 V
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 0.6%)
FREQUENCY RESPONSE	20 Hz to 30 kHz · 2 dB
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm · 64mm · 15mm

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0.1%

AL80

AUDIO AMPLIFIER MODULE

£7.92*
+35p p&p



35w R.M.S.

OUTPUT POWER	35 Watts RMS
SUPPLY	40-60 V
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 0.6%)
FREQUENCY RESPONSE	20 Hz to 30 kHz · 2 dB
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm · 64mm · 15mm

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0.1%

AL250

POWER AMPLIFIER

£19.24* +66p p&p



125w R.M.S.

OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50-80 V
LOADS	4-16 ohms
FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P at 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION	
50 WATTS into 4 ohms	0.1%
50 WATTS into 8 ohms	0.06%

This unit, designated AL250, is a power amplifier providing an output of up to 125W RMS, into a 4 ohm load

AL30A

AUDIO AMPLIFIER MODULES

£4.26 +35p p&p



10w R.M.S.

MAXIMUM SUPPLY VOLTAGE	30 V
POWER OUTPUT for 2% THD	10 Watts RMS
TOTAL HARMONIC DISTORTION	Less than 25%
LOAD IMPEDANCE	8-16 ohms
INPUT IMPEDANCE	100 K ohms
FREQUENCY RESPONSE	50 Hz-25 kHz ± 3 dB
SENSITIVITY	75 mV for full output
DIMENSIONS	74mm · 63mm · 28mm

These low cost 10 watt modules offer the utmost in reliability and performance, whilst being compact in size.

SPM80

STABILISED POWER SUPPLY

£4.95 35p p&p



INPUT A.C. VOLTAGE	33-40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA-1.5 amps
OVERLOAD CURRENT	1.7 amps approx.
DIMENSIONS	105mm · 63mm · 30mm

Designed to power two AL60s at 15 Watts per channel simultaneously. Circuit Techniques include full short circuit protection.

PA100

STEREO PRE-AMPLIFIER

£18.05
+40p p&p



FREQUENCY RESPONSE	20 Hz to 20 kHz · 1 dB
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 0.7%)
SENSITIVITY	1 TAPE INPUTS 100 mV/100 K ohms For an 100 mV/100 K ohms output 3.5 mV/50 K ohms 250 mV
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
BASS CONTROL RANGE	± 15 dB at 75 Hz
TREBLE CONTROL RANGE	± 10-20 dB at 15 kHz
SIGNAL/NOISE RATIO	Better than 65 dBs (All inputs)
INPUT OVERLOAD	Better than 26 dBs (All inputs)
SUPPLY	20 to 40 V
DIMENSIONS	300 · 90 · 33mm (less controls)

A top quality stereo pre-amplifier and tone control unit, the PA100 provides a comprehensive solution to the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

MPA30

STEREO MAGNETIC CARTRIDGE PRE-AMPLIFIER

£3.35
+35p p&p



Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

SENSITIVITY	3.5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V -re earth
DIMENSIONS	110 · 50 · 25mm (inc DIN socket)

PA12

STEREO PRE-AMPLIFIER

£8.75
+35p p&p



The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL 20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.

FREQUENCY RESPONSE	20 Hz-20 kHz (-3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	-60 dB
SIGNAL/NOISE RATIO	-65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm · 84mm · 25mm

PS12 POWER SUPPLY MODULE

Power supply for AL20A-30A, PA12, S450 etc. Transformer T538.

Input A.C. Voltage 15-20V
Output D.C. Voltage 22-30V approx. (Dependent upon input.)
Output Current 800mA maximum
Dimensions 60 · 43 · 26mm.



£2.13
+35p p&p.

BP124 SIREN ALARM MODULE

5 WATTS —

American Police siren powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer break-down, and other security purposes.



ONLY £3.78
35p p&p.

MA60 HI-FI AMPLIFIER KIT

Build your own top quality amplifier, save yourself pounds. The MA60 kit comprises the following Bi-kits modules, 2 · AL60 amps, 1 · PA100 pre-amp, 1 · SPM80 stab. power supply, 1 · BMT80 transf. giving 15 watts RMS per channel STEREO. All modules covered by the Bi-PAK satisfaction or money back guarantee. Details of the above modules are in this ad. Price £36.00 + 62p p&p.

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Noen, etc. Ideal for the MA60. Size: 425mm · 290mm · 95mm. Price £22.44 + 86p p&p.

TRANSFORMERS

T538 For use with S.450 AL30A MPA30 Order No. 2036	Price: £3.60 + 55p p&p
T2050 For use with Stereo 30 Order No. 2050	Price: £3.66 + 55p p&p
BMT80 For use with AL60 SPM80 Order No. 2034	Price: £6.08 + 86p p&p
BMT250 For use with AL250 Order No. 2035	Price: £7.14 + £1.10 p&p
2040. For use with AL60 Order No. 2040	Price: £5.85 + 80p p&p
2041. For use with AL80, AL120 and AL250 Order No. 2041	Price: £7.85 + 86p p&p

CASES

TEAK 30, 32 × 23 × 8cm. designed mainly for use with our stereo 30 Audio System but has proved very helpful to home constructors. Fitted with solid uncut front and back o/n 139 **£8.69 + p&p 70p.**
TEAK 60, 42 × 29 × 9cm. for use with AL60/MK60 Audio Kit. Useful for the home constructor requiring an amplifier sleeve — has no front or back panel o/n 140 **£7.87 + p&p 85p.**

Professionals and Enthusiasts from BI-PAK

AL120

AUDIO AMPLIFIER
(With integral heat sink and short circuit protection)

£12.91
+ p&p 35p



50W R.M.S.

OUTPUT POWER	50 Watts R.M.S.
SUPPLY	70 Watts
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	0.5% Max (Typically 0.2%)
FREQUENCY RESPONSE	25Hz-20kHz
SENSITIVITY	500mV
MAX HEAT SINK TEMP	45 deg. C
DIMENSIONS	192 x 89 x 49 mm

Introduced to fulfill the demand for a fully protected power amp capable of driving high quality speaker systems at up to 50watts with distortion levels below 0.5%. Ideal for domestic use. Discos, P.A. systems, electronic organs etc. The generously rated components ensure continuous operation at high output levels.

SPM120

SPM120/45
SPM120/55
SMP120/65

£6.52
p&p 35p



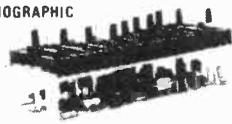
AC INPUTS	
SPM120/45	40-48v
SPM120/55	50-55v
SPM120/65	60-65v
OUTPUT CURRENT	2.5A
RIPPLE	1A 100mV 2A 150mV

SPM120 is a fixed voltage stabiliser available with an output voltage of either 45v, 55v, or 65v. Designed primarily for use in audio applications, the stabiliser which provides output currents up to 2.5A, operates direct from a mains transformer requiring only the addition of 2 electrolytic capacitors to complete the s/c protection.

GE100 Mk2.

10 CHANNEL MONOGRAPHIC EQUALISER

£22.50
p&p 35p



Control Range	±12dB
Dynamic Range	110dB
Maximum Output	-15dB
Frequency Response	30Hz-20kHz (±1dB)
Power Supply	15-0-15v
Voltage Handling Input	3v R.M.S.
T.H.D.	0.05%

Only 155mm x 65mm x 50mm including the 10 x 10K 1in slider potentiometers and knobs which are mounted on a board positioned above the circuitry. In the frequency range of 31Hz to 20kHz you can cut and boost ±12dB with the 10 sliders, each of which has its frequency marked on the circuit board. The GE100 has numerous uses including mixers, P.A. systems and discos. It will also greatly improve the sound reproduction of your existing audio equipment. Power Supply for GE100 or d SG30 £3.80

VPS30

REGULATED VARIABLE STABILISED POWER SUPPLY

£8.20
p&p 35p



AC Input Maximum	25v
Voltage Regulation	2-30v
Regulated Current	0.2A
Incorporating short circuit protection	

This NEW versatile Regulated Variable Stabilised Power Supply with short circuit protection and current limiting is a must for all electronics enthusiasts. It incorporates adjustable voltage from 2v-30v with a current limiting range of 0-2A. With this module there is no need to build a separate power supply for each of your projects, with the simple addition of a transformer to (20331) 0.1ma (d 1310 or 1305) plus a suitable shunt, a voltmeter (d 1311 or 1306) a 470ohm pot (d 1896) a 4K7 pot (d 1899) it can be used again and again as a self-contained bench power supply, eliminating the use of batteries and thus saving £££!

PA200

STEREO PRE AMPLIFIER

£18.61
p&p 40p



FREQUENCY RESPONSE	20Hz to 20kHz ±1dB
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 0.7%)
SENSITIVITY	100mV 100K ohms For an
INPUTS	2 RADIO TUNER 100mV 100K ohms output
	3 MAGNETIC P U 3.5mV 50K ohms 500mV
EQUALISATION	Within ±1dB from 20Hz to 20kHz
BASS CONTROL RANGE	±15dB at 75Hz
TREBLE CONTROL RANGE	±10-20dB at 15kHz
SIGNAL NOISE RATIO	Better than 65dBs (All inputs)
INPUT OVERLOAD	Better than 2dBs (All inputs)
SUPPLY	35 to 706v
DIMENSIONS	300 x 90 x 33mm (less controls)

The PA200 is basically our popular PA100. Modifications have been made to make it compatible with the higher output AL120 and AL250 amplifiers.

HEADPHONES

A top quality headphone with cushioned earpads and headband. Separate balance/volume controls. Stereo or Mono switch. Impedance 8 ohms. Frequency 30-18,000Hz. o/n 884. **£9.78 p&p 70p.**
A brilliant compromise between price and performance. Superb stereo reproduction for the newcomer to Hi-Fi. Impedance 8 ohms. Frequency: 30-18,000Hz. o/n 885. **£4.95 p&p 50p.**

BIB HI-FI ACCESSORIES

Parallel Tracking GROOV KLEEN

The very latest in automatic record cleaning. Designed to suit all modern single play decks. Simple to fit, it is extremely efficient. Complete with two types of base and three height extensions. o/n 8101. **£3.97 p&p 35p.**

Cassette Tape Editing Kit

Enables cassette tapes to be edited and joined easily, quickly and accurately. Kit comprises: Tape Splicer 1/4" (3.2mm) 2 Precision Tape Cutters, Tape Piercer, 9 Self-adhesive Labels, Reel of Splicing Tape, 3 Winders and removers and instructions, all in a handy wallet. o/n 8111. **£2.59 p&p 35p.**

GROOV-STAT

The BIB Groov-Stat static reducer neutralises the static charge on records and other plastic surfaces. o/n 8103. **£5.89 p&p 35p.**

Cassette Head Cleaner

Essential for cleaning of tape heads, capstans and rollers. Pack contains: Tape Head Applicator and tape head polisher tools. Plus bottle of special formula cleaning fluid and full instructions. o/n 832. **£0.72 p&p 35p.**

METERS

Miniature Balance & Tuning Meter

Miniature moving coil meter for stereo balance indicator, tuning indicator for FM or similar application. Pointer at centre indicates zero or null position. Robust construction. Sensitivity: 100-0-100µA. Dimensions 23 x 22 x 26mm. o/n 1318. **£2.11 p&p 35p.**



Balance and Tuning Meter

Clear view edgewise meter. Centre zero application. Sensitivity: 100-0-100µA. Dimensions: 45 x 22 x 34mm. o/n 1319. **£2.16 p&p 35p.**



Miniature Level Meter

Moving coil, for accurate level indication for tape recorders, amplifiers, etc. Neat design, rugged construction will withstand five times rated value. Sensitivity: FSD, 200µA. O/n 1300A. Dimensions: 23 x 22 x 26mm. o/n 1320. **£3.02 p&p 35p.**



Vu Meter

Calibrated -20 to +3 and 0-100%, making it suitable for use as a recording level meter or as a power output indicator. Sensitivity: 130µA. Dimensions: 40 x 29mm. o/n 1321. **£2.16 p&p 35p.**



ADAPTORS

AC-DC enables a large range of battery powered radios, recorders, calculators to be run off the mains. (220-240V AC). Switchable for 6.3v-6v-12. Current rating 300mA. Polarity reversing switch. Universal plug incorporated. o/n 137. **£4.05 p&p 35p.**

DC-DC for use in all cars, boats, etc, with pos, or neg, earth for a regulated output of 6, 7.5v or 9 volts DC at 300mA. For radios, recorders etc. o/n 138. **£3.15 p&p 35p.**

CROSSOVER NETWORKS

2-WAY channels for high and low frequencies to correct speakers — high to tweeters, low to woofers. Complete with instructions. Frequency: 3,000Hz. o/n 1904. **£1.24 p&p 35p.**
2-WAY for 8 ohms speakers up to 30 watts. Frequency: 3KHz. o/n 1905. **£1.85 p&p 35p.**
3-WAY for 8 ohms speakers up to 30 watts. Frequency: 800Hz and 4.5KHz. o/n 1906. **£3.32 p&p 35p.**

MICROPHONES

DYNAMIC CASSETTE
For equipment requiring a high quality microphone. Sturdy, solid moulded body in black with neat chrome surround. Pick-up pattern is omnidirectional. On/off switch, 1 metre of tough lead with floating 2.5 and 3.5mm plugs. Matching moulded strut. Impedance 200 ohms. Sensitivity: 90dB. Frequency: 90-10,000Hz. Size: 20mm dia x 120mm. o/n 1326. **£1.80 p&p 35p.**

DYNAMIC MICROPHONE

Superior quality portable cassette recorder mike with built-in remote control switch and lead, fitted with 5-pin 240° DIN plug (remote switch) and 3 pin DIN plug (microphone). Provides a direct replacement for those supplied with recorders. With detachable stand. Omnidirectional. Impedance: 200 ohms. Freq. response: 100 to 10,000Hz. Sensitivity: 79dB at 1,000Hz. o/n 1327. **£2.98 p&p 35p.**

RE-317: DYNAMIC MICROPHONE

Highly sensitive, high-grade desk or hand mike suitable for use with many popular cassette decks. Incorporates on/off switch and 1 metre lead with moulded standard jack plug. Complete with desk stand. Omnidirectional. Impedance: 5,000 ohms. Freq. response: 100 to 12,000Hz. Sensitivity: (-7dB at 1,000Hz) o/n 1336. **£4.48 p&p 35p.**

OMNIDIRECTIONAL CARDIOID

Powered by a 1 1/2v battery located within the aluminium body. Satin silver finish with front shield. Incorporates on/off switch and 1 metre lead with Busy type windshield "U" bracket and stem and extremely supple cable. Consumption: 0.2mA from 1 1/2v battery providing approx. 8-10,000 hours continuous life. Impedance 600 ohms. Sensitivity: 70dB. Frequency: 30-16,000Hz. Size: 23mm dia x 267mm. o/n 1329. **£14.40 p&p 35p.**

UNIDIRECTIONAL CARDIOID

Dual imp. 600 and 500 ohms. Response 50 to 14,000Hz. Sensitivity 54dB at 50K/ohms. Size: 1 1/2" dia x 6 1/2" long. Weight approx. 190gm. o/n 1328. **£12.32 p&p 35p.**

STANDS

GOOSENECK CHROME FLEXIBLE HOLDERS

Length 320mm. o/n 1333. **£2.70 p&p 35p.**

Length 515mm. o/n 1334. **£3.83 p&p 35p.**

FLOOR STAND HEAVY chrome. Slow away feet with rubber ends for maximum stability. Draws to a height of 5' maximum on 1335 + **£10.69 p&p 85p.**

BOOM ARM for use with the above stand. Heavy chromed metal, it gives 30" reach from the stand. o/n 1337. **£10.35 p&p 70p.**

WINDSHIELD COVERS

o/n 1331 Medium pair **£1.35 p&p 35p** o/n 1332 Large pair **£2.03 p&p 35p.**

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0.68*
113	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	£0.84*
114	5 pin DIN plug to 3.5mm Jack connected to pins 3&5. Length 1.5m	£0.95*
115	5 pin DIN plug to 3.5mm Jack connected to pins 1&4. Length 1.5m	£0.96*
116	Car aerial extension. Screened insulated lead. Fitted plug & ski	£1.24*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0.76*
118	5 pin DIN phono plug to stereo headphone jack socket	£1.18*
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0.2m	£1.01*
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions	£0.68*
123	6.6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug Black	£1.62*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.84*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.84*
126	5 pin DIN plug to Trinned open end. Length 1.5m	£0.84*
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.46*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.90*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.18*
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.76*
131	5 pin DIN plug to 3 pin DIN plug 1&4 and 3&5. Length 1.5m	£0.93*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1.10*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	£0.84*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	£0.76*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	£0.76*
136	Coiled stereo headphone extension lead Black. Length 6m	£1.97*
178	AC mains lead for calculators etc	£0.54*

All prices inc. VAT

BI-PAK
DEPT. ET17, P.O. Box 6, Ware, Herts.
Components Shop: 18 Baldock Street, Ware, Herts.

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

CAPACITORS Electrolytic Axial Leads 10% to +50% Tol <table border="1"> <tr><th>µF</th><th>V d.c.</th><th>16</th><th>25</th><th>40</th><th>63</th></tr> <tr><td>1.0</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>1.5</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>2.2</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>3.3</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>4.7</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>6.8</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>15</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>22</td><td></td><td></td><td></td><td></td><td>10</td></tr> <tr><td>33</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>47</td><td></td><td></td><td></td><td></td><td>10</td></tr> <tr><td>68</td><td></td><td></td><td></td><td></td><td>12</td></tr> <tr><td>100</td><td></td><td></td><td></td><td></td><td>12</td></tr> <tr><td>150</td><td></td><td></td><td></td><td></td><td>29</td></tr> <tr><td>220</td><td></td><td></td><td></td><td></td><td>34</td></tr> <tr><td>330</td><td></td><td></td><td></td><td></td><td>37</td></tr> <tr><td>470</td><td></td><td></td><td></td><td></td><td>44</td></tr> <tr><td>680</td><td></td><td></td><td></td><td></td><td>50</td></tr> <tr><td>1000</td><td></td><td></td><td></td><td></td><td>55</td></tr> <tr><td>1500</td><td></td><td></td><td></td><td></td><td>36</td></tr> <tr><td>2200</td><td></td><td></td><td></td><td></td><td>39</td></tr> </table>		µF	V d.c.	16	25	40	63	1.0					8	1.5					8	2.2					8	3.3					8	4.7					8	6.8					8	10					8	15					8	22					10	33					8	47					10	68					12	100					12	150					29	220					34	330					37	470					44	680					50	1000					55	1500					36	2200					39	Electrolytic Can Type High Ripple, IEC Grade 1, Low E.S.R. Supplied complete with Vertical Fixing Clip <table border="1"> <tr><th>µF</th><th>V d.c.</th><th>16V</th><th>25V</th><th>35V</th><th>50V</th><th>63V</th></tr> <tr><td>2200</td><td></td><td>16V</td><td>2.6A</td><td>3.6A</td><td>4.6A</td><td>5.6A</td></tr> <tr><td>4700</td><td></td><td>16V</td><td>5.8A</td><td>8.1A</td><td>10.4A</td><td>12.7A</td></tr> <tr><td>10000</td><td></td><td>16V</td><td>9.8A</td><td>13.7A</td><td>17.6A</td><td>21.5A</td></tr> <tr><td>22000</td><td></td><td>16V</td><td>13.8A</td><td>18.7A</td><td>24.6A</td><td>30.6A</td></tr> <tr><td>47000</td><td></td><td>25V</td><td>4.6A</td><td>6.4A</td><td>8.2A</td><td>10.0A</td></tr> <tr><td>100000</td><td></td><td>25V</td><td>8.0A</td><td>11.2A</td><td>14.4A</td><td>17.6A</td></tr> <tr><td>220000</td><td></td><td>25V</td><td>12.8A</td><td>17.9A</td><td>23.1A</td><td>29.2A</td></tr> <tr><td>470000</td><td></td><td>40V</td><td>0.9A</td><td>1.2A</td><td>1.5A</td><td>1.8A</td></tr> <tr><td>1000000</td><td></td><td>40V</td><td>2.4A</td><td>3.3A</td><td>4.2A</td><td>5.1A</td></tr> <tr><td>2200000</td><td></td><td>40V</td><td>5.6A</td><td>7.8A</td><td>10.0A</td><td>12.2A</td></tr> <tr><td>4700000</td><td></td><td>40V</td><td>9.2A</td><td>12.8A</td><td>16.4A</td><td>20.0A</td></tr> <tr><td>10000000</td><td></td><td>70V</td><td>1.5A</td><td>2.5A</td><td>3.5A</td><td>4.5A</td></tr> <tr><td>22000000</td><td></td><td>70V</td><td>4.0A</td><td>5.6A</td><td>7.2A</td><td>8.8A</td></tr> <tr><td>47000000</td><td></td><td>70V</td><td>7.5A</td><td>10.5A</td><td>13.5A</td><td>16.5A</td></tr> <tr><td>100000000</td><td></td><td>100V</td><td>4.0A</td><td>5.6A</td><td>7.2A</td><td>8.8A</td></tr> <tr><td>220000000</td><td></td><td>100V</td><td>7.8A</td><td>10.9A</td><td>14.0A</td><td>17.1A</td></tr> </table>		µF	V d.c.	16V	25V	35V	50V	63V	2200		16V	2.6A	3.6A	4.6A	5.6A	4700		16V	5.8A	8.1A	10.4A	12.7A	10000		16V	9.8A	13.7A	17.6A	21.5A	22000		16V	13.8A	18.7A	24.6A	30.6A	47000		25V	4.6A	6.4A	8.2A	10.0A	100000		25V	8.0A	11.2A	14.4A	17.6A	220000		25V	12.8A	17.9A	23.1A	29.2A	470000		40V	0.9A	1.2A	1.5A	1.8A	1000000		40V	2.4A	3.3A	4.2A	5.1A	2200000		40V	5.6A	7.8A	10.0A	12.2A	4700000		40V	9.2A	12.8A	16.4A	20.0A	10000000		70V	1.5A	2.5A	3.5A	4.5A	22000000		70V	4.0A	5.6A	7.2A	8.8A	47000000		70V	7.5A	10.5A	13.5A	16.5A	100000000		100V	4.0A	5.6A	7.2A	8.8A	220000000		100V	7.8A	10.9A	14.0A	17.1A	Miniature Low Value Polystyrene, Axial, -1% Tol., > 63V D.C. Wkg Ceramic Plate, Radial, Low K, 1.8pF - 8.2pF - 25pF Tol., 10-330pF - 2% Tol., 100V D.C. Wkg Ceramic Plate, Radial, Med K, 10% Tol., 100V D.C. Wkg Ceramic Plate, Radial, High K, -20% to +80% Tol., 63V D.C. Wkg <table border="1"> <tr><th>µF</th><th>424</th><th>632</th><th>630</th><th>629</th><th>µF</th><th>424</th><th>632</th><th>630</th><th>629</th><th>nF</th><th>424</th><th>632</th><th>630</th><th>629</th></tr> <tr><td>1</td><td></td><td></td><td></td><td></td><td>100</td><td>16</td><td>6</td><td></td><td></td><td>10</td><td>25</td><td></td><td></td><td>6</td></tr> <tr><td>1.5</td><td></td><td></td><td></td><td></td><td>120</td><td>16</td><td>8</td><td></td><td></td><td>12</td><td>26</td><td></td><td></td><td>8</td></tr> <tr><td>2.2</td><td></td><td></td><td></td><td></td><td>150</td><td>16</td><td>8</td><td></td><td></td><td>15</td><td>26</td><td></td><td></td><td>8</td></tr> <tr><td>3.3</td><td></td><td></td><td></td><td></td><td>180</td><td>16</td><td>6</td><td></td><td></td><td>18</td><td>27</td><td></td><td></td><td>6</td></tr> <tr><td>4.7</td><td></td><td></td><td></td><td></td><td>220</td><td>16</td><td>6</td><td></td><td></td><td>22</td><td>28</td><td></td><td></td><td>6</td></tr> <tr><td>6.8</td><td></td><td></td><td></td><td></td><td>270</td><td>18</td><td>8</td><td></td><td></td><td>27</td><td>38</td><td></td><td></td><td>8</td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td>330</td><td>18</td><td>8</td><td></td><td></td><td>33</td><td>41</td><td></td><td></td><td>8</td></tr> <tr><td>15</td><td></td><td></td><td></td><td></td><td>390</td><td>18</td><td>5</td><td></td><td></td><td>39</td><td>43</td><td></td><td></td><td>5</td></tr> <tr><td>22</td><td></td><td></td><td></td><td></td><td>470</td><td>18</td><td>5</td><td></td><td></td><td>47</td><td></td><td></td><td></td><td>5</td></tr> <tr><td>33</td><td></td><td></td><td></td><td></td><td>560</td><td>16</td><td>5</td><td></td><td></td><td>56</td><td></td><td></td><td></td><td>5</td></tr> <tr><td>47</td><td></td><td></td><td></td><td></td><td>680</td><td>16</td><td>5</td><td></td><td></td><td>68</td><td></td><td></td><td></td><td>5</td></tr> <tr><td>68</td><td></td><td></td><td></td><td></td><td>820</td><td>16</td><td>5</td><td></td><td></td><td>82</td><td></td><td></td><td></td><td>5</td></tr> <tr><td>100</td><td></td><td></td><td></td><td></td><td>1000</td><td>16</td><td>5</td><td></td><td></td><td>1000</td><td>16</td><td>5</td><td></td><td>5</td></tr> <tr><td>150</td><td></td><td></td><td></td><td></td><td>1200</td><td>16</td><td>5</td><td></td><td></td><td>1200</td><td>16</td><td>5</td><td></td><td>5</td></tr> <tr><td>220</td><td></td><td></td><td></td><td></td><td>1500</td><td>18</td><td>6</td><td></td><td></td><td>1500</td><td>18</td><td>6</td><td></td><td>6</td></tr> <tr><td>330</td><td></td><td></td><td></td><td></td><td>1800</td><td>18</td><td>6</td><td></td><td></td><td>1800</td><td>18</td><td>6</td><td></td><td>6</td></tr> <tr><td>470</td><td></td><td></td><td></td><td></td><td>2200</td><td>18</td><td>6</td><td></td><td></td><td>2200</td><td>18</td><td>6</td><td></td><td>6</td></tr> <tr><td>680</td><td></td><td></td><td></td><td></td><td>2700</td><td>18</td><td>6</td><td></td><td></td><td>2700</td><td>18</td><td>6</td><td></td><td>6</td></tr> <tr><td>1000</td><td></td><td></td><td></td><td></td><td>3300</td><td>18</td><td>6</td><td></td><td></td><td>3300</td><td>18</td><td>6</td><td></td><td>6</td></tr> <tr><td>1500</td><td></td><td></td><td></td><td></td><td>3900</td><td>18</td><td>6</td><td></td><td></td><td>3900</td><td>18</td><td>6</td><td></td><td>6</td></tr> <tr><td>2200</td><td></td><td></td><td></td><td></td><td>4700</td><td>23</td><td>7</td><td></td><td></td><td>4700</td><td>23</td><td>7</td><td></td><td>7</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>5600</td><td>23</td><td></td><td></td><td></td><td>5600</td><td>23</td><td></td><td></td><td>7</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>6800</td><td>23</td><td></td><td></td><td></td><td>6800</td><td>23</td><td></td><td></td><td>7</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>8200</td><td>23</td><td></td><td></td><td></td><td>8200</td><td>23</td><td></td><td></td><td>7</td></tr> </table>		µF	424	632	630	629	µF	424	632	630	629	nF	424	632	630	629	1					100	16	6			10	25			6	1.5					120	16	8			12	26			8	2.2					150	16	8			15	26			8	3.3					180	16	6			18	27			6	4.7					220	16	6			22	28			6	6.8					270	18	8			27	38			8	10					330	18	8			33	41			8	15					390	18	5			39	43			5	22					470	18	5			47				5	33					560	16	5			56				5	47					680	16	5			68				5	68					820	16	5			82				5	100					1000	16	5			1000	16	5		5	150					1200	16	5			1200	16	5		5	220					1500	18	6			1500	18	6		6	330					1800	18	6			1800	18	6		6	470					2200	18	6			2200	18	6		6	680					2700	18	6			2700	18	6		6	1000					3300	18	6			3300	18	6		6	1500					3900	18	6			3900	18	6		6	2200					4700	23	7			4700	23	7		7						5600	23				5600	23			7						6800	23				6800	23			7						8200	23				8200	23			7
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CASES Small Desk Console - Boss Industrial Mouldings Slope Front Console, Recessed Top ABS Base, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel Finished Grey <table border="1"> <tr><td>W161 D96 H39 (57)</td><td>186</td><td>Case BIM1005 OR</td></tr> <tr><td>W215 D130 H47 (73)</td><td>288</td><td>Case BIM1006 OR</td></tr> </table> Plastic Boxes - Boss Industrial Mouldings Moulded Box and Close Fitting Flanged Lid ABS Box, C/W Brass Bushes, and Lid In Orange <table border="1"> <tr><td>L112 W62 D31</td><td>87</td><td>Case BIM2003 OR</td></tr> <tr><td>L150 W80 D50</td><td>115</td><td>Case BIM2005 OR</td></tr> <tr><td>L190 W110 D60</td><td>195</td><td>Case BIM2006 OR</td></tr> </table> Instrument Case - Boss Industrial Mouldings Covers Manufactured from 14SWG Aluminium Chassis Manufactured from 18SWG Mild Steel Covers Finished Orange Chassis Finished Matt Black <table border="1"> <tr><td>W250 D167.5 H 68.5 (Chassis 153mm Deep)</td><td>1480</td><td>Case BIM3000 OR</td></tr> </table> Plastic Boxes with Metal Lids - Boss Industrial Mouldings Recessed Top Box ABS Base, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel Finished Grey <table border="1"> <tr><td>L85 W56 D29</td><td>97</td><td>Case BIM4003 OR</td></tr> <tr><td>L111 W71 D42</td><td>130</td><td>Case BIM4004 OR</td></tr> <tr><td>L161 W96 D53</td><td>182</td><td>Case BIM4005 OR</td></tr> </table> Diecast Boxes - Boss Industrial Mouldings Diecast Box and Flanged Lid Aluminium Box and Lid in Natural Finish <table border="1"> <tr><td>L113 W63 D31</td><td>104</td><td>Case BIM5003 NA</td></tr> <tr><td>L152 W82 D50</td><td>181</td><td>Case BIM5005 NA</td></tr> <tr><td>L192 W113 D61</td><td>280</td><td>Case BIM5006 NA</td></tr> </table>		W161 D96 H39 (57)	186	Case BIM1005 OR	W215 D130 H47 (73)	288	Case BIM1006 OR	L112 W62 D31	87	Case BIM2003 OR	L150 W80 D50	115	Case BIM2005 OR	L190 W110 D60	195	Case BIM2006 OR	W250 D167.5 H 68.5 (Chassis 153mm Deep)	1480	Case BIM3000 OR	L85 W56 D29	97	Case BIM4003 OR	L111 W71 D42	130	Case BIM4004 OR	L161 W96 D53	182	Case BIM4005 OR	L113 W63 D31	104	Case BIM5003 NA	L152 W82 D50	181	Case BIM5005 NA	L192 W113 D61	280	Case BIM5006 NA	Small Desk Consoles - Boss Industrial Mouldings Slope Front Console, Recessed Top ABS Base, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel Finished Grey Ventilation Slots In Base <table border="1"> <tr><td>W105 D143 H32 (56)</td><td>206</td><td>Case BIM6005 OR</td></tr> <tr><td>W170 D143 H32 (56)</td><td>271</td><td>Case BIM6006 OR</td></tr> <tr><td>W170 D214 H32 (82)</td><td>375</td><td>Case BIM6007 OR</td></tr> </table> All Metal Desk Consoles - Boss Industrial Mouldings Slope Front Console, Recessed Top Two Piece All Aluminium Construction Ventilation Slots In Rear and Base Choice of 15° or 30° Sloping Front Off White Top Panel, Blue Base <table border="1"> <tr><td>W102 D140 H28 (51) 15° slope</td><td>1016</td><td>Case BIM7151A</td></tr> <tr><td>W165 D211 H33 (78) 15° slope</td><td>1350</td><td>Case BIM7154A</td></tr> <tr><td>W254 D287 H33 (76) 15° slope</td><td>1572</td><td>Case BIM7156A</td></tr> <tr><td>W356 D287 H33 (76) 15° slope</td><td>1823</td><td>Case BIM7158A</td></tr> <tr><td>W102 D140 H28 (76) 30° slope</td><td>1018</td><td>Case BIM7301A</td></tr> <tr><td>W165 D193 H28 (102) 30° slope</td><td>1202</td><td>Case BIM7303A</td></tr> <tr><td>W254 D259 H28 (102) 30° slope</td><td>1572</td><td>Case BIM7306A</td></tr> <tr><td>W356 D259 H28 (102) 30° slope</td><td>1823</td><td>Case BIM7308A</td></tr> </table> Eurocard Size Desk Console - Boss Industrial Mouldings Slope Front Console ABS Case, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel, Finished Grey <table border="1"> <tr><td>W169 D127 H45 (70)</td><td>375</td><td>Case BIM8006 OR</td></tr> </table>		W105 D143 H32 (56)	206	Case BIM6005 OR	W170 D143 H32 (56)	271	Case BIM6006 OR	W170 D214 H32 (82)	375	Case BIM6007 OR	W102 D140 H28 (51) 15° slope	1016	Case BIM7151A	W165 D211 H33 (78) 15° slope	1350	Case BIM7154A	W254 D287 H33 (76) 15° slope	1572	Case BIM7156A	W356 D287 H33 (76) 15° slope	1823	Case BIM7158A	W102 D140 H28 (76) 30° slope	1018	Case BIM7301A	W165 D193 H28 (102) 30° slope	1202	Case BIM7303A	W254 D259 H28 (102) 30° slope	1572	Case BIM7306A	W356 D259 H28 (102) 30° slope	1823	Case BIM7308A	W169 D127 H45 (70)	375	Case BIM8006 OR	Resistors Carbon Film, Fixed <table border="1"> <tr><td>0.25W, E24 Values, 10R-10M, 5% Tol</td><td>1.5 ea</td><td>90¢/100 (Mult 10/Value)</td><td>£7.90/1000 (Mult 100/Value)</td><td>Res RD%</td></tr> <tr><td>0.5W, E12 Values, 10R-4M7, 10% Tol</td><td>2 ea</td><td>1.25¢/100 (Mult 10/Value)</td><td>£10.10/1000 (Mult 100/Value)</td><td>Res RD%</td></tr> </table> Metal Film, Fixed <table border="1"> <tr><td>0.5W, E24 Values, SR1 to 10M, 2% Tol</td><td>6 ea</td><td>3.80/100 (Mult 10/Value)</td><td>£32.40/1000 (Mult 100/Value)</td><td>Res MR30</td></tr> <tr><td>2.5W, E12 Values, 10R-27K, 5% Tol</td><td>13 ea</td><td>7.90/100 (Mult 10/Value)</td><td></td><td>Res PR52</td></tr> </table> Metal Glaze, Fixed <table border="1"> <tr><td>0.5W, E24 Values, 1M-33M, 5% Tol</td><td>10 ea</td><td>5.40/100 (Mult 10/Value)</td><td></td><td>Res VR37</td></tr> </table>		0.25W, E24 Values, 10R-10M, 5% Tol	1.5 ea	90¢/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD%	0.5W, E12 Values, 10R-4M7, 10% Tol	2 ea	1.25¢/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD%	0.5W, E24 Values, SR1 to 10M, 2% Tol	6 ea	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30	2.5W, E12 Values, 10R-27K, 5% Tol	13 ea	7.90/100 (Mult 10/Value)		Res PR52	0.5W, E24 Values, 1M-33M, 5% Tol	10 ea	5.40/100 (Mult 10/Value)		Res VR37	Skeleton Presets, Miniature <table border="1"> <tr><td>0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting</td><td>7</td><td>Min Preset V</td></tr> <tr><td>0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting</td><td>7</td><td>Min Preset H</td></tr> </table> Skeleton Presets, Standard <table border="1"> <tr><td>0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting</td><td>10</td><td>Std Preset V</td></tr> <tr><td>0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting</td><td>10</td><td>Std Preset H</td></tr> </table> Potentiometer, Rotary <table border="1"> <tr><td>0.5W, E3 Values, 1K-2M2 Lin.</td><td>34</td><td>Pot Lin</td></tr> <tr><td>0.25W, E3 Values, 4K7-2M2 Log.</td><td>34</td><td>Pot Log</td></tr> </table>		0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	7	Min Preset V	0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting	7	Min Preset H	0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	10	Std Preset V	0.3W, E3 Values, 100R-4M7, Lin. 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W170 D214 H32 (82)	375	Case BIM6007 OR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W102 D140 H28 (51) 15° slope	1016	Case BIM7151A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W165 D211 H33 (78) 15° slope	1350	Case BIM7154A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W254 D287 H33 (76) 15° slope	1572	Case BIM7156A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W356 D287 H33 (76) 15° slope	1823	Case BIM7158A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W102 D140 H28 (76) 30° slope	1018	Case BIM7301A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W165 D193 H28 (102) 30° slope	1202	Case BIM7303A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W254 D259 H28 (102) 30° slope	1572	Case BIM7306A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W356 D259 H28 (102) 30° slope	1823	Case BIM7308A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
W169 D127 H45 (70)	375	Case BIM8006 OR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.25W, E24 Values, 10R-10M, 5% Tol	1.5 ea	90¢/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
0.5W, E12 Values, 10R-4M7, 10% Tol	2 ea	1.25¢/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
0.5W, E24 Values, SR1 to 10M, 2% Tol	6 ea	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
2.5W, E12 Values, 10R-27K, 5% Tol	13 ea	7.90/100 (Mult 10/Value)		Res PR52																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
0.5W, E24 Values, 1M-33M, 5% Tol	10 ea	5.40/100 (Mult 10/Value)		Res VR37																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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DIGITAL INTEGRATED CIRCUITS

4000 Buffered C-MOS — High Speed

5 15V 'B' Series, Up to 20MHz

7400 T.T.L.

HEF4000	14	HEF4046	100	HEF4514	250	N7400N	9	N7444N	83	N74122N	39	N74192N	60	N74LS28N	32	N74LS138N	85	N74LS253N	105
HEF4001	14	HEF4047	87	HEF4515	299	N7401N	11	N7445N	65	N74123N	37	N74194N	80	N74LS30N	16	N74LS139N	85	N74LS257N	104
HEF4002	14	HEF4048	28	HEF4516	90	N7402N	11	N7446AN	62	N74125N	32	N74195N	79	N74LS32N	24	N74LS153N	76	N74LS258N	107
HEF4006	96	HEF4050	28	HEF4517	382	N7403N	11	N7447AN	51	N74126N	32	N74198N	120	N74LS33N	32	N74LS154N	122	N74LS260N	26
HEF4007	14	HEF4051	69	HEF4518	69	N7404N	12	N7448AN	44	N74128N	74	N74199N	139	N74LS37N	24	N74LS155N	80	N74LS266N	40
HEF4008	80	HEF4052	72	HEF4519	55	N7405N	12	N7449N	13	N74132N	16	N74201N	160	N74LS38N	24	N74LS156N	80	N74LS267N	300
HEF4011	14	HEF4053	72	HEF4520	65	N7406N	25	N7451N	13	N74145N	60	N74209N	116	N74LS40N	22	N74LS157N	54	N74LS273N	130
HEF4012	14	HEF4054	37	HEF4521	188	N7407N	27	N7452N	15	N74147N	126	N74208N	200	N74LS42N	53	N74LS158N	60	N74LS283N	116
HEF4013	32	HEF4057	380	HEF4528	99	N7408N	13	N7454N	13	N74148N	83	N74205N	150	N74LS51N	22	N74LS160N	120	N74LS290N	90
HEF4014	84	HEF4068	14	HEF4532	120	N7409N	13	N7450N	13	N74150N	65	N74206N	150	N74LS54N	16	N74LS161N	78	N74LS293N	100
HEF4015	60	HEF4069	14	HEF4534	510	N7410N	11	N7470N	26	N74151N	40	N74207N	120	N74LS55N	22	N74LS162N	130	N74LS298N	100
HEF4016	35	HEF4070	14	HEF4539	110	N7411N	18	N7472N	22	N74153N	55	N74208N	150	N74LS73N	29	N74LS163N	78	N74LS324N	170
HEF4017	55	HEF4071	14	HEF4543	155	N7412N	17	N7473N	23	N74154N	96	N74209N	200	N74LS75N	40	N74LS164N	90	N74LS325N	105
HEF4018	65	HEF4072	16	HEF4555	78	N7413N	23	N7474N	23	N74155N	53	N74210N	200	N74LS76N	33	N74LS170N	200	N74LS326N	105
HEF4019	46	HEF4073	16	HEF4556	78	N7414N	26	N7475N	28	N74156N	48	N74211N	200	N74LS78N	33	N74LS171N	100	N74LS327N	105
HEF4020	88	HEF4075	16	HEF4557	386	N7415N	22	N7476N	26	N74157N	49	N74212N	200	N74LS83AN	97	N74LS174N	100	N74LS328N	100
HEF4021	85	HEF4076	85	HEF4585	97	N7417N	23	N7480N	43	N74158N	54	N74213N	200	N74LS85N	70	N74LS175N	100	N74LS329N	100
HEF4022	82	HEF4077	14	HEF4724	171	N7420N	11	N7483N	63	N74160N	74	N74214N	200	N74LS86N	33	N74LS181N	320	N74LS332AN	150
HEF4023	14	HEF4078	16	HEF40097	90	N7421N	26	N7485N	65	N74161N	74	N74215N	200	N74LS87N	16	N74LS190N	91	N74LS333AN	150
HEF4024	45	HEF4081	16	HEF40098	73	N7425N	27	N7486N	23	N74162N	74	N74216N	200	N74LS89N	40	N74LS191N	95	N74LS334AN	150
HEF4025	14	HEF4082	16	HEF40106	62	N7426N	22	N7489N	30	N74163N	74	N74217N	200	N74LS93N	45	N74LS192N	128	N74LS335AN	150
HEF4027	32	HEF4085	64	HEF40160	119	N7427N	22	N7491AN	60	N74164N	65	N74218N	200	N74LS98N	16	N74LS193N	130	N74LS336AN	150
HEF4028	52	HEF4086	64	HEF40161	119	N7428N	30	N7492N	33	N74165N	65	N74219N	200	N74LS99N	116	N74LS194N	150	N74LS337AN	150
HEF4029	60	HEF4093	50	HEF40162	119	N7430N	11	N7493N	31	N74166N	93	N74220N	200	N74LS101N	16	N74LS195AN	120	N74LS338AN	150
HEF4030	46	HEF4094	175	HEF40163	119	N7432N	21	N7495N	74	N74170N	124	N74221N	200	N74LS102N	70	N74LS196N	80	N74LS339AN	150
HEF4031	209	HEF4104	166	HEF40174	119	N7433N	30	N7495AN	48	N74173N	111	N74222N	200	N74LS103N	23	N74LS197N	110	N74LS340AN	150
HEF4035	110	HEF4502	91	HEF40175	119	N7437N	21	N7496N	46	N74174N	63	N74223N	200	N74LS104N	38	N74LS198N	160	N74LS341AN	150
HEF4040	68	HEF4505	571	HEF40192	130	N7438N	21	N74100N	88	N74175N	62	N74224N	200	N74LS105N	74	N74LS199N	160	N74LS342AN	150
HEF4041	75	HEF4508	51	HEF40193	140	N7439N	60	N74107N	25	N74180N	80	N74225N	200	N74LS106N	24	N74LS200N	40	N74LS343AN	150
HEF4042	54	HEF4510	70	HEF40194	119	N7440N	12	N74109N	42	N74181N	165	N74226N	200	N74LS107N	16	N74LS201N	40	N74LS344AN	150
HEF4043	79	HEF4511	110	HEF40195	117	N7442N	40	N74116N	148	N74182N	69	N74227N	200	N74LS108N	22	N74LS202N	60	N74LS345AN	150
HEF4044	84	HEF4512	96	N7443N	79	N74121N	23	N74121N	23	N74192N	65	N74228N	200	N74LS109N	24	N74LS203N	37	N74LS346AN	150

LINEAR INTEGRATED CIRCUITS

CA3011	92	NE592K	162
CA3018	75	RC4136	130
CA3020	191	TBA120S	79
CA3028A	86	TCA580	346
CA3046	76	TCA730	450
CA3048	245	TCA740	450
CA3080E	70	TDA1008	326
CA3089E	253	TDA1022	648
CA3130E	90	TDA1028	338
CA3140E	38	TDA1029	338
CA3198E	266	TDA1034B	217
LM301AN	30	TDA2581	266
LM308N	95	TD2640	292
LM318N	200	TL081CP	75
LM319N	216	TL084CN	140
LM324N	70	UA709CT	46
LM339N	71	UA709CN	40
LM381N	110	UA710CN	61
LM381AN	180	UA711CN	65
LM382	120	UA714CT	42
		UA717CN	18
		UA747CN	50
		UA748CN	35

MC1458N	35	MC1459N	97
NE531	119	NE531E	216
NE540	225	NE540E	225
NE555N	25	NE555NE	60
NE568N	60	NE568NE	60
NE569N	35	NE569NE	427
NE562N	461	NE562NE	120
NE565N	120	NE565NE	155
NE567N	170	NE567NE	405
NE570N	405	NE570NE	459

SEMICONDUCTORS

Rectifier Bridges	Order Code
1A 400V S.I.L.	93 BY179
1A 400V D.I.L.	84 BY164
1.5A 100V D.I.L.	33 VM18
1.5A 400V D.I.L.	35 VM48
1.5A 100V	45 V01
1.5A 400V	52 V04
2A 100V	89 VS148
2A 400V	109 VS448
6A 100V	143 VJ148
6A 400V	193 VM448
10A 100V	172 VJ148
10A 400V	201 VJ448
15A 100V	215 VL148
15A 400V	226 VL448
30A 100V	242 VK148
30A 400V	250 VK448

S.C.R.'s

4A 400V	54	C106D
12A 400V	108	TIC1260

TRIACS

10A 500V	124	BT135-500
15A 500V	177	BT139-500
23A 500V	492	BTW41-500

COMMUNICATIONS INTEGRATED CIRCUITS — PLESSEY

SL360C	262	SL641C	384
SL362C	302	SL650C	865
SL610	230	SL651C	786
SL611C	230	SL652C	329
SL612C	230	SL650C	230
SL631C	384	SL701C	220
SL620C	347		
SL621C	347	SL1610C	166
SL622C	854	SL1611C	166
SL623C	629	SL1612C	166
SL624C	321	SL1613C	193
SL630C	218	SL1620C	225
SL640C	384	SL1621C	225
		SL1623C	251
		SL1625C	225
		SL1626C	291
		SL1630C	193
		SL1640C	193
		SL1641C	193
		SL1660C	890
		SL6640C	401
		SL6650C	378
		SP8629	446
		SP8630B	1361
		SP8655B	1058
		SP8657B	1058
		SP8659B	907
		SP8660B	907
		SP8690	907
		SP8760B	680
		SP8790B	454
		SP8794B	454

OPTO ELECTRONICS

Light Emitting Diodes, Individual	Order Code
125' (3mm) Red	14 CQY54
Green	17 CQY95
Yellow	19 CQY97
Panel Mounting Clip to suit.	3 LED5 Clip
2" (5mm) Red	15 CQY24A
Green	17 CQY94
Yellow	19 CQY96
Panel Mounting Clip to suit	5 LED5 Clip
Light Emitting Diodes — 7 Segment Display	
3" (7.6mm) C. Anode R.H. Decimal Pt. Red	160 XAN3061
C. Anode R.H. Decimal Pt. Green	199 XAN3051
C. Cathode R.H. Decimal Pt. Red, Low current drain	160 XAN3074
6" (15.2mm) C. Anode L.H. Decimal Pt. Red	230 XAN6620
C. Anode L.H. Decimal Pt. Green	230 XAN6520
C. Cathode L.H. Decimal Pt. Red	230 XAN6640
Photoresistors	
ORP12	90 ORP12
ORP61	90 ORP61
Phototransistors	
OCPT1	180 OCPT1
BPX25	175 BPX25
BPX29	175 BPX29
Photocoupler	
FCD820	150 FCD820

MAINS TRANSFORMERS

Secondaries may be connected in series or parallel to give wide voltage range	Order Code
Primaries 0.220, 240V	
6VA — Clamp Type Construction	
Approx. 18% Regulation F.C. 54, H36, W35	
0.4-5V, 0.4-5V Secondaries	220 Trans 6VA 45
0.5V, 0.6V	60
0.12V, 0.12V	120
0.15V, 0.15V	150
0.20V, 0.20V	200
20VA — Clamp Type Construction	
Approx. 16% Regulation F.C. 70, H48, W46	
0.4-5V, 0.4-5V Secondaries	335 Trans 20VA 45
0.6V, 0.6V	60
0.12V, 0.12V	120
0.15V, 0.15V	150
0.175V, 0.175V	175
0.20V, 0.20V	200
55VA — Clamp Type Construction	
Approx. 10% Regulation F.C. 92, H64, W57	
0.6V, 0.6V Secondaries	540 Trans 55VA 60
0.12V, 0.12V	120
0.15V, 0.15V	150
0.20V, 0.20V	200
0.30V, 0.30V	300
100VA — Frame Type Construction	
Approx. 6% Regulation H87, W74, D64	
0.25V, 0.25V Secondaries	825 Trans 100VA 250
0.40V, 0.40V	400

SWITCHES

Miniature Toggle — Honeywell	Order Code
SPDT	2A/250V A.C., 5A/28V D.C.</

POWERTRAN

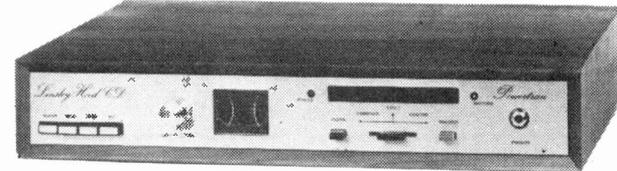
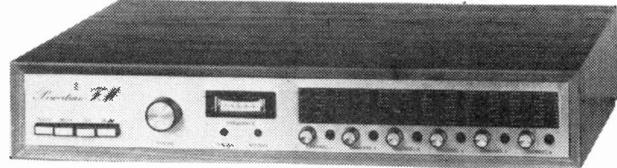
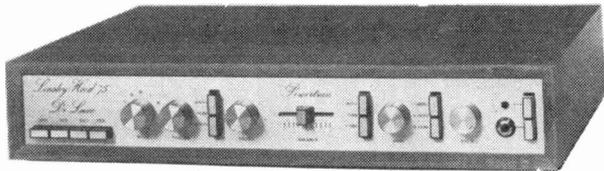
PSI 4002 STUDIO MODEL



cabinet size 17.2" x 17.2" x 8.7"

COMPLETE KIT ONLY £196.90 + VAT

READ THE REVIEW
IN SOUND INTERNATIONAL DEC. '78 !



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.

POWERTRAN SFMT TUNER £35.90 + VAT

This is a simple low cost design which can be constructed easily without special alignment equipment but which still gives a first-class output suitable for feeding any of our very popular amplifiers or any other high quality audio equipment. A phase-locked-loop is used for stereo decoding and controls include switchable afc, switchable muting and push-button channel selection (adjustable by controls on the front panel). This unit matches well with the T20 + 20 and T30 + 30 amplifiers

WWII TUNER £47.70 + VAT

This cost reduced model of our highly successful Wireless World FM Tuner kit was designed to complement the T20 + 20 and T30 + 30 amplifiers and the cabinet size, front panel format and electrical characteristics make this tuner compatible with either. Facilities included are pre-aligned front-end module, switchable afc, adjustable switchable muting, LED tuning indication and both continuous and push-button channel selection (adjustable by controls on the front panel).

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, cables, nuts, bolts, etc., and full instructions — in fact everything!

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

PRICE STABILITY. Order with confidence. Irrespective of any price changes. We will honour all prices in this advertisement until August 31st, 1979, if the July 1979 issue is mentioned with your order. Errors and VAT rate changes excluded.

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

U.K. ORDERS. Subject to 12 1/2% surcharge for VAT (i.e. add 1/8 to the price). No charge is made for carriage *or at current rate if changed.

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

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

FOR ELECTRONIC KITS OF DISTINCTION

200 + 200 watt AMPLIFIER

As featured in Electronics Today International

400W rms continuous — 800W peak!

0.03% THD at FULL power!

PLUS all the following features too!

- ★ Each channel totally independent with its own stabilised power supply driven by custom designed TOROIDAL transformers!
- ★ Inherent reliability — monster heat sinks for cool running at the hottest venues — electronic open and short circuit protection!
- ★ Ultra low feedback (an incredible low 14dB overall!), super high slewing rate (20V/μs). 200W rms continuous to 4 ohm from EACH channel, input sensitivity 0.775V (0dB).
- ★ Professional quality components, sturdy 19" rack mounting chassis complete with sleeve and feet for free standing work too.
- ★ Easy to build — plenty of working space with ready access to all components, minimal wiring, extensive instruction suitable for both experience constructors and newcomers to electronics.
- ★ Value for money — quality and performance comparable with ready-built amplifiers costing over £600!

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

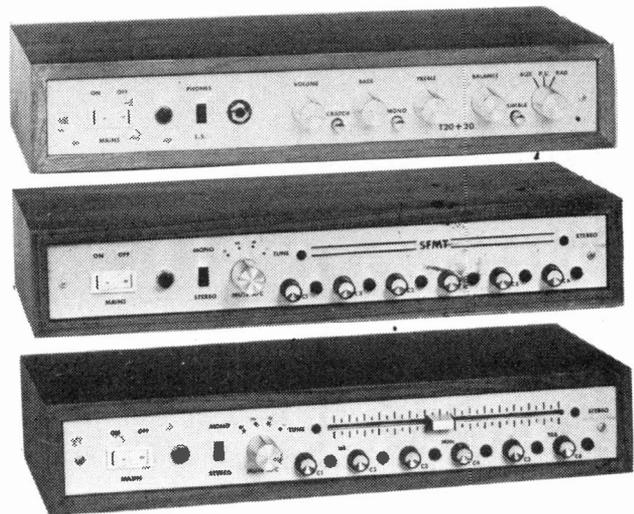
This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter,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

WIRELESS WORLD FM TUNER £70.20 + VAT

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

LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

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



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POWERTRAN ELECTRONICS

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news digest.....

