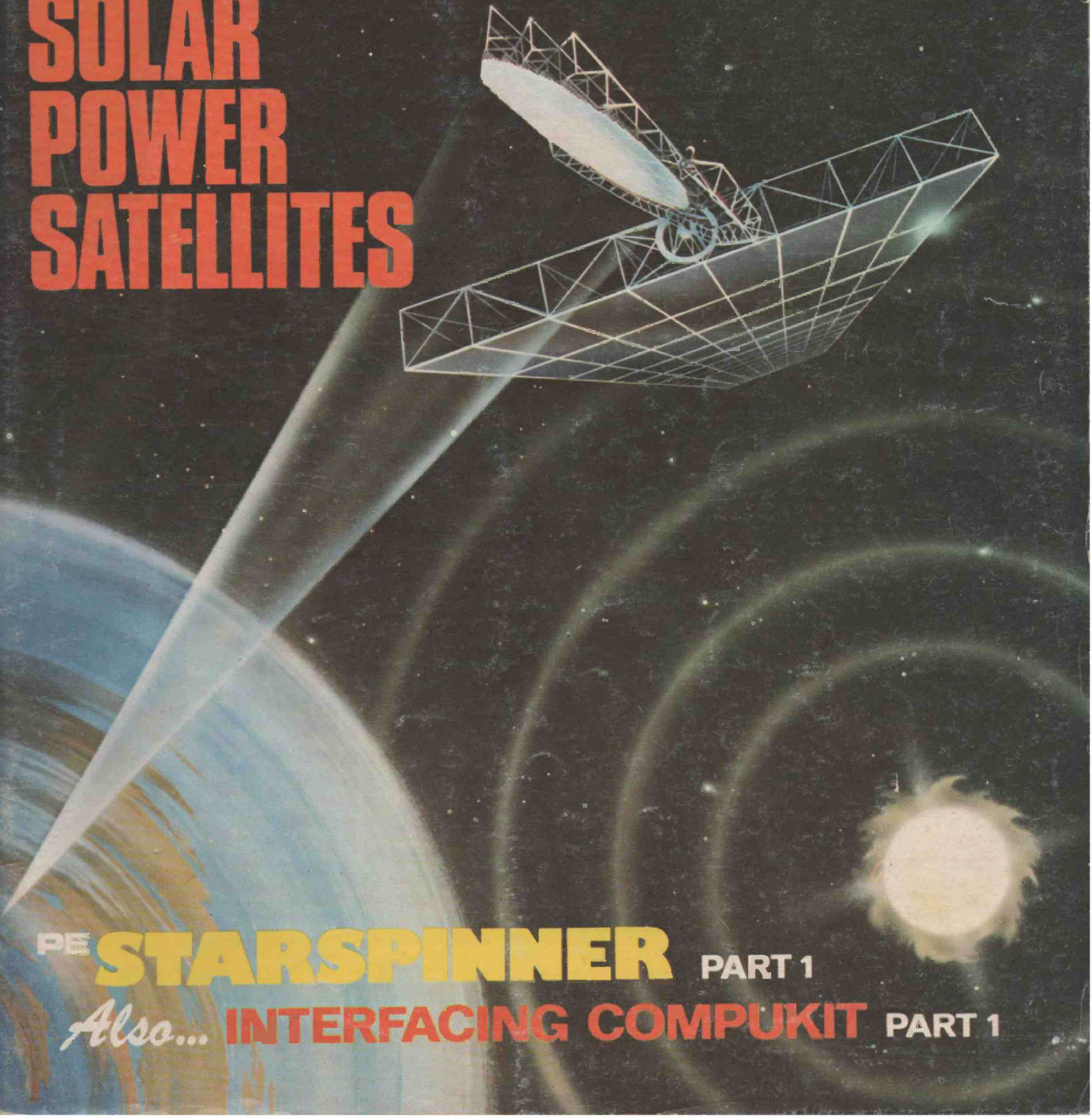
Australia $1.10 New Zealand $1.20 Malaysia $4.50

PRACTICAL ELECTRONICS

JANUARY 1981

65p

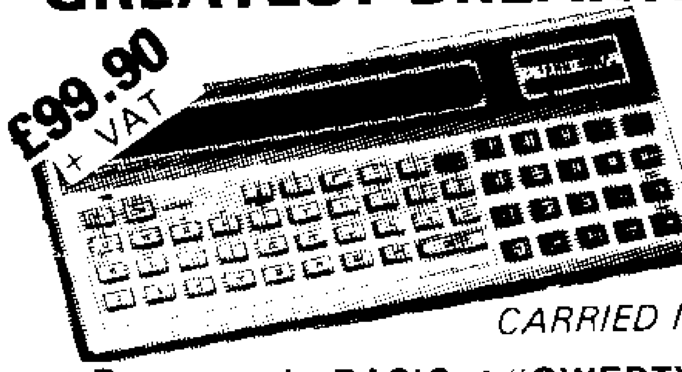
SOLAR POWER SATELLITES



PE STARSPINNER PART 1

Also... INTERFACING COMPUKIT PART 1

COMP POCKET COMPUTER GREATEST BREAKTHROUGH YET



COMPUTER POWER THAT ONCE FILLED A ROOM CAN NOW BE CARRIED IN YOUR POCKET!

● Programs in BASIC ● "QWERTY" Alphabetic Keyboard ● 1.9K Random Access Memory ● Long Battery Life.

Computer power that once filled a room can now be carried in your pocket! It's easy to load with ready-to-run software from cassette tape (interface and recorder optional) or program it yourself in easy-to-learn BASIC. 24-character liquid crystal readout displays one line at a time. Special feature is advanced non-volatile memory allows you to power on and off without losing the contents of memory. Note: Memory must be transferred to tape before changing batteries. Automatic statement compaction squeezes every ounce of memory space. Features power-off retention of programs and data. Powerful resident BASIC language includes multiple statements, math functions, editing, strings, arrays and much more. Multiple program loading capability subject to RAM availability. Carrying case and batteries included.

Program	Each	Program	Each
Real Estate	£13.95	Games 1	£8.95
Civil Engineering	£13.95	Business Statistics	£10.95
Aviation	£13.95	Business Financial	£10.95
Math Drill	£8.95	Personal Financial	£10.95

EXTENDED WARRANTY BY COMPUCARE — We give a full one year's warranty on all our products.

EXTENDED WARRANTY BY COMPUCARE

only **£325** + VAT

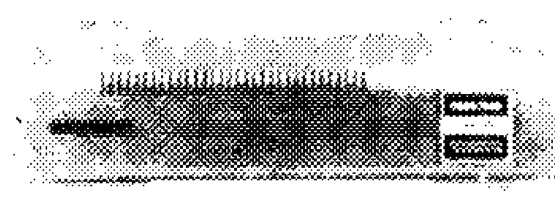
TRS80 LEVEL 2 16K

Fully converted to UK T.V. Standard. Comes complete with easy to follow manuals. UK Power Supply — Cassette Leads. Sample tapes. Special box to enable you to plug into your own TV. Recommended for first time buyers. Just plug in and go. Full Range of Software Available

Interface to Centronics Parallel for TRS80 **£75.00** + VAT

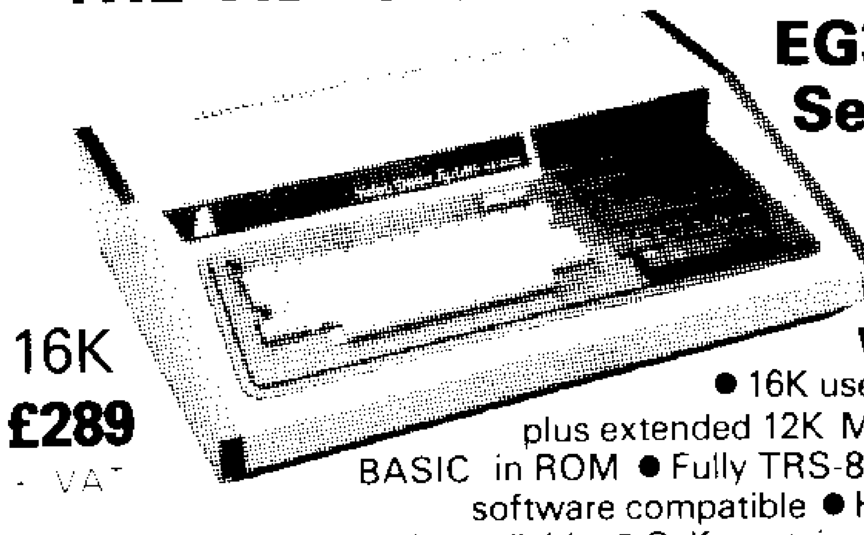
only **£295** + VAT **TRS80 32K EXPANSION INTERFACE**

Expand your TRS80 to 32K. 32K Memory on board. Centronics parallel port. Disk controller card. Real time clock. Requires Level II Basic. Interface for 2 cassette decks, complete with power supply.



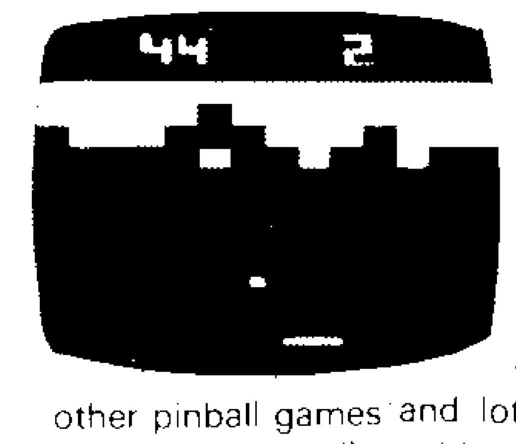
COMING SOON
THE MARTELL TV GAME

THE VIDEO GENIE SYSTEM EG3000 Series



16K **£289** + VAT

WITH ● 16K user RAM plus extended 12K Microsoft BASIC in ROM ● Fully TRS-80 Level II software compatible ● Huge range of software already available ● Self contained, PSU, UHF modulator, and cassette ● Simply plugs into video monitor or UHF TV ● Full expansion to disks and printer ● Absolutely complete — just fit into mains plug.



NEW TV GAME BREAK OUT

Has got to be one of the world's greatest TV games. You really get hooked. As featured in ETI. Has also 4 other pinball games and lots of options. Good kit for up-grading old amusement games.

MINI KIT — PCB, sound & vision modulator, memory chip and de-code chip. Very simple to construct. **£14.90** + VAT

OR PCB **£2.90** MAIN LSI **£8.50** Both plus VAT

EUROPE'S FASTEST SELLING ONE BOARD COMPUTER

COMPUKIT UK101

★ 6502 based system — best value for money on the market. ★ Powerful 8K Basic — Fastest around ★ Full Qwerty Keyboard ★ 4K RAM Expandable to 8K on board. ★ Power supply and RF Modulator on board. ★ No Extras needed — Plug-in and go. ★ Kansas City Tape Interface on board. ★ Free Sampler Tape including powerful Dissassembler and Monitor with each Kit. ★ If you want to learn about Micros, but didn't know which machine to buy then **this is the machine for you.**

40 pin Expansion Jumper Cable for Compukit expansion **£8.50** + VAT

Build, Understand and Program your own Computer for only a small outlay.

KIT ONLY **£179** + VAT NO EXTRAS NEEDED

Available ready assembled, tested & ready to go **£229** + VAT

NEW MONITOR FOR COMPUKIT UK101
● In 2K Eprom 2716 ● Allows screen editing ● Saves data on tape ● Flashing cursor ● Text scrolls down **£22.00** + VAT

FOR THE COMPUKIT	
Assembler/Editor	£14.90
Screen Editor Tape	£5.90

All Prices exclusive VAT

Game Packs	
1. Four Games	£5.00
2. Four Games	£5.00
3. Three Games 8K only	£5.00

Super Space Invaders (8K)	£6.50
Space Invaders	£5.00
Chequers	£3.00
Real Time Clock	£3.00
Case for Compukit	£29.50

NEW REDUCED PRICES

8K **£399**
16K **£499** + VAT
32K **£599**

RRP £795 for 32K

The PEDIGREE PETS

Very popular for home & business use. 8K Microsoft Basic in ROM. 8K Pet 32K & 16K with new improved keyboard. All with green screen.

Cassette Deck **£55** extra. Full range of software available.

Interface PET IEEE — Centronics Parallel
Not decoded **£49.00** + VAT Decoded **£77.00** + VAT

NOW IN STOCK SUPER 80 COLUMN PET
only **£825** + VAT

SPECIAL SCOOP GET YOURSELF A PRINTER FOR YOUR PET AND SAVE A FORTUNE

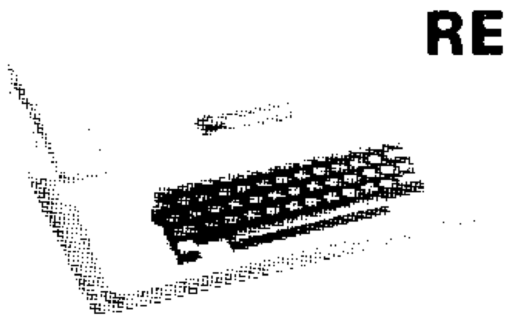
EXTENDED WARRANTY BY COMPUCARE

only **£299** + VAT

Interface Cards **£49**

Full Pet Graphics including cables. Ready to go. Interfaces with APPLE, PET, FXIDY, TRS80, COMPUKIT and NASCOM. **EX-STOCK.**

WE ARE NOW STOCKING THE APPLE II EUROPLUS AT REDUCED PRICES



16K **£599**
32K **£649** + VAT
48K **£659**

Getting Started APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too because of built-in features like:
● BASIC — The Language that Makes Programming Fun. ● High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays. ● Sound Capability that Brings Programs to Life. ● Hand Controls for Games and Other Human-Input Applications. ● Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM; for Big-System Performance in a Small Package. ● Eight Accessory Expansion Slots to let the System Grow With Your Needs.

You don't need to be an expert to enjoy APPLE II. It is a complete, ready-to-run computer. Just connect it to a video display and start using programs (or writing your own) the first day. You'll find that its tutorial manuals help you make it your own personal problem solver.

NOW OPEN

OUR NEW SHOWROOM & SALES CENTRE AT

311 Edgware Road, London W2.
Telephone: 01-441 2922

THE ATARI VIDEO COMPUTER GAMES SYSTEM

£83.00

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty Game Program^{TM} cartridges!

Most Cartriages only £13.90 + VAT
Prices may vary with special editions Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, Hunt & Score*, Space War, Sky Diver, Air Sea Battle, Codebreaker*, Miniature Golf.

Extra Paddle Controllers — **£14.90** + VAT
*Keyboard Controllers — **£16.90** + VAT

SPACE INVADERS NOW IN STOCK £25

COMP SHOP INC.

"Europes Largest Discount Personal Computer Stores"

Please add VAT to all prices — including delivery. Please make cheques and postal orders payable to **COMPSHOP LTD.**, or phone your order quoting **BARCLAYCARD, ACCESS, DINERS CLUB** or **AMERICAN EXPRESS** number.

CREDIT FACILITIES ARRANGED — send S.A.E. for application form.

MAIL ORDER AND SHOP:
14 Station Road, New Barnet, Hertfordshire, EN5 1QW *(Close to New Barnet BR Station — Moorgate Line).*
Telephone: 01-441 2922 (Sales) 01-449 6596 Telex: 298755 TELCOM G

NEW WEST END SHOWROOM:
311 Edgware Road, London W2. Telephone: 01-262 0387

OPEN — 10am - 7pm — Monday to Saturday

✸ **IRELAND:** 80 Marlborough Street, Dublin 1. Telephone: Dublin 749933
✸ **COMPSHOP USA,** 1348 East Edinger, Santa Ana, California, Zip Code 92705. Telephone: 0101 714 5472526

BARCLAYCARD VISA — AMERICAN EXPRESS — DINERS CLUB INTERNATIONAL — ACCESS

COMP COMPUTER COMPONENTS (Part of the Compshop Ltd. Group)

PRACTICAL
ELECTRONICS

VOLUME 17 **No. 1** **JANUARY 1981**

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

OUR FEBRUARY ISSUE WILL BE ON SALE FRIDAY, 9 JANUARY 1981
(for details of contents see page 29)

7400

7400	11p
7401	11p
7402	12p
7403	13p
7404	17p
7409	18p
7410	16p
7412	18p
7513	28p
7420	16p
7430	18p
7432	25p
7440	16p
7442	68p
7448	75p
7473	32p
7474	32p
7475	40p
7476	40p
7490	35p
7492	50p
7493	50p
7496	45p
74121	35p
74123	45p
74154	90p
74157	55p
74122	45p
74125	50p
74195	100p
74196	100p
74283	140p
74290	120p
74365	90p
74365	90p

74LS

74LS00	12p
74LS01	12p
74LS02	13p
74LS03	13p
74LS04	13p
74LS08	20p
74LS10	19p
74LS11	20p
74LS12	30p
74LS13	35p
74LS14	60p
74LS15	38p
74LS20	18p
74LS21	30p
74LS22	38p
74LS26	45p
74LS27	45p
74LS30	18p
74LS32	23p
74LS37	35p
74LS38	35p
74LS40	25p
74LS42	56p
74LS47	78p
74LS48	85p
74LS49	99p
74LS73	30p
74LS74	30p
74LS75	42p
74LS85	98p
74LS86	39p
74LS90	35p
74LS93	70p
7rLS96	150p
74LS107	40p
74LS112	75p
74LS123	63p
74LS125	50p
74LS126	50p
74LS132	79p
74LS138	69p
74LS139	75p
74LS148	170p
74LS151	75p
74LS153	75p
74LS155	65p
74LS157	74p
74LS160	115p
74LS161	78p
74LS163	90p
74LS164	90p
74LS165	150p
74LS168	190p
74LS173	100p
74LS174	99p
74LS175	99p
74LS181	280p
74LS190	110p
74LS195	87p
74LS196	100p
74LS221	110p
74LS240	210p
74LS241	200p
74LS242	220p
74LS244	175p
74LS245	220p
74LS251	120p
74LS253	120p
74LS257	110p
74LS260	90p
74LS273	175p
74LS290	95p
74LS293	120p
74LS366	57p
74LS373	170p
74LS374	170p
74LS375	140p
74LS393	135p
74LS490	140p
74LS670	260p

CMOS

4001	19p
4002	19p
4006	75p
4007	19p
4008	80p
4009	35p
4010	45p
4011	24p
4012	24p
4013	38p
4014	70p
4015	75p
4016	35p
4017	75p
4018	76p
4019	42p
4020	88p
4021	100p
4022	88p
4023	22p
4024	50p
4025	20p
4026	130p
4027	45p
4028	75p
4029	80p
4030	50p
4031	195p
4033	145p
4035	104p
4036	290p
4037	105p
4038	110p
4039	290p
4040	99p
4041	75p
4042	73p
4043	86p
4044	88p
4045	160p
4047	99p
4048	56p
4049	38p
4050	40p
4051	69p
4052	75p
4053	73p
4054	111p
4055	121p
4056	121p
4059	560p
4060	112p
4063	112p
4066	56p
4067	422p
4068	19p
4069	19p
4070	28p
4071	25p
4072	25p
4075	20p
4076	88p
4077	23p
4078	29p
4081	23p
4082	25p
4085	86p
4086	68p
4089	130p
4093	68p
4094	225p
4095	99p
4096	325p
4098	110p
4099	180p
4501	25p
4502	112p
4503	68p
4507	52p
4508	288p
4510	76p
4511	125p
4512	75p
4514	250p
4515	290p
4516	109p
4518	99p
4520	99p
4521	230p
4526	105p
4527	130p
4528	99p
4529	140p
4531	150p
4532	125p
4538	150p
4543	160p
4556	70p
4560	225p
4569	240p
4572	46p
4584	79p
4585	125p

DTL

930	55p
935	65p
937	55p
944	65p
946	55p
947	55p
962	55p
9099	90p

74C

74C20	30p
74C76	60p
74C85	145p
74C97	125p
74C98	125p
74C107	100p
74C160	110p
74C161	145p
74C162	145p
74C163	145p
74C192	175p
74C193	175p
74C194	175p
74C195	175p
74C903	45p

LINEAR IC's

AY-3-1350	795p
AY-3-8910	825p
709	30p
723	33p
741	18p
ICL7106	575p
ICL7107	695p
ICL8038	295p
ICM7216A	1875p
ICM7216B	1675p
ICM7555	80p
LM301AM	30p
LM311	50p
LM318	75p
LM324	45p
LM339	45p
LM380	65p
LM1496	65p
LM1871	550p
LM1872	550p
LM3900	50p
LM3914	225p
LM3915	225p
LM13600	125p
NE555	18p
NE556	50p
RC4136	85p
SN76477N	175p
TBA810DAS	85p
TL071	55p
TL074	130p
TL082	75p
TL084	110p
TL490	175p
XR2206	325p
XR2207	375p

DIL SWITCHES

4 pole	99p
6 pole	115p
8 pole	140p
10 pole	175p

INTERFACE LINEAR

MC1488	90p
MC1489	90p
DM8123	125p
75150	125p
75154	125p
75182	195p
75322	250p
75324	325p
75325	325p
75361	350p
75365	295p
75451	50p
75491/2	75p
8T26	155p
8T28	175p
8T95	175p
8T97	155p

LEDs

TIL209	9p
TIL211	13p
TIL212	15p
TIL220	12p
TIL222	15p
TIL224	18p

DISPLAYS

FND500	80p
FND510	80p
FND567	125p
DL704	85p
DL707	85p
MV57164	225p

ISOLATORS

ILD74	120p
ILQ74	325p
MCT6	90p
TIL111	75p

LOW PROFILE SOCKETS BY TEXAS SALE

8 pin	7p	18 pin	15p	24 pin	22p
14 pin	9p	20 pin	18p	28 pin	25p
16 pin	10p	22 pin	22p	40 pin	28p

PRIME COMPONENTS LOW PRICES

All our micro chips are at micro prices. Don't be fooled by low prices. We do not offer for sale sub-spec or rebranded devices. All our parts are guaranteed new, first quality, factory prime, full spec devices. It is also our policy to offer you the best of new devices that become available and these are featured regularly. Prices are exclusive of p&p and VAT – please refer to "Ordering Information" before ordering. Official orders from Schools, Colleges, Universities and Gov. Authorities accepted.

MEMORIES

2114L 300 NS	250p
2114L 450 NS	225p
4116 200 NS	250p
4116 150 NS	375p
4315 (4k · 1) CMOS RAM 450 NS	995p
6514 (1k · 4) CMOS RAM 450 NS	795p

CPU'S

6502	695p
6504	750p
6505	750p
6800	645p
6802	925p
6809	2450p
8080A	425p
8085A	1095p
Z80	700p
Z80A	900p
Z8001	12500p
Z8002	9500p

BIPOLAR RAMS

27LS00	995p
93419DC	1125p

KEYBOARD ENCODER

AY-5-2376	795p

FLOPPY DISK CONTROLLERS

FD1771 B-01 S/D Inverted Bus	2995p
FD1791 B-01 D/D Inverted Bus	4995p

SUPPORT DEVICES

6520	495p
6522	695p
6532	895p
6551	1095p
6810	375p
6820	360p
6821	325p
6845	2350p
6850	295p
6852	350p
8212	210p
8214	450p
8216	210p
8224	275p
8226	225p
8228	425p
8251	475p
8253	995p
8255	445p
8257	895p
8259	950p
MC 144 12VL	797p
Z80 P10	595p
Z80 CTC	595p
Z80A P10	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 S10/1	2995p
Z80A S10/0	3495p
Z80 S10/1	2995p
Z80A S10/1	3495p
Z80 S10/2	2995p
Z80A S10/2	3495p

UARTS

AY-5-1013A	325p
AY-3-1015D	398p
IM6402 IPL	425p

VOLTAGE REGULATORS

7805/7812	55p
7905/7912	65p
78HO5SC	575p
78HGKC	625p

EPROMS

1702A	450p
2708 450 NS	395p
2716 5V 450 NS	595p
2532 32K 450 NS	1995p
2564 64K (8Kx8) 450NS 28-pin	£120

NEW, LOW, LOW PRICES ON MEMORIES!!!

Compare *our* prices before you buy *elsewhere!* All devices are brand new, factory prime, full spec. and fully guaranteed!

MEMORIES	1+	50+	100+
2144 L 450 NS	225p	200p	175p
2144 L 300 NS	250p	225p	195p
4116 150 NS	375p	350p	325p
4116 200 NS Ceramic	250p	225p	195p
6514 (TC 5514P) 1k × 4 CMOS RAM 450 NS	550p	525p	495p

EPROMS			
2708 450 NS	395p	375p	350p
2716 Single 5V 450 NS	595p	550p	495p
2532 Single 5V 450 NS	1995p	1695p	1495p
LINEARS			
ICL 7106 CPL	575p	525p	475p
LCD 106 3½-digit LCD Display	575p	525p	475p
NE 555P	18p	17p	16p
723	33p	30p	28p

All prices exclude p&p and VAT. Please refer to 'Ordering Information' before ordering.

DON'T DELAY – BUY TODAY – SUCH LOW PRICES DON'T LAST FOR EVER! ! !

NEW

EXCITING, ENTERTAINING SOFTWARE FOR THE APPLE II and APPLE II PLUS!!

ASTEROIDS IN SPACE!!!

If you liked 'Invaders' you'll love ASTEROIDS IN SPACE by Bruce Wallace! Your spaceship is travelling in the middle of a shower of asteroids. Blast the asteroids with lasers, but beware – BIG ASTEROIDS FRAGMENT INTO SMALL ASTEROIDS! The apple game paddles allow you to rotate your spaceship, fire its laser gun, and give it thrust to propel it through endless space. From time to time, too, you'll encounter an alien spaceship whose mission is to DESTROY YOU, so you'd better destroy it first! High resolution graphics and sound effects add to the arcade-like excitement this program generates. RUNS ON ANY APPLE II WITH AT LEAST 32K AND ONE DISK DRIVE!

ON DISKETTE ONLY £14.95

BIPOLAR PROMS

All are identical and equivalent types – we reserve the right to substitute any make.

256 bit (32x8) 16-pin tri-state MB7051/27S09/7603/5600/6331/74S288/82S123	395p
256 bit (32x8) 16-pin open collector MB7056/27S08/7602/5600/6330/74S188/82S23	395p
1K (256x4) 16-pin tri-state MB7052/74S287/TBP14S10/93427/82S129/7611/6301	395p
1K (256x4) 16-pin open collector MB7057/74S387/TBP14SA10/93417/82S126/7610/6300	395p
2K (512x4) 16-pin tri-state MB7053/93446/82S131/7621/6306	495p
2K (512x4) 16-pin open collector MB7058/93436/82S10/7620/6305	495p
4K (1024x4) 18-pin tri-state MB7122/74S476/93453/82S137/7643/6353/27S33/3625/5626	995p

SE 01 Sound Effects Kit

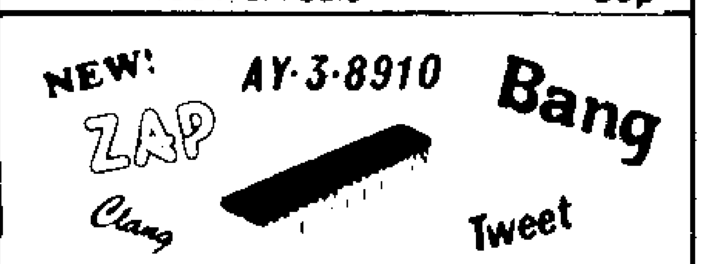
NEW

The SE-01 is a complete kit that contains all the parts to build a programmable effects generator. Designed around the new **Texas Instruments SN 76477** Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noises, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3¼"×3" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosion, Phaser Guns, Steam Trains,** or almost, an infinite number of **other sounds.** The unit has a multiple of applications. The low price includes all arts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MV amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included.)

COMPLETE KIT ONLY £14.99
P&P 67p + VAT

UNIVERSAL SCR

C106D 400V/5A Sale **30p**



THE NEW GI COMPUTER SOUND CHIP

The amazing AY-3-8910 is a fantastically powerful sound and music generator, perfect for use with any 8-bit micro processor. Contains 3 tone channels, noise generator, 3 channels of amplitude controls, 16-bit envelope period control, 2 parallel I/O, 3D/A converters plus much more. All in 40 pin DIP. Super easy to interface to the S-100 or other Busses.

ONLY **£8.50** + VAT, including FREE reprint of BYTE '79 article! Also, add £2.25 for 60-page data manual.

"Perhaps the next famous composer will not direct a 150-piece orchestra but, rather, a trio of microcomputers controlling a bank of AY-3-8910s." BYTE July '79.

Ordering information. Unless otherwise stated for orders under £50 add 50p p&p. Add 15% VAT to total (no VAT on books). All devices are brand new, factory prime and full spec and subject to prior sales and availability. Prices subject to change without notice. Minimum telephone order using ACCESS, is £10. If ordering by post with ACCESS, include name, address and card no. written clearly. Please allow 4/6 week's delivery on books.

NEW SUPER MUSIC MACHINE KIT!

AT LAST – an affordable kit that can be PROGRAMMED TO PLAY ANY SONG OR GROUP OF SONGS! Instead of a nightmare of numerous ICs and special expensive Bipolar ROMs, the SUPER MUSIC MACHINE uses a SPECIAL MASK PROGRAMMED COMPUTER CHIP, one CMOS gate and the most popular erasable EPROM, the 2708/2716 series. BASIC KIT includes drilled, plated and screened PC board and ALL components except the EPROM and 12V transformer. The basic kit will play short renditions of 25 tunes through its 7 WATT AMPLIFIER SECTION. Add an optional ROM and any tune programmed will be played. If you have the equipment to program 2708 EPROMs, we supply full information on programming your own music!

FEATURES:

* Basic kit contains 25 short tunes in the main IC!
* Will address external ROM for up to 1,000 MORE NOTES per ROM! (ROM is not included).
* Operates on 12V AC or 12V DC @ 500mA. (Using unit on 12V DC and with optional ROM requires 9V bias battery, not included).
* **7 watts of audio power** will drive 8 or 16 ohm speakers or horn speakers (not included).
* DIP switches not included.
* 'NEXT TUNE' provision steps sequentially through all tunes.
* tune address can be wire jumper selected or board is designed to take DIP switches.
* PITCH, VOLUME and TEMPO are all adjustable.
* SPECIAL 'CHIME' SEQUENCES can be activated regardless of tune address to provide for multiple doorbell applications.
* All tunes consist of electronic musical notes played one at a time. There are no chords or harmony sound to the music.
* STEP-BY-STEP ASSEMBLY INSTRUCTIONS provided.
* Large number of PREPROGRAMMED ROMS with popular and classical tunes readily available. Send SAE for list and prices.

ONLY £16.75 for basic kit (plus p&p 60p)

NEW STEREO! S100 SOUND COMPUTER BOARD

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY-3-8910 NMOS Computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

KIT FEATURES: ***Two GI sound computer IC's (AY-3-8910) *Four parallel I/O ports on Board *Uses on Board audio Amps or your STEREO *On Board proto typing area *All sockets, parts and hardware are included *PC Board is soldermasked, silk screened with gold contacts *Easy, quick and fun to build, with full instructions *Uses Programmed I/O for maximum system flexibility *Both BASIC and ASSEMBLY language programming examples are included**
COMPLETE KIT ....ONLY £59.96 includes 60 page data Manual
BARE BOARD ....ONLY £25.00 includes 60 page data Manual
AY-3-8910 chip special price with purchase of BARE BOARD (2 chips) £15
SOFTWARE: SCL is now available! Our Sound Command Language makes writing Sound Effects Programs a SNAP! SCL also includes routines for Register-Examine-Modify, Memory-Examine-Modify and Play-Memory. SCL is available on CP/M compatible diskette or 2708/2716. Diskette – £19.95, 2708 – £14.95, 2716 – £24.95. Diskette includes the source. EPROMs are ORG at EOOOH.

NEW 6809 S-100 SINGLE-BOARD COMPUTER

* Meets IEEE S-100 Standard!
* Uses Motorola's Powerful MC6809 CPU!
* 4K, 8K, 16K ROM!
* 2K RAM!
* ACIA, PIA, 8080 Simulated I/O!
* RS – 232 Handshake!
* Selectable BAUD Rates!
* Manual includes: 11"x7" Schematic, Parts List, User Notes, Software Listings and MORL

Bareboard only, **£49**! (plus £1 p&p), CPU (6809) **£24.50! ADSMON: Monitor (2716) £25!**
COMPLETE BOARD ASSEMBLED AND TESTED, ONLY £250! (plus £2 p&p)

FROM INTERSIL ICL 7660 Voltage Converter

The Intersil ICL7660 is a monolithic MAXCOMOS power supply circuit which offers unique performance advantages over previously available devices. The ICL7660 performs the complete supply voltage conversion from positive to negative for an input range of +1.5V to +10.0V, resulting in complementary output voltages of −1.5 to −10.0V.

FEATURES

* ★ Simple conversion of +5V logic supply to +5V supplies.
* ★ Simple voltage multiplication (V OUT = (-) nVIN).
* ★ 99.9% Typical open circuit voltage conversion efficiency.
* ★ 98.0% typical power efficiency.
* ★ Wide operating voltage range 1.5V to 10.0V.
* ★ Easy to use – Requires only 2 external non-critical passive components.

APPLICATIONS

* ★ On board negative supply for up to 64 dynamic RAMs.
* ★ Localized u-Processor (8080 type) negative supplies.
* ★ Inexpensive negative supplies.
* ★ Data acquisition systems.

ONLY **£1.95** EACH

Micro Circuits

Dept. PE5,
4 Meeting Street, Appledore, Nr. Bideford, North Devon EX39 1RY. Tel: Bideford (02372) 79507
Telex: 8953084

WATFORD ELECTRONICS

33/35, CARDIFF ROAD, WATFORD, HERTS, ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW. FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED (TELEPHONE ORDERS BY ACCESS NOW ACCEPTED Minimum order £10.00 please). TRADE AND EXPORT INQUIRY WELCOME. P & P ADD 40p to ALL ORDERS UNDER £10·00. OVERSEAS ORDERS POSTAGE AT COST.

VAT **Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to the total cost.**

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/Br. Rail Station: Watford High Street. Open Monday to Saturday 9 a.m.-6 p.m. Ample Free Car Parking space available.

POLYESTER CAPACITORS: (Axial Lead Type)
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n, **9p;** 18n **10p;** 22n, 33n **11p;** 47n, 68n **14p;** 100n **17p;** 150n, 220n **24p;** 330n, 470n **41p;** 680n **48p;** 1μF **64p;** 2μ2 **82p;** 4μ **85p.**
1000V: 10n, 15n **20p;** 22n **22p;** 47n **26p;** 100n **42p;** 470n **80p;** 1μF **175p.**

POLYESTER RADIAL LEAD CAPACITORS: 250V;
10n, 15n, 22n, 27n **6p;** 33n, 47n, 68n, 100n **7p;** 150n **10p;** 220n, 330n **13p;** 470n **17p,** 680n **19p;** 1μ **22p;** 1μ5 **30p;** 2μ2 **34p.**

ULTRASONIC TRANSDUCERS
40KHz **350p pr.**

ELECTROLYTIC CAPACITORS: (Values are in μF)
500V: 10 **50p;** 47 **78p; 250V**: 100 **65p; 63V**: 0.47, 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, **9p;** 10, 15, 22 **11p;** 32, 47, 50 **14p;** 63, 100, **27p; 50V**: 100, 220 **25p;** 470 **32p;** 1000 **80p; 40V**: 22, 33μF **8p;** 100 **12p;** 2200, 3300 **85p;** 4700 **115p; 35V**: 10, 33 **8p;** 330, 470 **32p; 25V**: 10, 22, 47, 100 **8p;** 160, 220, 250 **15p;** 470 **25p;** 640, 1000 **35p;** 1500 **40p;** 2200 **54p;** 3300 **77p;** 4700 **92p; 16V**: 10, 40, 47 **7p;** 100, 125 **8p;** 220, 330 **16p;** 470 **20p;** 1000, 1500 **30p;** 2200 **36p; 10V**: 100 **7p.**
TAG-END TYPE: 450V: 100μF **180p; 70V**: 4700 **165p; 64V**: 2500 **110p;** 3300 **150p; 50V**: 2200 **99p;** 3300 **135p; 40V**: 4700 **130p;** 4000 **92p;** 3300 **98p;** 2500, 2200 **90p;** 2000 + 2000 **120p; 30V**: 4700 **110p; 25V**: 15 000 **195p;** 6400 **120p;** 4700 **100p;** 330 **85p;** 2200 **60p.**

TANTALUM BEAD CAPACITORS
35V: 0.1μF, 0.22, 0.33, 0.47, 0.68, 1.0, 1μ5, 2μ2, 3μ3, 4μ7. **25V:** 10. **20V:** 6μ8. **16V**: 2μ2, 4μ7, 10 **20p each.**
16V: 22μ **32p;** 47, 100 **58p;** 220 **80p;**
10V: 15μ, 22, 33 **28p;** 100 **40p; 6V:** 47μ, 68μ, 100 **32p; 3V**: 100 **25p.**

MYLAR FILM CAPACITORS
100V: 0.001, 0.002, 0.005, 0.01μF **6p**
0.015, 0.02, 0.03, 0.04, 0.05, 0.056μF **7p**
0.1μF **8p; 50V:** 0.47μF **12p.**

CERAMIC CAPACITORS: (50V)
Range: 0.5pF to 10nF **4p**
15nF, 22nF, 33nF, 47nF **5p**
100nF/30V **7p;** 220nF 6V **8p**

POLYSTYRENE CAPACITORS:
10pF to 1nF **8p;** 1·5nF to 47nF **10p.**

POTENTIOMETERS: Carbon Track
0.25W Log & Linear Values.

500Ω, 1K & 2K (LIN ONLY) Single	**29p**
5KΩ-2MΩ single gang	**29p**
5KΩ-2MΩ single gang D/P switch	**69p**
5KΩ-2MΩ dual gang stereo	**88p**
1W Wire-wound 50Ω-20K	**105p**

SLIDER POTENTIOMETERS
0.25W log and linear values 60mm track

5KΩ 500KΩ Single gang	**60p**
10KΩ 500KΩ Dual gang	**80p**
Self-Stick graduated Alum. Bezels	**36p**

PRESET POTENTIOMETERS

0.1W 50Ω-2.2M Minl. Vert & Horiz.	**7p**
0.25W 100Ω-3.3MΩ Horiz. larger	**10p**
0.25W 250Ω-4.7MΩ Vert.	**10p**
Precision Cermet 1W 100Ω-100K	**90p**

SILVER MICA (pF)
2, 3.3, 4.7, 6.8, 8.2, 10, 12, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180, 200, 220 **11p each**
250, 270, 300, 330, 360, 390, 470, 600, 800 & 820pF **16p each**
1000, 1200, 1800, 2000, 4700 **26p each**

TRIMMERS miniature
2.5pF 3.10pF
3-30pF 3-50pF **28p**
5.25pF 65pF 88pF **35p**

COMPRESSION

3-40pF 10-80pF	**30p**
25-200pF	**33p**
100-500pF	**45p**
400-1250pF	**58p**

RESISTORS—Erie make 5% carbon
Miniature High Stability Low Noise

RANGE		Val	1-99	100+
0.25W	2Ω2-4M7	E24	**2p**	**1p**
0.5W	2Ω2-4M7	E12	**2p**	**1p**
1W	2Ω2-10M	E12	**5p**	**3p**
2% Metal Film	10Ω-1M		**6p**	**4p**
1% 0.5W	51Ω-1M	E24	**8p**	**6p**

100 - price applies to Resistors of each type not mixed values

TRANSISTORS

AC107	35
AC125	35
AC126	25
AC127	25
AC128	25
AC141	30
AC142	30
AC176	28
AC187	28
ACY17	70
ACY18	70
ACY19	75
ACY20	75
ACY21	75
ACY22	60
ACY28	75
ACY39	85
AD149	79
AD161	42
AD162	42
AF118	95
AF139	40
AF178	75
BC107	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC140	30
BC142	30
BC143	30
BC147	9
BC147B	10
BC148	9
BC148B	10
BC148C	10
BC149	9
BC149C	12
BC153	27
BC154	27
BC157	10
BC158	10
BC159	11
BC160	45
BC167A	10
BC168C	10
BC169C	10
BC170	15
BC171	11
BC172	11
BC173	11
BC177	20
BC178	20
BC179	20
BC181	20
BC182	10
BC183	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	26
BC212	10
BC212L	10
BC213	10
BC213L	10
BC214	10
BC214L	10
BC237	14
BC238	14
BC307B	14
BC308B	16
BC327	15

BC328	15
BC337	15
BC338	15
BC441	34
BC461	34
BC477	40
BC516	40
BC517	40
BC547	14
BC548	14
BC549C	14
BC557	15
BC558	15
BC559	15
BCY70	16
BCY71	18
BCY72	20
BD121	95
BD123	98
BD124	115
BD131	48
BD132	48
BD133	60
BD135	45
BD136	40
BD137	40
BD138	40
BD139	40
BD140	40
BD144	198
BD205	110
BD245	45
BD378	70
BD434	55
BD517	75
BD695A	85
BD696A	85
BDY56	180
BDY60	160
BDY61	160
BF115	35
BF167	29
BF177	25
BF178	30
BF179	35
BF180	38
BF194	12
BF195	12
BF196	12
BF197	12
BF198	16
BF199	18
BF224	25
BF244A	28
BF244B	29
BF244	30
BF245	28
BF256	35
BF257	32
BF258	32
BF259	35
BF274	42
BF336	40
BF451	35
BF594	30
BF595	39
BF910	95
BFR39	23
BFR40	23
BFR41	23
BFR79	23
BFR80	25
BFR81	25
BFR98	105
BFX29	28
BFX84	26
BFX85	28

BFX86	28
BFX87	28
BFX88	28
BFY50	23
BFY51	23
BFY52	23
BFY56	32
BFY64	35
BFY81	120
BRY39	40
BSX20	20
BSX29	34
BSY95A	25
BU105	170
BU205	190
BU208	200
E421	250
MD8001	250
MJ2955	90
MJE340	54
MJE370	100
MJE371	100
MJE520	95
MJE2955	99
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSU[illegible]	58
MPSU[illegible]	55
MPSU[illegible]	55
MPSU[illegible]	65
MPSU[illegible]	60
MPSU[illegible]	60
OC23	170
OC26	170
OC28	130
OC35	125
OC36	120
OC41	120
OC42	120
OC43	55
OC44	120
OC45	40
OC70	40
OC71	40
OC72	40
OC74	50
OC76	50
OC81	50
OC82	50
OC83	40
OC84	40
OC140	110
OC170	85
OC171	85
OC200	85
TIP29	34
TIP29A	36
TIP29B	56
TIP29C	60
TIP30	47
TIP30A	48
TIP30B	50
TIP30C	58
TIP31A	45
TIP31C	55
TIP32A	48
TIP32C	60
TIP33A	65

TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	160
TIP35C	185
TIP36A	170
TIP36C	199
TIP41A	55
TIP41B	60
TIP42A	60
TIP42B	75
TIP120	90
TIP121	99
TIP141	120
TIP142	120
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44	45
TIS45	45
TIS90	30
TIS91	32
UC734	65
ZTX107	11
ZTX108	11
ZTX109	12
ZTX212	28
ZTX300	13
ZTX301	16
ZTX302	16
ZTX303	25
ZTX304	17
[illegible]	25
[illegible]	30
[illegible]	30
[illegible]	30
[illegible]	14
[illegible]	15
[illegible]	15
[illegible]	18
[illegible]	25
[illegible]	25
[illegible]	25
[illegible]	23
[illegible]	40
[illegible]	48
[illegible]	19
[illegible]	19
[illegible]	32
[illegible]	32
[illegible]	35
[illegible]	24
[illegible]	24
[illegible]	60
[illegible]	65
[illegible]	60
[illegible]	65
[illegible]	68
[illegible]	215
[illegible]	28
[illegible]	26
[illegible]	25
2N2222A	25
[illegible]	18
[illegible]	45
[illegible]	55
2N2846	80
[illegible]	28
[illegible]	26
[illegible]	26
[illegible]	26
[illegible]	10
2N3053	26
2N3054	58
2N3055	48

2N3442	140
2N3614	199
2N3615	199
2N3663	17
2N3702	10
2N3703	10
2N3704	10
2N3705	10
2N3706	10
2N3707	10
2N3708	10
2N3709	10
2N3710	10
2N3711	10
2N3771	179
2N3772	195
2N3773	270
2N3819	22
2N3820	45
2N3822	65
2N3823	65
2N3866	90
2N3903	18
2N3904	18
2N3905	15
2N3906	17
2N4037	46
2N4058	10
2N4061	10
2N4062	10
2N4069	45
2N4427	80
2N4829	80
2N4859	78
2N4871	55
2N4922	60
2N5135	20
2N5136	20
2N5138	18
2N5172	18
2N5179	45
2N5180	45
2N5191	75
2N5245	30
2N5305	24
2N5457	36
2N5458	36
2N5459	36
2N5485	36
[illegible]	45
[illegible]	32
[illegible]	60
2SD234	75
[illegible]	112
[illegible]	112
[illegible]	85
[illegible]	97
[illegible]	60
[illegible]	130
[illegible]	60
[illegible]	95
[illegible]	60
[illegible]	71
[illegible]	60
[illegible]	50
[illegible]	50
[illegible]	75
[illegible]	60
[illegible]	70
[illegible]	285
[illegible]	65
[illegible]	130
40468	85
[illegible]	105
[illegible]	110
[illegible]	110
[illegible]	175
40673	95

ANTEX Soldering Irons

C15W	390
CX17W	398
CCN15W	420
X25W	415
Spare bits	50
Elements	190
Iron stand	150

DIL SOCKETS (TEXAS)

	Low profile	Wire wrap
8 pin	10p	25p
14 pin	12p	35p
16 pin	13p	46p
18 pin	16p	52p
20 pin	22p	65p
22 pin	25p	70p
24 pin	30p	78p
28 pin	35p	85p
36 pin	—	105p
40 pin	40p	109p

SPECIAL OFFER

2114-450ns	225
2114-300ns	295
2708	400
2716-5V	650
4116-16k	299

Access

LINEAR IC's

702	75
709C 8 pin	35
710	67
741	17
747C 14 pin	78
748C 8 pin	36
753 8 pin	185
810	159
AY-1-0212	595
AY-1-1313A	660
AY-1-1320	225
AY-1-5050	99
AY-1-5051	160
AY-1-6721/6	210
AY-3-1270	840
AY-3-8500	390
AY 3-8910	850
AY-3-8912	798
AY 5-1224A	235
AY-5-1230	450
AY-5-1315	595
AY-5-1317A	630
AY-5-8100	775
CA3011	110
CA3014	157
CA3018	68
CA3019	70
CA3020	186
CA3023	191
CA3028A	80
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	70
CA3048	214
CA3059	195
CA3075	213
CA3080E	65
CA3081	190
CA3089E	215
CA3090AQ	375
CA3123	150
CA3130	90
CA3140	48
CA3160	95
ICL7106	795
ICL7107	975
ICL8038CC	340
ICL8211	150
ICM7205	1150
ICM7207	475
ICM7207A	550
ICM7215	1050
ICM7216A	1950
ICM7216B	1950
ICM7217A	790
ICM7224	785

LD130	452
ICM7555	89
LF351	48
LF356	90
LM10	395
LM301A	26
LM308	95
LM311	70
LM318	200
LM324	50
LM339	68
LM348	90
LM349	115
LM379	415
LM380	80
LM381N	145
LM382	125
LM384	140
LM386	99
LM387	120
LM389	99
LM733	75
LM3900	60
LM3909	70
LM3911	125
LM3914	240
LM3915	240
LM13600	135
M252AA	625
M253AA	1150
MC1303	88
MC1304P	260
MC1310P	150
MC1458	45
MC1494	694
MC1495	350
MC1496L	92
MC1596	225
MC1710	79
MC3302	150
MC3340P	120
MC3360P	120
MC3401	52
MC3403	135
MC3405	150
MFC6040	97
MK50398	635
MM5303	635
MM5307	1275
MM57160	620
MSM5526	820
NE529	225
NE543	210
NE544	185
NE555	22
NE556DB	55
NE560	325
NE561	395
NE562B	410
NE564	435

NE565A	120
NE566	180
NE567	170
NE570	450
NE571	420
RC4136D	110
S5668	275
SAB3209	425
SAB3210	275
SG3402	295
SN76003N	240
SN76013N	170
SN76018	148
SN76023N	170
SN76033N	195
SN76115N	215
SN76131	125
SN76227N	95
SN76477	175
SN76660	120
SP8629	299
TAA621AX1	250
TAA661A	155
TAD100	159
TBA120S	70
TBA540	220
TBA550Q	330
TBA641-A12/BX1 or BX11	250
TBA651	190
TBA800	90
TBA810S	95
TBA820	70
TBA920Q	260
TBA990Q	270
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	575
TDA1024	105
TDA2020	320
TDA2030	300
TL061	46
TL064CN	159
TL071CP	45
TL072CP	90
TL074CN	140
TL081CP	42
TL082CP	70
TL083CP	95
TL084CP	120
UAA170	170
UAA180	170
XR2206	350
XR2211	575
XR2266	750
ZN414	95
ZN423	195
ZN424E	130
ZN425E	415
ZN427	660
ZN1034	200
ZN1040E	685

COMPUTER IC's

2102	125
2112-2N	250
2114-250ns	225
2114-300ns	299
2708	445
4116 16K	299
6502	650
6505	850
6520	350
6522	650
6530	1350
6532	850
6545	1450
6551	850
6592	2572
6800	700
74L00	68
74S132	138
74S138	240
74S158	240
74S188	210
74S189	158
74S194	360
74S195	795
74S241	540
74S262	850
74S287	325
74S288	210
74S470	325
74S472	1150
74S475	825
75150	140
75154	150
75450	95
75451	70
75452	70p
75454	225
75491/2	89
8080A	499
8085A	1195
8251	700
8253	1275
8T26AN	235
8T28N	280
8T95N	160
8T97N	150
81LS95	135
81LS96	135
81LS97	140
AY-3-1015	550
AY-5-1013	399
AY-5-2376	980
DM8123	195
IM6402	420
MC1488	90

MC1489	90
MC14411	1020
MC14412	1520
MK4027-2	470
MK4027-4	350
MM1702	299
RO-3-2513	650
SFF96364E	1050
SFC71301	820
SFS80102	205
TMS2516	650
TMS2716	1250
TMS 4035	250
TMS 4039	250
TMS 4047	775
TMS 6011	355
Z80CPU 2.5	650
Z80A 4M	825
Z80 P10	450
Z80 CTC	450
Z80A P10	550
Z80A CTC	550

TTL 74 (TEXAS)

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	36
7407	36
7408	17
7409	20
7410	17
7411	25
7412	20
7413	32
7414	38
7416	30
7417	30
7420	19
7421	38
7422	25
7423	28
7425	28
7426	43
7427	32
7428	35
7430	19
7432	27
7433	36
7437	35
7438	32
7440	20
7441	68
7442	58
7443	120
7444	116

7445	105
7446	132
7447	72
7448	75
7450	20
7451	20
7453	20
7454	20
7460	20
7470	40
7472	30
7473	35
7474	34
7475	56
7476	40
7480	52
7481	120
7482	75
7483	90
7484	99
7485	105
7486	33
7489	205
7490	42
7491	84
7492	50
7493	57
7494	85
7495	70
7496	80
7497	176
74100	130
74104	62
74105	62
74107	34
74109	60
74110	54
74111	68
74112	170
74116	170
74118	85
74119	120
74120	75
74121	35
74122	50
74123	65
74125	50
74126	45
74128	45
74132	55
74136	55
74141	75
74142	185
74143	250
74144	250
74145	90
74147	150
74148	125
74150	130
74151	70

74153	70
74154	120
74155	75
74156	75
74157	70
74159	165
74160	99
74161	99
74162	99
74163	99
74164	120
74165	120
74166	130
74167	205
74170	205
74172	375
74173	110
74174	100
74175	82
74176	80
74177	85
74178	110
74179	150
74180	90
74181	280
74182	85
74184	130
74185	130
74188	310
74190	130
74191	120
74192	120
74193	120
74194	102
74195	75
74196	99
74197	88
74198	160
74199	160
74221	150
74246	150
74247	151
74248	189
74249	189
74251	110
74265	66
74273	267
74278	249
74279	99
74283	149
74284	350
74285	350
74290	107
74293	135
74297	236
74298	185
74365	95
74366	95
74367	95
74368	95

74390	185
74393	185
74490	185

74LS

LS00	13
LS01	13
LS02	15
LS03	15
LS04	16
LS05	23
LS08	22
LS09	23
LS10	20
LS11	32
LS12	32
LS13	40
LS14	60
LS15	40
LS20	21
LS21	32
LS22	35
LS26	44
LS27	35
LS28	35
LS30	20
LS32	25
LS33	35
LS37	30
LS38	35
LS40	28
LS42	66
LS47	85
LS48	105
LS49	105
LS51	25
LS54	30
LS55	30
LS63	150
LS73	45
LS74	35
LS75	45
LS76	45
LS78	50
LS83	105
LS85	80
LS86	38
LS90	50
LS91	125
LS92	75
LS93	60
LS95	115
LS96	120
LS107	45
LS109	75
LS112	40
LS113	75
LS114	40
LS122	70

LS123	75
LS124	180
LS125	45
LS126	45
LS132	60
LS133	35
LS136	55
LS138	70
LS139	70
LS145	120
LS147	210
LS148	170
LS151	90
LS153	85
LS155	75
LS156	85
LS157	70
LS158	70
LS160	90
LS161	98
LS162	110
LS163	95
LS164	115
LS165	145
LS166	175
LS168	210
LS169	210
LS170	288
LS173	105
LS174	110
LS175	110
LS181	295
LS183	298
LS189	128
LS190	95
LS191	95
LS192	95
LS193	99
LS194	125
LS195	130
LS196	120
LS197	85
LS200	345
LS202	345
LS221	120
LS240	165
LS241	165
LS242	165
LS243	165
LS244	195
LS245	350
LS247	135
LS248	135
LS249	135
LS251	130
LS253	95
LS257	95
LS258	120
LS259	160
LS261	450

LS266	75
LS273	180
LS275	320
LS279	88
LS280	250
LS283	90
LS290	130
LS293	130
LS295	215
LS298	215
LS299	420
LS300	175
LS302	175
LS323	270
LS32[illegible]	450
LS324	200
LS325	320
LS326	330
LS327	315
LS346	185
LS347	150
LS348	190
LS352	185
LS353	185
LS365	65
LS366	65
LS367	65
LS368	90
LS373	150
LS374	150
LS375	150
LS377	199
LS378	140
LS379	215
LS384	250
LS385	420
LS386	85
LS390	140
LS393	140
LS395	210
LS396	199
LS398	275
LS399	230
LS445	140
LS447	195
LS490	245
LS668	105
LS669	105
LS670	270
LS673	750
LS674	850

CMOS

4000	14
4001	14
4002	15
4006	86
4007	19
4008	76
4009	40
4010	48
4011	18
4012	24
4013	43
4014	80
4015	82
4016	35
4017	70
4018	76
4019	48
4020	85
4021	90
4022	85
4023	24
4024	60
4025	24
4026	180
4027	45
4028	92
4029	98
4030	55
4031	185
4032	125
4033	175
4034	213
4035	95
4036	275
4037	115
4038	110
4039	299
4040	85
4041	80
4042	70
4043	80
4044	80
4045	175
4046	96
4047	98
4048	65
4049	35
4050	38
4051	86
4052	86
4053	86
4054	130
4055	130
4056	135
4057	2850
4059	575
4060	110
4061	1225
4062	995
4063	120
4066	46
4067	430
4068	26
4069	22
4070	25
4071	25
4072	25
4073	25
4075	23
4076	55

CMOS (CONT.)