CARRY-PACKS FROM JVC

A new range of equipment from JVC brings their VHS domestic video system into the portable market.

Leading the range is the HR4100 colour portable video cassette recorder, with a price tag of £799.92 including VAT. It is fully compatible with all VHS recorders and weighs only 9.3 kg, complete with cassette, battery pack and RF converter.

The new GC4100 colour video camera is a self-contained unit with the camera control unit built into the camera head.

Two-tube design uses a new colour stripe filter to improve colour reproduction, with an aperture correction circuit to give excellent resolution.

Recording is possible with illumination as low as 100 lux. Retail price will be £934.20p.

JVC have also launched the TV41 tuner/timer, which, when connected to the HR4100,

provides all the usual record/playback facilities of a deck-type recorder, the HR 3330, is a development of the previous successful model, but also includes extra refinements such as eight day timer, remote-control pause switch and audio dubbing facilities.

For further information on this new video range, contact JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF. to give



OPTO FETS

A new trio of opto-coupled FETs, available from Jermyn-Mogul Distribution, feature a minimum isolation resistance of 100 gigohms between input and output.

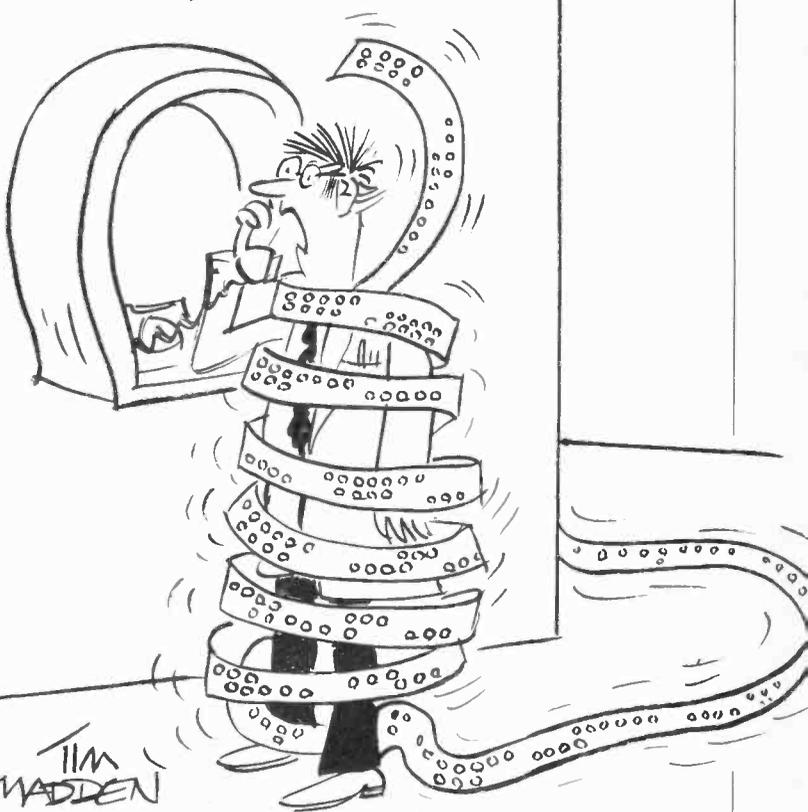
These new GE opto-couplers consist of a gallium arsenide infra-red emitting diode coupled to a symmetrical bilateral silicon photo detector. The detector is electrically isolated from the input and performs like an ideal isolated FET designed for distortion-free control of low level AC and DC analogue signals. They do this by varying in resistance from between 100

ohms to 300 megohms, the change in resistance being controlled by the amount of current flowing through the infra-red emitting diode.

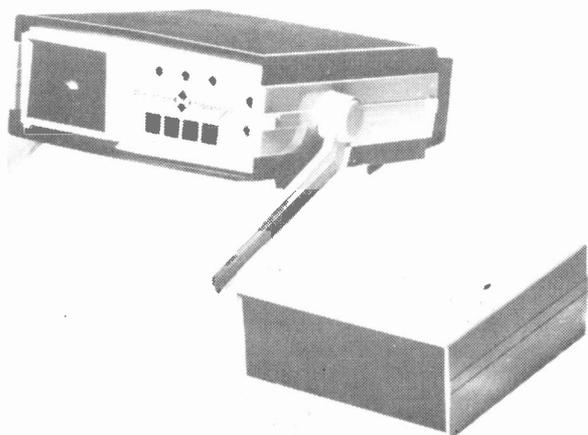
Applications include isolated variable attenuators, 70 db automatic gain control, remote band switching, sample and hold circuits, optically isolated multiflexers and reed relay replacement. The H11F family come in the popular six pin DIL package.

For products and application sheets contact Jermyn-Mogul Distribution of Vestry Estate, Sevenoaks, Kent.

"HELLO, HELLO - ABOUT THIS NEW GARDENING COMPUTER.....!"



..... news digest



ELECTRONIC TACHO

Orbit Controls are now producing a four decade electronic tachometer for measuring speed, rate, flowrate and frequency.

The 74A 430 has a four decade, solid state, digital read-out and a pre-wired timebase, controlled by a high precision 1MHz crystal oscillator.

Flexibility of construction allows pre-wiring to any interval from 1mS to 10S. The unit features high noise immunity and freedom from false triggering counts.

The frequency range extends from 0.5Hz to 10kHz with an input sensitivity of 100mV (adjustable). Input, positive pulse or sine wave, is fully protected to 240V rms. Power may be from 100 – 110V or 210 – 260V 50/60Hz, or from 12V DC.

Further details from Orbit Controls Ltd, Lansdown Industrial Estate, Gloucester Road, Cheltenham, Gloucestershire GL51 8PL

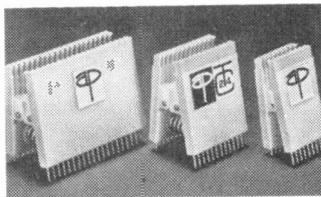
TEST CLIPPY

New IC test clips from Lektrokit offer a simple means of accessing any IC pin or lead.

The new aid clips over the IC bringing its individual pin connections out to a set of contacts at the opposite end of the clip. There are test clips available to match 8, 14 and 16 pin DIL packages.

The gold-plated, phosphor bronze spring contacts have been designed to achieve a wiping/cleaning action, making for high reliability.

The TC-14 which, as its name suggests, clips over a 14 pin DIP, costs £2.95. Further details from Lektrokit Ltd., Sutton Industrial Park, London Road, Earley, Reading, Berkshire RG6 1AZ,



BARGAIN BOXES

A new service from OK Machine & Tool can save up to 65% on the cost of cases for some commercially produced items.

If you need more than 1000 units, OK can incorporate your special requirements into their latest range of Pac Tec moulded enclosures, available in over 25 sizes.

As an example of the success of their new cost-cutting service, OK have been able to produce 2,500 alarm unit housings for £3.92 each, compared to £5.52 for sheet metal units. Taking the total assembly time into account, the saving rose to 65%. Customised front and rear panels can be supplied.

For further information, contact OK Machine & Tool (UK) Ltd, 48a The Avenue, Southampton, Hants SO1 2SY.

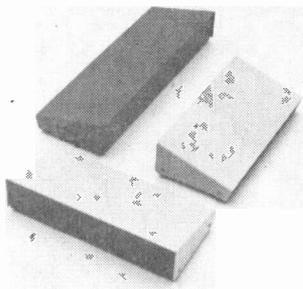
LOW KEY

A new range of enclosures designed for housing a variety of keyboards has recently been introduced by Boss Industrial Mouldings.

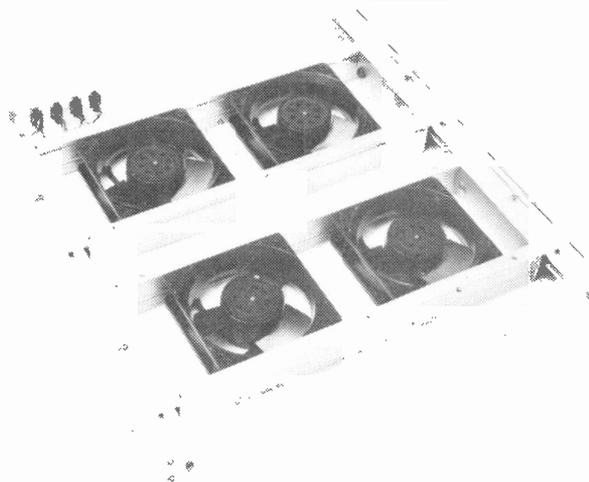
Bimconsoles are all-aluminium cases with a textured black base which contrasts with either the semi-gloss sand or charcoal grey top panels.

The top panels slope at about 20° to provide a relaxed keyboard operating position. Vibration is reduced to a minimum by the use of a gasket assembly between top and bottom panels.

Bimconsoles are available in three sizes and are suitable for both prototype and OEM type applications. Further details



from Boss Industrial Mouldings Ltd, Higgs Industrial Estate, 2 Herne Hill Road, London SE24 0AU.



COOLING OFF

Got any hot-spots in your cabinets? You can get the air circulating round your equipment with the Vero Electronics Fan Tray (AB 087).

Two versions (1U and 2U) are available for either 115V or 230V (50/60 Hz) input. Each is supplied with four 119mm square axial fans, but

additional fans can be fitted as required.

The 2U version has a polyurethane foam filter covering the air intake. If your living room or office isn't a smokeless zone, never fear, the filter is cleanable. Both versions operate at low noise levels.

If you need cooling off, contact Vero Electronics Ltd, Industrial Estate, Chandler's Ford, Hampshire SO5 3ZR.

Measure Resistance to 0.01Ω ... At a Price that has no resistance at all

New **ELENCO PRECISION** Digital Multimeter M1200B
USA

ONLY £55 (+£3 p&p + VAT £4.64 = £62.64)

***FULLY GUARANTEED
FOR 2 YEARS**

***METAL CASE**

***EX STOCK DELIVERY** (Subject to availability)



THE ULTIMATE IN PERFORMANCE - MEASURES RESISTANCE TO 0.01 OHMS, VOLTAGE TO 100 MICROVOLTS, CURRENT TO 1 MICROAMPS AT LOWEST EVER PRICE!

FEATURES

- 3½ digits 0.56" high LED for easy reading
- 100μV, 1μA, 0.01Ω resolution
- High input impedance 10 Megohm
- High accuracy achieved with precision resistors, not unstable trim pots
- Input overload protected to 1000V (except 200mV scale to 600V)
- Auto zeroing, autopolarity
- Mains (with adaptors not supplied) or battery operation-built-in charging circuitry for NiCad
- Overrange indication
- Hi Low power ohms, Lo for resistors in circuit, Hi for diodes

SPECIFICATIONS:

DC Volts	Range 200mV, 2V, 20V, 200V, 1000V Accuracy 1% ± 1 digit, Resolution .1mV Overload protection 1,000 volts max
AC Volts	Range 200mV, 2V, 20V, 200V, 1000V (Response 45Hz to 5KHz) Accuracy 1.5% ± 2 digits, Resolution .1mV Overload protection 1000V max, 200mV scale 600V
DC Current	Range 2mA, 20mA, 200mA, 2amp. Accuracy 1% ± 1 digit, Resolution 1 Microamp Overload protection -- 2 amp fuse and diodes
AC Current	Range 2mA, 20mA, 200mA, 2 amp Accuracy 1.5% ± 2 digits, Resolution 1 Microamp Overload protection -- 2 amp fuse and diodes
Resistance	Range 20, 200, 2K, 200K, 2 Meg. 20 Meg. Accuracy 1% ± 1 digit, Resolution .01 ohms
Environmental	Temp coefficient 0° to 30° C ± .025° C Operating Temp 0° to 50° C Storage - 20° to 60° C
General	Mains adaptor: 6 - 9 Volts @ 200mA (not supplied) 4C size batteries (not supplied) Size 8¼ x 5¼ x 2¼ Weight 2½ lbs.

At £55, M1200B is the best buy among DMM's currently available. Its 0.01 ohms resolution allows you to detect shorted windings in coils, transformers or motors. It is also useful in checking low contact resistance in switches, relays or connectors. Poor solder connections can also be spotted. The low power ohms function permits accurate measurements of in circuit resistance without forward biasing semiconductor junctions.

You have been waiting a long time for a digital multimeter with all these features at a price like this. Now its yours.

Also available from retail shops:

Audio Electronics, 301 Edgware Rd, London W2
Z & I Aero Services, 85 Tottenham Court Road
London W.1

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1st Floor, Unit 10, East Block
38 Mount Pleasant, London WC1X OAP

Please send me _____ DMM M1200B
@ £62.64 inc. p & p + VAT (overseas £60).

I enclose cheque/P.O./Bank Draft for £ _____

Name _____ (BLOCK
Address _____ LETTERS

PLEASE)

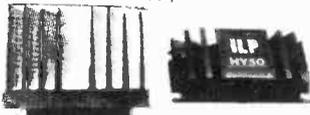
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ELECTRONICS TODAY INTERNATIONAL — JULY 1979

ILP MODULES 15-240 WATTS

We are now stockists for these world famous fully guaranteed (2 years guarantee on all modules) Pre amps, Amplifiers & Power Supplies.

- HY5** Preamplifier. Input, magnetic pickup 3mV, ceramic 30mV Output: Mains 500mV RMS, Distortion 0.1% at 1KHz. Price: **£6.27**
- HY30** Amplifier Kit. 15 Watts into 8Ω, extremely easy to construct Output 15W RMS, Distortion 0.1% at 15W Freq. 10Hz-16KHz. Supply ± 18V. Price: **£6.27**
- HY50** Hi-Fi Amplifier Module. 25 Watts 8Ω. Input Sensitivity 500mV. Output 25W RMS. Distortion 0.04% at 25W. Freq. 10Hz-45KHz. Supply ± 25V. Price: **£8.18**
- HY120** Amplifier Module — 60 Watts 8Ω. Input sens. 500mV. Output 60W RMS. Distortion 0.04%. Freq. 10Hz-45KHz. Power Supply ± 35V. Price: **£18.98***
- HY200** Hi-Fi/Disco Amplifier Module — 120 Watts 8Ω. Input sens. 500mV 120W RMS. Freq. 10Hz-45KHz. Power Supply ± 45V. Size 114 x 100 x 85mm. Price: **£27.99***
- HY400** (Big Daddy) Amplifier Module — 240 Watts 4Ω. Ideal for High Power Disco or P.A. Output 240 Watts RMS 4Ω 114 x 100 x 85mm. Distortion 0.1%. Price: **£38.60***



- POWER SUPPLIES**
- PSU36 — Drives 2 x HY30s **£6.44**
 - PSU50 — Drives 2 x HY50s **£8.18**
 - PSU70 — Drives 2 x H120s **£14.58***
 - PSU90 one HY200 **£15.10***
 - PSU180 2 x HY200 or one HY400 **£25.42***

JACK PLUGS		SOCKETS		SWITCHES*		SLIDE 250V:	
Screened chrome	Plastic body	open metal	moulded with break contacts	in line couplers	1A DPDT	1A DPDT	14p
2.5mm 13p	10p	8p	20p	11p	1A DPDT c/over	1A DPDT	15p
3.5mm 15p	10p	8p	20p	12p	1/2A DPDT	1/2A DPDT	13p
MONO 15p	14p	13p	24p	17p	4 pole 2-way	4 pole 2-way	24p
STEREO 32p	17p	15p	24p	22p			
DIN		PLUGS		SOCKETS		In Line	
2 PIN Loudspeaker	10p	7p	10p	20p			
3, 4, 5 Audio	15p	10p	20p				
CO-AXIAL (TV)	14p	14p	14p				
PHONO		8p single	12p				
assorted colours	10p	8p double	20p				
Metal screened	15p	15p 4-way	20p				
BANANA	4mm 11p	12p					
	2mm 10p	10p					
	1mm 6p	8p					
WANDER 3 mm	8p	8p					
DC Type	15p	20p					
AC 2-pin American	15p	15p					

DM900	TRANSFORMERS*	ALUM. BOXES*	PANEL METERS*
3 1/2 DIGIT LCD Multimeter with Capacitance Meter (ETI Aug. 78) Complete Kit £54.50 only (8p & 80p)	(Mains Prim. 220-240V) 6.0-6V, 9.0-9V, 12.0-12V 100mA 95p 8VA: 6V, 5A 6V-5A, 9V, 4A 9V-4A, 12V, 3A 12V-3A, 15V, 2.5A 15V-2.5A 185p 12V: 4.5V-1.3A 4.5V-1.3A, 6V-1.2A 6V-1.2A, 12V-5A 12V-5A, 15V-4A 15V-4A, 20V-3A 20V-3A 220p (20p p&p) 24VA: 6V-1.5A 6V-1.5A, 9V-1.3A 9V-1.3A, 12V-1A 12V-1A, 15V-8A 15V-8A, 20V-6A 20V-6A 290p (45p p&p) 60VA: 6V-4A 6V-4A, 9V-2.5A 9V-2.5A, 12V-2A 12V-2A, 15V-1.5A 15V-1.5A, 20V-1.2A 20V-1.2A, 25V-1A 25V-1A, 30V-8A 30V-8A 350p (50p p&p) 100VA: 12V-4A 12V-4A, 15V-3A 15V-3A, 20V-2.5A 20V-2.5A, 30V-1.5A 30V-1.5A, 40V-1.25A 40V-1.25A, 50V-1A 50V-1A 680p (60p p&p). (N.B. p&p charge to be added above our normal postal charge.)	3x2x1" 48 2 1/2x5 1/2x1 1/2" 68 4x4x1 1/2" 88 4x2 1/2x1 1/2" 88 4x5 1/2x1 1/2" 88 4x2 1/2x2" 64 5x4x2" 92 6x4x2" 88 7x5 1/2x2 1/2" 129 8x6x3" 188 10x7 1/2x3" 199 10x4 1/2x3" 162 12x5x3" 190 12x8x3" 260	FSD 475p each 60x46x 35mm 435 0-500µA 930 0-100µA 958 0-500µA 1050 0-1mA 240 0-5mA 240 0-10mA 240 0-500µA 240 0-100mA 240 0-500µA 240 0-1A 240 0-2A 240 0-25V 240 0-50V AC 240 0-300V AC 240 "VU" 240
CRYSTALS* 100KHz 385 455KHz 385 1MHz 323 1.0008M 395 3.2768M 323 4.032MHz 323 4.433619M 138 5.0MHz 355 8.08333M 275 10.0MHz 323 10.7MHz 323 18.432M 323 20.0MHz 323 27.648M 323 48.0MHz 323	VOLTAGE REGULATORS* 1A TO3 +ve -ve 220p 5V 7805 145p 7905 220p 12V 7812 145p 7912 220p 15V 7815 145p — 18V 7818 145p — 1A TO22D Plastic Casing 90p 5V 7805 80p 7905 90p 12V 7812 80p 7912 90p 15V 7815 80p 7915 90p 18V 7818 85p 7918 90p 24V 7824 85p 7924 90p 100mA TO92 Plastic Casing 65p 5V 78L05 30p 79L05 65p 6V 78L62 30p — 9V 78L92 30p — 12V 78L12 30p 79L12 65p 15V 78L15 30p 79L15 65p	COMPUTER HARDWARE* 2101 99 2102 100 2102-2 170 2107B 490 2111 175 2114 785 2513 595 2516 £29.50 2708 775 27L08 1095 2716 1650 3064 CP1610 4027 250 4047 750 74L30 TMS4035 74L75 TMS4039 74S188 185 74S262 875 74S297 325 74S470 325 74S475 825 81LS95 99 81LS96 99	81LS97 125 9900 £35 CP1610 930 MC14411 958 MC14412 1050 TMS2532 4600 TMS4035 240 TMS4039 240 TMS4042 240 TMS4045 760 TMS6011 325 TMS9900 3500 TMS9980 1985 Z80 1195

ETI Projects:	ULTRASONIC TRANS-DUCERS	VDU Chip and MODULE for TV
Parts available for: Click Eliminator Ambusher, Guitar Effect Unit. Send SAE plus 5p for list.	LM300H 170p LM305H 140p LM309K 135p LM317K 350p LM323K 825p LM325N 240p LM326N 240p	4450 74 4451 73 4452 150 4490F 665 4490V 525 4501 19 4502 120 4503 69 4506 61 4507 55 4508 298 4510 95 4511 150 4512 98 4513 208 4514 265 4515 299 4516 120 4517 382 4518 102 4519 55 4520 108 4521 228 4522 149 4527 152 4528 99 4529 145 4530 85
393 230 395 218 396 215 398 276 399 230 445 160 447 144 490 180 668 182 669 182 670 248	4046 128 4047 87 4048 58 4049 48 4050 48 4051 72 4052 72 4053 72 4054 110 4055 128 4056 115 4057 110 4058 116 4059 116 4060 116 4061 116 4062 116 4063 116 4064 116 4065 116 4066 116 4067 116 4068 116 4069 116 4070 116 4071 116 4072 116 4073 116 4074 116 4075 116 4076 116 4077 116 4078 116 4079 116 4080 116 4081 116 4082 116 4083 116 4084 116 4085 116 4086 116 4087 116 4088 116 4089 116 4090 116 4091 116 4092 116 4093 116 4094 116 4095 116 4096 116 4097 116 4098 116 4099 116 4100 116 4101 116 4102 116 4103 116 4104 116 4105 116 4106 116 4107 116 4108 116 4109 116 4110 116 4111 116 4112 116 4113 116 4114 116 4115 116 4116 116 4117 116 4118 116 4119 116 4120 116 4121 116 4122 116 4123 116 4124 116 4125 116 4126 116 4127 116 4128 116 4129 116 4130 116 4131 116 4132 116 4133 116 4134 116 4135 116 4136 116 4137 116 4138 116 4139 116 4140 116 4141 116 4142 116 4143 116 4144 116 4145 116 4146 116 4147 116 4148 116 4149 116 4150 116 4151 116 4152 116 4153 116 4154 116 4155 116 4156 116 4157 116 4158 116 4159 116 4160 116 4161 116 4162 116 4163 116 4164 116 4165 116 4166 116 4167 116 4168 116 4169 116 4170 116 4171 116 4172 116 4173 116 4174 116 4175 116 4176 116 4177 116 4178 116 4179 116 4180 116 4181 116 4182 116 4183 116 4184 116 4185 116 4186 116 4187 116 4188 116 4189 116 4190 116 4191 116 4192 116 4193 116 4194 116 4195 116 4196 116 4197 116 4198 116 4199 116 4200 116	

..... news digest

LATEST CASIO MINIS

Casio have managed to reduce their successful LC-78G calculator in three ways.

First of all - price. The RRP of the LC-78G is down by £3.00 to £16.95.

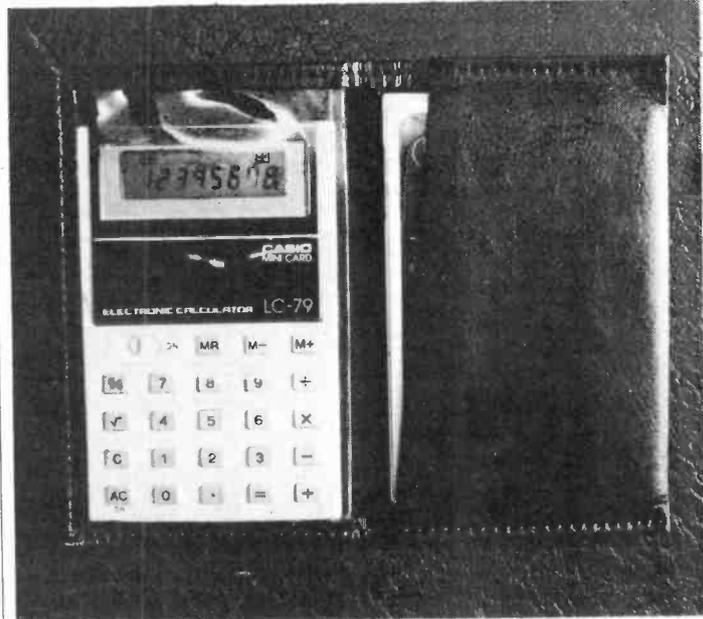
Second is the new Casio LC-7 which has the same display and functions except that the fully independent memory is replaced by a simple automatic accumulating memory and a square root function. The LC-78S has a RRP of only £13.95.

Thirdly, thickness has been cut down from four to two millimetres. Casio's new Mini Card LC-79 remains credit card size, but in upright format. It keeps eight digits capacity and LCD, four functions and independent memory plus perfect

percent and function indicator. Also featured is a responsive, 'feather touch' keyboard, so light that it can be operated inside its protective wallet. A battery-conserving circuit automatically switches off nine minutes after the last key depression. The Casio LC-79 will retail at £19.95 (or less, if you're lucky).

If you prefer something a bit beefier, try the LC-841, another new one from Casio. With the same technical features as Mini Cards (including independent memory), the LC-841 is 62 x 110mm, but still only 3.9mm thick, with digits 6mm high, and will retail at about £15.95.

For enquiries, get in touch with Casio Electronics Co Ltd, 28 Scrutton Street, London EC2A 4TY.



MILITARY FLASHER

Need a tough twinkler? Oxley are now producing a solid state indicator lamp, type PS/LH/8, in a military style rugged mounting. The mounting incorporates the latest high brightness, high reliability LEDs. The lamp is fitted with a sealed glass lens and black shroud to optimise the visual effect and afford emitter protection.

Standard colours are available, red, yellow and green, and light output is calibrated to photometric standards to ensure consistent performance. The aluminium alloy body is compatible with standard chassis and provides electromagnetic shielding for military applications. Further details from Oxley Developments Co Ltd, Ulverston, Cumbria LA12 9Qg.

T.V. GAMES

PROGRAMMABLE - £31.86 inc. VAT COLOUR CARTRIDGE TV GAME

This TV Game can be compared to an audio cassette deck and is programmed to play a multitude of different games in COLOUR, using various plug in cartridges. At long last a TV game is available which will keep pace with improving technology by allowing you to extend your library of games with the purchase of additional cartridges as new games are developed. Each cartridge contains up to ten different action games and the first cartridge containing ten sports games is included free with the console. Other cartridges are currently available to enable you to play such games as Grand Prix Motor Racing, Super Wipeout and Stunt Rider. Further cartridges are to be released later this year, including Tank Battle, Hunt The Sub, and Target. The console comes complete with two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons. Other features include several difficulty option switches, automatic on screen digital scoring and colour coding on scores, hits and balls. Lifelike sounds transmitted through the TV's speaker, simulating the actual game being played. Manufactured by Waddingtons Videomaster and guaranteed for 1 year.



EXTRA CARTRIDGES:

ROAD RACE - £9.58 inc. VAT.
Grand Prix motor racing with gear changes, crash noises, etc.
SUPER WIPEOUT - £9.90 inc. VAT
10 different games of blasting obstacles off the screen.
STUNT RIDER - £13.13 inc. VAT.
Motorcycle speed trials, jumping obstacles, leaping various rows of up to 24 buses, etc.

6 GAME - COLOURSCORE II - £14.58 inc. VAT

This non-programmable console offers four exciting COLOUR games: Tennis, Football, Squash and Solo as well as an auxiliary socket for connection to "Shooting Star", an electronic rifle, to add two additional Moving Target Shooting Games. Features of the Colourscore II include removable hand controls for movement both up and down the screen, handicapping switch, half speed switch, automatic on screen digital scoring and colour coding.



10 GAME - COLOUR SPORTSWORLD £24.30 inc. VAT

This non-programmable console offers ten exciting COLOUR games: Tennis, Squash, Hockey, Solo 1, Football, Basketball, Gridball, Solo 2 and two unique built-in target shooting games. Features include two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons. Other features include handicapping switch, half speed switch, automatic on screen digital scoring and colour coding. Realistic hit sounds are transmitted through the TV's speaker. Manufactured by Waddingtons Videomaster and guaranteed for 1 year.



CHESS COMPUTERS

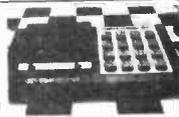
THE WADDINGTONS VIDEOMASTER STAR CHESS - £59.50 inc. VAT PLAY CHESS AGAINST YOUR PARTNER



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

CHESS CHAMPION 6 - £89.50 inc. VAT PLAY CHESS AGAINST THE COMPUTER - 6 LEVELS

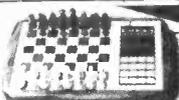
Chess Champion is a newly developed electronic microcomputer, manufactured by WADDINGTONS VIDEOMASTER. The stylish, compact, portable console can be set to play at six different levels of ability from beginner to expert including "Mate in two" and "Chess by Mail". The computer will only make responses which obey international chess rules. Casting a pawn and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given problem from magazine or newspaper or alternatively establish your own board position and watch the computer react. The positions of all pieces can be verified by using the computer memory recall button. Chess Champion comes complete with a free 9V mains adaptor, full instructions and a twelve month guarantee.



World chess champion ANATOLY KARPOV says:
"This chess computer is a new and interesting partner with remarkable game variations."

CHESS CHALLENGER 7 - £92.50 inc. VAT

Play chess against the computer at 7 different levels. (Similar to Chess Challenger 10 but unit has only 7 levels of play). Price includes unit with wood grained housing, and Stantion design chess pieces. Computer plays black or white and against itself and comes complete with a mains adaptor and 12 months' guarantee.



CHESS CHALLENGER 10 - £154.50 inc. VAT NEW IMPROVED PROGRAMME - MK 2, APRIL, 1979

Play chess against the computer at 10 different levels. Price includes unit with solid walnut case, deluxe simulated leather & brushed gold foil playing surface & Salatinon designed magnetised chess pieces. Comes complete with a mains adaptor and 12 months' guarantee.

[Chess Challenger 10 illustrated above]

BORIS - £178.50 inc. VAT

Boris is an advanced chess computer that's programmed for all classic chess moves. He will play Black or White, even himself. He'll even teach you how to play chess and suggests the moves for you when you're unsure of what to do next. Boris can talk to his opponent through his alphanumeric display and will flash different messages during each game to keep you on your toes. Boris will not allow illegal moves, and will allow you to enter problems or set up your own board positions. Boris comes in hand crafted, solid walnut case with chess pieces and board. Comes complete with a mains adaptor and 12 months' guarantee.

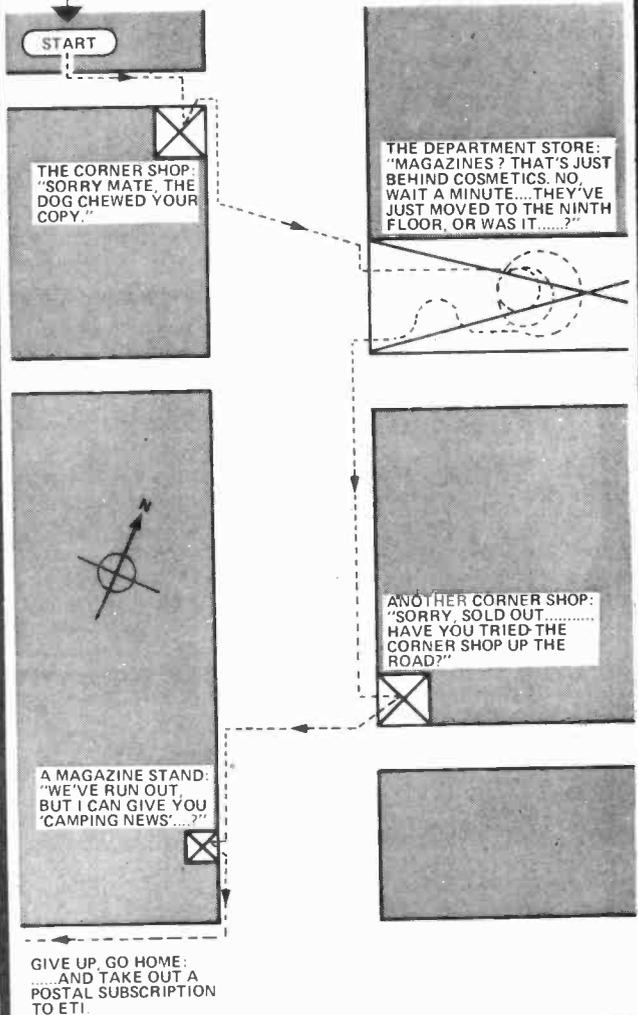


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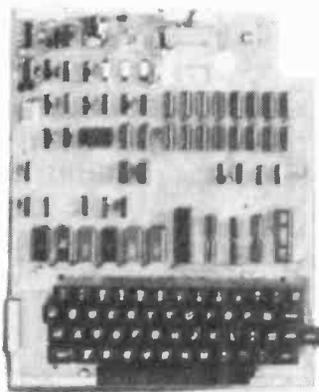
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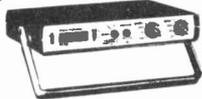
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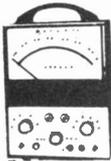


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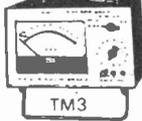
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- 3: A useful-sized bit of stiff paper to stop the window from rattling.
- 4: Rough calculations for your new combined egg timer/laser cannon project.
- 5: ETI makes a fair soldering iron stand.
- 6: The dog insisted on carrying your copy to you along with your slippers.

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GENTLEMEN the PET DISK has landed...



The U.K. designed and manufactured Novapac disk system for Commodore's PET*, first seen at Compec '78, is (after extensive industrial evaluation), now available to the domestic user. Its unique saddle configuration continues the integrated design concept of your PET, with no trailing wires or bulky desktop modules.

- **Novapac** may be used with any available RAM plane.
- **Data transfer** takes place at 15,000 char/sec — effectively 1000 times faster than cassette!
- **Storage capacity** is 125 K/bytes (unformatted) on 40 tracks per diskette side.
- **Dual index sensors** permit dual side recording for 250 K/bytes per diskette.
- **Easy operation** full width doors prevent media damage.
- **System expandable** to ½ M/byte on-line storage (4 drives).
- **Dual head and 2D** versions provide 2 M/bytes on-line.
- **Industry Standard IBM 3740** recording format for industry-wide media compatibility only offered by NOVAPAK
- **Dedicated Intel 8048** microprocessor and 1771 FDC minimise PET software overhead.
- **Local hardware and software** support available.

The sophisticated Disk Operating System is disk resident, which allows for future DOS enhancements without hardware alterations. PDOS supports multiple file handling, dynamically allocating disk space to each as and when necessary. Any file may occupy from 1 to 600 sectors as required, at up to 16 non-contiguous locations on the disk, PDOS may be used alone, or within a BASIC program, and offers user-specified password security for any file. Multiple access-modes simplify BASIC program construction.

Novapac dual-disk system complete with PDOS and BASIC demonstration programs on disc **£950 + VAT**. Available from the manufacturer or selected dealers.

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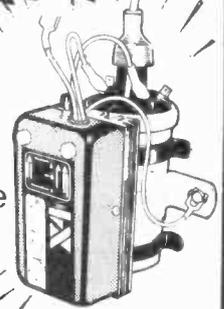
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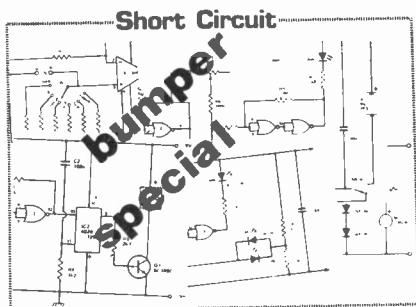
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Hobby Electronics

Next
Month

BUMPER SHORT CIRCUIT ISSUE



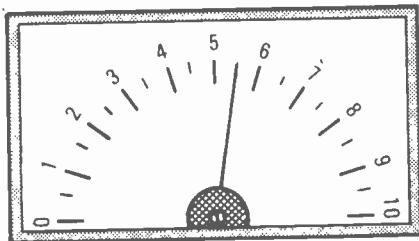
Look out this month for more than your usual share of our very popular, Short Circuit feature. Plenty of circuit designs for you to develop and experiment with.

SHARK



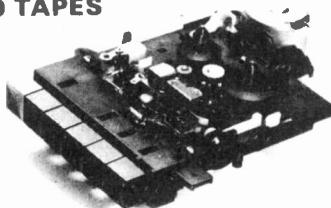
Not a game for the nervous. An LED-based game for two players which involved two swimmers in a race for survival in a shark-infested sea. Which of these two castaways will reach the safety of the island? The unfortunate one is swallowed by the hungry shark, accompanied by a shrill scream. All good family fun!

LINEAR SCALE OHMMETER



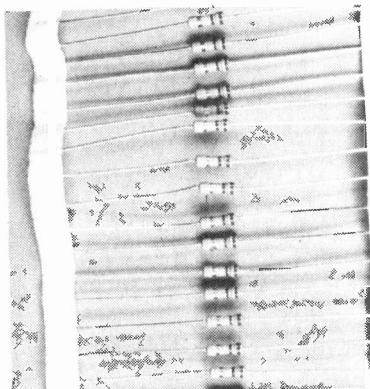
If you ever look at a multimeter on the ohms range you'll notice that most of the numbers are all squashed up one end; this makes accurate readings difficult. The HE Ohmmeter overcomes this difficulty with a linear scale. The range of resistance covered is from 1 k to 1 M ohms in four ranges, a useful addition to any workshop's range of test equipment.

CASSETTE DECKS AND TAPES



Next to the TV and Transistor radio, the Cassette tape recorder is probably the most common piece of domestic electronic equipment. Next month Gordon King takes a close look at what has made the Compact Cassette so popular and one or two of its advantages and drawbacks, warts and all.

RESISTORS

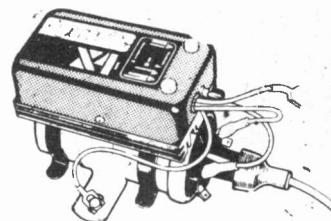


Following the success of our feature on Capacitors (according to our reader questionnaire) we're doing a follow up on the ins-and-outs of Resistors. Like Capacitors it's *not* going to be a formula-strewn study but a rather slanted look into their construction and use. So if you've never heard of Thick Film resistors and Metal Oxide, now's your chance.

HOBBY CHIT CHAT

Ray Marston our Project Editor/Designer starts a new monthly series looking at our fast-moving hobby from the technical point of view. These articles are designed to take a look into the world's largest growth industry, what's new and how it will affect us in our daily lives as well as a more specific look at our own side of the fence in HE.

KIT REVIEW

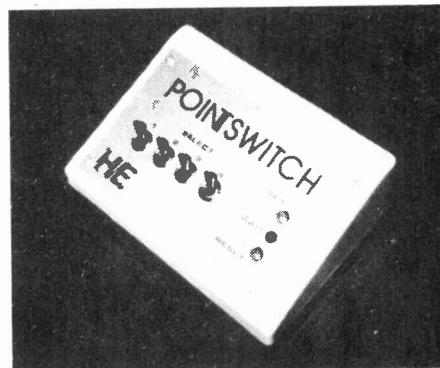


One for the motorist this month, we have built up an Electronic Ignition system from Sparkrite (X4); read all about it next month.

LINEAR ICs

If you've been wondering what's going to happen now Into Electronics has finished, don't worry. Ian Sinclair has begun his follow-up series Linear ICs. Month by month the articles will introduce most aspects of IC use, construction and theory. With the background knowledge gained from Into Electronics your understanding of new technology should increase dramatically.

POINTS CONTROLLER



Another project for model railway buffs. This unit gives full control over an unlimited number of electro-mechanical points using a push-button control. This makes an ideal companion to our HE Model Train Controller featured in the April issue.

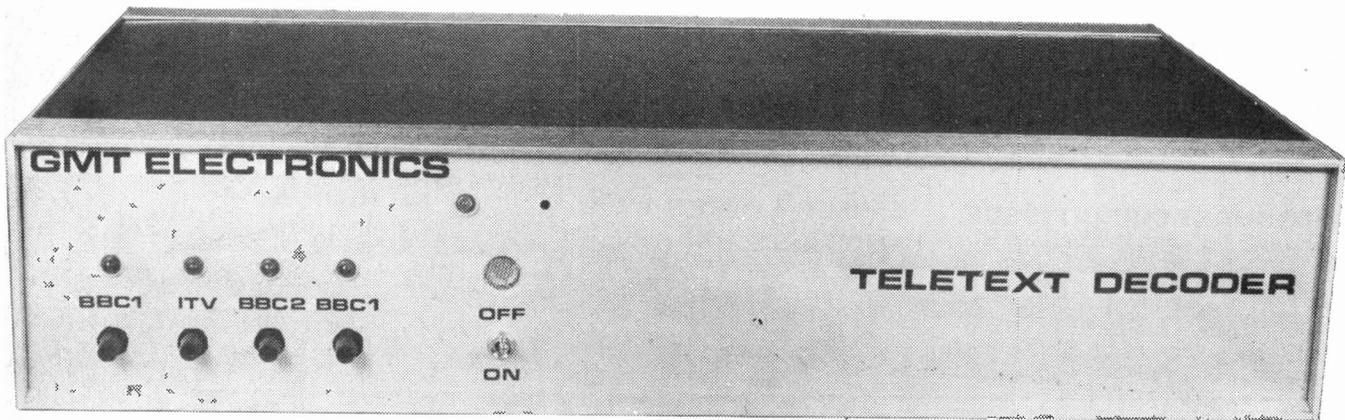
BABY ALARM

A really simple project to keep one ear on the kids whilst you're building your latest HE project.

The July issue will be on sale June 8th

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

TELETEXT SYSTEM



A complete ultrasonic controlled Teletext design employing the newly released Mullard chip set. Design by GMT Electronics for ETI. Facilities include double size characters and video superimpose.

THIS PROJECT is designed to allow the home constructor to produce himself a full spec Teletext unit at around half the cost of comparable commercial units. The design requires no hard wiring into the set, as it contains its own modulator and works into the aerial socket. Definition usually suffers utilising this method, but here great attention has been paid to overcoming this problem.

As with all decent designs remote control is ultrasonic, and gives both full and half page displays. The keyboard arrives already fitted to the PCB, and only needs the decoder chip and transducer soldering in to produce a complete unit.

A complete kit is available from GMT electronics, which includes plated-through hole PCBs, full metalwork and the hand controller. See Buylines for final details.

Construct-a-Text

Despite the complexity of this project construction is amazingly straightforward, all that is required is to assemble the four boards CAREFULLY following the overlays, and fit these into the chassis. Interwiring between the PCBs is dealt with by following the list given here, and referring to the wire nos. shown on the overlays. Don't be tempted to change this, best results — indeed any results — will only be obtained by strict adherence!

Once you're satisfied that all is as it should be, fit the ICs into their sockets and move on to the setting up.

FACILITIES

Keyboard Commands

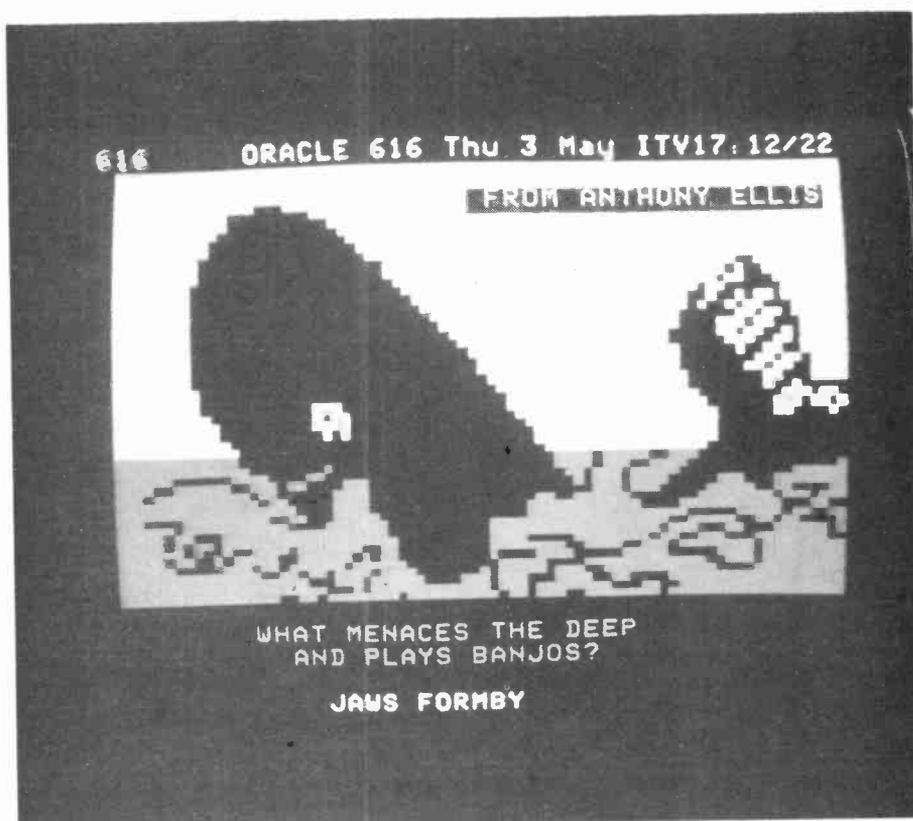
RESET	The screen is cleared and the converter is ready for channel change (timed page is cancelled). Television station identification appears top left of screen.
STATUS	
HOLD	Displayed page is held.
TOP	Large (2x) top half of display.
BOTTOM	Large (2x) bottom half of display.
MIX PAGE	 Cancels both above displays channel video and teletex together.
TIMED PAGE	On: — The selected time for the page selected can be inserted and is displayed in the top right of screen (4 Digits). Off: — Above cancelled.
REVEAL TEXT	Displays hidden characters. Calls up teletext. Page 100 selected automatically (currently for BBC 2 Ceefax key in 200).
CANCEL DATA	 Cancels text. Used for external data (not used in current design).
TV ON	Not used in current design. Last two facilities available for further expansions.

Set up!

- 1) Disconnect encoder video O/P from the modulator board.
 - 2) Disconnect blanking and picture on (PO) outputs from main board.
 - 3) Connect UHF O/P to set, and UHF aerial to converter.
 - 4) Select spare channel on T/V set.
 - 5) Tune T/V for blank screen (ie. no noise).
 - 6) Switch off.
 - 7) Link P.O. input of UHF and mixer board to 12V.
 - 8) Switch on.
 - 9) Tune RV 201 (front panel) to obtain best picture on BBC1.
 - 10) Re-adjust set for best colour picture, modulator RV 401 may need adjustment.
 - 11) Repeat 7 and 8 as required.
-
- 12) Switch off.
 - 13) Reconnect steps 1 and 2 remove link step 6.
 - 14) Switch on.
 - 15) Set RV 100 to midpoint.
 - 16) Connect pin 1 1C103(VIP) to 12V.
 - 17) Connect pin 7 via 5M6 to 12V.
 - 18) With transmitter switch to mix mode.
 - 19) Adjust CV101 until characters lock with picture.
 - 20) Switch off.
 - 21) Remove steps 14 and 15.
 - 22) Switch on.
-
- 23) Adjust L101 to obtain page header and time clock stepping (note this setting is sharply defined). L101 should not need adjustment (ignore any colour flicker).
 - 24) Switch off.
 - 25) Link pin 10 1C103 to 12V rail.
 - 26) Switch on. Note CV102 and L101 interactive repeat 20 and 24 as necessary.
 - 27) Adjust CV102 for best display (approx ¼ closed).
 - 28) Switch off.
 - 29) Remove step 22.
 - 30) Switch on.
 - 31) Switch to text mode.
 - 32) Adjust CV301 for best colour.
 - 33) Other channels can now be tuned (hit reset followed by channel No 1=BBC1; 2=ITV; 3=BBC2). ▶



Above and below, two typical screen displays from the ITV, Oracle service. Now do you see what you're missing out on?



HOW IT WORKS

Ultrasonic Receiver And Transmitter

In the transmitter the keyboard, commands are encoded by the SAA 5000 which switches the HEF 4069 transmitter IC in the correct code sequence.

This pulse coded 40Hz transmission is received by the TDB 1033 which provides 90dB of gain in AGC system and a carrier filter. The output is fed to the decoder section.

The Decoder

This design is based on the Mullard L.S.I. design and uses four main IC's and a memory section of seven 2102's.

The signal from the TDB 1033 is fed to the SAA 5010 receiver decoder and checked for error content and then produces various outputs.

1. Analogue Controls — Not used in this design.
2. Station Selector Drive Output — Used via an HEF 4011 inverter to step an HEF 4017 station selector.
3. Message Received Output — Used to drive an LED and audible indicator.
4. Control Signals for the SAA 5040 TAC.

SAA 5030 VIP Video Input Processor

The data retrieval section of IC, slices the incoming data signal by means of an automatic adaptive data slicer circuit. This circuit sets the threshold level for slicing at half the data amplitude, regardless of the amplitude of the incoming signal, and provides some compensation for distortion such as co-channel interference; the performance of the system under noisy conditions is thus improved. A clock signal is generated from the sliced data by using an external 6M9375Hz tuned circuit, and this signal is used to clock the data into the TAC integrated circuit.

A 6MHz display system clock is also included in the VIP, the output of which is divided in the TIC to produce a clock pulse every 64us. This signal is passed back to the VIP where it is compared with the incoming line sync signals. By this means, the timing system of the teletext display is phase-locked with the incoming television picture signal.

A 'signal quality' detector circuit is also included. When a signal with a high noise content is being received, or in the

absence of an incoming signal, the signal quality detector cuts off the teletext data to the TAC and allows the display system to free-run. Thus the detector prevents the data stored in the memory from being corrupted by noise. This facility, combined with the local display clock, allows a stable display even in the absence of an incoming television signal. Both are essential for after-hours display.

The IC also contains an adaptive sync separator which extracts the sync signals from the incoming video signal and also provides a sync output signal for the timebases of the television receiver. When a full page of text is displayed, the sync output signal is derived from the SAA 5020 TIC.

SAA 5040 TAC Teletext Data Acquisition And Control

The principal function of the data acquisition section of the TAC integrated circuit is to process the teletext data so that it can be written into the memory. The control section processes the information from the remote control

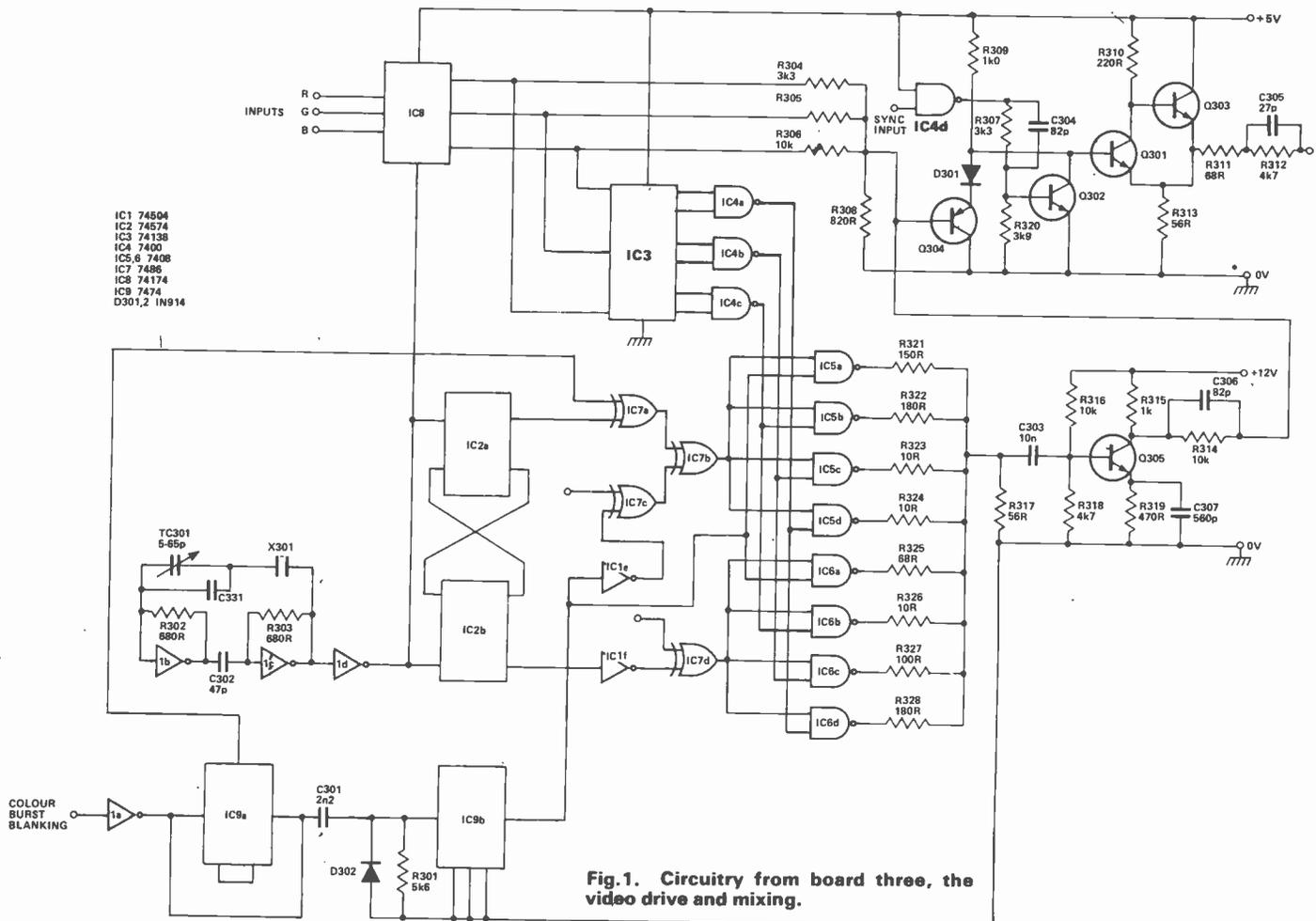


Fig.1. Circuitry from board three, the video drive and mixing.

system, and uses this information to operate the various display functions of the teletext decoder system such as selection of television, teletext, or viewdata modes; page hold, time display, or timed page select.

The data acquisition section, divides the data from the VIP into its component parts. The Hamming-coded address words are checked, and words having a single wrong bit are corrected. Address words having two wrong bits are rejected. The row address of the incoming data line (one of twenty-four) is fed by this section to the 5-bit row address bus, and the character date is fed through the data to the memory as a sequence of forty 7-bit parallel words.

A signal denoted as WOK (Write O.K.) indicates to the memory when valid data is to be written in, and a WACK (Write Address Clock) signal causes the address counters 74LS161 to step on after each character.

The IC also contains circuits for the implementation of the control bits for the page header.

SAA 5020 TIC Timing Chain

The divider stages in the TIC integrated circuit sub-divide the 6MHz clock signal from the VIP down to 25Hz, the television frame rate, and generate all the timing signals for the teletext display. During the display period, a 1MHz clock signal RACK (Read Address Clock) takes over from WACK to step the character addresses. The address counters 74LS161 are cleared at the end of every line and reset to the first position. After every ten lines during the display, the TIC steps the row address on by one to access the next row of characters in the memory.

In addition to providing all the timing signals for the display, the IC also generates a complete composite sync signal. This signal can be used to drive the timebases of the television receiver without the need for the transmitted sync signal. (This form of operation is also termed 'after-hours' operation.)

Memory Block

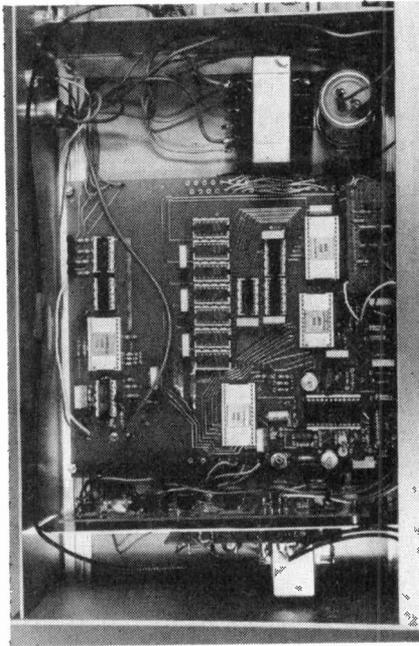
The memory block consists of seven 1k x 1 static RAMs.

SAA 5050 TROM Teletext Read-Only Memory

The read-only memory of the TROM converts the 7-bit character data from the memory into a dot matrix pattern. This matrix is in a 7-by-5 dot form for each character. It also contains a 'character rounding' facility which effectively increases this matrix to 14-by-10 dots, giving improved definition to the displayed characters.

Additional circuits enable various control functions to be performed. These functions are determined by control characters received from the memory. Examples of these control functions are the selection of graphics or alphanumerics, 'flashing' words, or newflashes and subtitles displayed in boxes within television pictures.

A 'concealed display' function is also provided which can be operated by the user.



BUYLINES

The designers of this project — GMT — have a complete kit of parts available. This includes all metalwork, PCBs and hardware. A manual is also included. Cost is £155 plus VAT (total £178 inc p&p).

As an alternative the teletext decoder board and control system is available separately at £125 for those who wish to wire into their own television.

PCBs and chip sets are available separately also — but are PoA.

See advert on page 6 for address.

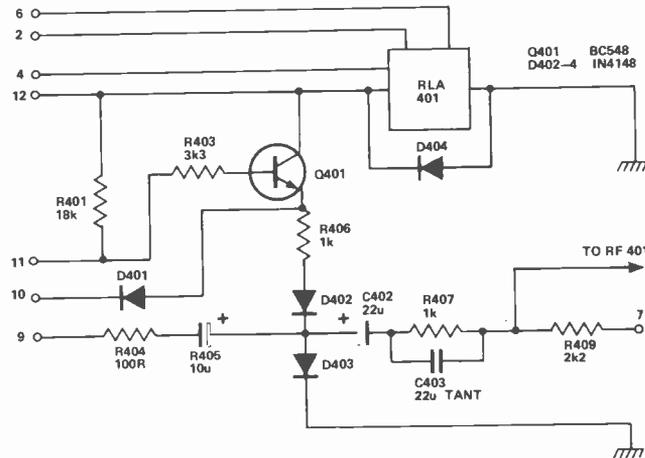


Fig. 2. Relay switching circuit (board four).

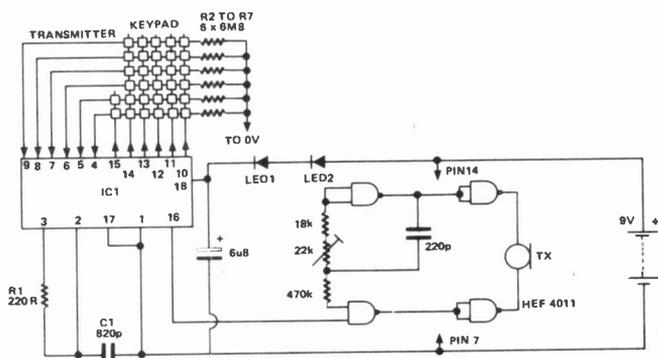


Fig. 3. Hand controller circuitry. Note that no overlay is shown for this, as no constructional work is needed using the kit. IC1 is a SAA5000 for those wishing to go it alone.

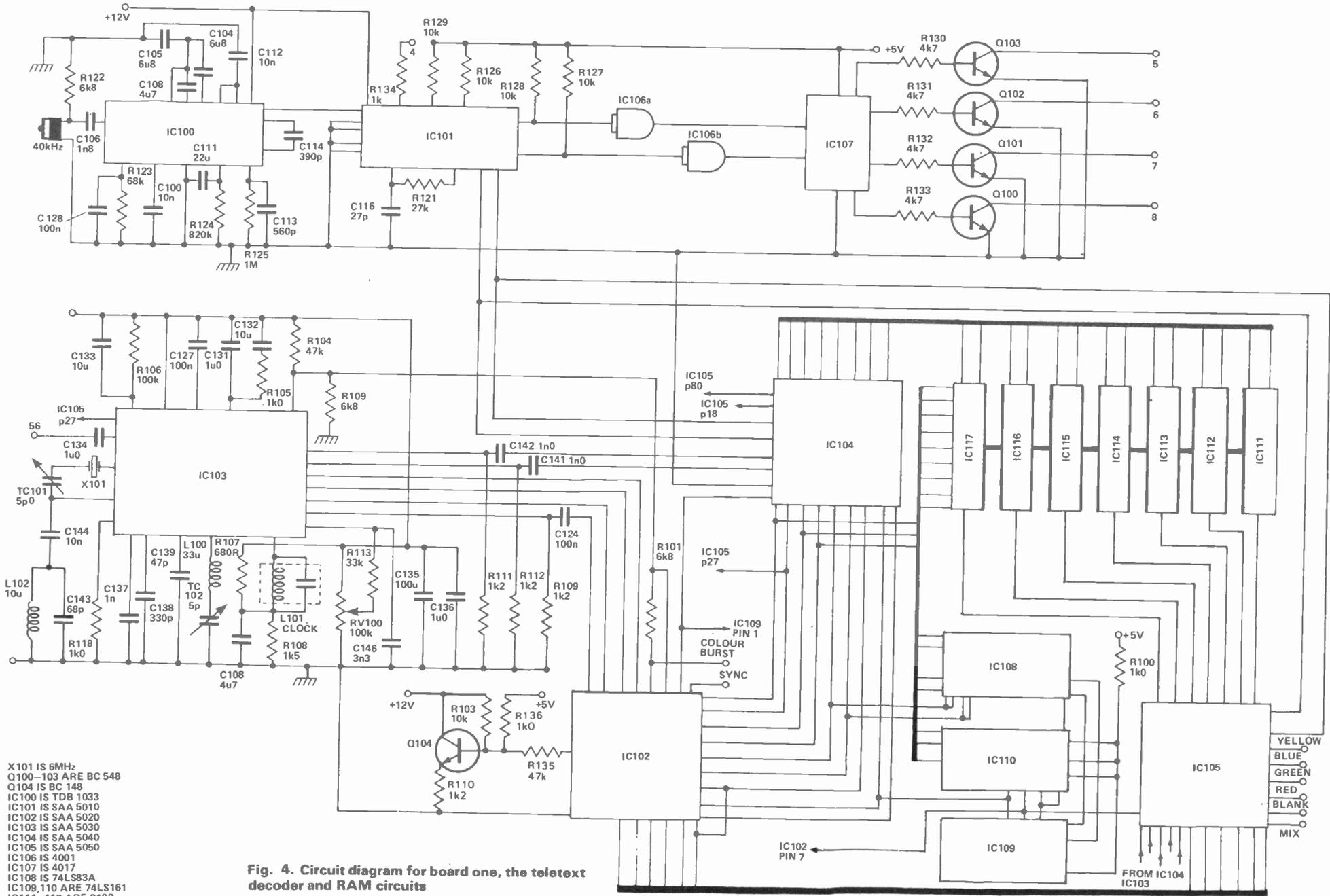
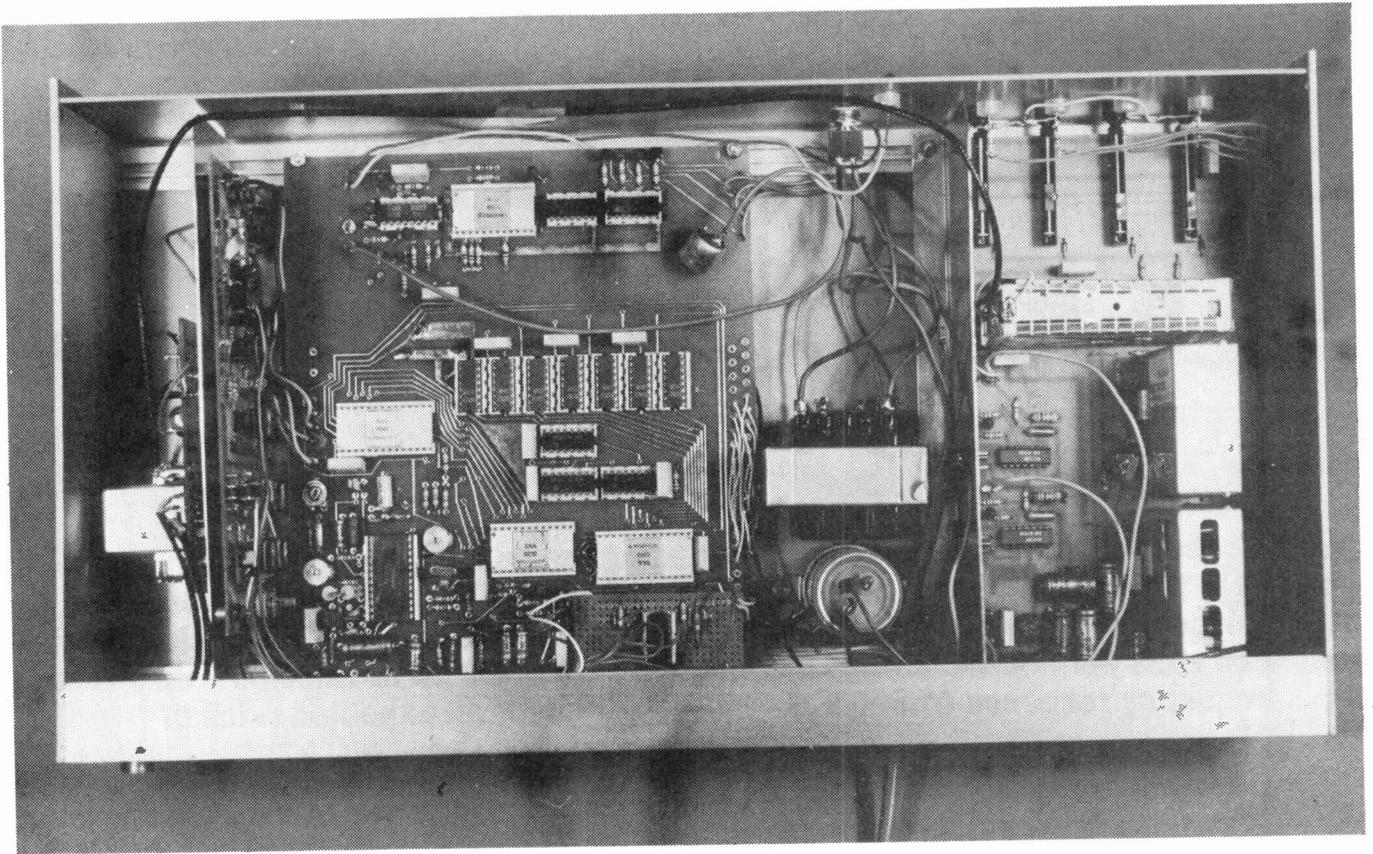


Fig. 4. Circuit diagram for board one, the teletext decoder and RAM circuits



Above: a unit complete except for mounting of the ultrasonic receiver

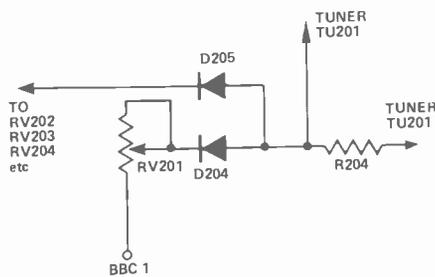
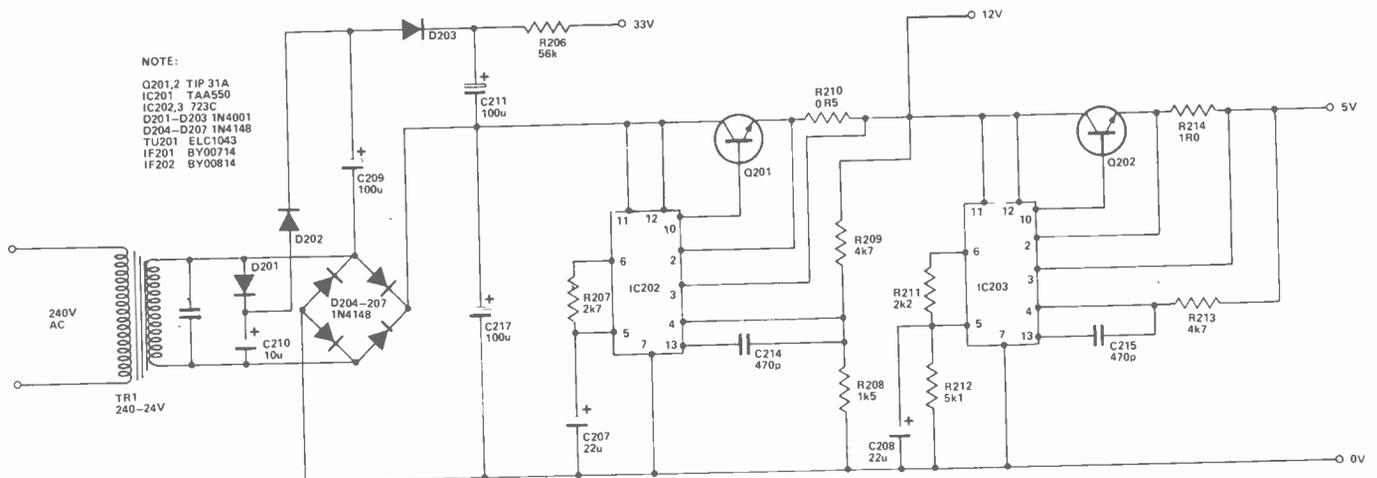


Fig. 5. (Above, left): tuning circuit.

Fig. 6. (Below): Power supply circuitry to produce the three rails needed.

Next month we conclude the project with component overlays, parts lists and some erudite hints upon getting the best results from this superlative design.

ETI



MAGNETIC FIELD AUDIO AMPLIFIERS

Carver Corporation's Model M400 amplifier using the unique 'magnetic cavity' was released in the US a few short months ago. Employing FETs throughout, except for bipolar silicon output transistors, Carver Corp. claims that the M400 has a slew rate around 80 volts per microsecond, hum and noise over 100 dB down, 0.05% distortion and a frequency response from 1 Hz to 250 kHz — all for an expected retail of US\$300!

IT REALLY DOES EXIST. ETI first reported Bob Carver's Magnetic Field Audio amplifier in our Australian issue saying . . . "we hear from normally authoritative sources that Bob Carver — founder of Phase Linear — has developed a totally new concept in audio amplifiers which . . . stores energy in a magnetic field rather than in power supply capacitors . . . his new device generates no heat, weighs a mere five kilos for vast numbers of watts and lasts for ever".

It seemed a bit hard to take seriously — even though we were totally aware of Bob's previous efforts such as the range of Phase Linear super-amps and the Autocorrelator noise reducer.

But it seems as if this revolutionary concept in audio amplifiers is for real — patent protection has been arranged and preliminary details have been released.

Bob's basic concept is to store energy in a magnetic field rather than very large value electrolytic capacitors — eliminating at the same time the need for a bulky expensive power transformer.

Our circuit drawing shows the essential features. The heart of the circuit is

the magnetic cavity (MC). This is basically similar to the AM detector transformer used in conventional AM radios but constructed on a grand scale. A further and significant difference is that the transformer is arranged such that an output occurs as the primary field collapses rather than builds up.

The secondary winding of the magnetic cavity is centre-tapped and the resultant full-wave output is rectified by a pair of high current diodes — the output waveform is thus a conjugate pair of time-varying audio voltages. Further circuitry, described later in this article, provides a feedback loop to remove commutation noise and reduce distortion.

The primary of the magnetic cavity is energised by an amplitude-modulated current (corresponding to the audio signal voltage). The current signal is produced from the audio input, via the optical isolator and modulation and control logic, to the scanning SCR, the ramp SCR, a pair of scanning and commutating diodes, and L1, L2 and C1.

This current signal energises the

primary of the magnetic cavity. The time taken for this is called the 'ramp period'. The primary energy is then reflected in the secondary windings (and thence to the speaker) during the subsequent 'scan period'.

As our graph shows, the ramp and scan periods are made up of four separate timing intervals. During the period $t_0 - t_2$ an incoming audio signal has caused a magnetic field to 'ramp' up in the primary of the magnetic cavity. At t_2 the field has reached its peak and is beginning to collapse. This collapsing field generates an associated decaying current i_1 and this decaying current falls to zero when the energy in the primary field falls also to zero (point t_3). During the time period $t_2 - t_3$, the control logic provides a positive signal on the gate of the scanning SCR, however this SCR will not again conduct until sufficient voltage is applied between its anode and cathode.

Throughout the scanning period, energy is of course being transferred from the primary of the magnetic cavity to the secondary — and thence to the speaker load.

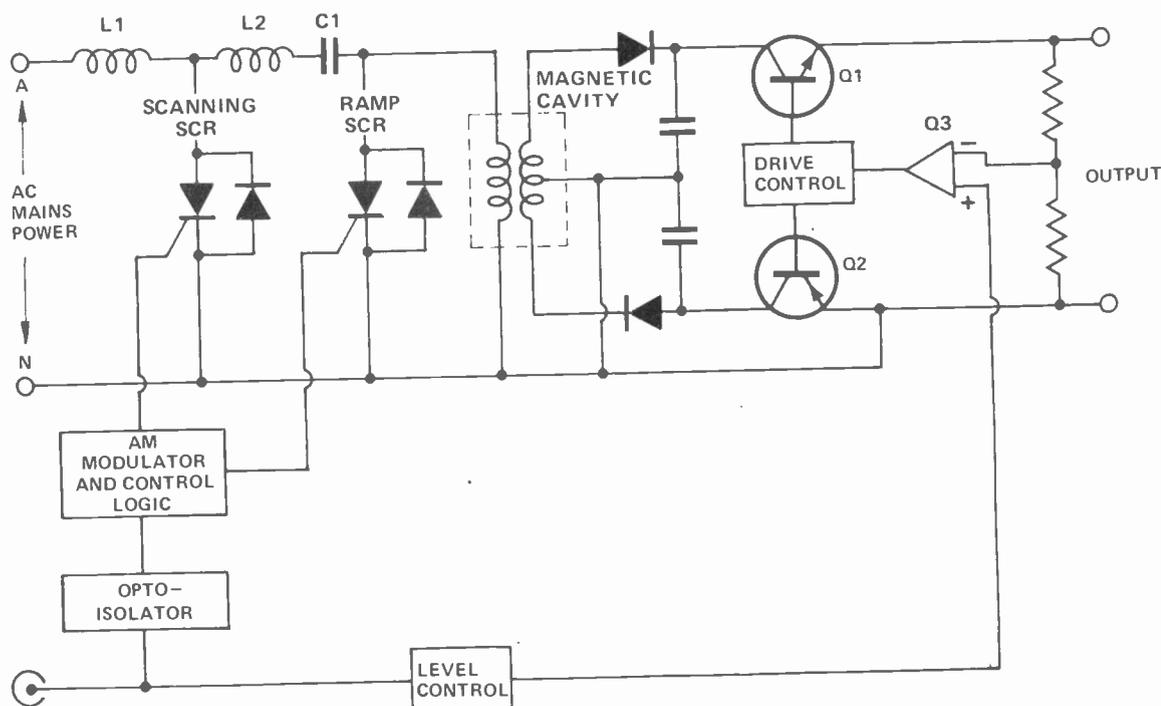


Fig. 1. This schematic shows the major operating components.

At time t_3 the direction of current is reversed — current being no longer maintainable by cavity inductance — and the scanning diode is reverse biased — this causes the scanning SCR to be forward biased and current flows as shown in our sketch.

Summarising then, energy stored in the magnetic cavity is caused to shuttle around the circuit of L1, L2, C1 and the speaker load depending on instructions from the control logic.

Noise and distortion

Components Q1 — Q3 form a feedback loop which reduces the inherently poor bandwidth, noise and distortion to very acceptable levels. Theoretically the circuit has some quite strong objections — at low frequencies Q1 and Q2 will act much as switches except that the feedback correction voltage developed by Q3 will adequately cancel aberrations — but at higher frequencies, i.e. 10 kHz — 20 kHz the modulator circuit is unable to follow accurately the audio input

signal. Hence the filtered output from the magnetic cavity is a dc level with a superimposed ac signal and Q1 and Q2 thus operate much as any other conventional amplifier.

Nevertheless as less power is generally required at high audio frequencies than at mid frequency and low frequency, amplifier efficiency is very high if fed with music signals. This situation does not of course apply if the amplifier is fed with a high frequency steady tone.

Bob Carver's radical amplifier will be rated in accordance with FTC rules — the specification is expected to include power output: 200 watts-per-channel into eight ohms from 20 Hz to 20 kHz. Total harmonic distortion is expected to be less than 0.08% across this range.

Signal noise ratio is expected to be 100 dBA below rated maximum output. All-up weight is an incredible 5.5 kg.

As far as we are aware the magnetic field amplifier exists at present solely as a prototype unit but we understand that Bob Carver has very real plans for putting the unit in to production at a presently projected price of US \$300 or so.

It's a fascinating concept, one that will cause amplifier designers and manufacturers world-wide to furiously rethink their design philosophies. It may even herald the coming of a new hi-fi technology. **ETI**

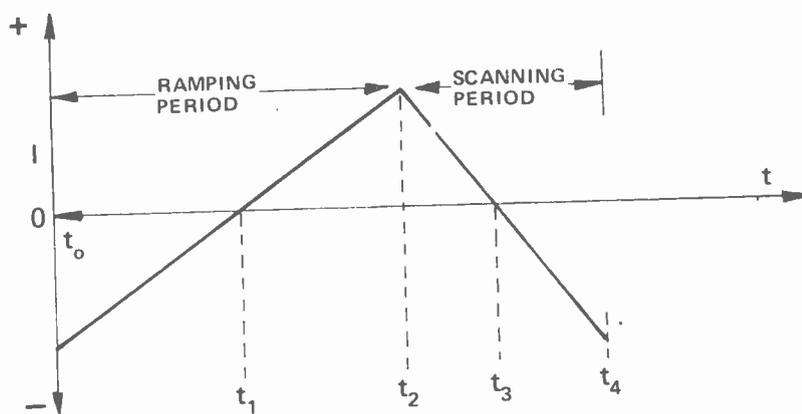


Fig. 2. During the ramping period energy builds up in the primary of the 'magnetic cavity'. Throughout the scanning period energy is transferred from the primary to the secondary of the magnetic cavity and thence to the speaker load via Q1 and Q2.



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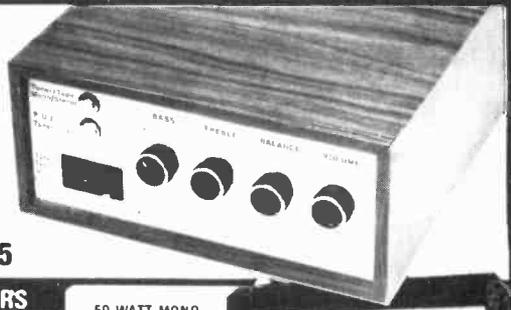
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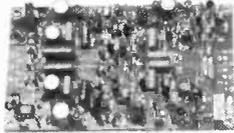
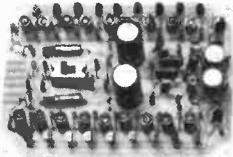
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POWER AMPLIFIERS

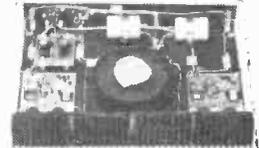
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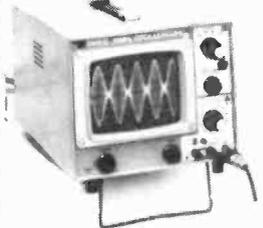
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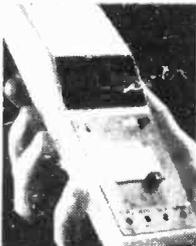
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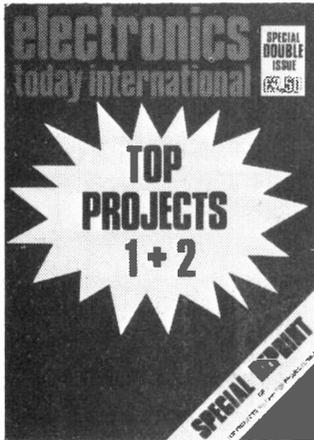
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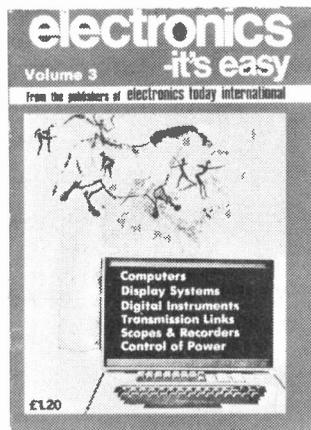
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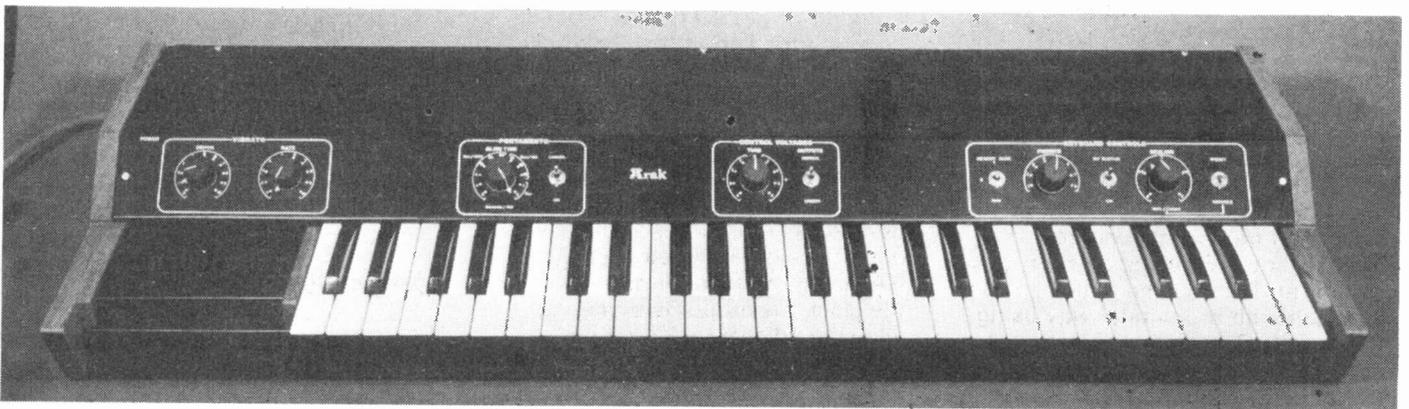
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POLYPHONIC KEYBOARD CONTROLLER

Tired of playing one note at a time on a boring old monophonic synthesizer? In this design Tim Orr describes how you can build a four octave polyphonic keyboard controller incorporating first note priority.



THE MUSIC synthesizer is probably the most powerful musical instrument of today, and it will most probably form the basis of the next generation of keyboard instruments. However, the synthesizer suffers from one major drawback due to its unique structure. The disadvantage is that it is a monophonic instrument as opposed to traditional keyboard instruments, such as organs and piano's which are polyphonic, or multi-voiced. A brief resumé of synthesizer structure should clarify the reasons behind this.

To start with, the synthesizer is composed of a set of modules or independent circuit packages whose parameters in most cases are voltage controllable. For instance, a voltage controlled oscillator (VCO) has an output frequency (pitch) which is dependant on the magnitude of the input control voltage. These modules can be split up into three distinct

groups. Firstly there are Sources, such as:

1. Noise
2. Voltage controlled oscillators

Secondly there are Modifiers which form by far the largest group:

1. Voltage controlled filters (VCF's)
2. Voltage controlled amplifiers (VCA's)
3. Ring modulators
4. Filter banks or graphic equalisers
5. Phase shifters
6. Reverberation

Thirdly there are control voltage sources:

1. Sample and holds
2. Sequencers
3. Transient generators
4. Trigger delays
5. Keyboard controllers

Getting Your Priorities Right

First note priority was adopted for this design, i.e. first note pressed to channel 1, second to channel 2, and so on. If more notes are pressed than the system can cope with, these are locked out. The reason for this, as opposed to last note priority, is that first note priority stops the note jumping that can occur when, momentarily, more notes are pressed than the system caters for.

Binary Notation

When the code (note code) driving the decoder energises a contact which is closed, the output of the OR gate goes high, showing a unique code on the input representing the particular note being pressed. This code, the note code, is arranged such that the lowest note is binary zero, the next note up binary one, the next

two and so on up to N.

The scanning can also be achieved using a multiplexer.

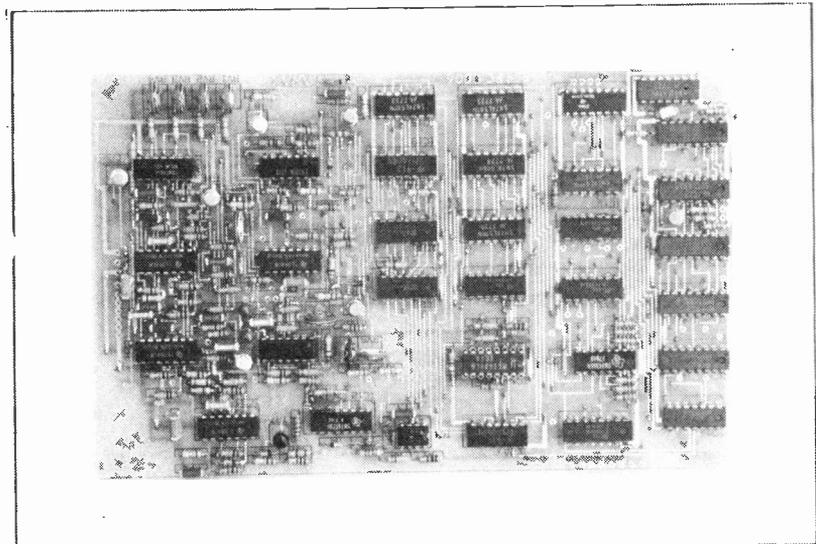
The size of keyboard decided on was a 4 octave one having 49 notes. Hence this makes the value of N 49 and therefore the size of the note code will be 6 bits (64 possibilities). In fact this is useful in that a 6 bit code will be just big enough to scan a 5 octave keyboard (61 notes) if required. In the case of this design it will simply be a matter of adding 12 extra diodes since the decoder already had a total of 64 outputs. Incidentally, the scanner will have another output not yet mentioned. This is called 63rd note, (the 63rd output on the decoder) which simply provides a pulse to the decision logic to say that a scan has been completed. The multiplexer method would require decoding of the note code to do this. The scanner simply gives each note a binary code, but how can this be extracted as a set of control voltages with associated gate signals?

Pumping Caps

The note code is changed to an analogue voltage using a D-A converter, the output of which is switched onto the correct analogue channel and held using a set of sample and holds. The gate signals are dealt with in a similar way using CR circuits. The counter for the note code causes the scanner to increment from the lowest note upwards. If three notes are depressed the scanner reaches the lowest note first and causes the output of the D-A to be stored by channel 1 sample and hold, and channel 1 gate capacitor to be pumped up. On moving on the channel counter is incremented, preparing the output channels for channel 2 data. When the scanner reaches the second note up the process occurs again only using channel 2 and again for channel 3, with the third note. When the scan has been completed the channel counter is reset and made ready for the next scan.

Dying Charge

If on the next scan the notes are still depressed, the gate capacitor will again be pumped up maintaining the gate output high. When a note is released the time constant is such that the gate capacitor's charge dies away in about one and a half scan



The largest of the four PCB's, carrying the logic circuitry.

times, thus removing the gate signal. By experiment it was found that the scan time needs to be about 4 mS. Even when a key is pressed and released very quickly, it will have been scanned about ten times or more. The NAND gate should be mentioned because it allows two adjacent notes to be played. This is because if two notes right next to each other are depressed, the output of the scanner remains high for the duration of both notes and so only one note would be detected. By NANDing the scanner output with the clock the output is broken up allowing adjacent notes to be detected.

Note Jumping

Although this circuit will work, it is far from satisfactory. When notes other than the top note are released, the channels on which the remaining notes appear, above the released note, all jump down one place. This makes the instrument very difficult to play as it must be remembered to release the keys from the upper one downwards, to get a chord that dies away nicely without the note jumping effect.

Special Decision

This means that the simple logic must be replaced by some special decision logic, incorporating a memory of notes already activated in previous scans.

The scheme here is that note codes are gathered into the memory as the scanner sweeps up the keyboard. When the 63rd note is reached, the

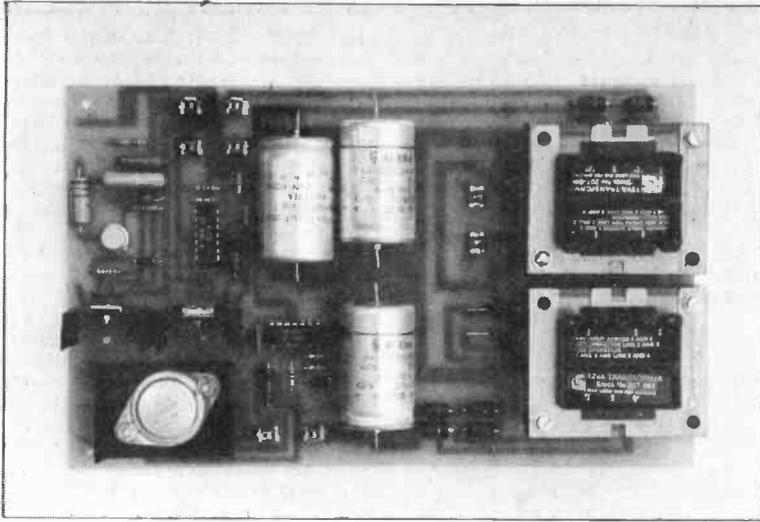
entire memory is dumped onto the output channels by sequencing the peripheral address lines. It is also necessary to reset all of the gate data bits in preparation for the next scan. This means that while a particular key remains pressed, the gate for that channel will be refreshed on every scan. When the key is released, the gate for that channel will go low when data is again output.

Logical Channels

The effect of the decision logic from the musician's point of view, is that upon playing a chord, say C, E and G the first one depressed normally comes out on channel 1, the second on channel 2 and the third on channel 3 (the difference in time between depressions need only be milliseconds). There is, however, an exception to this when a note is depressed that is already stored in memory. For instance, if the three note chord described above were depressed such that C was first E second and G third, then it would be expected that C would come out on channel 1, E on channel 2 and G on channel 3. But if a previous chord had been played using the same C which had emerged on channel 2 then the decision logic would cause it to remain on channel 2 and so the E would be placed onto channel 1 and G onto channel 3.

Key Question

Construction of this project will depend almost entirely upon the keyboard it is built around. If you ▶



Power for the keyboard controller comes from this twin transformer board.

HOW IT WORKS

The Scanner: The IC's used for the scanner itself are 74154, which are one out of 16 line decoders. They are arranged such that one output goes low with the rest remaining high, dependent on the four bit code on the input. These IC's also have a pair of enable inputs both of which must be low. These allow four 74152's to be used as a one out of 64 line decoder, simply by the inclusion of the two inverters on inputs 16 and 32. The 63rd note output is obtained from the 63rd output of the decoder, and the scanner output is taken from the keyboard contact bus bar, having been ORed using the diodes.

Logic: The reaction of the circuit to a new note that has not been picked up by the scanner before is as follows: the note code counter increments the scanner by one note on alternate falling edges of the clock, until it reaches this particular note. The output of the scanner goes high registering that the contact is closed. This triggers the monostable IC12 pin 2 causing its Q output to go low long enough to set the decision cycle flip flop IC15 input pin 9. The output of this flip flop pin 11, then inhibits further pulses from clocking the note coder by taking pin 1 of IC15 low. At the same time it initiates the first decision cycle by allowing the counters IC9 (address counter) and IC13 (decision counter) to run by taking their clear inputs high. When the output of the decision counter is zero the memory address counter is clocked round, so that the logic can check if the note is already in the memory.

The memory address counter is incremented on the low going edge of the K pulse, which is simply the clock divided by two. Since the decision counter is only 2 bits it was convenient to derive K using the spare single stage counter in the 7493. Note that K is only active during the decision cycles and data block since the counter is cleared down when the scanner is scanning.

When the address counter reaches the number set on the Phonics switch, it is reset, and the decision counter incremented by one via the NAND gates IC18. This starts the second decision cycle where the logic is looking for a spare location to insert the new note. It has been assumed that channel 1 is in use and that the first available channel is channel 2. The circuit stops the data being entered in channel 1 by observing the state of the gate data output from the gate RAM pin 5. If this output is a logical '0' the channel is in use and must not be corrupted, and so the address counter is incremented so that the next channel can be tested.

In the case of this example the decision logic succeeds in entering its data in channel 2, but if the decision counter is incremented a second time before an empty channel is found, simply because all channels are in use, the decision cycle is ended and the scan continued. This third condition of the decision counter is decoded by the NAND gate IC16 and the inverter IC19, and reset is achieved via the three input NAND gate IC22 and inverter IC20, which reset the decision cycle flip flop restarting the note code counter and clearing down the memory address and decision counters.

The second and subsequent times that the scanner is stopped by the note that was loaded in channel 2, the decision logic will only get as far as its first test 'Is the note already in the RAM', so when the memory

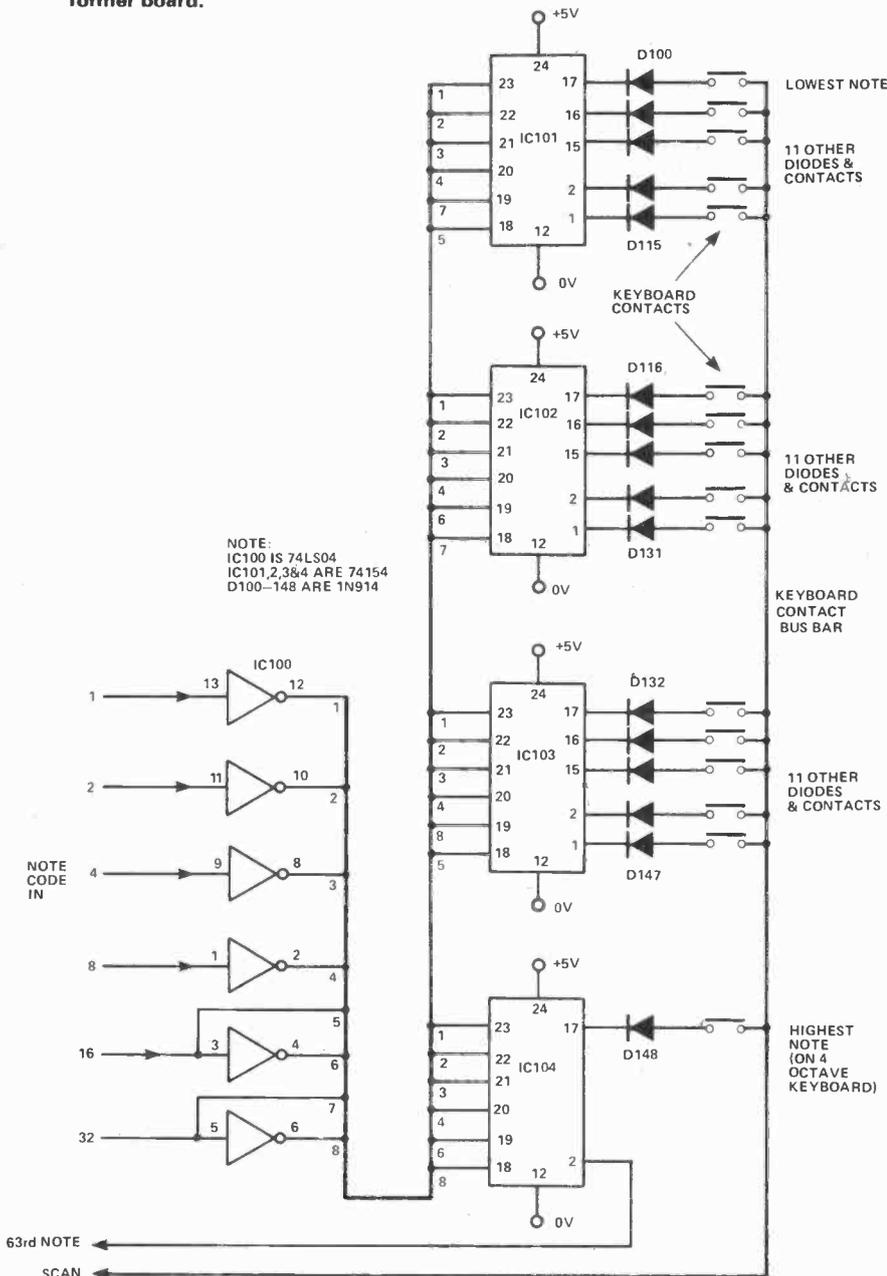


Fig. 1. Circuit diagram of the scanner. The four 74154's are used as a one out of 64 line decoder.

address counter reaches 2 the comparator output goes high acknowledging that the note is already entered. This causes the gate bit to be refreshed (since it is reset during data block) along with the data being re-entered into the note memory, (re-entering the data in the note memory is not necessary but occurs due to circuit architecture) after which the decision flip flop IC15 is again reset and the scanner restarted.

All the time a note remains depressed the decision logic will refresh the gate bit associated with the channel in which the note has been placed. At the end of a scan the gate bits are reset immediately after they have been placed on the output channels meaning that if the note is not still depressed on the next scan the gate signal on the output channel will go low in the next data block period.

During a scan the data valid signal is high, it only toggles in data block. Simply enabling the gate RAM during the decision cycle loads it with a '1', since data valid is the input. Note that loading these Ram's with a '1' results in the output going to a '0' as they invert. This is the reason for the invertors on the outputs of the note RAM's, which are also tri-state for the computer interface.

The clock for the system is an NE555 timer wired in the astable mode.

The Output Channels

There are two outputs per channel which

are multiplexed out by the data block period. These are the gate outputs and the control voltage outputs. The gates are obtained from the CD4099 addressable latch (note that these outputs may need buffering depending on the impedance they are driving as the CD4099 is CMOS). The address lines of the latch are attached to the memory address counter and the input is connected to the gate data line (IC10 pin 2). The enable input of the latch is connected to the data strobe line so that as the data is output from the memory the correct gate state (1 or 0) is stored on the relevant channel.

The data sample pulses are for loading the sample and holds on the analogue channels. They are derived from the 1 of 8 decoder and the clock. To interface between the TTL logic and the analogue switches comparators are used so that the analogue signals can be between -3 volts and +12 volts. All the comparator outputs are disabled when the clock is high by using the two resistors R65 and R53 to feed the reference input to the comparators, the clock signal being attached to R65. The binary codes representing the notes are converted into analogue voltages using the D-A convertor IC14.

As the memory address counter is incremented in data block the data in the note memory is converted into an analogue voltage and passed onto the correct analogue channel by the comparator and analo-

gue switch. The D-A convertor has a current output such that when the resistor R82 is added to convert it into a voltage, the output goes more negative with increasing binary codes. The op-amp IC29 (pins 12, 13 and 14) corrects this by inverting the output of the D-A. It also allows the scaling or volts per octave of the keyboard to be adjusted, by varying the resistor in the feedback loop. Another function that the op-amp allows is the summing of voltages that have to appear on all the output channels at once.

There are three sources of voltage that are summed at this point, the tune voltage, the vibrato voltage, and the pitch bender voltage. The tune voltage is derived from a potentiometer which draws its current from the voltage reference circuit. The vibrato voltage is generated by a standard triangle wave generator comprising a regenerative comparator IC29 pins 8, 9 and 10 and an integrator IC29 pins 5, 6 and 7. The output is coupled to the summing amplifier via a pair of back to back electrolytics to remove any DC offset and a pair of resistors that allow their centre point to be connected to earth via an external vibrato depth potentiometer.

Offsets around the circuit are trimmed out using the trimmer RV1 which obtains its reference from the diode D1. Since the offsets are predominantly in one direction due to Q2 the offset control only works in the negative voltage direction.

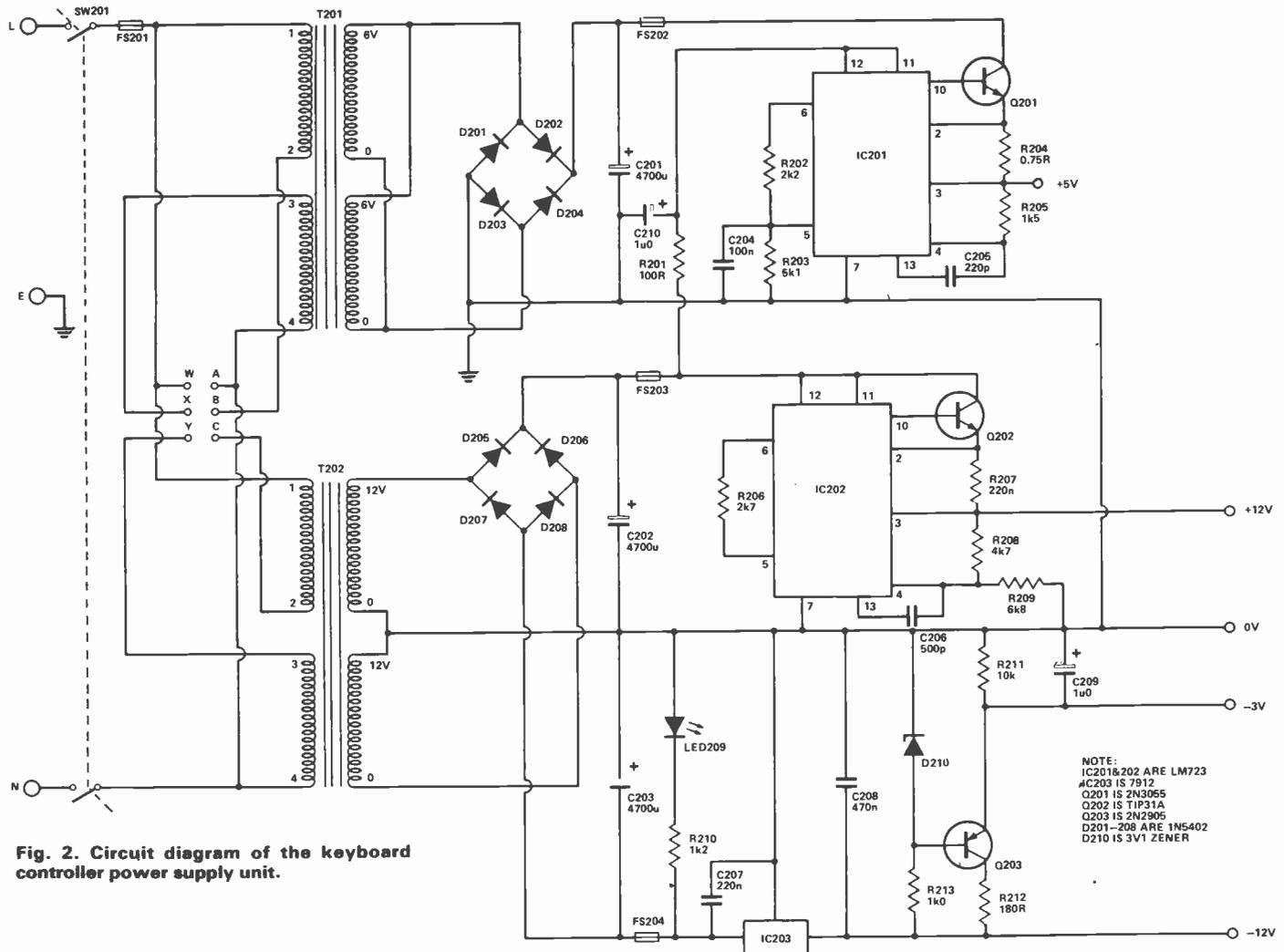


Fig. 2. Circuit diagram of the keyboard controller power supply unit.

employ the ARAK kit, no problems should arise at all. The PCBs are designed to fit their keys and comprehensive instructions are included with the kit.

We have not attempted to go into any detail with any other unit, simply because there is such a great diversity available on the market.

Setting Up

Once the components are all mounted on their boards, each section has to be set up. Let's start with the

PSU

Before the mains is connected to the PSU it should be thoroughly checked for shorts. The three low voltage fuses FS202, FS203 and FS204 should then be removed and the mains turned on. Now check the voltages across the smoothing capacitors C201, C202 and C203 which should be around +8V, +17V and -17V respectively. If this is the case the +12V regulator can be tested by replacing FS203. If this works the +5V regulator can be tested by replacing FS202. As the +5V regulator is supplied from the +12V supply via R201 they must be tested in this order. Finally the -12V and -3V supplies can be tested by inserting FS204. It should be noted that the fuse holders may need bending to give correct contact to the fuses as they are very simple pressed steel pieces for PC mounting.

The Logic Board

Check the logic board thoroughly for shorts on supplies. It is also wise to 'buzz out' every connection on the board to test for continuity which may well save a lot of fault finding time, but note that it will not guarantee correct operation as it does not test for shorts.

When these preliminary tests have been carried out and the power supply unit is functioning correctly power can be applied to the logic board. Firstly only apply the +5V supply until the TTL is known to be working correctly.

And a Log

Once the logic is working the analogue section can be tested. This time some setting up can also be done:

First check the positive reference is sitting at about 6V2 above earth. This level can be increased using the trimmer RV7 if a higher reference is required for any reason.

If the touch circuit is not to be used R63 should be removed as it will probably cause the output of IC29 pin 14 to saturate against one of the supplies as the output of the touch circuit is indeterminate.

R19 sets the maximum glide rate. The smaller it is the longer the maximum glide rate will be. However, it is unwise to make it any smaller as the maximum range is set by the V_{CE} on SAT of the switching transistor, this only creating an offset when it is turned on and not when it is turned off. It may be necessary to increase the value of R19 although problems will probably occur on one channel only and will most likely be remedied by replacing the switching transistor for one with a lower V_{CE} SAT.

PARTS LIST

BOARD 2

R201	100R
R202	2k2
R203	5k1
R204, R207	0R75 1W
R208	4k7
R209	6k8
R210	1k2
R211	10k
R212	180R 1W
R213	1k

CAPACITORS

C201-203	4700u 25V electrolytic
C204	100n polyest
C205	220p
C206	500p
C207	220n polyester
C208	470n polyester
C209, C210	1u0 35v electrolytic

SEMICONDUCTORS

Q201	2N3055
Q202	TIP31A
Q203	2N2905
IC201, IC202	LM723
IC203	7912
D201-208	1N5402
D209	LED
D210	3V1 Zener

MISCELLANEOUS

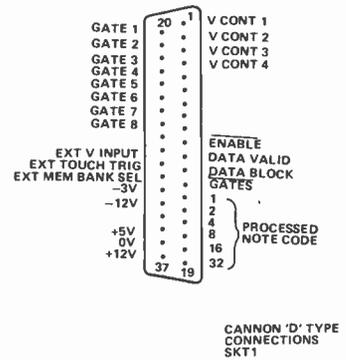
TX201	RS 207-683
TX202	RS 207-699
1A, 1A5, A (2 off)	fuses and holders,
DPST rocker switch.	

BOARDS 3 AND 4

SEMICONDUCTORS

IC100	74LS04
IC101-104	74154
D100-148	1N914

2 off of these components are required, as board 4 is identical to board 3.