4077	30
4078	28
4081	26
4082	25
4085	90
4086	90
4089	150
4093	53
4094	210
4095	95
4096	95
4097	340
4098	115
4099	150
4160	115
4161	115
4162	115
4163	115
4174	110
4175	120
4194	115
4408	790
4409	790
4410	750
4411	950
4412F	1250
4415F	480
4419	280
4422	570
4432	1050
4435	850
4440	999
4450	350
4451	350
4452	000
4490	350
4501	28
4502	105
4503	65
4506	75
4507	48
4508	48
4510	85
4511	98
4512	84
4513	225
4514	220
4515	250
4516	90
4517	415
4518	90
4519	80
4520	90
4521	210
4522	150
4526	98
4527	125
4528	100
4529	150
4530	90
4531	130
4532	120
4534	510
4536	310
4538	145
4539	120
4541	150
4543	150
4549	395
4553	399
4554	192
4555	85
4556	60
4557	425
4558	174
4559	450
4560	199
4561	104
[illegible]	525
[illegible]	195
[illegible]	299
[illegible]	195
[illegible]	36
[illegible]	495
[illegible]	320
[illegible]	135
[illegible]	105
[illegible]	55
[illegible]	99

WAT

(Continu

DIODES

AA129
AAZ15
BY100
BY127
CR033
OA9
OA47
OA70
OA79
OA81
OA85
OA90
OA91
OA95
OA200
OA202
IN914
IN916
IN400/2
IN4003
IN4004/5
IN4006/7
IN4148
IS44
3A/100V
3A/400V
3A/600V
3A/1000V

SCR's Thyristors

0.8A30V
0.8A100V
0.8A200V
1A/100V
1A/200V
1A600V
3A/400V
5A300V
5A600V
8A300V
8A600V
12A300V
12A500V
12A800V
15A700V
BT106
BT116
C106D
MCR101
TIC44
TIC45
2N4444

NEW SHOP & SHOWROOM
NOW OPEN

TELEPHONE 01-263 9493 01-263 9495

UK101 SOUND

Sound generator and combined parallel in out port kit containing P.C.B., AY-3-8910, 6520 PIA, fully documented and demo tape.

£29.95

AY-3-8910	**£8.50**

UK101 SOFTWARE

	£ p
Space Invaders	**6.50**
Real Time Clock	**5.00**
Chequers	**3.00**
Othello	**4.00**
Game Pack I	**5.00**
Game Pack II	**5.00**
Game Pack III	**5.00**
Screen Monitor	**4.00**
Assembler Editor	**14.90**
10 x C12 Blank Tapes	**4.00**

CPU'S

Z80 2.5 Meg	**7.95**
Z80A 4 Meg	**9.95**
6502	**6.95**
6800	**6.50**
8080	**4.75**
9900	**25.95**

SUPPORT CHIPS

Z80 CTC	**5.95**
Z80A CTC	**6.95**
Z80 PIO	**5.95**
Z80A PIO	**6.95**
6520	**3.95**
6522	**6.85**
6532	**8.50**
6821	**4.25**
6850	**3.60**
6852	**4.35**
8212	**1.95**
8216	**1.95**
8224	**2.75**
8228	**3.75**
8251	**4.95**
8253	**9.75**
8255	**4.50**
TMS9901	**13.16**
TMS9902	**11.18**
TMS9904 (74LS362)	**4.21**
DM8123	**1.75**
MC1488	**.90**
MC1489	**.90**

UARTS

AY-5-1013	**3.95**
AY-3-1015	**4.75**
MM5303	**4.75**
TMS6011	**3.55**

MEMORY

D. RAMS	£ p
4027	**2.75**
4050 (350NS)	**2.35**
4060 (300NS)	**2.39**
4116	**3.95**
S. RAMS	
2102A	**1.30**
2102A2	**1.69**
2112A	**2.75**
2114/4045	**2.75**
4035	**1.07**
4044-5257	**6.93**
6810	**3.50**
BULK PURCHASE	
8x2114	**18.00**
8x4116	**27.50**
16x2114	**34.00**

EPROMS

2708	**4.25**
2716 (5v)	**6.95**
2532	**29.95**

ROM

2513 (UC)	**5.95**

I.C. SOCKETS

	D.I.L.	W/W
8 pin	.09	.25
14 pin	.11	.35
16 pin	.12	.42
18 pin	.16	.50
20 pin	.20	.62
22 pin	.22	.65
24 pin	.24	.70
28 pin	.30	.80
36 pin	—	.99
40 pin	.40	1.10

BUFFERS

81LS95	**1.25**
81LS96	**1.25**
81LS97	**1.25**
81LS98	**1.25**
SN74365	**.52**
SN74366	**.52**
SN74367	**.52**
SN74368	**.52**
8T26	**1.50**
8T28	**1.50**
8T95	**1.50**
8T96	**1.50**
8T97	**1.50**
8T98	**1.50**

BAUD RATE GENS

MC14411	**8.75**
MM5307	**8.75**

SEND S.A.E. FOR COMPLETE PRICE LIST OR PHONE 01-883 3705

MONITORS
MONITORS
MONITORS

Uncased from 3" to 12"
Cased from 5" to 20"

Semi professional or professional available from stock.

Monitor PCB's including Transformers and Tubes also in stock.

All Monitors available with P4, P31 and P39 Tubes.

Phone or write for details.

CROFTON ELECTRONICS

Crofton Electronics Limited
35 Grosvenor Road, Twickenham, Middx.
Tel: 01 891 1513

NICKEL CADMIUM BATTERIES

	AA (HP7) 0.5AHr	SUB 'C' 1.2AHr	'C' (HP11) 1.65AHr	'C' (HP11) 2.0AHr	'D' (HP2) 4.0AHr	PP3 0.1AHr
1–24	£0.85	£1.38	£1.69	£2.25	£2.97	£3.79
25–49	£0.82	£1.28	£1.58	£2.10	£2.77	
50–99	£0.80	£1.24	£1.52	£2.02	£2.67	
100 up	£0.70	£1.15	£1.41	£1.87	£2.47	

All cells are brand new full spec devices from reputable mnfrs. All Nickel Cadmium cells (except PP3) are supplied complete with solder tags and are **'VENTED' devices** suitable for fast charge.

CHARGERS – single or dual O/P to charge PP3, AA or SUB 'C' cells in 12-14 hrs (chargers will charge 'C' and 'D' cells but with longer charging time). Units supplied complete in plug top case with flying leads. Number of cells (10 max) in series and type **must** be specified for each required O/P when ordering.

SINGLE O/P CHARGER **£5.04**
DUAL O/P CHARGER **£5.72**

TRANSFORMERS – as used in chargers, 2 x 12 volt 0.25 amp secondarys 240v primary, tag connections **£1.57** each.

Data and charging circuits free with orders over £10 otherwise 30p post. P&P 10% if order less than £10, 5% if order over £10. Prices *DO NOT INCLUDE VAT* and this should be added to the total order.

Cheques, P.O.'s Mail Order to:–

SOLID STATE SECURITY,
Dept. (PE), Bradshaw Lane,
Parbold, Wigan, Lancs.
Telephone 02576-3018.

PROGRESSIVE RADIO **31, CHEAPSIDE, LIVERPOOL L2 2DY**

SEMICONDUCTORS. Texas R1038 TO3 power trans. **50p.** 741 8 pin **22p.** NE555 **24p.** TAG4443 SCR **45p.** 723 14 PIN REGS. **35p.** AD 161/2 MATCHED PAIRS **70p.** 2N5062 SCR **18p.** TIL209 RED LEDS 10 for **75p.** BD238 **28p.** BD438 **28p.** MPU131 P.U.T.'s 40V, 200mA, 375M/W **15p** each. 2N3733 **£1.75.** Infra Red 0.2" LEDs **30p. Rectangular Red LED's 12p** each. CA3020 I.C.'s **40p each.** BY223 **20p.**

MINIATURE MAINS TRANSFORMERS. ALL 240VAC PRIMARY. 6-0-6 100mA, 9-0-9 75mA, 12-0-12 50mA all **75p** each. 12V 200mA **75p.** 12-0-12V, 250mA **£1.25.** 0-6V-0-6V 280mA **£1.30.**

PULSE TRANSFORMERS. 1:1 (GPO type) **30p.** 1:1 plus 1 min. P. C. mounting **60p.**

MINIATURE SOLID STATE BUZZER. 33×17×15mm, output at 3 feet 70db, only 15mA drain, operating voltage 2 types 6 or 12VDC **75p each.**

LOUD BUZZER. 6-12 volts **63p.** Rotary Alarm siren, 12VDC., Red plastic body and mounting bracket 68×75mm **£4.50p. 6" ALARM BELLS,** motorised aluminium gong, output 88db at 3 mtrs., 12V DC 65mA, **£7.95p.**

POCKET MULTIMETER. MODEL NH55 2,000 ohms per volt. 1,000 volts AC/DC. 100mA DC current, 2 resistance ranges to 1 meg **£5.50p.**

SOLDER SUCKER. High suction/teflon nozzle, **£4.65p.**

TRANSDUCERS. 40KHz. REC/SENDER **£3.50** pair.

MOTORS. 3V model type **22p.** 6V cassette motor **£1.20p.** Replacement 12VDC 8 track motors **55p.**

EX-EQUIP. B.S.R. RECORD DECK MOTORS, C129, C127 etc., 240V AC **£1.20p.**

AMPHENOL COAX CONNECTORS. Plugs **47p,** Sockets **42p,** Elbows **90p,** Reducers **13p.** Back to back sockets **65p,** Back to back plugs **65p.**

HIGH IMPEDENCE HEADPHONES, mono 2,000 ohms imp. transducer type, adjustable band and padded earpiece **£2.75.**

SPECIAL OFFER STEREO HEADPHONES. 8 ohms, adjustable, standard stereo plug only **£2.95p**

INTERCOM UNITS (can be used as baby alarm) supplied with approx. 60' cable, call button, 2 was **£5.25** pair, 3 way **£7.25p. WIRELESS INTERCOM,** 2 units both operate on 240VAC and mains connected. AM frequency 180KHz., **£29.95p.**

MINIATURE TIE PIN MICROPHONE. Omni, 1K imp., uses deaf aid battery (supplied) **£4.95p. LOW COST CONDENSER MIKE.** Stick type. Omni, 600 ohms, on/off switch, standard jack plug only **£2.95p. EM607 CONDENSER MICROPHONE.** Highly polished metal stick mike, uni directional, 600 ohms. 30-18KHz., on/off switch only **£7.95p. DYNAMIC STICK MIKE.** CARDIOD, dual imp., 600 ohms or 20K. 70-15KHz., attractive black metal case only **£7.75p.**

JACKSONS C280 **50p each. VARIABLE CAPS. 50p each. MERCURY (TILT) SWITCH,** 1"x¾", **35p.**

Special clearance offer of tools, (1) Side Cutters, (2) Long nosed Pliers, (3) Heavy duty pliers, insulated handles, all at **£1.00 each.**

CRIMPING TOOL, for standard terminals also 6 gauge stripper and wire cutter, insulated handles only **£2.30.**

Cash with order please, official orders welcome from schools etc., please add 30p post and packing. VAT inclusive. SAE for latest illustrated stock list. *ALL ORDERS DESPATCHED BY RETURN POST*

Why the Sinclair ZX80 is Britain's best-selling

Built: £99.95

Including VAT, post and packing, free course in computing, free mains adaptor.

Kit: £79.95

Including VAT, post and packing, free course in computing.

This is the ZX80. A really powerful, full-facility computer, matching or surpassing other personal computers at several times the price. 'Personal Computer World' gave it 5 stars for 'excellent value'. Benchmark tests say it's faster than all previous personal computers.

Programmed in BASIC – the world's most popular language – the ZX80 is suitable for beginners and experts alike. And response from enthusiasts has been tremendous – over 20,000 ZX80s have been sold so far!

Powerful ROM and BASIC interpreter

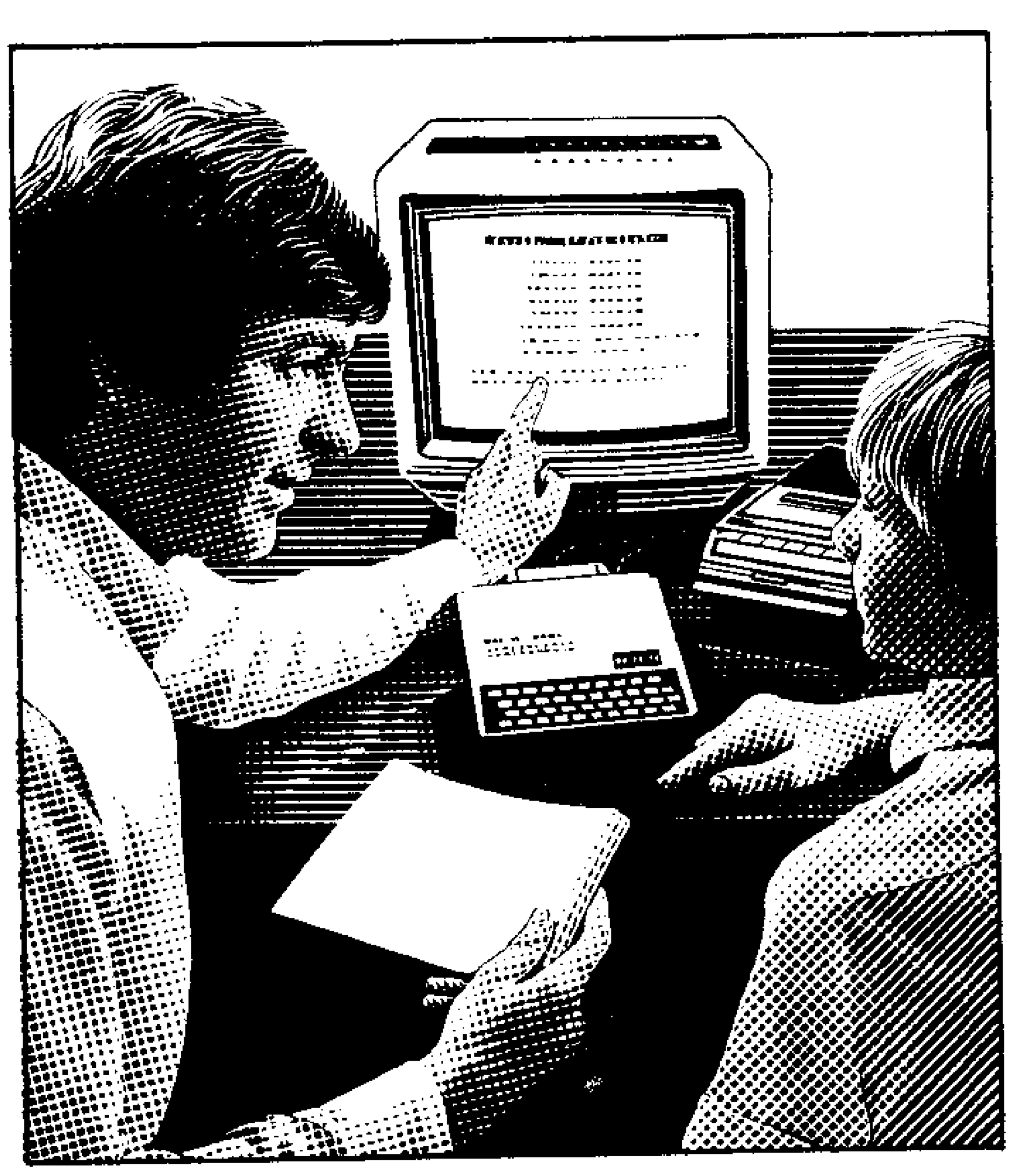
The 4K BASIC ROM offers remarkable programming advantages:

* Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
* Unique syntax check. A cursor identifies errors immediately.
* Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison).
* Up to 26 single dimension arrays.
* FOR/NEXT loops nested up to 26.
* Variable names of any length.
* BASIC language also handles full Boolean arithmetic, condition expressions, etc.
* Randomise function, useful for games and secret codes, as well as more serious applications.
* Timer under program control.
* PEEK and POKE enable entry of machine code instructions.
* High-resolution graphics.
* Lines of unlimited length.

Unique RAM

The ZX80's 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer – typically storing 100 lines of BASIC.

No other personal computer offers this unique combination of high capability and low price.



The ZX80 as a family learning aid. Children of 10 years and upwards are quick to understand the principles of computing – and enjoy their personal computer.

The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book (free with every ZX80). The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs.

Kit or built – it's up to you

In kit form, the ZX80 is pleasantly easy to assemble, using a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated. If not, see the coupon.

Both kit and built versions come complete with all necessary leads to connect to your TV (colour or black and white) and cassette recorder. Plug in and you're ready to go. (Built versions come with mains adaptor.)

personal computer.

Now available for the ZX80... New 16K-BYTE RAM pack

Massive add-on memory. Only £49.95.
The new 16K-BYTE RAM pack is a complete module designed to provide you – and your Sinclair ZX80 – with massive add-on memory. You can use it for those really long and complex programs – or as a personal database. (Yet it can cost as little as half the price of competitive add-on memory for other computers.)

For example, you could write an interactive or 'conversational' program to show people what your ZX80 can do. With 16K-BYTES of RAM, they could be talking to your computer for hours!

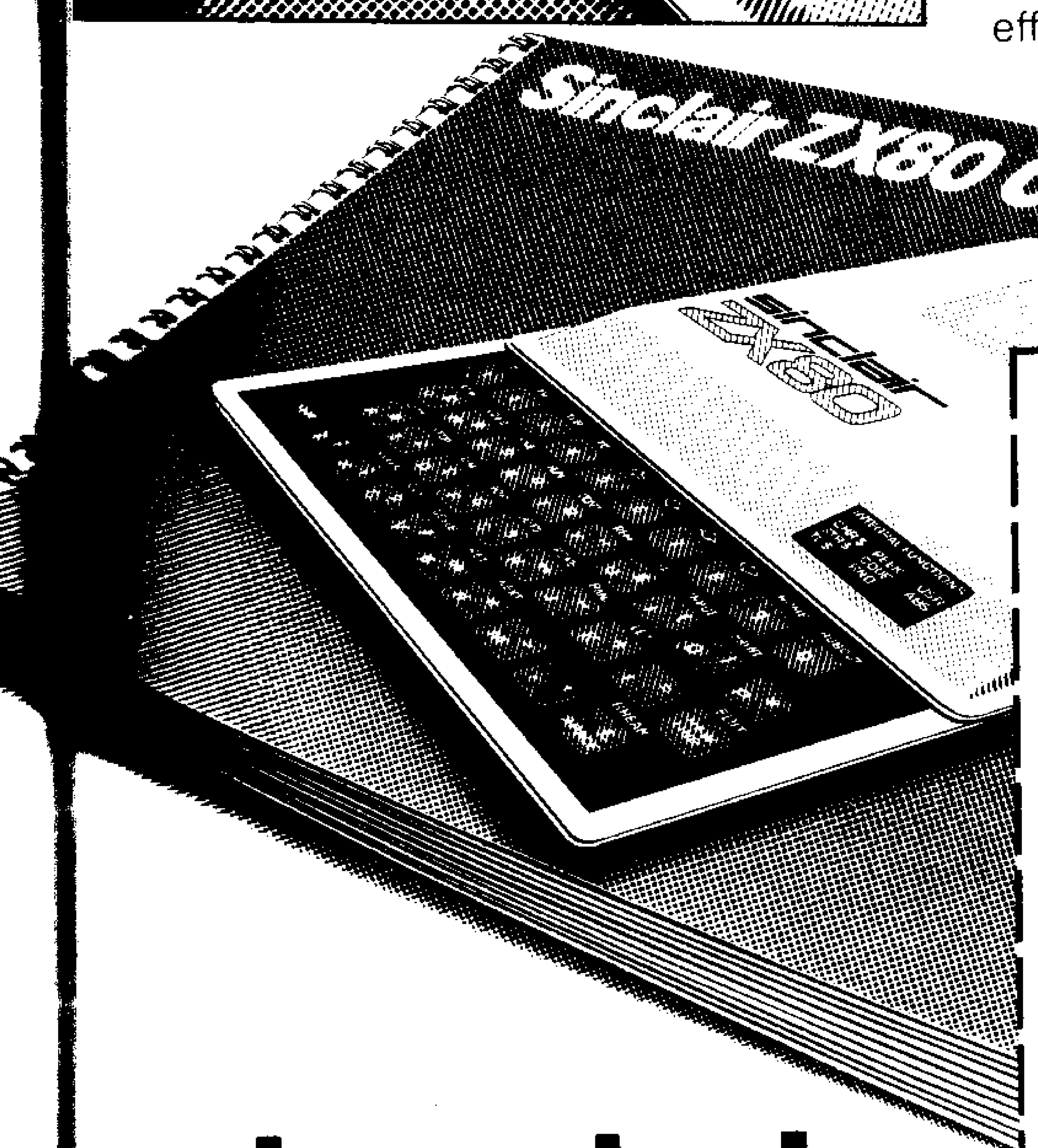
Or you can store a mass of data – perhaps in a fairly simple program – such as a name and address list, or a telephone directory.

And by linking a number of separate programs together into one giant, but modular, program, you can achieve the same effect as loading several programs at once.

We're also confident that it won't be long before you can buy cassette-based software using the full 16K-BYTE RAM. So keep an eye on the personal computer magazines – and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80. No wires, no soldering. It's a matter of seconds and you don't need another power supply. You can only add one RAM pack to your ZX80 – but with 16K-BYTES who could want more!

How to order
Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.



To: Science of Cambridge, FREEPOST 7, Cambridge CB2 1YY.
Remember: all prices shown include VAT, postage and packing. No hidden extras. Please send me:

Qty	Item	Code	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	02	79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	01	99.95	
	Mains Adaptor(s) (600 mA at 9V DC nominal unregulated).	03	8.95	
	16K-BYTE RAM pack(s).	18	49.95	
	Sinclair ZX80 Manual(s). (Manual free with every ZX80 kit or ready-made computer).	06	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense. **TOTAL: £**

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ ______
Please print
Name: Mr/Mrs/Miss ______
Address ______

FREEPOST – no stamp needed. **PE/1**

sinclair ZX80

Science of Cambridge Ltd.
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: 0223 311488.

PE VOLUME 17 No. 1 JANUARY 1981

REALISM

"WE ARE now, I believe, beginning to come to terms with the real world again. The myths are exploding and reality is breaking through."

So said Mr. John Nott, Secretary of State for Trade to the North West Branch of the Engineering Employers Federation in Bolton recently. A significant statement and one that we are sure is true in more ways than one! What worries us is that when its all over and the unemployment figures start to fall again will the inbred attitudes of industrialists and employees have changed significantly enough to have a real affect on our future? We live in a fast moving world and we must move with it, the electronics industry is good at doing this but we must introduce others to the advantages of robots and computers.

Take another quote if you will: "Today our profession is critically important to an effort that greatly concerns our nation—maintaining healthy technology through innovation. More people than ever understand that raising our standard of living to match our expectations largely depends on our ability to successfully advance our technologies."

"A growing concern is that we as a nation are losing our technological leadership and our traditional productivity advantage to others."

. . . "Our greatest single devotion must be to professionalism that in large measure requires technological currentness. On a wider scale, we need to renew ourselves in pursuing excellence in a world of change."

Mr. John Nott again, talking to the electronics engineer? No, wrong man and, believe it or not, the wrong country. That statement was made by William C. Hittinger, Executive Vice President, Research and Engineering for RCA.

Let us look more closely at this positive attitude which is perhaps what we in the UK lack. One thing that gives some insight into the feelings of America is the "growing concern that we as a nation are losing our technological leadership and our traditional productivity advantage to others." Few countries in the world would think in this way if they held the position of America in the electronics industry and for an RCA man to make the statement is even more significant.

There is also the realisation that "raising our standard of living to match our expectations largely depends on our ability to successfully advance our technologies". We believe this to be something of an understatement but one which everyone should consider.

AMERICA AMERICA!

We are not all lovers of the American way of life or of Americans in general—they have a lot to answer for in respect of our nightly TV entertainment—but we cannot afford to ignore them and we should be prepared to copy the good. We see no reason why the UK cannot capitalize on the "reality that is breaking through", and start the tide that was the brain drain, flowing in the other direction, but it must come from us all, from a new approach, a new realism and a new need in everyone.

According to Mr. John Nott the signs are there and he went on to echo Mr. Hittinger's feelings by saying.

"We cannot enjoy a better life unless we provide the wherewithal by producing more goods and services more efficiently . . . The time has come again to look ahead."

The time has come for electronics!

Mike Kenward

EDITOR
Mike Kenward
Gordon Godbold ASSISTANT EDITOR
Mike Abbott TECHNICAL EDITOR
David Shortland PROJECTS EDITOR
Jasper Scott PRODUCTION EDITOR
Jack Pountney ART EDITOR
Keith Woodruff ASSISTANT ART EDITOR
John Pickering SEN. TECH. ILLUSTRATOR
Isabelle Greenaway TECH. ILLUSTRATOR
Colette McKenzie SECRETARY

ADVERTISEMENT MANAGER **D. W. B. Tilleard** } **01-261 6676**
SECRETARY **Christine Pocknell** }
AD. SALES EXEC **Alfred Tonge** **01-261 6819**
CLASSIFIED MANAGER **Colin Brown** **01-261 5762**

Editorial Offices:
Practical Electronics,
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG
Phone: *Editorial* Poole 71191

We regret that lengthy technical enquiries cannot be answered over the telephone (see below).

Advertising Offices:
Practical Electronics Advertisements,
King's Reach Tower,
King's Reach, Stamford Street, SE1 9LS
Telex: 915748 MAGDIV-G
Make Up/Copy Dept.: 01-261 6601

Technical Queries

We are unable to offer any advice on the use or purchase of commercial equipment or the incorporation or modification of designs published in Practical Electronics.

All letters requiring a reply should be accompanied by a stamped, self addressed envelope and each letter should relate to **one published project only.**

Components are usually available from advertisers; where we anticipate supply difficulties a source will be suggested.

Back Numbers

Copies of most of our recent issues are available from: Post Sales Department (Practical Electronics), IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, at 95p each including Inland/Overseas p&p.

Binders

Binders for PE are available from the same address as back numbers at £4·30 each to UK or overseas addresses, including postage and packing, and VAT where appropriate. Orders should state the year and volume required.

Subscriptions

Copies of PE are available by post, inland or overseas, for £11·80 per 12 issues, from: Practical Electronics, Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH. Cheques and postal orders should be made payable to IPC Magazines Limited.

Market Place

Items mentioned are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned. All quoted prices are those at the time of going to press.

by David Shortland and Jasper Scott

PROTECTED MULTIMETERS

Following their introduction of the quality Tester range of multimeters with modular construction and "Do-it-Yourself" repair facilities, Alcon Instruments Ltd have now introduced the SUPER 20 and SUPER 50 Testers from the same Miselco stable. These new instruments now include cut-out protection and semiconductor test facilities all provided in a package small enough to be called "pocket-sized" without exaggeration.

As their names imply, the two are similar in almost all aspects but have basic different movements offering sensitivities of 20kΩ/V and 50kΩ/V a.c. and d.c. respectively. Each instrument has 39 ranges covering from 100mV (150mV for the S/50) to 1kV d.c. and from 10V to 1kV a.c. Current ranges extend from 100μA to 10A (3A for the S/50) d.c., and 3mA to 10A (3A for the S/50) a.c. There resistance ranges, are five, covering from 5kΩ to 5MΩ f.s.d. An optional high voltage probe extends the upper limit of the d.c. ranges to 30kV for TV and the like.

Accuracy figures are 2 per cent of f.s.d. for d.c., 3 per cent for a.c. and 1 per cent of centre scale for resistance. These values, coupled with the figures noted make the Super 20 an ideal general-purpose multimeter and the Super 50 well suited to specialist electronic measurement for which it was designed.

Both instruments are provided with fuse protection, a novel neon discharge system and a new electronic high-speed cut-out system. This latter serves to disconnect the instrument from external circuits should an overload voltage appear at the movement. The module is itself detachable from the circuit board, in line with the Tester practice, simply inserted on five pins. The cut-out operates when the applied energy exceeds that which the meter range indentifies by a factor sufficient to prevent movement damage. This action releases the reset button to indicate activation.

The system is resettable manually by depression of a button and can be tested simply by pressing a "Test" black button to indicate battery and circuit state.

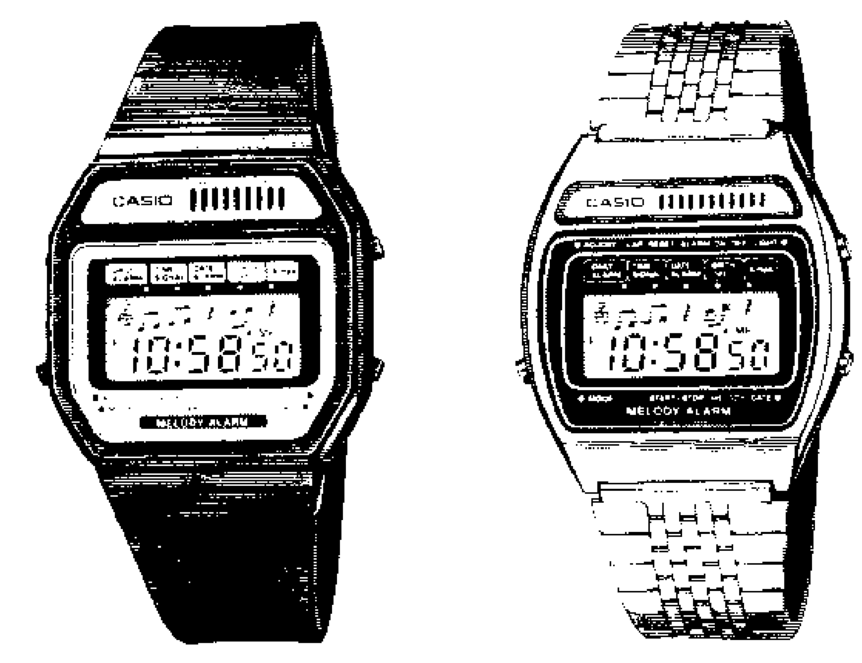
A simple semiconductor test facility is also provided capable of effecting basic function tests on most discrete devices swiftly and easily. In addition both instruments may optionally include a Universal Signal Injector capable of generating a signal rich in harmonics and detectable to 500MHz for radio and TV test purposes.

Prices for the two meters (complete with case, leads and instructions) are £56·81 and £59·00 including VAT. **Alcon Instruments Ltd., 19 Mulberry Walk, London SW3 6DZ (01-352 1897).**

JINGLE ALL THE WAY

Just in time for Christmas, the latest wrist job from Casio, their M12 melody alarm watch, has 12 memorised tunes (including Jingle Bells) as alarm signals.

In alarm mode, the M12 plays at the preset time each day a distinctive tune, changing according to the day of the week. With appropriate settings it plays "Happy Birthday", "Wedding Bells", or an alternative melody on suitable dates, and "Jingle Bells" as the Christmas Day alarm. For its twelfth trick, the M12 can sound hourly "Big Ben" chimes.



M12 M1200

A digital display shows time in hours, minutes and seconds plus am/pm (or 24 hour clock), with month, date and day available at the press of a button.

Also within the l.c.d. display is a five-line musical stave, on which "notes" appear as a melody is played. The M12 also has a countdown alarm/stopwatch function.

With resin case and strap, the Casio M12 is powered by a BR-2016 lithium battery with expected life of at least two years, and has a recommended retail price of £26·95.

Identical functions and characteristics are available in the superior packaging of stainless steel case and bracelet. This model is coded M1200, at RRP £34·95.

Casio Electronics Co. Ltd., 28 Scrutton Street, London EC2A 4TY.

SYSTEMA WEDGE

Systema Electronics have recently introduced a new style scientific calculator which should retail at around £13. Aimed directly at the volume end of the scientific calculator market, the Systema LC 34P offers comprehensive scientific operations including 3 level parentheses plus statistical functions.

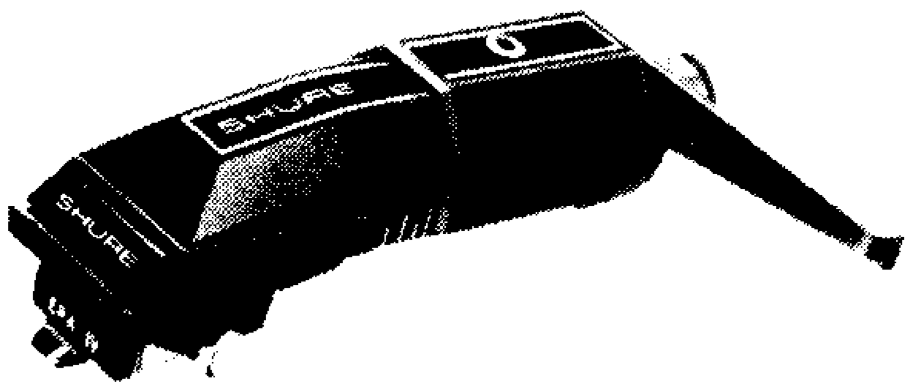
The wedge shaped design of the Systema LC 34P gives a perfect viewing angle on the students desk or engineers bench. The large liquid crystal display has an 8 digit capacity (or 5 digit mantissa and 2 digit exponent) plus operational symbols. Keyboard layout is clear and uncluttered with all dual functions colour coded.

This stylish scientific operates for about a year on 2 AA size penlight batteries which are easily available world wide. Supplied complete with soft carry pouch, the Systema LC 34P measures 144mm(L) × 75mm(W) × 18mm maximum (H) and should now be available from most good retailers.

INTEGRATED CARTRIDGE-HEADSHELL

Shure Electronics has announced the expansion of its line of M97 Era IV Series Cartridges with the M97HE-AH, a precision integrated cartridge-headshell with a universal four-pin bayonet headshell connector for instant installation in many leading turntables.

Shure claim that the integrated design of the M97HE-AH offers several advantages over separate cartridge and headshells, including easier installation, elimination of spurious resonances from insecure mountings, and a total weight reduction of 4–6 grams when compared to many other cartridge and separate headshell combinations.



As an added feature, the M97HE-AH is provided with a special pickup arm/cartridge alignment system which includes an overhang gauge and a non-operable alignment stylus. This allows precise overhang adjustment for minimum lateral tracking error without risk of damage to the actual playback stylus.

The M97HE-AH includes a nude-mounted hyperelliptical stylus, a viscous damped Dynamic Stabilizer, telescoped stylus, shank and the innovative Side-Guard—which protects against stylus damage frequently caused by sliding a cartridge across the surface of the record or by hitting the edge of the record. As a result, the M97HE-AH offers maximum stylus and record protection, as well as improved trackability in the critical mid and high frequencies at a tracking force of $\frac{3}{4}$ to $1\frac{1}{2}$ grams.

The recommended retail price for the M97HE-AH is £51·80 plus VAT.

Shure Electronics Ltd., Eccleston road, Maidstone, Kent ME15 6AU (0622 59881)

MINI TV

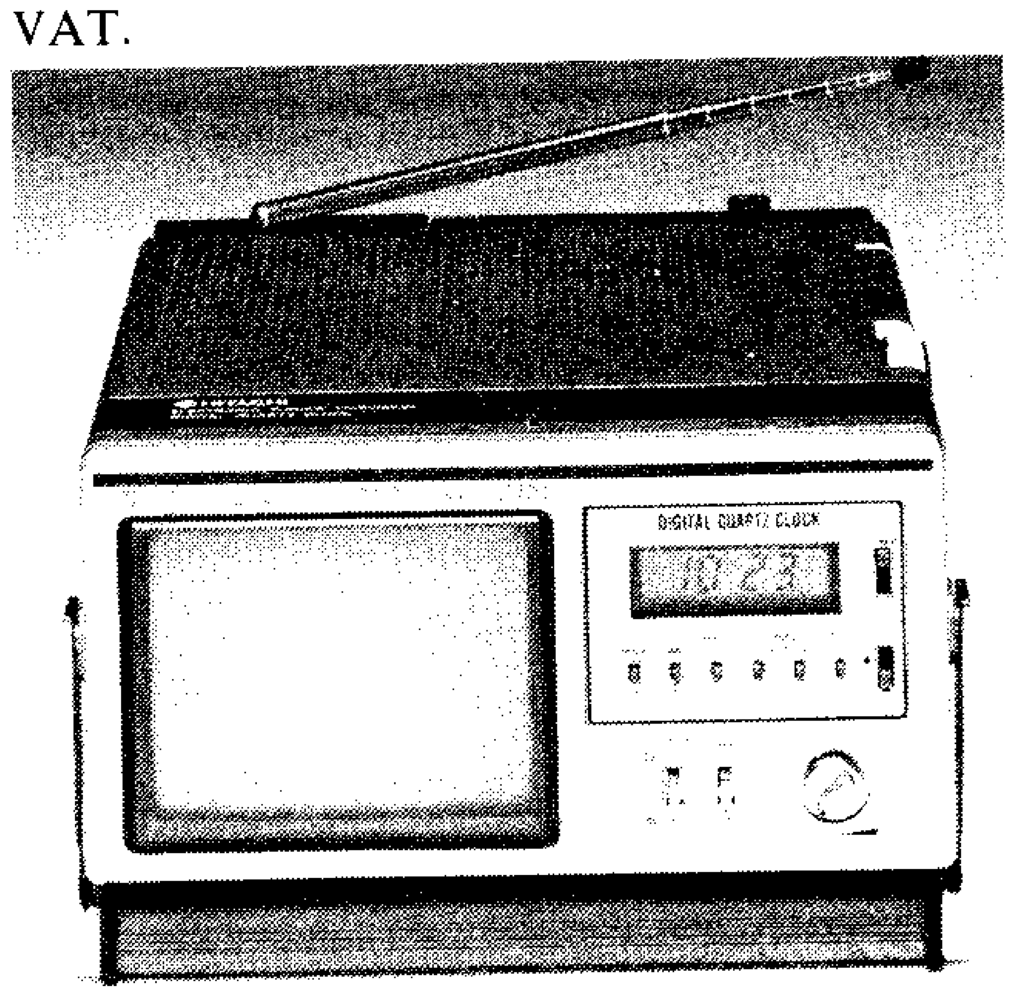
The latest TV from Hitachi is the K2300 model which is a $4\frac{1}{2}$in. monochrome set with a digital clock. The unit works from a.c. mains, car battery, internal batteries or an optional battery pack.

The set works on either v.h.f. or u.h.f. frequency bands switched over at the touch of a button. Tuning has been simplified by using a vertical line on the screen which indicates the channel being received and is cancelled by a button once tuned in correctly.

The quartz digital clock can be set to switch the TV on or off at any pre-determined time which is ideal when you want to watch a programme in bed as there is no worry about falling asleep whilst watching and the set remaining on. The K2300 is fitted with an earphone socket for private listening and a recording jack for audio recordings onto a tape recorder.

The K2300 is finished in a silver and black cabinet and is provided with a carrying handle which can also be used as a stand for the set.

The price of the K2300 is £115 including VAT.



SPEECH RECOGNITION SYSTEM

A speech input device for most popular microprocessors has been announced by William Stuart Systems Ltd.

Marketed under the name "Big Ears", the system consists of a microphone, pre-amplifier, analogue frequency filters and digital interface, complete with software.

Words are stored as voice patterns which the system learns from repetition by the user. Analysis is then by correlation over a statistical frequency plane which plots combinations of formants and harmonics throughout the speech waveform.

The unit has been designed to connect directly to the UK101/Superboard family of computers, or to any other via a spare user input port. The analysis programs are supplied in Basic language, with small real-time input routines written in 6502 or Z80 machine code.

Typical uses for the system include data enquiry, robot control, computer games etc.,

"Big Ears" is supplied fully assembled in a cabinet, and costs £45 plus VAT, including postage and packing. Please state which computer the unit is to be used with.

William Stuart Systems are at Dower House, Herongate, Brentwood, Essex, CM13 3SD. (0277 810244).

SCALED DOWN VIDEO

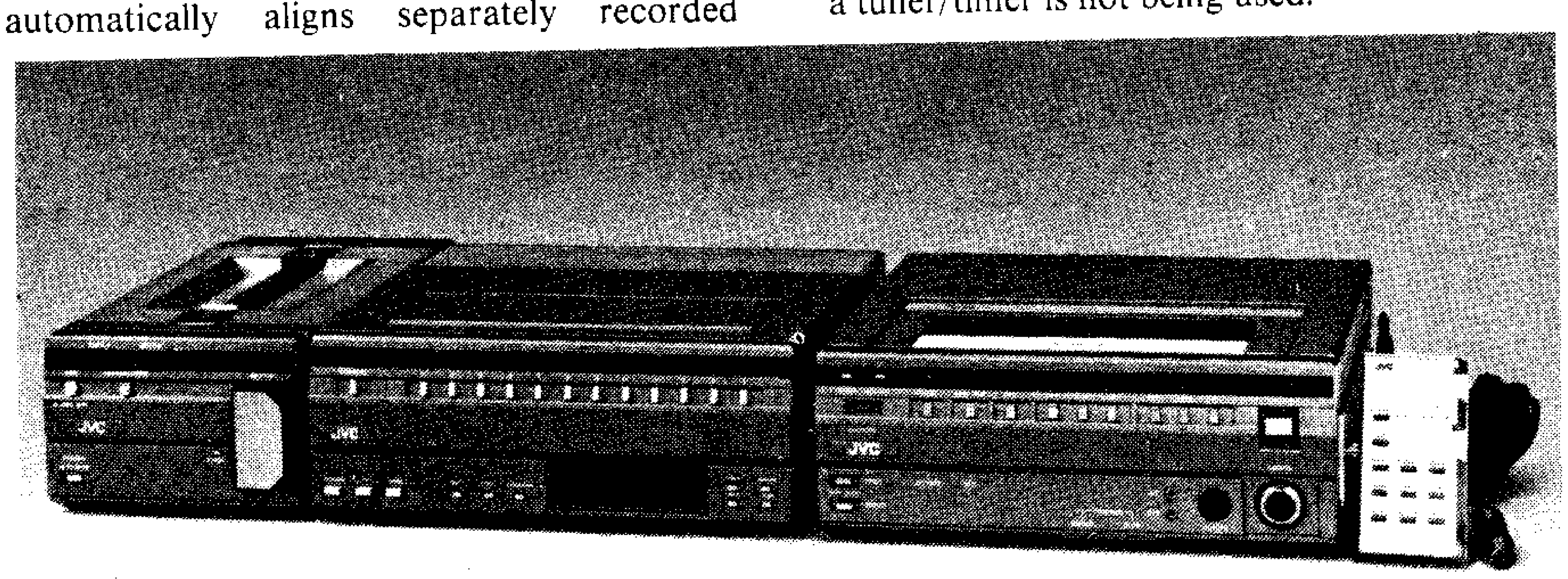
JVC are launching a new portable video system, the HR2200E. It incorporates highly advanced video technology in an ultra lightweight and compact form. Size and weight have been dramatically reduced while retaining full VHS compatibility.

The HR2200E weighs just 5·2kg and is constructed from R.R.P. – a new material which is both extremely light and strong. The chassis is moulded into a single unit and JVC have reduced the number of components by 50 per cent compared with their previous video recorders. A newly-developed high precision brushless quartz locked direct drive motor drives the head drum and transports the tape steadily while being carried.

The HR2200E is equipped with some superb facilities – a built-in microprocessor provides full logic control and solenoid operated pushbuttons mean that feather light touch is all that is required to change modes. For further convenience, the HR2200E comes complete with a remote control unit.

Other advanced features include variable speed playback, Edit Start Control, which automatically aligns separately recorded segments, avoiding distortion and a Shuttle Search facility – for the first time ever on a portable machine – which allows programmes to be reviewed in both forward and reverse directions at 10 times normal speed. A 3-way power supply gives the HR2200E added flexibility – it can be powered by household a.c. mains, car battery or by its own Nickel-Cadmium rechargeable battery pack which has over twice the life of lead acid batteries.

The HR2200E is complimented by the TU22E – a multi purpose unit which functions as a tuner/timer (with a 10 day preset capacity), a.c. power adapter and a battery charger. Together the HR2200E and the TU22E form a complete unit with no need for a separate a.c. power adapter or battery recharger. The TU22E can recharge the Nickel-Cadmium battery in just 90 minutes – this remarkable time-saving capability plus the long life of the Ni-Cad battery are yet two more important features that place the new JVC portable video system way above any other previous system. The AA P22E AC power adapter can also be used as a battery charger, and to supply power to the recorder if a tuner/timer is not being used.



Unique in concept - the home computer that grows as you do!

-The Acorn Atom

NEW! Colour Encoder for full colour graphics **£21.50**

£120 An outstanding personal computer kit

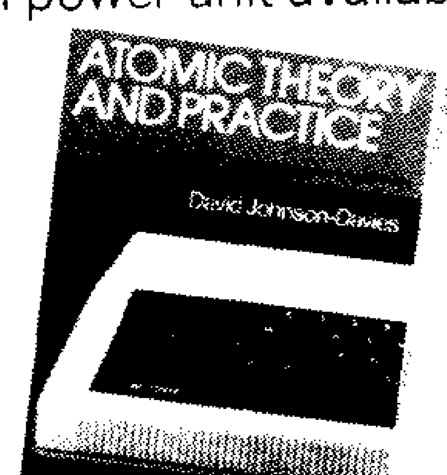
plus VAT and p&p.

Also available ready-built **£150** plus VAT and p&p

The ATOM – a definitive personal computer. Simple-to-build, simple-to-operate. But a really powerful full-facility computer. And designed on an expandable basis. You can buy a superb expanded package now – tailored to your needs. Or, you can buy just the standard Atom kit, and, as you grow in confidence and knowledge, add more chips. No need to replace your equipment. No need to worry that your investment will be overtaken by new technology. As you need more power, more facilities, you can add them!

*The picture shown demonstrates mixed graphics and characters in three shades of grey provided by the Standard Atom

The standard ATOM kit includes:
● Full sized QWERTY keyboard ● Rugged polystyrene case ● Fibreglass PCB ● 2K RAM ● 8K ROM ● 23 integrated circuits ● Full assembly instructions including tests for fault-finding. (Once built, connect it to any domestic TV and power source) ● Power requirement: 8V at 800 M A. ATOM power unit available. See coupon. PLUS FREE MANUAL written in two sections – teach yourself BASIC and machine code for those with no knowledge of computers, and a reference section giving a complete description of the ATOM's facilities. All sections are fully illustrated with example programs.



The ATOM concept
Adding chips into sockets on the PCB allows you to progress in affordable steps to large-scale expansion. You can see from the specifications that the RAM can be increased to 12K allowing high resolution (256 x 192) graphics. Two further ROM chips, e.g. maths functions, can be added directly to the board giving a 16K capacity. In addition to 5 I/O lines partly used by the cassette interface, an optional VIA device can provide varied I/O and timer functions and via a buffer device allow direct printer drive. An optional module provides red, green and blue signals for colour. An in-board connector strip takes the ATOM communications loop interface. Any number of ATOMs may be linked to each other – or to a master system with mass storage/hard copy facility. Interface with other ACORN cards is simplicity itself. Any one ACORN card may be fitted internally.
So you can see there are a vast number of modular options and additions available, expanding with your ability and your budget.

The ATOM hardware includes:
● Memory from 2K to 12K RAM on board (up to 35K in case) ● 8K to 16K ROM (two 4K additions) ● 6502 processor ● Video Display allows high resolution (256 x 192) graphics and red, green and blue output ● Cassette Interface – CUTS 300 baud ● Loudspeaker allows tone generation of any frequency ● Channel 36 UHF Modulator Output ● Bus output includes internal connections for Acorn Eurocard.

The ATOM software includes:
● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 32-bit integer variables ● 27 additional arrays ● random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● LINK to machine-code routines ● PLOT DRAW and MOVE.

ACORN COMPUTER **4a Market Hill, CAMBRIDGE CB2 3NJ**

Your ACORN ATOM may qualify as a business expense. To order complete the coupon below and post to Acorn Computer for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied. **All components are guaranteed with full service/repair facility available.**

Quantity	Item	Item price inc. VAT+p&p	TOTALS
	ATOM KIT–8K ROM+2K RAM (MIN)	@ £140.00	
	ATOM ASSEMBLED–8K ROM+2K RAM (MIN)	@ £174.50	
	ATOM KIT–12K ROM+12K RAM (MAX)	@ £255.00	
	ATOM ASSEMBLED–12K ROM+12K RAM (MAX)	@ £289.50	
	1K RAM SETS	@ £11.22	
	4K FLOATING POINT ROM (inc. in 12K Version)	@ £23.30	
	PRINTER DRIVE 6522 VIA	@ £10.35	
	(inc. in 12K version) LS244 Buffer	@ £3.17	
	COLOUR ENCODER	@ £21.50	
	MAINS POWER SUPPLY (1.3 amps)	@ £10.20	
		TOTAL	

To: Acorn Computer Ltd., 4a Market Hill, CAMBRIDGE CB2 3NJ

I enclose cheque/postal order for £
Please debit my Access/Barclaycard No.
Signature
Name (Please print)
Address

Telephone No.
Registered No: 1403810. VAT No: 215 400 220

PE/1/81

Access BARCLAYCARD VISA

INDUSTRY NOTEBOOK

By Nexus

Moral of the Metro

The almost universal chorus of praise which greeted the introduction of the BL Austin Mini Metro gave it a flying start in the market place. And, almost overnight, the public image of BL was transformed from a sick joke to a go-ahead organisation well able to compete in the cut-throat world of mass-production popular cars.

The explanation is simple. This was BL's first all-electronic car. Not the car itself but the dedicated application of electronic aids and techniques in research, development, testing and, above all, in production.

The Metro story is a superb practical example of the need for change and of its unhappy consequences. The highly automated production line is essential for achieving productivity and consistent quality. The product is better and cheaper. But automation reduces manpower and de-skills the work of those still retained on the production line. One BL worker on the Metro automated assembly track confessed to being even more bored than he was on the old manual track. Now, he complained, all he did all day long was to press buttons, a task which a child of ten could perform just as ably. He had become nothing more than a robot-minder.

Overall, however, there is just as much skill needed to produce the Metro as any other similar car. All that has happened is that the skill had been transferred away from the production line and into electronic hardware and software. Efficient, tireless, electronically programmed and controlled robots work round the clock. The line trouble-shooter is armed with a digital multimeter instead of a set of spanners. The semi-skilled assembler is down-graded to button-pushing, albeit with no loss of pay.

There is little choice in the matter. It may still be possible to almost hand-build a Rolls Royce limousine selling at £50,000 to an elite market. But for a mass market it is automate or die. It seems there is no escaping the social consequences of automation apart from re-training, and we all know how hard it is to teach an old dog new tricks.

There is nothing new in all this. It has been happening steadily over the past 20 years. The Metro story is just the latest positive example of the increasing need to adapt to the reality of a fast-changing world.

Low Profile

The nationalised industries and services are deservedly unpopular. They are a burden to the taxpayer with their insatiable appetite for subsidies and create antagonism by their reluctance to improve performance.

The one really notable exception is Cable &Wireless Ltd, a consistent profit-maker, which few people even realise is 100 per cent owned by the British Government.

The company's policy is to keep a low profile on ownership, not through any feeling of embarrassment but out of political consideration. For Cable&Wireless operates world-wide with one of its principal activities being the planning, management and operation of overseas national communications services on a concessionary basis. The company has some 50 branch offices starting alphabetically with Abu Dhabi and Antigua and ending with Tonga, Tortola, Turks Island and Vanuato (New Hebrides).

The British Government, again for international political reasons, observes a hands-off policy with the company on its operations and only an arm's-length control on finances. To all intents and purposes C&W operates autonomously and with local loyalty to the countries it serves.

Of course C&W has the supreme advantage of being in a high-growth industry. But it is a tempting thought that the facts of operating almost entirely overseas in widely dispersed locations and with considerable freedom of action in technical and commercial decision-making has also contributed to success.

Stock Market

Present economic policies have thrown up many surprises and have amply demonstrated that so-called experts in economics are either duffers or that economic forecasting itself is anything but an exact science. About the only thing all the experts have been correct on is the easily predictable rise in unemployment, a continuation of the trend since 1974 under both Labour and Conservative policies.

The biggest surprise, considering universal groans on the high international value of the pound sterling, is the healthy overseas trade surplus. From a prediction of £2·75 billion in the red it now seems probable that the balance of trade over a 12-month period will at least be in the black, if not handsomely so.

Another surprise is the remarkable buoyancy of the stock exchange indices, indicating that despite all the gloomy talk there is considerable confidence in the future of British business and industry.

Punters in electronics shares buying and selling at the right times should have done remarkably well. On the day it was announced that Britain had its highest ever recorded monthly balance of trade surplus I checked out some electronics share prices in terms of low and high price for 1980.

Here are some examples with low and high price in New Pence in brackets. Bulgin (22/38); Gray Electronics (30/76); Dubilier (31½/74); Electrocomponents (410/716); Electronic Machine (21/62); Farnell (218/378); Ferranti (254/490); GEC (325/538); Plessey (106/266); Racal (172/342); Rediffusion (65/104); STC (230/467); Thorn/EMI (262/378); Unitech (207/348).

With shrewd timing it was possible to more than double your money in a single deal. Arguably some of the shares are over-priced at their 'highs' but this merely reinforces the view that apart from oil and gold, well-managed electronics companies, with a long-term assured future, are the best bet in shares.

Writing of bets reminds me that at the recent Bookmakers Show 80 in London over a third of the exhibitors were showing electronic cash registers and calculators tailored to the bookies special needs in calculating and paying out complicated multiple bets like doubles and trebles and yankees. The bookies say they will be paying over £14 million to the Horserace Betting Levy Board this year, reflecting a 30 per cent increase in betting turnover, but whether in spite of or because of the recession is not clear.

UK Ahead

The struggle for international recognition of competing Viewdata services has resulted in a modest league table. The three contestants are France's Teltel, Canada's Telidon and Britain's Prestel. The scores in overseas sales at the time of going to press were France nil, Canada one and UK five.

Canada's only goal is Venezeula while the UK has already netted West Germany, Netherlands, Switzerland, Hong Kong and Austria.

Orders

Order books remain healthy. The TV fourth channel network generated a £5 million contract for microwave relay links for GEC and, still in the broadcasting field, Marconi booked a two million dollar US sale of VTRs. Racal-Decca has won a £4 million follow-on order for electronic warfare equipment for the Royal Danish Navy and MEL booked a £4 million contract for microwave landing systems for the Royal Navy. The first marine satellite earth terminal is to be constructed at Goonhilly under a £2·75 million contract with Marconi. UKADGE, a consortium of Marconi, Plessey and Hughes, has won the £100 million up-date contract for the UK Air Defence System which will be funded largely by NATO.

Meantime, exports are racing ahead with the aerospace industry with its large electronics content enjoying an all-time record year.

PE Master Rhythm

Part 2

A. J. Boothman B.Sc.

INSTRUMENTATION for the *PE* Master Rhythm comprises twelve instruments on a single printed circuit board. The basic generators are five drum and four noise related circuits, plus a gain control circuit driven by the Accent pulse. In addition the Snare Drum and Rim Shot sounds are derived by combined use of the basic generators as required. The Low and High Tom-Toms double up to give Conga Drum and Low Bongo respectively, and the degree of resonance can be set as a compromise or biased towards either type of instrument.

DRUMS

The complete instrumentation circuitry is shown in Fig. 7. Four of the Drum circuits utilise the quad NAND gate IC10, whilst the fifth uses an inverter section of IC11. Taking the Bass Drum circuit as an example it consists of an oscillator based on IC10c, having a twin-T network with frequency determining components R45-47 and C9-11, damped out of oscillation by R48 in series with VR4. When the Bass Drum is required to sound a positive pulse appears at the input to R41, is shortened by C8, and appears across R45 to excite the circuit into oscillation at approximately 65Hz. The oscillation decays at a rate dependant on the position of VR4, and the signal level passed to the preamplifier is controlled by VR5.

EXTRA RESONANCE

As VR4, 6, 8, 10 and 12 are turned clockwise the length of the decay time increases and at some point uncontrolled oscillation will occur. The extra resonance obtained can be put to good use, particularly in the case of VR6 and VR8 where advancing the controls improves the Latin American instrumentation. VR12 has to be set in a compromise position balancing High Bongo against the Snare Drum sound.

CYMBALS

Transistors TR1 and TR2 gate a noise signal to produce the Cymbal sounds. The Short Cymbal envelope is generated through C38 with a decay length determined by C39 and R93/94 whilst the Long Cymbal envelope consists of the full control pulse width followed by a decay determined by C41 and R97/98. A tuned circuit, consisting of L1 and C48, filters the noise into a narrow band of frequencies to give a metallic effect.

BRUSHES

These are similar in operation to the Cymbal circuits and are based on TR3 and TR4. However, the tuned circuit is omitted to give a wider band of noise, particularly introducing increased low frequency noise.

HYBRID CIRCUITS

The Snare Drum effect is produced by triggering the High Bongo and Short Brush simultaneously through diodes D53 and D54, whilst the Rim Shot further incorporates the Claves through D49.

PREAMPLIFIER/ACCENT

The preamplifier consists of a mixer, IC13a, followed by a voltage controlled output stage IC13b, the gain of which is increased above unity by the ratio of R116 to the resistance seen across VR14. The Accent is produced by switching the resistance across pins 4 and 5 of IC11b to a low state which places R122 across a portion of VR14 determined by its position, and consequently increases the feedback ratio and gain of IC13b. To carry out the switching operation the Accent control pulse is fed to the gate (pin 3) of IC11b through the envelope components R120, C58 and R121. Normally the f.e.t. which comprises IC11b is in a high impedance state and switches to low on receipt of the positive Accent pulse.

High frequency attenuation of the signal from IC13b is possible using the "Tone" control VR3. This allows compensation to be introduced for the frequency response of following amplifiers and in particular the avoidance of very high frequency distortion effects some times present. The Master Rhythm output level is controlled by VR2 which is combined with the supply switch S9.

INSTRUMENT BOARD ASSEMBLY

The track layout and component overlay details for the Instrument p.c.b. are given in Figs. 8 and 9. Whilst this board is less complicated than the Control Board careful assembly and inspection is again recommended. The suggested assembly order is pins, resistors, diodes, wire links, i.c. sockets, preset potentiometers, capacitors, transistors, and finally the Inductor.

When the Instrument board is complete, preset potentiometers VR4, 6, 8, 10 and 12 should be set fully anticlockwise, giving minimum length of sustain whilst VR5, 7, 9, 11, 13, 14 and 15 should be set to mid positions.

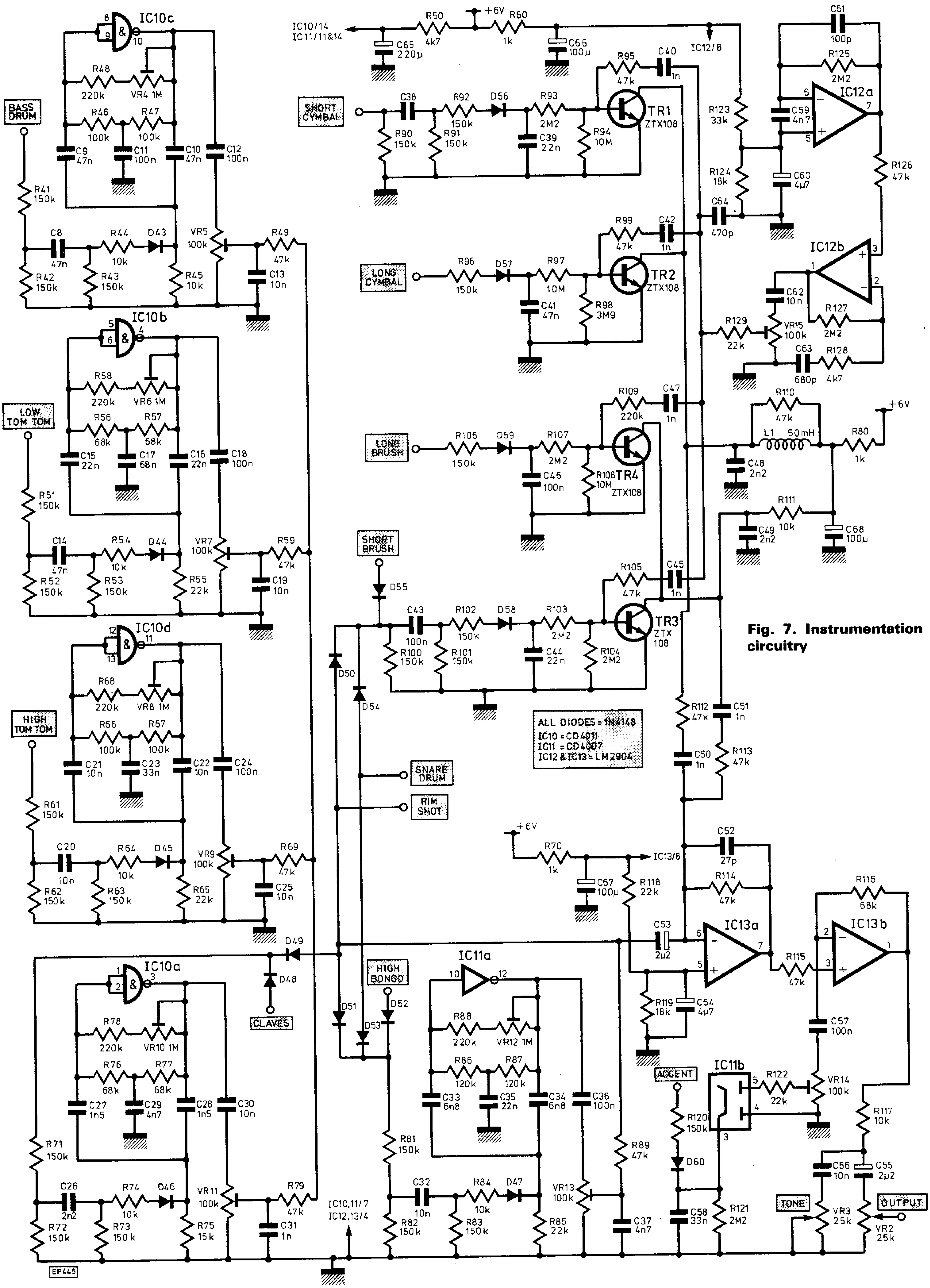


Fig. 7. Instrumentation circuitry

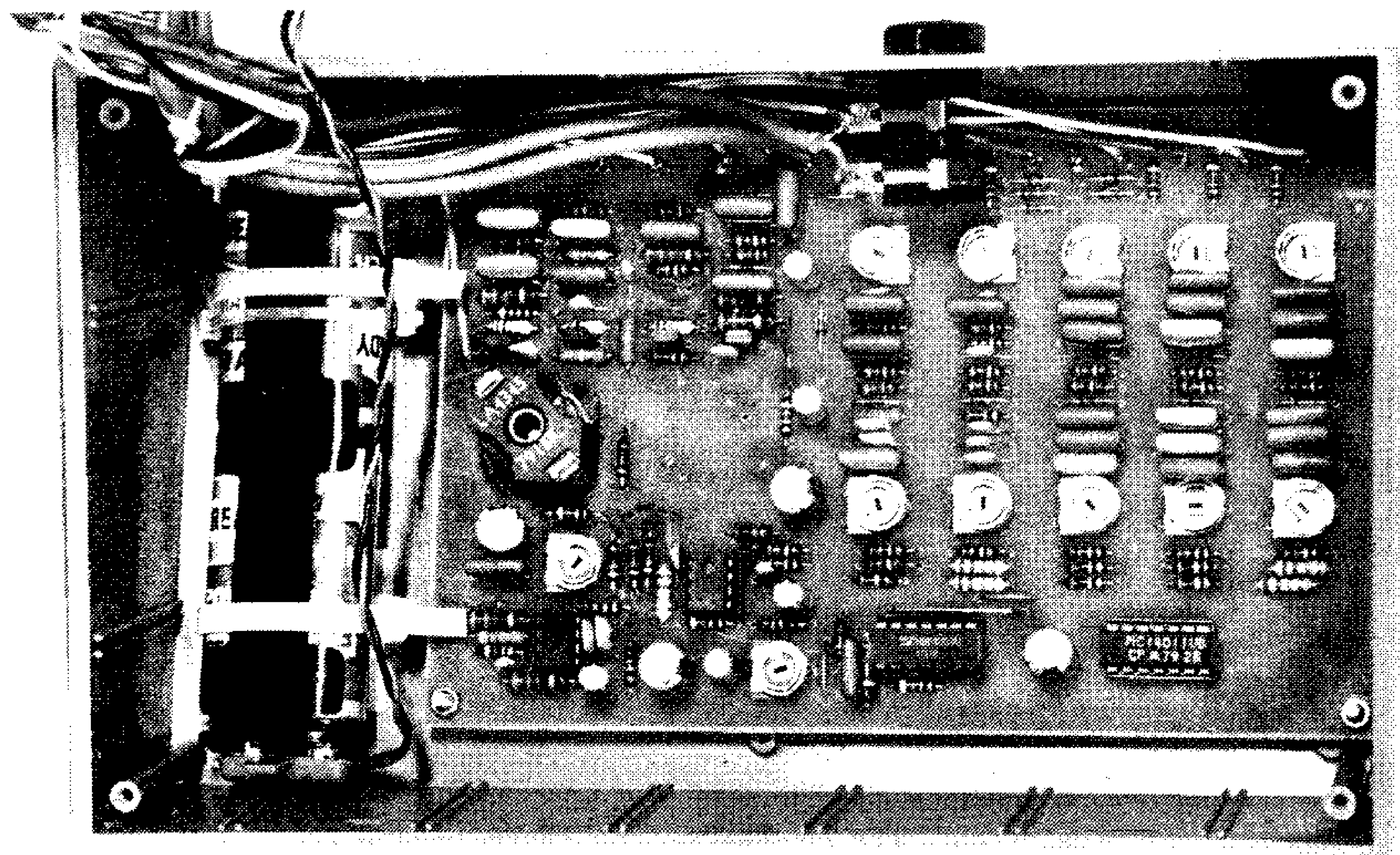
COMPONENTS . . .

INSTRUMENT BOARD

Resistors

R41–R43	150k (3 off)
R44	10k
R45	10k
R46, R47	100k (2 off)
R48	220k
R49	47k
R50	4k7
R51–R53	150k (3 off)
R54	10k
R55	22k
R56, R57	68k (2 off)
R58	220k
R59	47k
R60	1k
R61–R63	150k (3 off)
R64	10k
R65	22k
R66, R67	100k (2 off)
R68	220k
R69	47k
R70	1k
R71–R73	150k (3 off)
R74	10k
R75	15k
R76, R77	68k (2 off)
R78	220k
R79	47k
R80	1k
R81–R83	150k (3 off)
R84	10k
R85	22k
R86, R87	120k (2 off)
R88	220k
R89	47k
R90–R92	150k (3 off)
R93	2M2
R94	10M
R95	47k
R96	150k
R97	10M
R98	3M9
R99	47k
R100–R102	150k (3 off)
R103, R104	2M2 (2 off)
R105	47k
R106	150k
R107	2M2
R108	10M
R109	220k
R110	47k
R111	10k
R112, R113	47k (2 off)
R114	47k
R115	47k
R116	68k
R117	10k
R118	22k
R119	18k
R120	150k
R121	2M2
R122	22k
R123	33k
R124	18k
R125	2M2
R126	47k
R127	2M2
R128	4k7
R129	22k

All resistors 0·25W, 5% carbon film.



Capacitors

C8–C10	47n polyester
C11, C12	0·1µ polyester
C13	10n polyester
C14	47n polyester
C15, C16	22n polyester
C17	68n polyester
C18	0·1µ polyester
C19–C22	10n polyester
C23	33n polyester
C24	0·1µ polyester
C25	10n polyester
C26	2n2 ceramic plate
C27, C28	1n5 ceramic plate
C29	4n7 ceramic plate
C30	10n polyester
C31	1n0 ceramic plate
C32	10n polyester
C33, C34	6n8 polyester
C35	22n polyester
C36	0·1µ polyester
C37	4n7 ceramic plate
C38	47n polyester
C39	22n polyester
C40	1n ceramic plate
C41	47n polyester
C42	1n0 ceramic plate
C43	0·1µ polyester
C44	22n polyester
C45	1n ceramic plate
C46	0·1µ polyester
C47	1n ceramic plate
C48, C49	2n2 ceramic plate
C50, C51	1n ceramic plate
C52	27p ceramic plate
C53	2µ2/16V radial elect.
C54	4µ7/16V radial elect.
C55	2µ2/16V radial elect.
C56	10n polyester
C57	0·1µ polyester
C58	33n polyester
C59	4n7 ceramic plate
C60	4µ7/16V radial elect.
C61	100p ceramic plate
C62	10n polyester
C63	680p ceramic plate
C64	470p ceramic plate
C65	220µ/10V radial elect.
C66–C68	100µ/16V radial elect.

Semiconductors

D43–D60	1N4148 (17 off)
TR1–TR4	ZTX108 (4 off)
IC10	CD4011
IC11	CD4007
IC12–IC13	LM2904 (2 off)

Potentiometers

VR4, 6, 8, 10, 12	1M (5 off)
VR5, 7, 9, 11, 13, 14, 15	100k (7 off)

Inductor

L1	50mH

Miscellaneous

·040in. terminal pins (18 off)
14 pin i.c. sockets (2 off)
8 pin i.c. sockets (2 off)
printed circuit board (1 off)
box (minimum size $8\frac{1}{2}$in. × 5in. × $2\frac{1}{2}$in.)
battery container (4 × HP7)
$\frac{1}{4}$in. 6BA clearance spacers (10)
$\frac{3}{4}$in. 6BA screws (10)
6BA full nuts (19)
6BA insulated nut (1)
colour coded wire (10/0·1)
single core screened cable.

A complete kit can be obtained from **Clef Products, 16 Mayfield Rd., Bramhall, Cheshire SK7 1JU.**

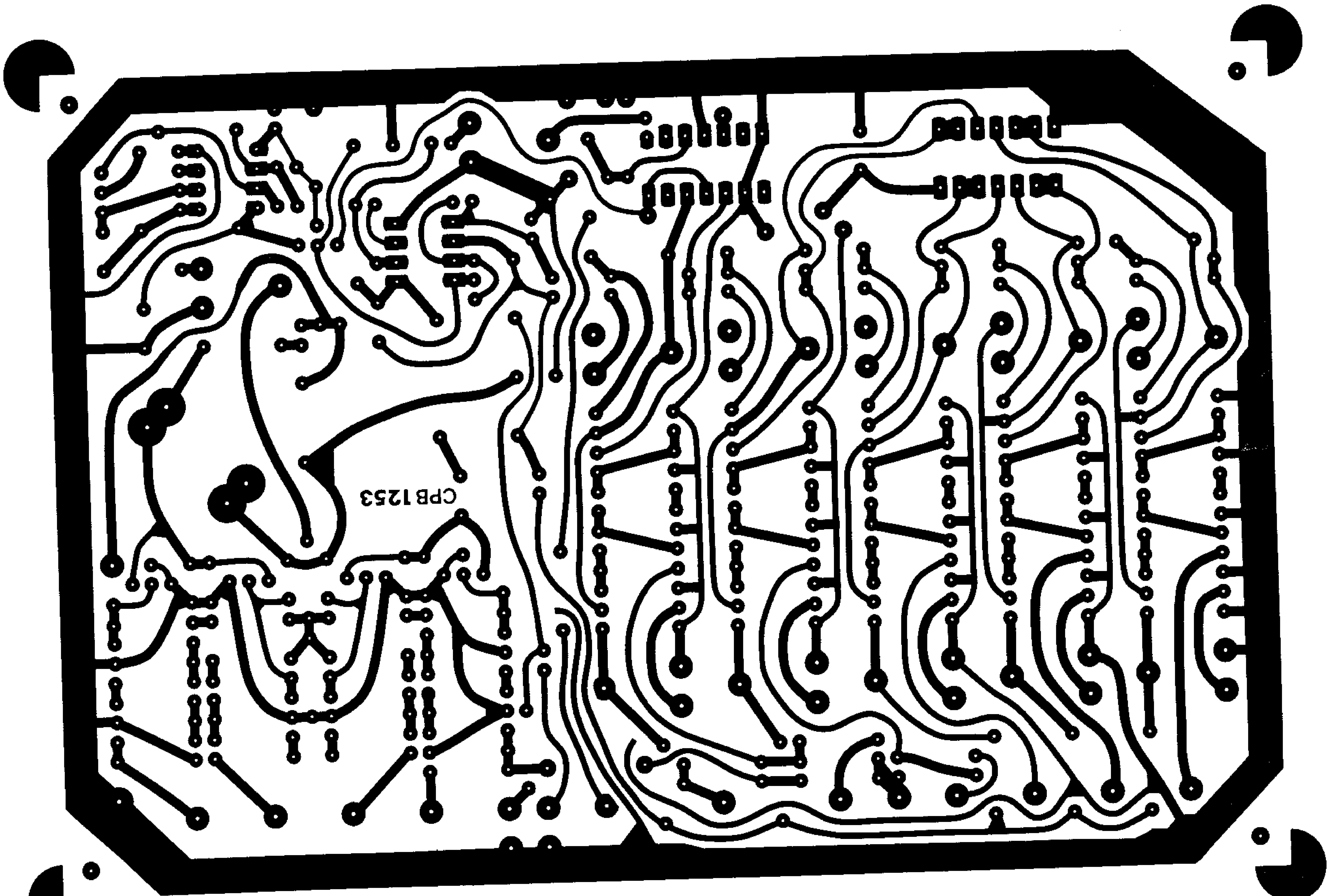


Fig. 8. Instrumentation p.c.b.

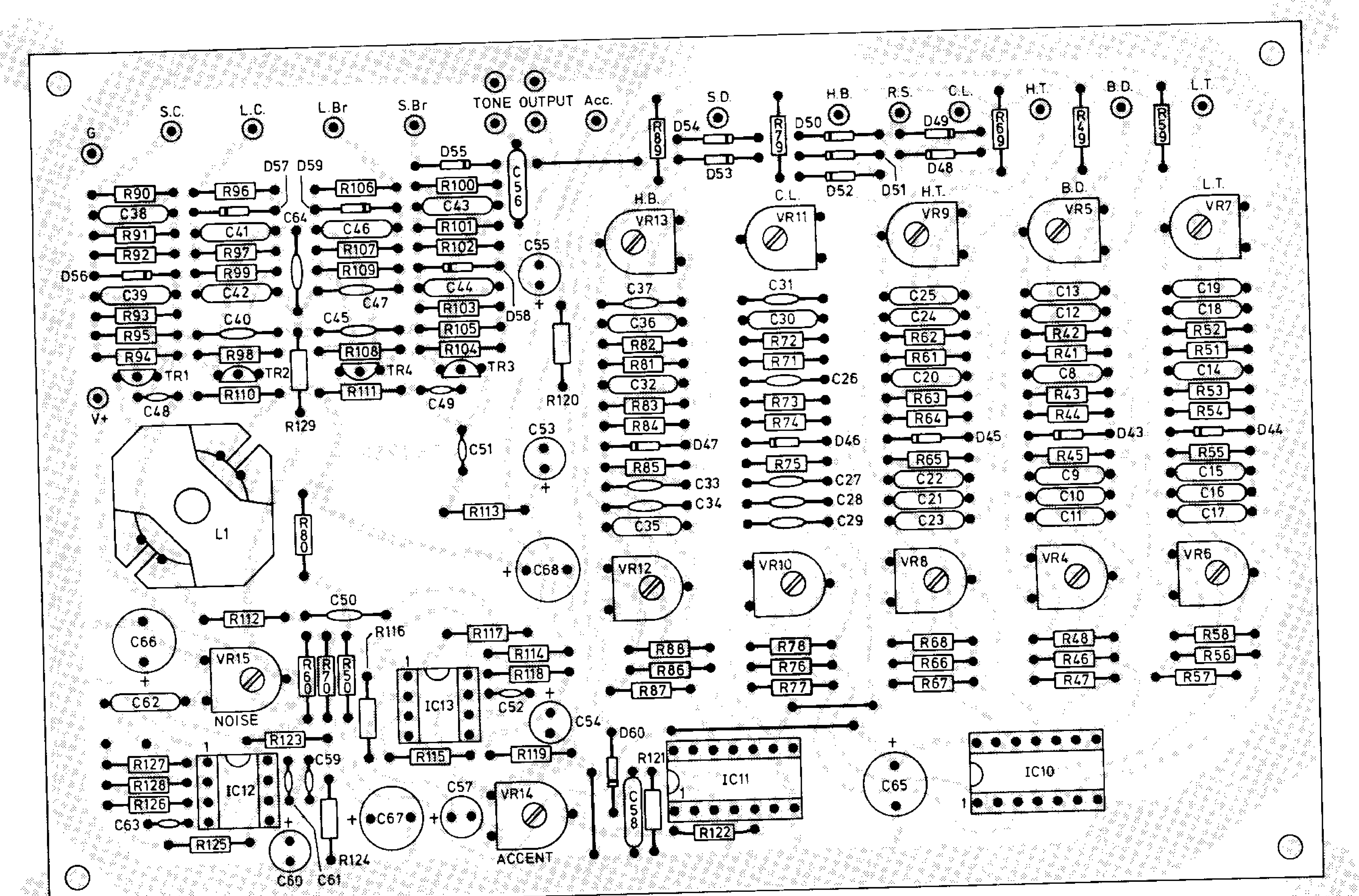
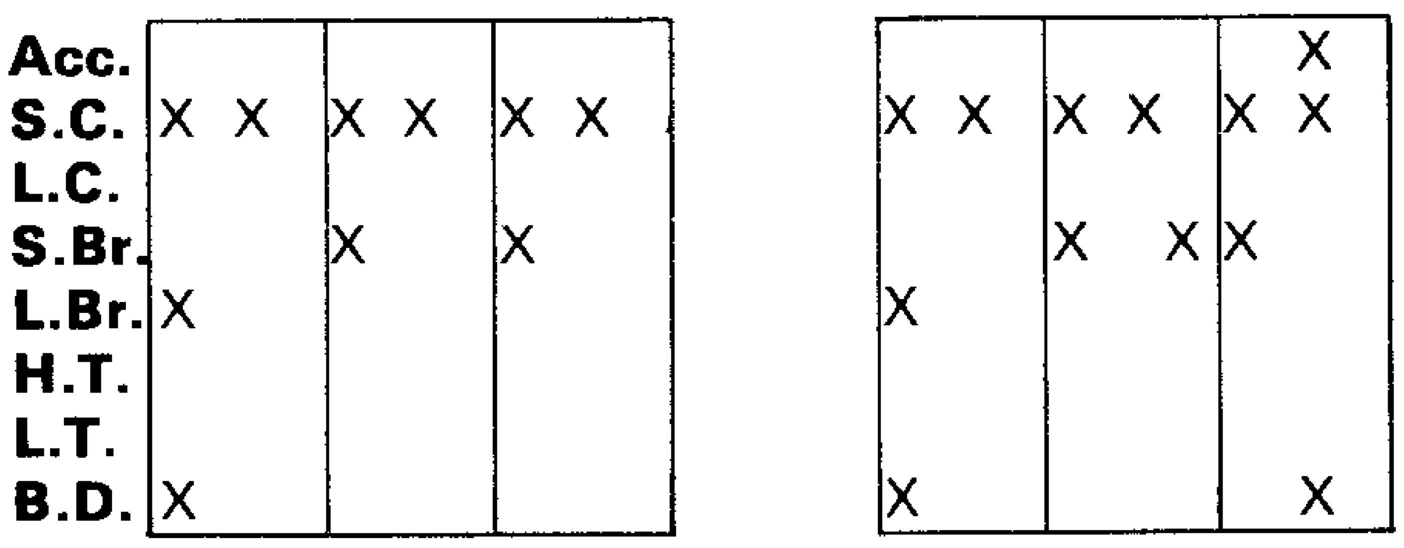


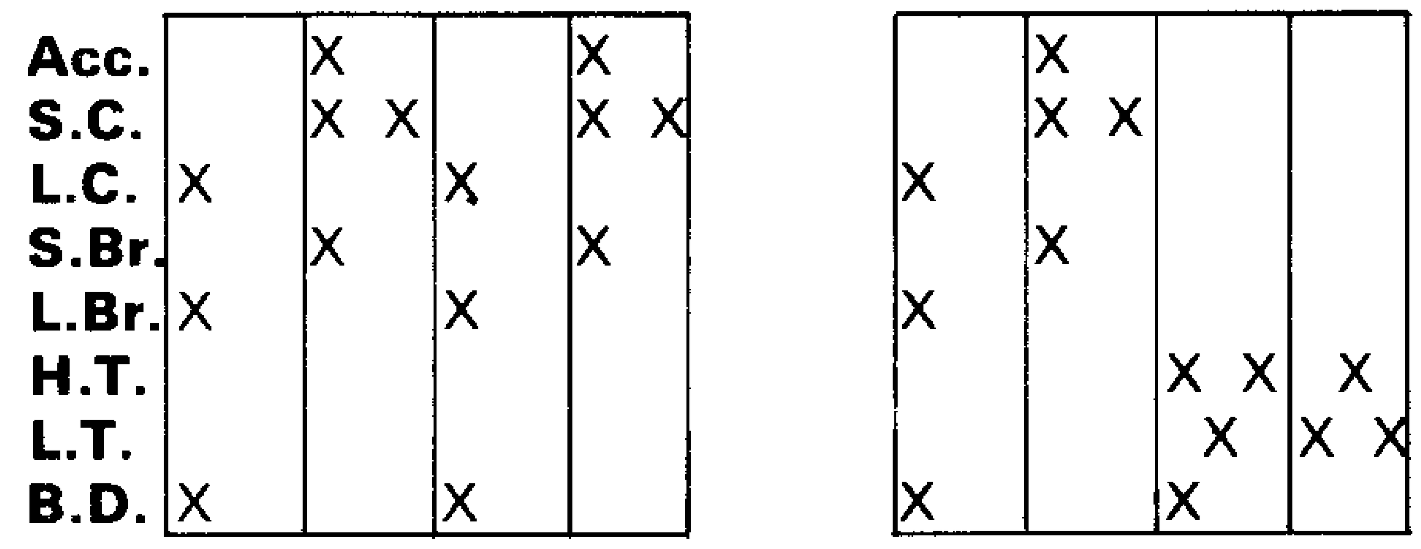
Fig. 9. P.c.b. overlay

RHYTHM PATTERN EXAMPLES

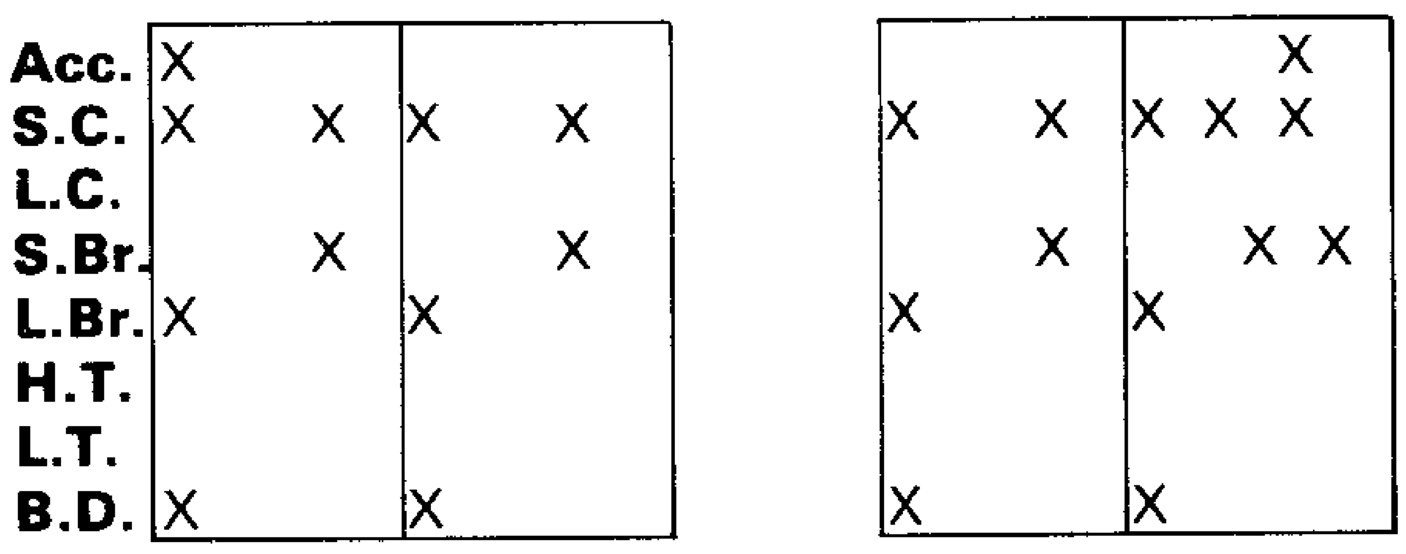
1 WALTZ (A) **(B)**



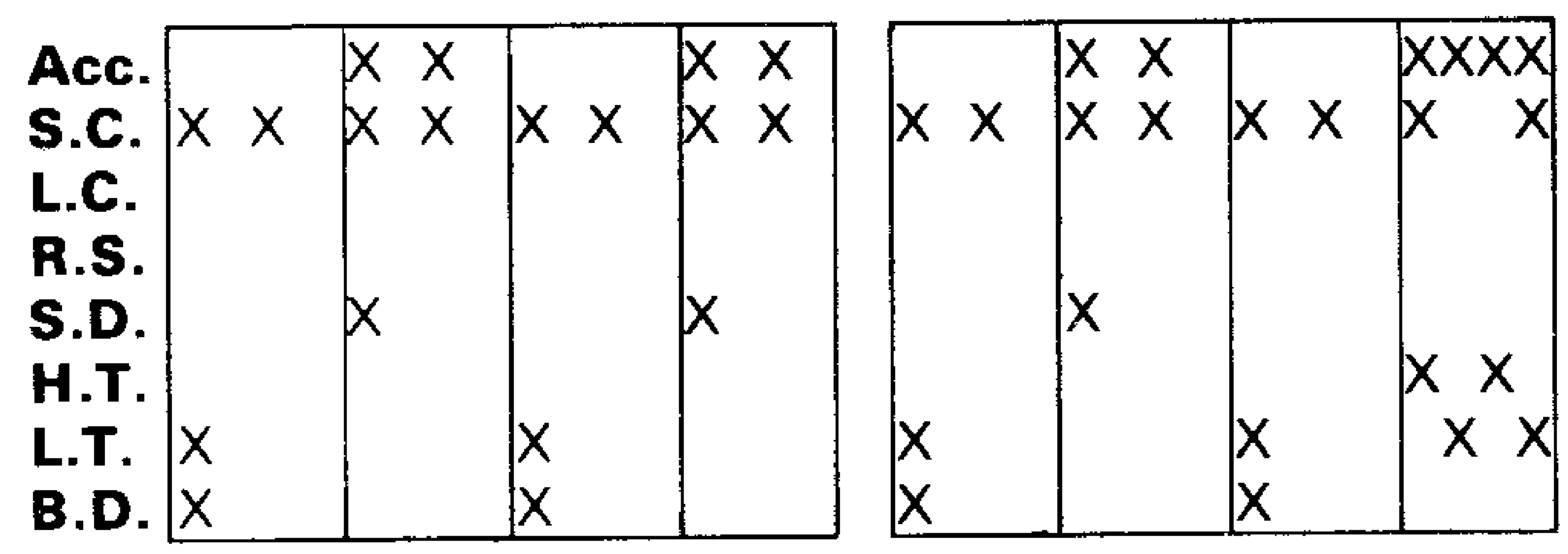
2 QUICKSTEP (A) **(B)**



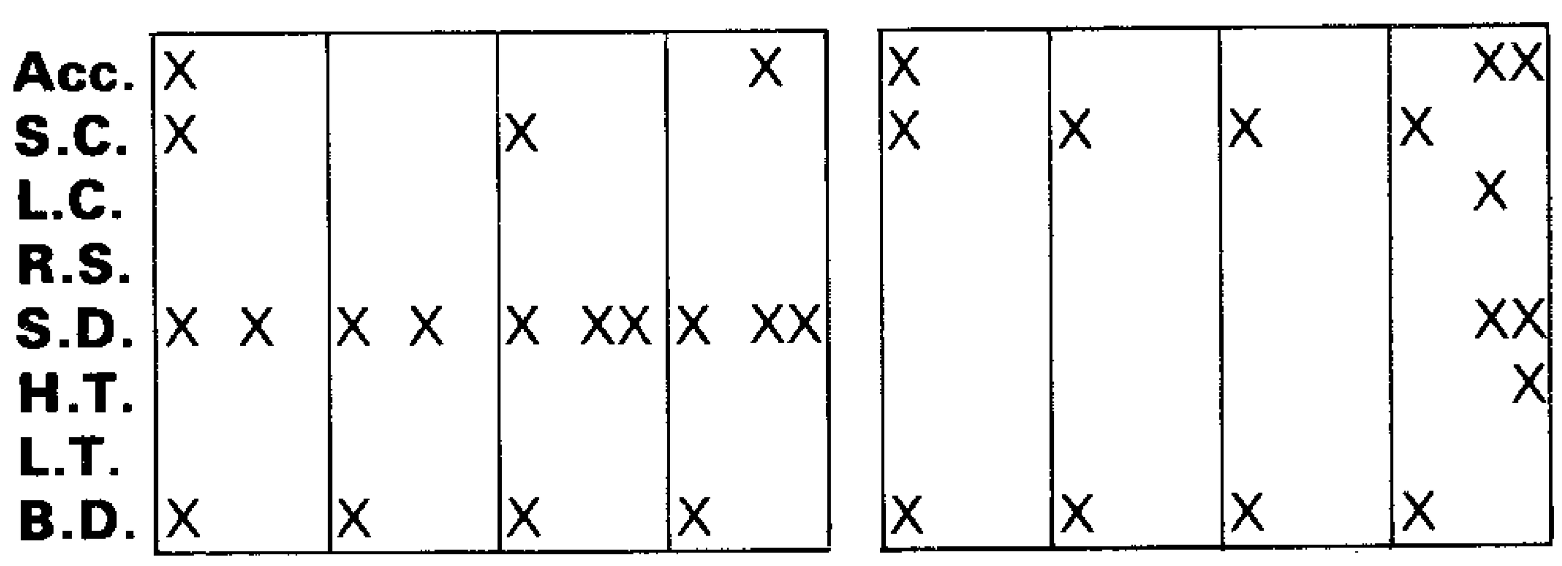
3 BALLAD (A) **(B)**



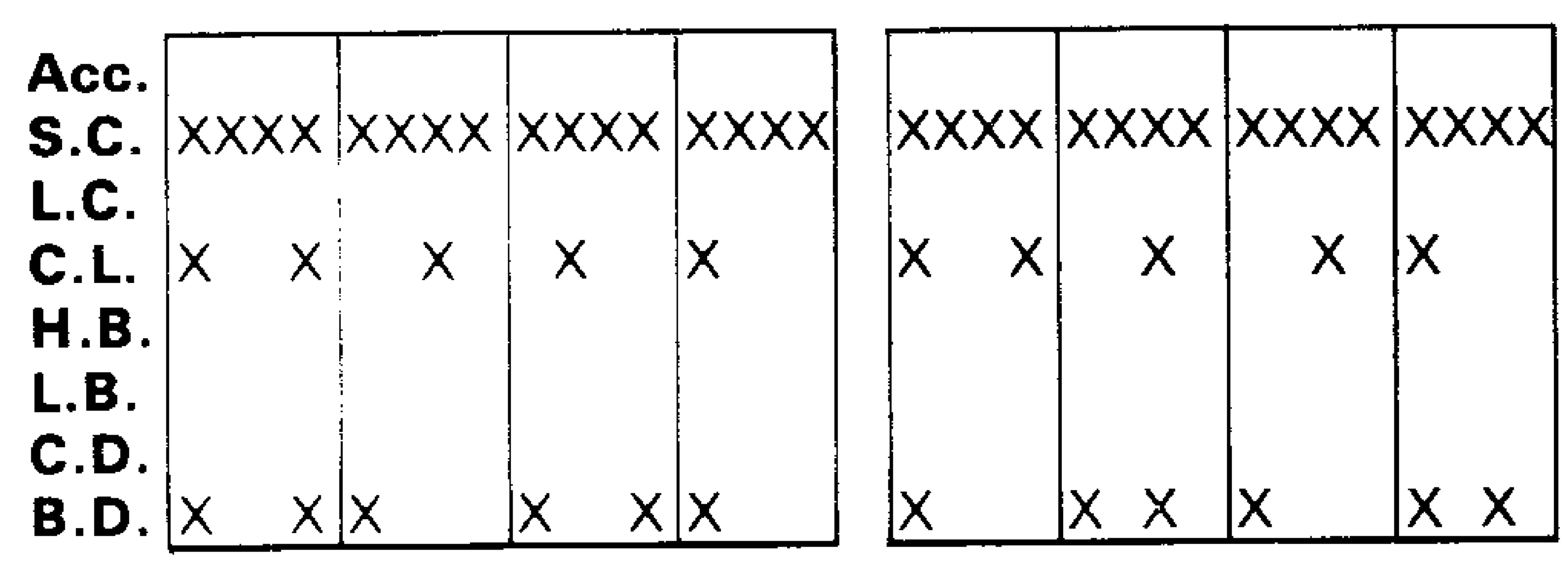
4 DISCO (A) **(B)**



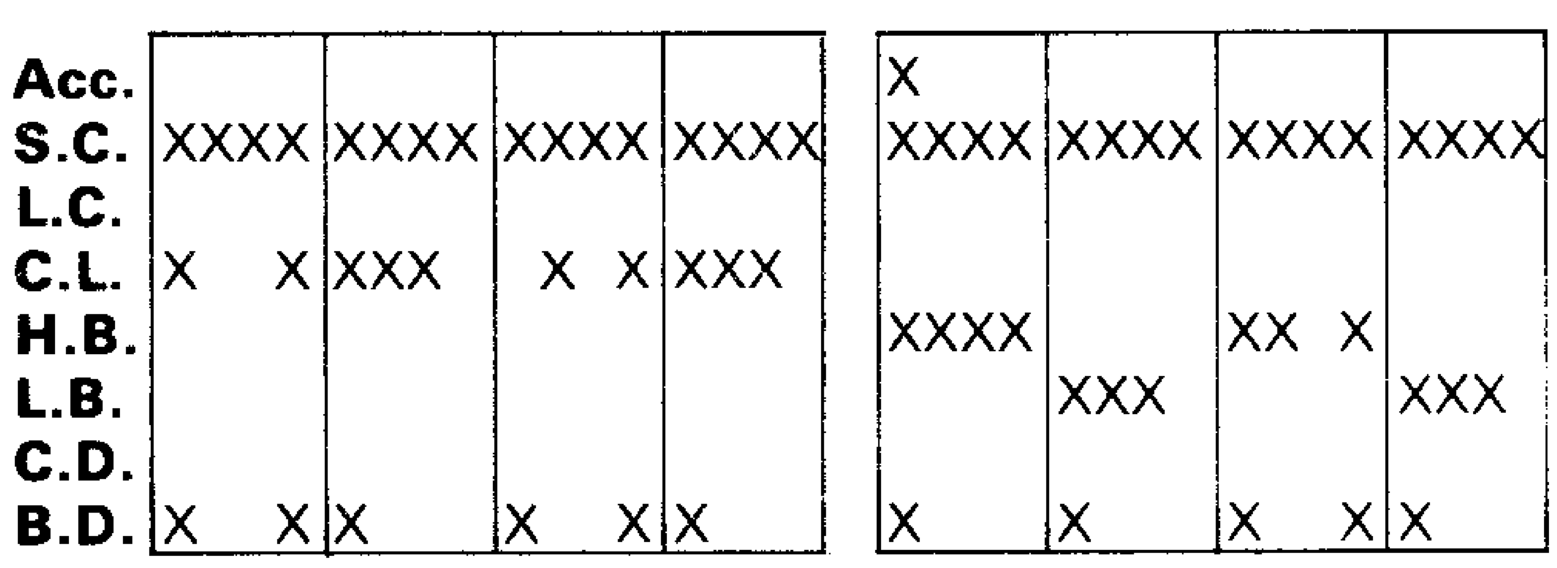
5 MARCH (A) **TANGO (B)**



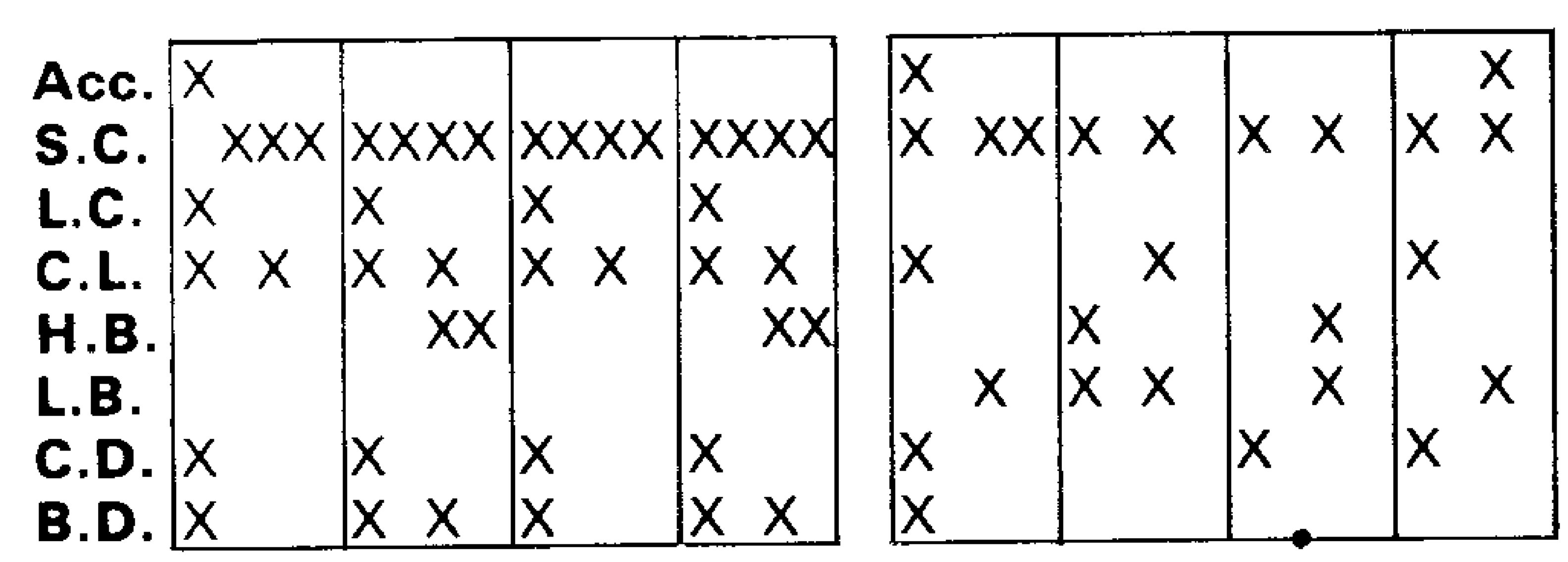
6 BOSSA-NOVA (A) **BEGUINE (B)**



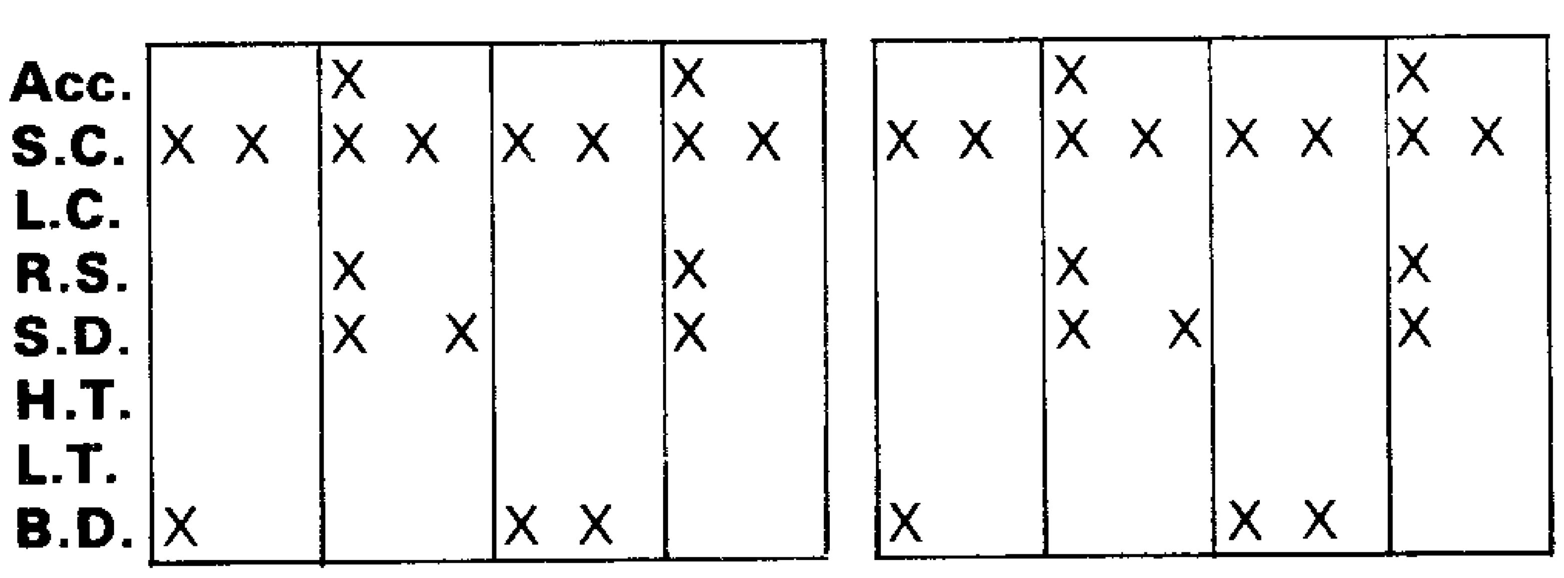
7 CHA-CHA (A) **SAMBA (B)**



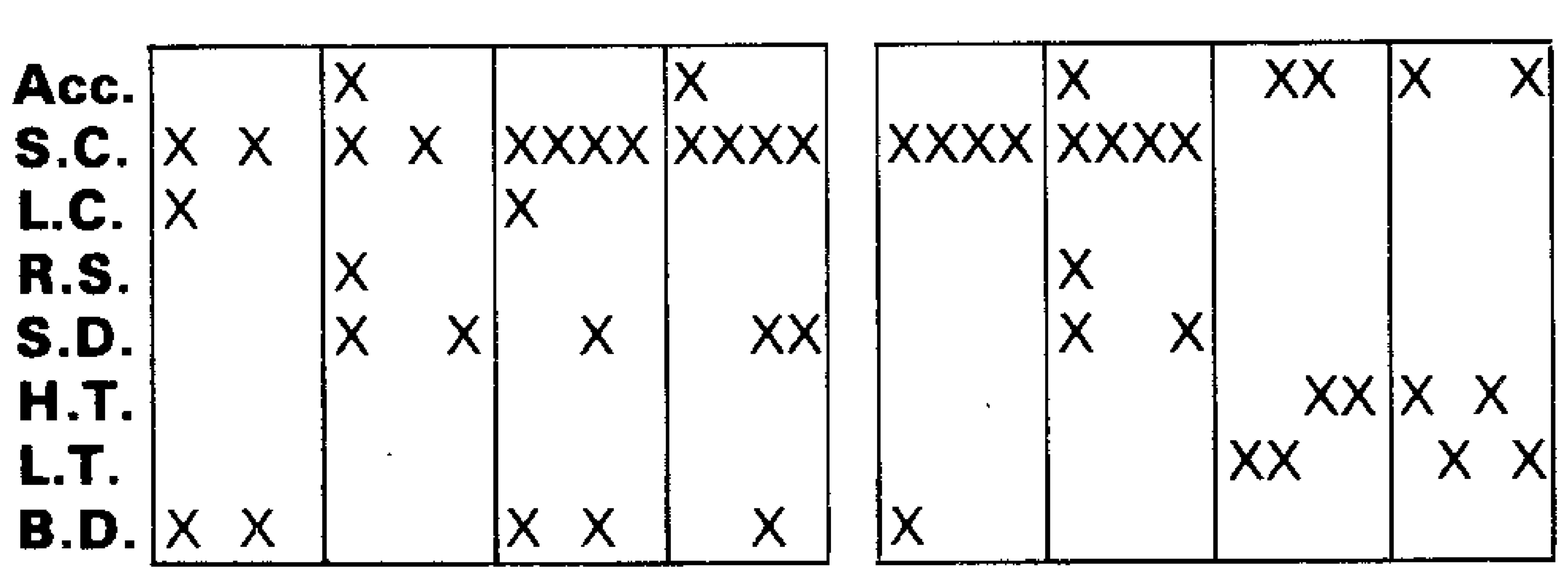
8 MAMBO (A) **RHUMBA (B)**



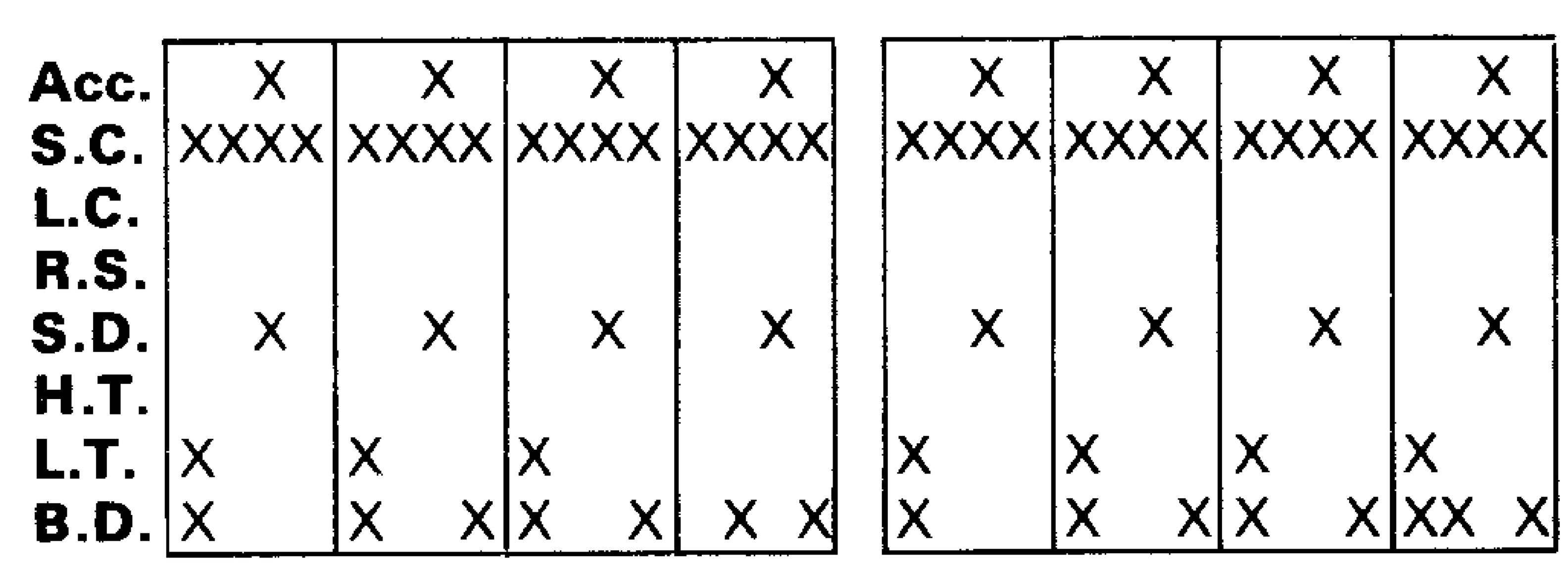
9 SLOW BEAT **(A)**



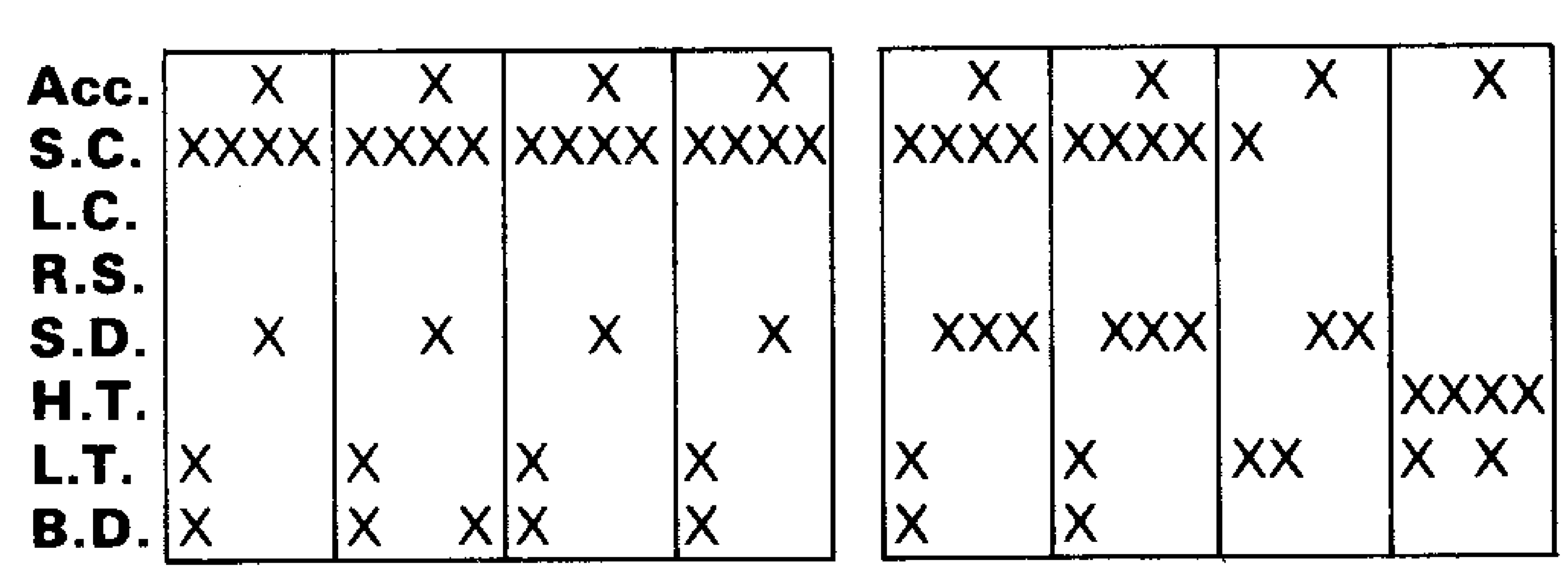
(B)



10 FAST BEAT **(A)**



(B)



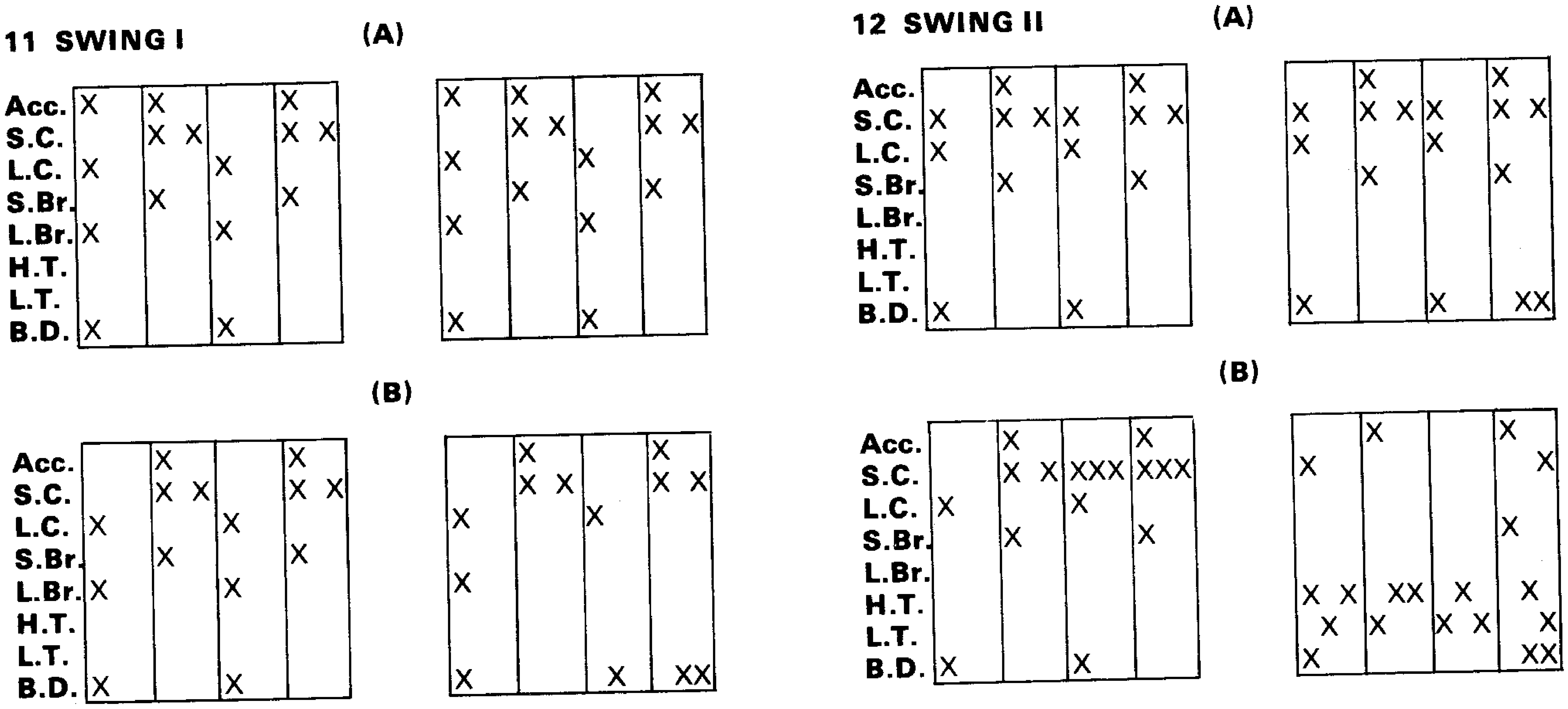


Fig. 10. Some suggested rhythm patterns

Key: Acc. ACCENT
S.C. SHORT CYMBAL
L.C. LONG CYMBAL
S.Br. SHORT BRUSH
L.Br. LONG BRUSH
H.T. HIGH TOM-TOM
L.T. LOW TOM-TOM
B.D. BASS DRUM

INTERWIRING

Twelve colour coded leads should first be soldered to the pins on the component side of the Control p.c.b. All leads should lie on the board such that they will exit at the side adjacent to the potentiometers. The use of 10/0.1 insulated wire is recommended for a neat finish, but care must be taken not to cut into the conductors when pairing back the insulation. The full interwiring details are given in Fig. 11, which shows a separation of approximately 3in. to allow for folding the Control board over the Instrument board and for the battery box to be positioned to the left of the Instrument board. Wiring can be completed with the boards in this position—i.e. Control board track and Instrument board components facing the constructor. Screened cable is required for the "Tone" and "Level" control connections.