CANNON 'D' TYPE CONNECTIONS SKT1

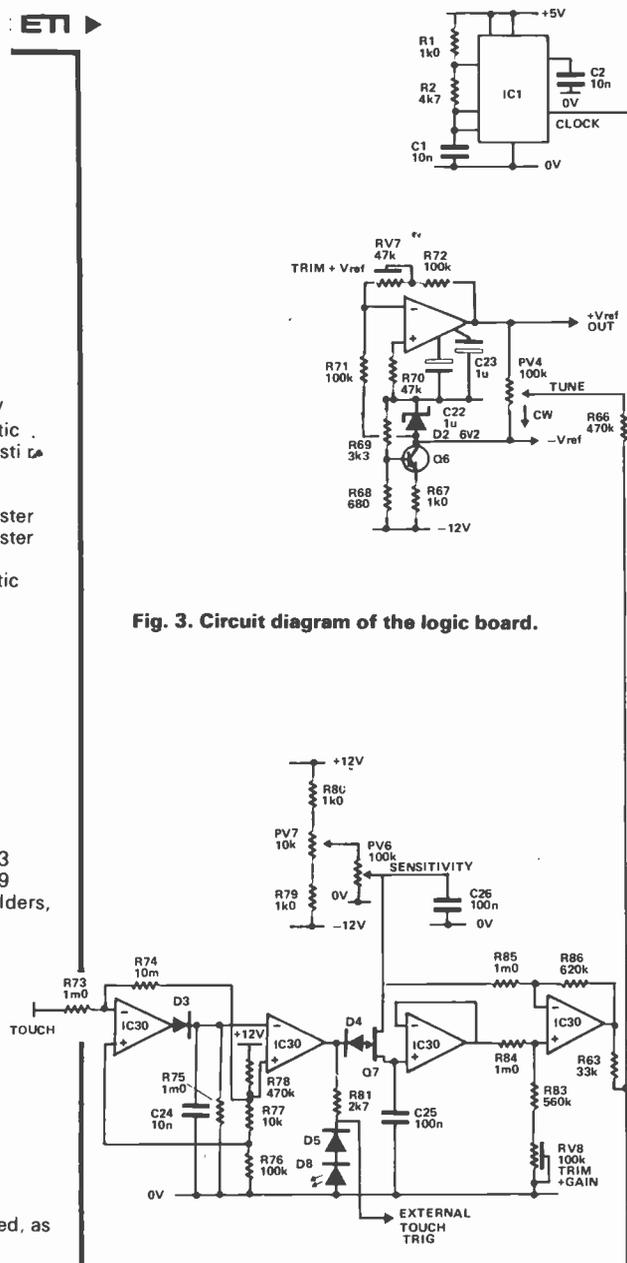


Fig. 3. Circuit diagram of the logic board.

CAPACITORS		IC9-11, IC13	74LS93
C1-3, C8, C9,		IC12	74LS123
C11, C12, C14, C15		IC14	MC1408L-8
C17, C18, C24	10n polyester	IC15-18,	
C4	22p	IC31, IC32	74LS00
C5, C6	100p	IC19, IC20	74LS04
C7, C10, C13, C16,		IC21	74LS366
C19, C25, C26	100n polyester		(or 74LS368)
C20, C21	33u	IC22, IC23	74LS10
C22, C23, C29	1u0 35V electrolytic	IC24	CD4066
C27, C28	330p	IC25	LM339
SEMICONDUCTORS		IC26, IC27,	
Q1	BCY72	IC28, IC30	TL084
Q2-6, Q8	BC107	IC29	LM4741
Q7	2N5163	D1, D3-7	1N914
IC1	NE555	D2	6V2 Zener
IC2	CD4099	D8	LED
IC3, IC4	74LS85	MISCELLANEOUS	
IC5-7	7489	37 way 'D' skt, stereo jack (3 off), SPDT	
IC8	74LS155	switch (4 off), SPDT centre off.	

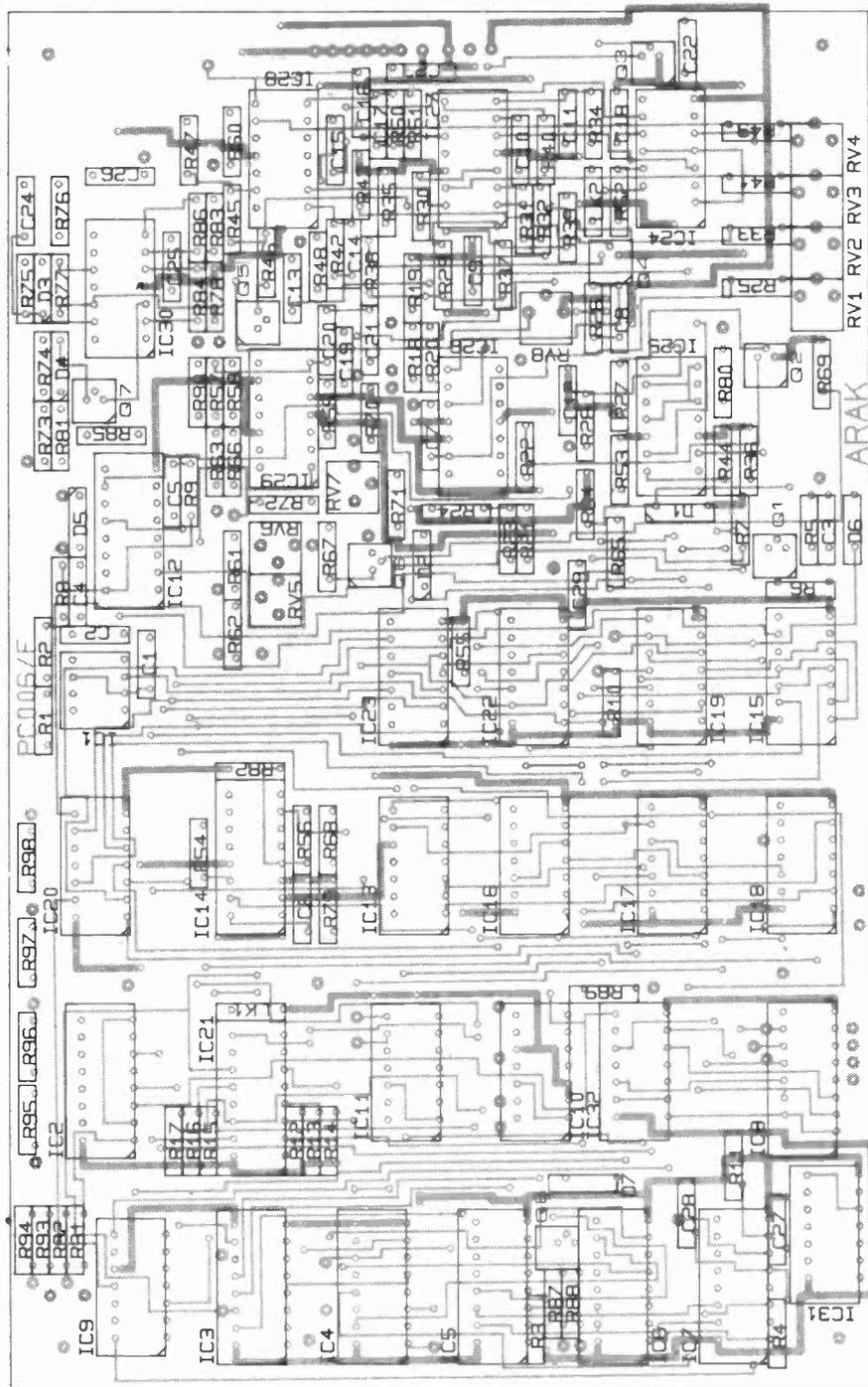


Fig. 6. (above) Component overlay for the logic board.

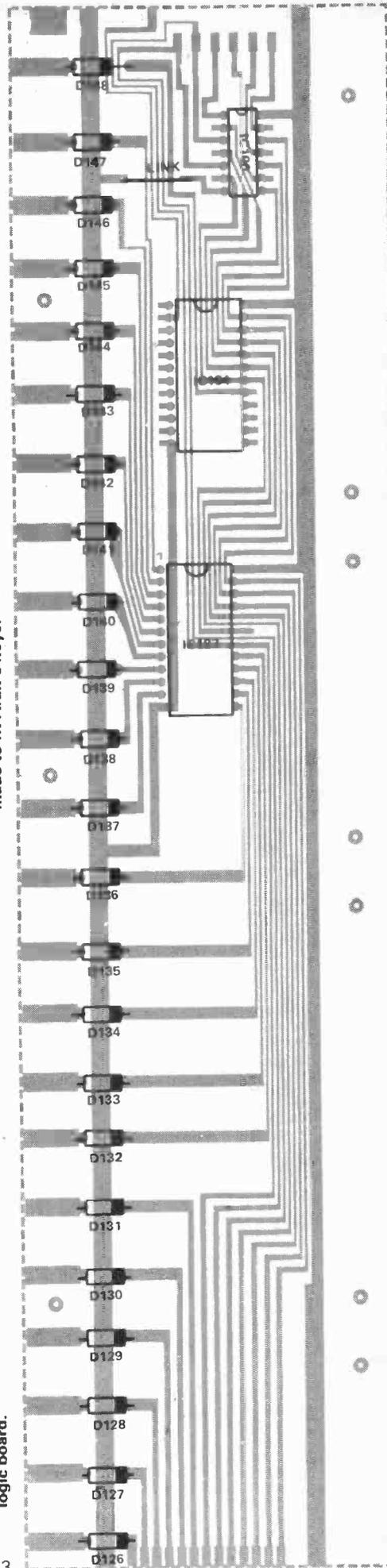
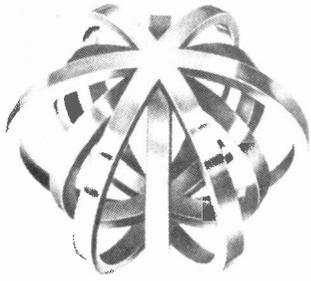


Fig. 7. (Below). One of the keyboard PCBs made to fit Arak's keys.



PARIS



IN SPRINGTIME

As a London-based magazine, we tend to concentrate our interest on exhibitions and electronics shows in the London area. Lest we become too parochial in our outlook, we decided to see what our fellow Europeans have to offer. We sent our roving reporter, Ian Graham, to Paris to see how the other half live.

I PROBABLY RECEIVE a couple of hundred Press releases every day. Most, concerning orders for electronic equipment won by companies or appointments to the top management of larger corporations or annual accounts, end up in the waste paper bin. Our reports on the cream of the rest appear monthly in our news pages. Occasionally I am invited to attend Press receptions. Again, few are interesting enough to prise us out of our armchairs. However, I did sit up and take notice when I was invited to attend an electronic components exhibition 'sur le continent'. The occasion was the Salon International des Composants Electroniques 79, held in Paris from the 2nd to 7th of April. Well, I thought about it, for several seconds at least, and decided that I had indeed been neglecting our European brothers.

On a sunny April morning I made my way from Charles de

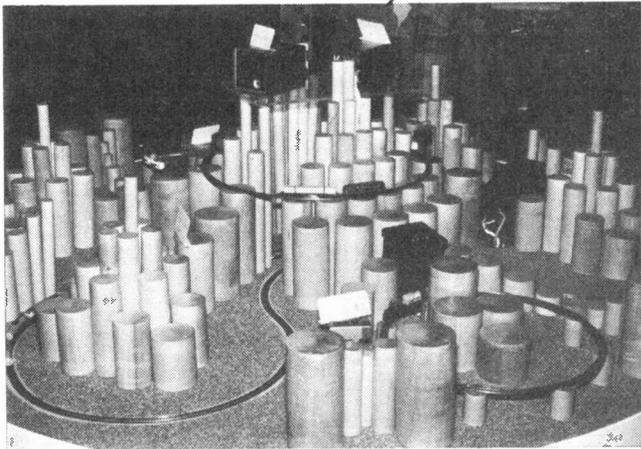


Row upon row of stands full of goodies — paradise for the exhibition addict.



The tops of stands stretch into the distance, in the biggest of the three exhibition halls.

Gaulle airport to the exhibition site at the Parc des Expositions in the Place de La Porte de Versailles. My first impression as I emerged from the Metro station was of the unexpected size of the exhibition, which stretched over a staggering 63,000 square metres, split up into four sections. It would have taken several days to see everything on display, certainly more than the single day I had allowed myself. Although it was essentially a trade show, the atmosphere inside was more akin to that of our own Ideal Home Exhibition. However, great expectations of an entertaining exhibition were not borne out by my admittedly swift tour of the stands.



A fun way of counting trains with photocounters. This stand attracted a great deal of interest from people who had probably never seen a photocounter before. This simple display illustrated the principle of the unit admirably for the layman.

Dry Stuff?

Unfortunately, few exhibitors showed any imagination in the presentation of their wares. Sound to light units and TV games naturally lend themselves to entertaining stands, but what about more mundane electronic components? General Instrument Microelectronics (a British firm, I'm happy to say) managed to make microprocessors a crowd puller (I wouldn't have thought it possible) by using one to control a noise generator. Pretty dry stuff, you might say. However, the generator was producing car engine, gear change, skid and crash noises for a model racetrack. Visitors could control the cars with conventional pistol grips. Well, perhaps a model race track has little to do with microprocessors and vice



A closer look at the electronic 'train' spotter above. One colour of wagon, in this case blue, can be counted, ignoring the train and all the other wagons.

versa, but it did attract interested visitors. Isn't that what it's all about?

Eyecatching Pyramids

Another firm displayed photocounters by using them to count wagons on a pyramid of model railway layouts. Talking about pyramids, yet another firm (American) presented a striking display, a pyramid of multimeters. They might uncharitably be called gimmicks, but they *were* eye-catching. Too many exhibitors relied on a glass case full of components accompanied by row upon row of standard black and white exhibition photos, none of which deserved or got a second look. Still, there were plenty of product demonstrations to keep me busy, as I made my way through the maze of stands. There were also lectures. How do you fancy soaking up 'Monolithic Memories' at half nine in the morning? No, neither did I.



Keithley's pyramid of multimeters. We strongly suggest that you don't try this with your Avo. 8's, or if you do, don't blame us if there are disastrous consequences.

Light Entertainment to Heavy Machinery

Although I found plenty to criticise at the Paris show, it put some of our own electronics shows to shame. Whatever you are interested in, from hi-fi to heavy machinery, there's plenty of it at the Salon, with some 1300 firms exhibiting. Hi-fi enthusiasts could spend a day or two wandering round the stands devoted to the love of their life. That goes equally well for every field of interest represented and there wasn't much that was not represented.

See You Next Year

My brief visit to the show was very enjoyable. There was plenty of food and drink to be had from seemingly numerous bars. The French exhibition staff were so good to me that I'm thinking of doing it again next year. If you feel like joining me, the Salon International des Composants Electroniques 80 will be held from March 27 to the 2nd of April. If you feel like nipping across the pond to pay your visit on Sunday, March 30th, don't.....they're closed. **ETI**

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MOTOR SPEED CONTROLLER

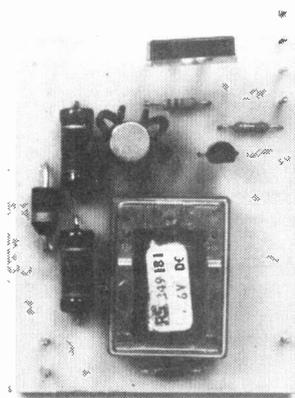
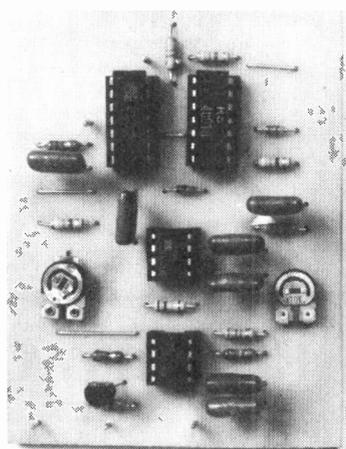
A sophisticated unit that allows control of model electric motor speed and direction via a single radio control channel. The unit can supply peak currents up to 10 amps.

THIS DEVICE lets you use a single channel of your radio control system to control both the speed and direction of an electric model motor. The unit has been designed specifically to control the drive motor of our 1/16th scale Tamiya Leopard tank, but can in fact be used to control any 4V5 to 8V DC electric motor that draws peak current below 10 amps. The unit is ideal for use in model boats and large-scale land vehicles, and costs only a fraction of the price of equivalent commercial units.

The unit derives its control signals from one of the output channels of a radio control decoder. It accepts standard positive or negative decoder pulses, which have widths variable over the 1 mS to 2 mS range, and is designed to work with systems having fixed frame (or frame repeat) periods of approximately 20 mS. The Strato 4+2 system, published in the May and June editions of ETI, can be used with the controller.

The controller circuit incorporates only two pre-set pots. One of these is a 'set null point' control, and can be used to set the motor speed to zero in any desired position of the transmitter joystick control. The other pre-set is used to set the maximum speed of the motor.

The two pre-sets can be used to give a variety of operating modes. If they are adjusted so that the null point occurs at the centre of the joy stick travel, the motor will have identical maximum speeds in forward and reverse. If the null is set to occur towards the 'low' end of the joy stick travel, the motor will have a high maximum forward speed and a low maximum reverse speed.



Construction And Use

The unit is assembled on two PCB's. Board 1 holds all the logic, timing components, and the two pre-set pots, and board 2 holds the power driver transistors and the relay. Construction of board 1 should present few problems: note, however, that no provision is made on the PCB for decoupling capacitor C8, since we hooked this component into the wiring harness on our prototype unit.

Note when constructing board 2 that power transistor Q4 can either be mounted directly on the board in low- to medium-power applications, or can be mounted externally on a suitable heat sink (such as a vehicle chassis, etc) in high power applications. The relay used on this board is a 6 volt two pole changeover type with a coil resistance of 70R (see Buylines).

When construction is complete, the two boards can be mounted in the model, preferably as far away from interference-generating motors and servos as possible. Board 1 is powered from the radio control decoder supply lines. The signals from the selected output channel of the decoder are fed to either the positive pulses or negative pulses input leads of board 1, depending on the pulse polarity of the particular decoder that is used.

Board 2 is powered from the motor supply leads. Note that the 0V line of the motor supply must be made common with the 0V line of the decoder. Also note that one lead must be connected between R6 on board 2 and pin 4 of IC1 on board 1, and another lead must be connected between R12 on board 2 and Q1 collector on board 1.

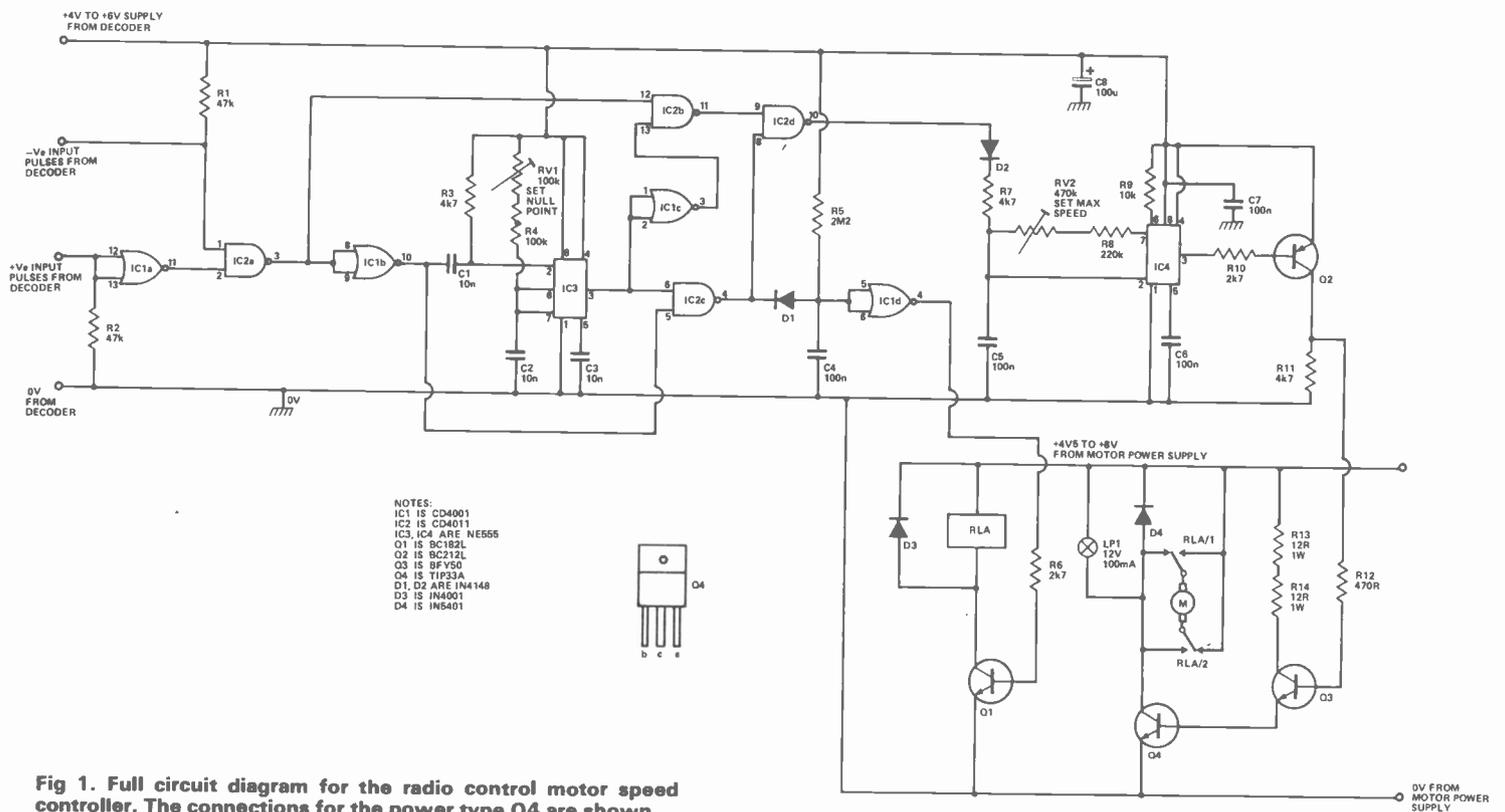


Fig 1. Full circuit diagram for the radio control motor speed controller. The connections for the power type Q4 are shown.

HOW IT WORKS

The input pulses from one channel of the decoder, which have widths that are variable between 1mS and 2mS, are fed to either pin 1 or IC2a (negative input pulses) or to pins 12 and 13 of IC1a (positive input pulses), and appear in positive-going form at the output of IC2a. This positive-going pulse is fed directly to pin 12 of IC2b, and is fed in inverted form to pin 5 of IC2c: the inverted pulse is also used to trigger reference-pulse generator IC3 via C1. This reference pulse has a nominal width of 1.5mS, which equals the mid-band width of the input pulses from the decoder.

The positive-going reference pulse is fed directly to pin 6 of IC2c, where it is compared with the negative-going version of the input pulse on pin 5. The action of IC2c is such that its output is normally high, but switches low for a period equal to the difference between the reference and input pulse widths only when the input pulse duration is less than that of the 1.5mS reference pulse. This negative-going output pulse, which has a width that is variable between zero and a nominal 0.5mS, is used to rapidly discharge C4 via D1 and thus cause the output of IC1d to switch high and drive relay RLA on via Q1 and R6. This relay, which dictates the direction (forward or reverse) of the motor that is being controlled, is thus off when the input

pulses are greater than 1.5mS (nominal), and on when the input pulses are less than 1.5mS.

The 1.5mS reference pulse of IC3 is inverted by IC1c and fed to pin 13 of IC2b, where it is compared with the positive-going version of the input pulse from the decoder. The action of IC2b is such that its output is normally high, but switches low for a period equal to the difference between the reference and input pulse widths only when the input pulse duration is greater than that of the 1.5mS reference pulse. This negative-going pulse, which also has a width that is variable between zero and a nominal 0.5mS, is fed to pin 9 of IC2d.

Thus, a negative-going pulse appears on pin 9 of IC2d if the decoder pulse is greater than 1.5mS, or on pin 8 of IC2d if the decoder pulse is less than 1.5mS. Consequently, IC2d generates a positive-going output pulse that has a width that varies from zero on a 1.5mS decoder input pulse to 0.5mS on a 1mS or 2mS input pulse.

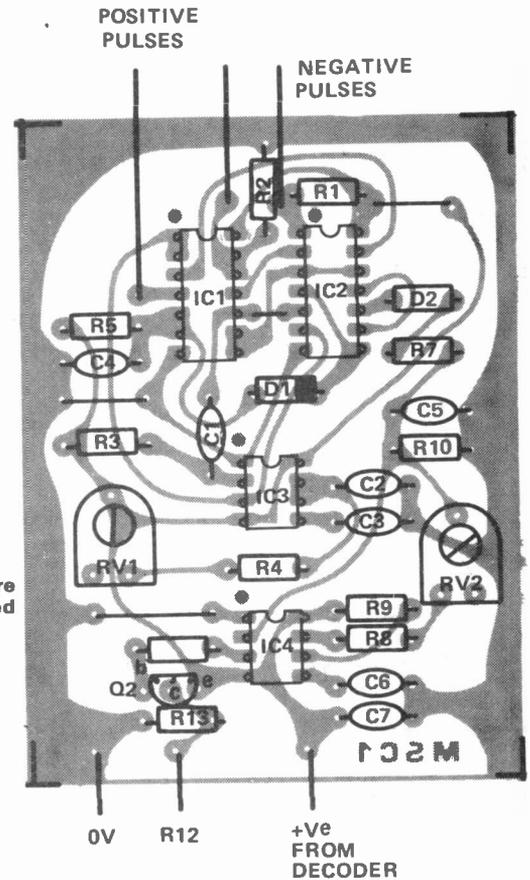
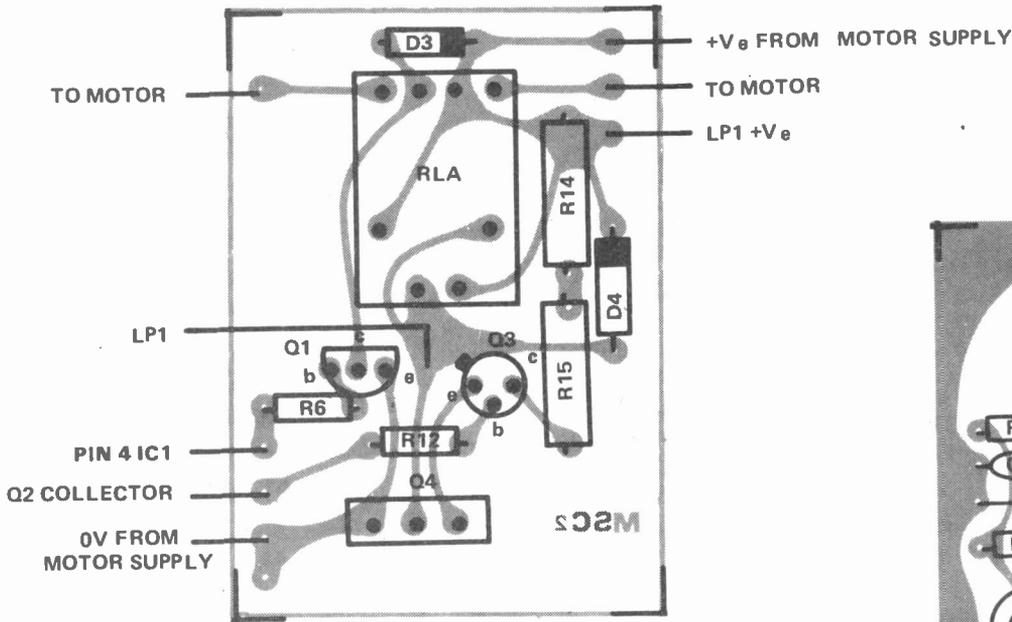
This pulse is fed, via D2, to a pulse-expander circuit designed around IC4, which expands the pulse width by a factor of about 40. The resulting expanded pulse is passed on to the external motor via transistors Q2 to Q4 and the contacts of the relay, and is used to give pulse-width or variable

mark/space-ratio control of the motor speed. Diode D4 is used to damp motor back-EMF, and lamp LP1 is used to minimise the effects of interference-generating current surges.

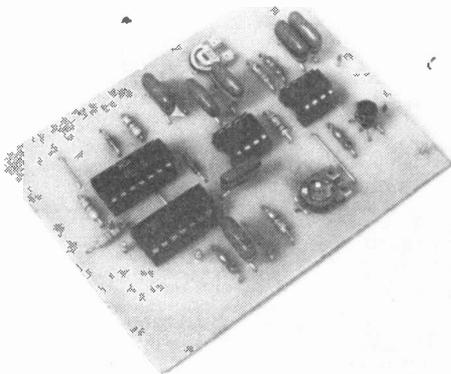
In practice, RV1 is used to adjust the width of the reference pulse (nominally 1.5mS) so that the motor speed is zero when the transmitter joy-stick control is in its central or null position, and RV2 is used to adjust the expansion factor of the pulse expander circuit and thus pre-set the maximum speed of the motor when the transmitter control is in its 'maximum' position.

BUYLINES

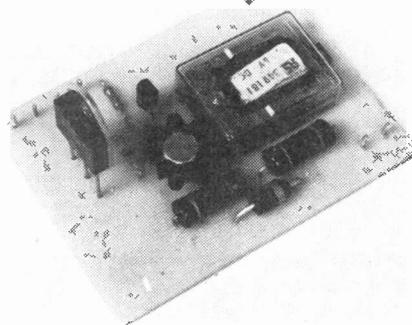
The relay is the only component that calls for comment here. It is a 6 Volt 2-pole changeover type with a coil resistance of 70R, and is available from Greenweld, 443 Millbrook Road, Southampton, SO1 0HX. The price is £3.30, including postage and the usual extras.



Above left and almost absolutely right are the component overlays for the speed controller.



And this is how the boards should look once you've built them up. Check very carefully before switching on.



PARTS LIST

RESISTORS (all 1/4w 5%)

R1, 2	47k
R3, 7, 11	4k7
R4	100k
R5	2M2
R6, 10	2k7
R8	220k
R9	10k
R12	470R
R13, 14	12R 1W

CAPACITORS

C1, 2, 3	10n polyester
C4, 5, 6, 7	100n polyester
C8	100u 25V electrolytic

SEMICONDUCTORS

IC1	4001
IC2	4011
IC3, 4	555
Q1	BC182L
Q2	BC212L
Q3	BFY50
Q4	TIP33A
D1, 2	IN4148
D3	4001
D4	IN5401

Relay = 6V, 2-pole changeover type. Coil resistance 70R.

What A Turn On

When installation is complete, turn on all power switches, check that the unit functions correctly, and then adjust pre-set pots RV1 and RV2 for the required operation. To set RV1, move the transmitter joy stick to the required 'null' position, and then adjust RV1 for zero motor speed: under this condition the relay should be on the verge of switching between the on and off states. Next, move the transmitter joy stick fully forward, and adjust RV2 for the desired maximum motor speed. The setting up procedure is then complete.

Finally, note that the operation of the motor speed controller can be adversely affected by electrical interference from motors, etc. All motors in the model must therefore be adequately suppressed. A 100n disc ceramic connected directly across the motor terminals works pretty well in most cases.

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Sep. 77	*Graphic Equaliser	601	2.50	23.75	BFGH
Sep. 77	*Graphic Equaliser P.S.U.	602	.90	2.50	BFG
Oct. 77	*Watchdog	604	1.20	21.95	BEGHL
Oct. 77	*Watchdog P.S.U.	605	1.10	7.45	BEH
Aug. 77	*Sweep Oscillator	606	4.00	41.95	BFGHL
Sep. 77	*Stereo Simulator	607	1.05	6.95	BEGHL
Dec. 77	*Freezer Alarm	608	.85	8.45	BFHL
Nov. 76	*General Purpose Preamp	609	1.00	4.85	BEG
Jul. 77	*GSR Monitor	612	1.10	19.75	BEGHL
Apr. 77	*Burglar Alarm	613	1.10	10.85	BEGH
Feb. 77	*Bench Amplifier	615	1.15	13.20	BEGHL
Nov. 77	*Compander	617	2.55	27.35	BEGHL
Mar. 77	*50 watt High Power Amp	618	2.10	9.75	BE
Mar. 77	*100 watt High Power Amp	619	2.10	12.80	BE
Mar. 77	*High Power Amp P.S.U.	620	1.65	8.70	BEJ
Oct. 77	*Digital Thermometer	621	1.70	21.85	BFGHL
Feb. 77	*LED Dice	624	.90	7.10	BEH
	*AEG Crossover (2 pcbs)	625	3.30	15.30	BFGHL
	*Marker Generator	626	1.20	8.40	BEGHL
Nov. 77	*Skeet	627	2.55	21.90	BEGHL
	*Flash Trigger	628	1.10	6.25	BEGJ
	*Disco Light Show	629	4.25	25.95	BFGJ
	*Pink Noise Generator	630	1.05	4.30	BEH
Nov. 76	*541 Train Controller	T0010	1.35	18.85	BEHL
Jan. 77	444 S watt Stereo (2 pcbs)	T002	3.10	26.95	BEGK
Feb. 77	448 Disco Mixer	T003	2.35	19.40	BEJ
Dec. 77	Clock B.	T004	3.30	16.75	BE
Jan. 78	House Alarm A.	T005	3.20	30.50	BEHM
Feb. 78	House Alarm B.	T006	1.50	5.50	BE
May 78	Metal Locator Mk. II	T007	1.50	22.50	BEHL
March 78	Frequency Shift P.S.U.	T008	1.10	5.95	BE
	Frequency Shifter	T009	2.50	24.95	BEL
	L.C.D. Meter	T010	1.60	27.95	BEG
	Light Dimmer	T011	.90	8.60	BEH
Apr. 78	Gas Monitor	T012	1.40	15.95	BEHL
May 78	Star Trek Radio	T013	1.55	9.80	BFH
	Stars & Dots	T014	3.00	T.B.A.	BEHL
June 78	Spectrum Analyser (2 pcbs)	T015	13.90	76.95	CEHM
	Wein Oscillator	T016	1.45	17.20	BEHL
	Torch Finder	T018	.75	2.40	BE
	Temperature Meter	T019	1.60	27.70	BEG
Aug. 78	Etiwet Plant Waterer	T020	1.30	6.10	BEH
Sept. 78	Cross Hatch Generator	T021	2.10	16.95	BEGHL
	Stac Timer	T022	3.00	27.45	BEHL
	Wheel of Fortune	T023	1.55	9.80	BEHL
Oct. 78	Complex Sound Generator	T024	3.95	25.75	BEH
	R.F. Power Meter	T025	1.60	15.30	BEHL
	Power Bulge	T026	.85	3.65	BEHL
Oct. 78	Telephone Bell Extender	T027	1.25	11.40	BEHL
Feb. 78	Proximity Switch	T028	2.30	15.35	BEGH
Feb. 78	Ultra Sonic Receiver	T029	1.00	10.75	BEH
Feb. 78	Ultra Sonic Transmitter	T030	.90	5.65	BEH
Nov. 78	Cuts Cassette Interface	T031	2.70	14.95	BEH
	Audio Oscillator (2 pcbs)	T032	4.60	39.95	BEHL
Dec. 78	Car Alarm (2 pcbs)	T033	2.50	6.95	BEJ
	Wine Temperature Meter	T034	1.30	—	—
	Curve Tracer	T035	1.20	10.95	BEHL
	Eprom Programmer	T036	2.65	23.35	BEH
	Eprom Programmer P.S.U.	T037	1.70	6.25	BE
Jan. 78	Car Tachometer	T038	2.50	12.20	BF
	Digital Module A & B (2 pcbs)	T039	2.55	21.55	BE
	Digital Dial (Excl. T039)	T040	1.40	9.90	BE
	Log Converter	T041	3.60	26.75	BE
Feb. 79	Tape Slide Synchroniser	T042	2.30	20.95	BEHL
	Tape Noise Limiter	T043	.80	3.70	BEHL
	Light Activated Tachometer	T044	2.65	35.85	BEH
Mar. 79	Headlight Delay	T045	.75	6.95	BEHL
	Logic Trigger	T046	2.70	18.95	BEH
	Stage Dimmer Control Module	T047	2.95	47.95	TBA
	Stage Dimmer Module 10 amp	T048	6.30	28.30	BEH
	Stage Dimmer Module 20 amp	T049	6.30	27.05	BEH
Apr. 79	Audio Power Meter	T050	3.45	72.45	BEH
	Click Eliminator	T051	4.55	49.95	BEHL
	Wind speed indicator	T052	3.40	27.40	BEH
	Guitar effect unit	T053	1.20	11.69	BEGHL
May 79	Double Die	T054	1.65	14.95	BEHM
	Headphone amp	T055	2.75	23.30	BEHL
	Car immobiliser	T056	1.20	7.95	BEH
	Ambush (3 pcb's)	T057	8.65	TBA	—
June 79	Tuner Amp	T058	TBA	TBA	—
	Main's speaker	T059	.90	5.45	BEGHL
	Accentuated beat metronome	T061	2.10	15.95	BEGHL

ADDITIONAL PRINTED CIRCUIT BOARDS

Pcbs are available for all projects from September 1976 (except where copyright restrictions exist).

1976	Audio Level Meter	1.60	June	Digital Freq. Meter (Set 4)	5.35
Mar	Audio Exp./Compressor	4.70		Bass Enhancer	3.15
May	560 ABC VDU (Set 3)	7.55	Jul	081 Tachometer	85
Sep.	710 2m Power Amp	1.50		Micro Amplifier	85
Oct.	241 Double Dice	2.10		Alarm Alarm	80
	252 1-2 Hour Timer	1.10	Aug.	Moisture Indicator	1.20
	152AB TV Pattern Gen (Set 2)	3.80		Bongas	1.15
Nov.	543AB STD Timer	3.10	Sep.	Egg Timer	1.10
	544 Heart Rate Monitor	1.65		Load Hafter	1.10
Dec.	447 Audio Phaser	2.15	Oct.	Continuity Tester	1.45
	446 Audio Limiter	1.85		Spirit Level	1.45
			Nov.	3 Channel Tone Control	1.00
				Clock A	1.80
				Rev. Monitor	1.65
1977			Elect	CMOS Switched Pre Amp (Set 2)	5.10
Jan.	570 Reaction Tester	2.25	To-	132 Experimenters P. 5	1.30
	549 Metal Locator 125	1.55	morrow	555 Timer pcb	0.90
	Patch Detector	80	1978		
Feb.	448A Headphone Amp	85	Jan.	Hammer Throw (Set 3)	7.45
	449 Balanced Pre-Amp	95		Race Track	2.00
	449A VU Meter	1.15	Feb.	Acc. Beat Metronome	1.05
	Door Bell	1.50		Porch Light	1.20
Mar.	155 ABCD Digital Voltmeter (Set 4)	6.10	Mar.	556 Shutter Timer	2.00
	Drill Controller	1.05		RMS Meter	1.60
	Function Generator	1.25		Line Follower	1.05
	Temperature Alarm (Set 2)	1.75	Apr.	Rain Alarm	1.60
	Fuzz	.85	May	Electronic Ignition	1.50
Apr.	630 Hex Display	1.00		Helping Hand (Set 2)	3.25
	P.S.U.	.85	1979		
	804 TV Game	2.30	Jan.	Digital Module A	1.55
May	Metronome (Simple)	0.80		Digital Module B	1.00
	Inject Tracer	1.00	Feb.	Digital Module C	1.05
				VCT	1.70
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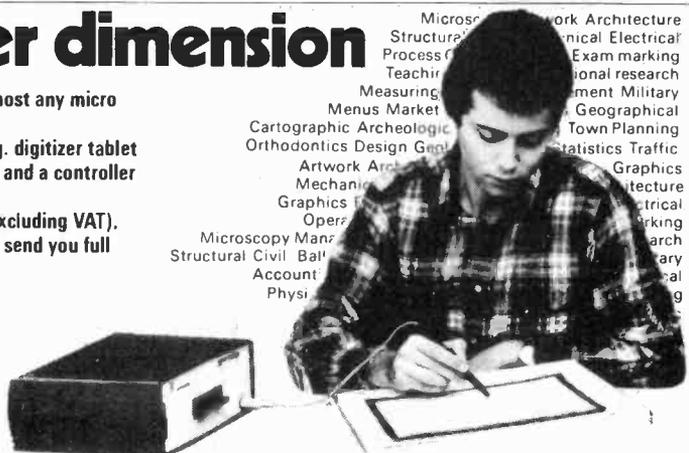
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40 CMOS CLOCKS

There are many ways of using the CD4001 and CD4011 CMOS ICs to make bistable, astable and monostable multivibrator circuits. Ray Marston presents the definitive work on the subject, with 40 practical circuits.

THE AMATEUR AND PROFESSIONAL circuit designer often finds himself in the situation where he needs to use a minimum-cost CD4001 or CD4011 CMOS pulse or clock generator circuit, or where he needs to use a few spare CMOS NAND or NOR gates from an existing circuit to make up a multivibrator that will meet his specific design needs. In either case, the designer will find a concise guide to practical NAND- and NOR-gate CMOS multivibrator circuits of inestimable value.

This article is just such a guide. It presents some forty different ways of using the low-cost CD4001 and CD4011 quad 2-input gate CMOS integrated circuits in bistable, astable and monostable multivibrator applications. All of the circuits shown can be operated over the full five volts to fifteen volts supply range when used with 'B' series CMOS.

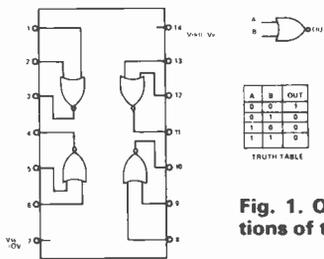


Fig. 1. Outline and pin connections of the CD4001.

THE CD4001 and CD4011 ICs

Figures 1 and 2 show the outlines and pin connections of the CD4001 and CD4011 integrated circuits. These two ICs are quad 2-input gates. The CD4001 provides NOR gate functions and the CD4011 provides NAND gate functions. Fig. 1 shows the truth table of each of the four NOR gates of the CD4001. Note that the output is high if both inputs are low, but goes low if either or both inputs go high. Fig. 2 shows the truth table of each of the four NAND gates of the CD4011. The output is normally high and goes low only if both inputs are high.

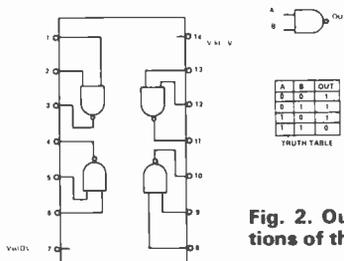


Fig. 2. Outline and pin connections of the CD4011.

The CD4001 and CD4011 are very inexpensive ICs. They typically retail at about 16 pence each in one-off quantities (allowing for some variation between suppliers), which works out at about 4 pence per gate. They can be used in a wide variety of very useful two-gate multivibrator applications and are thus highly cost-effective devices.

Bistable Multivibrator Circuits

The CD4001 and CD4011 can both be used in two-gate R-S (Reset-Set) bistable multivibrator circuits, but have quite different input triggering requirements. Fig. 3 shows the practical circuit and waveforms of a pulse-triggered NOR version of the bistable. The circuit has two outputs, a normal output from IC1a and an inverted output from IC1b. When a positive-going trigger pulse is applied to the IC1b input, the normal output sets high and locks in this state irrespective of any further signals at the input of IC1b. The output can only be reset low again by applying a positive-going pulse to the input of IC1a, at which point the output goes low and is then immune to any subsequent trigger pulses at the input of IC1a.

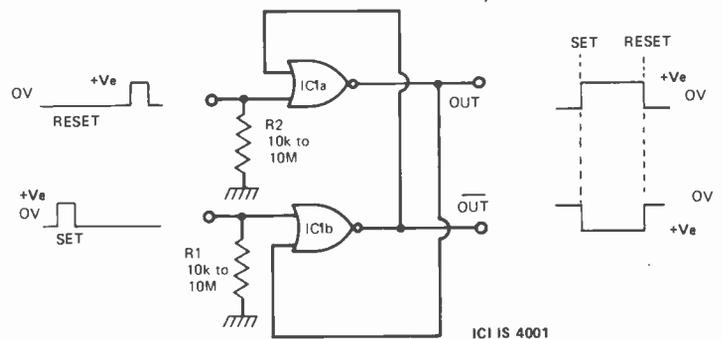


Fig. 3. Practical circuit of a pulse-triggered NOR bistable.

Note that the input terminals of IC1a and IC1b are tied to ground (the zero-volts line) via R1 and R2: these resistors can have any convenient values in the range 10k to 10M. If inputs to IC1a and IC1b are direct-coupled from preceding logic networks, however, R1 and R2 can be omitted from the circuit.

Manual NOR Gate

Fig. 4 shows a manually-triggered version of the Fig. 3 NOR gate circuit. This type of circuit is often referred to as a 'noiseless' switch, since its output is unaffected by the contact bounce, etc., of its two control switches. ▶

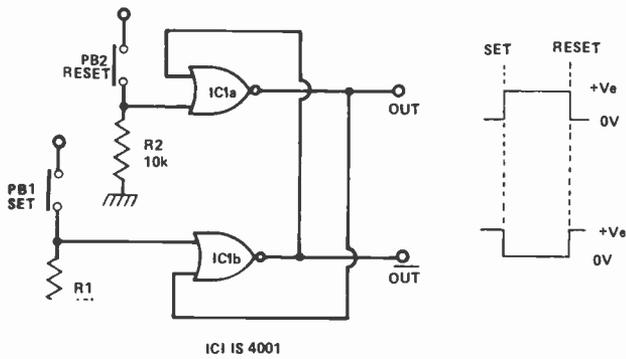


Fig. 4. Manually triggered NOR bistable.

NAND Bistable

Fig. 5 shows the CD411 NAND gate version of the bistable circuit. This circuit is almost identical with that of Fig. 3, except for the positioning of R1 and R2. Note, however, that the NOR gate circuit needs positive-going trigger pulses, while the NAND circuit needs negative-going pulses, and that the set pulse is applied to IC1b in the NOR circuit, but to IC1a in the NAND circuit.

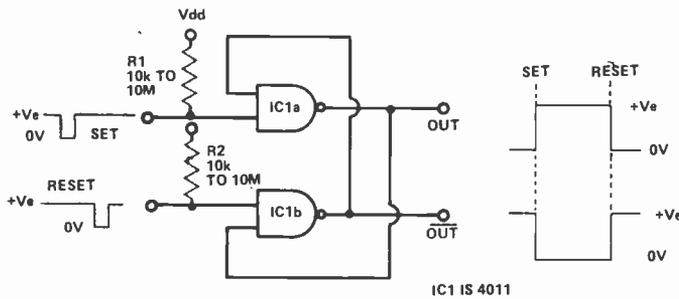


Fig. 5. A CD4011 NAND bistable, pulse triggered.

Manual NAND Bistable

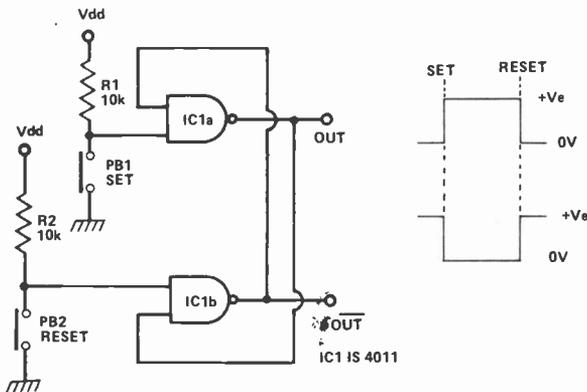


Fig. 6. Manually triggered NAND bistable.

Fig. 6 shows the manually-triggered version of the NAND-type bistable. Note here that although R1 and R2 are shown as having values of 10k, they can in fact have any resistance values from a few thousand ohms up to about 10M, depending on the precise details of the specific application. This versatility leads to the development of the touch-triggered NAND bistable circuit of Fig. 7, in which R1 and R2 have values of 10M, and the circuit can be triggered by placing any resistance that is significantly less than 10M (such as finger resistance) across the touch contacts. R3 and R4 are used in this circuit to protect the inputs of the two gates.

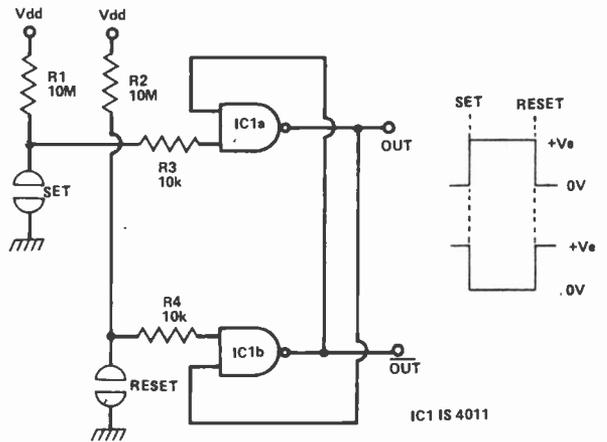
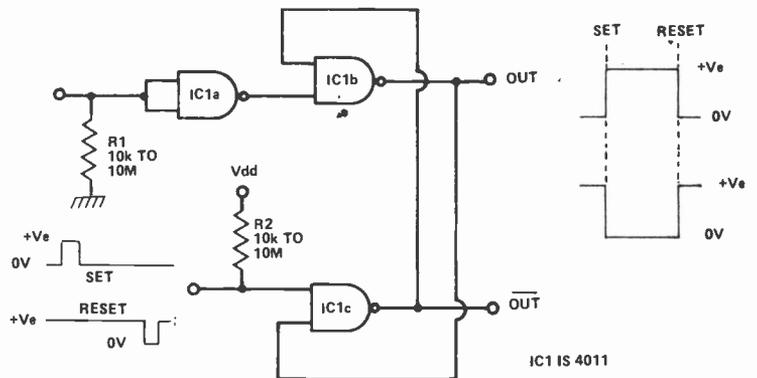


Fig. 7. Touch-triggered NAND bistable.

The bistable circuits that we have looked at so far all use same-polarity (either both positive or both negative) trigger signals. In some applications, however, it is necessary or convenient to use opposite-polarity signals to trigger the bistable, and this type of action can be obtained by placing an inverter stage in series with one or other of the normal bistable input terminals. Figs. 8 and 9 show two alternative circuits of this type.



Using opposite-polarity signals to trigger a 4011 bistable, Fig. 8 (above), and a 4001 bistable, Fig. 9 (below).

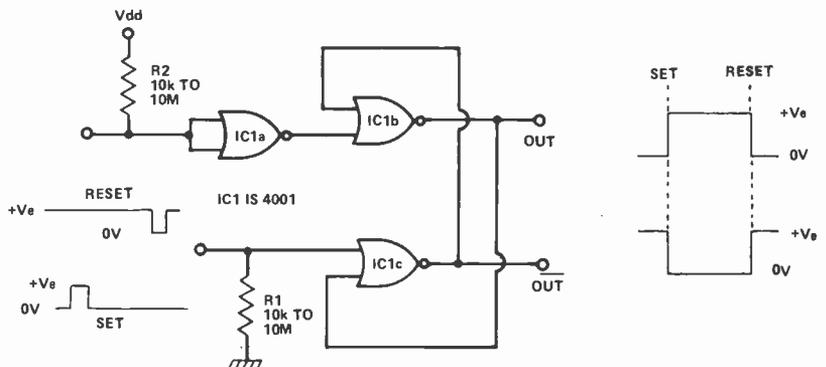


Fig. 10 shows alternative ways of connecting a 2-input NAND or NOR gate so that it acts as a simple pulse inverter stage. These circuits are useful in a multitude of applications.

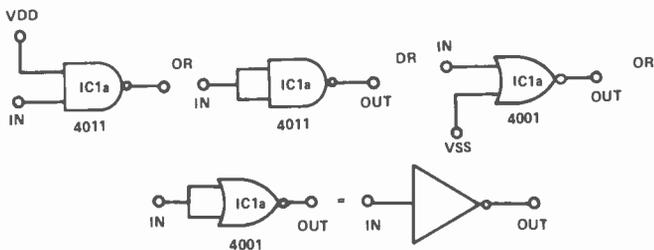


Fig. 10. Using a 2-input NAND or NOR gate as an inverter.

Basic 2-Gate Astable Circuits

The CD4001 and CD4011 can both be used in a variety of basic 2-gate astable multivibrator circuits. In these circuits the gates are connected as simple inverters, so the two types of IC give identical performances.

CMOS Astable

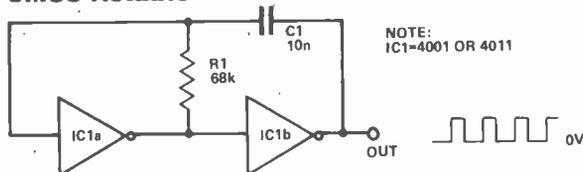


Fig. 11. Circuit of the basic 2-gate CMOS astable.

The most basic and useful 2-gate CMOS astable circuit is shown in Fig. 11. This circuit generates a decent square wave output, has excellent thermal stability and operates at about 1 kHz with the component values shown. The frequency is inversely proportional to the C-R time constant, so the frequency can be raised by lowering the values of either C1 or R1. In practice, C1 must be a non-polarized capacitor, and can have any value from a few tens of picofarads to a few microfarads. R1 can have any value from about 4k7 to 10M. For variable frequency operation, wire a fixed and a variable resistor in series in the R1 position.

The output of the Fig. 11 astable circuit switches (when lightly loaded) almost fully between the zero and positive supply voltage levels, but the junction of R1 and C1 is prevented from swinging below zero or above the positive rail levels by the built-in clamping diodes at the input of IC1a. This characteristic causes the operating frequency of the circuit to be somewhat dependent on supply rail voltages. As a rough rule of thumb, the frequency falls by about 0.08% for each 1% rise in supply voltage. Typically, if the frequency of this astable is normalised with a 10 volt supply, the frequency will fall by 4% at 15 volts, or rise by 8% at 5 volts.

Also, the operating frequency of the Fig. 11 circuit depends somewhat on the transfer voltage value of the individual gate that is used and can be expected to vary by as much as 10% between individual ICs. The output symmetry of the waveform is also dependent on the transfer voltage value of the IC and, in most cases, the circuit will give a non-symmetrical output. In the vast majority of 'hobby' and other non-precision applications, these deficiencies of the basic astable circuit are of little practical consequence.