MECHANICAL CONSTRUCTION

From various photographs given in the series it can be seen how the two p.c.b.s are mounted into the box with the Instrument board fixed to the base, and the Control board to the front panel.

The height of the three position slider switches above the Control p.c.b. is the determining factor for mounting the front panel, and this is matched using $\frac{1}{4}$in. spacers with 6BA full nuts and screws at each of the mounting holes to give the correct distance. These may be tightened to the panel to allow the board to be removed without loosening the screws from the front, and the p.c.b. finally retained with a second set of nuts. It is important that the nut in the top centre position be of insulated type to avoid shorting to the p.c.b. track.

FINAL ASSEMBLY AND TEST

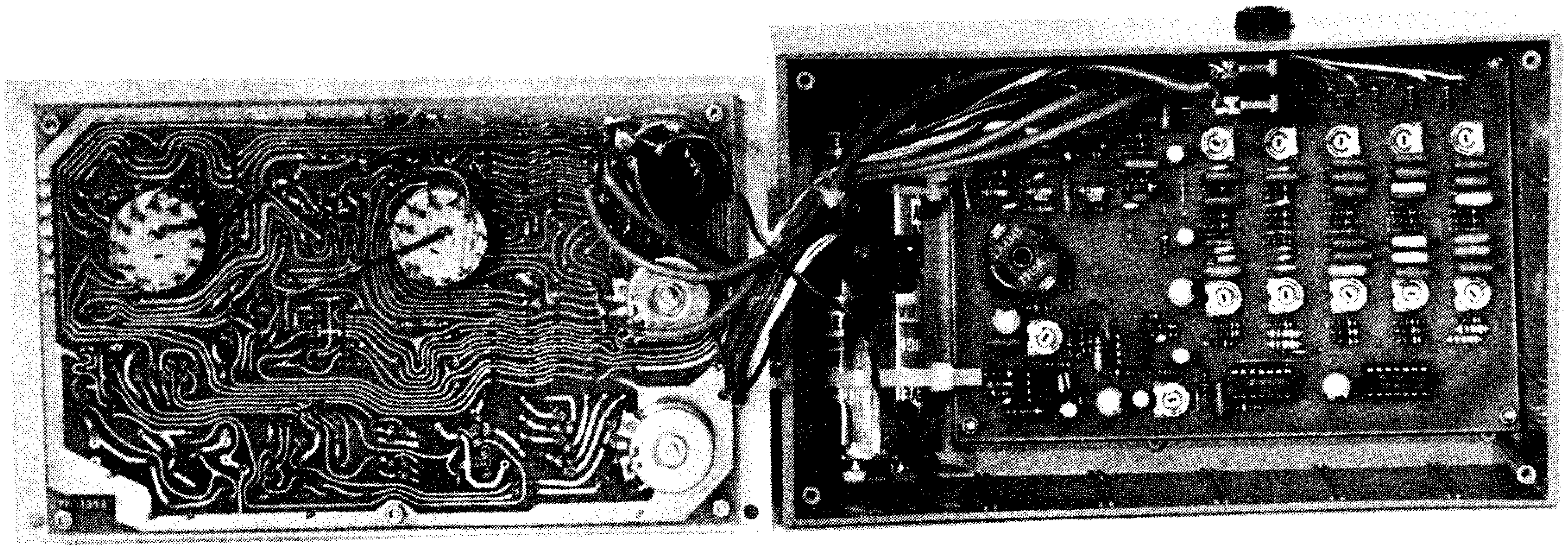
After completion of the interwiring and mechanics a few checks can be made before inserting any integrated circuits. The battery box polarity should always be observed carefully and on first connection C6 will charge to the full battery potential. With the power switch off the current drawn from the battery will slowly drop from around 20μA after initial charge to approximately 3μA. This effect is due to the forming of the capacitor during its early active life. The unit can then be turned to the on condition resulting in an increase in current to around 1mA. The current checks mentioned are not essential but could help in detecting track shorts, accompanied by a considerable increase in supply current, which could be difficult to detect after insertion of the i.c.s. Voltage checks could also be made on the i.c. sockets, corresponding with the supply pins, and on the "Rhythm Select", "Sequence" and "Section" controls. By tracing through the circuitry many more tests could be devised but experience has shown that very careful physical inspection of the trackside of p.c.b.s, comparing against the track layouts in the series to detect shorts and particularly looking for unsoldered connections, is the secret to successful results.

When satisfied that all soldering is correct, disconnect the battery and discharge C6. The i.c.s should then be inserted into the sockets ensuring that orientation is carefully observed and taking normal CMOS precautions.

SETTING UP ADJUSTMENTS

Adjustments required are very few and it is suggested that the rhythm patterns given in Fig. 10 are first loaded into the Master Rhythm. Using the rhythms as a reference, the relative levels of all instruments may be adjusted using VR5, 7, 9, 11, 13, 14 and 15, and the envelope characteristics of the Drums can be adjusted using VR4, 6, 8, 10 and 12.

INTERWIRING DETAILS



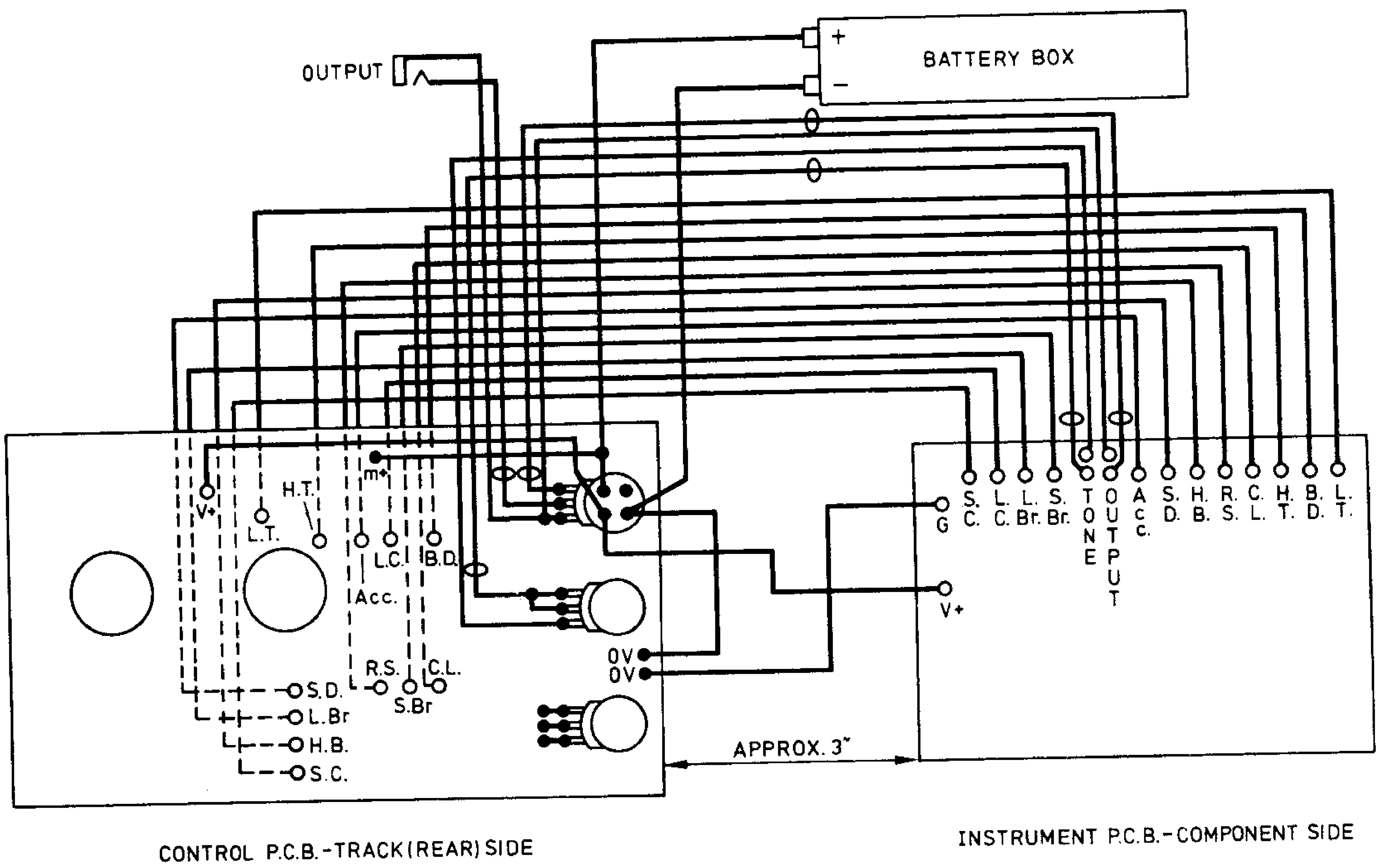


Fig. 11. Interwiring details

★

BOOK REVIEWS

ELECTRONICS EXPLAINED
by Peter Laurie
Published by Faber and Faber
132 pages, 190 × 245mm, Price £6·50 (loose leaf)

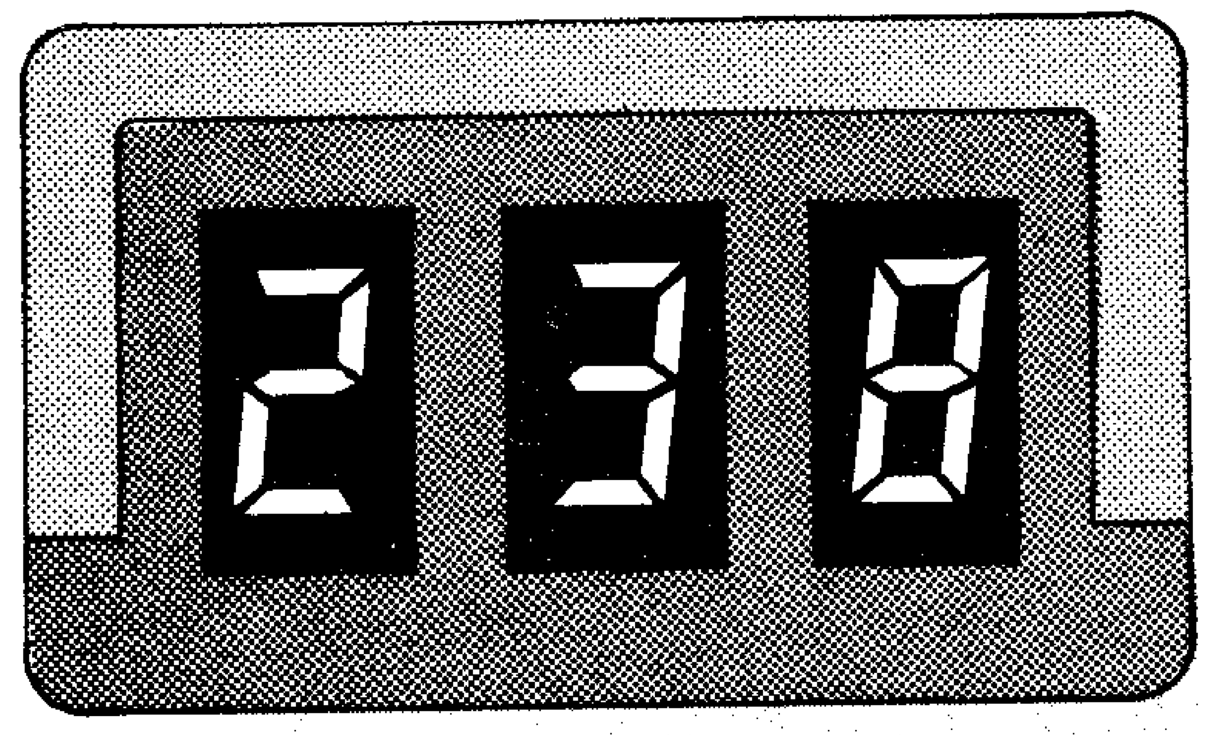
THIS book is subtitled 'A Handbook for the Layman' but unlike the handbook genre it makes no pretensions towards scholarship with the usual weighty appendages, chapter bibliographies and arid tortuous mathematical fleshing out. Amazingly it does pack into 129 pages introductions to audio, radio and digital electronics with an informal lucidity and an implicit anticipation in unravelling the more knotty areas for the newcomer to electronics. Much of this must stem from the author's avowed 'many years in pursuit of self education in these subjects' much of it practical.

The book is organised so that the reader is immediately drawn into audio topics and circuitry in Part 1 with modern semiconductor devices being used in the plentiful illustrations. For example these are 176 figures in the 50 pages that make up this section alone. Part 2 is devoted to radio and is a pithy read in the extent and application of modern communications. Part 3 on logic is a pretty well a text book approach on basics.

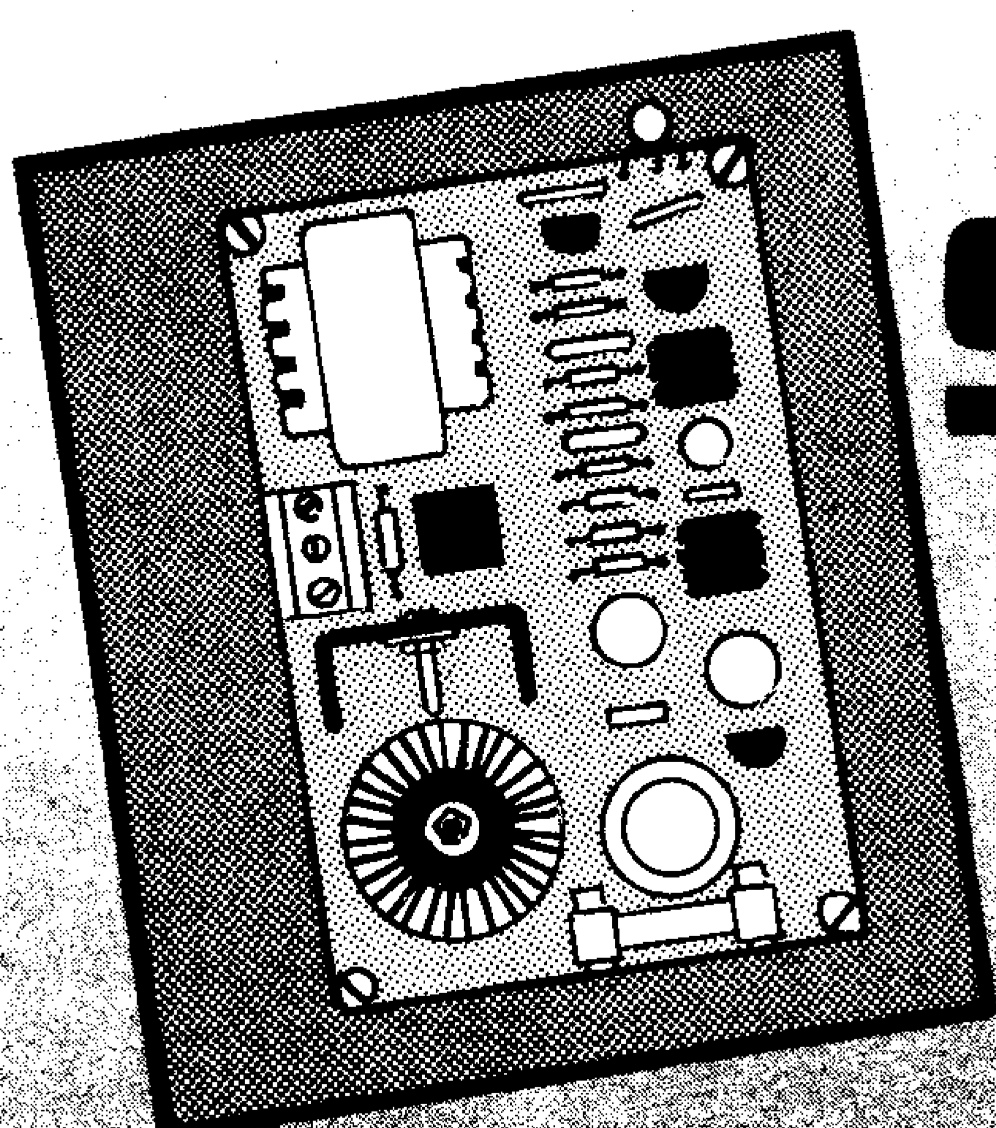
Part 4 is curiously placed in that it deals with fundamental concepts and the 'nuts and bolts' of electronics but since each part 'stands alone' there is no real reading order, but it would seem logical to bring this to the fore in a primer.

next month!

ELAPSED HOUR METER



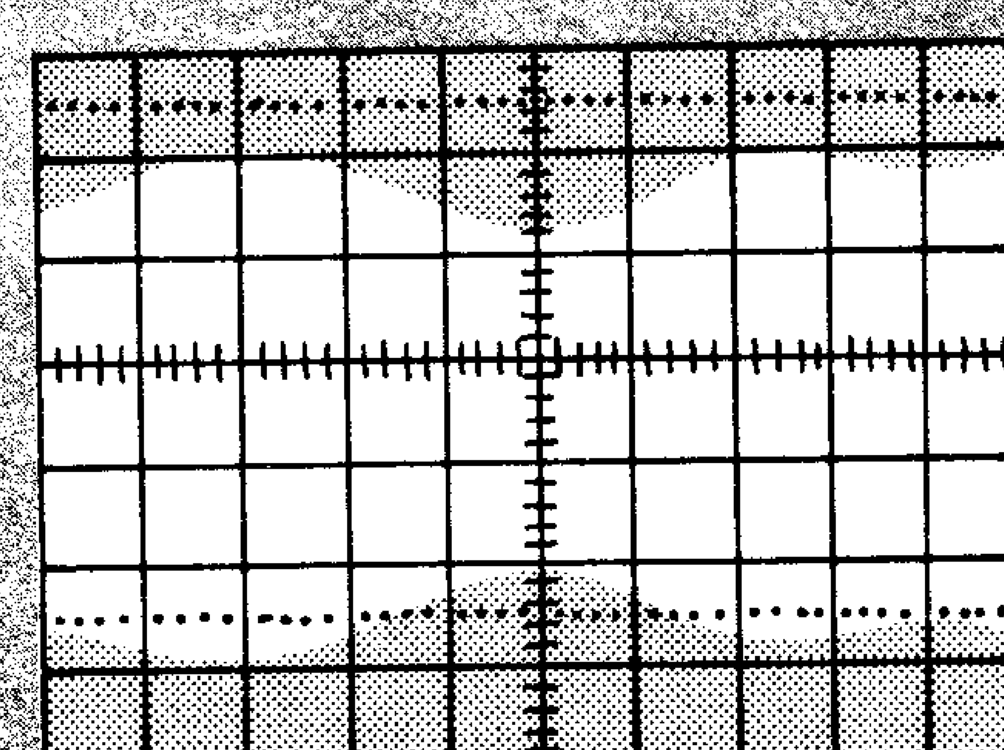
Enables a log of total usage time to be produced for equipment where regular servicing or replacement parts are required.



SLAVE LIGHT DIMMER

This flexible unit which follows a triac controlled master dimmer without any electrical connections enables extensions to present dimmers or light reinforcements.

SPECIAL OSCILLOSCOPE OFFER



A TELEQUIPMENT S61 'scope for just £114 plus postage and VAT—coupon in next month's issue.

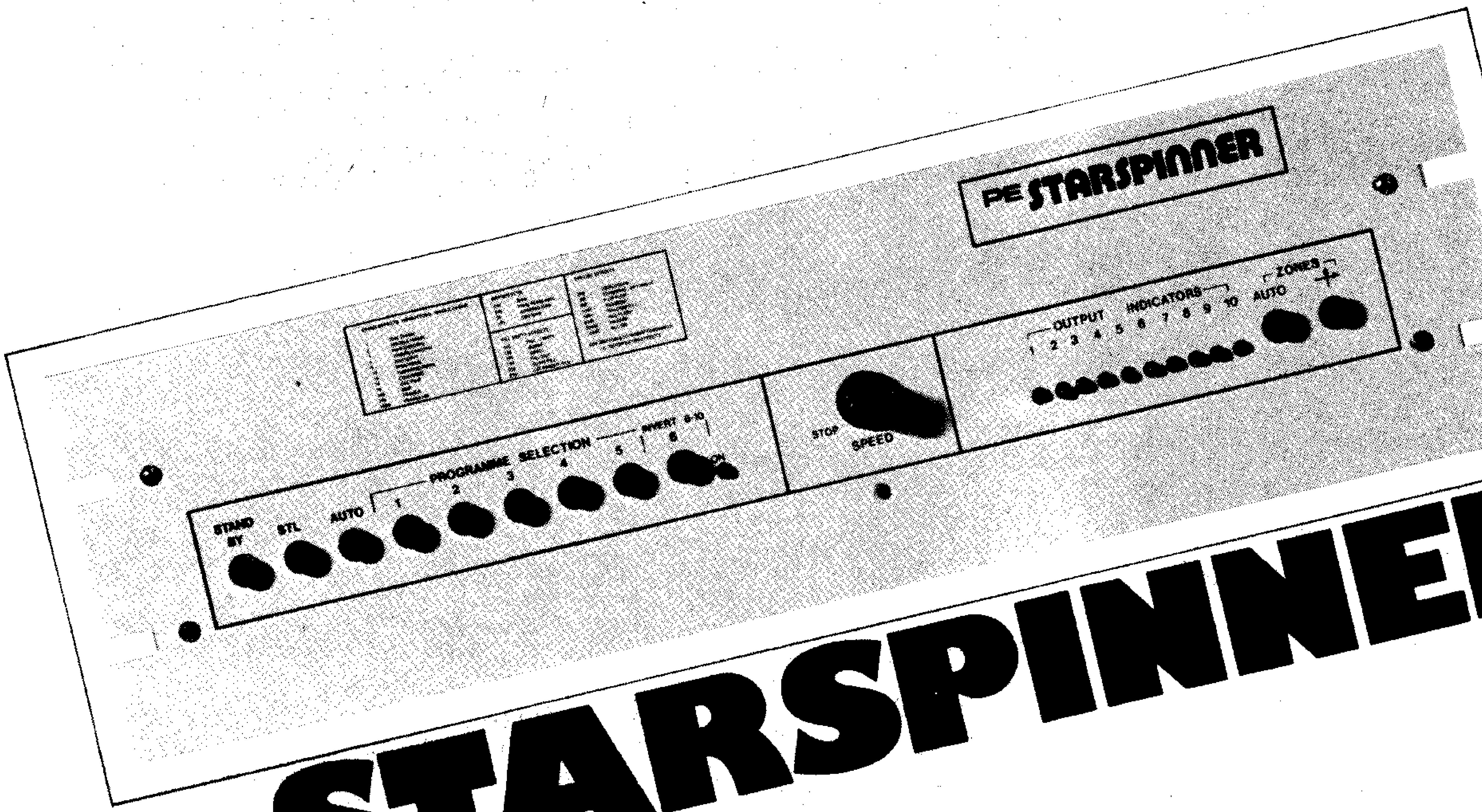
Plus... DIGITAL COUNTER TIMER

TANDY POCKET COMPUTER REVIEW

PRACTICAL

ELECTRONICS

OUR FEBRUARY ISSUE WILL BE ON SALE FRIDAY, 9 JANUARY 1981



STARSPINNER

THIS project describes a sophisticated lighting control unit known in discotheque circles as a 'zoning' or 'matrixing' unit. It is used with a display of up to 100 lamps which are normally arrayed in a star formation, comprising 10 bars each of ten lamps. The unit will produce a wide variety of sequential effects either in a circular motion (starspin) or in a radial motion (starburst). Either mode may be selected manually or the unit may be set to 'auto matrix' when the effect will change periodically from starspin to starburst and back again. The light display may also be set up as a rectangular formation with ten parallel rows of ten lamps. The matrix effect will then switch between horizontal and vertical scanning.

A total of 62 dynamic effects and 2 static effects are available and a sound to light facility is provided which will advance the sequential effects according to the beat of the music. Since the clock can be advanced a large number of steps in a very short time, certain sequences will appear to be reversed by the beat of the music. Along with the program selection which is controlled by six buttons, there is an automatic advance facility. This runs through the 32 basic programs in rotation, running each one four times. Some of them such as the 'fill and empty' routines described below occupy a program completely. Others, such as 'bar' effects are repeated four times in each run and are therefore repeated more times in the 'automatic' mode.

The unit described, and the printed circuit layout are for a total power handling of 6 kilowatts. This corresponds to four starburst displays made from 15W pigmy lamps, or one display using 60W spotlamps. It should be noted, however, that the basic design could be used for loads up to 2kW per channel if the power supply output devices, and printed circuit board were all uprated. Remember however that many of the programs are far more complicated than those on proprietary chaser units and allowances should be made for all lamps being on at once. If used in a mobile system with a standard 13A plugtop, the maximum load will be 3kW. This corresponds to two 15W pigmy lamp displays.

CIRCUIT DESCRIPTION

Although it provides a very impressive display the principle of the matrix unit is quite simple. A normal chaser has one side of all the lamps commoned and the other side of the lamps are connected to the switched 'live' outputs. With the matrix/zoner unit both sides of the supply are able to be switched. There are (for a ten channel unit) twenty outputs instead of ten plus one common. The outputs are connected to circular and radial common lines in the case of the starburst display and to vertical and horizontal common lines where the display is rectangular (Fig. 1.1). Selection of a particular mode switches all the triacs which are connected to the live or neutral permanently 'on' whilst the other ten triacs are operated from the sequential circuitry.

The heart of the unit is a 2708 EPROM (IC6), preprogrammed with 31 sequences of 20 bytes plus a further 20 bytes which provide a static display. The section of the memory required is selected in the manual mode by a combination of 5 buttons (S2 to S6) which, via an OR gate for each button places a '1' directly on the address inputs A5 to A9. If the 'automatic' mode is selected, then the supply to these five buttons is removed and replaced with a zero potential, whilst a pair of 7493 (IC9) 4 bit counters connected in cascade are enabled. The two 7493's (IC9 and 10) address A5 to A9 via the other inputs of the two input OR gates (IC7 and 8). Outputs Q2 and Q3 from the first 7493 (IC9) and outputs Q0, Q1, and Q2 from the second 7493 are used, so that the automatic program advance takes place every 4 cycles of the main clock section. A sixth button is provided (S7) which inverts the signal to the last five channels (i.e. channels 6 to 10). This enables the unit to effectively double the number of programs available. It is also necessary to obtain certain effects. When selecting the automatic mode, the choice must be made whether or not to select button 6 manually and thus determine one of two groups of automatic programs.

A full list and description of the complete set of programs is given in Fig. 1.2 whilst Fig. 1.3 gives details of some of the more complicated routines available.

Note that some use button 6 and some do not. Because the 2708 is 8 bits wide and the unit was required to operate on ten channels, the sequential details are handled by five bits only. The other three bits are used to enable subsequent circuitry to direct the information as required. Outputs 1 to 5 of the EPROM contain actual information for the lamps. Output 8 enables channels 1 to 5 to receive information, output 7 enables channels 6 to 10

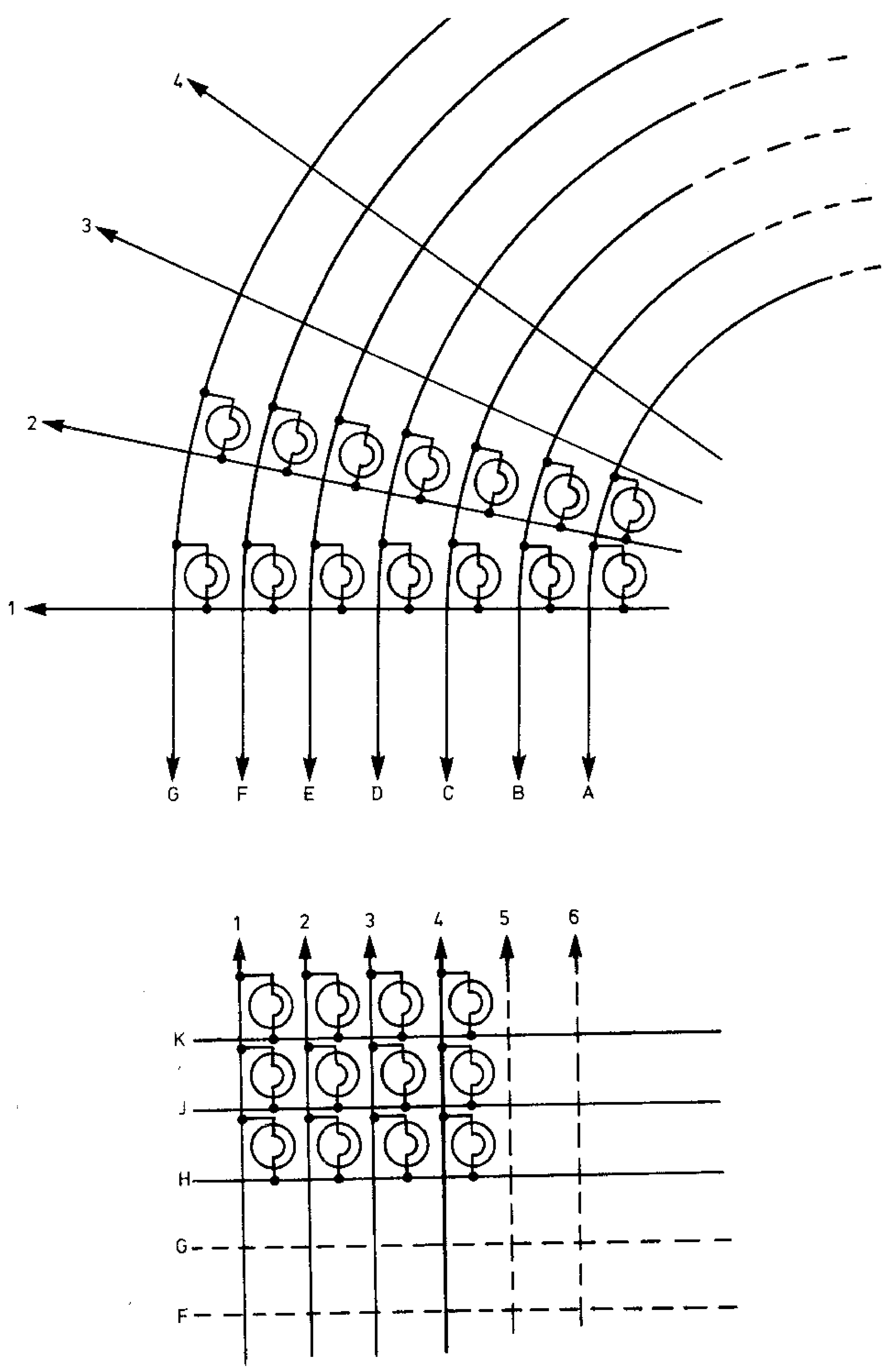


Fig. 1.1. Connection diagrams for starburst and rectangular displays.

1	2	3	4	5	6	
						CHASE—single lamp chasing in one direction
X						DOUBLE CHASE—two lamps chasing in one direction
	X					OSC CHASE—one lamp running forward and backward at irregular intervals
		X				PAIR CHASING—two lamps side by side chasing in one direction
			X			2 PAIRS CHASING—two sets of four lamps chasing in one direction
				X		WHITEOUT—spaces chasing (ie dark lamps)—a bright display
X	X					PING PONG—single lamp running ten-ways forward and then reversing
X		X				TWIN PING PONG—two lamps running backwards and forwards in opposite directions
X			X			CONVERGE—lamps light at the extremities of the display and move to the centre and repeat
X				X		OSC PAIR—as osc chase but with two lamps
X			X	X		SKIP—chase pattern which runs through two or three lamps, jumps and continues
	X		X	X		TRACER—lamps run 1,3,5,7,9,2,4,6,8, 10 etc
X	X	X		X		PENDULUM—A chase but with the speed increasing at the centre of the display so that the lamp appears to be operating in a simple harmonic mode
	X	X			X	BAR—a group of lamps moving across the display continuously
	X		X		X	PING PONG BAR—a group moving backwards and forwards from side to side
		X	X			JUMPING BAR—a group of lamps moving in leaps across the display
X		X		X		OSC BAR—as previous osc effects but with a group of lamps
X	X	X				FILL-EMPTY—display fills towards centre and empties from the outside
X	X		X			BURST—DISPLAY FILLS FROM CENTRE AND EMPTIES slowly back again
X	X			X		SWELL—as burst but with a smooth motion
X		X	X			FILLOUT—display fills from the centre, extinguishes and repeats
	X	X	X			SLOW FILL—lamps run from outside to centre, stop and this repeats until the display is full—extinguishes and repeats.
	X	X		X		LEFT-RIGHT FILL—LAMPS light in order 5,4,3,2,1, extinguish then 6,7, 8,9,10. and extinguish
	X			X	X	HARLEQUIN—1 lamp chases 1 to 5 whilst a dark lamp chases 6 to 10 pattern then reverses and repeats
		X	X	X		STROBING—lamps 1,2,3,4,5 light four times, then 6,7,8,9,10 four times
			X	X	X	FLIP FLOP—lamps 1,3,5,7,9, illuminate simultaneously then 2,4,6,8,10
X		X	X	X		RANDOM—a number of lamps light, are replaced by apparently unsequenced others and so forth
X	X		X	X		RANDOM FILL—first one and two lamps light at random, then the number of on lamps increase until the display is full
	X	X	X	X		ALL FLASH—no explanation needed
	X	X	X	X	X	HAZARD—lamps 1,2,3,4,5 then 6,7,8, 9,10 light simultaneously and alternately
X	X	X	X	X		ALL LAMPS ON

Fig. 1.2. Complete program set.

	MEMORY OUTPUTS									MEMORY OUTPUTS							
	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8
0	1	0	0	0	0	1	0	1	0	1	1	1	1	1	0	1	1
	0	1	0	0	0	1	0	1		0	1	1	1	1	0	1	1
	0	0	1	0	0	1	0	1		0	0	1	1	1	0	1	1
	0	0	0	1	0	1	0	1		0	0	0	1	1	0	1	1
	0	0	0	0	1	1	0	1		0	0	0	0	1	0	1	1
5	0	0	0	0	1	1	0	1	5	0	0	0	0	0	0	1	1
	1	1	0	0	1	1	0	1		1	0	0	0	0	0	1	1
	0	1	0	0	1	1	0	1		1	1	0	0	0	0	1	1
	0	0	1	0	1	1	0	1		1	1	1	0	0	0	1	1
	0	0	0	1	1	1	0	1		1	1	1	1	0	0	1	1
10	0	0	0	1	1	1	0	1	10	1	1	1	1	1	0	1	1
	1	0	0	1	1	1	0	1		0	1	1	1	1	0	1	1
	0	1	0	1	1	1	0	1		0	0	1	1	1	0	1	1
	0	0	1	1	1	1	0	1		0	0	0	1	1	0	1	1
	0	0	1	1	1	1	0	1		0	0	0	0	1	0	1	1
15	1	0	1	1	1	1	0	1	15	0	0	0	0	0	0	1	1
	0	1	1	1	1	1	0	1		1	0	0	0	0	0	1	1
	0	1	1	1	1	1	0	1		1	1	0	0	0	0	1	1
	1	1	1	1	1	1	0	1		1	1	1	0	0	0	1	1
	0	0	0	0	0	1	0	1		1	1	1	1	0	0	1	1
	SLOW FILL									BAR—USE BUTTON 6							

Fig. 1.3. Listing of memory outputs.

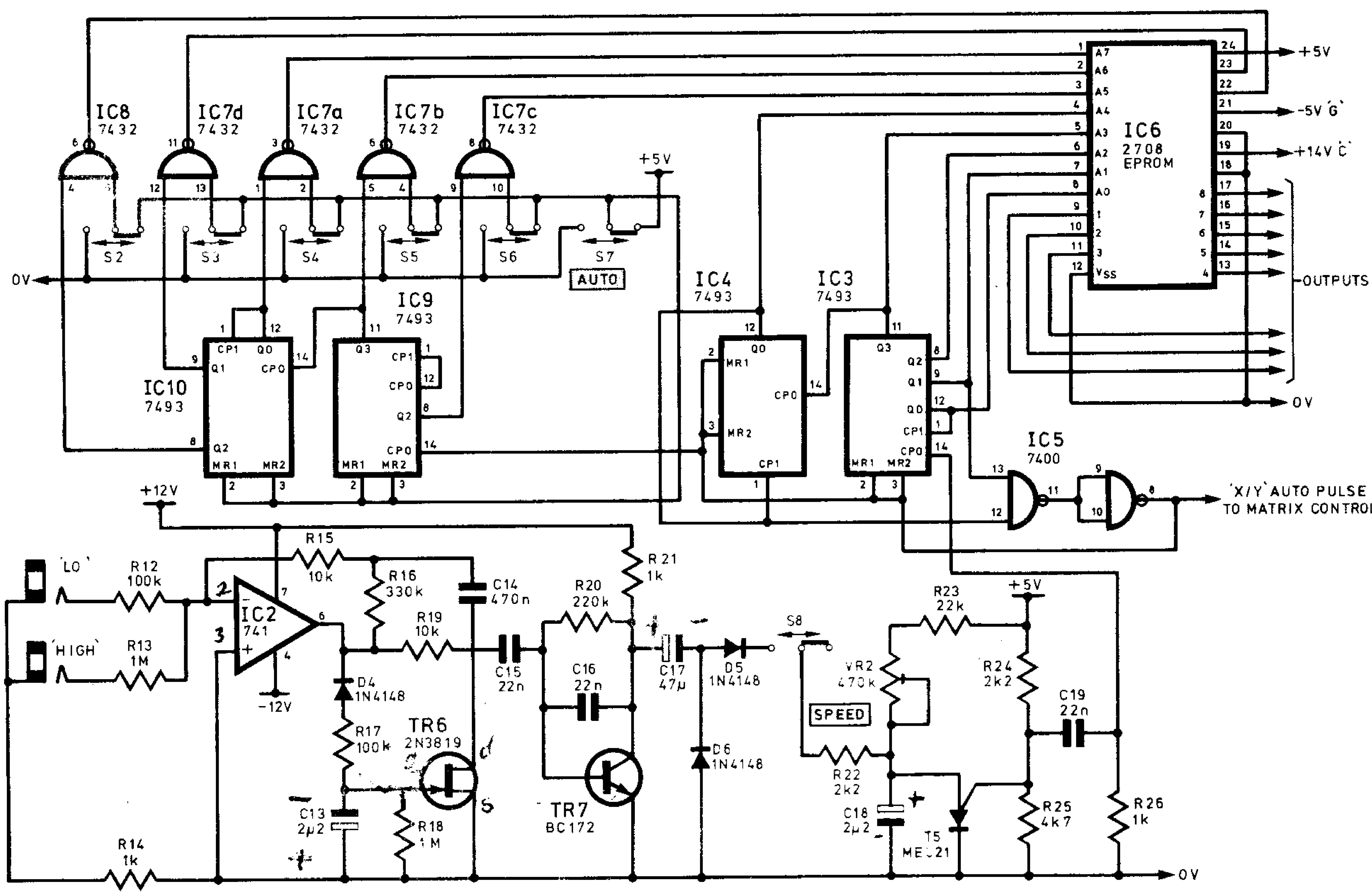


Fig. 1.4. Memory circuit and counter section.

COMPONENTS . . .

Resistors

R1	220 1W
R2, R3, R8, R11	470 (4 off)
R4, R27–R57	270 (32 off)
R5, R14, R21, R26, R118, R119	1k (6 off)
R6, R9, R25, R122	4k7 (4 off)
R7, R10	22k (2 off)
R12, R17	100k (2 off)
R13, R18	1M (2 off)
R15, R19	10k (2 off)
R16	330k
R20	220k
R22, R24	2k2 (2 off)
R23	22k
R58–R77	180 (20 off)
R78–R97	22 (20 off)
R98–R117	100 (20 off)
R120, R121	82 (2 off)

All resistors ¼W 5% carbon except where otherwise stated.

Potentiometers

VR1, VR2	470k lin. preset (2 off)

Capacitors

C1, C2, C7, C8	330µ 16V elect (4 off)
C3	1000µ 10V elect
C4, C5, C6, C12	100n (4 off)
C9, C10, C17	47µ 16V elect (3 off)
C11	47n
C13, C18	2µ2 10V tant (2 off)
C14	470n ceramic
C15, C16, C19	22n
C20–C39	47n (20 off)

Semiconductors

D1	1N4001
D2	4V7 400mV Zener
D3, D27–D36	Red l.e.d. 0·2 in (11 off)
D4–D6, D7–D26	1N4148 (23 off)
REC1–REC4	WO1 (4 off)
TR1–TR3, TR7, TR8 TR9	BC172 (6 off)
TR4	ME 8002
TR5	MEU 21
TR6	2N3819
CSR1–CSR20	TXAL226B (20 off)
IC1	LM309
IC2	741
IC3, IC4, IC9, IC10	7493 (4 off)
IC5, IC13, IC14, IC15, IC16	7400 (5 off)
IC6	2708 EPROM
IC7, IC8	7432 (2 off)
IC11, IC12	7486 (2 off)
IC17-IC36	SOC72 darlington opto-isolator (20 off)
IC37	7473

Miscellaneous

Push button switches d.p.c.o. 6mm spacing (11 off)
Jack socket (p.c.b. type) mono (2 off)
Mains transformer
Fuseholders 20mm p.c.b. type (21 off)
FS1–FS10 20mm 3A fuse (10 off)
FS11 10mm 1A fuse
L1–L20 3A choke (20 off)

Constructor's Note

A complete kit of parts or individual components can be obtained from **Feltglow Ltd., 105B London Road, Bexhill, East Sussex (0424 221686).**

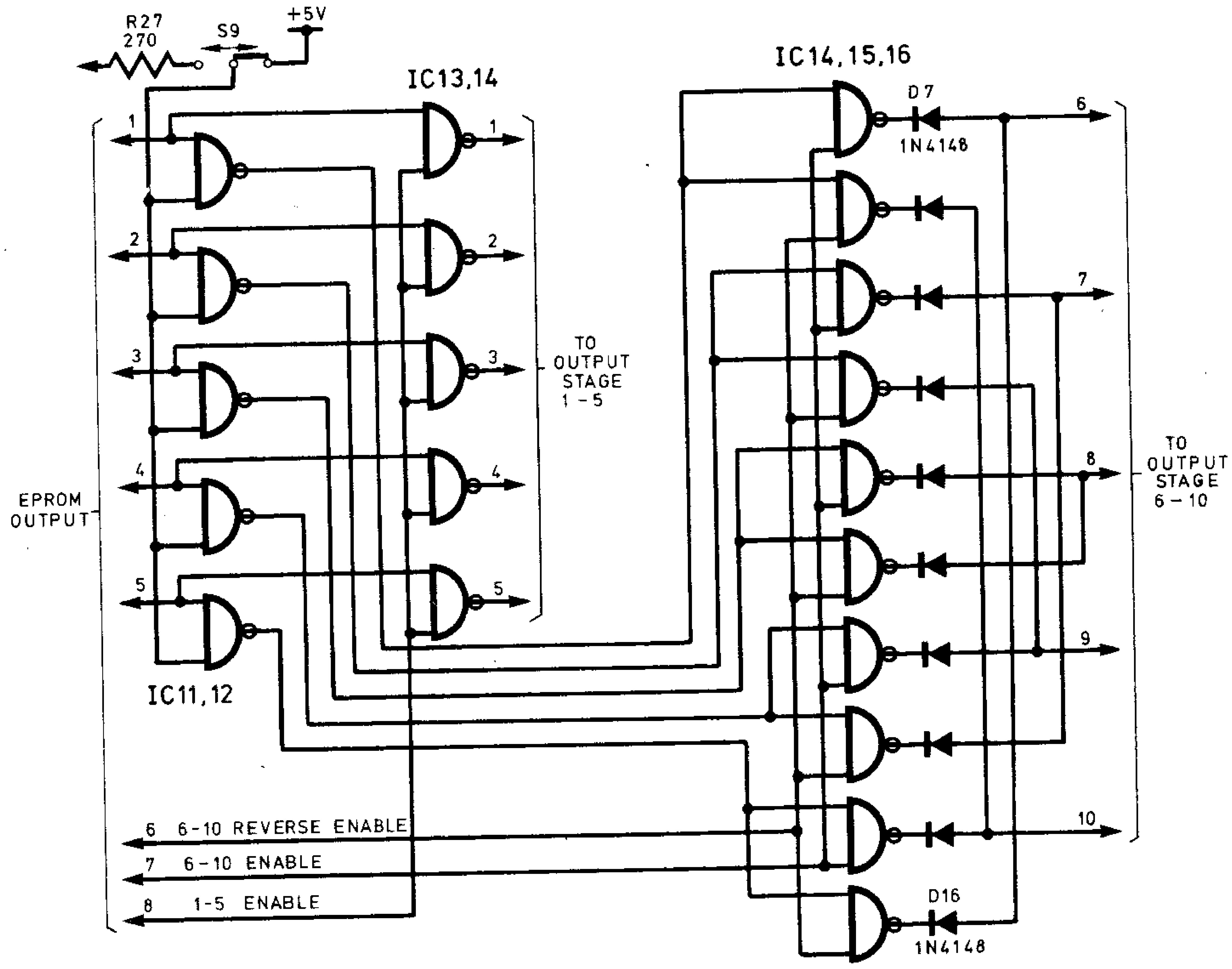


Fig. 1.5. Output signals from the EPROM.

to receive information and output 6 also enables channels 6 to 10 but in reverse order. Only the first 20 bytes of each group of 32 are utilised and the main clock resets after each count of 20.

CLOCK AND AUDIO TRIGGER

The memory circuit and the counter section is shown in Fig. 1.4. This consists of a programmable uni-junction transistor (TR5) which oscillates at between 0·5Hz and 5Hz. All four outputs of IC3 are used to address the EPROM at A0 to A3 whilst the Q0 output of IC4 addresses A4. The Q0 output of IC4 and the Q1 output of IC3 are fed to a 2 input NAND gate (IC5) and then inverted and fed back to the master reset pins on the two counters. This reset pulse is also used to clock IC3 in the automatic program section described above. A feed is also taken to the automatic matrix/zone selection.

If the automatic program button is depressed, all the selection buttons 1 to 5 receive zero volts in either position. The master reset terminals of the auto section counter (IC9 and 10) are switched to 0V and the counter is then free to operate. It is triggered from the reset pulse of the main counter and therefore clocks once every full cycle of the program playing at that time. When set to automatic this will initially be the basic chase having address 00000, i.e. no buttons depressed, since the automatic counter has been 'waiting' in the reset mode. When the program has run through four times a '1' will appear at the Q2 terminal of IC9, addressing the memory via the OR gate. Each of the main addresses will be selected in this way, running through a total of 32 separate programs. Button 6 may be left in or out giving a grand total of 64 separate programs, although the automatic program mode is intended for use with button 6 not operated, since it applies to only a few of the catalogued effects. The clock is also triggered by the output of the audio section. There are two audio inputs, covering a signal range of 200mV up to 50 volts input. Both are high impedance. These inputs feed a 741 op-amp which is used as a compressor in conjunction with a 2N3819 f.e.t. The output of the 741 is rectified and used to bias the f.e.t. As the output of the 741 increases, the bias on the f.e.t. becomes increasingly negative and the f.e.t. tends to have less effect in shunting the feedback path comprising 330k and 10k. The 470n capacitor (C14) ensures that this shunt effect takes place with a.c. only thus making the circuit stable as far as d.c. conditions are concerned. The output of the 741 is also fed to a 'booster' stage which provides heavy bass emphasis. The output is rectified and then fed, via the sound to light switch, to the clock oscillator.

SIGNAL ROUTING

The routing of the EPROM output signals is shown in Fig. 1.5. Only five outputs of the memory contain information to operate the lamps. These five outputs are fed to:

(a) Five (2 input) NAND gates (IC/13 and 14). The other inputs of these five gates are commoned together and taken to output 8. When both inputs of a gate receive a '1' the output of the gate becomes '0' thus operating the two opto-isolators and channel indicator l.e.d.

(b) Five exclusive OR gates (IC/11 and 12). The other inputs of these two input gates are commoned and taken to button 6 which when operated will place a '1' on the commoned inputs. The exclusive OR gates will then invert any signal arriving at the other inputs. The output of each gate is fed to two 2 input NAND gates (IC/14, 15, and 16). The spare inputs of each pair are commoned up to their counterparts on the other four channels providing two commoned lines which then connect to outputs 6 and 7 on the EPROM. The outputs of the NAND gates are wired to the opto-isolators in pairs, using blocking diodes, the second set of 5 being wired in reverse order.

NEXT MONTH: Output stage, power supply, phase control, construction and testing.

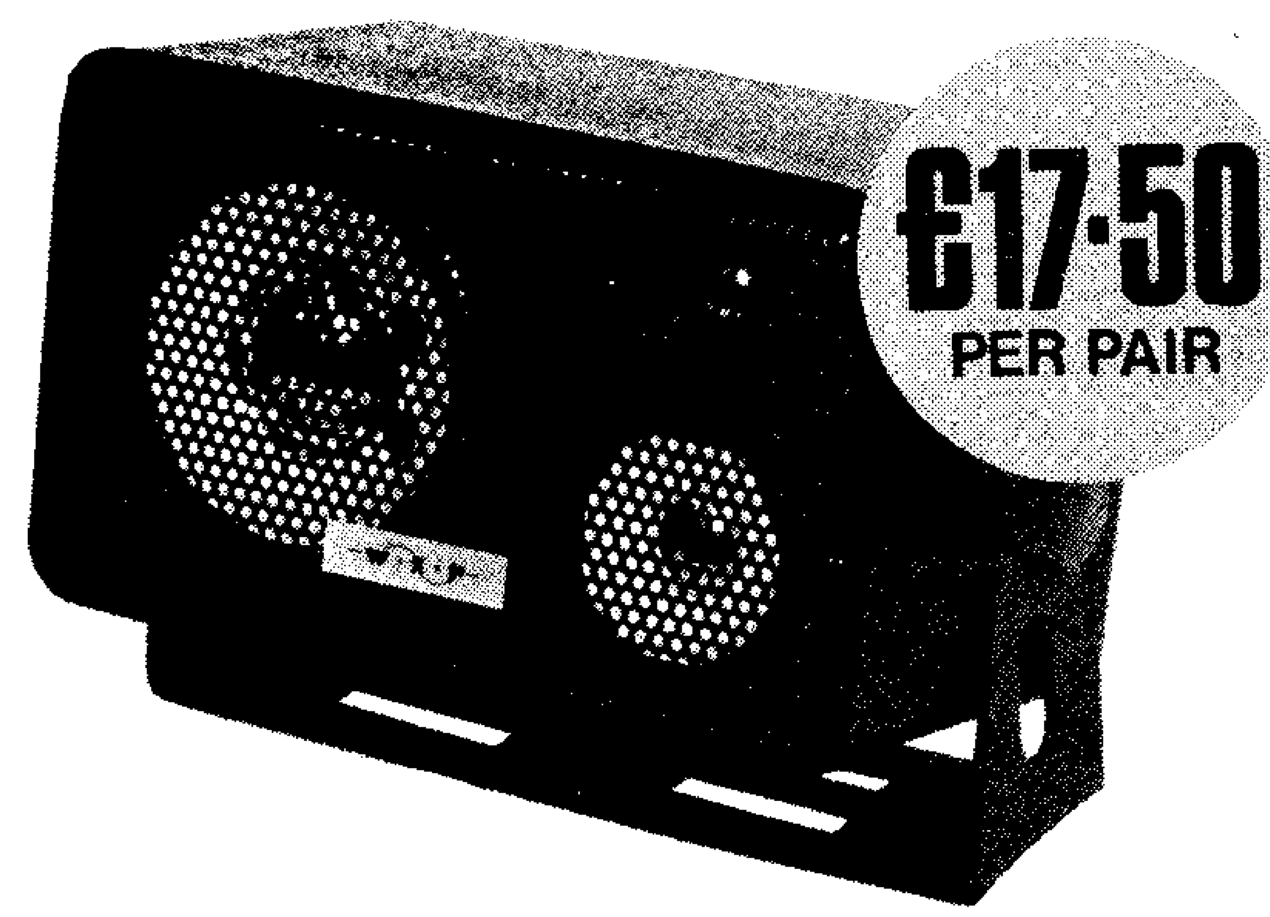
SPECIAL OFFER
IN CAR ENTERTAINMENT

PE has taken a pride in bringing readers some excellent offers over the months. Offers arranged to enable the purchase of technical products at exceptional prices. Back in April we arranged a special offer on Videotone speakers. That offer was so successful that Videotone have again come up with exceptional prices, this time on in-car-entertainment products, just for PE readers.

We believe these products represent incredible value for money, and that this is one of the best offers we have ever been able to arrange. The equipment and speakers on offer, shown and described here, are all covered by a full one year guarantee and money back facility if you are not satisfied.

£42

AM/FM STEREO RADIO AND AUTOREVERSING CASSETTE PLAYER



AS6123 20W HiFi GRADE SPEAKERS WITH 3 DRIVE UNITS ON SWIVEL MOUNT

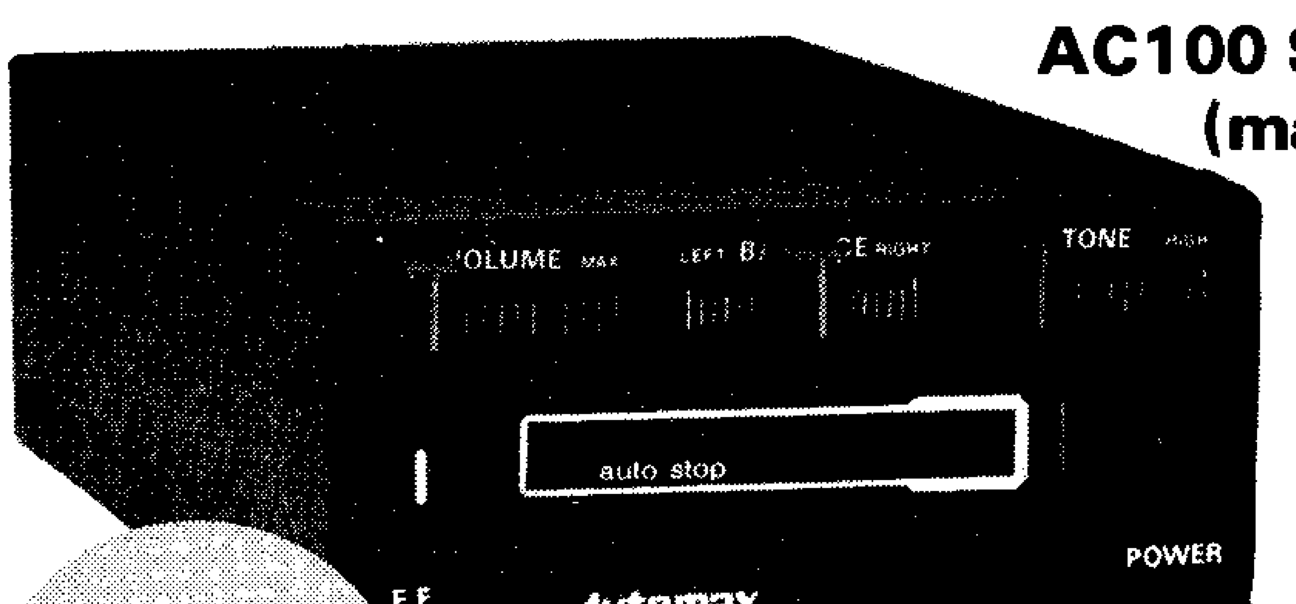
£17·50 PER PAIR

£17

AC200 STEREO 10W per channel (max.) CASSETTE PLAYER

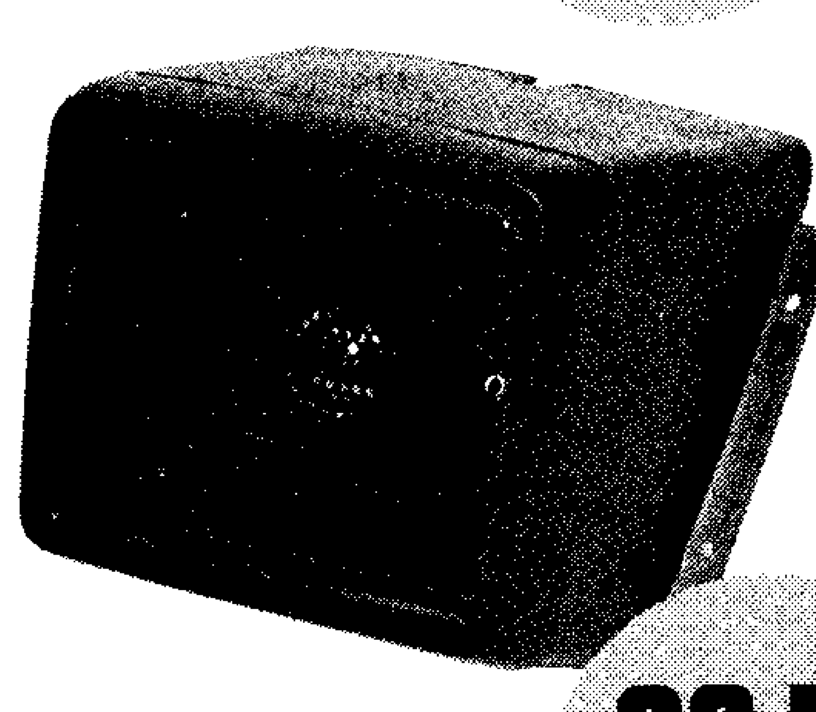
AS4107 10W HIGH QUALITY WATERPROOFED DOOR MOUNTING SPEAKERS

£10·50 PER PAIR



£14·50

AC100 STEREO 7W per channel (max.) CASSETTE PLAYER



AS6111 15W WEDGE TYPE SPEAKERS WITH METAL GRILLE

£8·50 PER PAIR

ALL PRICES INCLUDE POSTAGE PACKING & V.A.T.

AM 540 – 1605kHz, 20μV sensitivity (at 20dB S/N), 455kHz i.f.
FM 88 – 108MHz, 5μV sensitivity (at 30db S/N), 10·7MHz i.f., antenna impedance 75Ω unbalanced, l.e.d. stereo beacon, AM/FM/FM multiplex switch.
TAPE PLAYER Autoreversing, 4 track 2 channel stereo, wow and flutter <0·3% (WRMS), signal to noise >–40dB, crosstalk >–40dB, l.e.d. indication of tape direction, manual tape reverse button, fast forward and rewind.
GENERAL Output 7W per channel, frequency response 80Hz – 10kHz, output impedance 4 – 8Ω, supply voltage 12V (11 – 16V d.c.) **negative earth only,** tone, balance, volume and tuning controls, range switch, scale illumination, size 180 × 44 × 148mm deep, weight 1·9kg, supplied with fixings for in-dash mounting, in line fuse holder and fuse and instructions for mounting, wiring and operating the unit.

Autostop, 4 track 2 channel stereo, wow and flutter <0·25% (AC200), <0·3% (AC100) WRMS, frequency response 50Hz – 12kHz, signal to noise <–45dB, fast forward time <180 sec. for C60 cassette, output impedance 4 – 8Ω, supply voltage 12V (11 – 16V d.c.) **negative earth only,** size 110 × 50 × 170mm deep (AC100), 110 × 55 × 170mm deep (AC200), loudness +7dB (AC200 only), supplied with fixing brackets, connecting plug, wire, in line fuse holder and fuse and instructions for mounting, wiring and operating, including circuit diagram.

To: Videotone Ltd. (PE Offer), 98 Crofton Park Road, Crofton Park, London SE4. Tel: 01-690 8511/2.

Please complete both parts of the coupon in BLOCK CAPITALS

Please send me:

QUANTITY	DESCRIPTION	PRICE
	AM/FM RADIO CASSETTE at **£42.00**	
	AC200 10W CASSETTE at **£17.00**	
	AC100 7W CASSETTE at **£14.50**	
pr/s	AS6123 20W SPEAKERS at **£17.50**	
pr/s	AS4107 10W SPEAKERS at **£10.50**	
pr/s	AS6111 15W SPEAKERS at **£8.50**	

I enclose a cheque/P.O. No: ....for £

made payable to Videotone Ltd. (All quoted prices include post, packing and VAT.)

Name ....

Address ....

....

....

Please allow 28 days for delivery
OFFER CLOSES FRIDAY JANUARY 30 1981

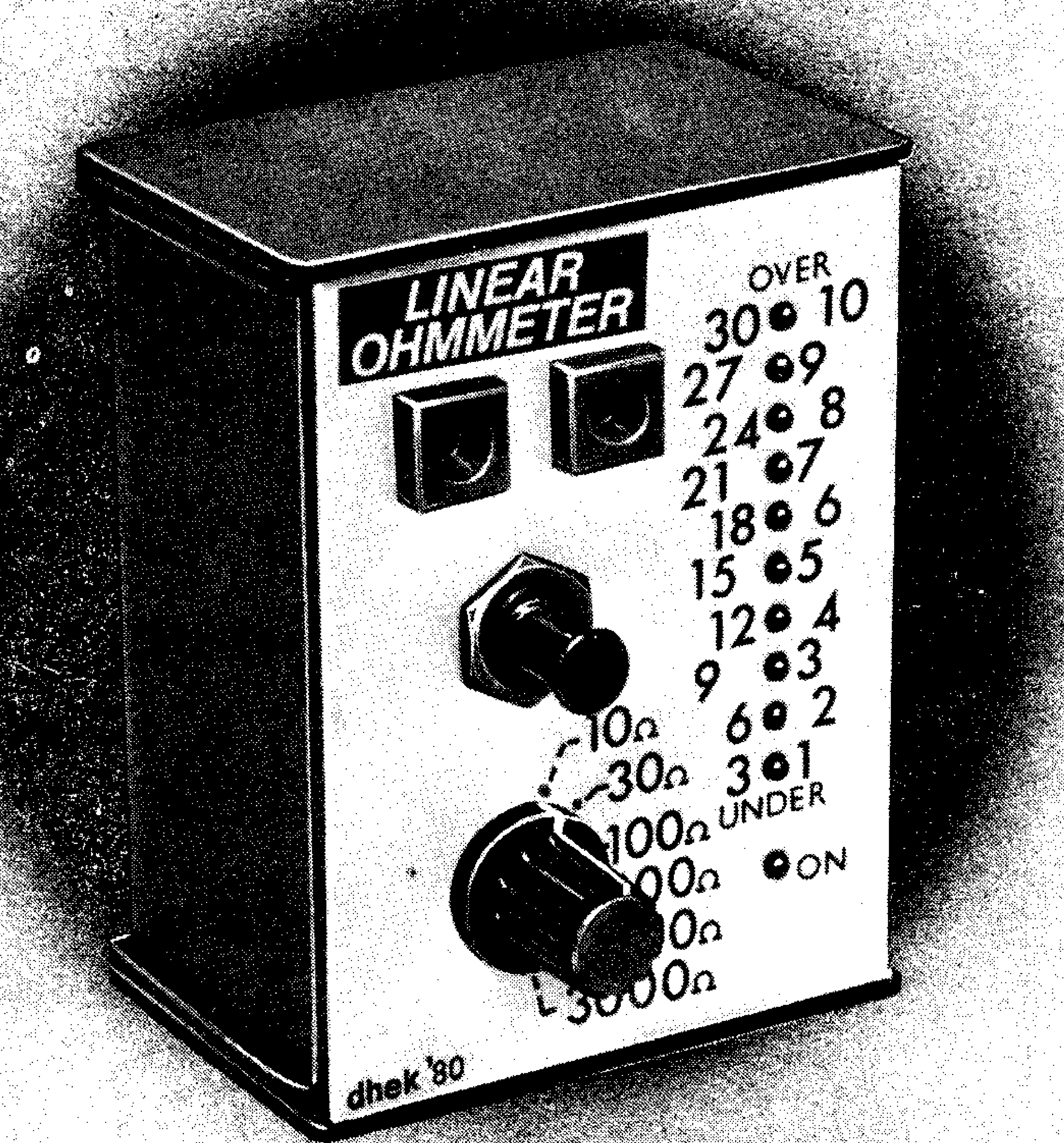
Name ....

Address ....

....

....

To: Videotone Ltd. (PE Offer), 98 Crofton Park Road, Crofton Park, London SE4. Tel: 01-690 8511/2.



A constant current generator in its simplest form is shown in Fig. 3. The base voltage is defined by the Zener diode, the base-emitter volt-drop is fairly constant for a silicon device at 0·6V, so a given value for the emitter current (Re) is set and constant, providing that the volt-drop across the load does not exceed a sensible value. For Fig. 3 values, Vb = 2V, Ve = 1·4V and if the emitter current is required to be 10mA then Re = 1·4V/10mA =

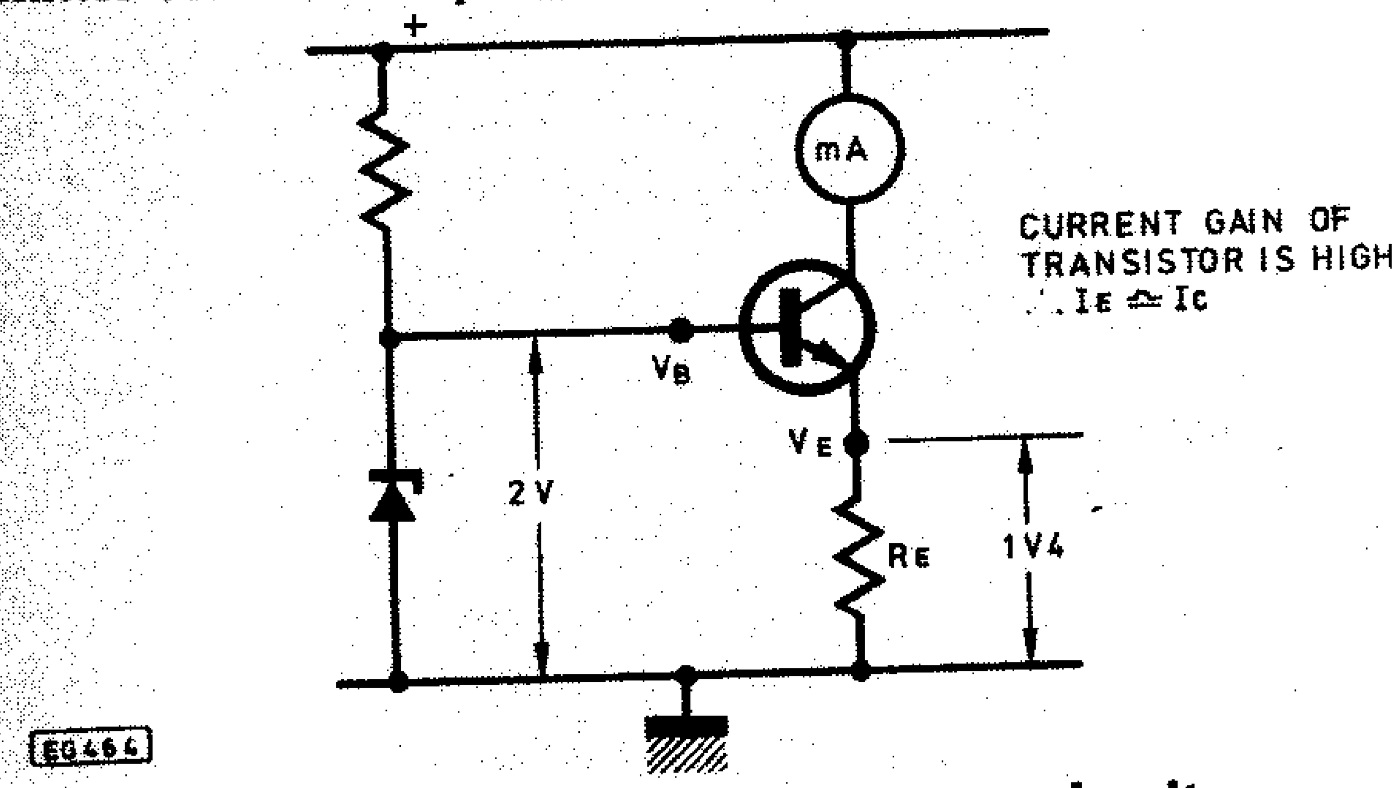


Fig. 3. A basic constant current generator circuit.

140Ω. There are a number of assumptions made here and in the absence of standard 140Ω resistors it would be preferable to have a constant but pre-set base voltage available. By using a resistor larger or smaller than the value as calculated the constant current will be proportionally decreased or increased (but do not forget the transistor ratings Ic max and Pc max).

LINEAR OHMMETER

D.H.E. KING

THIS ohmmeter has been designed around the LM3914 display driver i.c. and has six ranges with a 10 l.e.d. display.

A basic ohmmeter consists of a 1·5V cell, a zero-setting resistor and a milliammeter as shown in Fig. 1. As R_x is varied so the current varies but not in proportion this means that the scale calibration is non-linear. However if a constant current is

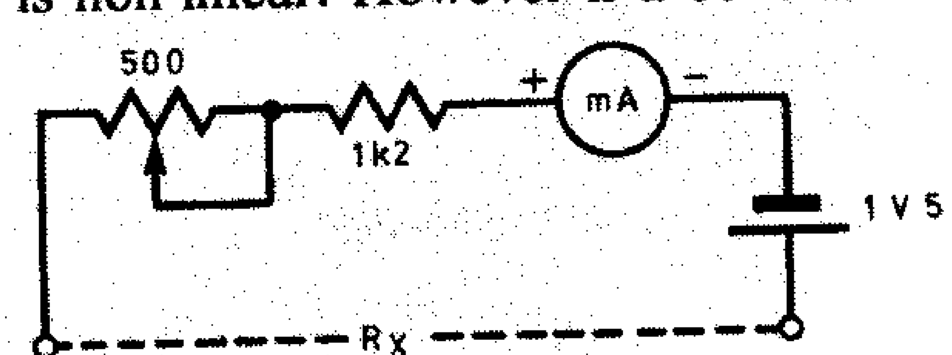


Fig. 1. Basic series-type ohmmeter circuit.

fed through R as in Fig. 2 then the voltage developed across it would be directly proportional to the value of resistance and a voltmeter across R can be scaled in ohms instead of volts. The LM3914 i.c. has a voltmeter function with an l.e.d. readout and has the characteristic of only demanding a 50nA input current. The i.c. can via pin 9 give "dot" or "bar" readings; a moving dot has been chosen for this application.

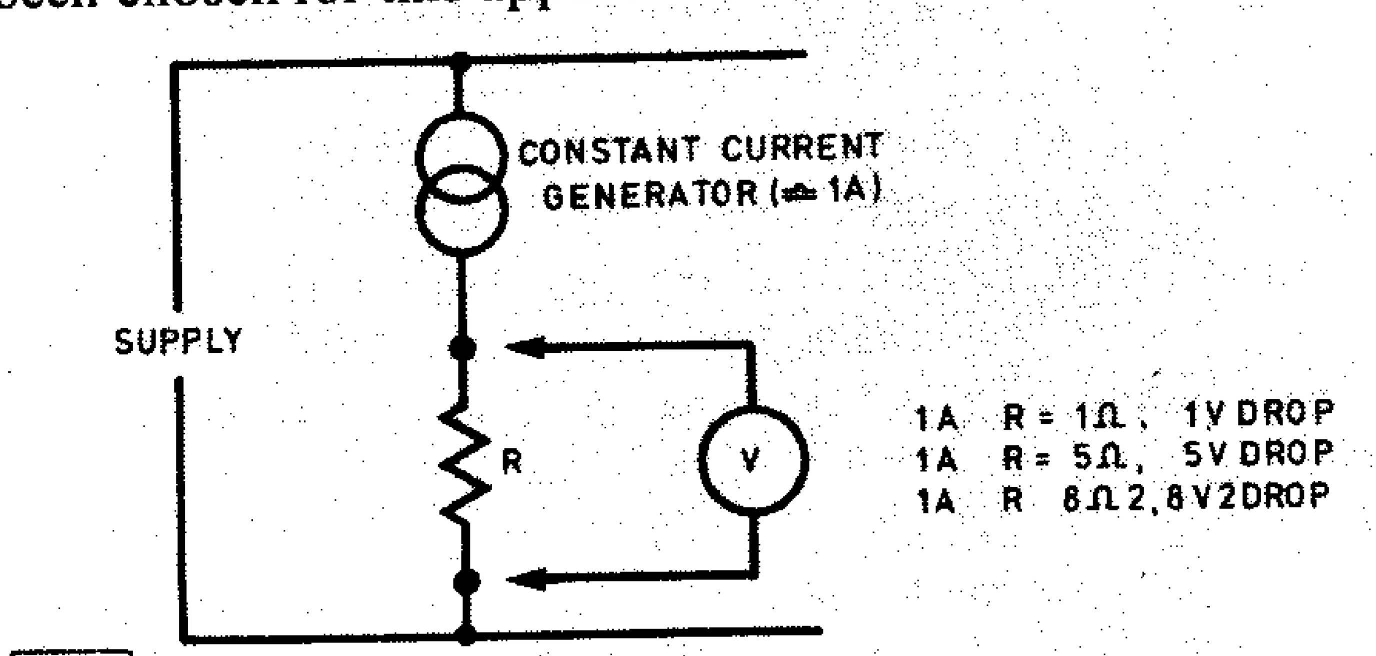


Fig. 2. The constant current generator enables the voltmeter to be scaled in ohms.

CIRCUIT DESCRIPTION

The LM3914 has a stabilised voltage of about 1·25V available at pin 7 and a part of this voltage applied to pin 6 (with pin 4 connected to zero) defines the full-scale voltage sensitivity. In the circuit diagram (Fig. 4) two full-scale values are selected by means of S1b, 0·3V and 0·9V. The constant 1·25V is also applied to TR1 base and thus R2 defines the collector current of TR1 as Ic = (1·25–0·6)/47 = 14mA approx. This is maintained constant despite any drop in battery voltage and the constant volt-drop across D15 provides a constant voltage drive to TR2

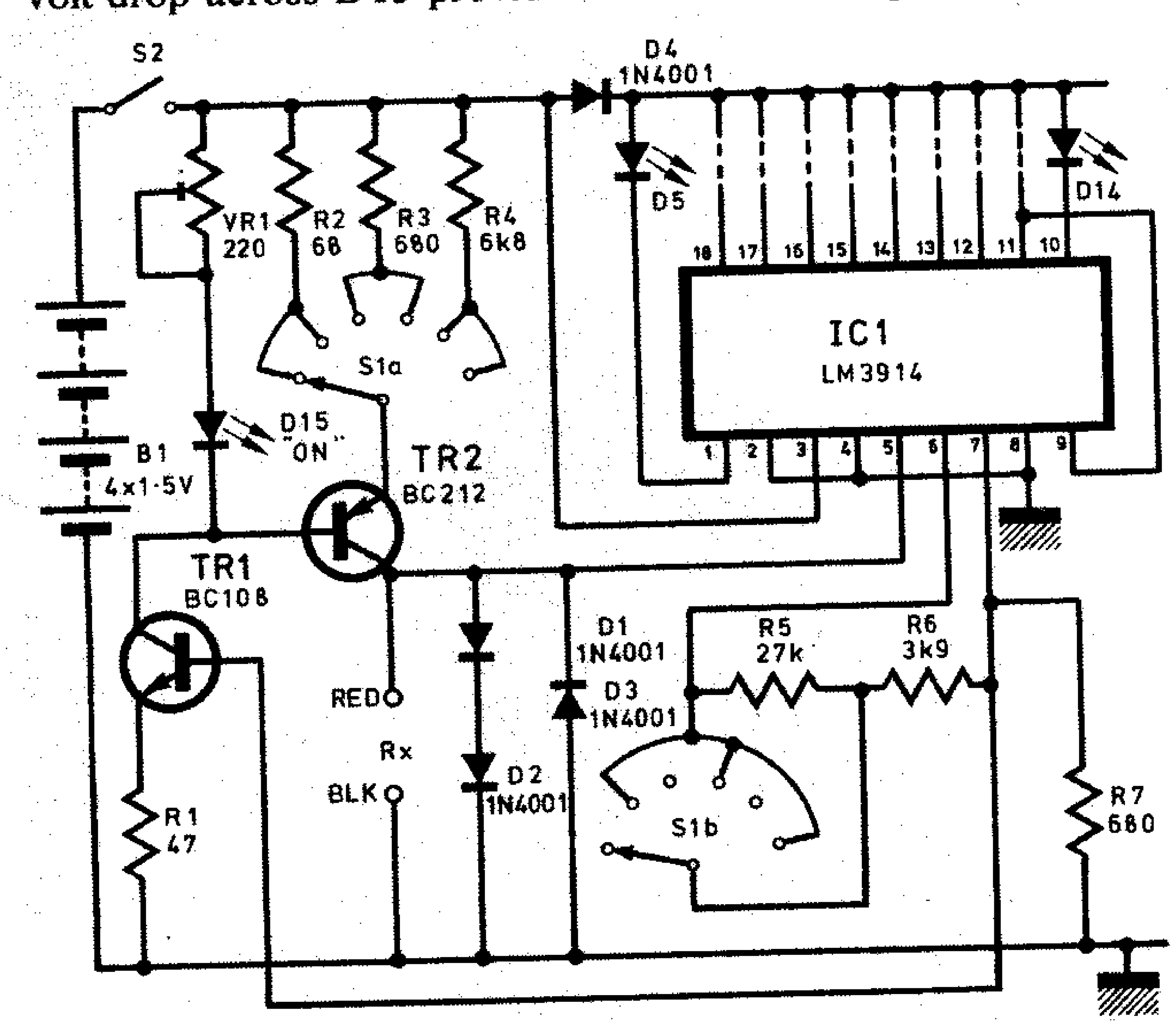


Fig. 4. Complete circuit diagram of the Ohmmeter.

base as well as giving an "on" indication. When the voltage drops to 3V the brilliance of D15 reduces considerably and informs that battery replacement is necessary. TR2 is the second constant current generator, having currents of 30, 3, 0·3mA selected by R2, R3, R4; with these standard values fitted, a presetting of TR2 base voltage is available by use of VR1 since the p.d. across D15 is not accurately known, being between about 1·6V and 2·5V depending upon the size, manufacturer and colour of the l.e.d. Using a basic 68Ω for R2 it is assumed that TR2 base voltage is set to about 2·6V below the positive rail, i.e. IC2 = (2·6–0·6)/68 = 30mA.

With 30mA flowing through 1 to 10 ohm resistor a p.d. is developed and indicated on the 0 to 0·3V scale in ten equal 1Ω steps. By changing the range of the voltmeter circuit to 0·9V (short-circuiting R6 via Slb) the same 30mA through 0 to 30Ω is indicated in ten steps of 3Ω each. If "Rx" in Fig. 4 were open-circuit then D1 and D2 allow the current to flow and drive D14 indicating a full- or over-scale. If inductors are tested and opposite polarity back-e.m.f.s generated, D3 takes over from D1–2 in the other direction and limits any reverse voltage to 0·6V.

RANGE VARIATIONS

Variations to the circuit design are quite simple; six ranges are not essential, S1 may be omitted and a single emitter resistor fitted for TR2. Six ranges in a 1:10 ratio might be considered, allowing for measurements from 1Ω up to 1MΩ; attention should then be paid to the values of resistors since the high-range constant current of 0·3μA is getting near to circuit leakage values! A "low" range of 0 to 1Ω would need a battery to supply the constant 300mA (HP7s are quite suitable for this) but TR2 would need to be uprated to a BD132, the collector power dissipation of TR2 would be some 1·5W. It is not really feasible to consider a 9V battery supply since the anodes of D5 to D14 are ideally fed from no greater than 5V and a more complex voltage regulator would be needed. The brightness of the l.e.d.s may be varied by means of R7, at present about 20mA flows through a selected l.e.d.; a value of 1kΩ reduces the current to about 10mA while a value of 390Ω increases the current to nearer 30mA. (In fact R7 has a similar function for IC1 as has R3 for TR1 or R4 for TR2 in defining the value of the constant current for the illuminated l.e.d.s.)

The p.c.b. design for the ohmmeter is shown in Fig. 5 with the component layout shown in Fig. 6. The switch S2 can be replaced by an on-off slider or toggle type rather than with a spring-loaded type. The suggested layout and panel markings allow for the unit to be held and switched on by the left hand whilst using the probes with the right hand, all l.e.d.s and markings being visible at the same time.

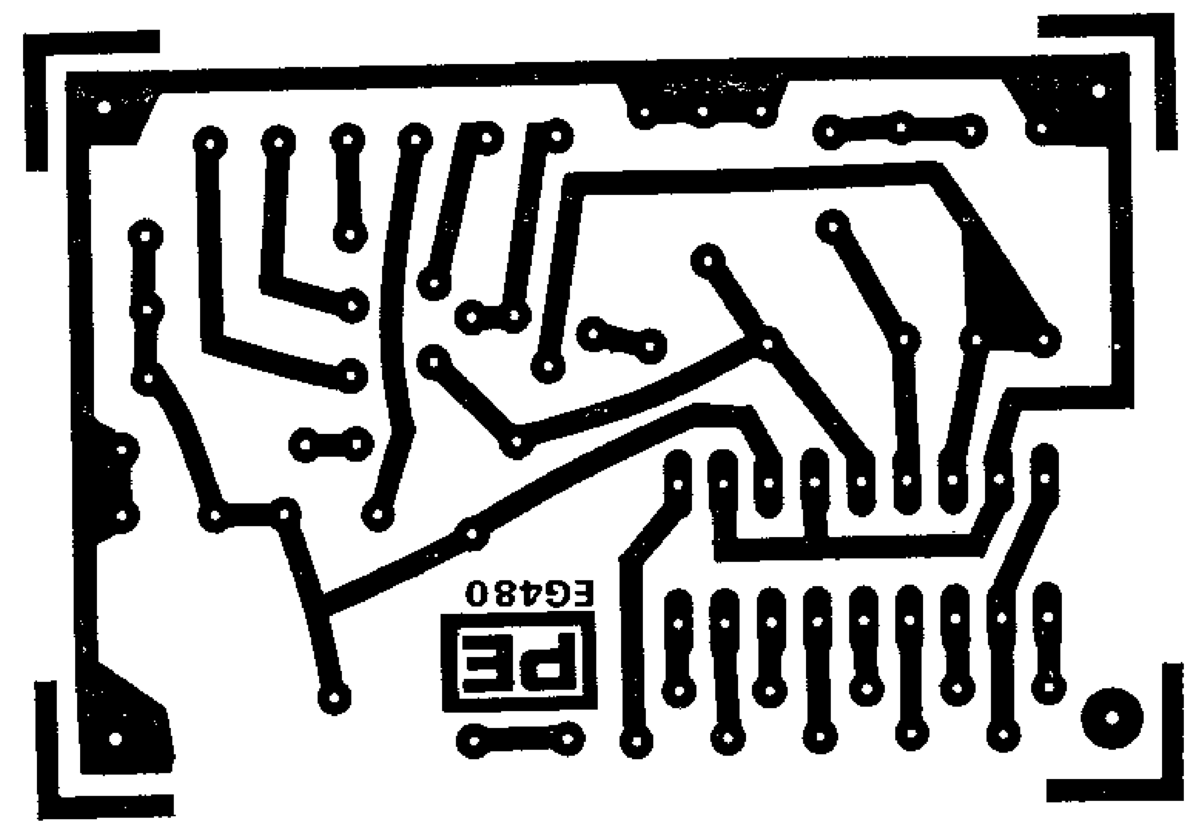


Fig. 5. Design for the Ohmmeter p.c.b.

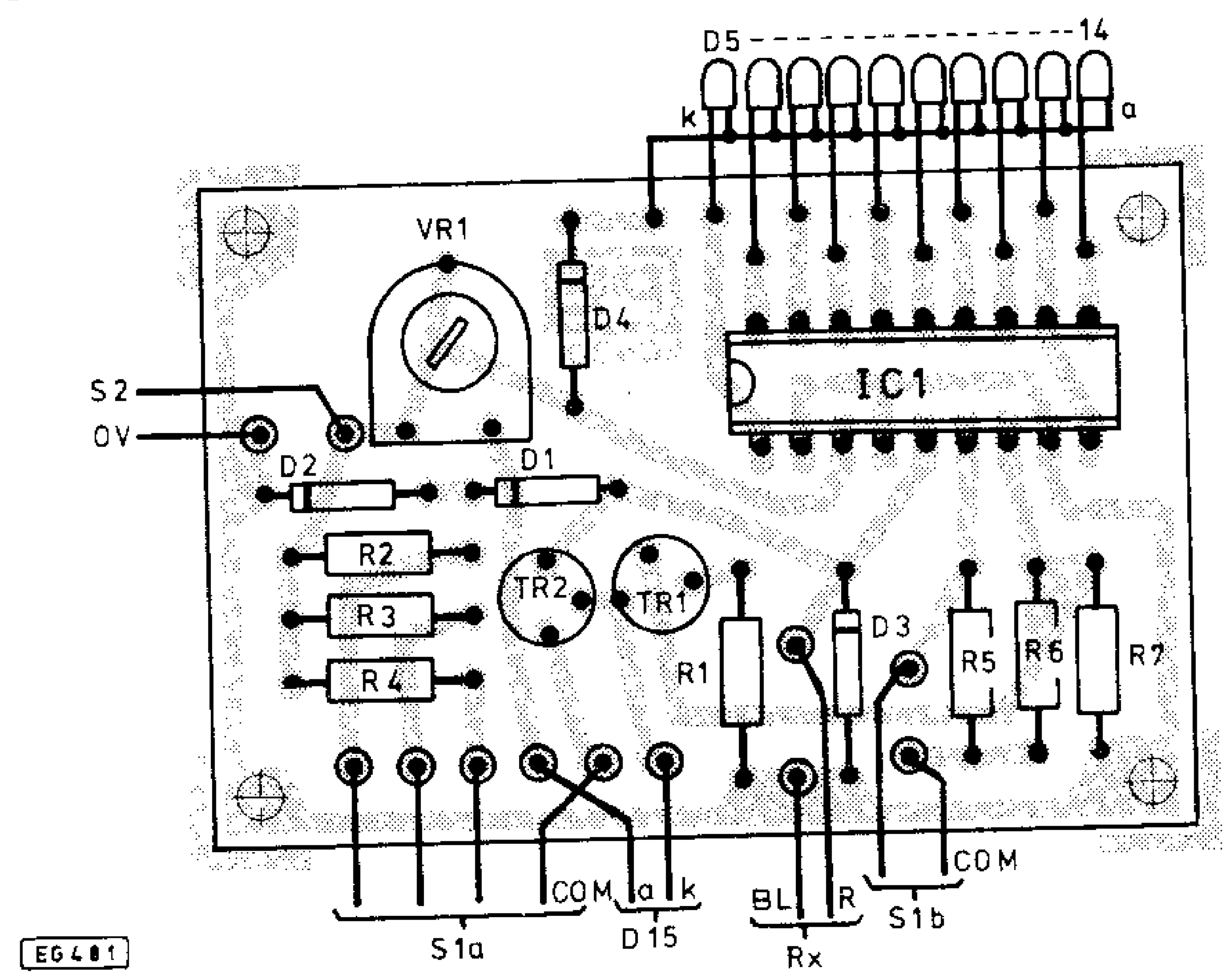


Fig. 6. Component layout and wiring.

COMPONENTS . . .

Resistors

R1	47
R2	68
R3, R7	680 (2 off)
R4	6k8
R5	27k
R6	3k9

All resistors 0·25W 5% carbon

Potentiometers

VR1	220 min. hor. preset

Semiconductors

D1–D4	1N4001 (4 off)
D5–D14	l.e.d. TIL 209 (10 off)
TR1	BC108
TR2	BC212
IC1	LM3914

Switches

S1	2 pole 6-way rotary switch
S2	s.p.s.t. switch

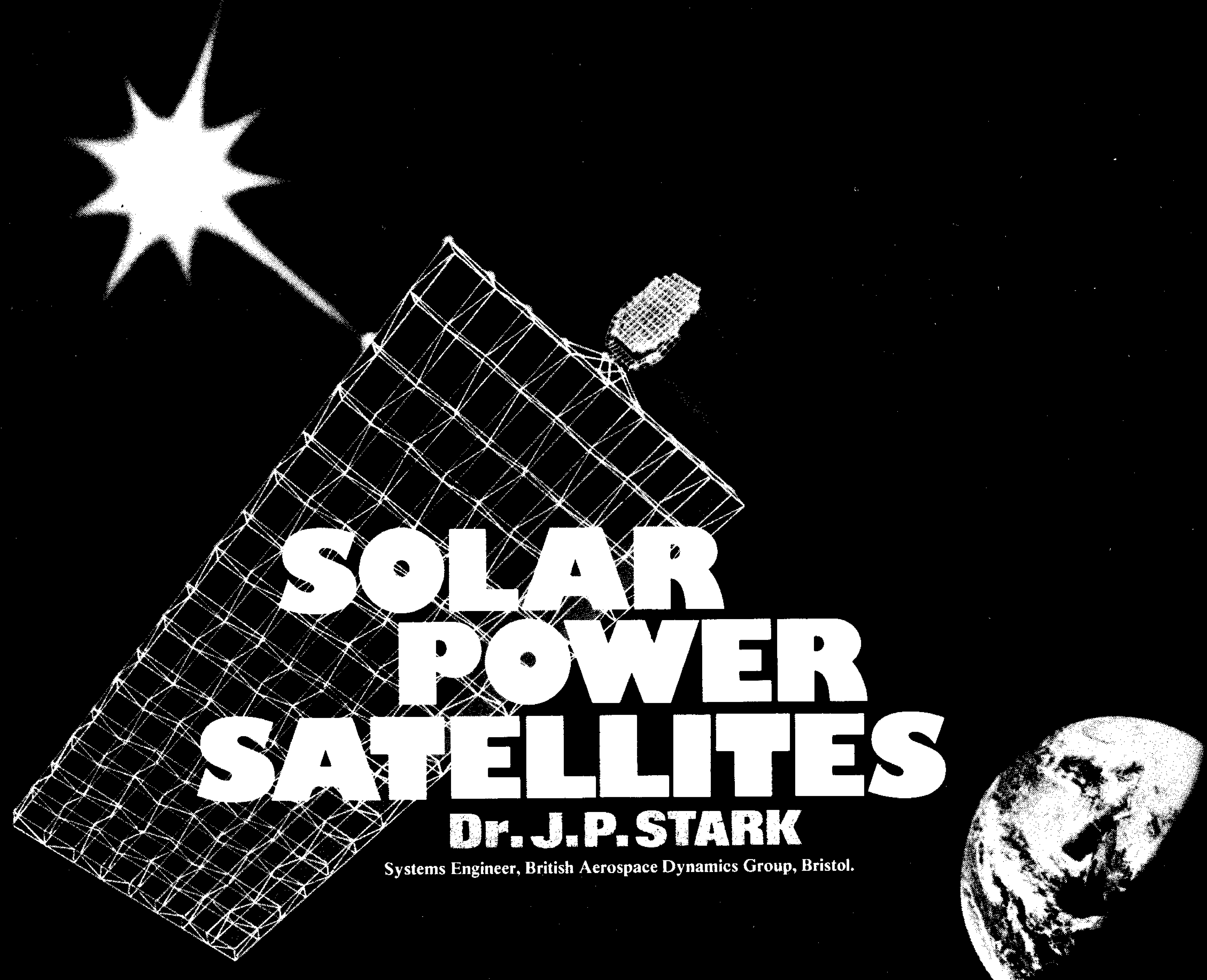
Miscellaneous

Battery holder and connector
HP7 battery (4 off)
Terminals red and black
Holder for i.c.
Case.

SETTING UP

Only one range of the instrument need to be calibrated using either a milliammeter or an accurate resistor. Set S1 as shown in Fig. 4 and vary VR1 to pass 30±1mA via a milliammeter connected across the test terminals. Or, connect a known 5Ω resistance (two 10Ω in parallel) across the test terminals and adjust VR1 to be in mid position between just lighting D9 and D11, i.e. indicating "centrally" on D10. The resulting settings will hold true for all other ranges to within the accuracy of the instrument, i.e. $\pm\frac{1}{2}$ a step, dependent upon the range.

Using the 30/300/3000 ranges the known 0·9V full-scale sensitivity allows for identification of diodes: a full or over-scale indication results for reverse-polarity tests (i.e. high resistance) while a 0·6V forward volt-drop indicates a silicon device and about 0·1 to 0·2V clearly suggests a germanium device. The battery voltage should be above 4V; the LM3914 will operate with down to 3V but the 4V limit is due to the minimum requirements of 0·9V across "Rx" plus 2V across R4 to R5 plus 1V needed for TR2 Vce operation. ★



SOLAR POWER SATELLITES

Dr. J.P. STARK

Systems Engineer, British Aerospace Dynamics Group, Bristol.

THE "Energy Debate" is now, after the growing publicity of recent years, a subject of which we are all aware. The crux of the energy problem is that the earth's resource of fossil fuels is being depleted at an ever increasing rate as a result of existing international energy policies. The appreciation of this problem has led to an evaluation of hitherto unexplored energy routes, many utilising the inexhaustible (as far as concerns us on this planet) supply of energy from the sun.

One such route, which has been under active consideration principally in the U.S., is via the solar power satellite (SPS). This system collects solar radiant energy, 36,000km above the surface of the earth (in a geostationary orbit (GEO)), converts this energy to a form suitable for transmission to a ground receiving site where it is coupled into an existing electrical grid network.

Below, the energy situation particular to the UK is outlined. This information is presented so that the usefulness to the UK, of alternative methods of electricity generation, may be identified. The SPS system itself is subsequently described. Finally, the usefulness and applicability to UK of such a system is defined.

UK ENERGY CONSUMPTION

Figures provided by the department of energy for primary energy consumption in the UK for last year (1979) indicate that an equivalent of 354 million tons of coal (mtce) were used. Of this, approximately 23 per cent was consumed in the generation of electricity. Table 1 indicates the detailed breakdown. It should be noted that 1 mtce is equivalent to the energy derived from 0·6 million tons of oil or would be consumed in the generation of 20 $\times$ 10^9kW hours of electricity; it is also equivalent to 1 billion (10^9) therms.

Table 1. Primary UK Energy Consumption (1979)

Petroleum	34·8%
Gas	27·4%
Electricity	22·6%
Solid Fuel	15·2%
Total	354mtce

SPS generates electrical power only and thus has the potential for altering our present fuel dependance in this area.

Table 2 indicates the fuel usage for electrical energy generation. It is evident that we are heavily dependant upon coal and oil, with only 1·5 per cent of our electrical power generated from any non-depletable source; in the UK this is hydro-electricity. Considering the information of Table 2 with that of Table 1, one can derive information relating to our dependance on different

Table 2. Power Station Fuelling

Coal	72·9%
Oil	14·9%
Nuclear	10·2%
Hydro	1·5%
Gas	0·5%
Total	280 × 10^9kW hr.

fuels for our overall energy requirements. This is shown in Table 3. This indicates that our dependance on fossil fuels is in excess of 95 per cent of our total energy requirement. One method of reducing this dependance is to alter the ways in which we generate electricity. Adoption of such a policy would have the potential of reducing our fossil fuel dependance by 20 per cent. This is obviously a significant reduction, however, on its own, it does not solve the energy crisis. This fact must be remembered for any energy system which, fundamentally, only generates electrical energy.

Table 3. UK Energy Dependance

Petroleum	39·3%
Coal	36·4%
Gas	19·7%
Nuclear	3·5%
Hydro	0·5%
Other	0·6%

This energy crisis is derived from the world's usage of fuels which are not being replaced. In order to establish the time scale for exhaustion of these fuels it is essential to gain some knowledge of present estimated fuel reserves, present rate of usage and projections for future usage.

The only one of these figures which is known to any accuracy is the present rate of usage. Future projections are highly dependant upon overall world growth rates and the extent to which the third world participates in industrial expansion. Estimates for the fuel reserves, both for the world and the UK, are given in Table 4. The reserves are shown in terms of their energy equivalent relative to coal.

Table 4. Depletable Fuel Reserves Estimates

Fuel	World (mtce)	UK (mtce)
Solid fuel	10^6	5×10^4
Oil	3×10^5	6×10^3
Gas	2×10^5	2×10^3
Oil Shales	4×10^5	$8{\cdot}3 \times 10^2 - 3{\cdot}3 \times 10^3$
Uranium	4 Mteu	4×10^4 (Assuming breeders)

This table shows that the UK has considerable resources of coal. These deposits represent 5 per cent of the estimated world reserve. In Britain this is the only significant energy reserve. The world figure indicated for uranium is given in terms of tons of uranium, and is the estimate for economic recovery of Uranium Oxide. The economic extraction cost is estimated to be £25/lb, which is just over twice the present market price. Highly speculative estimates based on geological interferences suggest about three times this level, but the cost of recovery could make such reserves unattainable.

The reserve of uranium indicated for the UK, 4 × 10^4mtce, is the amount of energy which could be derived from the stock-pile of suitable material held in establishments such as Windscale, if fast breeder reactors are commissioned. It must be emphasised that breeders do not produce a limitless supply of energy, they do, however, use fuel some 50 to 100 times more efficiently than the present generation of thermal reactors such as the Pressure Water, Magnox and Advance Gas Cooled reactors.

DEPLETION RATES

Consideration of energy growth rates in isolation from socio-economic and socio-political factors can not, with any great accuracy, indicate when our depletable fuel reserves will be exhausted. There is most certainly a relationship between gross national product and energy demand, however, the difficulty of economic forecasting alone is evidenced by the plethora of contradictory projections provided by various independent bodies. Thus, whilst acknowledging the limitations of such an analysis, Table 5 provides details for world depletion of fossil fuels for varying energy growth rates. It should be noted that for the years 78/79 the UK total energy demand increased by 4·2 per cent, however, the usage of coal and gas each increased by 7 per cent. It is clear that as certain fuels become exhausted more rapidly than others, the strain on the remaining fuels will become more severe.

Considering the total world fossil fuel usage at present, and if one assumes a 4 per cent per annum growth rate in usage, then all fossil fuel reserves will be exhausted in less than 50 years. This is clearly very worrying.

Table 5. Timescales for Depletion Fossil Fuels

Growth (Annual)	Current Total Reserves (years)	Solid Fuel (years)	Oil (years)	Gas (years)
0%	139	379	82	155
2%	67	108	49	72
4%	48	71	37	51

The depletion rate of fuel used in nuclear reactors is more difficult to identify, due to the varying technologies employed for electrical power generation by this means. If reactors of the fast breeder type are never employed on a commercial scale, then the reasonably assured reserve of 4 million tons, assuming a growth rate in demand of only 2 per cent, will be exhausted in less than 30 years according to figures published by the Energy Technology Support Unit (ETSU). In fact the average increase in the usage of nuclear fuel over the last five years was twice this in the UK.

If one considers the world growth rate then the situation is considerably more perplexing; for the period 76/77 a growth rate of nearly 18 per cent occurred. One way to reduce the demand for uranium is to introduce breeder reactors. These reactors can effectively utilise the most abundant isotopes of uranium, namely U238, rather than only U235 used in the present generation of nuclear reactors. However, breeder reactors rely, in the first instance, upon plutonium generated by thermal reactors before they can become independent of the U235 supply. Work published by ETSU indicates that even if fast reactors are introduced on a large scale by the year 2010, requiring orders for them to be placed by the year 2000, then the economically accessible Uranium will already have been exhausted. However, the total requirement for uranium over the next 100 years should be kept below 8 million tons, which although not being economic to extract, probably does exist.

In summary, there will be (unless world demand for energy falls dramatically) serious shortfalls in energy availability by the turn of the century. Fig. 1 indicates how this gap will continue to grow in the future.

This shortfall is entirely resultant from our almost total dependance on fossil fuels. Fossil fuels are no more than stored

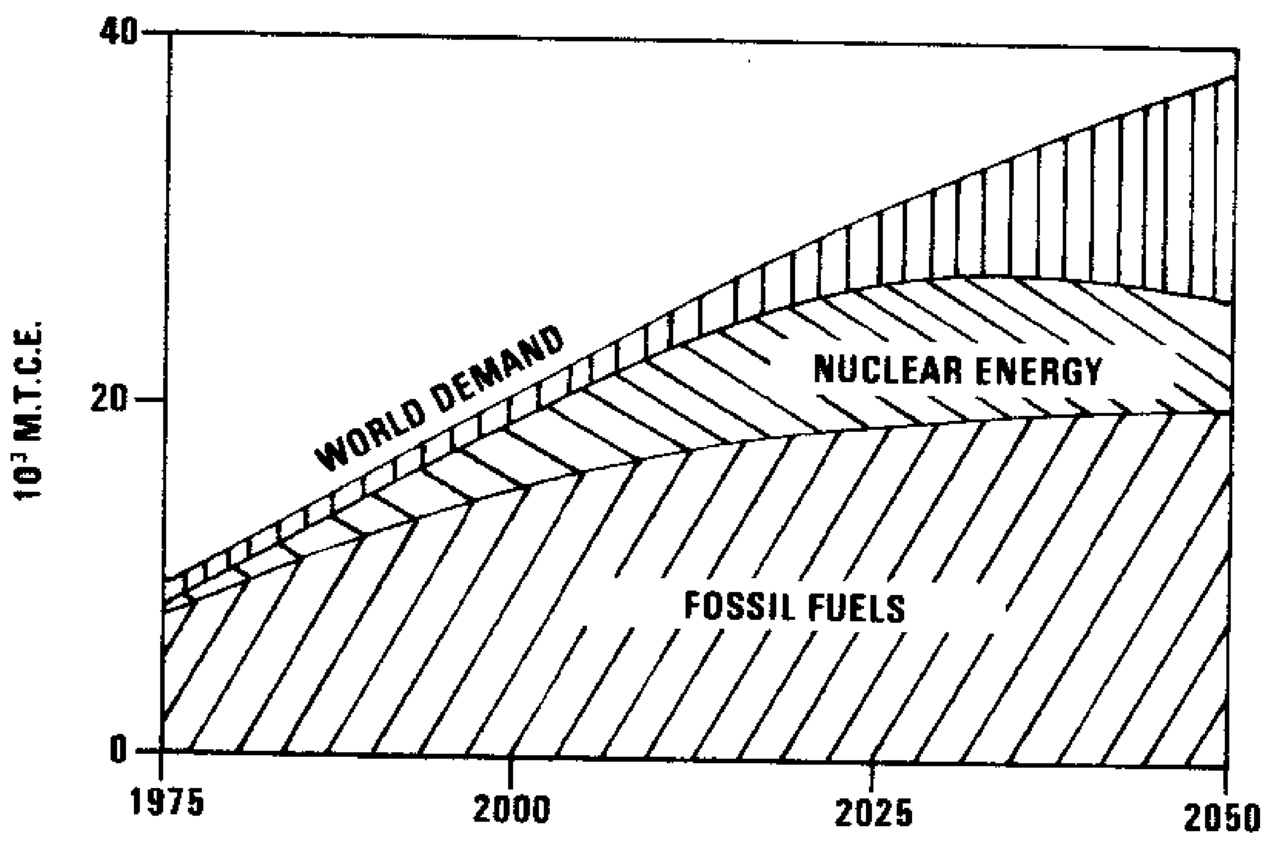


Fig. 1. The growing energy gap assuming a low (2%) growth in energy demand.

solar energy, the process of accumulation, however, takes millions of years. However, the solar radiant energy incident upon our planetary atmosphere is occurring at a continuous rate in excess of 10^{14}kW. At this rate the accumulated solar input to the planet in just four days exceeds the energy content of the fossil fuel reserves. The planetary energy balance (Fig. 2) indicates how this input is used by the planet.

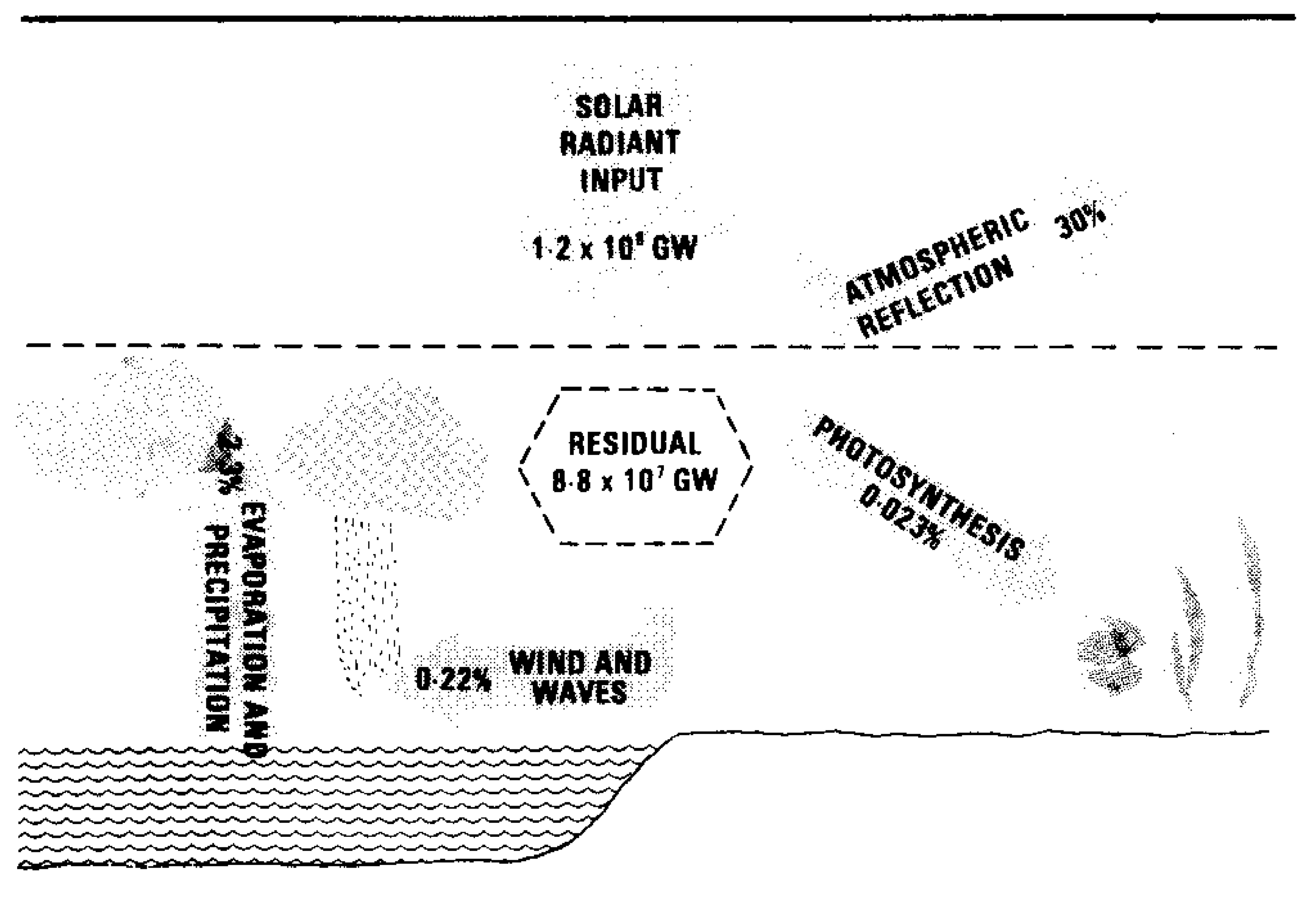
One of the most notable features of this balance is that 30 per cent of the energy is reflected by the atmosphere, and thus positioning of energy collection systems *above* the atmosphere shows an immediate advantage. Two other benefits are also derived from space operation, namely, independence of weather conditions and, assuming a suitable orbit such as geostationary orbit, a much higher potential duty cycle with the energy collection system being in sunlight for more than 99% of the year. Clearly, there are associated disadvantages of space operation, the most significant being the complexity of the space operations required, and also the expense of material transportation to space which must be taken into the overall cost of the energy system.

SPS SYSTEM

An outline of the present SPS system concept is shown in Fig. 3. This system has been derived in the US from two parallel studies over the last three years funded by NASA and the US Department of Energy to the tune of £10 million. These studies were performed principally by Rockwell International and Boeing Aerospace.

The main elements of the satellite system are the photovoltaic solar cells and the microwave antenna system. Both of these are mounted on a carbon fibre composite structure. The total mass of the system lies between 30 and 50 million Kg. Clearly, a system on this scale cannot be launched in a single unit as conventional satellites are at present, indeed the implementation of SPS requires the development of a new fleet of fully re-usable space transport vehicles for the movement of both cargo and personnel to GEO for the fabrication in space of the satellite. The development of these vehicles is essential if energy derived in this way is to be competitively priced relative to other, albeit depletable, energy sources.