Some can be minimised by using the 'compensated' astable circuit of Fig. 12, in which resistor R2 is wired in series with the input of IC1a. This resistor can have any value between two and ten times that of R1, and its main purpose is to allow the R1-C1 junction to swing freely below the zero and above the positive supply rail voltages during the switching action and thus reduce the dependence of the circuit operating frequency on the supply voltage. Typically, when R2 is given a value ten times greater than R1, the frequency varies by only about 0.5% when the supply voltage is varied between 5 and 15 volts.

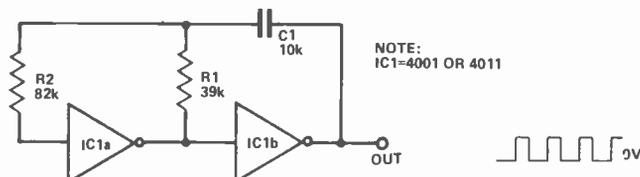


Fig. 12. A compensated astable circuit.

The basic and compensated astable circuits of Figs. 11 and 12 can be built with a good number of detail variations. Some of these are shown in Figs. 13 to 18. In the basic astable circuit, for example, C1 alternately charges and discharges via R1. Figs. 13 to 15 show how the basic circuit can be modified to give alternate C1 charge and discharge paths.

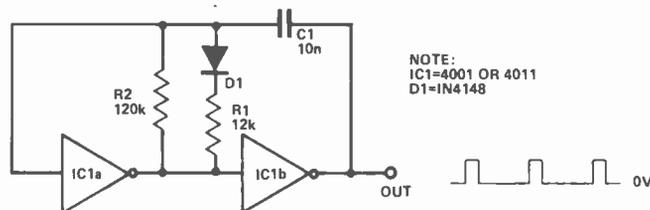


Fig. 13. Modifying the circuit to give C1 alternate charge and discharge paths and produce a non-symmetrical output waveform.

Fig. 13 shows one way of modifying the stable so that it gives a non-symmetrical output waveform. Here, C1 charges in one direction via R1 and R2 in parallel, to give a high output, but discharges in the reverse direction via R2 only, to give a low output.

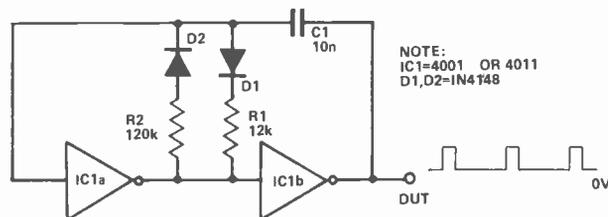


Fig. 14. Controlling the astable's on and off time.

On/Off Control

Fig. 14 shows how the circuit can be further modified by also wiring a diode in series with R2, so that the ON time of the output is controlled only by R1, and the OFF time is controlled only by R2. These two circuits can be made to give variable outputs by replacing either or both of their timing resistors with a fixed and a variable resistor in series.

Variable Symmetry

Fig. 15 shows how the astable can be modified to give a variable symmetry or M/S-ratio output, while maintaining a near-constant frequency. C1 in this circuit charges on one direction via D1-R2 and one half of RV1, and in the other direction via D2-R1 and the other half of RV1. The M/S-ratio can be varied over the range 1:10 to 10:1 via RV1.

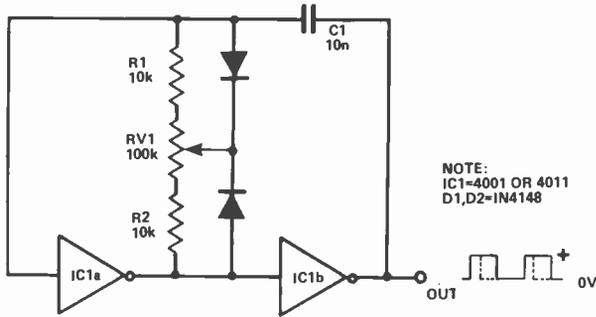


Fig. 15. Controlling the mark/space ratio.

Fig. 16 shows the circuit of a multi-tone push-button activated astable. Normally, when all push-button switches are open, R5 holds the input of IC1a (and thus the output of IC1b) low. Resistors R1 to R4 all have values that are low relative to R5, so the circuit acts as a normal astable when any one of the push-button switches is closed. This circuit can be used in multi-tone musical instruments and gadgets, etc. and has the major advantage that it draws negligible current when in the standby mode. There is no limit to the number of push-button switches that can be used with the circuit.

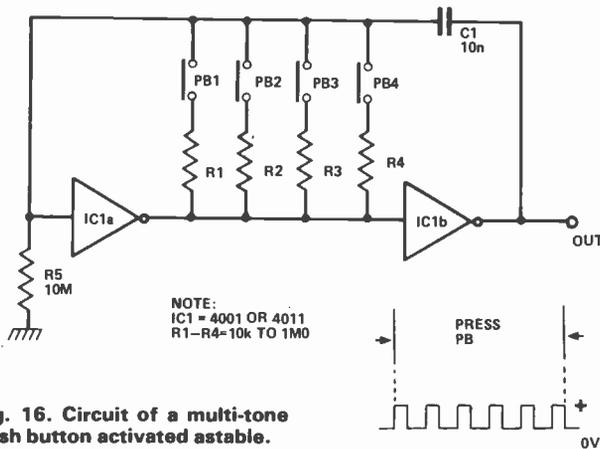


Fig. 16. Circuit of a multi-tone push button activated astable.

NOTE:
IC1 = 4001 OR 4011

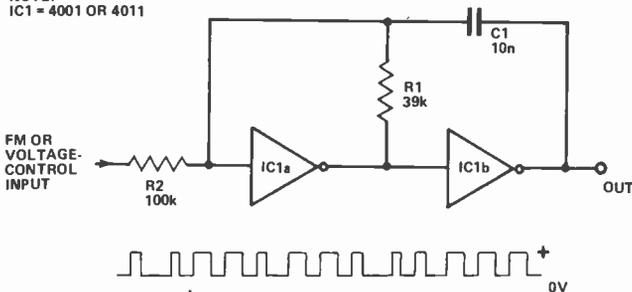


Fig. 17. Frequency modulation of an astable.

Frequency Modulation

Fig. 17 shows how the astable can be subjected to frequency modulation or voltage control of frequency by simply feeding the FM or voltage-control signal to the input of IC1a via a resistance that is much larger than R1 and Fig. 18 shows how the circuit can be further modified to act as a special-effect voltage-controlled oscillator that shuts off when the input voltage falls below a pre-set value.

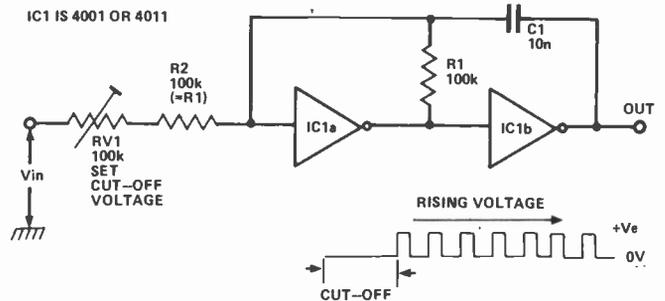


Fig. 18. Using an astable as a voltage-controlled oscillator with an output cut-off.

Gated 2-Gate Astable Circuits

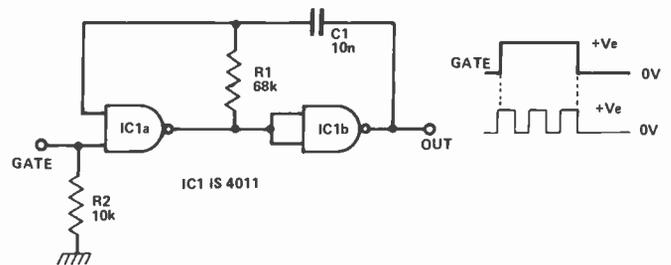


Fig. 19. A NAND astable with a normally-low output, gated by a high input signal.

All of the astable circuits of Figs. 11 to 15 can be modified for gated operation, so that they can be turned on and off via an external signal, by simply using a 2-input NAND or NOR gate in place of the inverter in the IC1a position and applying the input control signal to one of the gate input terminals. The CD4001 and CD4011 ICs can both be used in this type of application, but give quite different types of gate control and output operation. Figs. 19 and 20 show the two basic versions of the gated astable circuit.

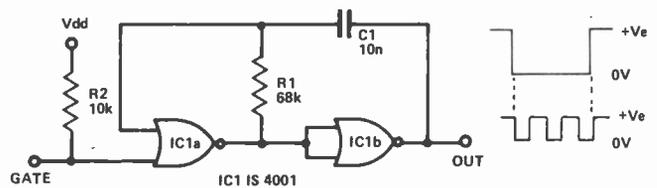


Fig. 20. A NOR astable with a normally-high output, gated by a low input signal.

Note that the Fig. 19 NAND astable circuit has a normally-low output and is gated by a high input signal, while the fig. 20 NOR astable has a normally-high output and is gated by a low input signal. Also note that, although R2 is shown in the diagram as having a value of 10k, R2 can in fact have any value in the range 10k to 10M and can be omitted altogether if the gate signal is applied from a preceding logic state.

Note in the Fig. 19 and 20 circuits that the output signal terminates immediately the input gate signal is removed. Consequently, any noise present at the gate terminals of these circuits also appears at their outputs.

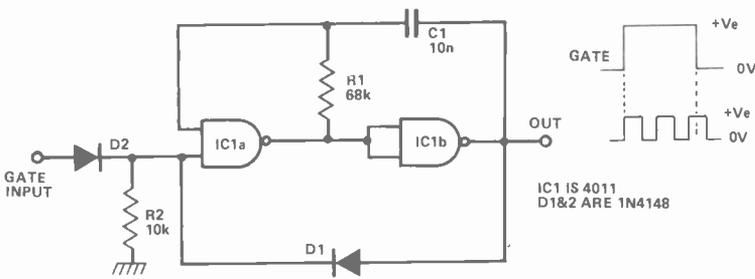
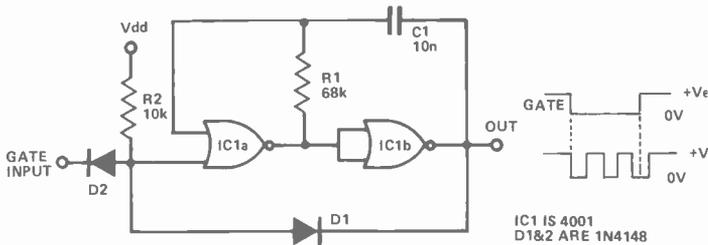


Fig. 21 (above) and Fig. 22 (below) overcome the problem of noise appearing at the gate terminals.



Figs. 21 and 22 show how the circuits can be modified to overcome this defect. Here, the gate signal of IC1a is derived from both the outside world and from the output of IC1b via diode OR gate D1-D2-R2. As soon as the circuit is gated from the outside world via D2 the output of IC1b reinforces the gating via D1 for the duration of one half astable cycle, thus eliminating any effects of a noisy outside world signal. The outputs of the circuits are complete numbers of half cycles. Note that R2 is an essential part of these circuits.

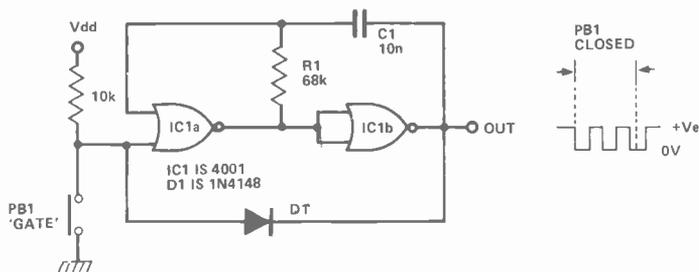
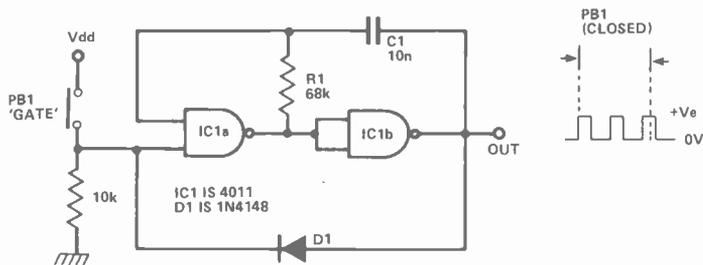


Fig. 23 (top) and Fig. 24 (above) show manually-triggered astables with noise-elimination networks.

Figs. 23 and 24 show manually-triggered versions of the Fig. 21 and 22 circuits. These circuits are of particular value when they are used as low speed clock generators, operating at about 5 Hz: when PB1 is briefly stabbed, they generate a single clean clock pulse: when PB1 is held down, they generate five clean clock pulses per second.

Clock Generator Circuits

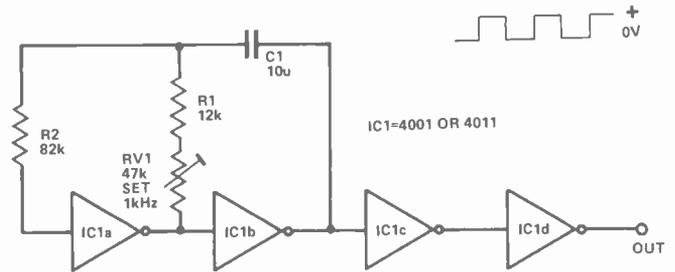


Fig. 25. Speeding up the rise and fall times of the astable output to produce clean clock signals.

The 2-gate astable circuit is generally not suitable for direct use as a clock generator with fast-acting counting and dividing circuits. Such circuits require the use of clean clock signals, with fast rise and/or fall times. The problem is that 2-gate astables designed around 'A' series or non-buffered CMOS produce clock outputs with rather slow rise and fall times, whereas 2-gate astables designed around buffered-output 'B' series CMOS produce outputs with good rise and fall times, but tend to produce 'dirty' clocking if there is the slightest trace of noise on their power supply lines.

Fortunately, these problems can easily be overcome by wiring a couple of inverter-connected gate stages in series with the output of the astable circuit, as shown in the example of Fig. 25. These inverter stages speed up the rise and fall times of the astable output waveform and also produce effective level shifting between the output of the astable and the clock input terminal of any external device, thereby reducing or eliminating the effects of noise on the clock circuit.

The Ring-of-Three Astable Circuit

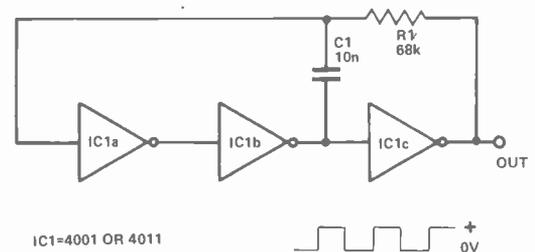


Fig. 26. The 'ring of three' astable circuit produced a very clean output waveform.

An alternative way of making a clock generator is to use the 'ring-of-three' astable circuit of Fig. 26. This circuit is similar to the basic circuit of Fig. 11, except that the positions of R1 and C1 are transposed, and the inverting input stage (IC1a) of the Fig. 11 circuit is effectively replaced by an ultra-high-gain non-inverting stage (comprising IC1a and IC1b in series) in the Fig. 26.

circuit. Because of the very high gain of its composite input stage, the Fig. 26 'ring-of-three' circuit produces a very clean output waveform, with excellent rise and fall times, and is directly suitable for use as a clock generator.

The 'ring-of-three' astable circuit can be subjected to all of the basic design variations shown for the 2-gate astable. For example, C1 alternatively charges and discharges via R1 in the same way as in the Fig. 11 circuit, so the circuit can be subjected to all of the variations shown in Figs. 13 to 15. It can be designed in either basic or 'compensated' versions, etc.

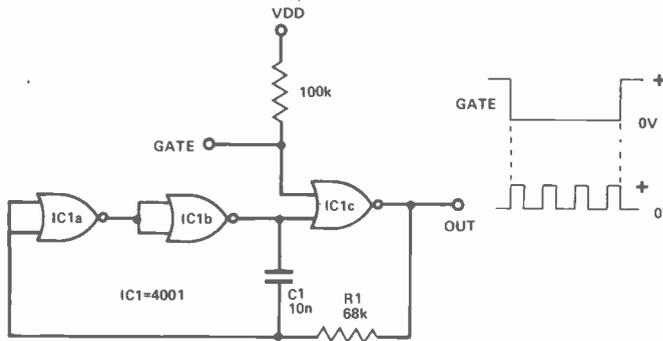


Fig. 27. A gated NOR 'ring of three' circuit with a normally low output, gated by a low input.

The 'ring-of-three' circuit offers interesting possibilities when it is used in the gated mode, because it can be gated on and off via either its IC1b or IC1c stages. Figures 27 to 30 show four variations on this theme.

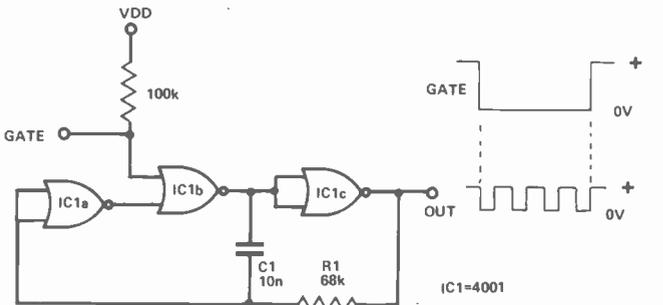


Fig. 28. A gated NOR 'ring of three' circuit with a normally high output, gated by a low input.

Figs. 27 and 28 show alternative versions of the gated NOR-type 'ring-of-three' circuit. Both circuits need a 'low' signal to gate the astable on. Note that the output of the circuit is normally-low if the gate signal is applied to IC1c, or is normally-high if the gate signal is applied to IC1b.

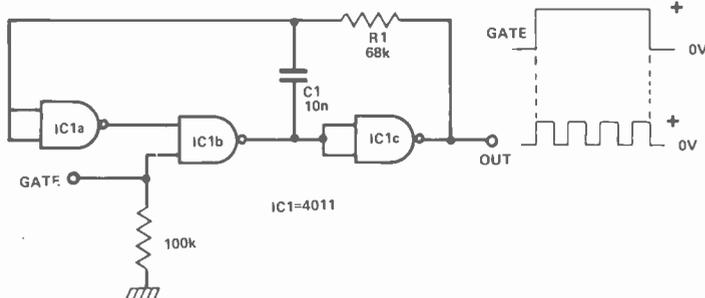


Fig. 29. A gated NAND 'ring of three' circuit with a normally low output, gated by a high input.

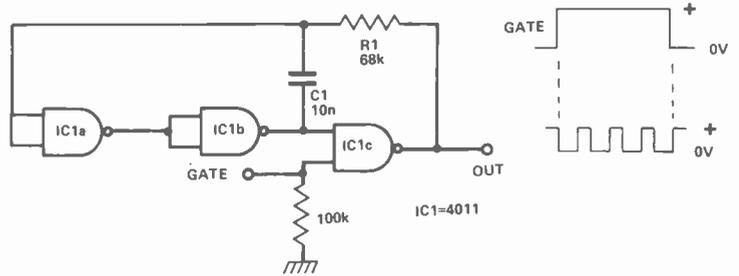


Fig. 30. A gated NAND 'ring of three' circuit with a normally high output, gated by a high input.

Similar variations are found in the NAND version of the gated 'ring-of-three' circuit, as shown in Figs. 29 and 30. These circuit need a 'high' signal to gate them on, and have a normally-low output if the gate signal is fed to IC1b, or a normally-high output if the gate signal is fed to IC1c.

Monostable Multivibrator Circuits

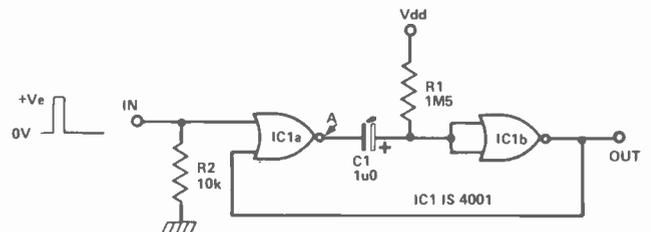


Fig. 31. A 2-gate NOR monostable multivibrator.

The CD4001 and CD4011 can both be used to make an exceptionally useful type of 2-gate monostable multivibrator or pulse generator circuit. The two basic versions of this circuit are shown in Figs. 31 and 32. In these circuits the duration of the output pulse is determined by the values of R1 and C1, and approximate one second per microfarad of C1 value when R1 has a value of 1M5. In practice, C1 can have any value from roughly 100 p to a few thousand u, and R1 can have any value from about 4k7 to 10M.

One outstanding feature of these circuits is that the input trigger pulse or signal can be direct coupled and has no appreciable effect on the length of the circuit's output pulse: the trigger pulse can be shorter or longer than the output pulse. The NOR version of the circuit has a normally-low output, and is triggered by a positive-going input pulse, while the NAND version of the circuit has a normally-high output and is triggered by a negative-going input pulse.

A signal feature of these circuits is that the pulse signal appearing at point 'A' has a length that is equal to that of either the output pulse or the input trigger pulse, depending on which is the greater of the two. This feature is of value when making pulse-length comparators and over-speed alarms, etc.

The Fig. 31 and 32 circuits have only two significant defects. One of these is that the pulse length depends somewhat on the transfer voltage value of the individual IC that is used in the circuit. The other is that the pulse length also depends somewhat on the supply voltage value that is used with the circuit, just as the operating frequency of the basic 2-gate CMOS astable varies slightly with the supply voltage value. These defects are of little consequence in most practical applications, however.

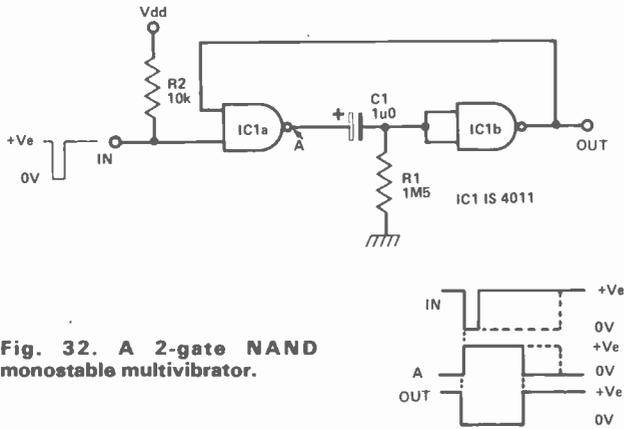


Fig. 32. A 2-gate NAND monostable multivibrator.

If a number of the Fig. 31 and 32 circuits are to be interconnected to give cascaded delays (as in a delayed-pulse generator, for example), an inverter stage must be interposed between the outputs and inputs of successive monostables, to give correct-polarity trigger signals. Figure 33 shows the basic system.

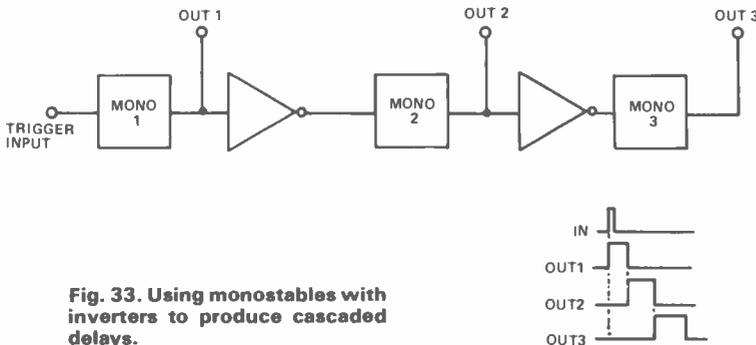


Fig. 33. Using monostables with inverters to produce cascaded delays.

Alarm Call Sound Generator Circuits

A single CD4001 or CD4011 IC and one or more transistors can readily be used to make a variety of types of very useful alarm call sound generator circuits. Figs. 34 to 41 show some practical circuits of this type. In all cases, the circuits can be powered from any supply in the range 5V to 15V and can be used with any speaker in the range 3R to 100R. Output powers range from tens to hundreds of milliwatts, depending on speaker impedances and supply rail voltages used, but can readily be boosted to tens of watts by using additional transistor power-boosting stages.

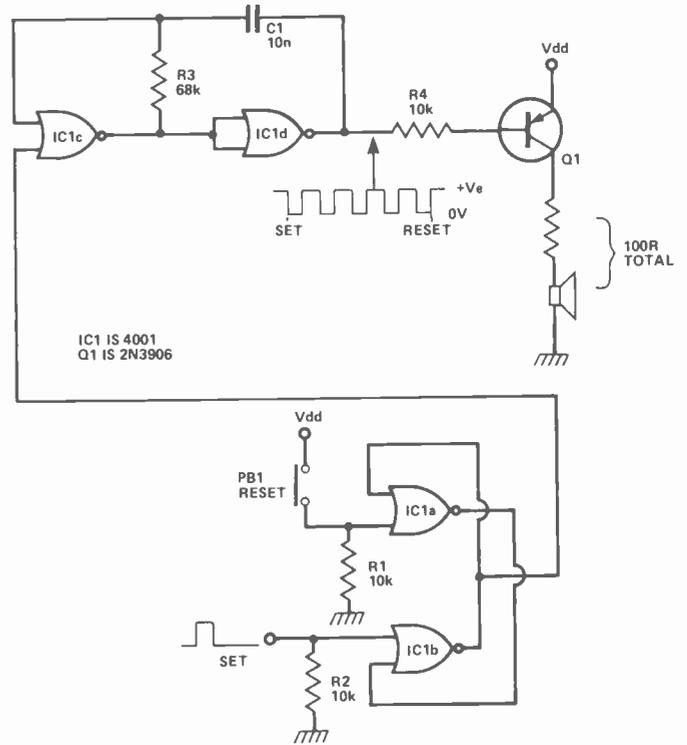


Fig. 34. Circuit of a NOR latching monotone alarm call generator.

Figs. 34 and 35 show two versions of a latching monotone alarm call generator. IC1a and IC1b are wired as a bistable self-latches and switches on the IC1c-IC1d-1kHz astable tone generator. The circuit can be reset to the OFF state by momentarily closing PB1.

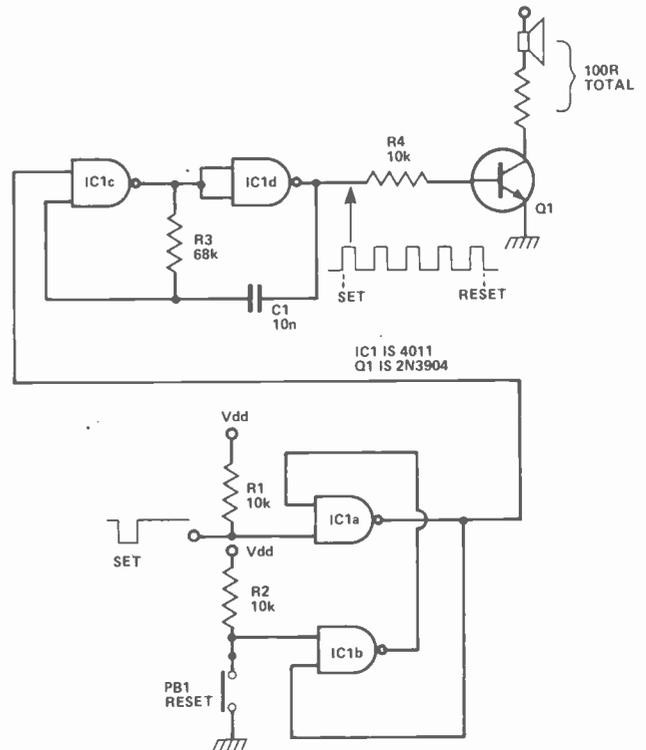


Fig. 35. Circuit of a NAND latching monotone alarm call generator.

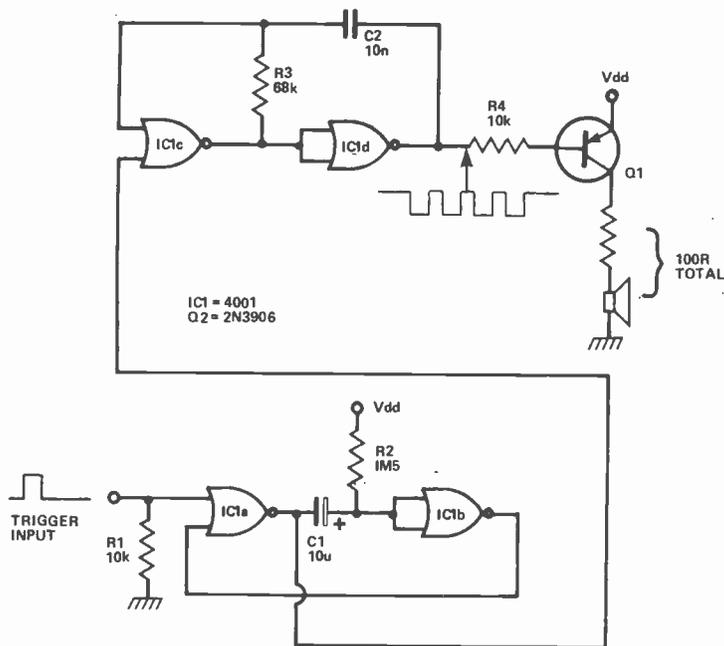


Fig. 36. A NOR alarm call generator with auto turn-off.

Figs. 36 and 37 show versions of an auto-turn-off monotone alarm call generator. IC1a and IC1b are wired as a monostable multivibrator, which turns on the IC1c-IC1d astable for about 10 seconds each time that it is triggered.

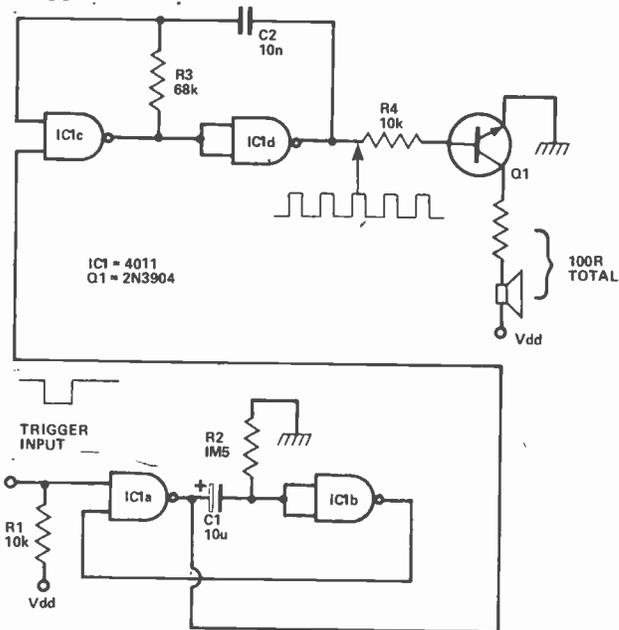


Fig. 37. A NAND alarm call generator with auto turn-off.

The Fig. 38 and 39 circuits generate a pulsed-tone signal, in which a 1 kHz astable (IC1c and IC1d) is gated on and off by a 6 Hz astable (IC1a and IC1b) when a suitable control signal is applied to the input terminal of IC1a.

Finally, Fig. 40 shows a warble-tone generator, which switches through a 2-tone cycle once per second when a suitable control signal is applied to the inputs of IC1a and IC1c, and which generates a sound similar to a British police car siren. The depth of frequency variation of the circuit is determined by R3, which can have any value in the approximate range 120k to 1MΩ. **ETI**

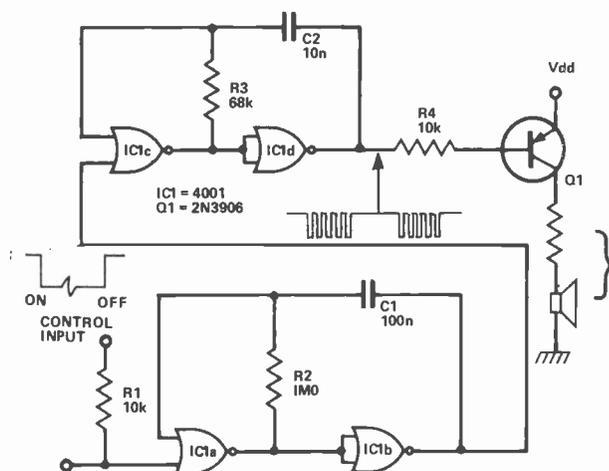


Fig. 38. Generating a pulsed-tone signal with 6Hz and 1kHz NOR astables.

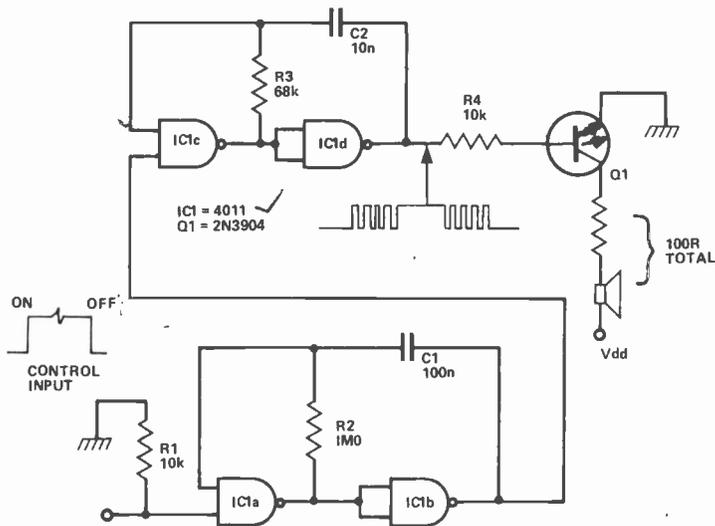


Fig. 39. Generating a pulsed-tone signal with 6Hz and 1kHz NAND astables.

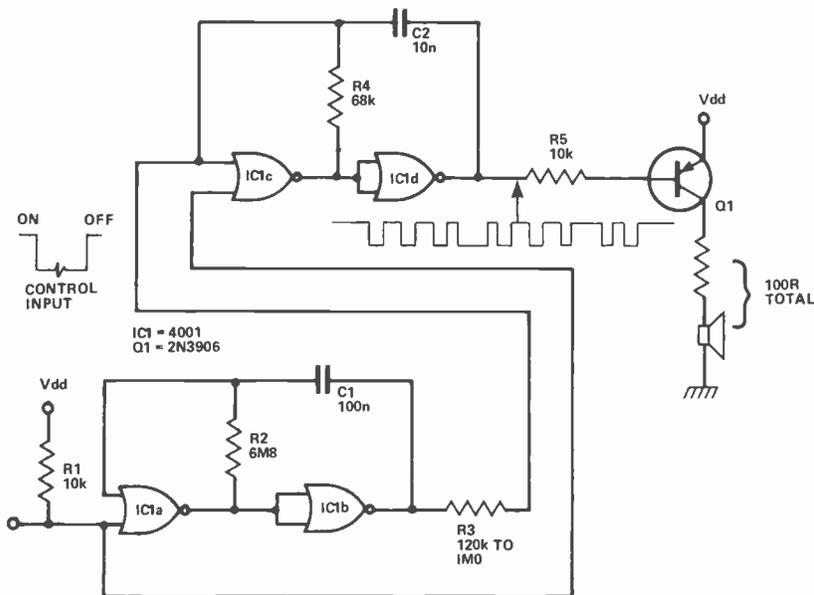


Fig. 40. A warble-tone generator — sounds like a police car siren.

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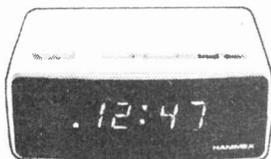
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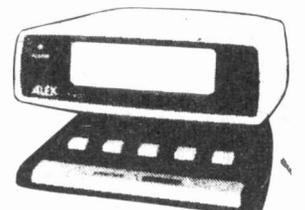
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audiophile...

Hi-fi 79 at the Cunard Hotel attracted Ron Harris this month, as did a new record cleaner. Also a good chance to show how witty you are and win a free subscription.

A TALE OF MANY speakers is what the 1979 Spring hi-fi show turned into. Wandering the halls of the Cunard in search of the sonic grail you get buffeted from side to side by the alternate blasts of sound emanating from the demo rooms. After about two hours of solid listening I start to get ear fatigue and things don't seem the same somehow.

In consequence things get done in bursts of two hours at a time punctuated with clinking of refreshments. On the first pass this year it became apparent that it was to be the Year of the Cone.

MA24U

Monitor Audio first. The MA2 is a 'domestic reference' design and stands some 850mm high. (About 33in in English height). It will handle around 100W of programme power, and produces a very nice sound indeed. At about £300 the pair they are going to give the competition a tough time.

Wharfedale have extended their 'E' series upwards into an E90 design which is twice the size of the E70 nearly and more than twice as imposing. We've got no photographs of the beast simply because Wharfedale hadn't got any and haven't kept their promise to send us any since! So there. Its still a nice speaker anyway.

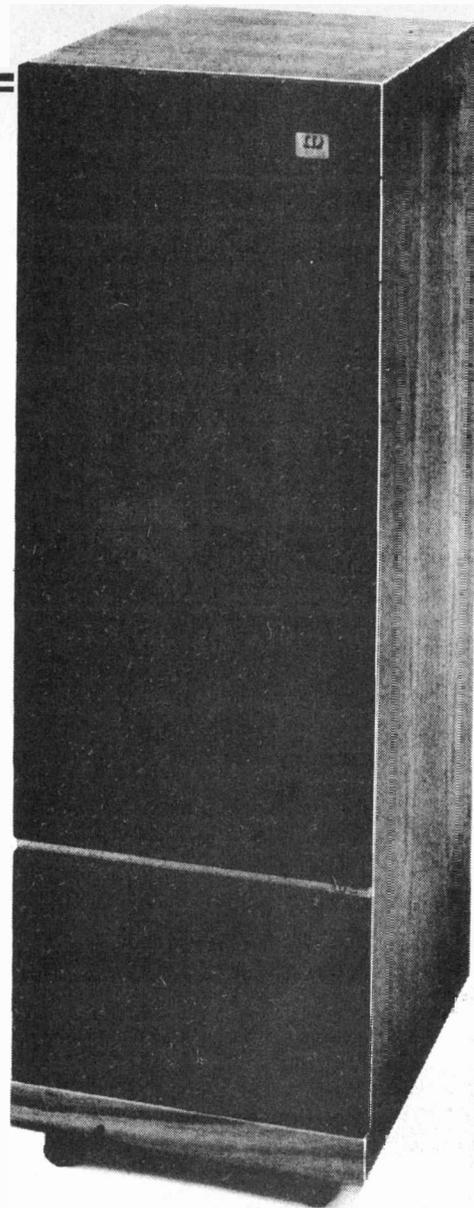
KEFs contribution to the herd was a small one. Tiny in fact. I'd go so far as to say it was so small I almost missed it. The Reference 101 is a bookshelf speaker that just might fit into a bookshelf. This was the real surprise of the show, however, as upon first encounter the almost universal reaction was to hunt the 105s that were not hiding behind the curtains.

The sound was open and spacious with good imaging and a convincing bass response. Very nice one Kef.

Celestions Follies

The Celestion stand was dominated by two huge double boxes which, when energised, did a quick 'room empty' job. The efficiency is somewhat high you see, and the amplifier somewhat powerful.

I think they're designed for PA and studio usage but they are finished in wood veneer and more than likely quite a few dozen will end up in living rooms. Big living rooms I hope. At their price and size they come up against things like the JBLs and for sound quality I personally prefer the P1s (that's what they're called by the way). Well worth the listen if you're in that market.



Above: the Monitor Audio MA2 loudspeaker. A highly recommended domestic design.

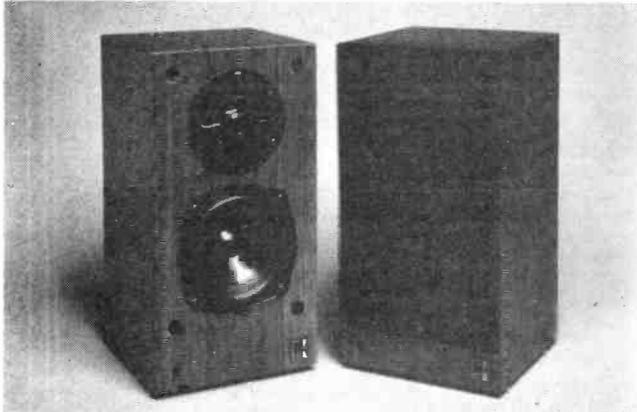
Below: the Celestion P1. It sounds as imposing as it looks.





Left: JVC's KDA8 computerised cassette deck. It fixes up its own own bias and equalisation levels, and can cope with metal tape.

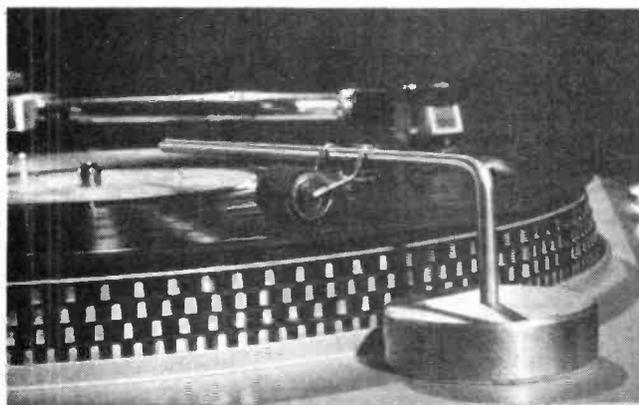
Below: KEF's 101 reference model. If your living room (or preference) favours small enclosures then don't miss 'em out.



Below: Celestions new Dittons. In the centre is the new 662, which is their new version of our reference-the faithful ole 66. It remains to be compared whether it is *that* much better!



Below: No this wasn't at the show but it's worth the look anyway. A new record cleaner called a TANTRACK. Two arms are provided to cope with any turntable height, and the finish is a very posh steel and chrome. Available from Dorking Systems Ltd, 23 South Street, Dorking, Surrey. Price £6.25 plus VAT.



Right: Goldring headphones! Suprex classic CL1s, a good smooth sound at a decent price. No, I'm not gonna tell you how much, find out yourselves!

Head Man

New for heads from Goldring is the Suprex headphone range. Amongst the four models they decided to import the Classic C1 — the middle of the group caught my attention most. They possess a nice smoothness to them that could be lived with. And they're comfortable. Koss take note please. Speaking as someone stuck with the habitual earache engendered by ESP10s the Suprex could be very attractive if for no other reason than that.

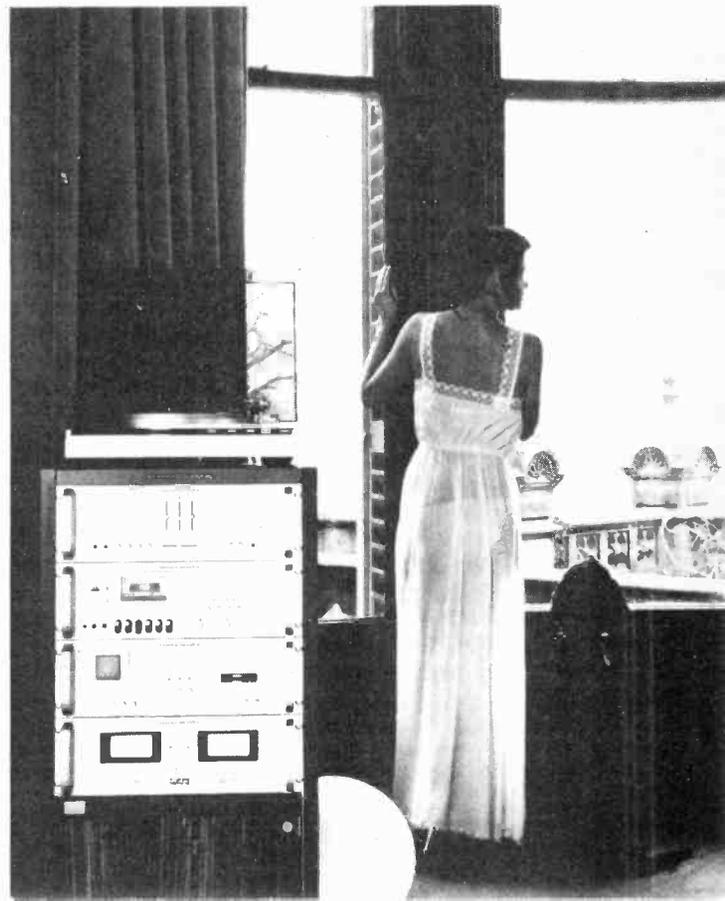
On Your Metal

Scotch and JVC between them made an exhibition of the new metal tape formulations and the JVC KDA8 machine to use them. The KDA8 is quite a story in itself really. It sets up for each type offered to it by recording a test tone and optimising bias, sensitivity and equalisation automatically — it even rewinds to the beginning again and all in 25secs. The demonstration was most impressive — as they usually are — and we hope to do more with the machine in the near future.

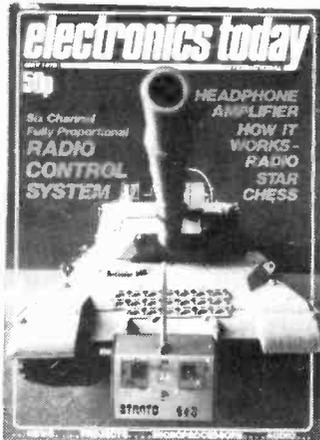
Before anyone asks I could find no possible reason to include the beautiful Felicity Kendal in this month's Audiophile. She was not at the exhibition nor has she anything to do with any of the products featured here. That being the case I have no reason to mention the lovely lady and therefore I shall refrain.

ETI

This here picture advertises Marantz. But we couldn't find the Marantz stand!! Now with a picture like this, there just HAS to be a brilliant, witty, superb caption. But we can't find THAT either, so its open to you lot. The best wins a years subscription. Closing date June 30th. Mark envelopes 'Audiophile Caption.'



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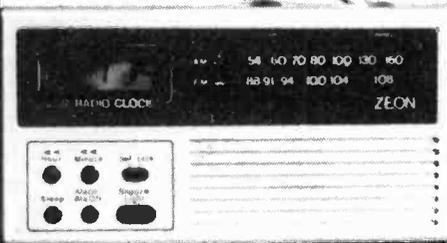
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Find out why ETI is No. 1 for yourself. Could it be something to do that it's better than the competition?

ETI MA

CLOCK RADIO



You probably won't believe us as we're selling the goods but we're going to tell you anyway! We have *rejected* eight clock radios for Marketplace, they were all cheap enough but the quality was so poor that we couldn't have lent our name to them. However, we are now able to offer a portable LCD Clock Radio to you which meets our standards.

The clock is a 12-hour one with AM/PM indicated and a back light. The radio is Medium Wave and FM with very nice quality for a small speaker — for FM there's a telescopic aerial. The alarm can be either a 'beep-beep' type or the radio, there's also a snooze facility.

The case is sensibly rugged and is printed on the back with a World Time Zones map, a bit of a cheek really, especially as the time is relative to Japan!

We won't even mention the RRP — but just check on comparable prices — you'll find ours a bargain.

An example of this Clock Radio can be seen and examined at our Oxford Street offices.

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We feel we've got to tell you carefully about this offer which we're introducing for the first time. Why? Because our price is so enormously lower than anywhere else you may suspect the quality.

The exact same watch is currently being offered by another magazine as a special at £24.95 — some of the discounters are selling it at £29.95, the price to ETI readers for exactly the same watch is £12.95.

The display is LCD and shows the seconds as well as the hours — and minutes — press a button and you'll get the date and the day of the week.

Press another button for a couple of seconds and you have a highly accurate stopwatch with hundredths of a second displayed and giving the time up to an hour. There is a lap time facility as well — and of course a back light.

Our Chrono comes complete with a high grade adjustable metal strap and is fully guaranteed.

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60FE06	6+6	4A each	3.98	85p	80FE24	24+24	1.75A each	4.72	1.00
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20FE12	12+12	0.8A each	2.74	70p	30FE30	24+30	1A	3.55	70p
50FE12	12+12	2A each	3.25	70p	60FE36	24+30	2A	4.78	85p
60FE12	12+12	2.5A each	3.98	85p	80FE36	24+30	3A	5.95	1.00
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15µ	20 14p 11½p
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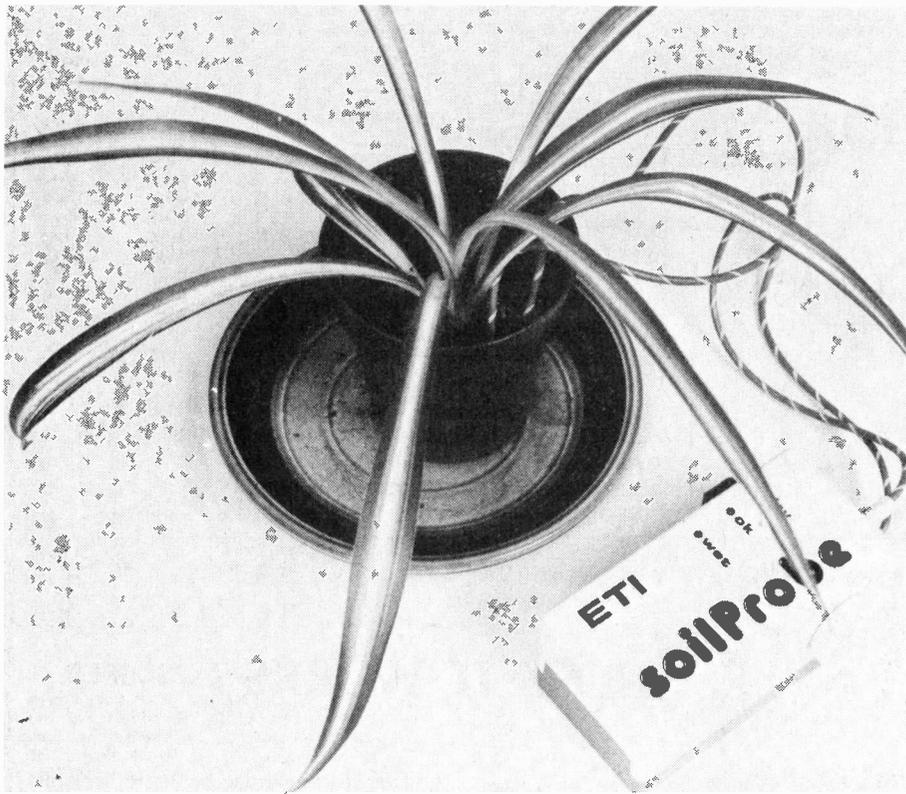
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A Better Buzz

A small 9 volt battery powers the circuit which is built around a few cheap CMOS chips and a low power quad op-amp. To avoid undesirable electrolytic effects at the probes, the resistance bridge is AC

energised. We don't know if the plants like this but we have had no complaints. The probes may be made of any conducting material or just tinned copper

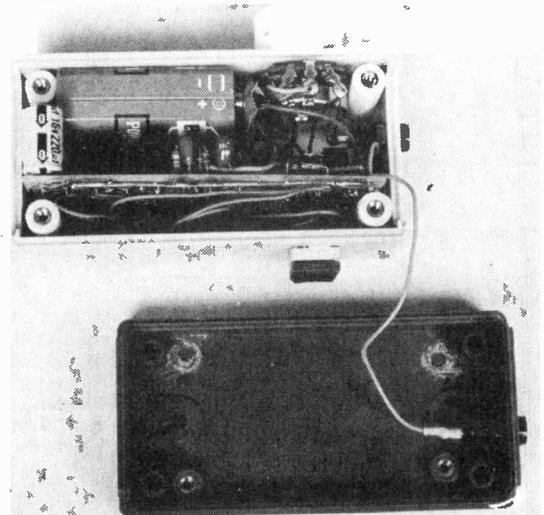
What it is that is on the inside. ETI's Soilprobe exposed. Note that there is not much room in here — not even enough to swing dahlia. So be ye careful of placing and wiring up. A PP3 is the only power source that will fit the box specified so if you want more amps (not needed) be it in your own case.

wires placed in the soil a few inches apart and a couple of inches deep. The circuit will tolerate wire leads up to a few feet in length and no special screening is required. A three level comparator whose pass range is internally preset indicates whether the soil is too wet, dry or OK and the required resistance is set by adjustment of a case-mounted potentiometer.

Construction and Use

If you want to use the case shown in the accompanying photographs, be prepared for some precision work as some of the internal pillars need to be removed and the components and PCB are a very snug fit.

Construction is straightforward provided care is taken and attention paid to the polarity and orientation of the diodes and capacitors. Wire links should be inserted first, note that some of these are mounted under the integrated circuit sockets, followed by the sockets themselves, resistors, capacitors, transistor and diodes. The ICs should be inserted last after the off-board components have been



connected. Also ensure that the flying leads have all been soldered into place and that the LEDs are connected correctly. A short lead, indent or flat on the plastic encapsulation usually indicates the cathode. We used miniature LEDs, two red and one green. However, any desired colour may be used. The prototype also featured a miniature 'keypad' type pushbutton for SW1 though this is only critical if the specified verobox is used. 2mm sockets were used to connect the probe leads and the power source was a PP3.

In use, the unit is turned on; the probes plugged in, and RV2 adjusted until the OK LED lights. This setting may be noted and recorded on a calibrated scale. As the probes are simple and cheap to make they may be left permanently buried in the soil and a set made for each plant, facilitating the repeatability of measurements.