Fig. 2. The planetary energy balance.



At present, launch costs for material are around £800/kg; with the advent of shuttle, cost should drop to £200/kg. The SPS transportation system should reduce this cost to less than £25/kg. To achieve these costs SPS requires four types of vehicle, each for a specialised task. Two of these (Fig. 4) are required for launch activities from earth to a low earth orbit (around 500km) staging base (Fig. 5). One is for cargo, with a payload of 424 tonnes (Saturn V, used in the manned lunar Appollo missions, had a payload capability of one-quarter of this); the other, an uprated version of shuttle, has the ability to carry 75 passengers.

The other two vehicles are used for orbital transfer to GEO. The cargo vehicle is electrically powered and carries some 4,000 tonnes, taking 180 days for the round trip. Clearly, passenger transfer must be in a much shorter period than this and thus a chemically propelled vehicle is proposed, taking less than a day for a one way trip; 160 passengers may be transferred in a single flight.

Cursory examination of these vehicles seems to suggest that great strides in technology advancement will be required to realise these vehicles. However, one must remember that the original versions of shuttle were to be fully reusable (an essential for the SPS launch vehicles). The only reason for shuttle not now being fully reusable was the limited funding available for the shuttle development programme. In addition, large sums have been invested by NASA into electric propulsion. Thus much of the fundamental development work that would be required for the cargo orbital transfer vehicle, has already been performed. Clearly, the amount of work still to be performed in advancement of vehicle technology must not be underestimated, indeed the cost of development is estimated to be 40 per cent of the overall SPS cost.

THE SATELLITE

Returning to the satellite itself, this consists of some 10,000 million individual solar cells. The voltage generated across each cell is less than half a volt, clearly much too low to be of practical use for power raising, and therefore the cells must be connected in so-called "strings" of cells in a series/parallel arrangement. This arrangement is the standard method used on solar arrays for satellites, however, the string length is totally different. For satellites such as UK VI, launched last year, the voltage required dictated a string length of approximately a quarter of a meter, however, for SPS the string length is in excess of 5km! These strings, generating some 2000 amps at 40kV, feed into the main 8m wide aluminium conductors running the length of the satellite. These conductors run to the end of the satellite where the microwave antenna is situated.

The antenna is mounted on the solar array structure by means of a rotary joint. This joint accommodates the diurnal variation in position, relative to the satellite, of the sun and earth, and thus the joint rotates once in 24 hours.

The antenna is 1km in diameter and consists of 100 thousand radiating waveguide elements. R.F. power is generated from the d.c. supplied by the solar array, by the use of klystrons. The relative phasing of these klystrons is controlled so that the beam may be focused on the ground receiving site. The signal for this phase control is generated at the receiving site; removal of this

Fig. 3. The present U.S. Solar Power Satellite Concept *(Courtesy NASA).*

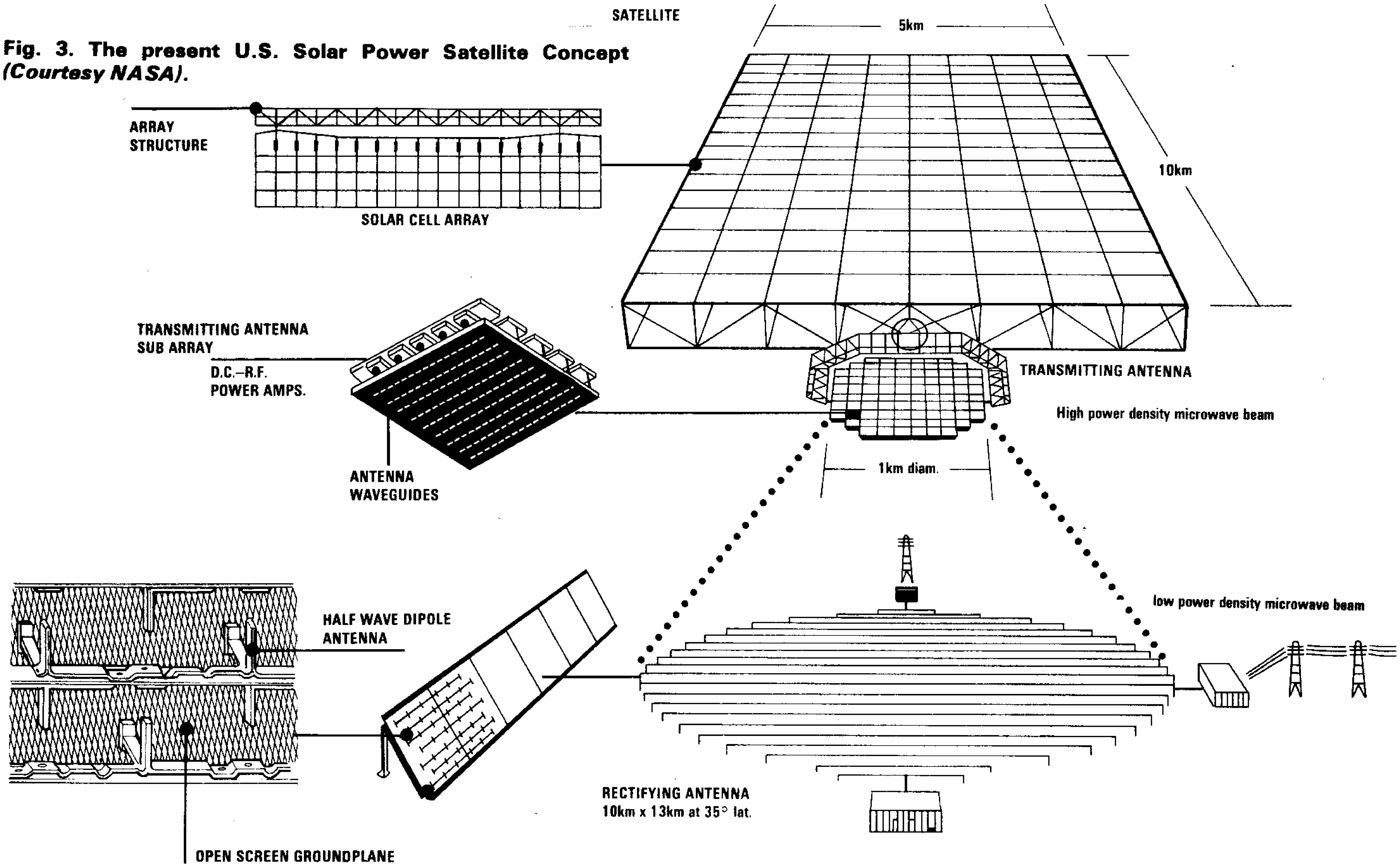
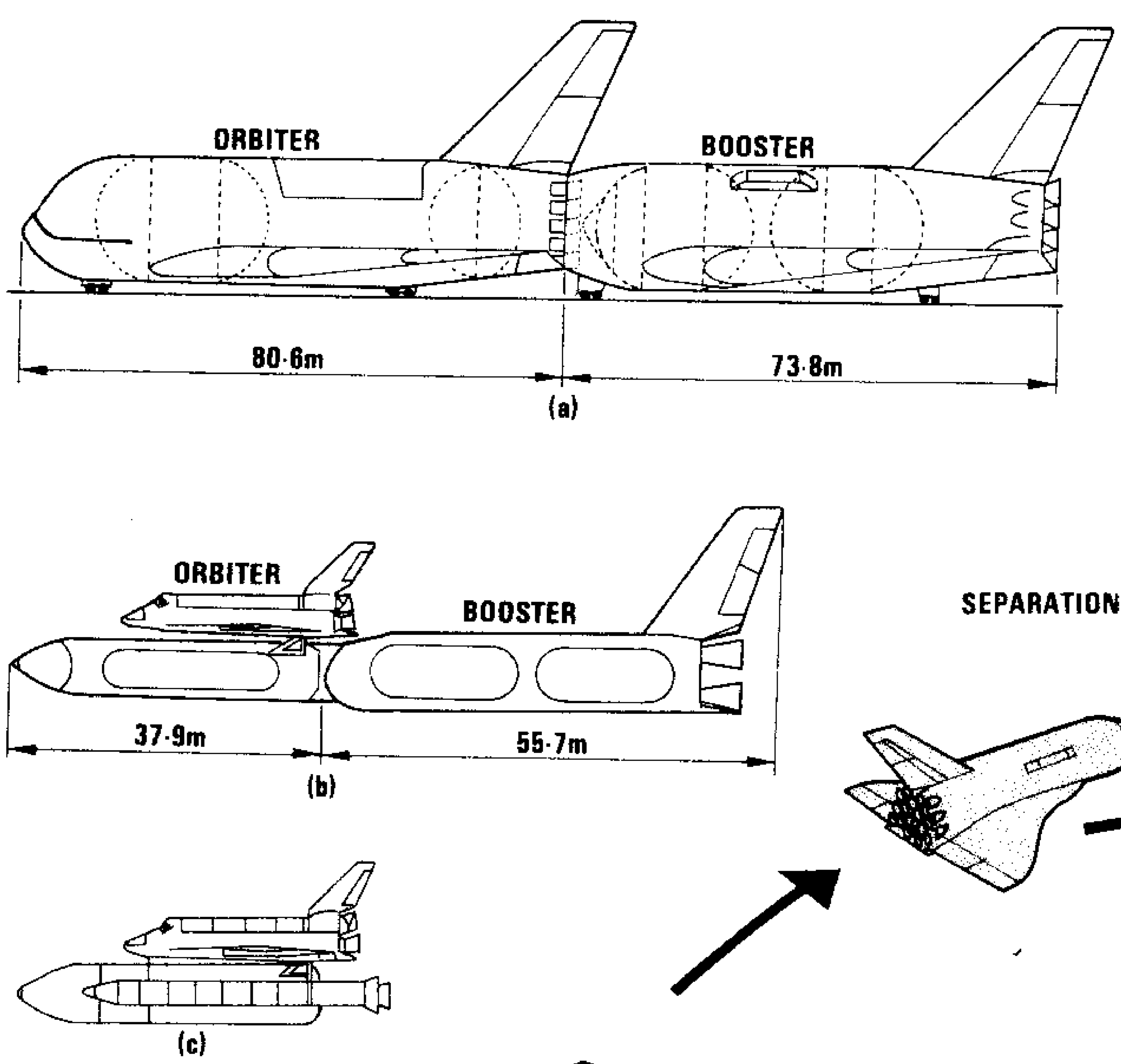


Fig. 4. Vehicles required for SPS launch activities: (a) The heavy lift launch vehicle; (b) The personnel launch vehicle; (c) The present shuttle system (for scale).



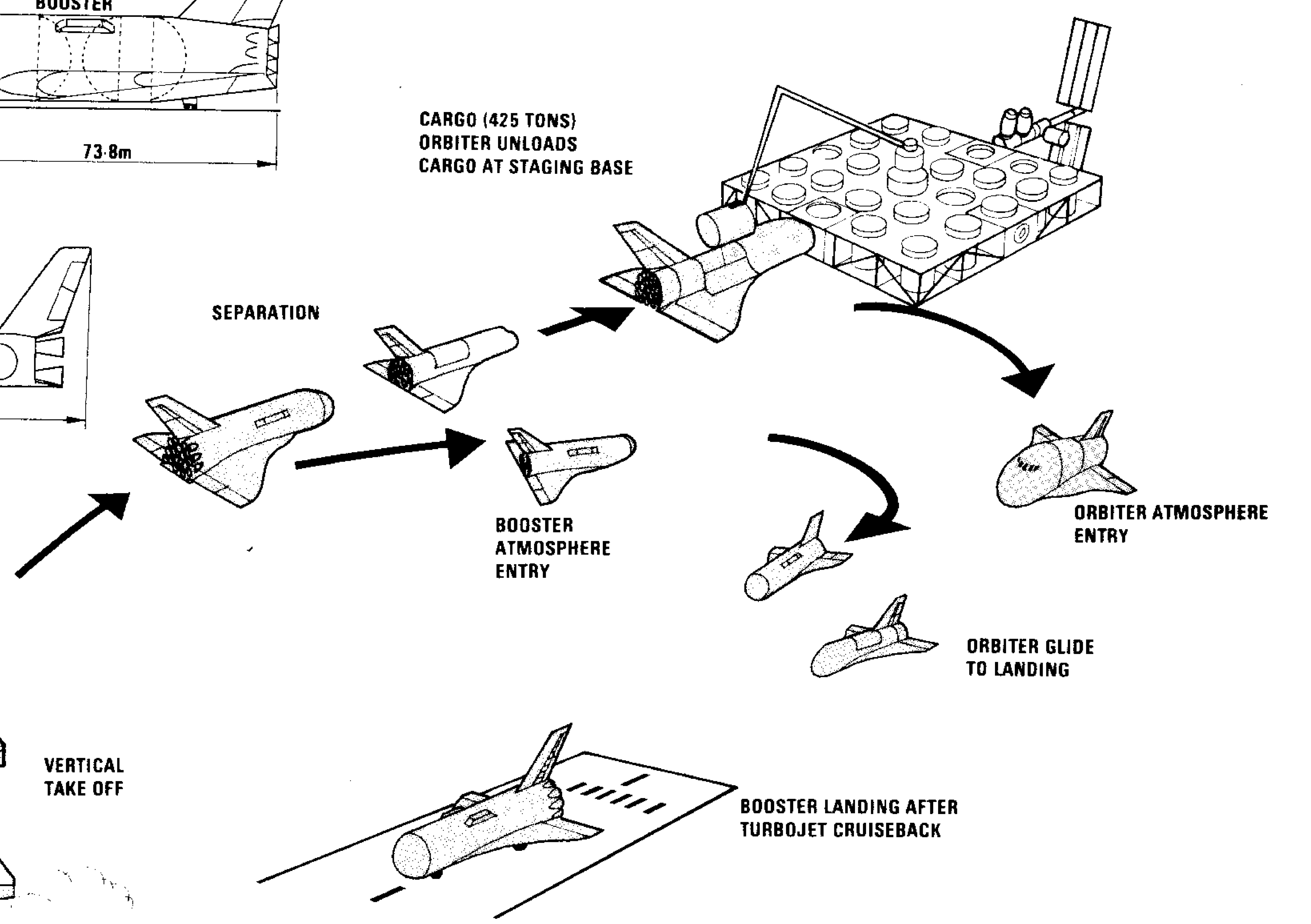


Fig. 5. Activities associated with the low earth orbiting staging base *(Courtesy NASA).*

signal automatically defocuses the beam to a safe microwave radiation level over a large area. The frequency for the r.f. power link (2·45GHz) was chosen so that there would be minimal dependance upon atmospheric conditions, and also to minimize interference effects on the already crowded radio bands. The peak microwave power density is 23mW/cm^2 so that ionospheric heating effects should not be significant.

GROUND SITE

The ground site consists of approximately 10^{10} dipoles with associated diode rectifiers together with a power distribution system feeding to a fairly conventional power grid interface. The power input to the grid network would be 5GW—or nearly four times the designed output from the Dungeness B AGR still under construction. So that this power might be received in the UK, the antenna required would be an ellipse some 20km in a North-South direction and 10km in an East-West direction.

The size of the sites increases with distance from the equator due to projection effects of the beam onto the earth. Clearly, the availability of sites of this size on the UK land mass is virtually non-existent and thus, in the past, off-shore siting has been proposed. More recently, study with the UK has shown the feasibility of splitting the microwave beam into several components. This has the advantage of smaller individual receiving sites thus making their placement on land, or possibly in river estuaries, feasible, with also the possibility of delivering power to where the power is actually required and thus reducing transmission costs.

The overall end-to-end efficiency chain for SPS does not, at first sight, appear impressive. In order to obtain the input of 5GW to the grid, the satellite system intercepts a total of 71GW, an overall efficient of 7 per cent. The best thermal efficiencies for conversion of fossil fuels to electricity are some five times this value. However, if one considers the energy payback ratio, namely the ratio between the total electrical energy delivered over the lifetime of a power plant to the primary, non-renewable energy required to construct and operate the power plant, then SPS comes to the fore.

Table 6 shows the energy ratio comparison between coal fired power plants, nuclear power plants and SPS, each taking into account operational energy requirements. The figures shown in the table were derived in the early part of the US SPS study. The range shown for SPS is as a result of the uncertainties associated with the methods used for component manufacture. More recent estimates show SPS to be in a more favourable position still, with energy ratios approaching the value of 20. The important point to realise from the table is that both the fossil fuel power station and the nuclear fission power station generate less electrical energy during their lifetime than the energy required to construct and operate them.

Table 6. Energy Ratios

Power plant type	Energy Ratio
Coal fired	0·31
Nuclear (Light Water)	0·24
SPS	0·5–9·0

COST

The cost estimates available for SPS for the first operational system, together with all the research development and test programmes, are close to £43 billion. This investment, required over a twenty year period in order to have an operational system by the turn of the century, would be less per year than the combined UK fission programme and the U.S. breeder programme. Subsequent systems, built at the rate of *two per year*, would cost around £1,250/kW, comparable to the AGR costs (including fuel) of £1,135/kW.

It is no longer possible to develop an energy system and combat the environmental problems subsequent to power generation. Within the US programme, considerable effort has been expended in evaluation of environmental issues. At the recent review of the SPS activities in the US (April 1980), 44 of the papers presented considered various environmental aspects. This represented a quarter of the overall presentation and covered topics such as potential microwave health hazard, ionospheric and atmospheric disturbance due to both microwave radiation and transportation activities, and the effects of possible interference on other r.f. users. Clearly, SPS will not go ahead without a fundamental understanding and solution of potential environmental problem areas. As yet no environmental hazards, nor system "show stoppers" have been identified.

So, how could SPS fit into a UK energy policy? As outlined above the principal problem for the UK is the relatively large areas of land (or sea) required for suitable ground site location. By a combination of both multiple beams and off-shore sites it appears feasible for the UK to receive SPS generated power. Another area which must be considered is how much SPS power could be used in the UK. This is driven by the combination of how many ground sites can be found and how many satellites can be suitably located in GEO.

Assuming suitable off-shore sites can be found (clearly UK expertise in off-shore oil platforms is useful here), then one only has to consider what space is available in GEO. An analysis along these lines indicates that a reasonably conservative estimate of some 30GW could be obtained. The total installed electrical power generation in the UK is nominally 67GW, however, the average power supplied during 1979 was only 32GW.

Clearly, SPS has considerable potential ability to offset the coming UK electrical energy crisis in the next century. It must be emphasised, however, that the solution to the electrical energy problem,proposed here to be aided by SPS, and by others using nuclear breeder reactors, does *not* solve the energy problem as a whole. Less then a quarter of our primary energy usage is electrical; we must still solve the problem associated with the remaining three quarters. ★

Readout...

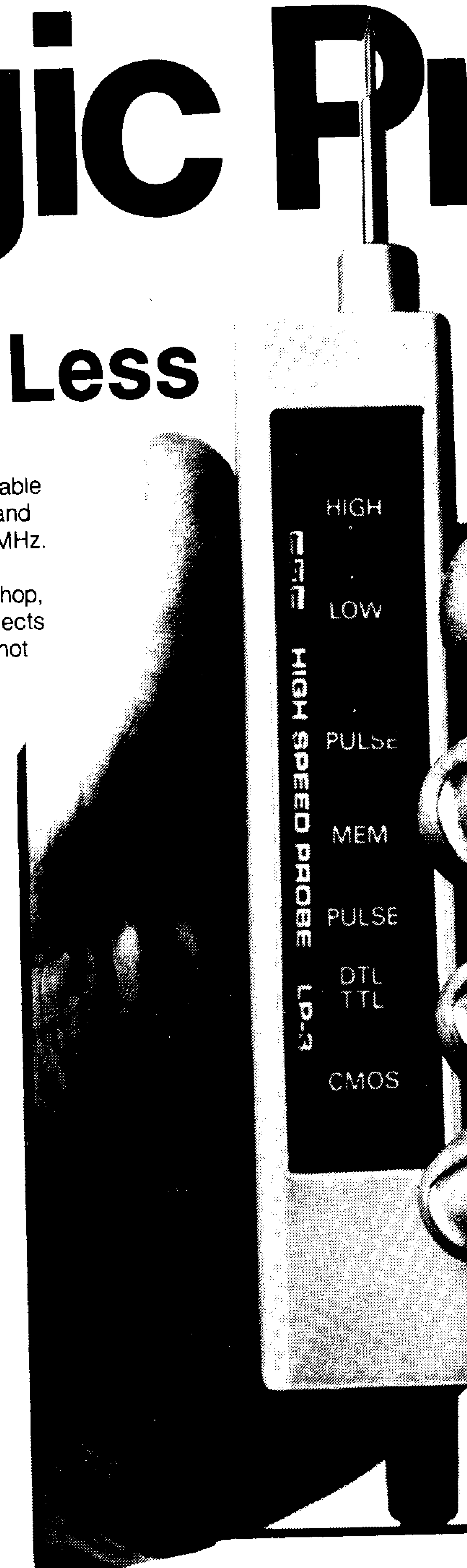
The SIS and Velikovsky

Sir—I have followed the controversy in your columns regarding the ideas of Immanuel Velikovsky with interest as this Society has been investigating his work for some years in the columns of its *Review* where papers, both pro and con, have appeared by astronomers, physicists, archaeologists and other scholars.

I note that you have decided to terminate the correspondence on the topic and would agree that your letters column does not really have the space to deal with these complex matters in any detail, but I also note that Mr. Hyde is to be given space to reply to the letters and in the light of his strong views on the matter he is quite likely to raise new aspects of the controversy. In view of this, and in fairness to your readers who may be interested, perhaps you would consider adding some sort of editorial note to Mr. Hyde's comments drawing attention to the existence of the SIS as a forum for the Velikovsky debate? I would be happy to give further information on any aspect of the debate on catastrophism to any of your readers who contacts me at the following address.

Brian Moore A.L.A.
Society for Interdisciplinary Studies,
Central Libary,
Clarence Road,
Hartlepool,
Cleveland.

The Logic Probes

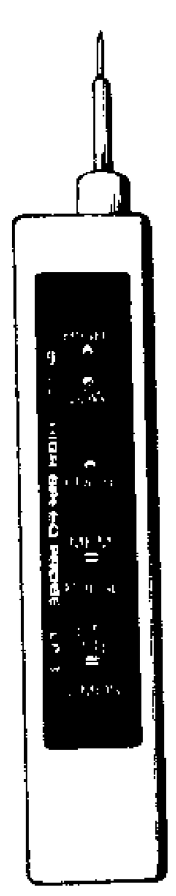


Spend Less Test More

LP-1 Logic Probe

The LP-1 has a minimum detachable pulse width of 50 nanoseconds and maximum input frequency of 10MHz. This 100 K ohm probe is an inexpensive workhorse for any shop, lab or field service tool kit. It detects high-speed pulse trains or one-shot events and stores pulse or level transistions, replacing separate level detectors, pulse detectors, pulse stretchers and pulse memory devices. All for less than the price of a DVM

£31.00*



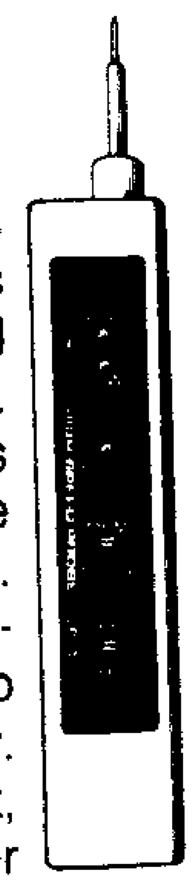
LP-2 Logic Probe

The LP-2 performs the same basic functions as the LP-1, but, for slower-speed circuits and without pulse memory capability. Handling a minimum pulse width of 300 nanoseconds, this 300 K ohm probe is the economical way to test circuits up to 1.5 MHz. It detects pulse trains or single-shot events in TTL, DTL, HTL and CMOS circuits, replacing separate pulse detectors, pulse stretchers and mode state analysers.
(Available in kit form LPK-1 £11-92)

£18.00*

The logic probes shown are all suitable for TTL, DTL, HTL and CMOS circuits.

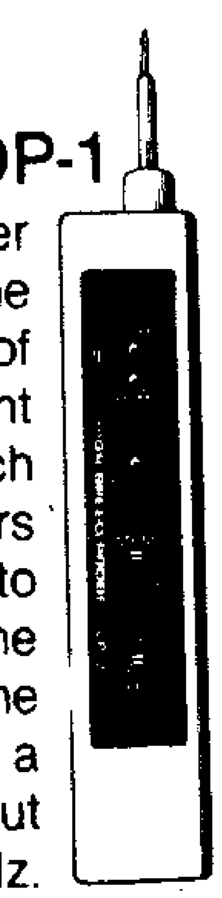
**price excluding P.&P. and 15% VAT*



LP-3 Logic Probe

Our LP-3 has all the features of the LP-1 plus extra high speed. It captures pulses as narrow as 10 nanoseconds, and monitors pulse trains to over 50 MHz. Giving you the essential capabilities of a high-quality memory scope at 1/1000th the cost. LP-3 captures one shot or low-rep-events all-but-impossible to detect any other way. All without the weight, bulk, inconvenience and power consumption of conventional methods.

£49.00*



The New Pulser DP-1

The Digital Pulser: another new idea from C.S.C. The DP-1 registers the polarity of any pin, pad or component and then, when you touch the 'PULSE' button, delivers a single no-bounce pulse to swing the logic state the other way. Or if you hold the button down for more than a second, the DP-1 shoots out pulse after pulse at 1000 Hz. The single LED blinks for each single pulse, or glows during a pulse train. If your circuit is a very fast one, you can open the clock line and take it through its function step by step, at single pulse rate or at 100 per second. Clever! And at a very reasonable price. **£51.00***

CONTINENTAL SPECIALTIES CORPORATION

CSC

C.S.C. (UK) Limited, Dept. 5II
Unit 1, Shire Hill Industrial Estate
Saffron Walden, Essex CB11 3AQ.
Telephone: Saffron Walden (0799) 21682
Telex: 817477

C.S.C. (UK) Limited, Dept. 5II, Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.
Prices include P.&P. and 15% VAT

LP-1	£37.38	Qnty.	LP-2	£22.14	Qnty.	LP-3	£58.08	Qnty.	DP-1	£60.38	Qnty.	LPK-1	£14.86	Qnty.

Name ______ Address ______

I enclose Cheque/P.O. for £ ______ or debit my Barclaycard/Access/American Express card no. ______ exp. date ______

FOR IMMEDIATE ACTION — The C.S.C. 24 hour, 5 day a week service. Telephone (0799) 21682 and give us your Barclaycard, Access, American Express number and your order will be in the post immediately.

For FREE catalogue tick box ☐

Interfacing COMPUKIT

Part 1 D.E.Graham

THE COMPUKIT UK 101 is one of the few personal computers with 8K BASIC and full keyboard that does not have an input/output port for interfacing external devices. In this series we propose a remedy for this in the shape of an Address Decoding and Port Module which plugs directly into the Compukit's expansion socket. It is also Superboard II compatible.

The Module has been designed with flexibility in mind, and as well as housing an MC6821 Parallel Interface Adaptor (PIA), which gives two 8-bit input/output ports, the board also provides 7 uncommitted address-decoded *read*, and 14 decoded *write* lines, each of which may be used with interfaces of the reader's choice, and a pair of specially decoded lines that will directly interface an AY-3-8910 or 8912 PSG. In addition there is on-board address decoding for a further 6 blocks of 16 memory locations; again these are completely uncommitted, and each could be used to enable devices with up to 16 independent registers, such as the 6522 Versatile Interface Adaptor, details of which will be given later in the series. The board also houses an independent 5 volt regulated power supply which may be used to run a limited number of external circuits.

During the series the principles of interfacing the Compukit using various devices will be developed, and circuits will be given for a range of interfaces that may be plugged directly into the Decoding Module. Amongst these will be featured interfaces for joysticks, l.d.r. light sensors, 7-segment l.e.d. displays, audio generators, power controllers, and D/A and A/D converters. Software support for each will also be discussed.

The first part of the series is devoted to the Decoding Module itself.

DECODING PRINCIPLES

The 16 address lines of the Compukit can be confugured in 2^{16} or 65,536 different ways, or in other words it can address 65,536 different memory locations. To pick out just one of these, gating circuitry must be used. The circuit in Fig. 1.1, employing a single 16-input AND gate, would give a high output if, *and only if*, each of the address lines was simultaneously high. The Compukit's address lines are active-high, so that the circuit could be used to provide a Chip Select signal when the address FFFF hex (or 65,536) was put on the address bus by the Compukit's CPU. Different addresses could be decoded by simply placing inverters between chosen address lines and the gate inputs. Putting an inverter in lines A0 and A4, for example, would decode for the address FFEE hex (65,519 decimal). In Table 1.1 we give a listing of a hex to decimal/decimal to hex converter that may prove useful for calculating addresses on the Compukit.

COMPONENTS . . .

DECODING MODULE

Resistors

R1, R2	1k ¼W (2 off)
R3	220 1W
R4–R6	10k ¼W (3 off)

Capacitors

C1	2200µ 15V
C2, C5	100n disc cer. (2 off)
C3	10µ 15V
C4	100µ 15V
C6	1000µ 15V
C7	10µ 15V

Diodes

D1–D4	1N4001 (4 off)
D5	5V 1·2W Zener

Integrated Circuits

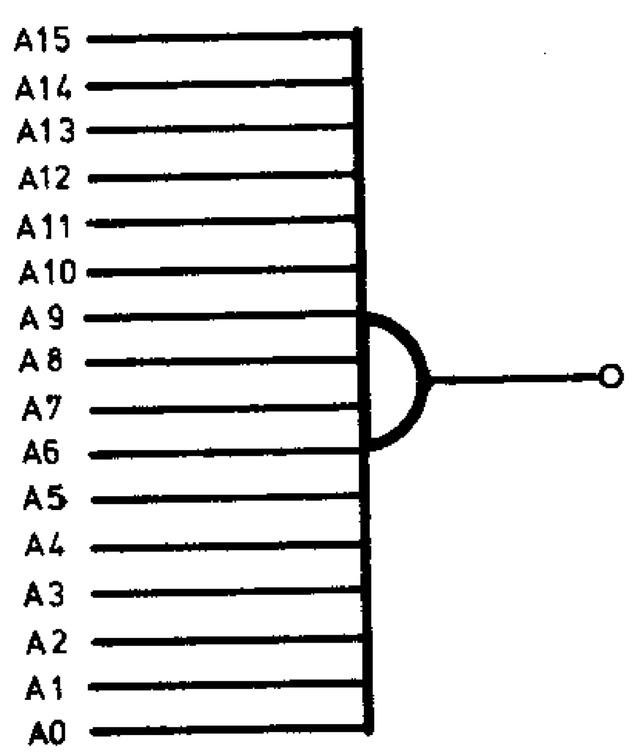
IC1	74LS133
IC2, IC4	74LS138 (2 off)
IC3	74LS154
IC5–IC7	74LS04 (3 off)
IC8	74LS03
IC9	6821
IC10	7805

Miscellaneous

2 off	40-pin d.i.l. socket
5 off	16-pin d.i.l. socket
2 off	24-pin d.i.l. socket
4 off	14-pin d.i.l. socket
1 off	40-pin d.i.l. plug
2 off	22-pin 0·1in. edge connector
2 off	25-pin 0·1in. edge connector
1 off	24-pin d.i.l. plug
2 off	16-pin d.i.l. plug
2 off	8T28 to plug into Compukit

Ribbon cable
1A 20mm slo-blo fuse and p.c.b. holder
push-to-make switch.

The ENABLE line of Fig. 1.1 could be used to trigger a data latch (such as the 7475) to latch data appearing instantaneously on the CPU's data bus for use by some external device. In practice, in order to ensure that the ENABLE pulse comes at exactly the right instant, it is desirable to make it conditional on Compukit's Ø2 clock line going high. Fig. 1.2 shows a circuit using a 17-input AND gate that would decode for the address EF18 hex (61028 decimal). This is a



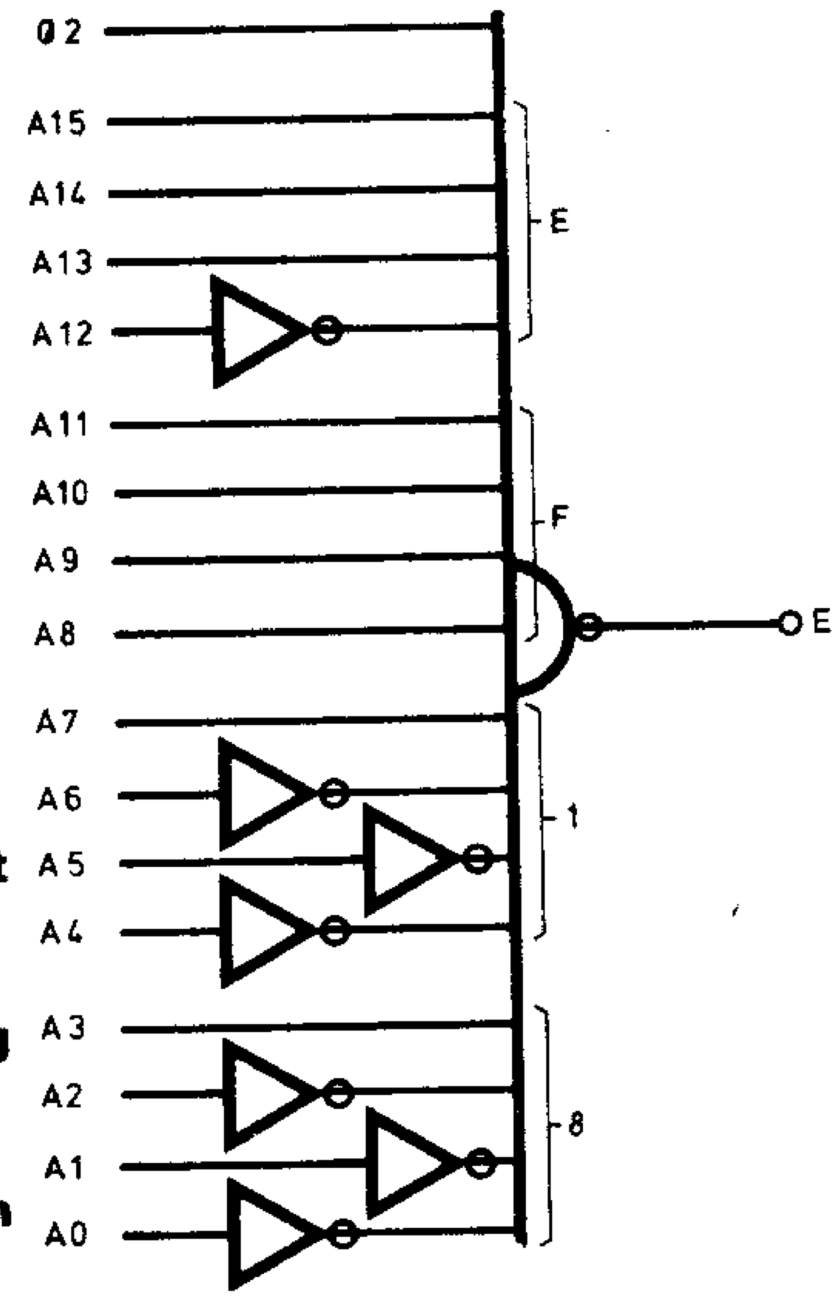
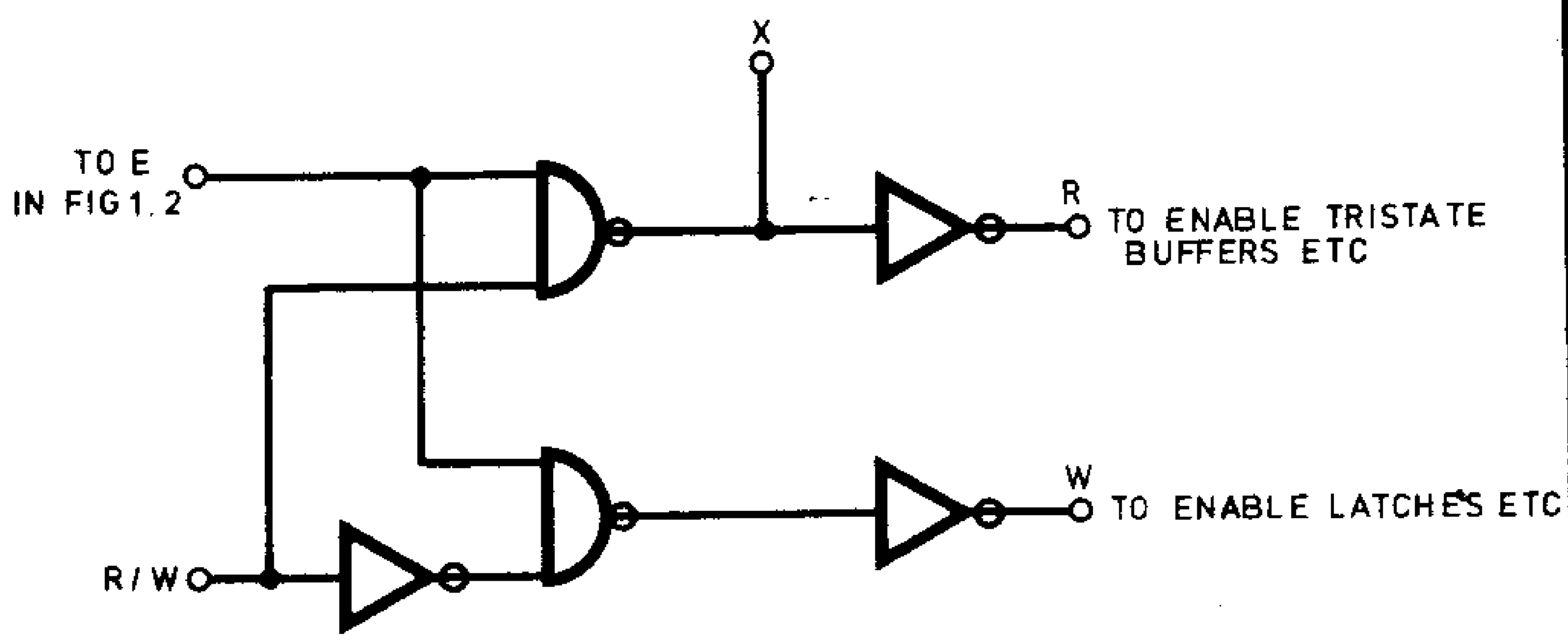


Fig. 1.1. Above. 16 input AND gate

Fig. 1.2. Right. Decoding for EF 18

Fig. 1.3. Below. Separation of R/W decoding



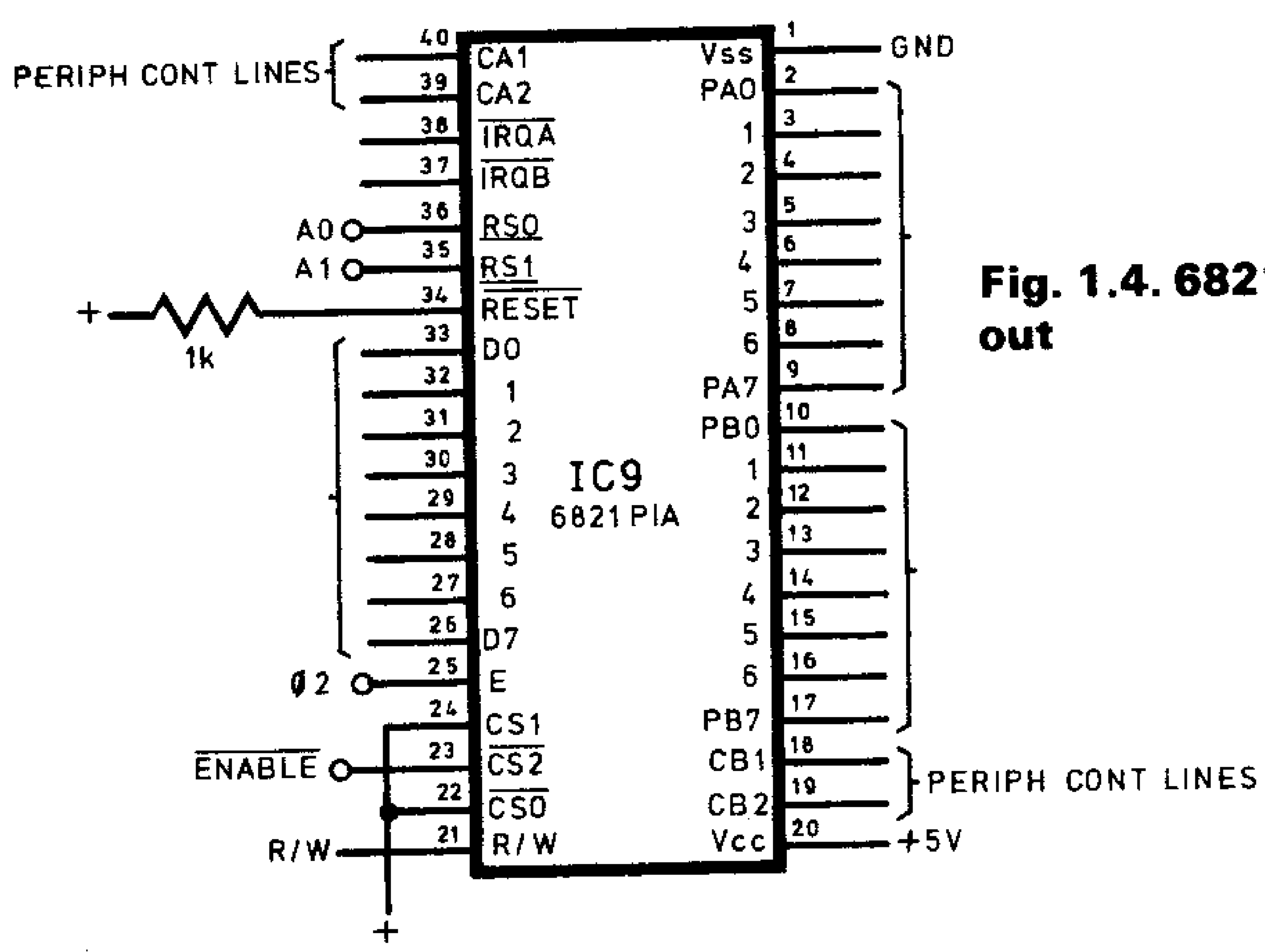


Fig. 1.4. 6821 pin-out

```
90 REM HEX-DEC-HEX CONVERTER
95 REM PE UK101 INTERFACING PROG NO 1
100 FORA=1TO16:PRINT:NEXT
110 PRINT,"HEX-DEC-HEX CONVERTER"
115 PRINT:PRINT:PRINT:PRINT
120 PRINT"    IS DATA HEX OR DECIMAL ?"
125 INPUT"    ENTER H OR D";Y$
130 IFY$="D"THENGOSUB550:GOTO165
140 IFY$="H"THENGOSUB550:GOTO350
150 PRINT:PRINT"    NOT RECOGNISED: ENTER AGAIN"
160 GOTO120
162 REM
163 REM DEC TO HEX ROUTINE
164 REM
165 PRINT:PRINT:PRINT
166 INPUT"    DECIMAL DATA PLEASE";N
168 IFN=0THEN350
170 A=INT(N/4096)
180 A1=A*4096
190 B=INT((N-A1)/256)
200 B1=B*256
210 C=INT((N-A1-B1)/16)
220 C1=C*16
230 D=N-A1-B1-C1
240 X$="0123456789ABCDEF"
250 PRINT,"HEX EQUIVALENT=  ";
260 PRINTMID$(X$,A+1,1);
270 PRINTMID$(X$,B+1,1);
280 PRINTMID$(X$,C+1,1);
290 PRINTMID$(X$,D+1,1)
300 GOTO165
350 REM
360 REM HEX TO DEC ROUTINE
370 REM
390 PRINT:PRINT:PRINT
400 INPUT"    HEX DATA PLEASE";H$
402 IFH$="0"THEN165
403 IFLEN(H$)<>4THENPRINT:PRINT"    4 DIGIT FORMAT ONLY":GOTO400
405 N=0
410 X$="0123456789ABCDEF"
420 FORJ=1TO4
430 FORI=1TO16
440 IFMID$(H$,J,1)=MID$(X$,I,1)THEN460
450 NEXTI
455 PRINT:PRINT"    CHARACTER NOT IDENTIFIED - RE DO"
456 GOTO390
460 N=N+(I-1)*16↑(4-J)
470 NEXTJ
480 PRINT,"DECIMAL EQUIVALENT=  ";N
490 GOTO390
500 END
550 PRINT:PRINT:PRINT"    NOTE THAT ENTERING A ZERO WHEN"
560 PRINT"    DATA IS REQUESTED REVERSES FUNCTION"
570 RETURN
```

Table 1.1 Hex/Dec. and D/H converter program

Table 1.2. Compukit's Memory Map showing gaps

Address	
0000-02FF	Scratchpad RAM for operating system
0300	Start of Basic Workspace
1FFF	End of On-board RAM
9FFF	End of Possible Ram expansion
A000-BFFF	Basic Interpreter
D000-D3FF	Video RAM
DFOD	Polled keyboard
F000, F001	ACIA serial port
F800-FFFF	Monitor ROM

quite arbitrary address, and clearly any of the Compukit's 65,536 addresses could be decoded in this way; although of course since 17-input AND gates are not readily available, one would be forced to use a combination of gates to achieve the same effect in a practical circuit.

There are two further factors which must be considered in decoding for an interface, both of which relate to the R/W (Read/Write) signal. The circuit of Fig. 1.2 will give an output at any time that the address 61208 appears on the address bus. Thus, executing POKE 61208, X or Y=PEEK (61208), would both cause an output from the decoding circuit. But in most applications it is useful to distinguish between read and write operations. If, for example, we are using the signal to trigger a set of latches to give a data output, we will only want this to occur in response to a POKE command, whereas if it were used to turn on a tristate buffer for the input of data to the CPU, we would want this to occur exclusively in response to a PEEK statement.

Differentiation between the two can be achieved by using the R/W line at Compukit's expansion socket. This goes high during a Read Cycle, and low during a Write Cycle. The configuration in Fig. 1.3 would derive two separate Chip Select lines from the output of the circuit in Fig. 1.2, one for a Read to the address 61,208, and one for a Write. As may be seen, even though the two resulting decoded lines share the same address in the Compukit's memory map, they could be used for entirely different purposes. The Write might be used to trigger latches driving a D/A converter, while the Read might trigger tristate buffers to feed the CPU with the counting registers of an external clock, for example.

Finally, in our decoding circuitry we must include a means of controlling the DD or Data Direction line of the Compukit. This determines the direction in which data is allowed to pass through the two 8T28 data buffers on the Compukit's main board. Note, incidentally, that while these two i.c.s are essential in any use of the data bus at the expansion socket, they are not provided in the basic UK101 kit, and must be purchased separately. With the DD line high, data can pass from the CPU to the expansion socket, but not in the reverse direction. When it is low, on the other hand, the converse is true. With no external signal on this line, it is kept high by Compukit's on-board resistor network R9 R74. If we did not service the DD pin at the expansion socket, we could successfully write data to external devices with the circuit of Figs. 1.2 and 1.3, but even though the R line of Fig. 1.3 would go high when a PEEK(61208) was executed, no data from the tristate buffers, or whatever else was enabled, would actually get to the CPU data bus. This could be remedied by connecting point X in Fig. 1.3 directly to the DD pin of the expansion socket. This would bring DD low only when a Read instruction was carried out at the given address, and the associated interfaces could then be both written to, and read from, in a satisfactory manner.

THE DECODING MODULE

The Decoding Module requires a 128 byte address block, a requirement easily met within the Compukit's memory map. This is reproduced in table 1.2, and it may be seen that the Compukit possesses unused blocks at COOO-CFFF, D400–DEFF, DFO1–EFFF and F100–F7FF hex. For reasons of simplicity we have chosen to locate the module between EF80 and EFFF hex (61,312–61,439 decimal). This falls immediately below the serial port at F000 hex. An address map of the major 8 blocks of the module is given in Table 1.3.

Table 1.3. Address Map of Module

Base Address of (Hex)	Block (Dec)	Block Number	Function
EF80	61312	BLO	Base address for 8 decoded lines
EF90	61328	BL1	Base address for PIA block
EFAO	61344	BL2	Free Block
EFBO	61360	BL3	Free Block
EFCO	61376	BL4	Free Block
EFDO	61392	BL5	Free Block
EFEO	61408	BL6	Free Block
EFFO	61424	BL7	Free Block

The board uses a combination of edge connectors and d.i.l. sockets for external connections, and the pin-outs of these are given in Tables 1.4–1.8. Edge connector SK1 carries the 40 leads from the Compukit's expansion socket, and the wiring between these should be kept as short as possible. The 40-pin socket SK2 allows for further expansion of the Compukit, and has the same pin-out as Compukit's own expansion socket. The two 16-pin d.i.l. sockets SK3 and SK4 carry ports A and B of the PIA, respectively, together with associated control and power supply lines.

The decoded lines produced by the Decoding Module are taken out through the 24-pin d.i.l. socket SK5, carrying six Write and two Read lines, and the 2 x 25 pin edge connector SK6 which carries the remainder. Both SK5 and 6 also carry Vcc and the data bus, and in addition SK6 carries address lines A0–A3, $\Phi 2$, $\overline{NMI}$, $\overline{IRQ}$ and $\overline{RESET}$ to allow full use of the six 16-byte blocks.

Next month we will deal with the circuit operation of the Decode Module, showing the printed circuit board layout and component overlay. We shall also cover the operation of the PIA, and the construction and testing of the Decoding Module; and will look at the inputting of data to the COMPUKIT, both via the PIA, and sets of tristate buffers.

Table 1.4. Connections to edge connector SK1.

	UPPER ROW		LOWER ROW	
SK1 pin	Function	Connection to compukit exp. soc.	Function	Connection to compukit expansion
1	A2	12	GND	40
2	A1	13	GND	39
3	AO	14	GND	38
4	A3	15	GND	37
5	A4	16	n/c	—
6	A5	17	n/c	—
7	A6	18	R/W	32
8	$\overline{IRQ}$	1	02	31
9	$\overline{NM1}$	2	A15	27
10	DD	3	A14	26
11	DO	4	A13	25
12	D1	5	A12	24
13	D2	6	A11	23
14	D3	7	A10	22
15	Spare	11	A9	21
16	A8	20	GND	30
17	A7	19	GND	29
18	n/c	—	GND	28
19	n/c	—	D7	33
20	GND	8	D6	34
21	GND	9	D5	35
22	GND	10	D4	36

Table 1.6. SK3 and 4 of PIA.

1	GND	16	ADO
2	CA1	15	AD1
3	CA2	14	AD2
4	GND	13	AD3
5	GND	12	AD4
6	GND	11	AD5
7		10	AD6
8	Vcc	9	AD7

SK4—PORT B of PIA is identical

Table 1.7. Connections to SK5.

GND	1	24	W10
GND	2	23	D6
GND	3	22	D4
D7	4	21	D1
D5	5	20	D3
DO	6	19	W12
D2	7	18	W14
$\overline{\text{W11}}$	8	17	GND
W13	9	16	GND
W15	10	15	GND
Vcc	11	14	R5
Vcc	12	13	R4

Table 1.8. Connections to SK6 edge connector.

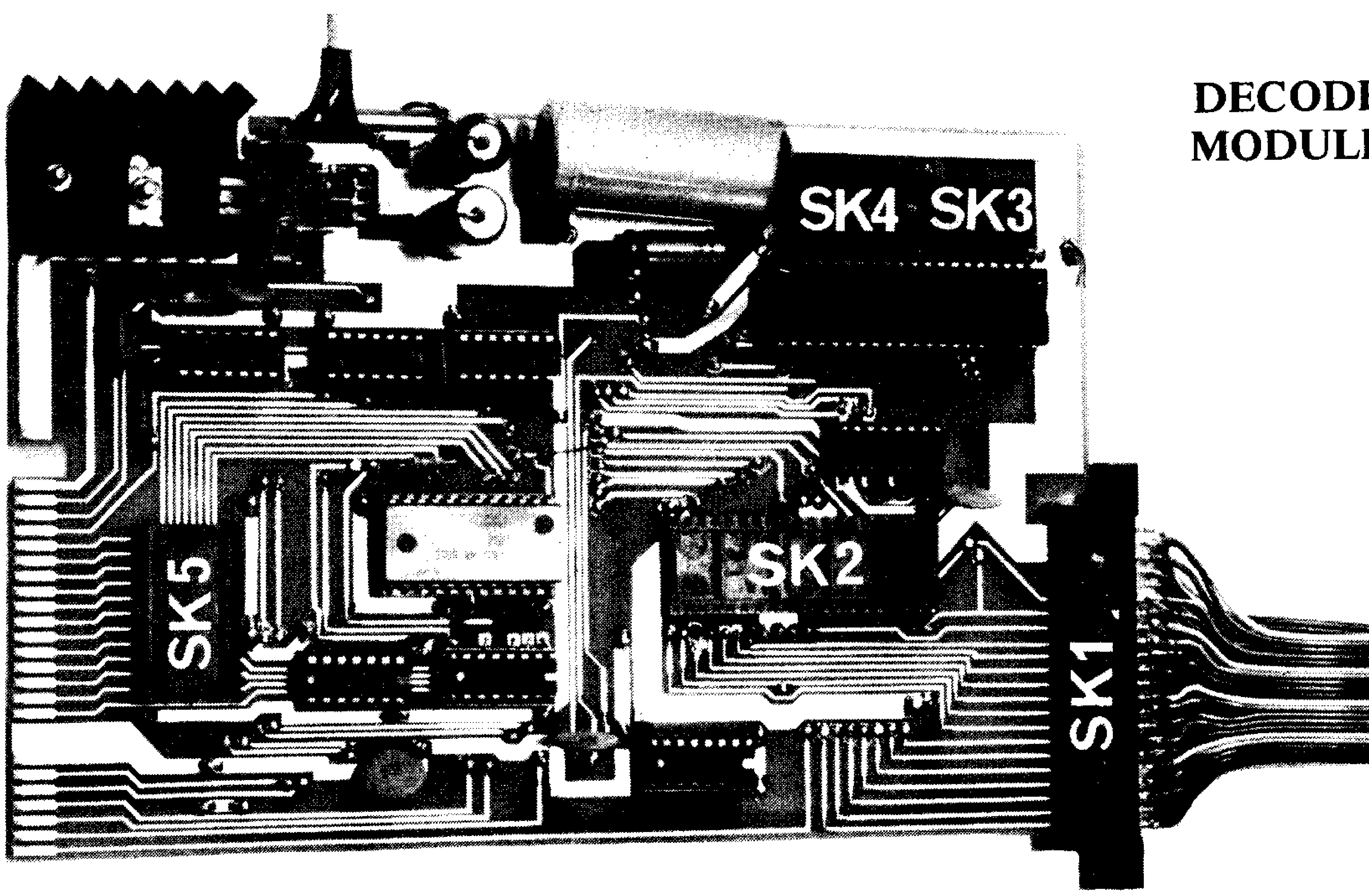
	upper (Component side)	lower
1	Vgg	$\overline{\text{RESET}}$
2	Ø2	W7
3	$\overline{\text{IRQ}}$	W8
4	BC1	R7
5	BD1R	RO
6	W1	R1
7	$\overline{\text{WO}}$	R/W
8	$\overline{\text{W2}}$	GND
9	$\overline{\text{W3}}$	GND
10	$\overline{\text{W4}}$	D7
11	$\overline{\text{W7}}$	D6
12	W9	D5
13	A3	D4
14	A2	DO
15	A1	D1
16	AO	D2
17	GND	D3
18	GND	Vcc
19	GND	Vcc
20	BL4	GND
21	BL3	GND
22	R3	GND
23	R2	BL6
24	BL7	BL5
25	NM1	BL2

Table 1.9. Address within Block 1. * Note that all but the three lines with an asterisk are uncommitted, and may be used with interfaces of the reader's choice, but that, as may be seen, a number of others have been earmarked for projects within the series.

Address	Write		Read
61327	W15	To SK5	—
61326	W14	for 4 digit	—
61325	W13	7-segment	—
61324	W12	display	—
61323	W11	To SK5	—
61322	W10		—
61321	W9	To SK6	—
61320	W8	D/A converter	—
61319	W7	A/D converter	R7 A/D converter
61318	W6*	Audio (data)	R6* Audio (data)
61317	W5*	Audio (address)	R5 to SK5
61316	W4		R4
61315	W3		R3
61314	W2	To SK6	R2 To SK6
61313	W1	inverted	R1 inverted
61312	WO	inverted	RO inverted

Table 1.10. Selection of Base Address of Decoding Module. * "O" indicates inverter in use.

State of A11–13*			Address hex	Comments
A13	A12	A11	of 128 byte block	
1	1	1	FF80–FFFF	These two already used by monitor.
1	1	0	FE80–FEFF	
1	0	1	EF80–EFFF	If pads are left untouched, the module assumes this slot.
1	0	0	E780–E7FF	6 possible relocation sites for Module
0	1	1	DF80–DFFF	
0	1	0	DE80–DEFF	
0	0	1	CF80–CFFF	
0	0	0	CE80–CEFF	



DECODE MODULE

Semiconductor UPDATE...

FEATURING TMOS UTN2886B TMS5100 TMS6100 R.W. Coles

TIME FOR TMOS

The trouble with conventional power transistors is that they have a low current gain at high collector currents, and therefore you have to supply lots of base current via a driver stage. Internally connected Darlington devices help to reduce the problem by giving a three terminal device with a much higher gain, but frequency response and switching times leave a lot ot be desired. Although gradual improvements are being made all the time, the fundamental problems of the bipolar power transistor are not going to disappear overnight, and attention is now being focussed on the alternative, MOS, power transistor technologies.

MOS devices offer very high input impedances and can switch large currents in a fraction of the time taken by their bipolar counterparts, and they are more stable at higher temperatures and easier to parallel into the bargain. They do have a special problem all of their own—they have higher on resistances than equivalent bipolar types—but this is often an acceptable price to pay for the other goodies. One confusing aspect of the power MOSFET scene is the proliferation of "new" technologies, each with subtly different characteristics. A glance through manufacturer's catalogues reveals that although VMOS is the most common variety, DMOS, HEXMOS, and other unnamed variations are also available.

The traditional bipolar power transistor manufacturers are not standing idly by in the face of all this competition, because although relatively few power applications are using MOS devices at the present time, mainly because of higher cost, the chances are that up to half the bipolar market will fall to the MOSFET before long. Motorola for example, while still strongly backing their bipolar line, have conceded that MOS devices have an important future role to play by introducing a new series of MOS devices of their own. Because Motorola have entered the MOS power field as a "me too" venture, they have been able to choose very carefully between competing MOSFET technologies, and the result is a new name—TMOS.

TMOS is a variation on the vertical DMOS process, but no doubt Motorola have added some special tricks of their own. Initial TMOS transistors are *n* channel enhancement mode silicon gate devices, although *p* channel devices will follow. Six devices are now available with voltage ratings of up to 500V at 4A and current ratings of up to 12A at 100V. The dice used resemble integrated circuits in that each chip consists of thousands of interconnected source regions, paralleled to minimise "on" resistance while preventing the formation of "hot spots".

The new family are available in T03 or T0220 packages with power ratings of 75W at 25°C. They are coded from MTM 560 onwards.

QUANTITY DISCOUNT?

If you need a lot of SCRs to hook your pet micro' up to lamps, solenoids or relays, you *could* use a row of T05 devices with their associated gate resistors. You may even get a quantity discount on your SCR purchase!

A much neater way to handle the problem would be to plug in one or more UTN 2886Bs from Sprague. These new devices consist of an array of SCR devices on a single monolithic substrate, packaged in a 16 pin DIL package. The package actually houses eight SCR devices, but four of these are connected as two pairs for higher current applications, making six effective SCRs available at the pin outs. The anodes of all eight devices are connected together and to pins 4, 5, 12 and 13 which also act as heat sink tabs. Each SCR (or SCR pair) has individual cathode and gate pins, and a resistive potential divider is provided internally for each gate. The current rating of each device is 800mA continuous with a 2A peak capability for the switch on surge. At higher temperatures the rating for each device during simultaneous operation reduces to 250mA, but if you need higher currents you can use the pairs, or even parallel several devices externally.

You may have noticed that full capability SCRs do not normally crop up inside integrated circuits. This is because the SCR power circuits need very different diffusions to those used for ordinary transistors. Sprague have side stepped this problem by making an integrated array consisting only of SCR devices and resistors.

I don't know how much the UTN 2886B costs, but I bet it's less than the price of eight T05 SCRs and a dozen resistors, even with the quantity discount!

SPEAK AND SELL

As *we* all know, microprocessors are a great gift to mankind, destined to find a place in every corner of our day to day lives as our willing helpers and obedient servants. Unfortunately, other, less enlightened sections of the community who do not share our vision of the silicon future, seem to be resisting this benign revolution! These people, unable to use a simple ASCII keyboard, or understand simple direct VDU messages such as "WHAT?" and "ERROR 04 IN 340" are attempting to impede the great march forward by refusing, without proper justification, to buy appliances which use them.

Well, the bountiful micro' can accommodate even these deviants, and micro' manufacturers eager to sell their chips by the shovelful, have the answer ready. In future, microprocessor systems will be able to talk to their masters in ordinary English—even Devonshire!

If you have seen the Texas Instruments' Speak and Spell learning aid for children, you will already be aware of the power of microprocessor speech output. (Don't look too closely at earlier models which encouraged kiddiwinks to spell "grey" as "gray", and other howlers—the new Oxford English version is now available). Behind this Texas toy is an ordinary four bit micro' and a speech synthesis chip set using a patented Texas technique called Pitch Excited Linear Predictive Coding. Until recently Texas have kept these chips, and their technology, all to themselves, but now to aid the revolution they have released the devices for use by other manufacturers, and have also produced complete circuit boards, using the chips, which can be plugged into a microprocessor system to give it the power of speech.

All you need to get your micro' talking is a TMS 5100 PELPC synthesiser, a TMS 6100 ROM to store the vocabulary of 150 words or more, and a few TTL interface circuits. Codes for twelve synthesis parameters are stored in the ROM and supplied in sequence to the synthesiser which employs a linear equation model of the human vocal tract and a prediction system to reduce the amount of data storage required. An on-chip 8 bit digital-to-analogue converter is used to change the computed digital speech samples into a synthetic speech signal ready for amplification and subsequent speaker drive.

The two devices use the well tried and low cost PMOS technology and come in 28 pin plastic packages. A standard-vocabulary version of the ROM is available, but it is up to the micro' to string these words together to make useful sentences such as "WHAT?" or "ERROR 04 IN 340!"

PE MICROTUNE
...ENGINE TUNE-UP UNIT

Part Two

MARTIN KENT

CONSTRUCTION

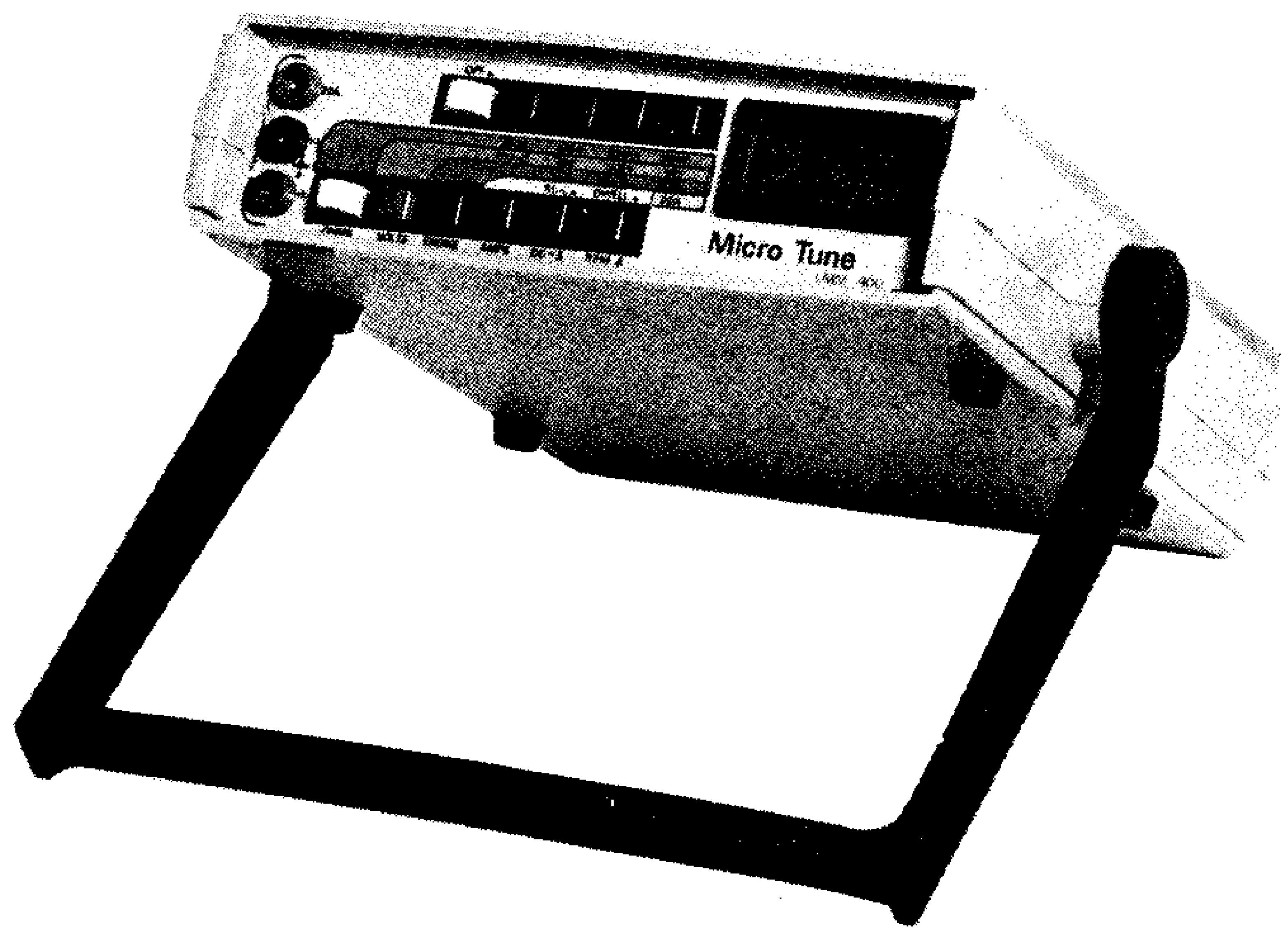
THE MICRO TUNE has been designed to be easily assembled, but it will be as well to employ the following procedure:

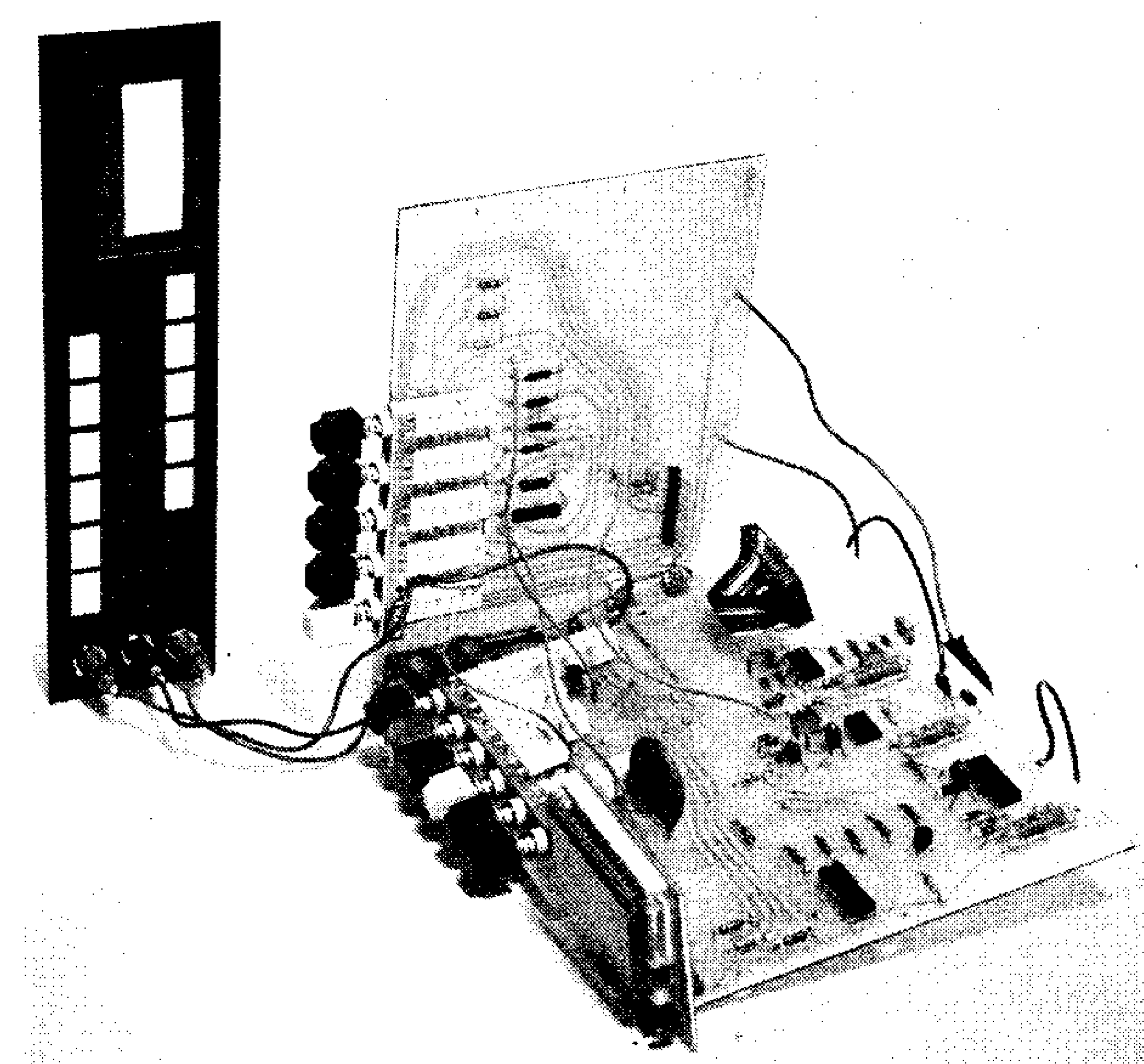
Circuitry is accommodated on three printed circuit boards which plug together, and assembly should commence with the small display board. There are a large number of solder pads on the top surface of the double-sided boards, which should all be soldered as assembly proceeds to ensure circuit continuity.

The a/d convertor circuitry is accommodated on the display board to form a self-contained 200mV f.s.d. voltmeter with liquid crystal display. A double sided board is used and the upper and lower printed circuit track layouts are shown in Figs. 2.1 and 2.2, with the component layout shown in Fig. 2.3.

The display board is plugged at right-angles into the main board which contains the signal conditioning circuitry and function switches. Upper and lower p.c. track layouts are shown in Figs. 2.6 and 2.7 with the component layout in Fig. 2.8.

The range board is mounted above the main board on four pillars, and contains all the range setting resistors and switches. A 10-way ribbon cable connects the range board to the main board via plugs and sockets. The range board is single sided and the track layout and component layout are shown in Figs. 2.4 and 2.5 respectively.



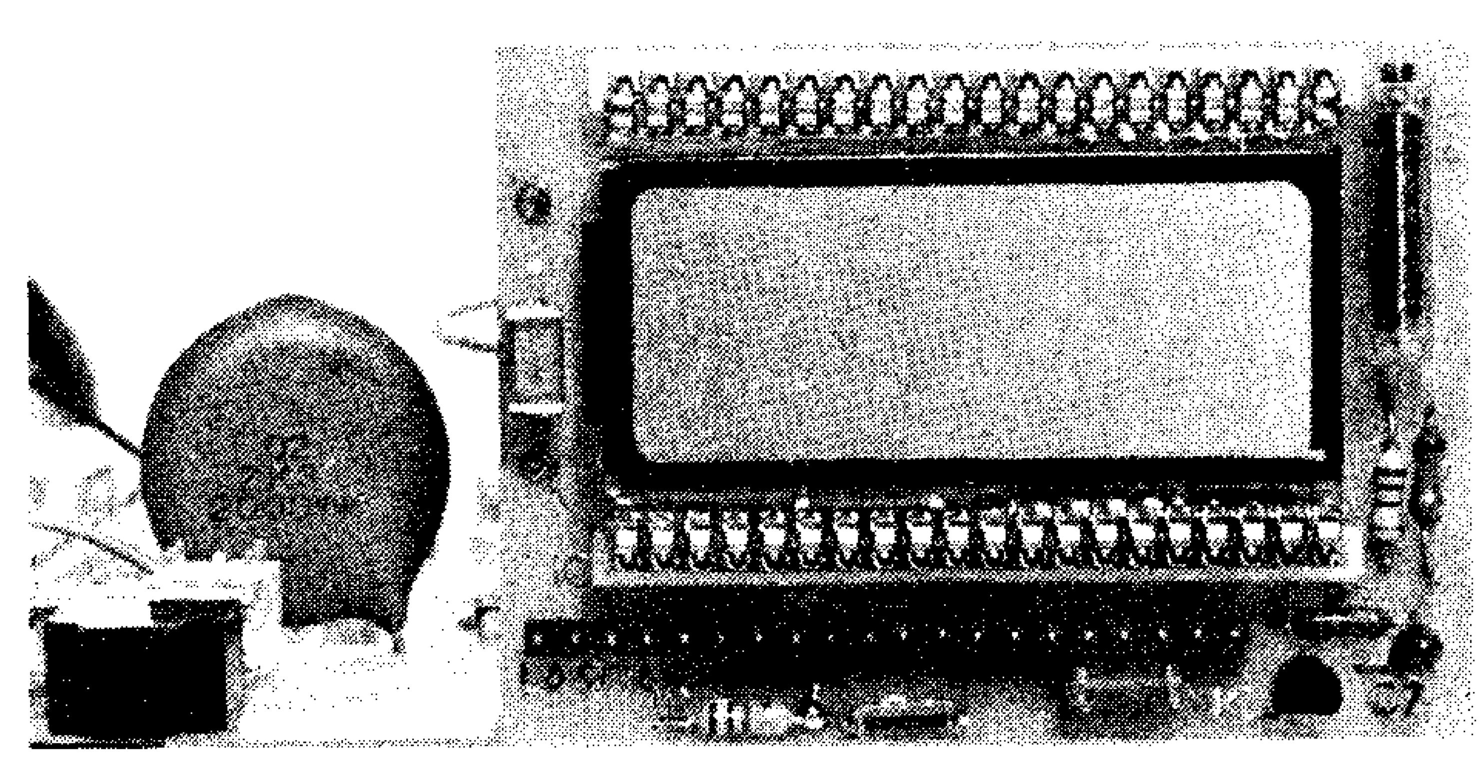


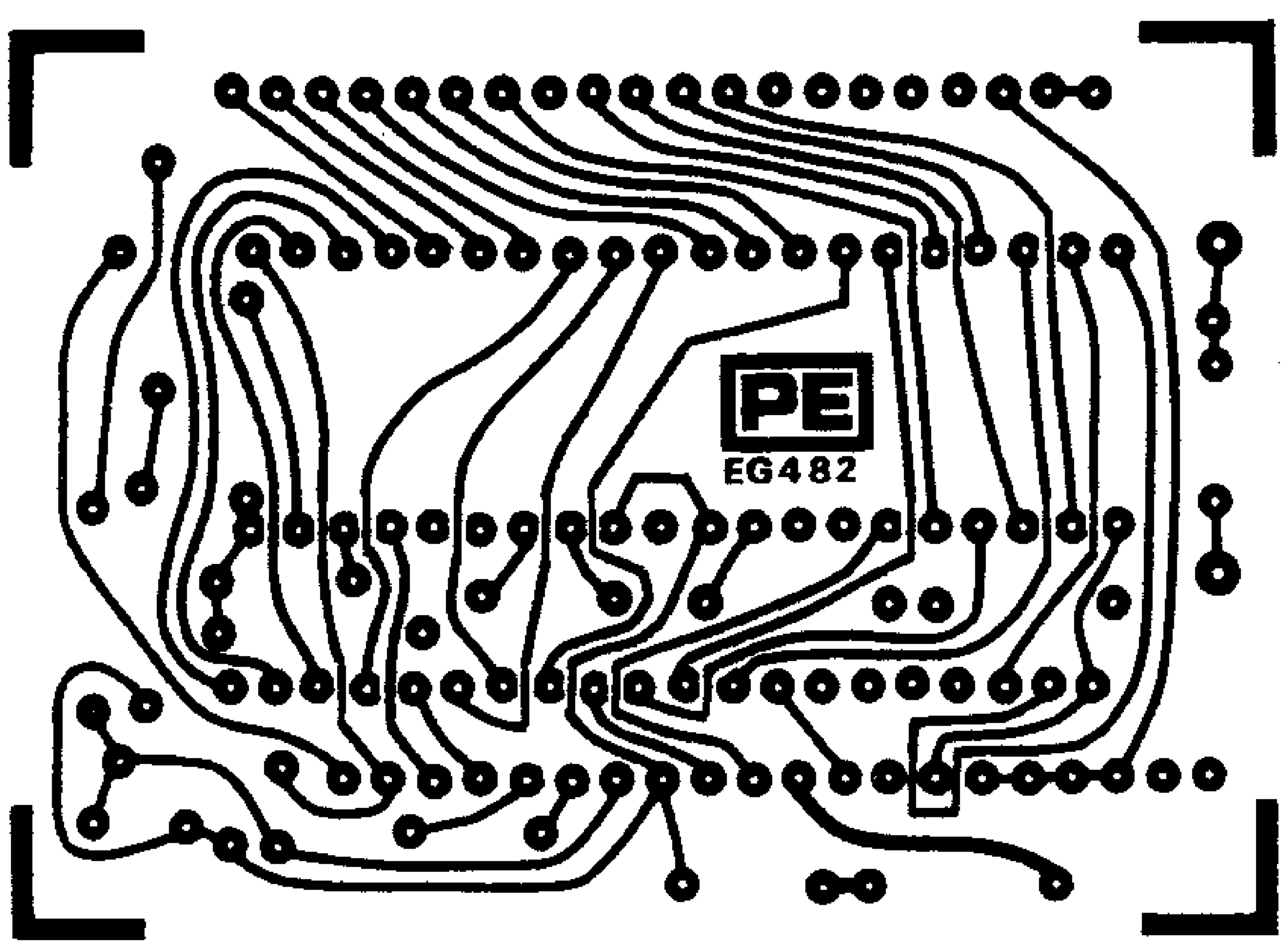
DISPLAY BOARD

Two 10-way p.c.b. mounting plugs with long pins are inserted from the front of the board and ultimately used to plug the display board at right angles to the edge of the main board. When soldering the plugs in place, care should be taken not to allow solder onto the pin surfaces. The two strips of 20-way soldercon pins used for mounting the L.C.D. should be fitted into the insulating nylon nests, and after soldering in place, the connecting bars may be broken away from each strip by gradual bending.

Two through-board pins are used on this board and should now be soldered in place. The six fixed resistors and one variable resistor should now be soldered into place, followed by IC1, IC3 and the seven capacitors.

When soldering is complete, carefully check for correct component positioning and ensure there are no short circuits. The liquid crystal display should be carefully removed from its packaging, and gently inserted into the soldercon sockets. Note that two white dots identify the left-hand side of the display. The display pins are very fragile and it will be found easiest if one row of pins is located first, but not pushed fully in. The second row should then be located in the sockets, and after checking the location of all pins, the display may be pushed fully in. Check that the display underside is not touching any components. If this is the case, the display should be gently raised. The display board should now be complete and ready for testing.





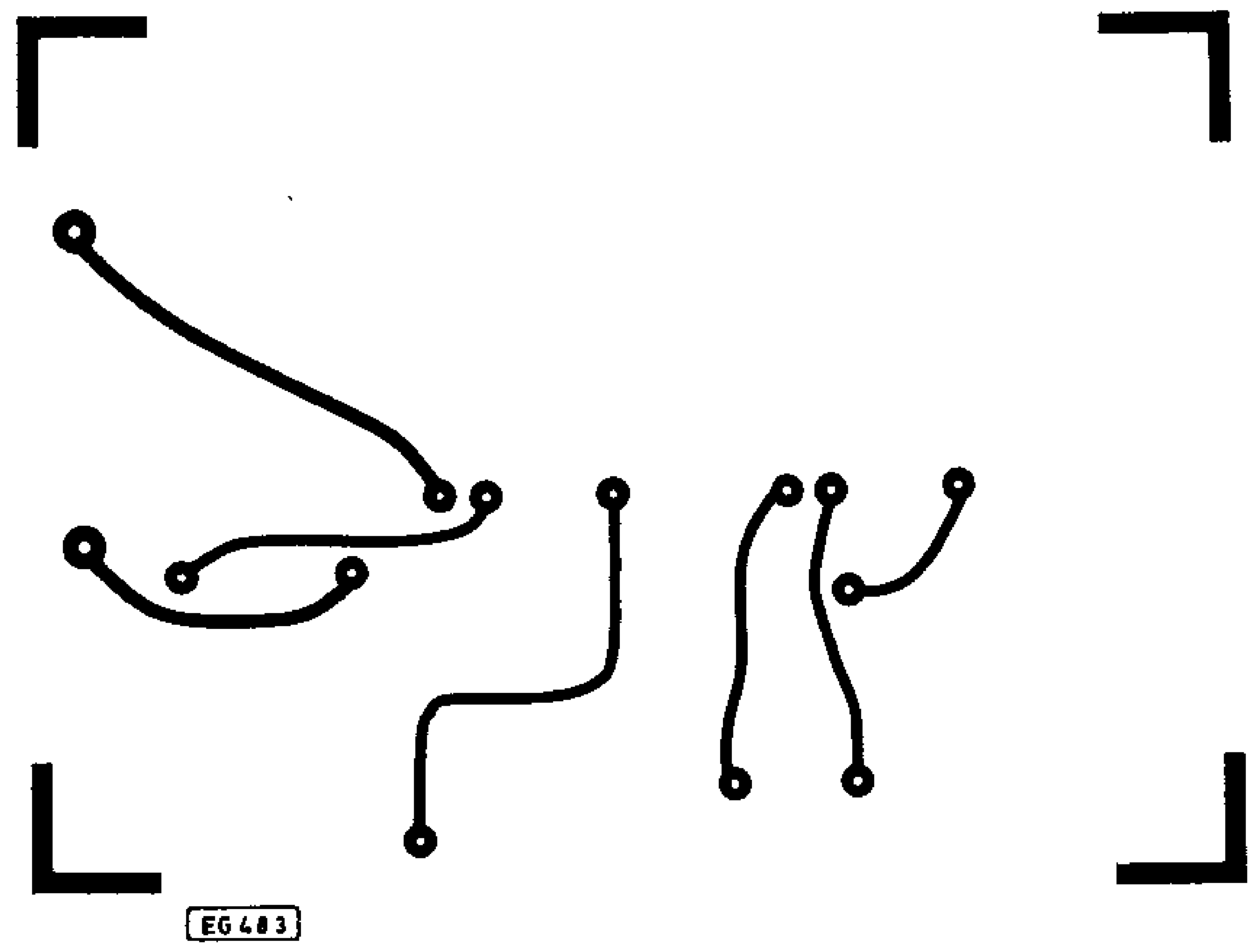
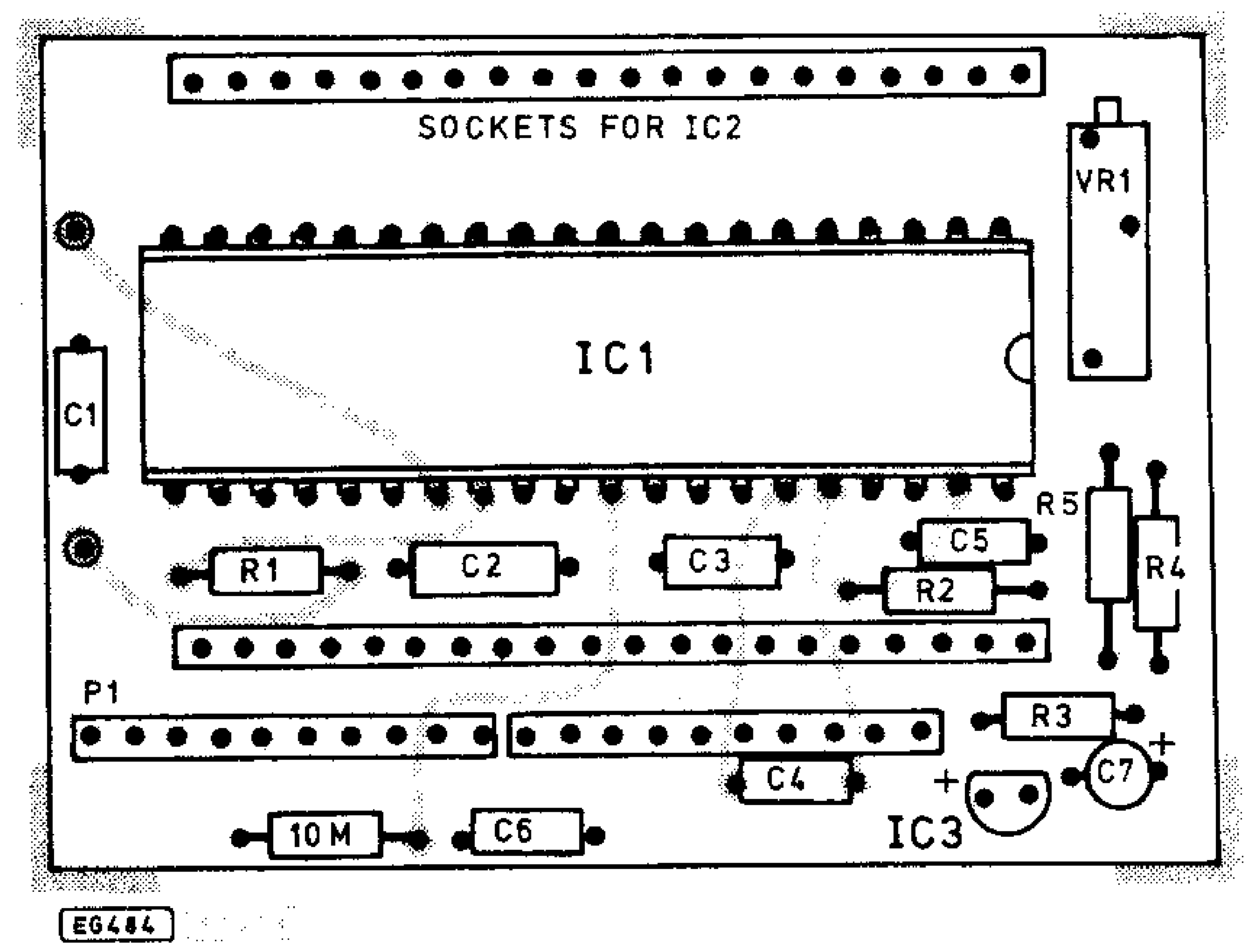
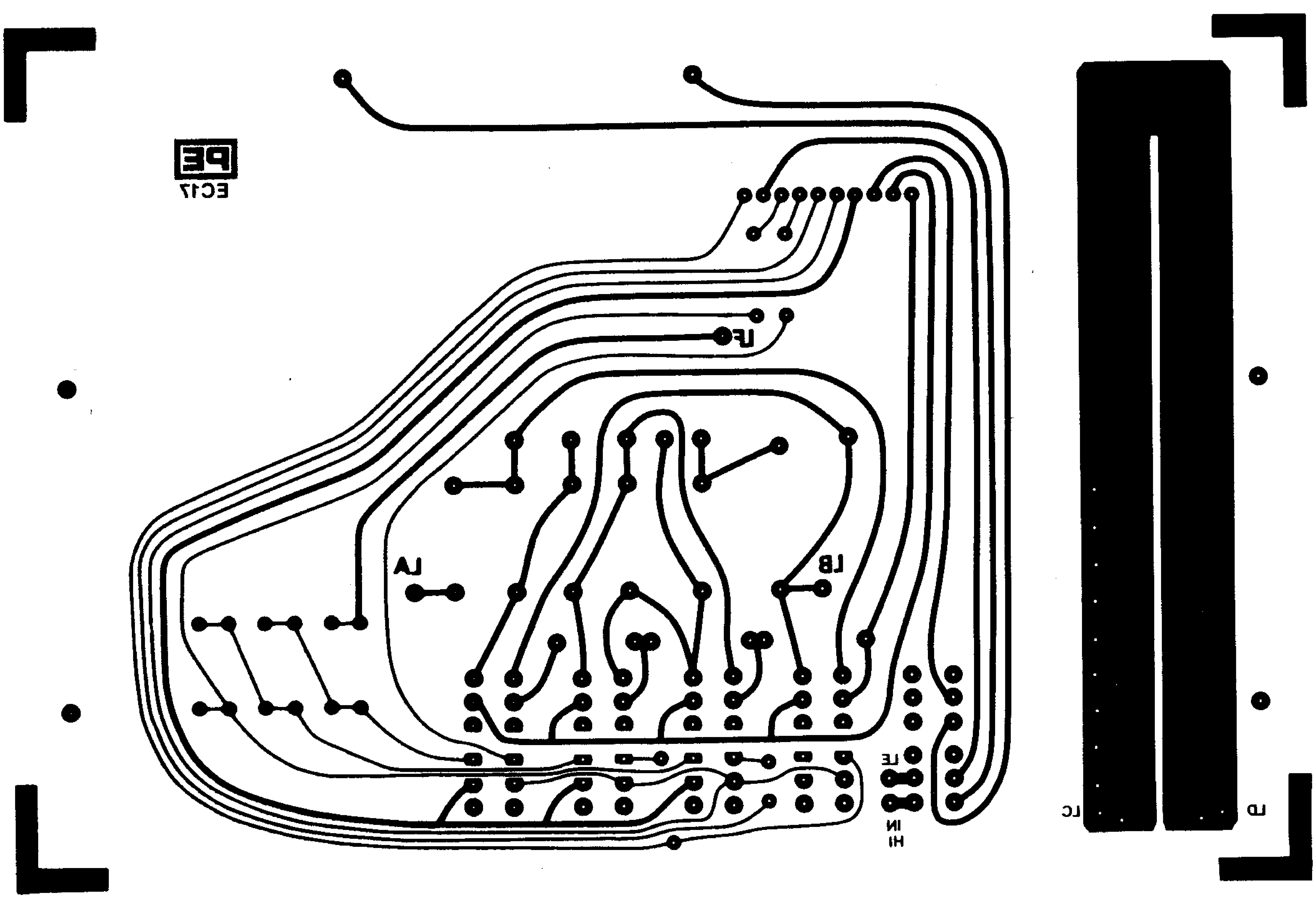


Fig. 2.1. Above. Display Board p.c.b. (copper side, actual size)
Fig. 2.2. Above Right. Display Board p.c.b. (component side)
Fig. 2.3. Right. Component layout of Display Board
Fig. 2.4. Below. Range Board p.c.b.





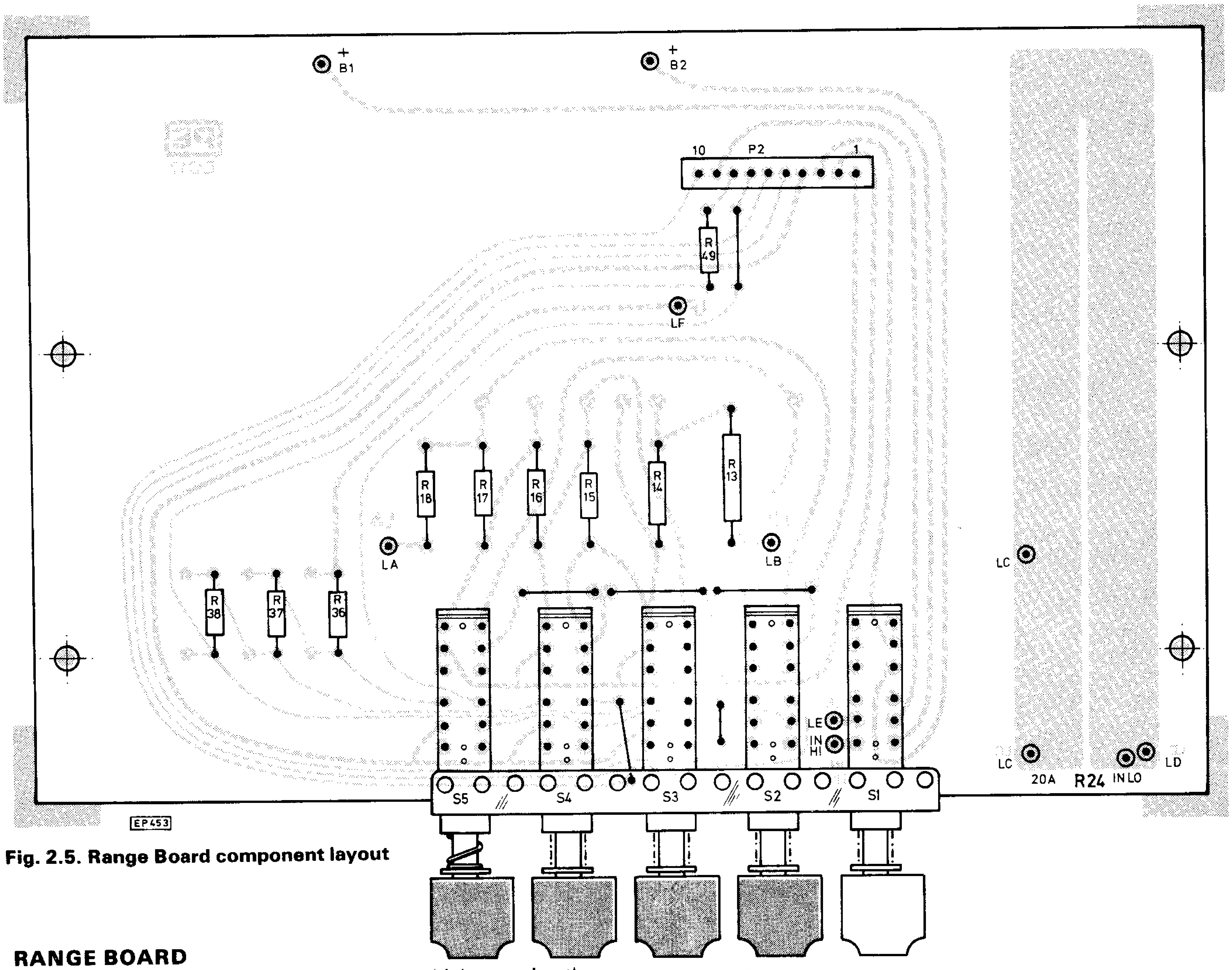


Fig. 2.5. Range Board component layout

RANGE BOARD

The range board is a single-sided p.c.b. which contains the range setting resistors and switches.

There are six wire links which should be located first, followed by the bank of five range switches. The switches should be pushed fully down onto the p.c.b. to ensure alignment with the front panel cut-outs. The six voltage attenuator resistors R13–R18 should now be positioned, followed by R36–R38 and R49.

The 10-way vertical plug, P2, should be positioned at the rear of the board, together with the two battery positive leads. The board should now be soldered and checked carefully.

MAIN BOARD

The double-sided main board carries the function switches and the signal conditioning circuitry for d.c. measurement, resistance, dwell and r.p.m. measurement, and ancillary display driving.

There are twenty-one through-board pins to be soldered in place, followed by the switch bank and fuse holders. Note that the switch bank should be pushed fully down onto the p.c.b.

The 10-way plug (P2) should be mounted at the rear of the board, and the 15-way right-angled socket (P1) at the front of the board to the far right of the row of mounting holes.

Devices IC4-IC7 should be positioned, followed by TR1-TR2 and D1-D11. There are twenty-five fixed resistors, three variable resistors, three VDRs, one thermistor and ten capacitors which should be positioned, followed by the two battery negative leads.

After soldering all the upper and lower joints, the board should be carefully checked.

TESTING

Before securing the boards into the case they should be tested, and the calibration controls checked for ease of setting up.

The six insulated wire links LA-LF should be connected between range board and main board. Secure the three input terminals to the front panel and connect the three heavy duty input leads from the terminals to the range board. Connect the 10-way ribbon cable assembly between Range Board and Main Board, insert 2A fuse and locate the Display Board into the socket on the Main Board.

Set the switches to Volts, 20V, d.c., and then connect PP7 battery BT1 to the battery leads. Current consumption should be typically 2mA and the display should read 0·00. The voltage measured between Input LO and battery positive should be 2·8V $\pm$ 0·4V.

Calibration may be carried out using reference sources, or by comparison with a known instrument. Alternatively, a calibration service is offered by *Lascar Electronics Ltd.*

All measurements made by the Micro Tune are dependant upon the setting of VR1 DC CAL which adjusts the sensitivity of the main analogue-to-digital converter. Calibration d.c. should be carried out with a 10V reference source, and the instrument switched to the 20V range. Adjust DC CAL to make the display read 10·00, reverse the input leads and check that the display reads −10·00 $\pm$ 2 digits. Reverse the leads again and check that the display reads 10·0 when switched to the 200V range, and then 010 when switched to the 1KV range. Switch to the 200mV range where the reading should be 1—·– indicating overrange input. Connect a 100mV reference source and check the reading on the 200mV range.

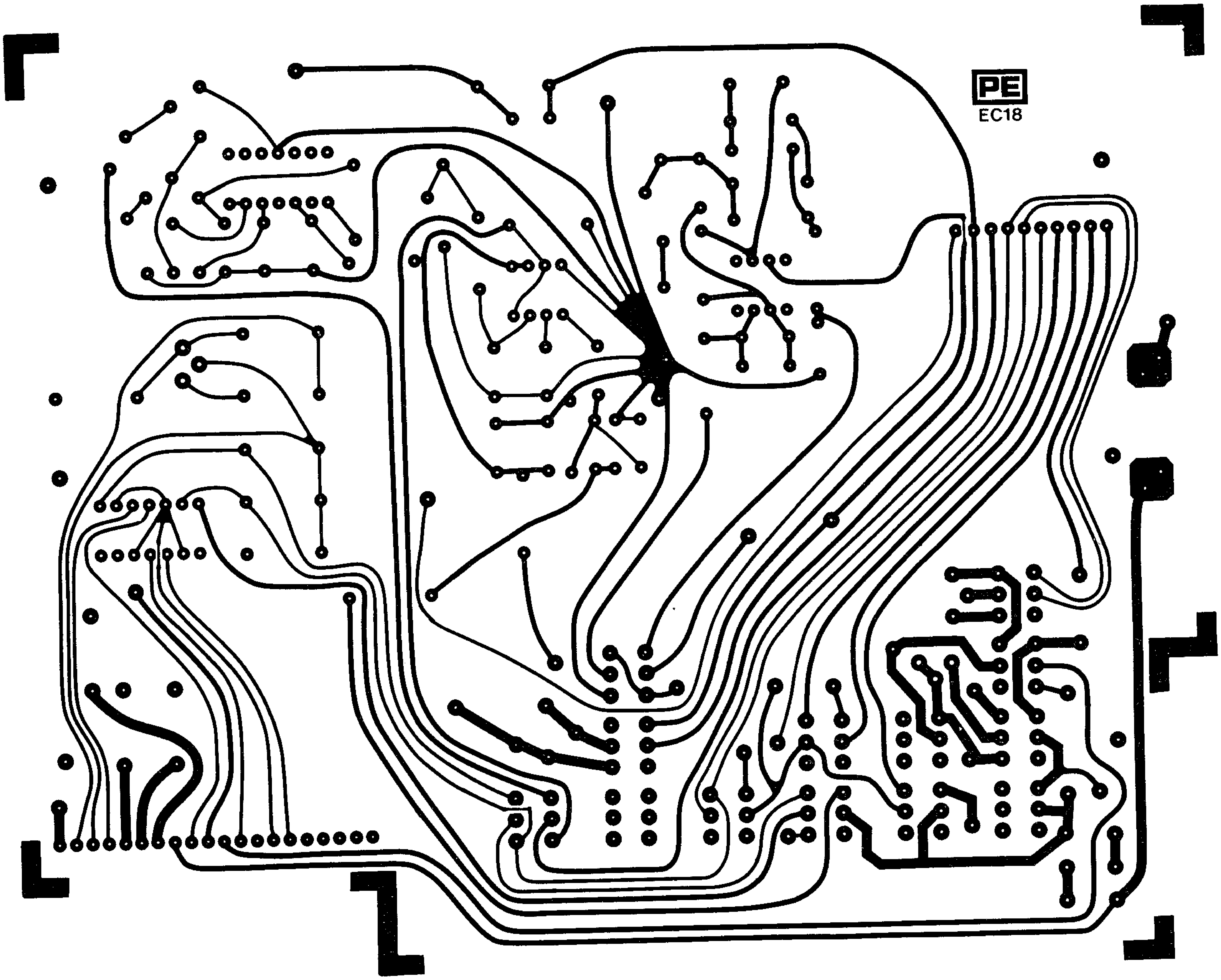


Fig. 2.6. Main Board p.c.b. (copper side, actual size)

The ratiometric method of resistance measurement does not require any calibration as it relies upon the basic DC calibration and the stable reference resistors R13-R18. With the Micro Tune switched to Ohms, DC, 20kΩ, and the input leads open circuit, the reading should be 1-·— indicating overrange. Short-circuit the input and the reading should be 0·00. Connect a 10k standard resistor, and the reading should be 10·00, then check the reading on the 200k and 20M ranges. Connect a 100Ω standard resistor and check the reading on the 200Ω range; on this range there will be an offset of three or four digits due to switch and lead resistance when the input is short-circuited.

The a.c. voltage ranges should be calibrated by switching to Volts, 20V, AC, applying a 10V r.m.s. sinewave reference and adjusting VR2 AC CAL accordingly.

To check the Current range, switch to Amps, DC, 20A, and apply a constant current source of typically 1A or 500mA between terminals 20A and Input LO. Note that no protection is provided on the Current range, and the sense resistor value is 10mΩ. The "plated" resistor, R24, is provided with a series of adjustment holes to allow the value of sense resistance to be trimmed to allow for tolerances in copper and roller-tinning thicknesses which may alter its value. With the constant current source connected, the position of link LC may be varied along R24 until the display is correct.

To test the engine functions of r.p.m. and Dwell, a second battery is required, connected to the BT2 leads. The battery is only used when S8 Engine Function is selected, together with a range switch. A pulse generator with an output of at least 5V should preferably be used for calibrating both functions.

For calibration of r.p.m., switch to Engine, DC, RPM, 4CYL. Referring to the formula derived earlier:

$$RPM = \frac{\text{pulses/min} \times 2}{\text{number of cylinders}}$$

To simplify the calibration it would be convenient, of course, if a 50Hz frequency source could be used in the absence of a pulse generator unit. For a frequency of 50Hz, or 3,000 pulses/min, the corresponding r.p.m. for a four cylinder engine is 1500 r.p.m. Using a mains transformer with a low voltage secondary, typically 6V r.m.s., and half-wave rectification by a single diode, followed by waveform shaping with a transistor Schmitt trigger, a suitable 50Hz calibration source may be obtained. With the 50Hz frequency

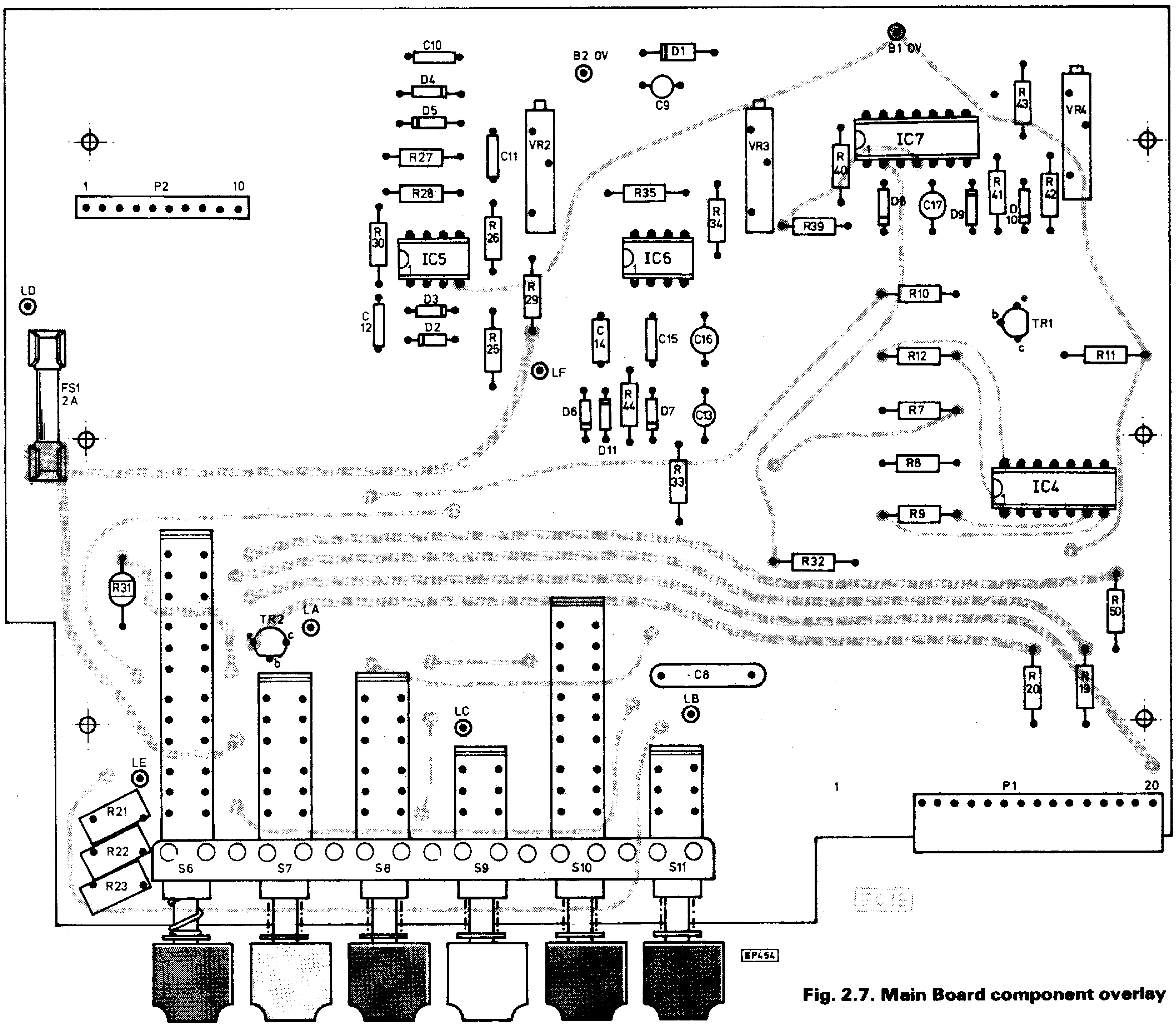


Fig. 2.7. Main Board component overlay

source connected to the Micro Tune, adjust VR3 RPM CAL until the display reads 1·50. The display reads in r.p.m. x 1000, corresponding therefore to 1500 r.p.m. Select the 6 CYL range and the reading should be approximately 1·00, the 8 CYL range should read approximately 0·75.

To test the Dwell function, a pulse generator with variable mark/space ratio output is preferable but a 50Hz square wave source is a useable substitute. On a four cylinder engine there are four lobes on the contact breaker cam resulting in a maximum points closure angle, or dwell angle, of 90deg. Switch to Engine, DC, Dwell, 4 CYL and with a 50Hz square wave input to the instrument adjust VR4 DWELL CAL to provide a display of 45·0 since the mark-space ratio will be 50:50. When the input leads are open-circuit the display should be approximately 90·0.

Reading on the 8 CYL range should be half those on 4 CYL range, and 6 CYL range readings should be two-thirds of those on 4 CYL range.

FINAL ASSEMBLY

When the p.c. boards have been tested, the front panel should be inserted into the slot in the lower half of the case. After removing the protective plastic film from the l.c.d. the main board should be secured to the case by two M3 self-tapping screws at the rear of the board. The range board is spaced above the main board by four fibre pillars and secured by four M3 x 45 screws with washers placed under their heads. Each of the battery retaining springs is secured to moulded pillars on the lower half of the case by two M3 self-tapping screws. Position the two batteries and insert the rear panel into the slot in the lower half of the case. In order to fit the batteries, it may be necessary to cut two notches each in the p.c.b. to accept the rims of the PP7s. Attach the sides and handle assembly to the case, noting that the side of the display board engages in a slot in the right-hand side piece.

Whilst the calibration controls are still accessible, it may be advisable to check their settings, then place the case lid over the assembly. Four screws pass through plastic feet and secure the case halves together.

The position of the handle may be altered by pulling its two sides outwards simultaneously while altering the angle of the case.

USING THE MICRO-TUNE

When assembly of the instrument is complete, it will be found to be extremely versatile and suitable for use both in the lab. and when servicing cars. A guide to some applications of the Micro Tune follow:

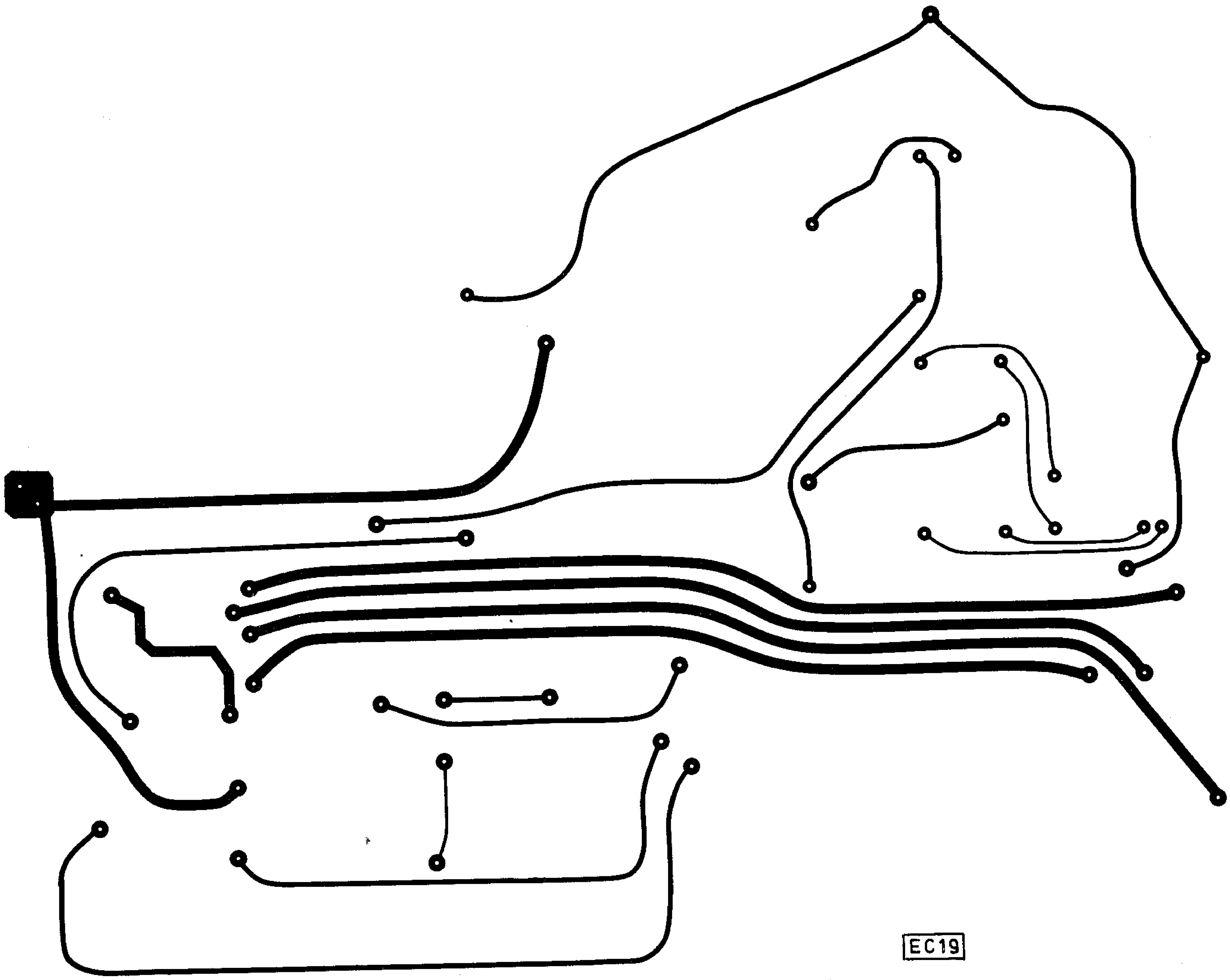


Fig. 2.8. Main Board p.c.b. (component side).