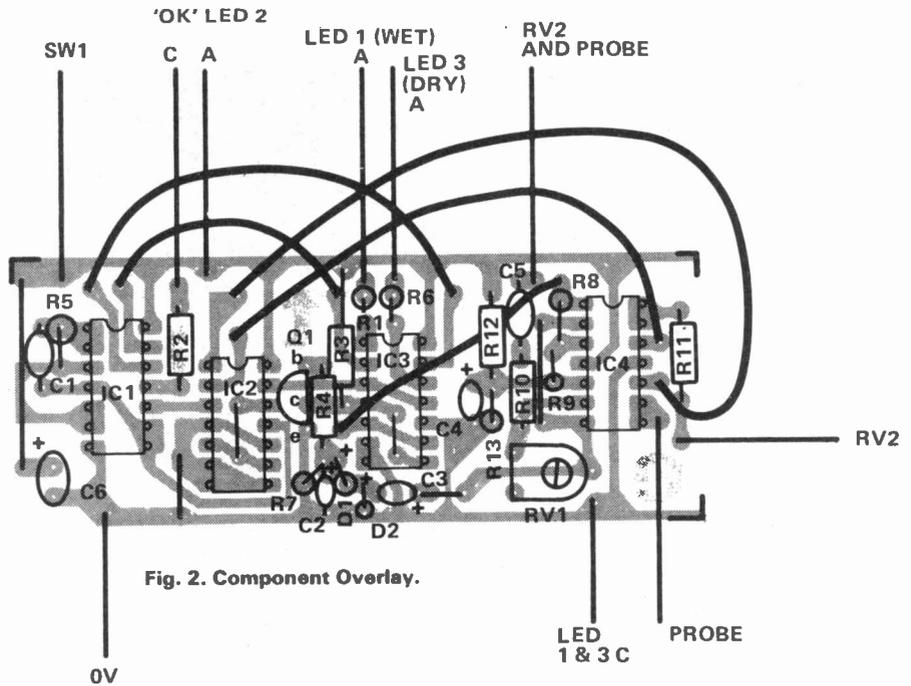


Fig. 2. Component Overlay.

BUYLINES

All components should be readily available. If you use the PCB they should be as small as possible.

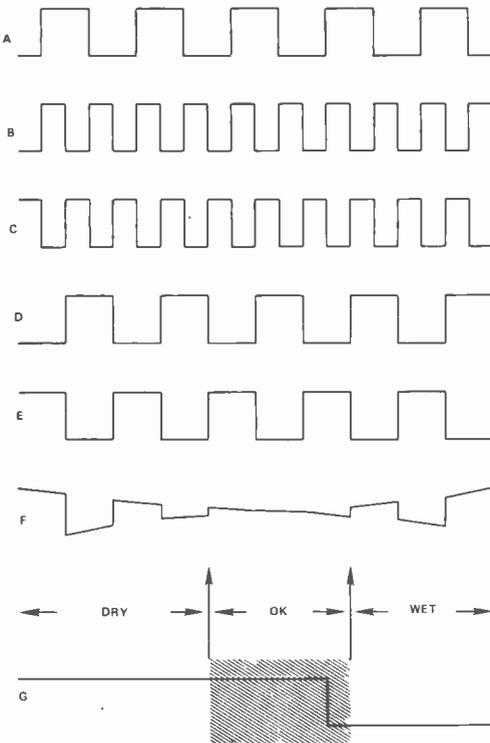


Fig. 1. Waveforms associated with the ETI Soil Moisture indicator, resulting in an LED display of whether the soil is wet, OK or dry.

HOW IT WORKS

The circuit consists of an AC energised bridge whose two active arms are formed by R11 plus RV2 and the soil resistance between the probes. Its operation may be best understood by reference to the circuit diagram and Fig. 1. IC1a and IC1b are configured as an astable oscillator whose squarewave output (Fig. 1b) clocks IC2a. This signal, inverted by IC1c (Fig. 1c), clocks IC2b.

The antiphase Q and \bar{Q} outputs of IC2b are buffered by IC4a and IC4b whose outputs (Fig. 1d and 1e) drive the resistance bridge formed by R11 plus RV2 and the soil resistance between the probes. R11 protects the amplifier outputs against inadvertent short circuits.

The output of IC2a (Fig. 1a) is a squarewave of the same frequency, phase shifted by 90 degrees. This means that the edges of the waveform are coincident with the centre of the squarewave from IC2b (Fig. 1d and 1e) and facilitates phase detection by IC3a and IC3b. When the soil resistance measured between the probes is equal to the resistance of R11 plus RV2, the signals from IC4a and IC4b will cancel out. However, when an imbalance occurs, there will be an error signal whose phase will depend on whether the soil has a greater or lesser resistance than the other arm of the

bridge. The amplitude of the error signal will also diminish as the bridge approaches balance (Fig. 1f).

This signal is coupled via C5, R10 to amplifier IC4c and squared up to provide CMOS input levels by schmitt trigger IC4d, where it is input to IC3a and IC3b and clocked in by the signal from IC2a. The outputs of IC3a and IC3b will follow the phase of the input; reflecting the state of imbalance of the bridge, and either LED 1 or LED 3 will be lit (Fig. 1g).

The amplified signal from IC4c is also fed via C3, D1 and D2 to C2 which will acquire a charge proportional to the level of the input. This drives Q1 which controls the direct, clear, and set inputs of IC3a and IC3b respectively. When the input signal is insufficient to turn on Q1, these inputs are driven to their active high state by R3.

This causes both LED 1 and LED 3 to extinguish and the condition (shown shaded in Fig. 1g) is detected by nand gate IC1d whose output goes low causing LED 2 to light. The sensitivity of the circuit to this condition is preset by adjustment of RV1 which controls the gain of IC4c. The required soil resistance is set by RV2. The circuit is powered from a 9V battery decoupled by C6. A mid voltage point is provided by R12 and R13 decoupled by C4.

PARTS LIST

RESISTORS

R1, 2, 6	820R
R3, 4, 10	100k
R5	10M
R7, 12, 13	10k
R8	1M
R9	100R
R11	68R

POTENTIOMETERS

RV1	470k preset
RV2	250k lin

CAPACITORS

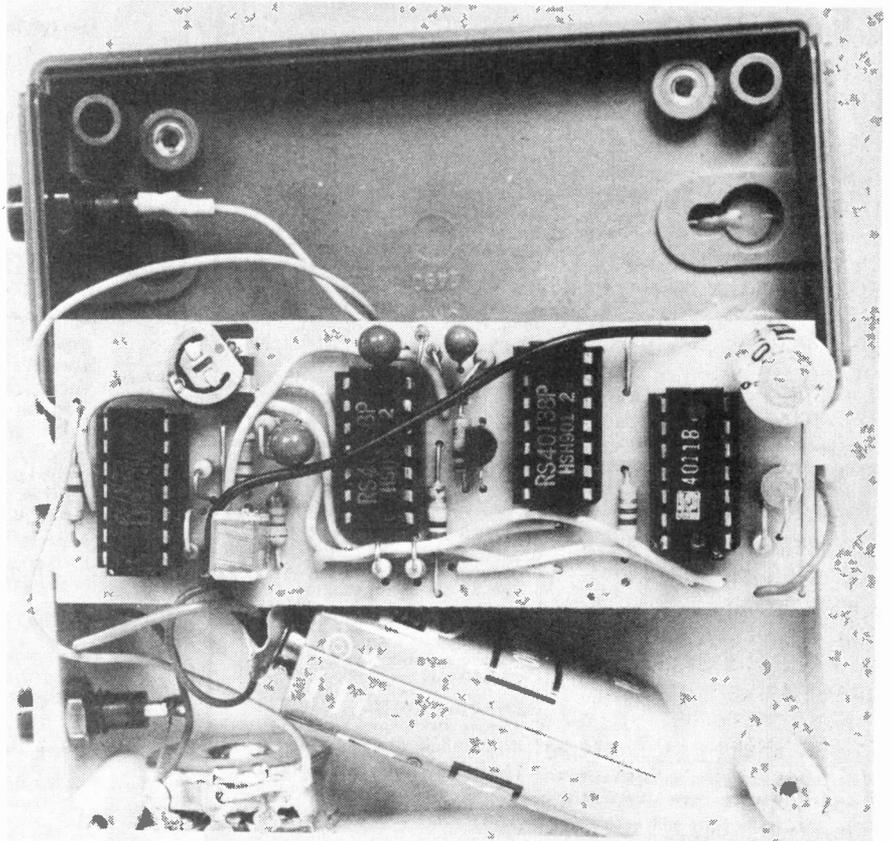
C1	1n
C2	4u7
C3	10u
C4	22u
C5	220u

SEMICONDUCTORS

IC1	4011B
IC2, 3	4013B
IC4	LM324
Q1	BC108
D1, 2	1N4148
LED 1, 2, 3	0.125"

MISCELLANEOUS

PCB	
SW1	SPST
VERO BOX	
65-2516G	



An internal view of the Soil Moisture Indicator, showing the position of the four ICs.

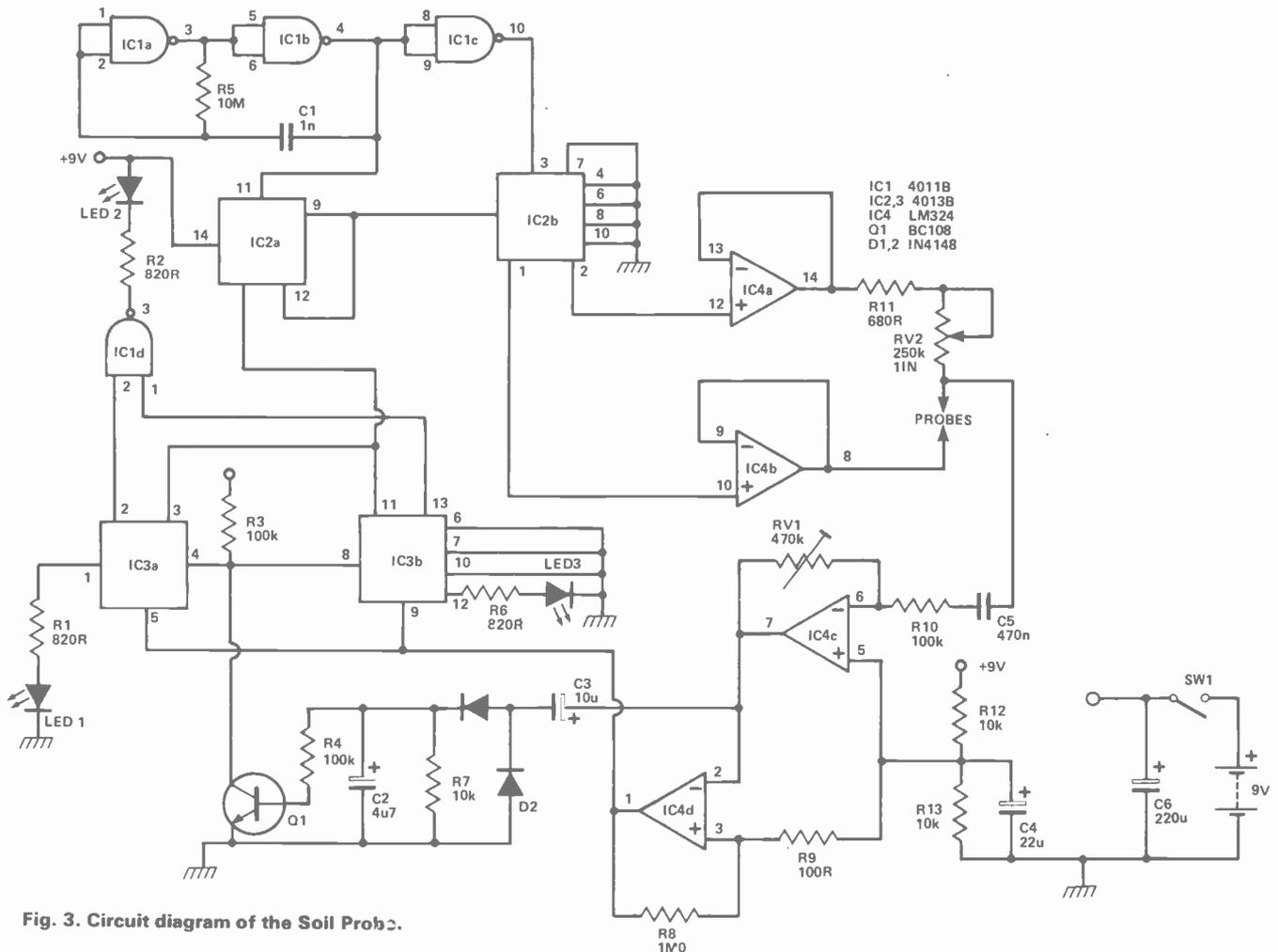


Fig. 3. Circuit diagram of the Soil Probe.

electronics today

international

What to look for In the August Issue: On sale July 6th

STRING THING

To call this project an electronic piano would be an injustice. To call it a string ensemble likewise fails to explain all the mysteries and beauties awaiting the builder once this beast is activated. Yes it can be a piano. Yes it can play string sounds.

The designer (Tim Orr who also can be blamed or praised for the Transcendent 2000) wanted to call it a "Digital Multi-

Voice String Synthesising Keyboard Instrument". But we wouldn't let him. We couldn't think of a better title ourselves, but we still wouldn't let him. It's the way we are.

Being fitted with a CCD choraliser allows our String Thing to sound like several of 'em at once. Why not tune in and be amazed next month?



BENCH AMPLIFIER

One for the workshop or table top. How many times have you been half-way through a project and needed to test something, somehow, somewhen. And that of course is exactly when it occurs to you that there is nothing around suitable.

A bench amp is worth its weight in soldering ten times over, and if you DON'T build this you will regret it.

MICROSENSE

MPUs are definitely for you. Oh yes they are, don't give me that old line about them being all covered in mystery and incomprehension. MPUs are nice friendly little chips, and next month we've got the definitive article to prove it. Based on a book by John Miller Kirkpatrick it takes you through the subject from scratch in a thorough but light-hearted manner.

LED AUDIO DISPLAY

A really lovely little design to amaze, astound and hypnotise the entire universe. This project takes the input from your hi-fi or TV or budgie and turns it into a dazzling and bemusing shifting pattern of light upon a LED matrix.

Build it any size you like it'll add a bit of visual spice to the hi-fi rack — or simply keep mother-in-law quiet while you nip off down the local.

LIFE OUT THERE ?

Is there anybody there? Does anyone care? Yes to both. Read on . . .

ABOUT 20 YEARS AGO scientists, realised that their equipment might be able to detect suitably powerful radio emissions from intelligent beings on planets in other solar systems which may be many light years away from us. Attempts to detect Extra-Terrestrial Intelligence (appropriately abbreviated to ETI!) have already been made in the USA, Canada and the USSR without success, but much more work with larger aerials is required to provide workers in this field with a reasonable chance of success.

Apart from the Search for Extra-Terrestrial Intelligence (SETI), drawings and radio signals have been sent into space outside the solar system in the hope that they will eventually be detected and understood by intelligent beings many light years distant. Unfortunately the chances of two way communications with such beings are very remote, since the nearest star is a few light years away and most planetary systems are at much greater distances. Thus anyone sending a message from the earth to anywhere but one of the very nearest of the stars would be dead by the time any reply could be returned to the earth.

Attempts have also been made to detect signs of life within the solar system. In particular, the Viking spacecraft which landed on Mars conducted prolonged tests

to try to detect life or the chemicals associated with life. Although no organic molecules that could be the past or present constituents of living things were found and the results were generally rather discouraging, they were certainly not conclusively negative as regards the possibility of life on Mars.

Communication Techniques

It seems likely that there are three possible ways in which we may be able to communicate with intelligent beings from outside the solar system. The first way involves a direct meeting of space vehicles or a landing by them on the earth. Unless the other beings have a longevity which far exceeds that of man, the journey time would make this method quite impossible. Many people do not fully appreciate how much vaster are the distances involved in interstellar space than those within the solar system. Light takes about 8 minutes to reach us from the sun, but about 180 000 years to cross our galaxy and some thousands of millions of years to reach us from the farthest known objects.

As we require something which will convey information quickly, the obvious thing to use is electro-magnetic

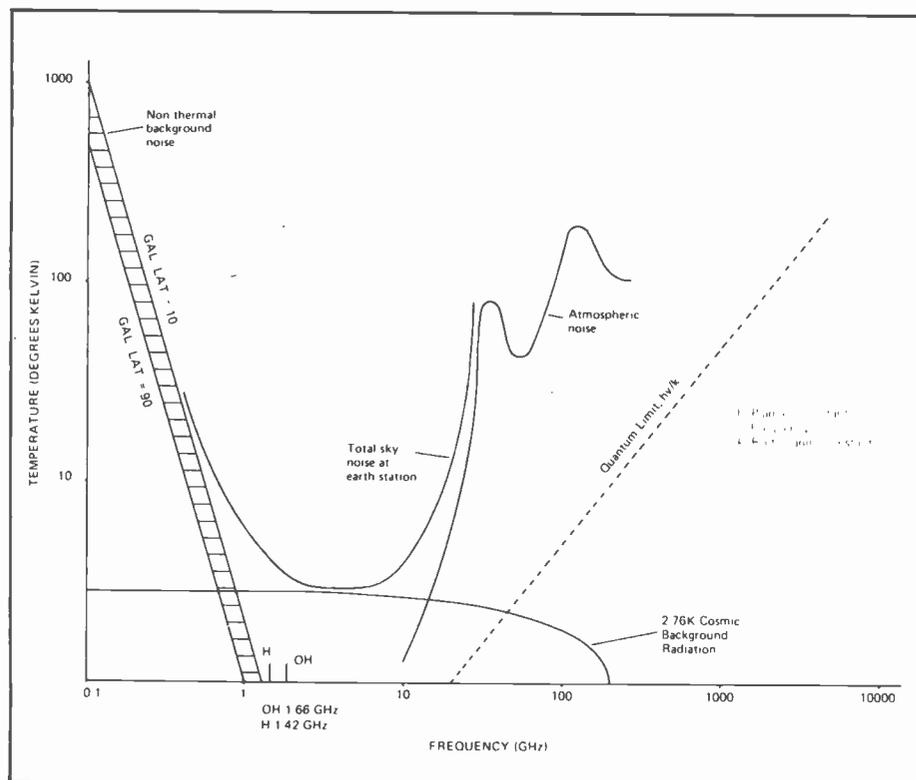


Fig. 1. Some of the most important factors which determine the choice of listening frequency. As signals from other stars would be very weak, it is important to choose a frequency where the natural background noise is relatively small. Most SETI work has been done in the relatively low total noise region of 0.5 to 10 GHz, christened the 'Water Hole', since it contains frequencies strongly associated with water. The favourite frequency is 1.42 GHz, emitted when the electron in a hydrogen atom flips over, reversing its direction of spin.

The noise contributions shown are — the 2.76 K cosmic background radiation (remnants of the big bang), atmospheric noise (as water and oxygen absorb and reradiate energy), quantum noise associated with the arrival of each photon in the atmosphere and synchrotron radiation emitted by particles spiralling round galactic magnetic fields (the level varies with galactic latitude. The extreme lines shown are for galactic latitudes of 10° and 90°).

signals which travel at the speed of light. We can only send signals by this technique and not material objects, but generally it is far more sensible to send information on how to construct an object rather than to send the object itself over such vast distances. Should one use light, infra-red, radio waves or some other form of electromagnetic radiation? Radio-waves are to be preferred, since the energy required per transmitted photon is relatively low.

The third possible communicating technique involves the acceleration of sub-atomic particles to velocities very near to the speed of light, but as far as is known this technique has not yet been tried. If particles which can travel faster than light (known as 'tachyons') are ever discovered, one can only wonder whether they could be used in an extra-terrestrial communications system if they can be produced relatively easily; however, at the moment such a suggestion is nothing more than pure speculation.

It has been suggested that we should avoid transmitting any signals into space which would inform possibly hostile intelligent beings of our location. It is generally felt, however, that we can take comfort from the fact that any intelligent beings would be more interested in sharing information with us and co-operating with us as far as possible rather than in attacking us as in science fiction stories. In any event, it seems likely that it would take them so long to arrive here that our civilization would be in a very different state by the time they could reach us.

Basic Problems

Let us first consider the basic problems associated with receiving radio signals from outside the solar system, since any of our attempts to send messages are not likely to bring any result for an enormously long time. Any radio signals reaching the earth from outside the solar system are likely to be extremely weak owing to huge distances involved and it therefore follows that SETI projects require the use of the largest radio telescopes in the world.

One is left with decisions to make on the direction in which one should point the telescope, the frequency or frequencies which one should attempt to receive, the bandwidth one should use and perhaps even the time at which one should attempt to receive any transmissions. In the work on SETI which has been performed up to the present time, the telescopes have usually been pointed towards some star in our galaxy which is not excessively distant and which astronomers feel may possibly have a satellite system on which life could have evolved in some form or other.

In general astronomers have concentrated their searches in the regions of stars of the same or similar spectral classes as the sun. It has been felt that if a star has a luminosity much greater than that of the sun, then the lifetime of any planetary system associated with that star is probably too short to have enabled life to have developed to the point where intelligent civilizations have evolved. Stars of luminosity much smaller than that of the sun seem to have rather violent coronal activity which would probably result in any associated planetary system being rather inhospitable to most imaginable forms of life. Other stars have departed from the main sequence as a result of a super-nova or nova explosion and SETI workers have tended to disregard these

because it seems doubtful whether any living species could survive the catastrophe event of such an explosion in the star.

Signal Types

What types of signal should we expect to receive from other planetary systems and how could we recognise such signals as originating from intelligent life? The SETI workers are basically searching for coherent signals, possibly modulated. For example, our own radio transmissions have a coherent carrier wave, although the modulation present inevitably involves a finite bandwidth. The presence of this type of signal would almost certainly indicate it is not of natural origin and hence would imply the existence of intelligent life elsewhere in the universe.

There are three basic types of signal from other planetary systems which we may be able to detect. The first type of signal is leakage of a signal into space in just the same way that our own radio and television signals leak away to a greater or lesser extent through our ionosphere. Indeed, a spherical wave of radio signals of a fairly wide range of frequencies has been travelling away from the earth over a period of rather over 50 years. In the case of more highly developed societies, it seems probable that they have been transmitting such signals for a far longer period (although one hopes they have not been stupid enough to destroy themselves by nuclear war).

A second type of signal we may possibly be able to receive is some form of inter-stellar or even inter-galactic communications between highly developed communities. Such reception would be by chance and it must be assumed that highly developed communities would employ very high gain antennae which are unlikely to be pointing towards our solar system. Thus the chances of intercepting such messages cannot be regarded as being very high.

The third type of signal we may hope to receive is an intentional one directed at our solar system by a society in a distant stellar system in order to notify us of their presence. It is also possible that such a society may send signals out isotropically (that is, all directions at equal intensities), but unless they have transmitters of extremely high power, such signals would be so weak at the earth that it is doubtful if we could detect them.

It is difficult to make an estimate of the optimum bandwidth one should select for SETI work. Narrow bandwidth receivers (possibly with a bandwidth of a few Hz) enable very weak signals to be detected, since the narrower the bandwidth of the channel used, the less the external noise which can penetrate into that channel. (Someone once said: "The wider you open the window, the more the amount of dirt that flies in," and this certainly applies to radio bandwidths). Unfortunately if one has a very narrow bandwidth channel, it takes a very long time to examine an appreciable range of frequencies. Modern plans are to use both narrow and wide band search techniques together with spectrum analysers for the simultaneous examination of numerous frequencies by computer techniques.

The Drake Equation

Before spending millions of dollars on SETI programmes, one would like to have some approximate

estimate of the number of civilizations which are likely to possess the technology to be able to communicate with us. Such an estimate can be obtained by the use of the Drake equation. Professor Frank Drake is one of the leading SETI workers and is now Director of the National Astronomy and Ionosphere Centre of Cornell University. His equation reads:

$$N = R^* f_p n_e f_i f_c L$$

- where
- N** is the number of existing civilizations possessing the interest and capability for inter-stellar communications
 - R*** is the mean rate of star formation averaged over the lifetime of a galaxy
 - f_p** is the fraction of stars with planetary systems
 - n_e** is the mean number of planets in each system with an environment favourable for the origin of life
 - f_i** is the fraction of suitable planets on which life does develop

- f_i** is the fraction of life bearing planets on which intelligence together with manipulative abilities appears
- f_c** is the fraction of the planets evolving advanced technical civilization
- L** is the lifetime of the technical civilization (perhaps very difficult to estimate!)

The estimate obtained from the use of this equation will obviously vary widely according to the estimated values employed. However, most estimates now place the value of N around one million, these being distributed amongst approximately 500 million stars in our galaxy.

SETI History

Perhaps the first important paper on SETI work appears in *Nature* in 1959 under the title "Searching for Inter-stellar Communications" by Philip Morrison and Giuseppe Cocconi. It is interesting to note that they suggested the use of the 1.420 MHz hydrogen

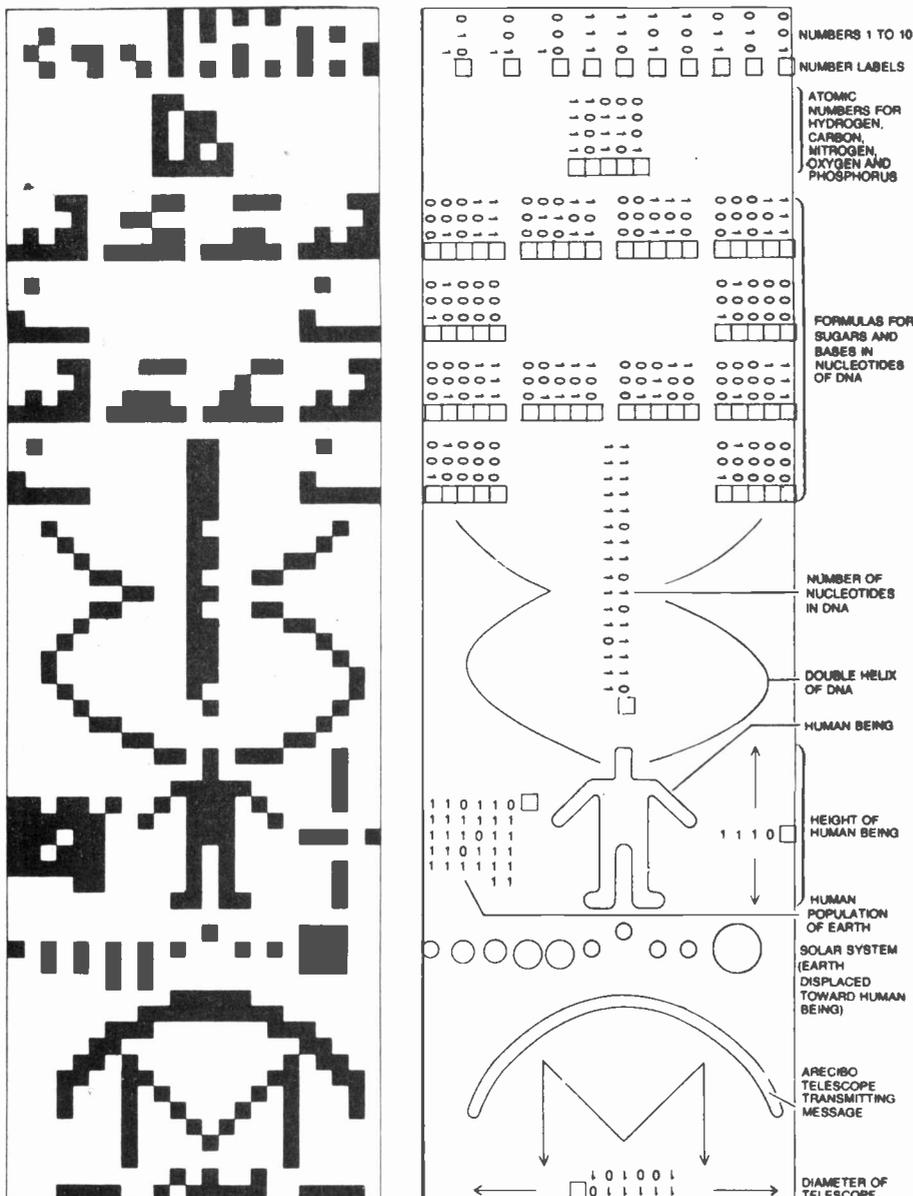


Fig. 2. On November 16th, 1974, the Arecibo telescope was used to transmit a message at 2380 MHz towards the Great Cluster in Hercules, Messier 13, some 25,000 light years away.

The message, 1679 bits long, can be decoded by breaking it into 73 consecutive groups of 23 characters and arranging these groups in sequence under one another as shown. The first piece of information consists of the first ten digits in binary form — the numbering system to be used. It continues with the atomic numbers of five common elements found in living things. Information on sugars and DNA follows, with a sketch of a human being and the solar system, ending with information about the Arecibo telescope.

Encoding information in various types of message poses some interesting problems in order that decoding can be carried out as easily as possible by intelligent remote beings.

frequency, since it is a unique standard frequency which must be known to every observer in the universe.

Eight separate major efforts have been made by US, Canadian and Russian radio astronomers since 1960 to detect extra-terrestrial signals from intelligent beings. Although each search has concentrated on one or more specific frequencies in the range from 600 MHz to 22.2 GHz, the receivers used were those designed mainly for normal radio astronomical work which involves the detection of incoherent naturally produced radiation rather than the coherent radiation the SETI workers were seeking.

Although no confirmed sources of signals from intelligent beings outside the solar system have yet been detected, it has been estimated that the number of stars which have been examined is about 0.1% of the number which would have to be investigated if there is to be a reasonable statistical chance of detecting extra-terrestrial intelligent signals.

Project Ozma

The first SETI work was led by Frank Drake using the 1420 MHz hydrogen frequency. It was named "Project Ozma" after the ruler of Oz — a far away place populated by exotic beings. Drake employed a bandwidth of 100 Hz and aimed his receiver at the two stars Tau Ceti and Epsilon Eridani which are both some 11 light years away from the earth. The observing time was some 150 hours using a 26 m (85 feet) diameter steerable antenna in 1960.

Project Ozma II is a much more extensive one which has also been carried out at the National Radio Astronomy Observatory, Green Bank, West Virginia. In this work some of the largest and most sophisticated radio telescopes in the world have been used; they include the 92 m (300 feet) diameter partially steerable antenna completed in 1962 at a cost of about 1 million dollars (500 000 pounds) and the 43 m (140 feet) diameter

equatorially mounted, fully steerable antenna which was completed in 1965 at a cost of some 14 million dollars (£7 million).

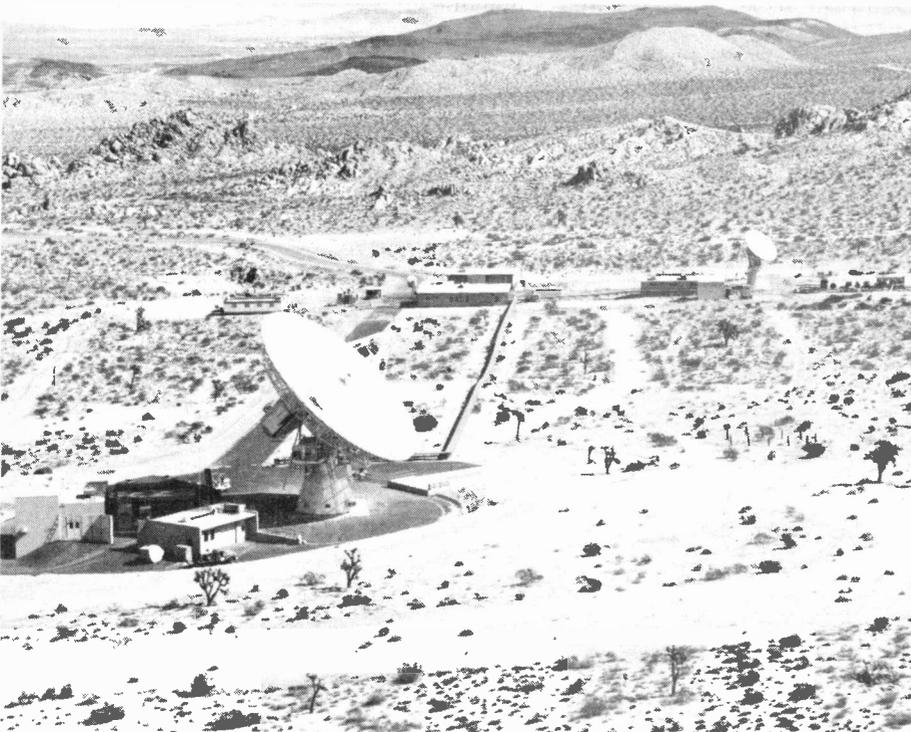
Project Ozma II was commenced in late 1972 under the leadership of Benjamin M. Zuckerman of the University of Maryland and Patrick Palmer, of the University of Chicago, the intention being to run the project for about two years. However, the Observatory made more time available and the project continued until December 1976 with an examination of about 700 stars at distances of up to some 65 light years. The prime targets were main sequence stars of the F5 to K5 class. The observations were carried out at 1420 MHz, each of 384 separate receivers being tuned to a slightly different frequency near to the 1420 MHz hydrogen line. A total bandwidth of 3 kHz was used.

At the end of the Project Ozma II work, about 12 stars showed some unexplained phenomena which were probably due to terrestrial radio interference, but which could have been due to faint signals from intelligent beings. These stars will doubtless be examined very carefully at some later date.

Arecibo

Some SETI work has been carried out using the largest telescope in the world at the Arecibo Observatory in Puerto Rico which has a diameter of 305 m (500 feet) in the air. The reflector panels consist of 38,778 individual panels each a little over 1 m by 2 m in size; each pane, must be positioned with an accuracy of better than 1 mm.

In 1967 a British post-graduate student noticed a mysterious regular pulsing signal from space and there was much speculation as to whether this was a signal from intelligent life beaming a message to earth. The Arecibo antenna was used to show that this signal was coming from the first pulsar to be discovered and that it was in the Crab Nebula.



The Goldstone 26 m Deep Space Network Antenna may be used in an all sky search. (Photo by courtesy of Jet Propulsion Laboratory)

Two of the best known SETI workers, Prof. Frank Drake and Prof. Carl Sagan, have used the Arecibo antenna to examine the radiation from whole galaxies for signs of signals from intelligent life. Although the use of this technique has enabled them to examine many millions of suitable types of stars simultaneously, it would require a signal of very great intensity to enable frequencies of 1420 MHz, 1654 MHz and 2380 MHz, but the time allocated to this work is relatively small.

Canadian Work

Dr. Bridle and Dr. Feldman commenced work at Canada's nationally owned Algonquin Radio Observatory in Algonquin Park, Ontario in 1974. They are using a 46 m (150 feet) diameter telescope to examine many of the nearest sun-like stars, but the frequency employed is 22.2 GHz — the emission frequency of the water molecule — which is much higher than that used by other workers.

Project Cyclops

One of the most ambitious SETI projects yet proposed is known as Project Cyclops. This is intended to be suitable for not merely detecting high power signals (such as those from our own Arecibo antenna), but also to allow eavesdropping on much lower intensity signals which other civilizations use for their own communications (like our radio and television transmitters). In order to be able to receive such signals from stellar systems at distances of a few hundred light years from the earth, enormous antenna systems are required.

It seems unlikely that it would be a practical possibility to construct a single reflecting dish of adequate size and therefore it has been suggested that the Cyclops project could employ an enormous array of radio telescopes, each of which may be about 100 m in diameter. For example, as many as 1500 such 100 m dishes could be spread out in lines over an area of perhaps 65 km² and connected together electrically to

provide the same performance as a single dish of enormous dimensions.

Project Cyclops was initiated as a study by the NASA Ames Research Centre and Stanford University in 1971 under the leadership of Dr. John Billingham and Dr. Bernard Oliver. There have been vast improvements since then in solid state memories, microprocessors, wideband maser low-noise amplifiers, etc.

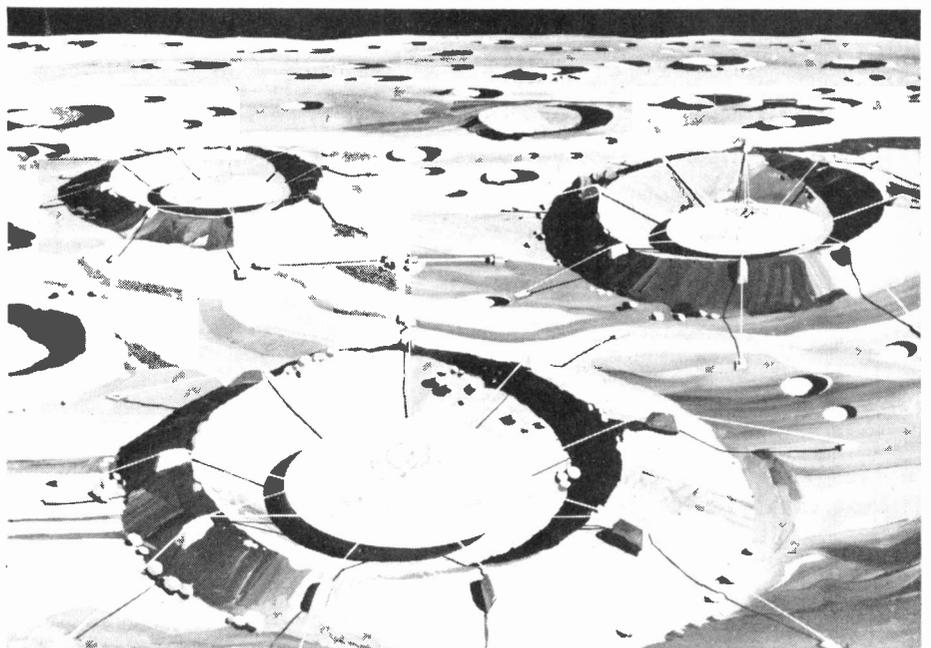
Conclusion

The Search for Extra-Terrestrial Intelligence has not yet been successful, but this is not particularly surprising in view of the small number of star systems which have been examined with high sensitivity equipment. Some people (including many of those who control scientific finance) may feel that the SETI project is rather frivolous and perhaps even a silly one. However, there are many scientists very strongly committed to work in this field — a point which can be demonstrated by the fact that a new journal, *Cosmic Search* devoted entirely to SETI work will be published from January 1979 under the editorship of Dr. Robert S. Dixon who is well-known for his SETI work at the Ohio State University Radio Observatory.

Dr. Frank Drake at times feels somewhat cynical about the cuts in the SETI budgets. Indeed, he has commented that the search for extra-terrestrial intelligence begins with the search for intelligence here on earth! He feels that at the present time there is a very well qualified group of people who are keen to carry out an extensive SETI project and, if no funds are forthcoming for a year or more, it is likely that many of these people will move to other work. If you were paying taxes in a country considering becoming involved in an extensive SETI project, how would you feel about paying an extra amount (far less in total than that to place a man on the moon) in order that the project could proceed? SETI work will doubtless continue, but more funds are required if it is to proceed at a rate which is likely to bring success within the lifetime of most people who are living today.

ETI

An artists impression of a complex Cyclops array on the far side of the moon containing 216 large (200 m diam.) reflecting radio telescopes with a control building in the middle of the array. The lunar base is in the middle distance towards the left-hand side and is quite small. (Photo by courtesy of NASA Ames Research Centre).



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on the right title.

TUNER ~ AMPLIFIER

PART TWO: This month we conclude the System 8000 project with the setting up procedure and a description of the digital frequency readout.

THE SETTING UP and alignment must be approached in a systematic fashion.

Procedure

- a) Power Supply
- b) Power Amp L & R
- c) Auxilliary
- d) Tone Controls
- e) Filter Controls
- f) Tape
- g) Magnetic pre-amplifier
- h) FM sections
- i) AM
- J) Frequency read out module

Before commencing alignment it is necessary to check that:

- i) All wiring has been checked and components are correctly positioned and orientated
- ii) That there are no solder bridges
- iii) A good multimeter is also required

Power Supply

Remove all fuses except for the mains fuse. Switch on, you should

hear the relay click over. Measure from earth to positive and negative on the smoothing capacitors. The voltage should read approximately plus or minus 50V. Check that regulator reads about 30V. Switch off.

Power Amp

Check each power amp in turn, ensure that speakers are switched out. Using a meter, do a resistance check from the case of each power transistor to chassis to ensure that there is no short. Find two high wattage resistors (56R-300R will do) and place in fuse holders of amp being checked.

Switch on volume control (minimum). If there appears to be no problems feel cases of power transistors — should be cool. Switch on speaker. Power transistors may be slightly warm. Now 'Buzz' input pins of the amplifier with your finger. If okay switch off, remove the resistor fuses, insert two amp fuses. Switch on, if everything is okay one can now set RV1.

If you have access to a low distortion audio generator put this on the input and a distortion meter across the speaker sockets using a dummy load. Feed in 100mV sine wave and set for minimum distortion. Without this test equipment set RV1 to mid travel. Repeat for other channel.

Tone and Filters

Insert either an audio generator, or any music source such as a tape-recorder, into the Aux. socket. Select Aux. on switchbank, slowly increase volume, and listen to sound, check that the tone controls are working. To check the high and low filters turn the bass control on full and this will emphasise the rumble filter, likewise the treble control will emphasise the scratch filter.

Tape

If the above is working, check that pressing tape 1 and tape 2 disconnects the Aux. Transfer the tape recorder/audio generator to take 1 and 2 in turn and ensure that



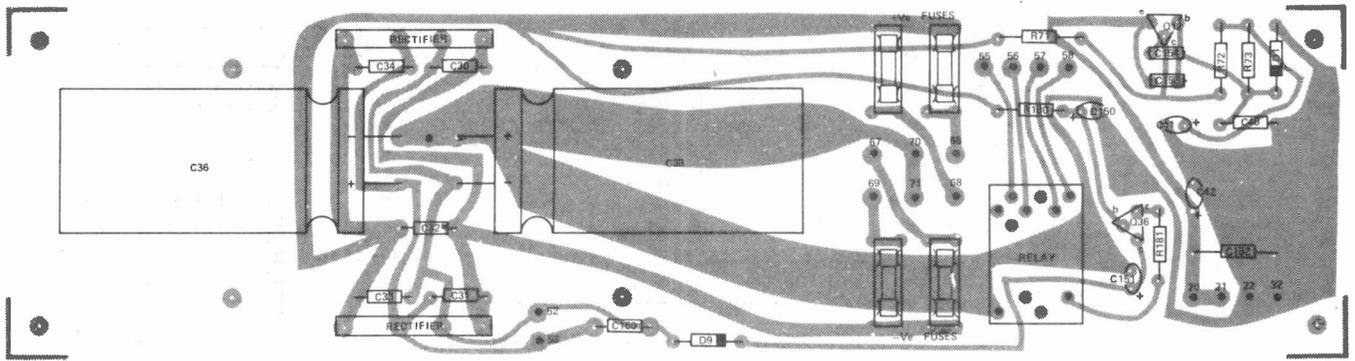


Fig. 1. Component overlay for the power supply board.

pressing the respective switch brings them into circuit. The pre-set resistors are adjusted to match the levels of your own tape recorders otherwise they can be turned full on.

Magnetic

Using a record player with a magnetic cartridge check that everything sounds okay. Excessive hum indicates an earthing fault.

FM

Before aligning this section it may be an advantage to set the frequency counter straight away. However, this is not essential. The tuner head is pre-aligned and will not need adjustment. Tune through the band with an aerial connected — ensure that mute and AFC are off. You should hear a continuous hiss, with stations heard between 88 MHz and 95 MHz. If this is so, tune to an area above 95 MHz without stations and adjust using a non-inductive tool L4 until centre zero needle is centred. This should correspond with

maximum hiss level. L3 can only be adjusted ideally if an FM signal generator is used. Generate 100 MHz, attach a distortion meter to pin 6 of the CA3189E, there is a test pin for this, tune for maximum signal strength and adjust L3 for minimum distortion. Re-adjust L4 for centre zero. Adjust L1 for maximum signal level. RV11 is the muting adjustment, and can be set all the way from no mute to absolute quiet between stations — however, do not overset, as the mute may not lift quickly enough when tuning a station.

Move next to the stereo decoder, KB 4437 — either:—tune to a stereo broadcast, set RV6 to the middle of the range that brings the stereo light on, set VC5 and RV7 for mid-way; or:—using a stereo generator, adjust VC5 and RV6 for maximum, set separation at 1 kHz. Observing the 19 kHz component of the multiple signal on an oscilloscope, set RV7 for minimum 19 kHz. This completes the FM.

Amplitude Modulation

The frequency counter can help considerably, and an AM generator is an asset.

MW

Tune to minimum volts on varicap line, feed in a 470 kHz signal, peak until there is no improvement, Tune L9 for a 550 kHz station. Move to maximum varicap volts, set CV1 for a 1620 kHz signal. Tune up and down the band checking that 550-1620 kHz is covered without any shifting in noise level. Tune to 600 kHz. Peak L5 and L7 for maximum. Tune to 1400 kHz. Peak CV2 and CV4 for maximum. Repeat until there can be no improvement. RV8 is set to give a satisfactory signal level reading on the meter.

LW

Switch to LW. Set CV3 so that minimum varicap volts 175KHz. Tune to 200 kHz (Radio 4) peak L6 and L8 for maximum. If no generator

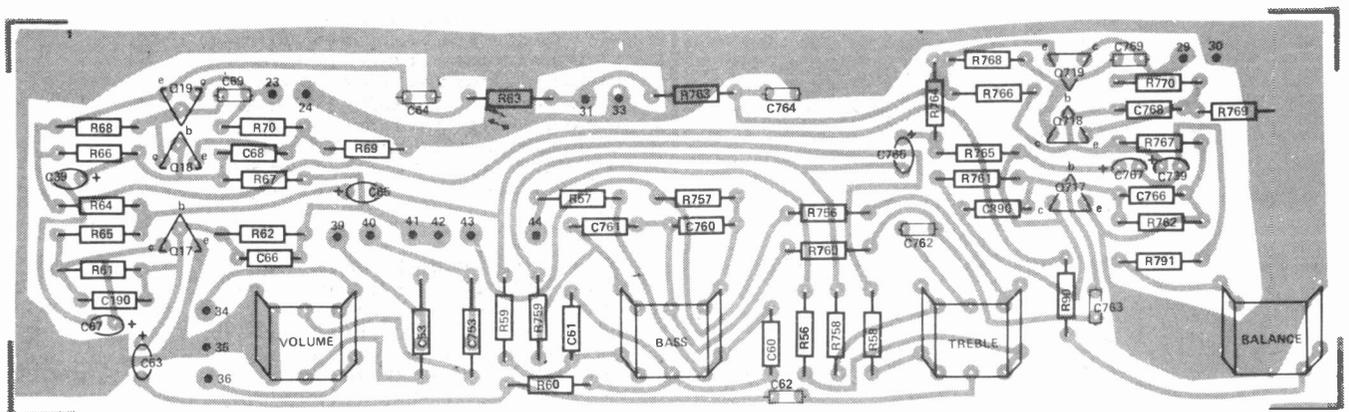


Fig. 2. Component overlay for the tone control board.

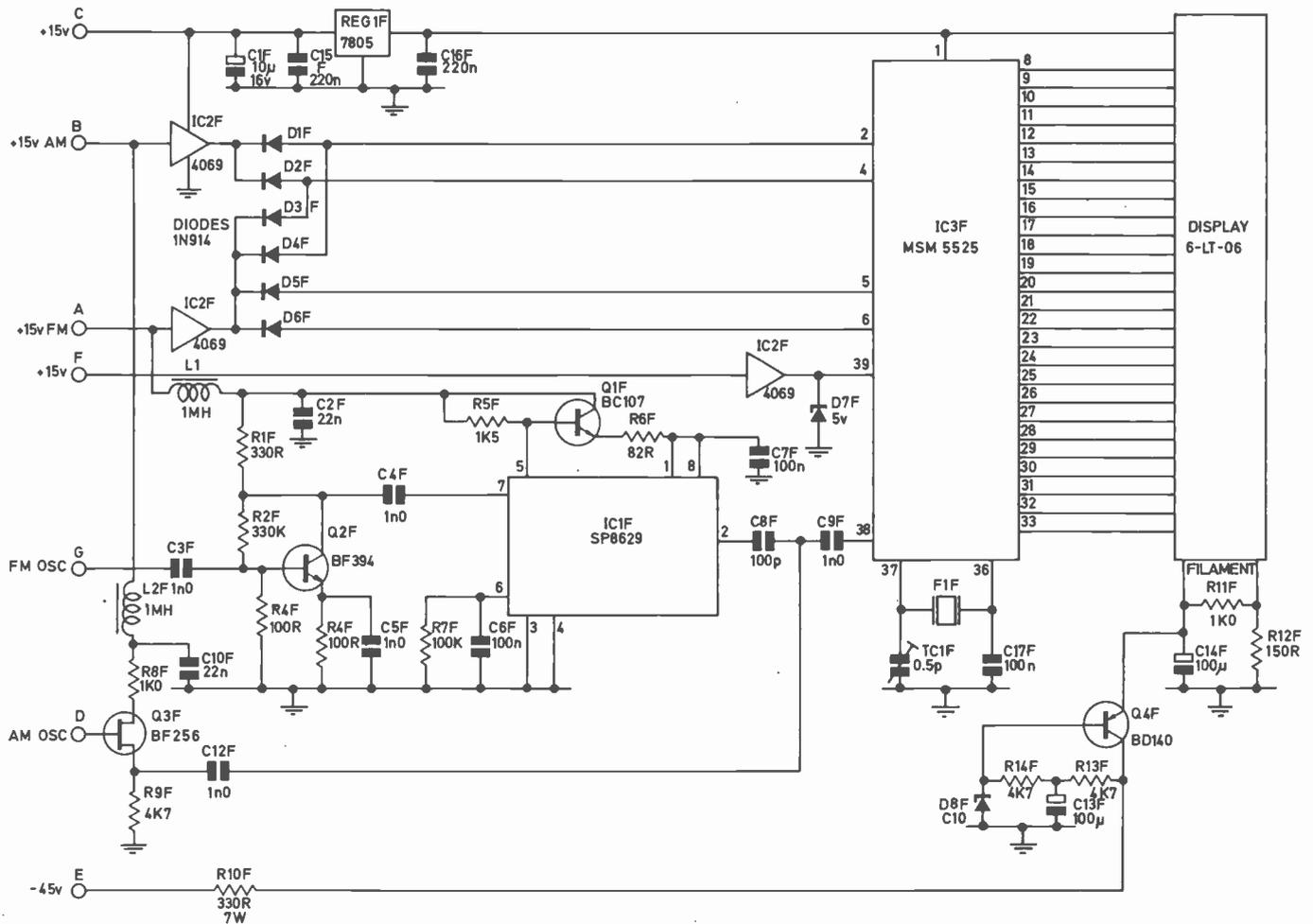


Fig. 3. Circuit diagram of the digital frequency meter.

HOW IT WORKS

A digital frequency readout is both cost effective and an accurate method of displaying the frequency of a radio station. GEM has been developed to interface directly with the tuner sections of the SYSTEM 8000, and most existing AM/FM receivers.

The principle of operation is simple, and is a progression from the many digital clock ICs. Basically, the oscillator of the radio being 'read' is fed (via buffer stages) into the 5525, and converted to digital pulses. These are counted by the IC, for a period determined by the external crystal, and the count is fed to the display.

Allowance is made for the IF offset of the radio — 470 kHz and 10 kHz. This offset is externally programmed by the diodes DI-D6.

In this application, the source for switching from AM to FM is obtained from the switch bank of the System 8000, and uses the positive power line. This is converted from

a 'Hi' to a 'Lo' signal by IC2, a HEX inverter. The beauty is that the buffer stages for the AM/FM oscillators are also switched off when not in use, and thus cannot cause interference.

Because the display would be running when the tuner is not being used. A section of the hex inverter takes an additional 15V input (F) and uses this to reset the counter and thus give a fixed reading. D7 ensures that this signal cannot accidentally exceed 5V. The unit must be earthed directly to the central earthing point of the system 8000, otherwise noise may be fed back into the system.

The unit may be used independently of course and requires $\pm 12V$ at least, for operation. If using a supply of lower than $\pm 20V$, omit R10. Maximum supply is $\pm 35V$. Other IF offsets may also be programmed in. It uses a fluorescent display for a good readability and gives AM/FM and MHz/kHz indication.

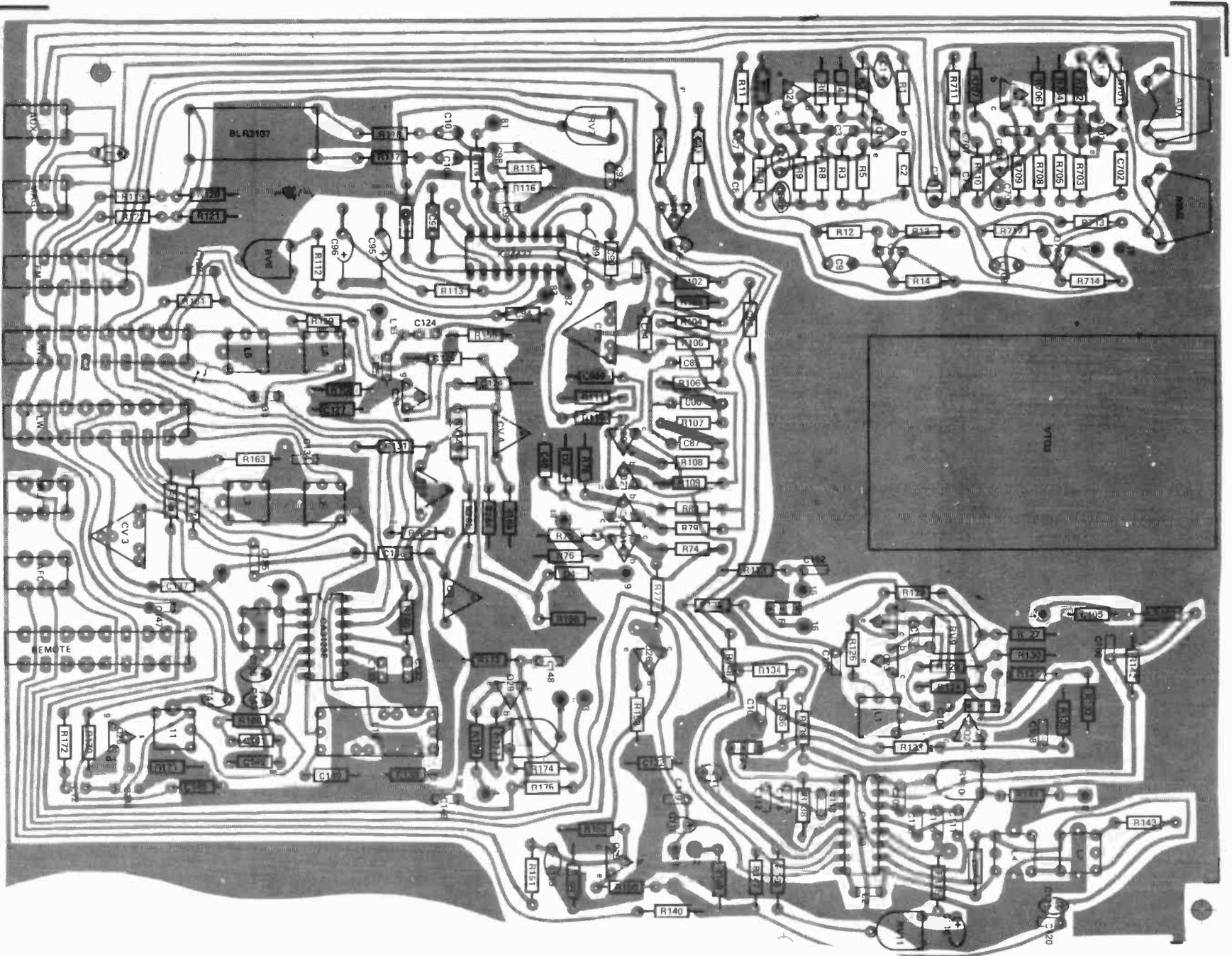
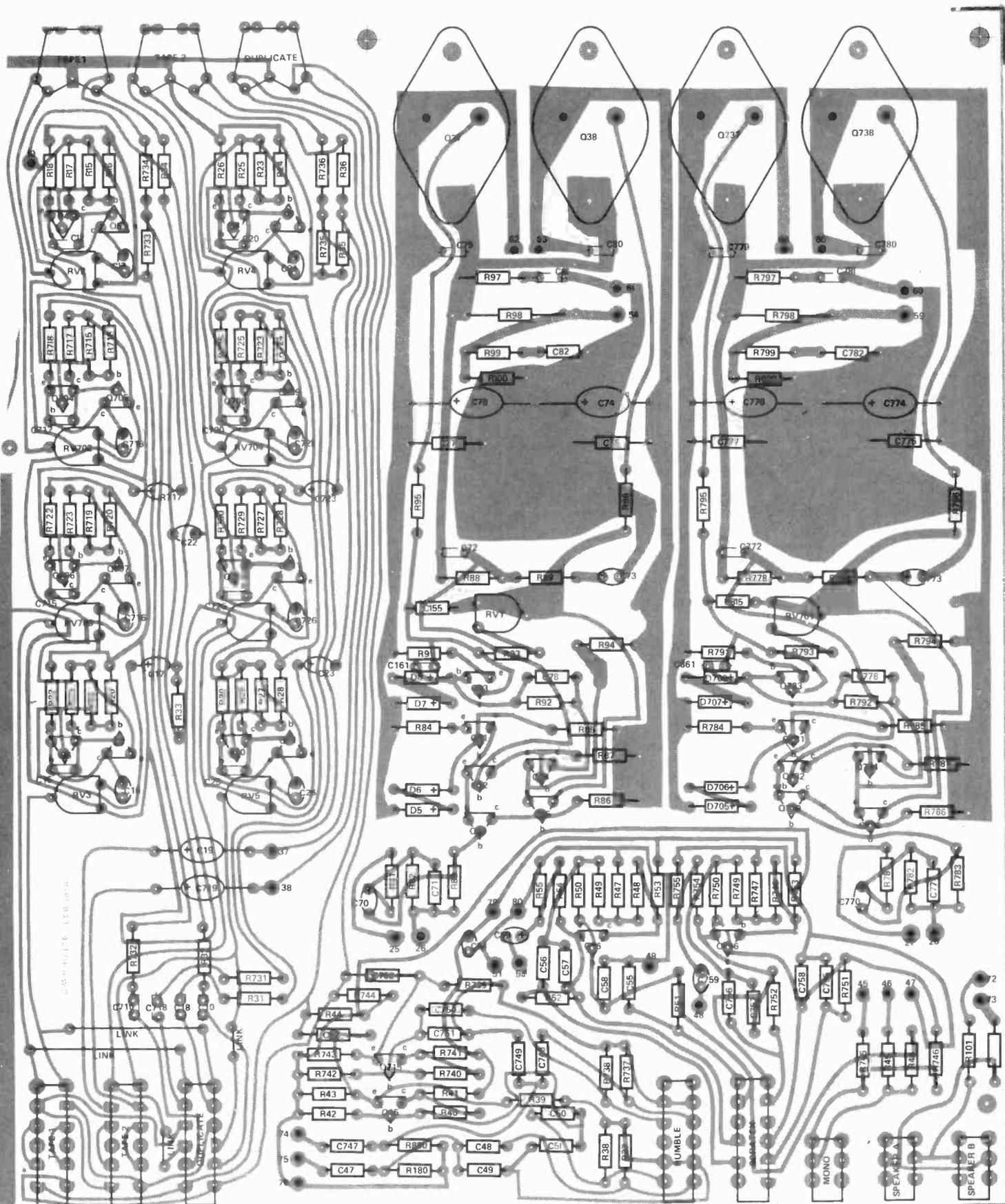


Fig. 4. Component overlay for the System 8000 main board. Check this board very carefully before you switch on, particularly capacitor and diode polarity and transistor connections.



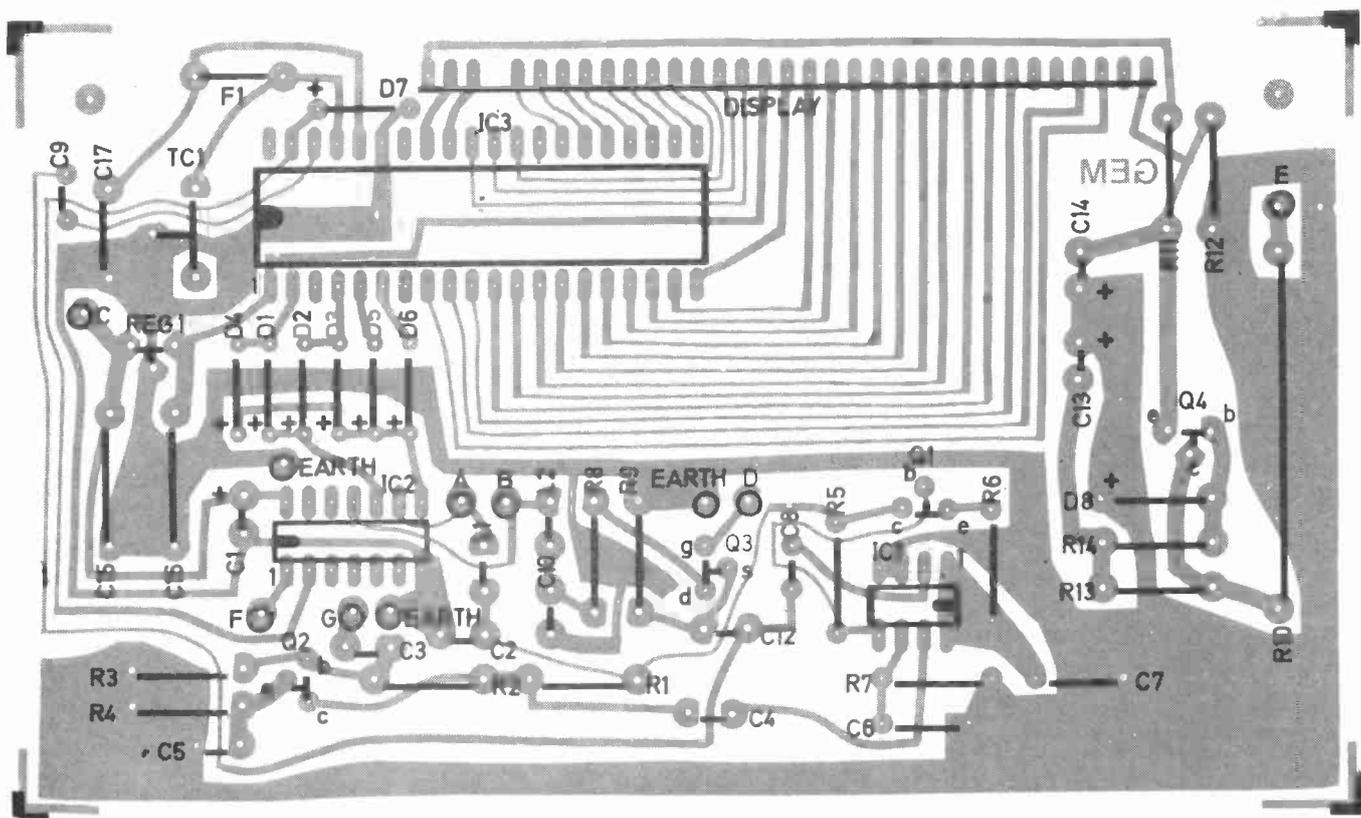
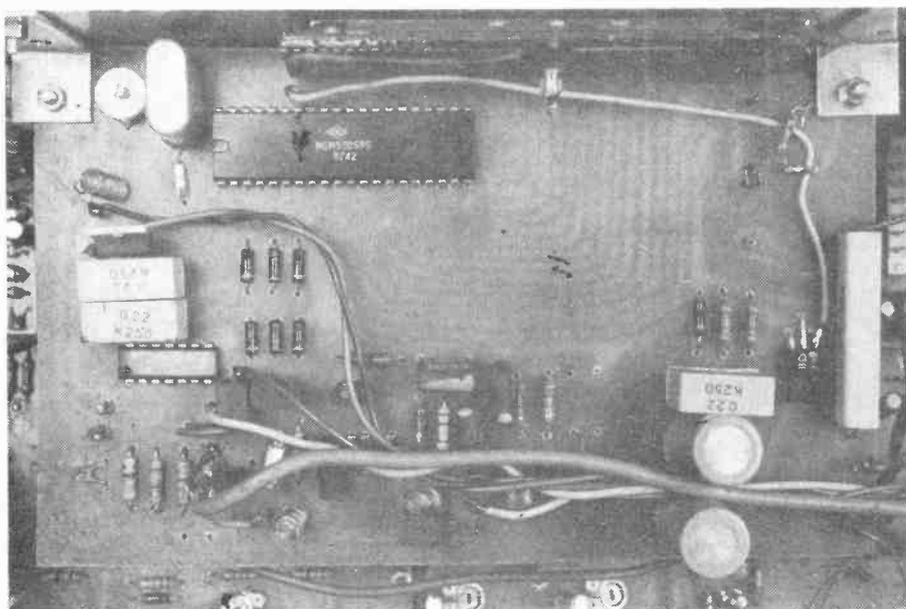


Fig. 5. Component overlay for the digital frequency meter board.

(Below) The digital frequency meter display and driver board.



is available, the digital frequency counter can be peaked. L11, L10, can be set for maximum output (be careful — small adjustment only).

Readout

The frequency counter should need no adjustment, however, if another frequency counter is available, the crystal input should be tuned to precisely 6553k6Hz with TC1.

NB: It has been found in practice that two laminated transformers give excellent regulation and a low hum field, also low voltage taps are available to power the centre zero and signal meter. The metal case will take both toroidal and conventional transformers.

ETI

PARTS LIST

RESISTORS (all 1/2W 5%)

R1, 10	330R
R2	330k
R3	1M
R4	100R
R5	1k5
R6	82R
R7	100k
R8, 11	1k
R9, 13, 14	4k7
R12	150R

CAPACITORS

C1, 14	10u 16V electrolytic
C2, 10	22n polyester
C3, 4, 5, 9, 12	1n polyester
C6, 7	100n polyester
C8	100p ceramic
C13	100n 45V electrolytic
C14, 15	220n polyester
C17	22p ceramic

SEMICONDUCTORS

Q1	BC107
Q2	BF394
Q3	BF256
Q4	BD140
IC1	5525
IC2	4069
IC3	SP8629
D1-6	1N914
D7	5V 400mW zener
D8	10V 400mW zener
Reg.	7805

INDUCTORS

L1 2	1mH
------	-----

MISCELLANEOUS

TC1-0-50p, F1-6553k6 H7 X71, 6LT06 display, PCB

- 30/ to pin (28)
- 31/ to pin (31)
- 32/ } to pin (33)
- 33/ }
- 34/ to pin (37)
- 35/ Earth
- 36/ to 38 pin
- 37/ to pin (34)
- 38/ to pin (36)
- 39/ to pin (45)
- 40/ to pin (46)
- 41/ to pin (47)
- 42/ Earth pin 49 and 51
- 43/ pin 48
- 44/ pin 50
- 45/ pin 39
- 46/ pin 40
- 47/ pin 41
- 48/ pin 43
- 49/ Earth pin 42
- 50/ pin 44
- 51/ Earth pin 42
- 52/ }
- 53/ } to 56V winding of Transformer
- 54/ }
- 55/ } Connect
- 56/ to speaker switch L
- 57/ to speaker switch R
- 58/ }
- 59/ } Connect
- 60/ pin 70
- 61/ pin 71
- 62/ +45V fuse 66
- 63/ -45V fuse 67
- 64/ +45V fuse 68
- 65/ -45V fuse 69
- 66/ to 62
- 67/ to 63
- 68/ to 64
- 69/ to 65
- 70/ to 60
- 71/ to 61
- 72/ }
- 73/ } -to L and R of Head-Phones
- 74/ -L
- 75/ -R to FM switch
- 76/ Earth
- 77/ on FM switch, to mono switch

- 78/ +15V
- 79/ on mono switch, to stereo. LED anode
- 80/ Earth
- 81/ to stereo LED
- 82/ }
- 83/ } mono options, disconnected

All other earth connections to tabs of power board—including centre-tap of transformer.

CORRECTIONS FOR DIGITAL FREQUENCY DISPLAY

pin 7—(FM tuner lead) to pin 100
pin (6)—to pin 101

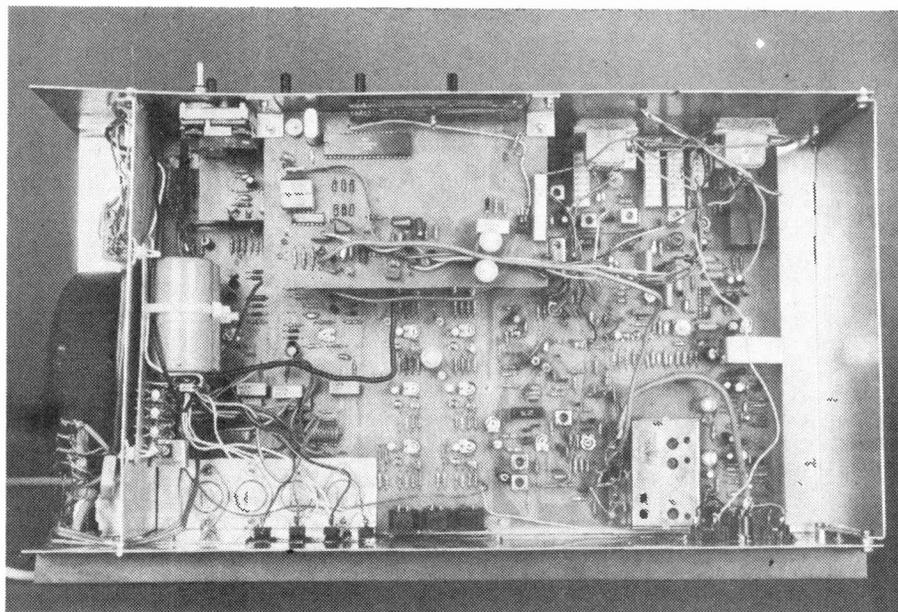
Uni-Electric have sent us the following list of corrections to the parts list and circuit diagrams published last month.

C105 in 100n.
Circuit diagram shows a short from output of 7815 to earth. Omit indicated line.
Switch marked 'rumble' is tape switching. 'Mono' switch, left channel shown connected to earth, via a 470k resistor. This should be connected to Mono switch via a 1k resistor.
C67 and C150 are 10 uF capacitors.
C136 is 470p. C137 is 330p. 10n capacitor omitted from pin 7 to CFU050D. C147 is 10n. R171 is 10k.
R120 are R121 are 47k. Base of Q20 is shown shorted to earth — should be a 47p capacitor here.
R10 is shown connected to the base of Q2, and Q2 connected to earth. This is wrong, R10 goes to earth and not to Q2, R3 is 47R, not 47k.
Mast head preamp uses 2 not 5 Mosfets. AM coverage is 2 band not 5 band. Sensitivity is 1.0 uV not 10 V.

In Buylines, the complete kit with metalwork is £165. Uni-Electric will align the RF sections and check finished mother boards for £15.00.

Pin Wiring for PCBs

- 1/ AM Aerial
- 2/ } -Link
- 3/ }
- 4/ To +Ve of signal level *
- 5/ To -Ve of signal level and pin (8)
- 6/ Output to D.F.D.
- 7/ Test Point
- 8/ To pin (5)
- 9/ of Varicap pot
- 10/ +12V end of Varicap pot
- 11/ +1V end of Varicap pot
- 12/ }
- 13/ } -Link
- 14/ to (3) on Tunerhead
- 15/ to (6) on Tunerhead
- 16/ to (8) on Tunerhead
- 17/ to pin (19), and pin 20 (on Power Board)
- 18/ to pin 22 (on power board)
- 19/ to pin (17)
- 20/ to pin (19)
- 21/ to pin ((31) (on Tone Board)
- 22/ to pin (18)
- 23/ to pin (25)
- 24/ to pin (26)
- 25/ to pin (23)
- 26/ to pin (24)
- 27/ to pin (29)
- 28/ to pin (30)
- 29/ to pin (27)



An internal view of the complete unit, ready for the setting up procedure. The digital frequency meter board is top centre.

STEVENSON

Electronic Components

REGULATORS

78L05 30p	7805 60p	79L05 70p	7912 80p
78L12 30p	7812 60p	79L12 70p	7915 80p
78L15 30p	7815 60p	7905 80p	LM723 35p

HARDWARE

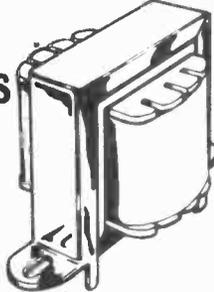
MINIATURE TRANSFORMERS

240 Volt Primary

Secondary rated at 100mA.

Available with secondaries of:

6 - 0 - 6,	9 - 0 - 9 and
12 - 0 - 12,	92p. each.



LOUDSPEAKERS

56mm dia. 8 ohms	70p
64mm dia. 8 ohms	75p
64mm dia. 64 ohms	75p
70mm dia. 8 ohms	100p
70mm dia. 80 ohms	110p



TERMINALS

Rated at 10A. Accepts 4mm plug, black, blue, green, brown and red . . . 22p

SWITCHES

Subminiature toggle. Rated at 3A 250V.

SPDT 70p	SPDT centre off 75p
DPDT 80p	DPDT centre off 95p

Standard toggle

SPST 34p	DPDT 48p
----------	----------

Waveshape switches.

1P12W, 2P6W, 3P4W or 4P3W	all 43p ea.
---------------------------	-------------

Miniature switches (non-locking)

Push to make 15p	Push to break 20p
------------------	-------------------

Slide switches (DPDT)

Miniature 14p	Standard 15p
---------------	--------------

CONTROL KNOBS

Ideal for use on mixers etc. Push on type with black base and marked position line. Cap available in red, blue, green, grey, yellow and black. 14p



TRANSISTORS

AC127 17p	BCY71 14p	ZTX109 14p	14p
AC128 16p	BCY72 14p	ZTX300 16p	16p
AC176 18p	BD131 35p	2N697 12p	12p
AD161 38p	BD132 35p	3N1302 38p	38p
AD162 38p	BD135 38p	2N2905 22p	22p
BC107 8p	BD139 35p	2N2907 22p	22p
BC108 8p	BD140 35p	2N3053 18p	18p
BC109 8p	BF244B 36p	2N3055 50p	50p
BC147 7p	BFY50 15p	2N3442 135p	135p
BC148 7p	BFY51 15p	2N3702 8p	8p
BC149 8p	BFY52 15p	2N3704 8p	8p
BC148 9p	MJ2955 98p	2N3705 9p	9p
BC177 14p	MPSA06 20p	2N3706 9p	9p
BC178 14p	MPSA56 20p	2N3707 8p	8p
BC179 14p	TIP29C 60p	2N3904 8p	8p
BC182 10p	TIP30C 70p	2N3905 8p	8p
BC184 10p	TIP31C 65p	2N3906 8p	8p
BC184L 10p	TIP32C 80p	2N4058 12p	12p
BC212 10p	ZTX107 14p	2N5457 32p	32p
BC212L 10p	ZTX108 14p	2N5458 30p	30p
BC214 10p		2N5459 32p	32p
BC214L 10p		2N5777 50p	50p
BC477 19p			
BC478 19p			
BC479 19p			
BC548 10p			
BCY70 14p			

DIODES

1N914 3p	1N5401 13p
1N4001 4p	BZY88ser. 8p
Full spec. product.	
1N4148	£1.40/100. £11/1000

LINEAR

CA3140 38p	NE555 21p
LM301A 26p	NE556 50p
LM318N 85p	NE565 85p
LM324 45p	NE567 170p
LM339 45p	SN76003 200p
709 28p	LM380 75p
741 16p	LM382 120p
747 40p	LM1830 150p
748 30p	LM3900 50p
CA3046 55p	LM3909 65p
CA3080 70p	MC1496 60p
CA3130 90p	MC1458 32p
	ZN414 75p

CAPACITORS

TANTALUM BEAD		each
0.1, 0.15, 0.22, 0.33, 0.47, 0.68,		
1 & 2.2uF @ 35V		8p
4.7, 6.8, 10uF @ 25V		13p
22 @ 16V, 47 @ 6V, 100 @ 3V		16p
MYLAR FILM		
0.001, 0.01, 0.022, 0.033, 0.047		3p
0.068, 0.1		4p
POLYESTER		
Mullard C280 series		
0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1		5p
0.15, 0.22		7p
0.33, 0.47		10p
0.68		14p
1.0uF		17p
CERAMIC		
Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF		
RADIAL LEAD ELECTROLYTIC		
63V	0.47 1.0 2.2 4.7 10	5p
	22 33 47	7p
		13p
		20p
25V	10 22 33 47	5p
		8p
		10p
		15p
		23p

CONNECTORS

JACK PLUGS AND SOCKETS			
	screened	unscreened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p
DIN PLUGS AND SOCKETS			
	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p
1mm PLUGS AND SOCKETS			
Suitable for low voltage circuits, Red & black.			
Plugs: 6p each Sockets: 7p each.			
4mm PLUGS AND SOCKETS			
Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each			
PHONO PLUGS AND SOCKETS			
Insulated plug in red or black			9p
Screened plug			13p
Single socket	7p	Double socket	10p

74LS

LS00 13p	LS73 25p	LS156 60p
LS01 13p	LS74 25p	LS157 48p
LS02 13p	LS75 30p	LS164 65p
LS03 13p	LS76 25p	LS174 48p
LS04 13p	LS78 35p	LS175 48p
LS08 15p	LS83 35p	LS190 62p
LS10 13p	LS85 70p	LS192 60p
LS13 28p	LS86 30p	LS193 60p
LS14 45p	LS90 36p	LS196 60p
LS20 13p	LS93 45p	LS251 50p
LS30 13p	LS95 35p	LS257 50p
LS32 16p	LS123 70p	LS258 50p
LS37 24p	LS125 38p	LS266 30p
LS40 17p	LS126 38p	LS283 60p
LS42 40p	LS132 60p	LS290 60p
LS47 90p	LS136 28p	LS365 40p
LS48 70p	LS139 50p	LS366 40p
LS54 15p	LS151 50p	LS367 40p
	LS153 50p	LS368 40p
	LS155 55p	LS386 35p
		LS670 140p

TTL

7400 10p	7454 12p	74132 45p
7401 10p	7473 20p	74141 55p
7402 10p	7474 22p	74148 90p
7404 12p	7475 25p	74150 55p
7408 12p	7476 20p	74151 40p
7410 10p	7485 55p	74156 40p
7413 22p	7489 135p	74157 40p
7414 39p	7490 25p	74164 55p
7420 10p	7492 30p	74165 55p
7427 20p	7493 25p	74170 100p
7430 10p	7494 45p	74174 50p
7442 38p	7495 35p	74177 50p
7447 45p	7496 45p	74190 50p
7448 50p	74121 25p	74191 50p
	74122 38p	74192 50p
	74123 38p	74193 50p
	74125 35p	74196 50p
	74126 35p	74197 50p

CMOS

4001 12p	4018 55p	4050 25p
4002 12p	4023 12p	4066 35p
4007 12p	4024 40p	4068 18p
4011 12p	4026 90p	4069 12p
4013 28p	4027 30p	4071 12p
4015 50p	4028 48p	4081 13p
4016 30p	4029 50p	4093 45p
4017 48p	4040 60p	4510 65p
	4042 50p	4511 65p
	4046 90p	4518 65p
	4049 25p	4520 60p

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SKTS

Low profile by Texas			
8 pin	8p	16 pin	11p
14 pin	10p	24 pin	18p
		40 pin	32p
Soldercon pins: 100:50p. 1000:370p			

OPTO

LED's	0.125in.	0.2in	each	100+
Red	TIL209	TIL220	9p	8p
Green	TIL211	TIL221	13p	12p
Yellow	TIL213	TIL223	13p	12p
Clips	3p	3p		
DISPLAYS				
DL704	0.3 in CC		130p	120p
DL707	0.3 in CA		130p	120p
FND500	0.5 in CC		100p	80p

RESISTORS

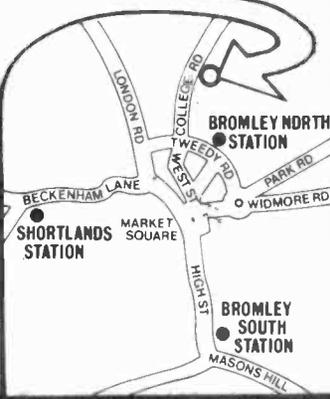
Carbon film resistors. High stability, low noise 5%.			
E12 series, 4.7 ohms to 10M. Any mix:			
	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p
Special development packs consisting of 10 of each value from 4.7 ohms to 1 Meg-ohm (650 res) 0.5W £7.50. 0.25W £5.70.			
METAL FILM RESISTORS			
Very high stability, low noise rated at 1/2W 1%. Available from 51ohms to 330k in E24 series. Any mix:			
0.25W	each	100+	1000+
	4p	3.5p	3.2p

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DESIGNER'S NOTEBOOK

A monthly look at the notebook of ETI's chief design engineer, project editor Ray Marston.

AUNTI IRIS (the one with the big eyes) says that the ETI gremlins loved last month's "Notebook." They gobbled up the original figure 1 (a method of precision gating a 555 astable) and left a copy of Fig 4 (a 555 pulse expander) in it's place. To set the record straight, this month's Fig 1 shows what last month's Fig 1 should have looked like. I hope auntie Sible approves.

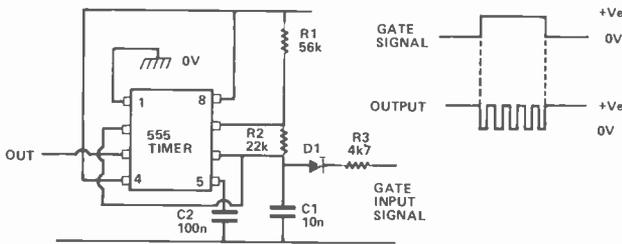


Fig. 1. Here it is in all its glory, the missing link, Fig 1 from last month — a precision gated astable.

Who Loves Yer, Baby?

Regular readers of ETI will have noticed that the design team has a particular love of the CD4017 IC. This modestly priced (about 80 pence in 1 off quantities) little device glories in the title of a "decade counter/divider with ten decoded outputs." It's the "ten decoded outputs" bit of the title that makes us really like the device, because those outputs can be used to do a lot of useful things.

The ten decoded outputs of the B-series 4017 can be used to directly drive a bank of LED's to make pretty displays, or to switch tone generators to create pretty tunes. Alternatively, outputs can be coupled back to the devices control terminals to make the IC count to, or divide by, 'n' (any number from 2 to 9) and then either stop or recycle. Numbers of 4017 IC's can readily be cascaded to give either multi-decade division, or to make counters with any desired number of decoded outputs. Let's take a closer look at the device.

4017 Basics

Figure 2 shows the outline and pin designations, the functional diagram, and the basic timing diagram of the CD4017, which incorporates a 5-stage Johnson counter. The device has clock, reset, and clock inhibit input terminals.

The counters are advanced one count at each positive transition of the clock signal when the clock inhibit and reset terminals are low, with the remaining output high, at any given time. The outputs go high sequentially, in phase with the clock signal, with the selected output remaining high for one full clock cycle. An additional carry out signal completes one cycle for every ten clock input cycles, and can be used to ripple-clock additional 4017's in multi-decade counting applications.

The 4017 counting cycle can be inhibited by setting

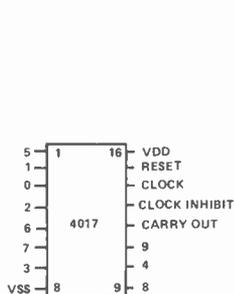


Fig. 2a. Outline and pin designations of the CD4017

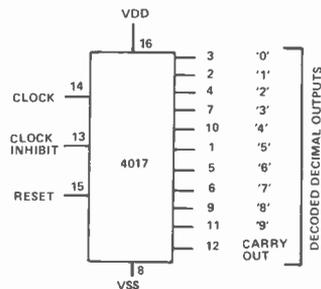


Fig. 2b. Functional diagram and data for the CD4017.

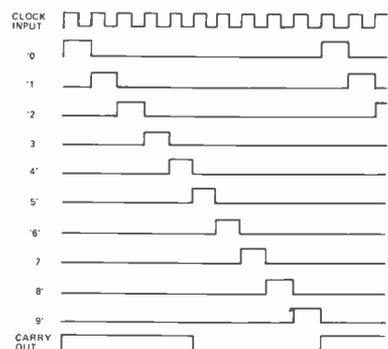


Fig. 2c. Waveform timing diagram of the CD4017, with its RESET and CLOCK INHIBIT terminals grounded.

the clock inhibit terminal high. A high signal on the reset terminal clears the counter to zero and sets the '0' output terminal high.

4017 Applications

Figures 3 to 7 show a few ways of employing the decoded outputs of a single B-series 4017.

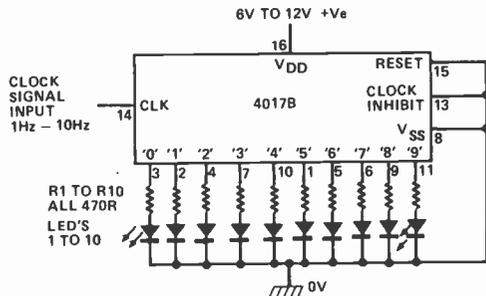


Figure 3: the circuit of a 10-stage sequential LED flasher or chaser, in which one LED is on and the other nine are off at any given time, and the on LED moves one step up the line each time a clock pulse arrives. An alternative action, in which nine LED's are on and one is off at any given time, can be obtained by reversing the polarity of all LED's and taking their common point to the positive supply line.

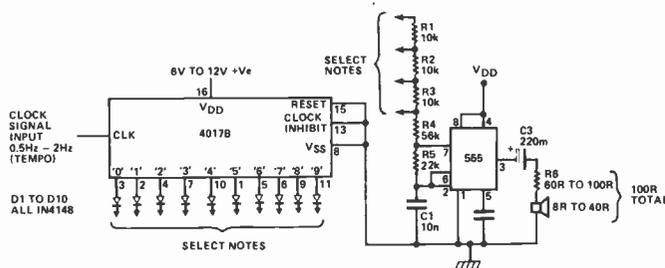


Figure 4: the circuit of a 10-stage 4-note musical sequencer, that can be used to generate simple tunes or melodies. The number of available notes can be increased by adding more resistors to the R1-R2 component chain.

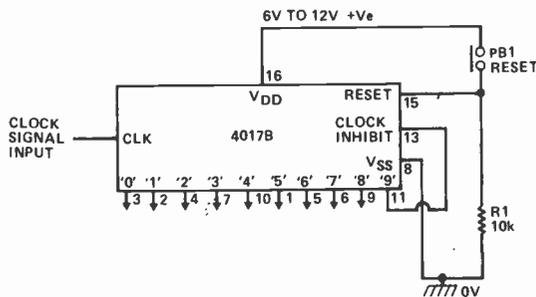


Figure 5: how to connect the 4017 so that it stops operating after completing a pre-determined counting sequence. Here, the counter is set to stop when its clock inhibit terminal is driven high by the '9' output. The count sequence can be restarted by pressing reset button PB1.

Note in the figure six and seven circuits the counter can be made to divide by any number simply by taking the "free" terminal of the circuit's multi-vibrator to the Nth output terminal of the counter.

Greater than 10

There are times when ten stages of counting/decoding aren't enough for a particular task. Examples that spring to mind are complex remote control coders and decoders

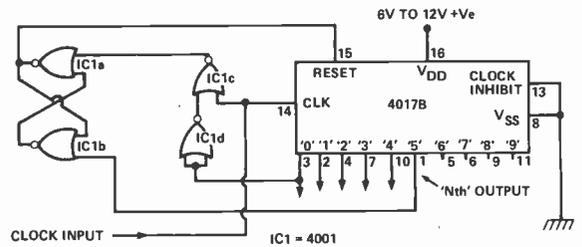


Figure 6: one way of connecting a 4017 as a divide-by-N ($2 < N < 9$) counter with N decoded outputs. This circuit is set to divide by 5. The circuit operation here is such that the Nth output of the counter momentarily goes high on the positive transition of the Nth clock pulse, and immediately causes the IC1a-IC1b flip-flop to change state and apply a reset command to pin 15 of the 4017, which in turn causes its '0' output to go high and feed a low signal to one terminal of NOR gate IC1c. When the negative transition of the Nth clock pulse arrives, it places a low signal on the remaining terminal of the IC1c NOR gate, which therefore feeds a high signal to IC1a and causes the flip-flop to again change state and remove the reset command from pin 15 of the 4017. The 4017 is then free to count again.

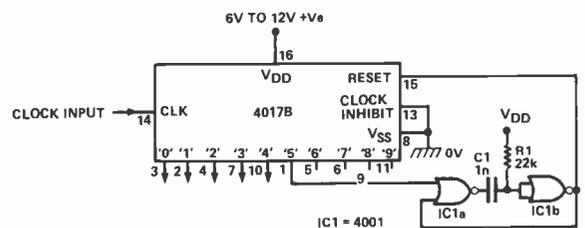


Figure 7: an alternative way of obtaining divide-by-N operation. Here, the Nth output (the 5th in this diagram) momentarily goes high on the arrival of the positive transition of the Nth clock pulse and causes the IC1a-IC1b monostable to generate a 15 uS pulse that immediately resets the counter to the '0' or empty state, ready for the arrival of the positive transition of the next clock pulse.

that may require as many as nineteen sequential stages, simple music or tone sequencers that may require more than twenty stages, and LED-driving electronic games such as roulette which may require up to thirty-eight sequential stages. In such cases it is a fairly simple matter to interconnect a number of 4017 IC's to obtain any required total of decoded output stages.

Note in the Fig 9 circuit that the 1 counter gives nine useful outputs, and that all succeeding stages give eight useful outputs. The basic circuit can be expanded to incorporate any number of 4017 stages by simply adding slightly modified IC2-IC4a-IC4b stages between IC1 and the final two stages of the system.

Rabbiting on

You may be wondering why I've chosen this precise moment of history to rabbit on about applications of the 4017. The fact is, I'm presently playing with some rather unusual 4017-based multi-channel remote control systems for possible future projects, and all the stuff that I've crammed into this month's Notebook is spin-off from that development work. I'll tell you more about these next month.

In the meantime, if you want to play with the 4017 circuits that I've already described, you may find the Fig 11 clock generator circuit useful. It uses only one quarter of a CD4093 Schmitt, but generates beautifully clean and interference-free clock pulses.

You can fiddle with the R1 and C1 values to get any

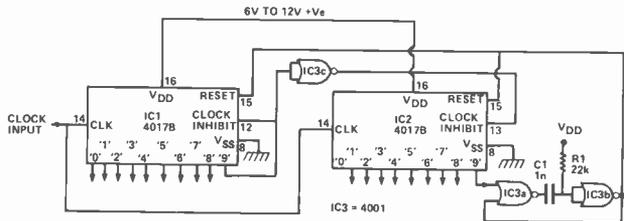


Figure 8 how to interconnect a pair of 4017's to make a 10- to 17-stage counter/decoder. The circuit is shown set for divide-by-17 operation.

The clock input signal is parallel-fed to IC1 and IC2. When, however, the count is below 9, the '9' output of IC1 is low and causes the clock inhibit terminal of IC2 to be set high via IC3c, so IC2 is not influenced by the clock signals. As soon as the 9th clock pulse arrives the '9' output of IC1 goes high and inhibits IC1 from further clocking action, and simultaneously drives the clock inhibit terminal of IC2 low via IC2c and enables IC2 to respond to subsequent clock signals.

Eventually, on the arrival of the 17th clock pulse, the '9' output of IC2 goes momentarily high and triggers the IC3a-IC3b 15 μ s monostable, which in turn resets both counters to the empty or '0' states. The counting sequence then repeats.

Note that the '9' output of IC1 and the '0' and '9' outputs of IC2 are "lost" in the counting action, so the circuit provides a maximum of 17 usable counter/decoder stages. The circuit can be made to count by any number in the range 10 to 17 by connecting the "free" input terminal of IC2a to the appropriate output terminal of IC2.

clock frequency that you want. C1 can have any value from 100p to 10u, and R1 can have any value from 10k to 10M. Values of 10n and 100k give a clock frequency of about 1 kHz.

Smarter than the average bear

Does your cranium tend to inflate ever-so-slightly each time that you develop a particularly clever little circuit? If

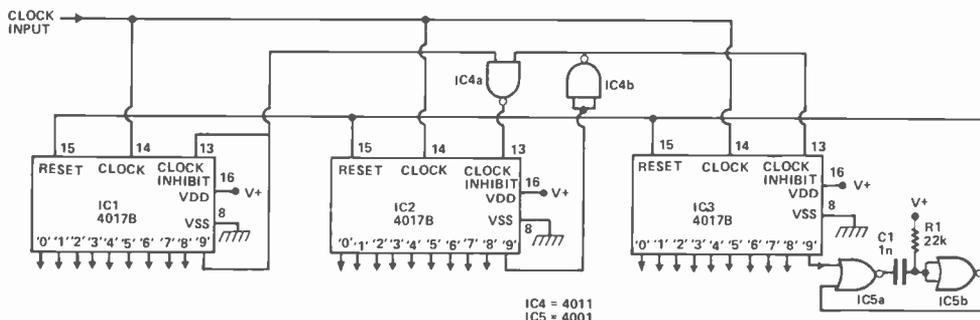


Figure 9 shows the connections for making an 18- to 25-stage counter/decoder from three 4017's. In this case IC3 is inhibited via IC4b and the low output '9' of IC2, and IC2 is inhibited via IC4a and the low output '9' of IC1, up to the 9th clock pulse. IC1 is inhibited via its high '9' output, and IC3 is inhibited via IC4d and the low output '9' of IC2, between the 10th and 17th clock pulses.

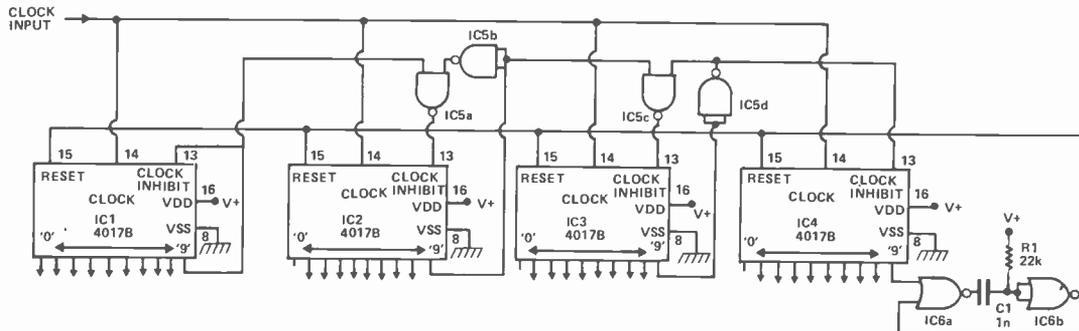


Fig. 10. A 26- to 33-stage counter/decoder set for divide-by-33 operation. This circuit can be expanded to give a ny number of decoded output stages by interposing additional IC2-IC52-IC5b stages between IC2 and IC3. Each additional 4017B stage makes an extra eight decoded outputs available.

so, imagine how Robert J. Widlar must feel. He's the guy who, virtually single handed, designed the original 709 op-amp. And the 710, the 711, the LM101, the 108, the 109, and the 111. On top of that, he either owns or shares patents on the band gap reference and the super beta transistor.

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We plan to give full details of the LM10, complete with extensive applications information, in the near-future. Meantime, it really *does* seem that Robert J. Widlar is a lot smarter than your average bear.

ETI

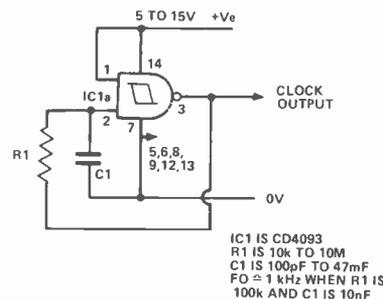


Fig. 11. This simple circuit makes an excellent clock generator for driving 4017 circuits.



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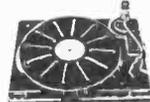
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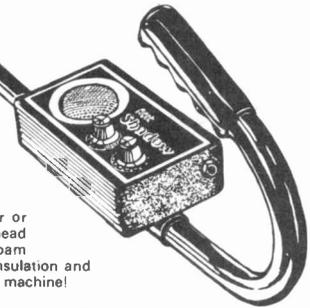
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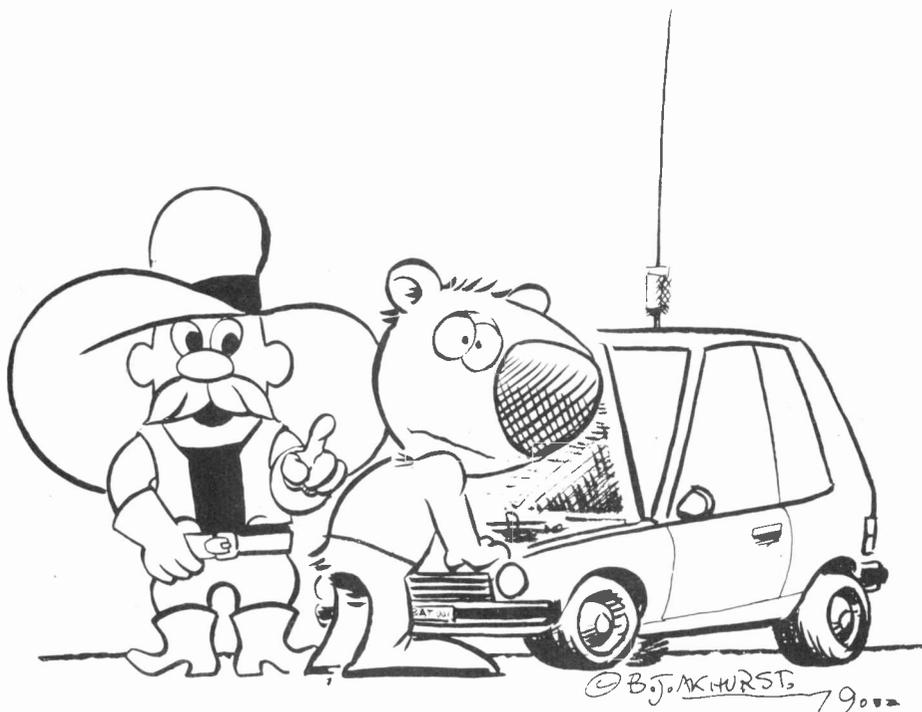
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BATTERY INDICATOR

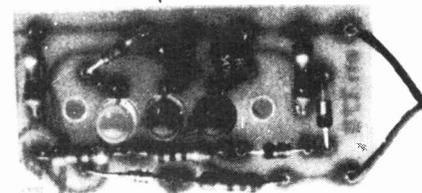
Ever been caught by a battery that went flat at an embarrassing moment — like when you've just offered a friend a lift? The conversation goes a little flat when you're both riding the bus to work, 20 minutes late. Jonathan Scott found a solution . . .



terminal voltage under normal working load somewhere between 11.6 and 14.2 volts. When a battery shows a terminal voltage below 11.6 volts its capacity is markedly decreased and it will discharge fairly quickly. Like as not, it won't turn the starter motor for very long! On the other hand, if the voltage on load is above 14.5 volts then the battery is definitely fully charged! However, if it remains that way for any length of time while the car is on the road, the vehicle's alternator-regulator system is faulty and the battery may be damaged by overcharging.

Reading the battery voltage can be done in a number of ways. You could use a digital panel meter, set up as a voltmeter. Their drawback is that they cost nearly ten times as much as a hydrometer! The next best method is to use an 'expanded-scale voltmeter'. Reading the voltage range between 11 and 15 volts on a meter face calibrated 0-16 volts is a squint-and-peer exercise. On a 0-30 volts scale, as used on many modern multimeters, it's worse. A meter which reads between 11 volts at the low end of the scale and 16 volts at the high end is ideal. Hence, the term 'expanded-scale'.

However, you don't want to be peering at a meter on the dash board when you're driving through traffic. The range of voltage over which your battery is healthy is some two volts. An indicator which simply requires the



THE OLD, RELIABLE lead-acid battery may be way ahead of what ever is in second place for vehicle electrical systems, but they do need a 'weather eye' kept on them. Particularly if they're out of warranty. The same applies to 'reconditioned' batteries, so often found in secondhand vehicles of some age.

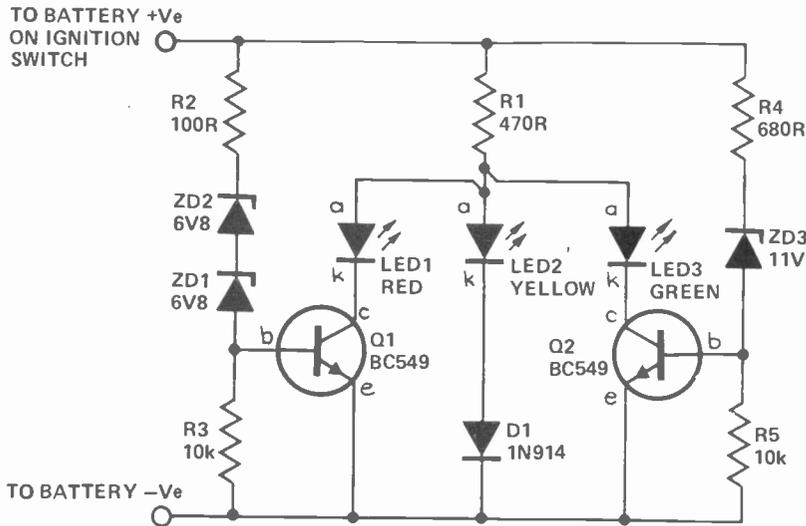
That's the problem with cars — running out of petrol and running out of battery produces the same heart-rending result. Immobility.

Most vehicles have a petrol gauge. Few have an equivalent for the battery. Many 'older' cars included a 'charging current' meter. This told you something about the car's generator-regulator and required some inter-

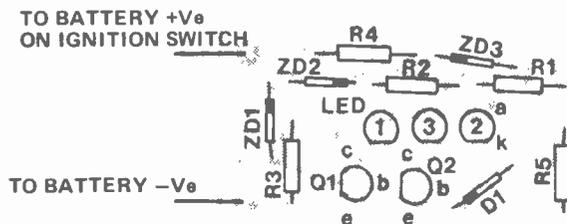
pretation to figure out whether the battery was in good health.

Probably the best way to check on the state of your battery is to use a hydrometer. However, hydrometers have a number of drawbacks. Being made of glass, they're fragile and can't be used while a car is in motion. The small amount of battery acid that remains on them presents a storage problem — the drips and fumes attack most metals and materials. They're okay for the corner garage but justifying their cost, for the occasional use they get in home workshops, is not always possible.

Another method of testing battery condition is by checking the voltage 'on load'. A lead-acid vehicle battery in a reasonable state of charge will have a



The circuit diagram and component overlay (below). During construction, make sure all of the diodes and LEDs are the right way round.



occasional glance, and needs no 'interpretation', is what is really needed.

With this project, that's exactly what we've done.

Go, caution, stop

We have devised a simple circuit that indicates as follows:

Yellow: battery 'low'
Green: battery okay
Red: battery overcharging

When the battery voltage is below 11.6 volts, a yellow indicator lights. This indicates the battery is most likely undercharged or a heavy load (such as high power driving lights) is drawing excess current. When it is between 11.7 and about 14.2 volts the green indicator lights, letting you know all is sweet. If the red indicator lights, as it will if the voltage rises above 14.2 volts, maybe the vehicle's voltage regulator needs adjusting or there is some other problem.

The circuit

The circuit is ingeniously simple, having barely a handful of parts. Reliability should be excellent.

We actually started out with a somewhat complex circuit. It used only two indicators and required you to 'interpret' what was happening. In trying to convert that to a yellow-green-red style of indication it sort of grew like topsy. This circuit had four transistors, a dozen resistors etc and didn't look at all attractive as a simple project that the average hobbyist or even handyman could build one Saturday afternoon and get going immediately. A rival circuit was devised by another staff member using a common IC. This sparked a controversy as to which was the better! Certainly, both did the job required... but maybe there was a simpler method.

It was discovered that different coloured light emitting diodes (LEDs), which we had decided to use for the indicators in the project, had different voltage drops when run at the same current. Seizing on this idea, the original circuit (four transistors, a dozen resistors...) was modified to exploit this characteristic and the simple circuit you see here was the result.

Construction

Construction is straightforward. If you haven't soldered electronic components before — and this project was designed for the motorist/handyman as well as electronics enthusiasts — then we suggest you practice on something before tackling this project. Soldering is one of those things like swimming or riding a bicycle, or sex — it's okay once ▶

HOW IT WORKS

This circuit depends for its operation upon the different voltage drops across different colour LEDs.

At 20 mA the voltage drops across red, yellow and green LEDs are typically 1.7, 3.0 and 2.3 volts respectively. When the vehicle battery voltage is too low to cause either ZD1/ZD2 or ZD3 to conduct, Q1 and Q2 are held off by R3 and R5. Under these conditions the yellow LED is forward biased and conducts via D1 producing a potential of about 3.7 volts at point A (see circuit diagram). When the supply rises above about 11.6 volts ZD3 conducts, biasing Q2 on. By virtue of its lower voltage requirements the green LED conducts, reducing the voltage at point A to approximately 2.6 volts. This is not enough to bias D1/LED3 on, so the yellow LED goes off. The green LED 'steals' the bias from the yellow LED. When the supply rises above about 14.2 volts, Q1 is biased on and the red LED 'steals' the bias from the green. The potential at point A falls to two volts and only the red LED conducts.

R1 limits the current through the LEDs. R2 and R4 limit the base currents into Q1 and Q2.

PARTS LIST

Resistors all ¼W, 5%
R1 470R
R2 100R
R3, R5 10k
R4 680R

Semiconductors

D1 1N914
ZD1, ZD2 6V8 400 mW zener
ZD3 11V 400 mW zener
Q1, Q2 BC547,8,9 or BC107, 8, 9 or common silicon NPN type

Miscellaneous

pcb
Aluminium angle bracket for under-dash mounting.

BUYLINES

Nothing to worry about here really, but make sure the LEDs are the correct colours, otherwise the voltage drops will not be correct!

you've done it once or twice but you don't practice out on the street!

We recommend you use the printed circuit board designed for this project. The actual layout of the components themselves is not critical but a printed circuit board reduces the possibility of errors.

It is best to mount and solder the resistors first. Follow this by soldering in the diodes D1 and the zener diodes ZD1, ZD2 and ZD3. Carefully follow the accompanying component overlay making sure the diodes are all inserted the correct way around. Next, mount the transistors, again referring to the overlay, checking to see they are inserted correctly before soldering.

Finally, mount the light emitting diodes. These too may only be inserted one way. Check with the component overlay and connection diagrams. Make sure they are in the correct sequence. On the component overlay, LED 1 is the red LED, located at the left. The yellow LED is on the right, marked with a '2'. The green LED, marked '3' is between them.

The circuit could be tested at this

stage if you have a variable power supply, or access to one. Simply vary the voltage across the range between 11 and 16 volts and note whether the LEDs light up in the correct sequence and close to the voltages indicated.

Mounting

As vehicles vary so much in dash panel layout, we can only make general suggestions.

Clearly, the indicator should be mounted such that the three LEDs are not in direct sunlight. A low part of the dash, but make sure it's readily visible from your normal driving position, will pretty well ensure the display may be easily read during the daytime. Alternatively, if you have an 'overhung' dash, or a portion which overhangs (usually where the instruments are mounted anyway), then a suitable position will generally suggest itself.

Exact mechanical details will have to be determined according to your particular situation. Two holes are provided in the board for mounting bolts. Alternatively, the whole assembly

may be mounted from the LEDs. Three LED holders inserted through part of the dash panel, or an escutcheon plate mounted on the dash, will hold the LEDs quite securely. Providing the leads on the LEDs are fairly short, the board will place little strain on them and the assembly should be mechanically secure.

Connection

The indicator may be installed in vehicles having positive or negative earth electrical systems.

The component overlay shows the connection for a negative earth vehicle. The 'battery +ve' lead goes to the ignition switch — the indicator only operates when the vehicle is being used — the battery negative lead should be taken to a good 'earth' point on the vehicle frame.

For a positive earth vehicle, the lead marked 'battery -ve' goes to the ignition switch connection, while the 'battery +ve' lead goes to the vehicle frame.

ETI

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CD4026	1.55	CD4050	0.43	CD4085	0.84				

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microfile.....

Henry Budgett wandered across the States in the name of Microfile. This is his report, and other small world shattering items that happened to crop up while he was away.

Pets In Business

THE LONG AWAITED PET add-on's have arrived at last, honest! Launched at a Cafe Royal press conference was a new PET based business system with a price tag of £2,500 excluding software. Utilizing the new, large-keyboard 32K machine with Commodore's own dual disk drive and tractor-fed printer it forms the cheapest small business system yet available. The software is being written by a new division of ACT, Petsoft's parent company, called PETACT and will cost between £225 for a single package to about £800 for a complete suite of programs. It will be available in either disk or cassette format and is the first business software for a micro to be written by a professional software house. The software price also includes a day's training for an employee.

We rather thought that the printer was never going to arrive as it was trapped at Heathrow in customs but it surfaced during the Champagne and Orange cocktails and appeared to be of high quality. The second reason for the Press reception was to announce the forming of an "endorsement" scheme for non-Commodore produced PET add-on's, the PETACT software being the first product to be launched under the scheme.

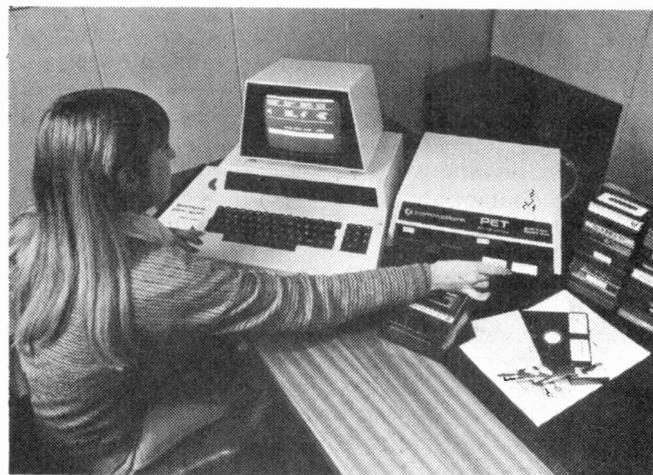
Deliveries of the new style PET's have started and should be available in most areas now, the disks and printers will start to appear in mid-May at some of the 100 dealers and will hopefully be generally available within a couple of months. Chuck Peddle the father of the PET and KIM was at the reception and gave a strong indication that new and exciting things were on the way in connection with both machines, memory expansion being one possibility.

On a final note the sales of the UK machine were around 3000 during 1978 and this figure had been reached by the end of April of this year, the market is still growing.

NASCOM With Added Plus

After the phenomenal success of the NASCOM I (150,000 sales worldwide) the company have announced a new single board machine called NASCOM II.

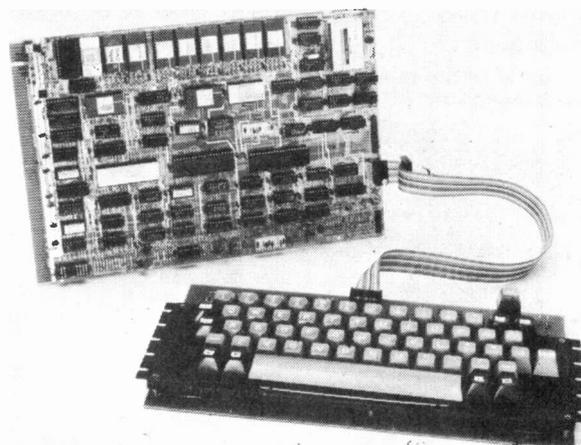
Although it is physically the same size as the 'I' and uses the same bus structure it is not intended as a simple upgrade but rather as a new starting point in the home computing market. Based on the Z80A it offers a 75% increase in processing speed along with an 8K Microsoft BASIC in ROM. Several new features are included on the machine, a new 2K monitor with many improvements over the T4, A CUTS cassette interface, 8K of user RAM and a new extended keyboard. The interfaces supplied include an on-board UART for the RS232 or the cassette interface, capable of running at 300 or 1200 Baud, and an uncommitted P10 for two 8 bit ports. The video is run from a 1KA RAM with a 2K character generator, an optional socket is supplied for another 2K graphics ROM which is software selectable.



Above and below: the new bits for PET.



Below: the new more powerful NASCOM.



Both the new monitor and the BASIC can be used with the 'I' and all the peripherals for the 'I' can be used with the 'II' making it the basis of a very nice OEM system. The circuit board is of the usual superb quality and the kit will be available from June at £295 ex VAT. We hope to get our hands on one to review soon and this will be published in CT as close to the release date as possible.

Clubbing Together

A couple of new clubs have sent us details of themselves this month. The first is the Sorcerer Programme Exchange Club, SPEC, which has been formed to promote the Exidy Sorcerer. Rather than having an actual club they are aiming to become an information exchange on useful hints and programs for the machine and would be most grateful for anyone who has some to send them in. The people to contact are Mr G. F. Counsell and Mr M. P. Hannaby at 65 Trafalgar Road, Birkdale, Southport, Merseyside.

The second club is the South Yorkshire Personal Computing Group, SYPCG, who are appealing to people in the area interested in do-it-yourself computing. They hope to meet on the second Wednesday of each month with a variety of topics under discussion. Membership is £3 for 1979 and the meetings will be held at 7.00pm in the University of Sheffield. For further information you should contact the Secretary, Mr Tony Rycroft, at 88 Spinneyfield, Moorgate, Rotherham, S. Yorkshire.

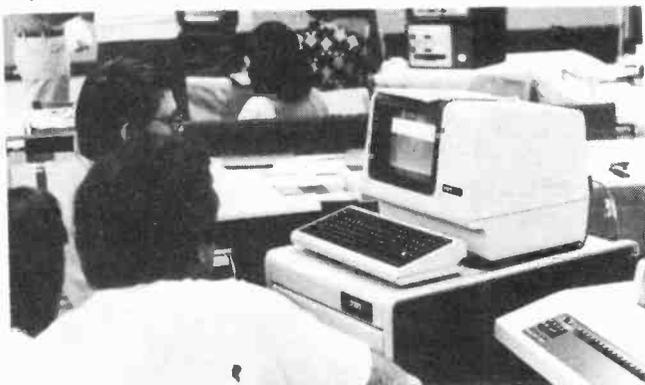
Showing It Off USA Style

I spent a pleasant weekend in Orlando, Florida, last month at a micro-show. It really was a micro-show, dealing with the machines and also being very small. However this was really an advantage as it allowed free and personal access to the exhibitors rather than the situation which arises at some of the UK exhibitions. The variety of machines was impressive, ranging from an IAM65 to an LSI 11, but there were no PET's, KIM's or Superboards which was rather surprising. The only new machine there was an Z80 based S100 system called Informer which also used an SC/MP for keyboard and video control. Supplied either with or without an integral floppy it looked impressive but is unlikely to appear on this side of the Atlantic.

The show also featured a siminar programme, again on a very informal and personal level which resulted in a most entertaining question and answer forum. The whole show was most professionally run and I only wish that some of the UK shows could adopt a similar attitude and become smaller and more personal instead of bigger and unhelpful.

ETI

The biggest business system at the show, an LSI 11 with dual floppies being used for stock control.



The familiar Apple II with a speech recognition board installed. It worked remarkably well and 'echoed' back your word through a synthesizer.



New TRS 80 printer. Will it reach us, we wonder.

A Texas system with dual floppies and integral thermal printer as well as a Centronics 702 on-line. It played a mean game of Star Trek!



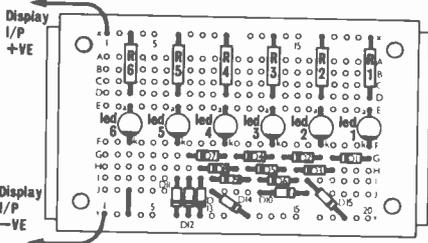
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ELECTRONICS BY NUMBERS LED BAR GRAPH UNIVERSAL INDICATOR

Now using **EXPERIMENTOR BREADBOARDS** and following the instructions in "Electronics by numbers" ANYBODY can build electronic projects.

Look at the diagram and select R1, this is a resistor with a value between 120 to 270 ohm. Plug it into holes X20 and D20, now take LED 1 and plug it into holes E20 and F20. Do the same with the Diodes e.g. plug D7 into holes G7 and G10.



YOU WILL NEED

EXP. ANY EXPERIMENTOR BREADBOARD

D1 to D15 - Silicon Diodes (such as 1N914)
R1 to R6 - From 120-270 ohm resistors ¼ watt.

LED1 to LED6 - Light emitting diodes.

LED BAR GRAPHS are replacing analogue meters as voltage-level indicators in many instances.

This circuit uses the forward voltage drop of diodes to determine how many LEDs light up. Any type of diode can be used but you must use all the same type. For full working details of this circuit fill in the coupon. If you have already built the Two-transistor Radio and the Fish'n'cliks projects you will find that you can reuse the components from these projects to build other projects in the series.

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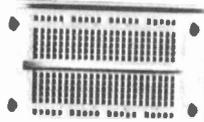
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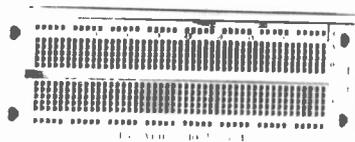
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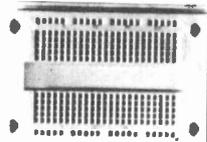


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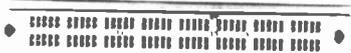


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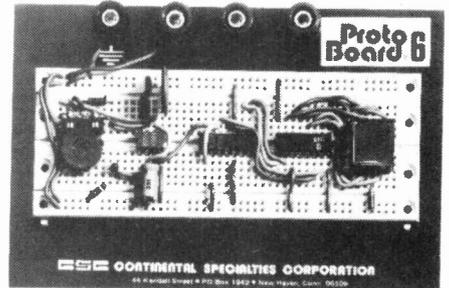
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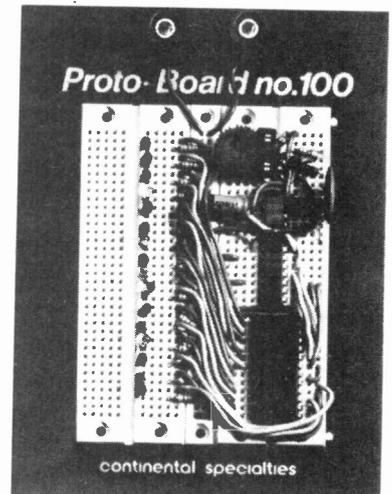
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<p>Terms. Cash with order (official orders welcomed from colleges etc) 30p postage please unless otherwise shown. VAT inclusive prices. S.A.E. for new illustrated lists.</p>	<p>PROGRESSIVE RADIO 31 CHEAPSIDE, LIVERPOOL L2 2JD</p>				

MINESWEEPER PROGRAM FOR TI 58 & 59

Mine Sweeper

E. A. Johnson

The object of the game is to locate and destroy a moving minesweeper. The ship moves along a set course, but, to avoid destruction it can deviate slightly from the course and alter its speed.

Playing the game

The game is started by entering a number (in the range 0 to 1) into register E, to set the initial position of the minesweeper through a random number generator. A shot is made by entering the xy co-ordinates (into the A and B registers respectively) of the square where the ship is believed to be. The calculator determines the position of the ship and displays the distance by which the shot missed. If the shot is within five units of the ship, damage occurs which slows the ship down in proportion to the nearness of the shot. When the ship is destroyed the display flashes.

After the ship has been destroyed, the number of shots used can be displayed by pressing 'C', and a new game can be started by pressing 'D'.

Method of calculation

The initial value of Θ , which determines the ship's position is determined using the calculator's random number package. The ship's co-ordinates are then calculated by the following equations:

$$x = (50 + 45 \cos 3\Theta) + RNUMX$$

$$y = (50 + 45 \sin 2\Theta) + RNUMY$$

where RNUMX and RNUMY are random numbers (in the range of -3 to +3) to give the ship its avoiding action.

The distance of the shot from the ship is calculated using pythagoras and displayed in integer mode.

The next value of Θ is then given by

$$\Theta = \Theta + \Theta INCR$$

where $\Theta INCR$ is originally set to 5, the calculator then determines the new co-ordinates of the ship.

When the distance of the shot from the ship is less than five units, the value of $\Theta INCR$ is reduced to slow the ship down. The new value is given by $\Theta INCR = \Theta INCR - (5 \div \text{distance})$.

The above procedure continues until $\Theta INCR \leq 0$ when the ship is destroyed.

A new game, if required, is started by automatically generating a new random initial value of Θ .

LOC	CODE	KEY					
000	43	RCL	03	3	00	0	
	01	1	58	Fix	65	x	
	44	SUM	00	0	02	2	
	00	0	36	Pgm	54)	
	43	RCL	15	15	38	som	
	02	2	71	SBR	71	SBR	
	91	R/S	88	D.MS	33	X	
	76	Lbl	65	X	85	+	
	33	X	03	3	05	5	
	65	x	06	6	32	x \blacktriangleright t	
010	04	4	00	0	95	=	
	05	5	95	=	34	\sqrt{x}	
	85	+	42	STO	090	42	STO
	05	5	00	0	02	2	
	00	0	25	CLR	77	x \geq t	
	85	+	91	R/S	00	0	
	36	Pgm	76	Lbl	00	00	
	15	51	11	A	55	\div	
	71	SBR	69	Op	32	x \blacktriangleright t	
	88	D.MS	23	23	95	=	
020	65	x	75	-	35	1/x	
	06	6	53	(22	INV	
	75	-	43	RCL	100	44	SUM
	03	3	00	0	01	1	
	95	=	65	x	29	CP	
	33	X	03	3	43	RCL	
	92	INV SBR	03	3	01	1	
	76	Lbl	54)	77	x \geq t	
	15	E	39	cos	00	0	
	42	STO	71	SBR	00	00	
030	09	9	33	X	25	CLR	
	76	Lbl	32	x \blacktriangleright t	35	1/x	
	14	D	00	0	22	INV	
	05	5	91	R/S	58	Fix	
	42	STO	76	Lbl	91	R/S	
	01	01	12	B	76	Lbl	
	00	0	75	-	13	C	
	42	STO	53	(25	CLR	
			53	(43	RCL	
			43	RCL	03	3	
					91	R/S	

Example Game

Comment	Enter	Display
Enter a number between 0 & 1	0.258 E	0
Enter guess for x co-ordinate	50 A	0
Enter guess for y co-ordinate	11 B	65 (Distance)
x co-ordinate	84 A	0
y co-ordinate	70 B	62
x	40 A	0
y	85 B	7
x	43 A	0
y	87 B	3
x	51 A	0
y	89 B	3
x	54 A	0
y	90 A	9.999999 99 (Flashing)
To display number of shots	C	6
To start a new game	D	0
x co-ordinate	50 A	0
y co-ordinate	11 B	42
ETC.		

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, 25-27 Oxford St., London W1R 1RF.

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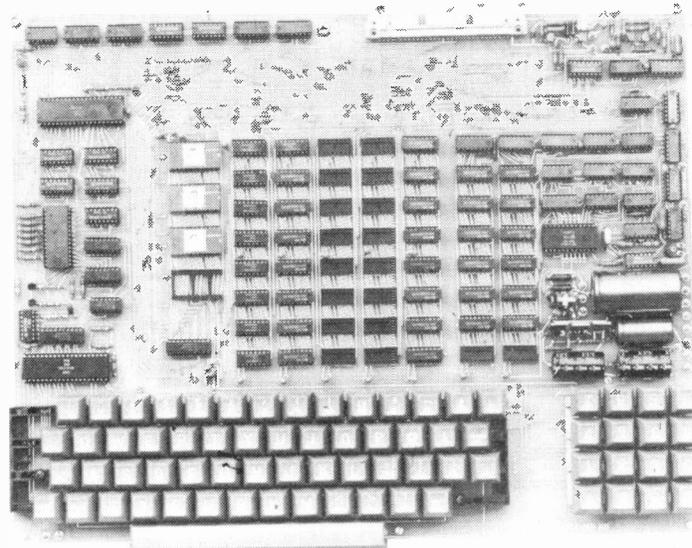
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Lunar Landing

Sarah J. Owen.

Recommended periods for Retro-rocket firing

This program was devised for use on the Commodore PR.100 calculator, but is easily adapted for use on any other programmable ones. Imagine you are the Astronaut controlling the final descent of a lunar module, at regular intervals the speed of descent is displayed, the period of burn of the retro-rocket has to be calculated, after allowing for the reducing weight of the fuel on board. Five speed corrections are allowed, after which the final impact velocity is displayed. If an error is made and all fuel is used, there is just time to transmit an urgent S.O.S. message before destruction on the lunar surface. Due to the lack of program space, the method of selecting the initial random speed is unusual, but ranges between 20 and 100 m.p.h.

SPEED	BURN	
5	1.6	180
7	1.9	200
10	2.3	220
15	2.7	250
20	3.0	270
30	3.4	300
40	3.7	330
50	3.9	365
60	4.1	400
70	4.2	450
80	4.4	500
90	4.5	550
100	4.6	600
110	4.7	660
120	4.8	730
130	4.9	800
150	5.0	900
160	5.1	1000

PROGRAM

Result of impact speed:—

0 — 5 m.p.h. PERFECT LANDING
 6 — 10 m.p.h. SLIGHT DAMAGE,
 LIFT OFF DELAYED.
 11 — 15 m.p.h. STRUCTURAL DAMAGE
 LIFT-OFF DOUBTFUL
 16 — 25 m.p.h. SEVERE DAMAGE &
 INJURY — USE
 SUICIDE PILL.
 ABOVE
 25 m.p.h. MODULE & ALL
 LIFE DESTROYED . . .

SET UP:—

F—CA—F—FP—8—GOTO—00
 Mode switch to load — enter program —
 mode switch to run — goto — 00 enter
 any two or more numbers (date etc.)
 Each followed by Xn key. Press R/S —
 speed of descent displayed.
 Allow for weight of fuel remaining,
 enter period (in seconds) of rocket burn
 to reduce speed, press R/S — new rate
 of descent displayed, correct as before.
 After five speed corrections, impact
 speed will be displayed. If fuel in
 excess of 20 seconds is used, module
 transmits an urgent message before
 destructing.
 Press R/S to re — start.

LOC	CODE	KEY	Memory 1 — Seconds of fuel left	Memory 0 — Accurate descent speed	
00	21	F	36	85	—
01	63	S	37	52	MR
02	21	F	38	81	1
03	51	FRAC	39	85	—
04	74	X	40	52	MR
05	81	1	41	91	0
06	91	0	42	74	X
07	95	=	43	95	=
08	51	M	44	35	x
09	91	0	45	51	M
10	53	Xn	46	91	0
11	82	2	47	52	MR
12	91	0	48	81	1
13	51	M	49	94	+/-
14	81	1	50	15	SKIP
15	71	4	51	14	GOTO
16	51	M	52	73	6
17	82	2	53	63	9
18	52	MR	54	52	MR
19	91	0	55	82	2
20	74	X	56	85	—
21	62	8	57	81	1
22	84	+	58	95	=
23	52	MR	59	15	SKIP
24	81	1	60	14	GOTO
25	95	=	61	81	1
26	51	M	62	73	6
27	91	0	63	52	MR
28	21	F	64	91	0
29	52	INT	65	13	R/S
30	13	R/S	66	14	GOTO
31	21	F	67	91	0
32	85	M—	68	91	0
33	81	1	69	72	5
34	21	F	70	91	0
35	32	e ^x	71	72	5

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- ★ On board expansion for additional 161 / 0 lines
- ★ Memory may be expanded to full 60K



SOFTWARE

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- ★ 8 operating commands, supporting Mem examine / modify, tabulate, copy, break, single step execute tape load, tape dump
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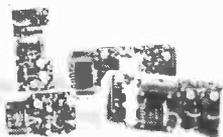
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A five digit number (no two digits the same) is set by one player, and then the second player must deduce what it is. There are 30,240 possibilities.

After each guess the calculator indicates how many digits in the guess were correct and in the right position, and how many were correct but in the wrong position.

To play:

Player A enters a 5 figure number and then presses GSB 1.

Player B enters his guess and presses R/S. After several seconds calculation the display shows a number such as 1.2 which means 1 digit in the right place and 2 more correct figures but in the wrong position.

Player B then enters another guess and presses R/S, etc. until he achieves a score 5.0.

For cheats (!) or if the number set has been forgotten, it is held in STO .5.

The use made of the calculators stores is shown below.

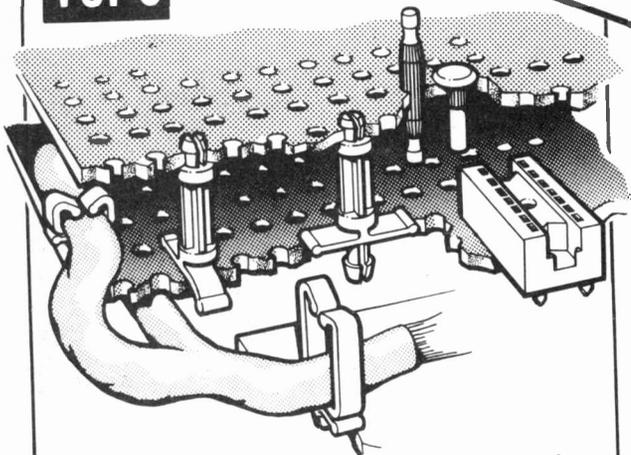
If the number set was ABCDE, and the guess is FGHIJ, then:

STO 0	Used
1	J
2	I
3	H
4	G
5	F
6	Used
7	Used
8	Used
9	Used
.0	E
.1	D
.2	C
.3	B
.4	A
.5	ABCDE

<u>STEP</u>	<u>INSTRUCTION</u>	<u>STEP</u>	<u>INSTRUCTION</u>
01	gLBL1 fFIX1 STO.5 1 4 CHS GSBO gLBL9 0		STO i fLAST x gFRAC
10	STO7 STO8 R R/S (Enter guess) 5 CHS GSBO 1 STOO gLBL5	50	1 0 x gISZ GTO 2 RTN gLBL 4 1 4 STO 9
20	RCLi 9 STO+0 x ≥ y RCLi — gx = 0? GSB3 8 STO-0	60	gLBL6 RCL 9 STO 0 RCL i STO 6 5 STO 0 gLBL 7 RCL i RCL 6
30	RCL0 6 fx = y? GTO4 GTO5 gLBL3 1 STO+7 RTN gLBL0	70	— gx = 0? GSB 0 gDSZ GTO 7 1 STO-9 RCL 9 9 fx ≠ y?
40	STO 0 x ≥ y EEX 4 ÷	80	GTO 6 RCL 7 STO-8 1 0 STO÷8 x ≥ y RCL 8 + GTO 9
45	gLBL2 fINT	90	gLBL 0 1 STO+8 RTN

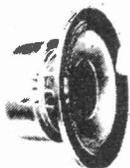
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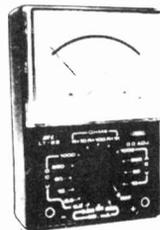


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11.50

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DC current:- 0 to 0.05, 25, 250 ma
Resistance:- 0 to 300, 3K, 30K, 50K, 500K, 5 meg ohms
Decibels:- -20 to +62 db
Size:- 5 x 3½ x 1½ inch

MM3 Y7206EN 20,000 opv



11.80

AC volts:- 0 to 10, 50, 250, 500, 1000
DC volts:- 0 to 0.5, 5, 25, 125, 250, 500, 1000
DC current:- 0 to 0.05, 5, 250 ma
Resistance:- 0 to 3K ohms, 300K ohms, 3 meg ohms
Decibels:- -20 to +63 db
Size:- 5 x 3½ x 1½ inch

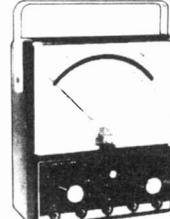
MM7 C7200EM 20,000 opv



16.00

AC volts:- 0 to 6, 30, 120, 300, 600, 1200
DC volts:- 0 to 6, 30, 120, 600, 1200, 3000, 6000
DC current:- 0 to 60 ua, 6 ma, 60 ma, 600 ma
Resistance:- 0 to 6K, 600K, 6 meg, 30 meg, 60 meg
Decibels:- -20 db to +63 db
Size:- 6 x 4½ x 2 inch

MM8 PROE 20,000 opv



27.75

AC volts:- 0 to 2.5, to 0/5000 in 6 ranges
DC volts:- 0 to 0.25 to 0/5000 in 8 ranges
DC current:- 0 to 50 ua, to 0/10 amps in 6 ranges
Resistance:- 0 to 12 ohms, to 0/20 meg ohms in 6 ranges
Decibels:- -20 to +50 db
Size:- 7½ x 6½ x 2½ inch

MM11 7081GN 50,000 opv



20.80

AC volts:- 0 to 1.5, to 0/500 in 10 ranges
DC volts:- 0 to 0.5, to 0/500 in 12 ranges
DC current:- 0 to 25 ua, to 0/10 amps, 10 ranges
Resistance:- 0 to 100 ohms, to 0/16 meg ohms in 4 ranges
Decibels:- -20 to +62 db
Size:- 6½ x 4½ x 2¼ inch

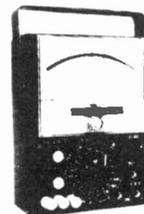
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22.20

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Resistance:- 0 to 6K, 60K, 6 meg, 60 meg, -20 to +56 db
Short test:- Internal buzzer
Size:- 160 x 110 x 55mm

MM14 360TR 100,000 opv



32.50

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AC current:- 10 amp
Resistance:- 0 to 5K, 50K, 5 meg, 50 meg ohms
Decibels:- -10 db to +62 db
Transistors:- usual measurements of NPN and PNP
Size:- 7 x 5½ x 2½ inch

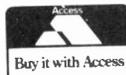
MM1 LT101



1,000 opv

5.80

AC volts 0 to 10, 50, 250, 1000
DC volts 0 to 10, 50, 250, 1000
DC current 0 to 1 ma, 100 ma
Resistance 0 to 3K ohms
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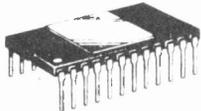
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UNDERSTANDING DIGITAL ELECTRONICS

In the years ahead the products of digital electronics technology will play an important part in your life. Calculators and digital watches are already commonplace. Tomorrow a digital display could show your vehicle speed and fuel consumption; you could be 'phoning people by entering their name into a telephone which would automatically look up their number and dial it for you.

These courses were written by experts in electronics and learning systems so that you could teach yourself the theory and application of digital logic. Learning by self-instruction has the advantages of being faster and more thorough than classroom learning. You work at your own pace and must respond by answering questions on each new piece of information before proceeding.

After completing these courses you will have broadened your career prospects and increased your fundamental understanding of the rapidly changing technological world around you.



Digital Computer Logic and Electronics is designed for the beginner. No mathematical knowledge other than simple arithmetic is assumed, though the student should have an aptitude for logical thought. It consists of four volumes - each A4 size - and serves as an introduction to the subject of digital electronics. Everyone can learn from it - designer, executive, scientist, student, engineer.

Contents include: Binary, octal and decimal number systems; conversion between number systems, AND, OR, NOR and NAND gates and inverters; Boolean algebra and truth tables; De Morgans Laws; design of logic circuits using NOR gates; R-S and J-K flip flops; binary counters, shift registers and half adders.

FLOW CHARTS & ALGORITHMS help you present: safety procedures, government legislation, office procedures, teaching materials and computer programs by means of YES and NO answers to questions.

The Algorithm Writer's Guide

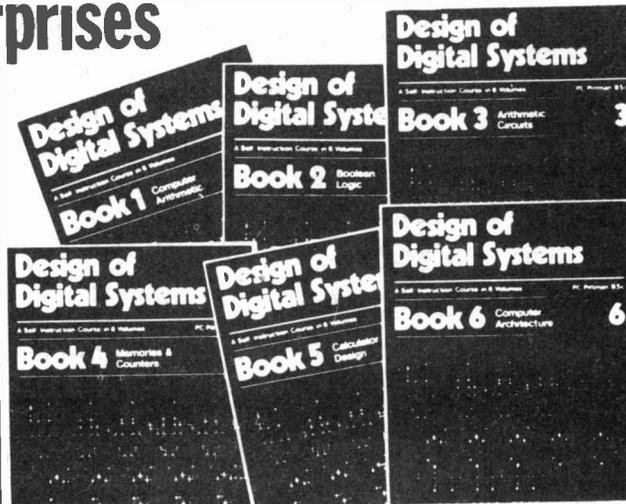
explains how to: define the questions, put them in the best order and draw the flow chart, with numerous examples shown. All that students require is an aptitude for logical thought. Size: A5, 130 pages. This book is a MUST for those with things to say.

NEW from Cambridge Learning Enterprises

O - LEVEL ENGLISH LANGUAGE

More and more jobs require a C-GRADE PASS, and over 250,000 people fail to get this every year. Will one of them be in your family? This new course, written by experts in a style that's serious yet fun to read, shows you how to mark your own work and compare it with the work of other people in their exam year. Set your own pace and assess your results immediately with no postal delays: watch your speed and standards improve. In Book 1 learn how you will be marked on COMPREHENSION, Book 2 covers SUMMARY, PUNCTUATION & SPELLING, and Book 3 coaches you in the principles of COMPOSITION. Size: 3 A4 volumes totalling 250 pages.

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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 number systems; representation of 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 decoding; control programme structure.

Book 6 Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.

Four volumes Digital Computer Logic & Electronics at £6.50 inc p
 Six volumes Design of Digital Systems at £10.50 inc p & p
 Three volumes O-Level English Language at £6.50 inc p & p
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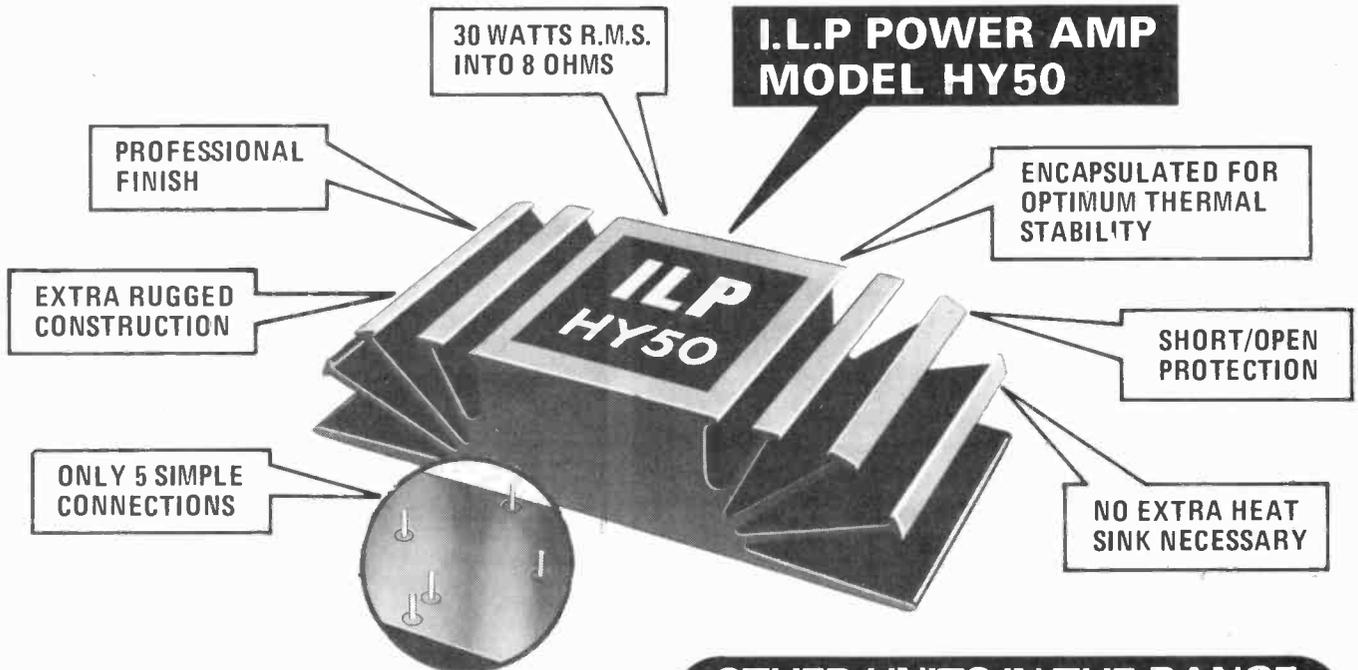
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Of all the purpose-built power amplifier modules by I.L.P., the HY50 is understandably the most popular with those wanting to build new or up-grade an existing hi-fi system, run a small high quality P.A. system, amplify a musical instrument (say for practice or small range use) or use it for lab work. Its useful 30 watts RMS output into 8 ohms, its rugged construction and freedom from heatsink worries make it the ideal all-purpose quality power amp — and it is unconditionally guaranteed for five years! Tens of thousands are in regular use throughout the world.

...and a spec that means what it says!

Encapsulated power amp with integral full-rated heatsink.
Input — 500mV.
Output 30 watts RMS/8Ω.
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Nothing has been overlooked in the design and manufacture of I.L.P. Modular Units. Heavy duty heatsinks, encapsulated circuitry, no-compromise production standards and true professional finish ensure world leadership in their field for I.L.P. Now we have **up-graded** output ratings and **down-graded** prices to bring I.L.P. within easier reach of all who want the best with which to build with. Prices reduced by an average around 20%.

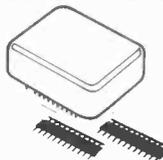
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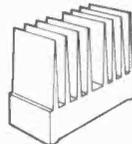


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HY5 PRE-AMPLIFIER

Compatible with all I.L.P. power amps and P.S.U.s. In a single pack, needs external pots and switches. Multi-function equalization, Mag./Ceramic/Tuner/Mic./Aux. inputs. High overload margin. Active tone controls; 500 mV out. Distortion at 1 KHz — 0.01%. Two HY5s connect easily for stereo.

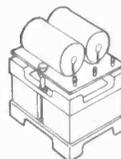
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THE POWER AMPS

With heatsinks, full load line and thermal protection.
Distortion typically 0.05% at 1 KHz.

HY120	60 Watts RMS/8Ω	114 x 50 x 85mm	£16.42
HY200	120 Watts RMS/8Ω	114 x 50 x 85mm	£19.92
HY400	240 Watts RMS/4Ω	114 x 100 x 85mm	£29.89



THE POWER SUPPLY UNITS

(Split line outputs to suit I.L.P. power units and HY5).

PSU 50	for 1 or 2 x HY50	£9.11
PSU 70	for 1 or 2 x HY120	£14.70
PSU 90	for one HY200	£14.70
PSU180	for one HY400 or 2 x HY200	£24.86

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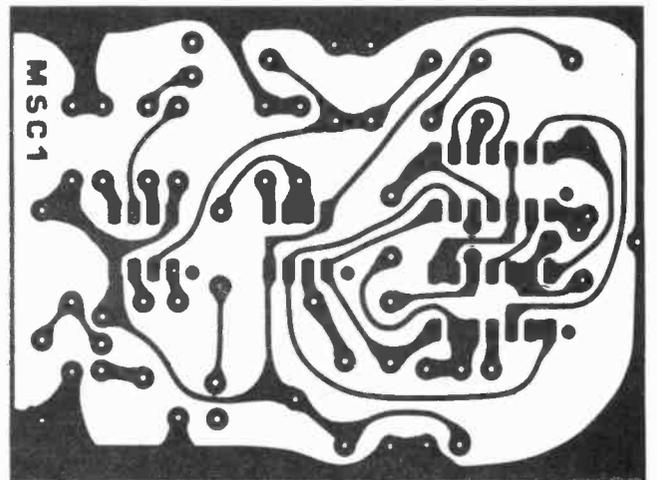
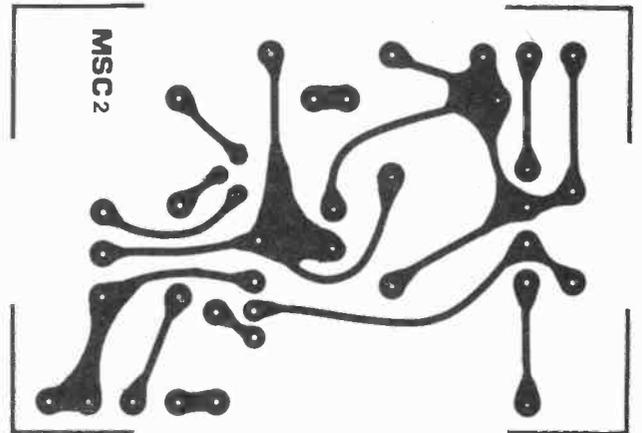
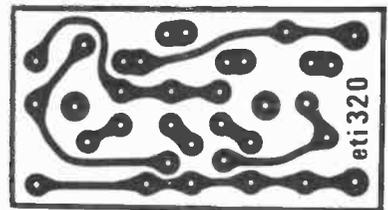
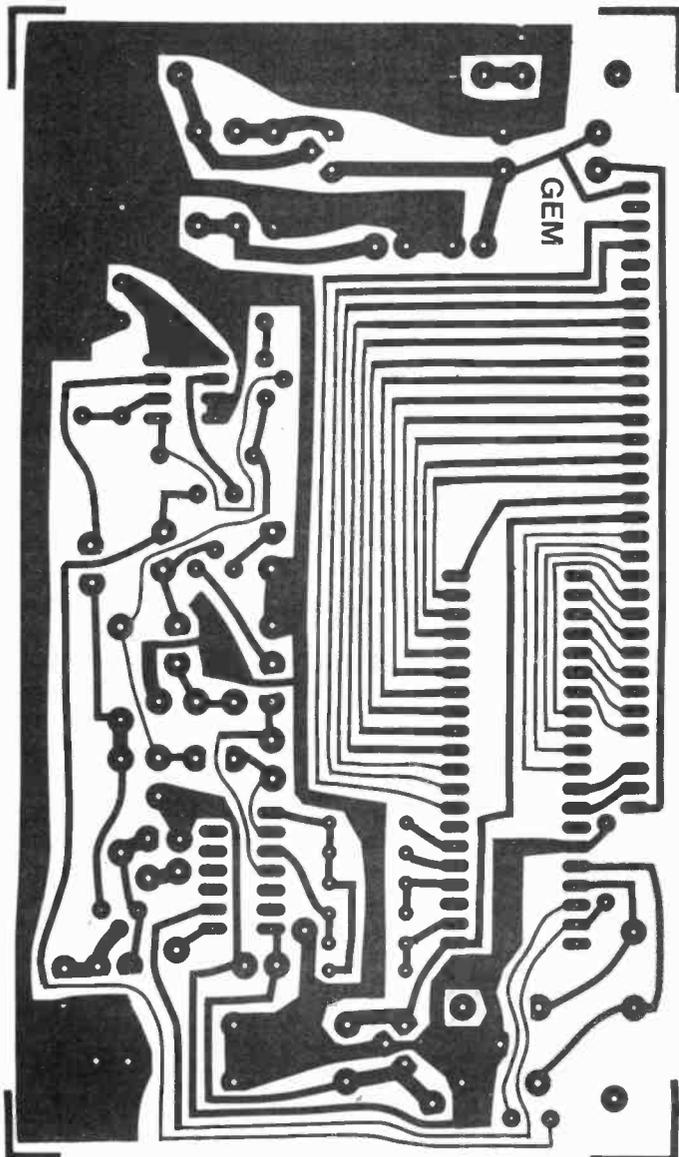
PCB FOIL PATTERNS

GATHERED HERE are all the PCBs for this month's projects.

All are shown foil side up, and full size. Companies wishing to produce these for sale as ready made PCBs should note that where the board carries a copyright symbol, the designer retains that copyright to himself, so his company,

and that particular board may not be produced on a commercial basis.

These pages form the basis of our ETIPRINT sheets, which are etch resistant transfers of the foil patterns, designed to simplify one-off PCB production.



Come to the Great British Electronics Bazaar

WALLY PALLY!
Thursday-Saturday
28th-30th June.

FREE!

(AND WAIT TILL YOU SEE OUR SEMINAR PROGRAMME)

The Great Big 'Bazaar' for the hobbyist, amateur, and small buyer.

There's never been an event like this before.

First, the very scale of the exhibition is huge. Virtually all the companies you're used to hearing about (and buying from) will be there. Companies like Fluke and Gould showing off their low cost multimeters; smaller but important manufacturers like Lektrokit and Chromasonics; and even the R.S.G.B. who will have a station 'on the air' throughout the 'Bazaar.'

Then there are the suppliers of low-cost components and equipment. Plus almost all the journals in the business. Plus, oh, so many more interesting people catering for your needs (including computer kits!).

And you get in FREE if you send an s.a.e. (see alongside).

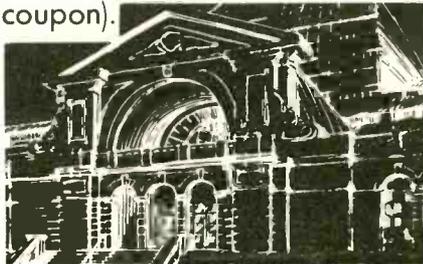
Our Symbol.
We think it tells
you just what the
Bazaar is all about.



The Seminars.

If you would like to hear just what the experts have to tell you, a *season ticket* for three whole days can be yours for only £1.50.

Send an s.a.e. and we'll give you all the information (just use the coupon).



Our home for three days - Alexandra Palace, where it all began. (Our seminars are sited alongside the organ - for those who know this unique hall.)

SEMINAR TICKETS

£1.50.

I'd like to sit in at your seminars. (And like a free ticket to the exhibition.) Send me full details, please, and I enclose a large-ish s.a.e.

Name:

Address:

Post to: 'The Bazaar,' 34/36 High Street, Saffron Walden, Essex.

When?

Between Thursday to Saturday 28th-30th June.

You'll be in very good company; some ten thousand enthusiasts - and over a hundred stands displaying all that you want to see.

You'll come?

Eyes down for the appropriate coupon.

ADMISSION FREE

(or 50p on the door).

I'd like to see 'The Bazaar' FREE. I enclose a large-ish s.a.e. and will receive by return a ticket and full information.

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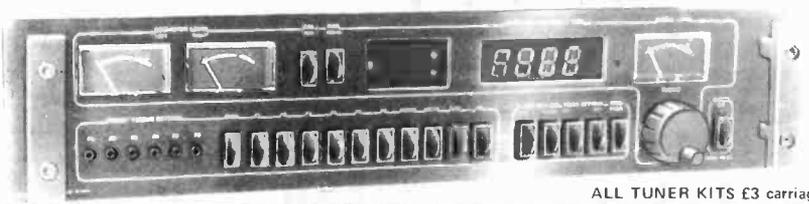
Post to: 'The Bazaar,' 34-36 High Street, Saffron Walden, Essex. If you'd rather just pay 50p, go to Wood Green Tube Station and take a bus (every 3 minutes) to Alexandra Palace. We're open 10 am-6 pm daily, Thursday to Saturday, 28th-30th June.

Tecknowledghey for sale.

The Mark III FM Tuner

DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically & visually superior to all others. Some options available, but the illustrated version with reference series modules: £149.00 + £18.62 VAT

With Hyperfi Series modules £185.00 + £23.12



Features of the system:

- Precision construction & design of all parts
- True frequency display
- State of the art performance with facilities for updates, using modular plug-in systems.
- Deviation level calibrator for recording
- All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

A multiband superhet tuner, constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon) £33.00 + £4.12 VAT
Complete with digital frequency readout/clock-timer hardware £99.00 + £12.37 VAT
Complete with MA1023 clock/timer module with dial scale £66.00 + £8.25 VAT

Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Update your old radio, or build this into a new design. Or use it as a servicing aid - this low power unit with LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency.

Low power LCD means no RF! - 15-20mA at 9v even with the divide by 100 prescaler. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV

Complete kit £19.50 + £1.56 VAT. Built and tested version £24.00 + £1.92 VAT
Various other DFM systems described in our catalogue part 2 - including a one chip solution to providing digital display of FRG7 kHz dial, combined with clock/timers etc.



PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction "Sandbanks". Now with injection molded casing for greatly improved environmental sealing. £37.00 + £2.90vat.

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design - but using standard 3rd OT crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 + £3.90vat.

ETI - REMCON RADIO CONTROL

A tried and tested RC system with a full set of supporting hardware from a well known manufacturer. Please send for details - and watch our ads for further news of developments in RC products.

Radio and Audio Modules - The biggest range/ best specs:

EF5801/3/4 6 stage varicap tunerheads with LO feed and various levels of sophistication. New 5804 include pin AGC loop 'on board'. 5801: £17.45+£2.18vat. 5803: £19.75+£2.47vat. 5804: £24.95 +£3.18vat. Frequencies in 40-180MHz on approx.

EF5402 4 stage varicap with TDA1062, compound FET/Bipolar input stage, low noise, balanced mixer, pin agc, osc output. A worthy successor to the 5400. £10.75+£1.34vat

The 5402 is available centred on a wide range of frequencies from 30MHz to 180MHz. Non standard units £14.75+£1.84 - 3 weeks. 8319 4 stage varicap tunerhead from Larsholt using MOSFET RF and mixer stages. New temperature compensated oscillator for wide ranges of ambient temperature £13.45+£1.68vat

7252 Complete Larsholt FM tuner less stereo decoder. £26.50+£3.31vat
7253 Stereo FM tunerhead from Larsholt with FET head. (as 7252)
944378 Hyperfi stereo decoder. The very best. £19.95+£2.49vat
911223 Pilot cancel stereo decoder, priced to make the MC1310 as obsolete as it now deserves to be. £12.50+£1.56vat

Inotec 1-A fully DC tuned and switched LW/MW/FM stereo tuner to interface with synthesiser control etc. A first! Details OA

COMPONENTS for Radio and Audio ICs, HMOS etc.

The list is too long to attempt here, but AMBIT specializes in all types of semiconductor for radio reception, including devices operating from DC to 5GHz. New low cost SBL1 diode ring mixers (equiv case MD108 etc) - first with HMOS fets, now with a PCB for DC amplifier, and offset sense and protection relay for speakers. See catalogue and updates for most info, please send an SAE for information on anything you cannot find in catalogues.

Radio ICs	cost + vat	Stereo ICs	cost + vat	AF power ICs	cost + vat
CA3089E	1.94 24	MC1310P	1.50 19	LM380N	1.00 12
CA3189E	2.45 30	uA758	2.20 27	TBA810AS	1.09 14
HA1137W	2.20 27	CA3090A	2.75 34	TDA2002	1.95 24
SN76660	0.75 9	HA1196	3.95 49	TBA820M	0.75 9
TDA1090	3.35 42	HA11223	4.35 54		
TDA1083	1.95 24	KB443	4.35 54		
TDA1220	1.40 17	KB2224	2.75 34		
SL6640	2.75 34	Preamp ICs/switches			
MC3357	3.12 39	TDA1028	3.50 44		
HA1197W	1.40 17	TDA1029	3.50 44		
MC1496	1.25 16	TDA1074	4.14 52		
LM373/4	3.75 49	KB4438	2.22 28		

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are your very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering.

TTL Standard AND LP Schottky

N'	LSN'	N'	LSN'	N'	LSN'	N'	LSN'	N'	LSN'	
7400	13	20	7465	35	24	74126	57	44	74185	134
7401	13	20	7460	17		74128	74		74188	275
7402	14	20	7463	17		74132	73	92	74190	115
7403	14	20	7470	28	124	74133	79		74191	115
7404	14	24	7472	28		74136	40		74192	105
7405	18	26	7473	32	38	74138	60		74193	105
7406	38		7474	27	38	74139	60		74194	105
7407	38		7475	38	40	74141	26		74195	95
7408	17	24	7476	37	38	74142	56		74196	99
7409	17	24	7478	38	38	74143	312		74197	85
7410	15	24	7480	48	38	74144	312		74198	150
7411	20	24	7481	66		74145	65	97	74199	160
7412	17		7482	69		74147	75		74445	92
7413	30		7483A	99	110	74148	109	191	74447	90
7414	51		7484	97		74150	99		74449	140
7415		24	7485	104	99	74151	64	84	74450	110
7416	30		7486	40	40	74153	64	54	74451	90
7417	30		7489	205		74154	96		74452	105
7420	16	24	7490	33	90	74155	54	110	74453	108
7421	29	24	7491	76	110	74156	80	110	74454	153
7422	24	24	7492	38	78	74157	67	55	74455	124
7423	27		7493	32	99	74158	57		74456	124
7425	27		7494	78		74159	210		74457	124
7426	36	27	7495A	65	99	74160	82	130	74458	124
7427	27	29	7496	58	120	74161	92	78	74459	124
7428	35	32	7497	185		74162	32	130	74460	124
7430	17	24	74100	119		74163	92	78	74461	124
7432	25	24	74104	63		74164	104	130	74462	124
7433	40	32	74105	62		74165	105		74463	124
7437	40	24	74107	32	38	74166			74464	124
7438	33	24	74109	63	38	74167	20		74465	124
7440	17	24	74110	54	54	74168			74466	124
7441	74		74111	68		74169			74467	124
7442	70	99	74112	68	38	74170	210	200	74468	124
7443	115		74113	38	38	74172	625		74469	124
7444	112		74114	38	38	74173	625		74470	124
7445	94		74116	198		74174	87	120	74471	124
7446	94		74118	83		74175	87	110	74472	124
7447	82	89	74119	119		74176	75		74473	124
7448	56	99	74120	115		74177	75		74474	124
7449	56	99	74121	26		74178	85		74475	124
7450	17	24	74122	46	57	74181	165	150	74476	124
7451	17	24	74123	48	73	74182	160		74477	124
7453	17		74124	48	137	74183		210	74478	124
7454	17	24	74125	38	44	74184	115		74479	124

IMPORTANT: ALL OSTS PRICES EXCLUDE VAT - CURRENTLY 8% - BUT MAY BE CHANGED BY THE TIME YOU READ THIS. PLEASE REMEMBER TO ADD VAT, AND 25p POSTAGE !!

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
4002	17p	4063	109p	4528	102p
4006	109p	4066	53p	4529	141p
4007	18p	4067	400p	4530	90p
4008	18p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4014	95p	4074	20p	4541	141p
4016	52p	4075	20p	4542	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	358p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4100	90p	4572	25p
4032	100p	4160	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
4048	60p	4514	260p		
4049	65p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	382p		
4052	65p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4055	135p	4521	236p		

Micromarket

6800 series	8216	1.95	2114	110
6801P	8224	3.50	2708	1
6801P F6	8228	4.78		
6805P	8251	6.25		
6810P E4	8255	5.40		
6852				
8080 series	2102	£1.70		
8080	2112	£3.40		
8212	2513	£7.54		
	4027	£5.78		

MISC. LSI/Scalars/DVMs

NE555	30p	NE556	75p	NE558	180p
LM3909	72p	95H900C	732MHz	7.80p	
11C900C	650MHz				
ICM7216B	PI 8 decade	10MHz	DFM/timer with		
direct LED drive	and all counter features				
ICM7217A	BI 4 decade	programmable	ctrl	£9.50	
ICM7207	clock pulse generator	IC		£4.95	
ICM7208	7 decade	counter/display drive		£14.95	
ICM7106CP	LED DVM IC	(3 1/2 digit)		£9.55	
ICM7106CPK	LED DVM KIT			£24.80	
ICM7107CP	LED DVM IC			£9.55	
ICM7107CPK	LED DVM KIT			£20.65	
SP8629	divide by 100	700MHz	scalar	£4.70	
MSL2318	divide by 100 to 1.75MHz	min			
	divide by 10 to 45MHz	max			

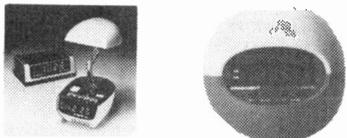
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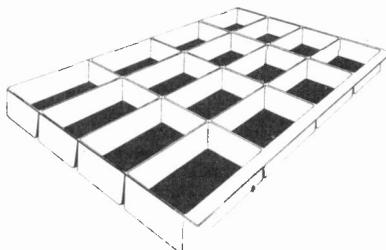
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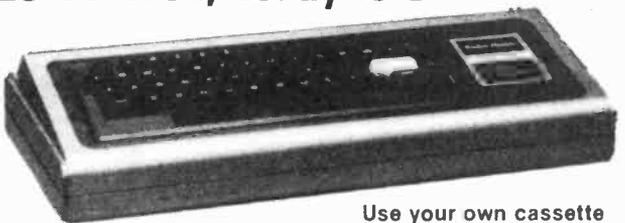
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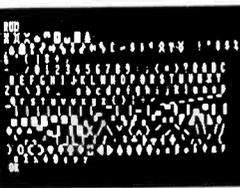


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- "BREAK IN LINE XXXX" is printed, indicating line number of next statement to be executed or printed
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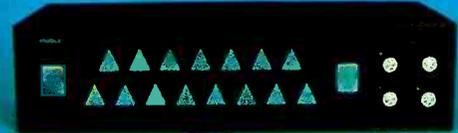
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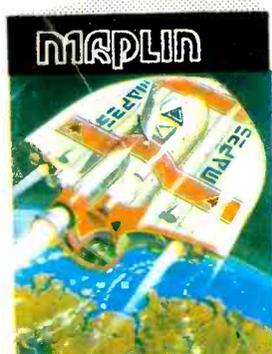
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