(a) Voltage Measurement
The instrument will measure from 100µV to 1kV but care should be taken not to connect it across a vehicle HT circuit, which may be 20kV.

BATTERY CHECKING

To check the condition of a vehicle battery, make sure, by using a hydrometer, that each cell is fully charged. Disconnect the HT lead from the centre of the distributor cap and ground it to a suitable earth. Switch the Micro Tune to Volts, DC, 20V, and connect it across the battery. Turn on the car headlights, heated rear window, and blower, then turn the starter for approximately 30 seconds. The cranking speed should remain constant and the battery voltage should remain higher than 9·5V if the battery is in good condition.

The instrument may also be used to test the generator or alternator output and the open-circuit voltage through the regulator.

(B) Current Measurement
A single current range of 20A is provided, with resolution of 10mA. Due to the low sense resistor value of 10mΩ, no protection is included and care should be exercised when undertaking current measurements. *Do not attempt* to measure the starter motor current as this may exceed 60A. The 20A and Input LO terminals should be used, with the instrument switched to Amps, 20A.

(C) Resistance Measurement
Although protection is included on the resistance ranges, measurements should not be taken on live circuits. Continuity of cable looms may be accurately checked on the 200Ω range where resolution is 100mΩ.

COIL RESISTANCE CHECKS

Disconnect all leads from the ignition coil. Switch the Micro-Tune to Ohms, DC, 200Ω and connect the input leads to the two primary terminals on top of the coil (normally marked SW and CB, or + and –). The reading for a 12V coil should be approximately 4·0Ω. If the coil has a ballast resistor fitted, the reading should be approximately 1·0Ω.

To measure the secondary circuit resistance, connect one lead to the centre HT terminal and the other to the LT terminal marked CB or –. A short in the secondary winding will result in a reading below 2kΩ, whereas a reading above 40kΩ will indicate an open-circuit secondary winding or a bad connection at the coil terminals.

POINTS RESISTANCE CHECKS

Tachometer and dwell measurements are dependant upon correct operation of the contact breaker, and it is advisable to check this first.

Switch the Micro Tune to Volts, DC, 20V and remove the distributor cap. Switch on the ignition, and crank the engine until the contact breaker opens. The reading should be approximately 12V and if this is not the case, check the connections and the points insulation.

When a satisfactory reading has been obtained with the contact breaker open, crank the engine until the c.b. is closed. If the c.b. is perfect the reading should be OV. A reading of up to 4V is acceptable, but a higher reading suggests that the points require attention.

(D) Tachometer Measurements

The measurement of r.p.m. is very useful when tuning a car engine and the Micro Tune is easily connected across the ignition coil LT, and the vehicle chassis, with the instrument switched to Engine DC, RPM and cylinders as required.

Correct polarity should be observed. For negative earth vehicles Input LO should be connected to chassis, and Input HI connected to the coil LT trigger point. The leads should be reversed when the instrument is used on positive earth vehicles.

As with all engine tuning procedures, tests should be carried out with the engine at normal operating temperature.

DIRTY AIR CLEANER CHECK

Remove the air cleaner and ensure that the choke is open. Start the engine and adjust the carburettor to idle the engine at approximately 800 rpm. Replace the air cleaner.

If the r.p.m. changes, clean and/or fit a new filter.

If the r.p.m. remains constant, the air cleaner is efficient and working properly.

CARBURETTOR IDLE AND MIXTURE ADJUSTMENT

Set the engine to idle at the speed recommended by the manufacturer by adjustment of the throttle stop.

Adjust the mixture screw on the carburettor, until the highest steady reading is obtained on the tachometer.

Reset the engine to the speed recommended by the manufacturer. If difficulty is experienced when obtaining a second reading the manifold and carburettor should be checked for air leaks.

During the points closed, or dwell period, a magnetic field is produced around the ignition coil as the primary current builds up. If the magnetic field does not reach sufficient magnitude, due to the dwell period being too short, its collapse when the points open may not produce sufficient voltage across the secondary winding to cause a spark at the plugs.

AIR/FUEL RATIO MIXTURE

Remove the air cleaner. Set the engine to idle at approximately 800 r.p.m. Ensure that the choke is open.

Slide a flat plate slowly over the mouth of the carburettor to partially choke off the air supply.

Note the r.p.m. reading and any changes. If the r.p.m. increases as the mouth is blocked, a lean mixture is indicated. A rich mixture is indicated if the r.p.m. reading decreases.

If there is little or no change in r.p.m. reading until the mouth is almost completely blocked (typically three-quarters covered) an acceptable mixture is indicated.

(E) Dwell Measurements

For dwell measurements, the Micro Tune should be connected as for tachometer use but switched to Dwell instead of r.p.m. Start the engine and allow it to idle at a smooth speed. When the correct points are fitted and correctly adjusted, the dwell reading should correspond with that quoted in the workshop manual. On all engines the dwell angle should be constant at speeds up to approximately 1500 r.p.m.,which is the point at which the advance and retard unit comes into operation.

As a guide to typical dwell angles, a note of those quoted for some four-cylinder engines is given below:

Lucas distributor	60° BLMC
AC Delco distributor	37° Ford
Autolite distributor	40° Vauxhall

If the dwell reading fluctuates, increase the engine speed slightly until a steady reading is obtained. If the dwell reading is too high, the contact breaker gap is too close and requires adjustment. If the reading is too low, the c.b. gap is too wide and should be reduced.

Slowly increase the engine speed to approximately 1000 r.p.m. and then return it to idle speed while observing the dwell reading, which should remain approximately constant, the maximum permissible variation is typically 2-3 deg.

Quickly increase the engine speed to approximately 1500 r.p.m. and then return it to idle speed whilst observing the dwell reading, which should fluctuate by only 2-3 deg.

DWELL ADJUSTMENT

Remove the distributor cap and the rotor arm, then loosen the contact breaker fixing screws so that the points are not loose, but may be adjusted with a screwdriver in the adjusting slot.

Switch on the ignition and move the c.b. with the screwdriver in the adjusting slot, until the dwell is correct while the starter motor turns over the engine.

Tighten the screws and replace the rotor arm and distributor cap. The points are now adjusted and for complete tuning it is advisable to time the engine using a stroboscope.

It may be considered preferable by some owners to remove the spark-plugs before turning over the engine, to reduce the load on the starter.

When the dwell reading is correct, the contact breaker gap should also be correct. If it is not possible to get the two right at the same time, check that the correct type of c.b. is fitted. Also check that there is no wear on the heel of the pivot, and that the spring tension is not too weak.

If the contacts are in good condition, then suspect wear on the distributor shaft bearing, advance/retard plate, or damage to the cam.

To check distributor wear, disconnect the vacuum unit and note the dwell angle at idle speed. Increase engine speed to 3000 r.p.m. and observe the dwell reading, a variation of more than 3 deg. indicates distributor bearing wear.

In these days of spiralling petrol prices it is advisable to ensure that one's car engine is correctly tuned and operating efficiently. The Micro Tune enables the car owner to tune the engine regularly while avoiding ever-increasing servicing costs. ★

CONSTRUCTORS NOTE:

Lascar Electronics offer a calibration service (£7·50 inc. VAT) and a combined trouble-shooting and calibration service (£10·00 inc. VAT) for the Micro Tune.

A complete Kit of all parts for the PE Micro Tune is available from Lascar Electronics Ltd., Unit 1, Thomasin Road, Burnt Mills, Basildon, Essex SS13 1LH (price £69·80 inc. VAT)

At last the speculations are over and the 'mystery' of Pluto appears to have been resolved. There have been many attempts to arrive at a satisfactory solution since Flammarion first suggested in 1879 that there was a planet beyond Neptune. Those others who also predicted, arrived at figures for size and density which varied from half the size of the Earth to twice the size of the Earth and periods from 250 years to a 1000 years.

The first direct measurement of the planet was made by Kuiper using the 82 inch reflector at Macdonald Observatory in Texas. The diameter was quoted as being 6400 miles and the mass about 80% of that of the Earth. However when Kuiper and Humason made an attempt to observe with the 200 inch Palomar telescope, a new figure for the diameter was given as 3200 miles, smaller than Mars. This was in 1950. Earlier in 1936 R. A. Lyttelton had suggested that Pluto could have been one of Neptune's moons that had escaped. This was feasible for the hold that Neptune has on Nereid is very tenuous. Nereid is the smaller of Neptune's moons. In 1956 Kuiper supported Lyttleton's hypothesis that the planet may have been an escape from Neptune.

In 1978 June 22nd J. W. Christy, at US Navy Observatory at Flagstaff Arizona, when making measurements with the 1·55m telescope noted that Pluto appeared to be elongated. Examination of plates taken in 1965, 1970 and 1971 also showed this but had been ignored because there were defects in the plates. By 1978 a fortnight after Christy made his announcement, Graham using the 401cm telescope at Cerro Tololo observatory, showed that the planet was not elongated but that there was in fact a large satellite associated with Pluto. It was provisionally called Charon. It was not however fully confirmed until April 1980 by Alistair Walker at the South African Observatory. Pluto was due to pass in front of a star but not closely enough to occult it. However Walker observed that the star disappeared for 50 seconds. The conclusion was that it could have been occulted by Charon, the Pluto satellite.

The next episode of this intriguing astronomical serial came later in 1980. In a joint project using the 3·6m telescope at Mauna Kea, Hawaii, the cooperatively owned instrument of Canada-France-Hawaii, D. Baneau and R. Foy, have used the special technique of *Speckle Interferometry*. This a technique which has been in successful operation for some time now where light levels are very low indeed. So low are they that so many hours of exposure would be required that definition by blurring alone would make them of little value. Enough is already known about the electronic enhancement of images from satellite and spacecraft observations especially those from the Pioneer and Voyager missions

The speckle interferometry uses very short exposures in succession. The result of combining these gives a composite picture which when translated enables the separation of close celestial objects like double stars. The results of using this technique on Pluto has revealed that the satellite is in fact so large that the two bodies must surely be properly designated a double planet. The figures are that the smaller body is at a distance of 19000km from the primary body, that Pluto itself is 4000km in diameter and the smaller body, or, Charon as it must now be called, 2000km in diameter. The density of both planets is calculated to be 0·4 g/cm². This suggests that the period is about 6·9 days the figure which was given for the rotational period of Pluto itself by Walker and Hardie in 1955. Pluto then is only 500km greater in diameter than the Earth's Moon and Charon a little larger than Saturn's moon Iapetus or the moon Titania of Uranus. So one more correction to the dimensions of the Solar System.

New features are apparent in the rings of Saturn as disclosed by the Voyager 1 images. The latest images were taken when the vehicle was at a distance of $51\cdot5 \times 10^6$ km from the planet. There appear, in pictures taken a few hours apart, spoke like features. These appear on the inner edge of a ring and retain their identity for a long period in spite of the fact that the inner edge of the ring is rotating much faster than the outer edge. Because these features extend over a considerable distance it is of very considerable interest to know the mechanism. It is likely that the features are not in fact solid bodies but could rather be areas where there is less material. Why? is the question to be asked here.

It must of course be taken into account that the resolution available at this distance is about 200 to 300km. When the next stepped up observation conditions which began on October 24th 1980 with the highest resolution images on the 2nd of November are analysed it may be possible to offer more details.

The last course manoeuvre was made on 6th October but there could be the need for a trajectory check and modify on November 6th a few days after this article is being written. The Voyager flyby is expected to provide significant data about the planet. The rings have appeared smooth but when the spacecraft comes to 124000km details of their structure may be apparent as well as details about the cloud cover of the planet. It is known so far that Saturn's rotation period is 10hr. 39min. The Voyager imaging system has a greater resolution facility than the previous spacecraft Pioneer 11 when it made its close encounter. Two television cameras using 200mm and 15000mm focal length lenses will be able to discriminate to 5km on the planet itself and down to 1km on the rings. It is hoped that after passing inside the rings the effect of the rings on the radio transmissions may help to decide the size of the particles, if such there be, as conjectured, like ice covered rocks. Voyager will have passed within about 4000km of the cloud cover of Titan some eighteen hours before the actual Saturn encounter on November 12th. The extent of Titan's atmosphere will be measured by radio waves as they propagate through the atmosphere. The surface of Titan is unlikely to be seen through the clouds.

In the far Encounter-1 phase of observation, which began on October 24th, it was no longer possible for the whole disc of the planet to be accommodated in one frame. To overcome this four frames at a time were taken. The near encounter phase of the observations began on November the 13th and will end on December 15th. There will be a film sequence of this part of the mission. Signals at the time of closest encounter, November 11th with Titan will arrive at 11 pm PST. Eighteen minutes later the spacecraft will dip below the ring plane and make its closest approach to Saturn 18 hours after the Titan encounter and then will make an ascending ring crossing on the outbound trajectory and out of the Solar System.

Popov and Ryumin were out walking within 24 hours of their return to earth. They were undergoing observation at the launch site after 185 days in space. They were debriefed and offered some comment about the effects and their reaction to the set regime for their health. Ryumin thought that the 185 day mission was better than the 175 day mission and efficiency was higher. He felt this was partly due to better preflight briefing and better organised station work routine on board the spacecraft.

Both cosmonauts were of the opinion that rest days from exercise were of positive help in maintaining their stability. Boredom was a thing to be avoided. Another point was the need to have a widely varying range of tasks to avoid routine regime.

Following Frank Hyde's reply last month to the letters on the Velikovsky debate, we have received a letter from the Society for Interdisciplinary Studies suggesting that any reader who wishes to continue the debate should write to them. See Readout for details.

DISCO DESK

Part 5 BEN DUNCAN

IN this final part end wiring, a suitable power supply and the setting up of the desk will be described.

CABLE LOOM

Making a neat cable loom is a skilled job; one must have a 'feel' for the flow of wires and also be able to see how the loom will take shape. It is often necessary to reroute occasional wires until the loom 'flows'. Because there is no a.c. in the vicinity, unscreened wires are permissible for the following connections:—

1) Crossfader to monitor and source selector switches.
2) Line level wires leading from the routing switches to the send return sockets.
3) Tone control wires.

The latter requires qualification. The relatively long wires leading to the tone controls can precipitate instability unless they are neatly routed. Although intuition suggests that screened wire would be a good way of minimising interaction between these wires, it should be remembered that the screen is also a capacitance to earth, and the phase shifts resulting from such capacitance may cause instability. The applicability of screened wires to the tone control connections can only be determined empirically; in the prototype, screened wires gave the best performance for the microphone tone controls, whilst unscreened wires were used for the music tone controls. Regardless of whether these wires are screened, they must be carefully routed to be as short as possible and mutually spaced apart.

The 12V subsystem and audio looms should be kept apart wherever possible, to avoid the induction of switch clicks, etc. Twin screened wires are used for the stereo connections. Crosstalk should be negligible here because cable lengths are relatively short and source impedances are generally low. All screens should be tied to the 0V rail at *one end only.* Connecting screens to the chassis may be expedient in some cases, but susceptibility to RFI could be increased. Therefore, if there isn't a convenient 0V point where the screen is to be terminated, it should be connected to 0V via 7/0·2 wire. Bearing in mind the proximity of the disc input wires, single screened wire is also used to connect the turntable motors to the mains supply. It is most important that the cable used here is capable of withstanding mains voltages; medium and heavy duty types will generally be suitable. Note especially that separate cables are used for the live and neutral connections and that the screen is earthed in both cases.

Although the 0V and chassis earths will be eventually joined at some point in the audio system, there is a significant impedance between the two points at r.f. Decoupling is therefore essential if RFI is not to be troublesome. This is achieved by connecting ceramic or polystyrene capacitors with values between 100p and 100n between 0V and chassis earth. Convenient points are from pins 11 and 21 on all volume controls to a solder tag sandwiched between the adjacent slider body and spacer. The input sockets should also be decoupled, likewise the PSU and 0V busbars and the disc input termination under the turntable (Fig. 17). Note that the disc input cables are quasi-balanced in that the screen does not carry a signal.

If possible, low noise cable (utilising a conductive plastic screen) should be used to connect the disc inputs and microphone transformer secondary to their respective cards to prevent microphony.

CROSSFADER

With reference to Fig. 18, the quad crossfader specified consists of two dual crossfaders ganged together, each with log and antilog tracks. This provides audio taper in both directions, but as the slider traverses the centre area, the audio level is relatively low. This type of action is suitable for discotheque performances which incorporate a predominance of rock and heavy metal material, where records are treated as individual entities. Discotheque operators who concentrate on soul and disco-funk, however, may wish to mix two music sources and 'double beat' as they crossfade. This can be achieved on the desk by skilful manipulation of the crossfader and music volume control, but it is also possible to alter the law of the crossfader such that the audio level remains substantially constant during crossfading. In this case, a 25k *linear* quad pot should be used. A semi audio taper is then provided by connecting resistors from the slider to the top and the bottom of the pot on each track. Experimentation will be required to determine a suitable value for these resistors, but their value will be of the same order of magnitude as the potentiometer. A more conventional method of achieving double-beating is to use separate level controls for each turntable and/or line source. Minor modifications to the circuitry are involved here and details will be given later.

In Fig. 14, note that the normally closed (n/c) relay contacts are used to switch the lamps and turntables. This ensures that a failure in the 12V subsystem does not bring the

CABLE DESIGNATIONS

Colour/type	Audio unscreened	Other
Red 32/02	—	+12V to monitor amplifier. All main +ve feeds from power input socket to barrier strip 3
Red 7/0·2	—	+15V, +12V, +47V lines
Black 7/0·2	—	−15V lines
Black 32/0·2	—	Main −ve feeds from power input socket to barrier strip 3
Green 32/0·2	—	+12V subsystem 0V connections. All main 0V feeds from power input socket to barrier strip 3
Green 16/0·2 and 7/0·2	0V connections	0V and chassis earths
Orange 7/0·2	Sends	—
Purple 7/0·2	Returns	—
Blue 7/0·2 Brown 7/0·2 Mains live	Miscellaneous	Mains neutral from power input socket to barrier strip 3 and to turntable lamps

Colour/Type	Audio screened	Other
Grey, pink, and Brown 7/0·2	—	Autofader
White 7/0·2	—	L.e.d.s and meters
Yellow 32/0·2 and 16/0·2	—	12V subsystem (lamps and relays)
Single screened 7/0·2	All mono connections, ie:—for monitor and mic circuits	
Single pair with foil screen (e.g. Belden 7/0·2)	All stereo connections	
Heavy duty single pair screened	—	Mains wiring from barrier strip 3 to turntable motors
Low noise two pair screened with conductive plastic screen (e.g. Filotex)	Disc inputs from cartridges	

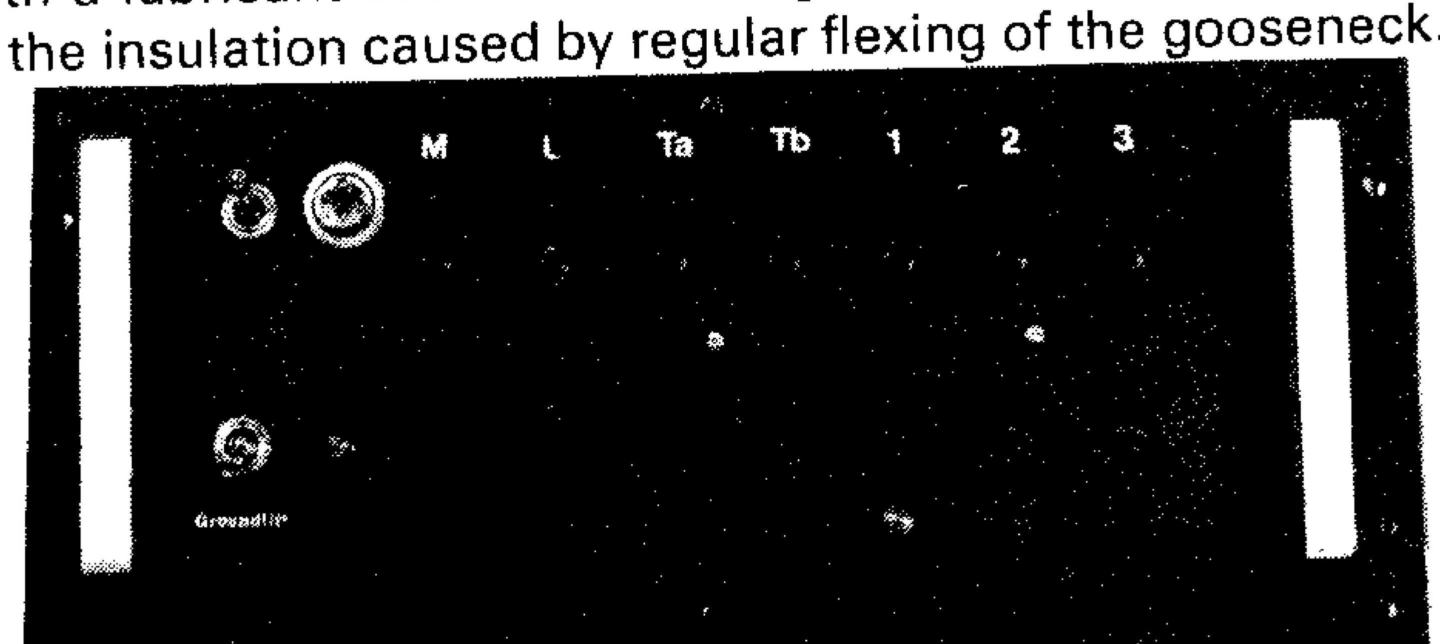
music to a standstill. The snubbers C1/R2—C8/R9 should be wired as close to their respective switches as possible; their purpose is to suppress switching clicks, particularly when the turntable motors (an inductive load) are energised. It may be necessary to wire additional snubbers directly across these motors in extreme circumstances. These may be of the same value as C5/R6 on Fig. 14. If turntable 'clicks' persist, find out whether the noise is due to inadequate suppression of the mains supply to the motors, the appropriate relay or switch; then try rerouting the mains wires leading to the turntables with a view to keeping them as far from the disc input cables as possible. If the clicks cannot be eliminated or satisfactorily attenuated, then zero-voltage switching could be used to turn the turntables on and off. Usually, however, good suppression and diligent cable routing will ensure that clicks do not intrude.

With reference to Fig. 15, note that the 12V subsystem input wires are doubled up between the input socket and barrier strip no. 3. These double cables extend to the power supply, which may be 10′ away in terms of cable length. In this way, excessive voltage drop is avoided.

TURNTABLE LAMPS

The turntable lamps used in this design were chosen after lengthy experimentation. Localised, high intensity lighting is essential to enable the operator to pick out record tracks regardless of how tightly they are packed and how poor the ambient lighting conditions are. Even more important is the need to be able to see the position of the stylus in relation to the end of the track. All the broadcast cartridges specified for this desk are designed with good stylus visibility in mind, but even so, lamp positioning is critical.

Lighting power requirements are proportional to the inverse square of the lamp-stylus distance but the minimum working distance is around 8in. otherwise the lamp may foul and scratch discs when they are removed from the turntable. In practice, a 15 watt mains pygmy lamp meets the criteria and has the great advantage that an additional 30 watts of power supply capacity is not required, as in the case of 12 volt lamps which are frequently used for these applications. Such a lamp can be readily shielded to prevent glare by coating one side with heat-resistant paint. The absence of a shield or shade is most useful, in that should a record be accidentally brought in contact with the lamp, little damage will result, since unlike a shade, the lamp's surface is smooth and rounded. Although goosenecks bearing mains (BC) lampholders are not readily available, standard discotheque gooseneck lamps can be readily modified by cutting off the end and soldering or gluing on a BC lampholder. Such a lampholder should preferably be brass for robustness. If the lampholder is glued to the gooseneck, it *must be earthed separately.* Wires leading down the latter should be smeared with a lubricant such as silicone grease; this limits abrasion of the insulation caused by regular flexing of the gooseneck.



Prototype p.s.u. front panel

COMPONENTS

12V SUBSYSTEM, OUTPUT ROUTING AND MONITOR SWITCHING

Potentiometer
VR1a/b — 1k dual log slide pot
(Maplin type HB00A)

Capacitors
C1–4 — 100n mylar
C5–8 — 100n, 1000V polypropylene or mixed dielectric (Mullard 330 series)

Miscellaneous

S1, 3, 5, 6, 7, 8	Push button illuminated switches made up from RS. 339–358, 339–415 (Switch and shield)
S2	Same as above, but requires an extra switch element 339–033 and extension screws 339–049. Coloured lenses are required for the above and come in packs of three: Green—339–370, Blue 339–386, Red 339–392, Orange 339–409
S4	Three way four pole miniature rotary switch
S5	Three way three pole miniature rotary switch
SKT1–2	5 pin female XLR socket
LP1–9	T5·5 wedge lamps, 12V 100mA (RS type 586–649)
LP10–11	These are normally available with the VU meter and should be rated at 12 volts
RLA1–4	Enclosed single pole relay with 12V, 185 ohm coil and 3A @ 250 volt AC switching capacity (RS 348–908)
D1–4	1N4004

Resistors
R1 100k
R2, 3, 4, 5 — 47R
R6, 7, 8, 9 — 100R
(All $\frac{1}{2}$ watt, 5% unless otherwise stated.)

General Hardware
2 handles—RS type 509–917
4 0·1in. x 24 way gold-plated edge connectors (RS type 466–545)
1 x 1SEP Horizontal rail SR.RL 169 (ITT E-PAK 46) (to be cut into 8 x 55mm lengths)
or 8 x 55mm lengths of 10 x 12mm aluminium bar
4 x foam rubber 'spacing pads' to suit card areas, $\frac{1}{2}$in. thick
20 x 12mm CSK Pozidrive screws } to mount slide pots
20 x $\frac{3}{8}$in. brass spacers M4 or 4BA } to mount slide pots
10 x Slider Bezels (RS type 543–406)
1 x relay mounting plate (e.g. RS type 349–119 if RS continental series relays are used)
7 x 5 amp barrier strips (RS 423–497)
14 x 5 amp barrier blades (RS 423–504)
1 x 20 way Cannon chassis plug (RS type 466–040)
1 x 20 way Cannon cable socket (RS type 466–084
1 x Cable shell to suit socket (RS type 466–129
Solder tags, rubber sleeving, single and balanced (twin) screened cable, 7/0·2, 16/0·2 and 32/0·2 wire. 14 swg or 2·5mm square solid copper wire.

Turntables—	See text
Cartridges—	Stanton 500AL, 500E or 680EL (Wilmex Ltd.) or Shure SC35
Turntable Lamps—	Maplin type WF22Y (See text) (Wilmex Ltd., Compton House, 35 High Street, New Malden, Surrey KT3 4DE)

THE POWER SUPPLY

The discotheque desk is connected via an umbilical cord to a remote power supply, which can be rack mounted with other equipment. In this manner, design compromises are avoided to a great extent.

With reference to Fig. 16, the mains supply is applied to an IEC connector which has an integral RFI filter. S1 is a heavy duty switch capable of handling the large surge currents which occur at switch on. S2 is an optional lockswitch which is intended to prevent unauthorised operation of the equipment. This switch is not suited to handling the current surge which occurs at switch on, therefore it is always wise to turn S1 off before turning S2 on. The unit is then turned on by means of S1 in the normal fashion. Fuses 2–7 have been selected to protect individual power supplies. If the stated fuse values or their close equivalents are used, then there will be discrimination between FS1 and the remaining fuses. Thus if FS3 blows, all other circuits will continue to function. Neons LP1–7 indicate fuse failures. The transient suppressor (VDR) and the snubber (C1, R1) ensure that high voltage transients appearing on the mains supply are rendered harmless.

REGULATOR PROTECTION

IC1–7 are protected against short circuits and shutdown if the supply current or device dissipation becomes excessive. The regulators are mounted on large heatsinks to ensure a low operating temperature; this in turn ensures longevity. RLA1–2 and the Zeners provide overvoltage protection by disconnecting the supply rails.

47V SUPPLY

The 47V supply is Zener regulated and can supply some 5mA which will suit the majority of capacitor microphones. In some circumstances, C14 may require uprating, depending on the degree of ripple rejection in the head amplifier. Some capacitor microphones operate only on lower supply voltages, e.g. 9V. In this case, T3, R6, R7 and D10 must be changed and advice should be sought from the microphone manufacturer on current and ripple rejection requirements. If dynamic microphones are to be used exclusively, then this supply can, of course, be omitted, along with FS7 and LP6.

The monitor l.e.d.s indicate any supply failures which do not cause fuse failure, for instance, operation of RLA1 or regulator shut-down in the event of a short circuit. S3 controls the earthing arrangements. In any audio system using more than one mains powered unit, the mains earth must be connected at only one point, otherwise a hum loop will be formed. (This does not apply to units connected by audio transformers, e.g. those using balanced lines.) For safety however, all exposed metalwork must be earthed.

An elegant solution is to separate chassis (safety) and 0V (signal) earths. The chassis earth is always connected directly to the mains earth whilst the 0V connections also go to this point, but via a small resistor, which provides 'groundlift'. The value of this resistor is selected so as to limit the magnitude of the current flowing in the earth loop(s), hence minimising hum. A suitable value is 47R (R2 in Fig. 16), but a higher value may be necessary if the groundlift resistors in other items of equipment can appear in parallel. It is a good idea to connect the OV rail on one item of equipment directly to the mains earth, and S3 provides this option on the power supply. If possible, all equipment to be used in conjunction with the desk should be modified so as to incorporate a groundlift resistor between chassis and OV. In this way, the dangerous practice of removing earth wires from mains plugs in a desperate attempt to banish an annoying buzz is made redundant.

CONSTRUCTIONAL DETAILS

C5, 6 and 11 must be close wired to their respective regulators; they are most conveniently mounted on a tagstrip. Tubular capacitors are specified because standard p.c.b. types are readily broken when they are wired in this fashion. The resistors associated with each l.e.d. together with the components associated with the 47V supply are mounted on a p.c.b. IC1 and 2 are readily mounted directly onto a heatsink, but IC3 has a TO3 style package and must be mounted on a bracket. This in turn is bolted to the heatsink. The bracket should be aluminium and could be either a slab bent at right angles or better, a short section of 35 × 35mm angle of reasonable thickness, so as to minimise the thermal resistance between the device and the main heatsink. All surfaces should be smeared with heatsink compound for the same reason.

All three regulators must be insulated from their respective heatsinks with mica washers; be sure to deburr the mounting holes and to clean and sand the area thoroughly so that the mica is not punctured or subsequently weakened by sharp projections.

Before testing the completed unit, remove all the fuses; then replace one fuse at a time and test each supply individually. Check especially that each voltage appears at the appropriate pins on the output socket.

POWERING-UP THE DESK

Disconnect all d.c. supply connections at barrier strip No. 7 and connect up the power supply via the umbilical cord. Remove the fuses again and turn on, then power up each supply individually, as before, and Check that all voltages appear at the appropriate points on barrier strips 3 and 7. Then turn off the power supply, replace the barrier strip connections. Plug in all the cards and turn on the power supply. Check the monitor l.e.d.s in case of short circuits on the supply rails. Connect an amplifier to the mono ouptut socket and test all the functions.

The completed desk should be soak tested for a couple of days if possible so that faulty components are weeded out before the equipment passes into service, where failures are inexcusable.

Before taking it on the road, strap down the cards to the front panel and tension them towards the edge connector by means of two rubber bands. However firmly they may fit, it is possible that they will shake loose in transit unless made captive in this manner.

DISCS, TURNTABLES AND CARTRIDGES

Apart from being easy to operate, versatile, reliable and robust, the desk is capable of providing sound quality equal to up-market Hi-Fi systems. In order to make use of this, a high power sound system which need not be run into clipping at discotheque sound pressure levels is essential. Next, good loudspeakers, then good discs, then good acoustics, turntables, equalisation, and a host of other requirements. But the first three items on the list are certainly the most crucial. The quality of disc pressings warrants particular attention. Using the prototype desk in conjunction with high quality power amplifiers, a horn-loaded speaker stack and a good record pressing provides sound that is to all intents and purposes indistinguishable from a live performance under appropriate conditions. To make the most of this system then, it's essential to seek out well pressed discs. It is said that some 60% of records are faulty or poorly pressed and you may need to return a record several times before you receive a good pressing. A few records are poorly recorded; in particular, out of balance tonal quality can result from incorrect compensation for high SPL and lengthy all-night mixdown sessions. Alternative mixes may be sought, or an equalised tape recording of the disc may need to be made. 12in discs are invariably well pressed and very lifelike. Surprisingly 'Once a good pressing—always a good pressing'—a well pressed disc will retain its sparkle for a long time. With all this in mind, the disc remains far superior to most taped material unless you have access to master tapes; a well pressed disc has an ability to 'jump out of the speaker' with alarming realism. A good record pressing can also be played at higher levels than a tape without inducing nausea; presumably because distortion is either lower or more amenable to the ear.

CHOICE

Whether used live for discotheques and broadcasting, or for recording, the cartridges must withstand slip and back cueing. In mobile applications they must also withstand severe shocks. It is not unknown for cartridges to fall out of arms in transit. Under no circumstances should ordinary magnetic cartridges intended for domestic hi-fi systems be used; the frequent necessity for high tracking weights (>3 grams) and back cueing in particular will rapidly degrade the performance of such a cartridge, or even worse, cause sudden failure. Readily available cartridges which are designed to withstand the rough handling inherent in broadcast and discotheque applications are manufactured by Stanton and Shure. The Stanton 500 series cartridges have found great favour on the American discotheque scene and are also widely used by the IBA in this country. The Shure SC35 on the other hand is favoured by the BBC. The choice of cartridge mainly boils down to what sort of colouration you like, the Stanton 500AL for instance having a response peak around 25Hz which gives it a characteristic sound. Turntables may be budget domestic types with integrated arms such as the Garrard SP25 used in the prototype. Ideally, these should have idler wheel drive for rapid starting but belt driven turntables can prove satisfactory in practice and also exhibit lower rumble. The desk deserves the best turntable you can afford however, and if possible, a professional broadcast model should be sought, such as classic models from Technics, Gates or Russco. Arms should be chosen for robustness over any other consideration.

Record bounce causes headaches for many operators. Short of hiring a concrete mixer and laying your own floor, there is a simple way around the problem provided you are willing to flex your muscles—the desk should be mounted on the heaviest possible stand. The prototype resides on a stand weighing some 100kg (inclusive) and floor vibrations with a peak-to-peak amplitude of around $\frac{1}{2}$in are necessary before record bounce occurs. Breeze blocks, paving slabs or tractor weights can be borrowed and tied to the stand under such severe conditions. It is also useful to place the stand in a corner, where it will receive most support, and to keep the audience back. Under these conditions, a tracking weight of $4\frac{1}{2}$ grams will usually be quite adequate, as opposed to 7 or 8 grams which may be required without a heavyweight stand.

COMPONENTS

POWER SUPPLY

Resistor

R1	100 0·5W
R2	47 0·5W
R3	680 1W
R4	470 1W
R5	470 1W
R6	2k2 3W
R7	1k 5W
R8	245V transient suppressor (RS 238-457)
R9	470 1W

Capacitors

C1	100n, 100V polypropylene
C2	100n 250V tubular polyester
C3-C4	33,000µ, 40V can elect.
C5-C6	100n tubular polyester 160V
C7-C8	470n tubular polyester 160V
C9	100n 250V tubular polyester
C10	33,000u, 40V can elect.
C11	1µ tubular polyester 160V
C12	470n tubular polyester 160V
C13	100n tubular polyester 250V
C14	100µ axial elect. 100V

Semiconductors

IC1	7815-1·2A plastic regulator
IC2	7915-1·2A plastic regulator
IC3	78H12-5A metal can regulator
D1-D2	1N5355B (18V, 5W)
D3	BZX-61C-47V (47V, 1·3W)
D4-D7	Red panel l.e.d.s (RS 576-327)
D8	Yellow panel l.e.d. (RS 576-355)
REC 1	6A Bridge (100V $_{VRRM}$, 180A IFSM)
REC 2	10A Bridge (100V $_{VRRM}$, 180A IFSM)
D9, D10	1N5401
REC 3	2A Bridge (200V $_{VRRM}$)

Miscellaneous

SK1	IEC socket with integral r.f. filter, 2A type
SK2	20 way Cannon chassis socket—(RS 466-084)
	20 Way Cannon cable plug and shall (RS 466-040) (RS 466-129)
S1	S.p.s.t. toggle 15A
S2	D.p.s.t. toggle 3A
FS1	5A 20mm quickblow
FS2-FS4	600mA 20mm quickblow
FS5-FS6	200mA 20mm antisurge
FS7	100mA 20mm quickblow

(Fuseholders all 20mm flush bayonet release types)

LP1-LP7	Panel neons
RLA-RLB	12V, 110 ohm, coil, 10A d.p.c.o (RS 348-756) Relay sockets (RS 401-706)
T1	15-0-15V, 1·6A
T2	15V, 4A
T3	40V, 150mA
Heatsinks	1·5°C/Watt (2 off)

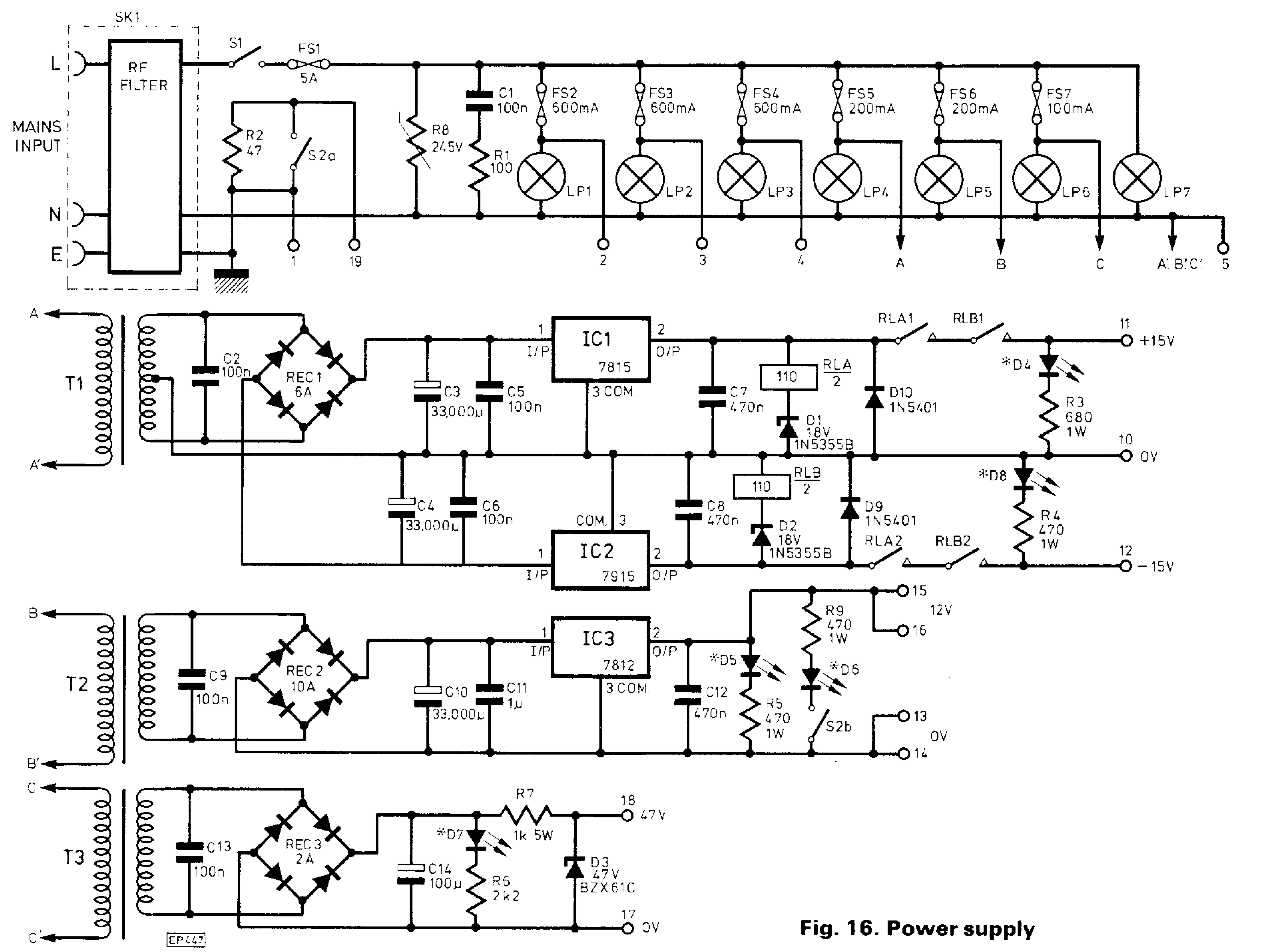
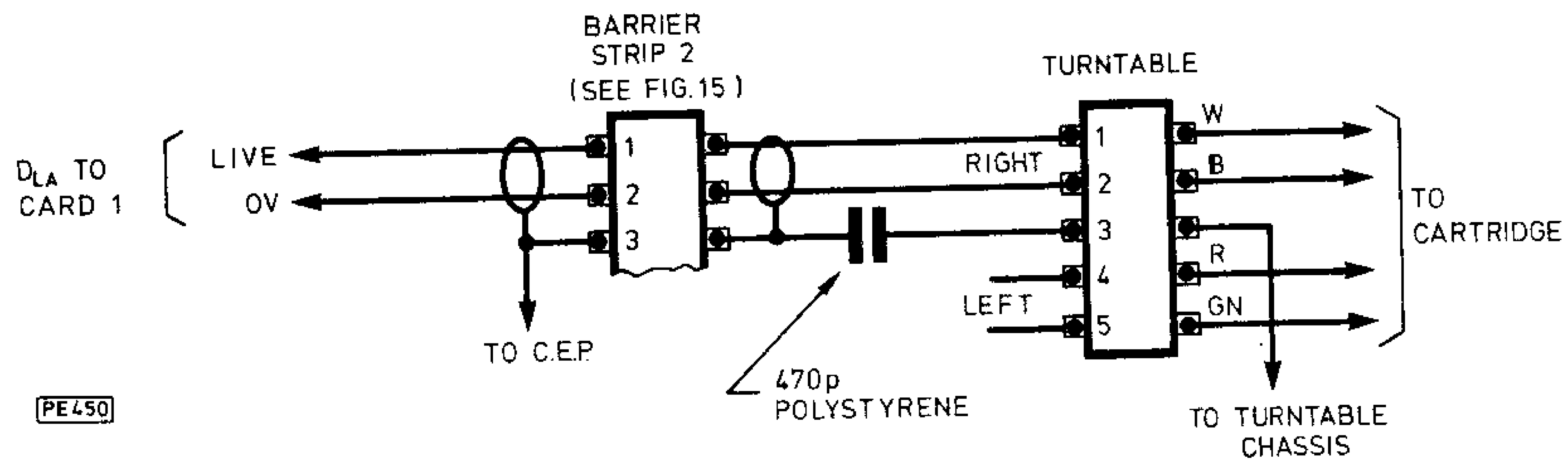


Fig. 16. Power supply

Fig. 17. Cartridge wiring to one turntable. Note that the 0V connection DLA is not connected to the cable screen or turntable chassis at any point. The screen is connected to chassis earth at the barrier strip only



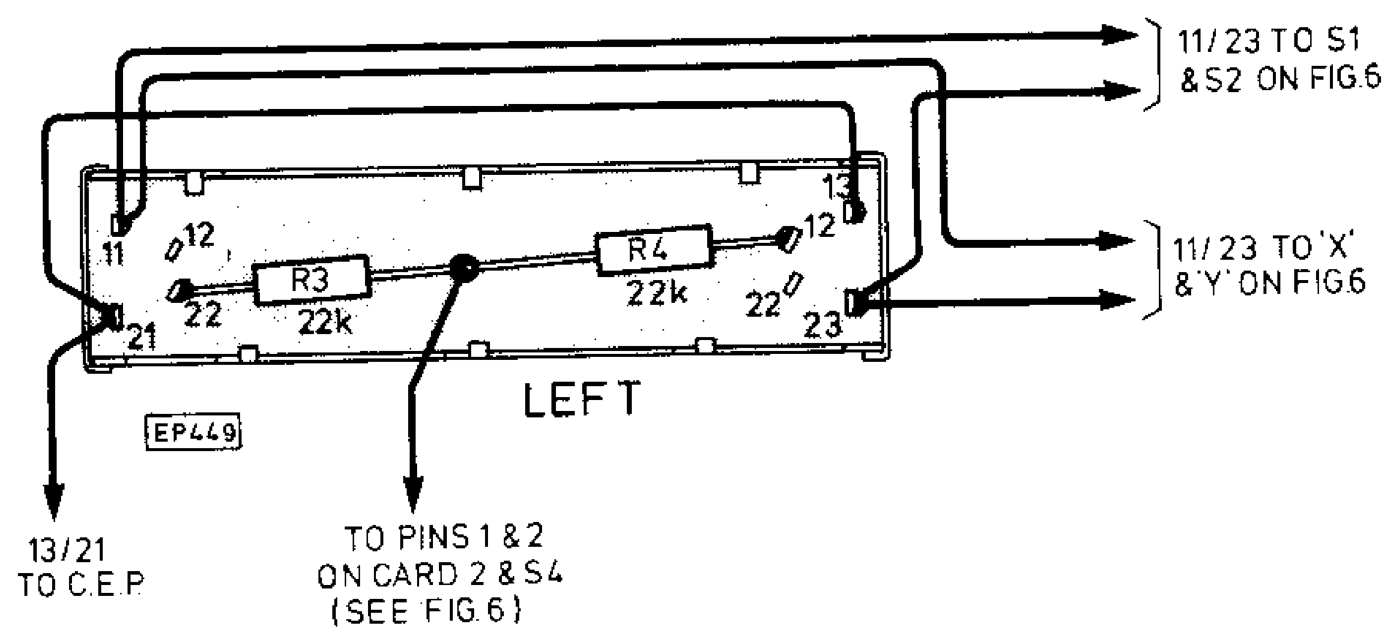
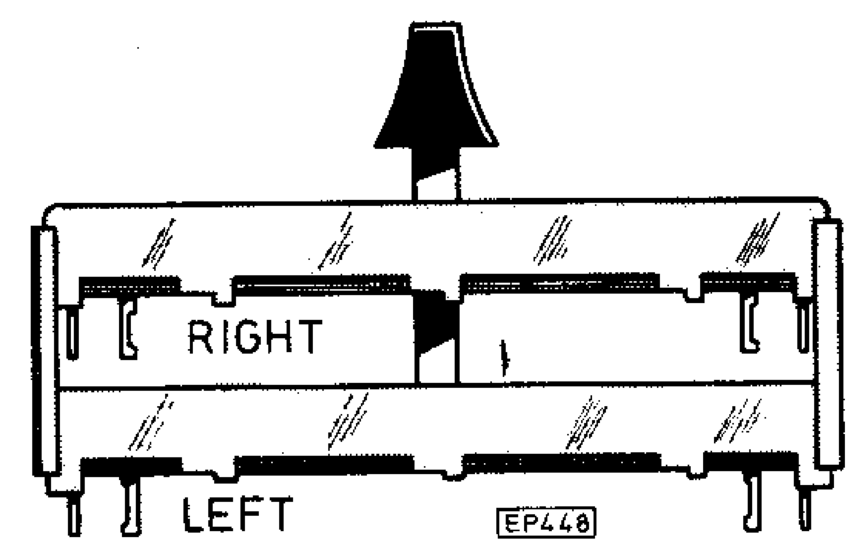
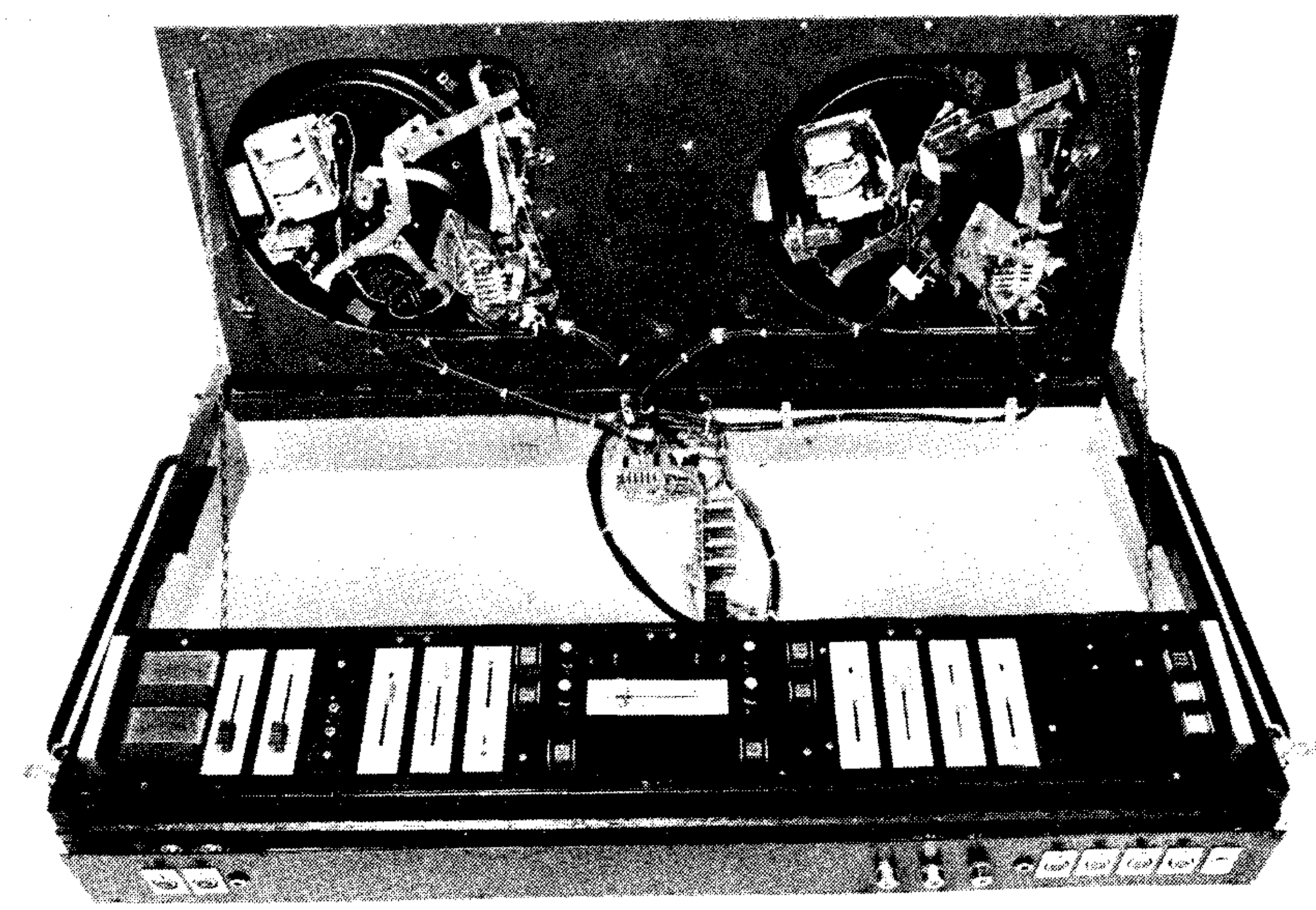
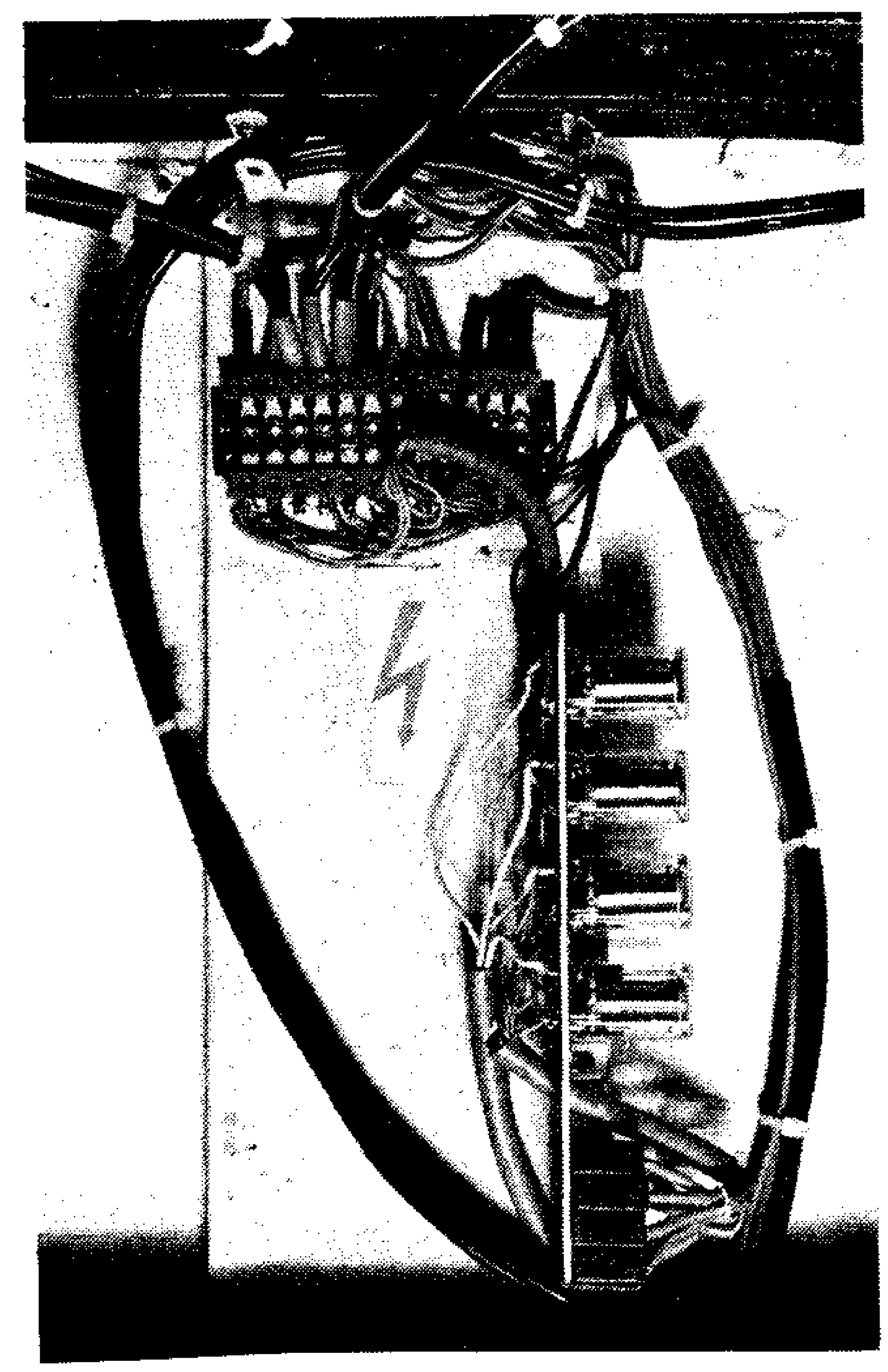


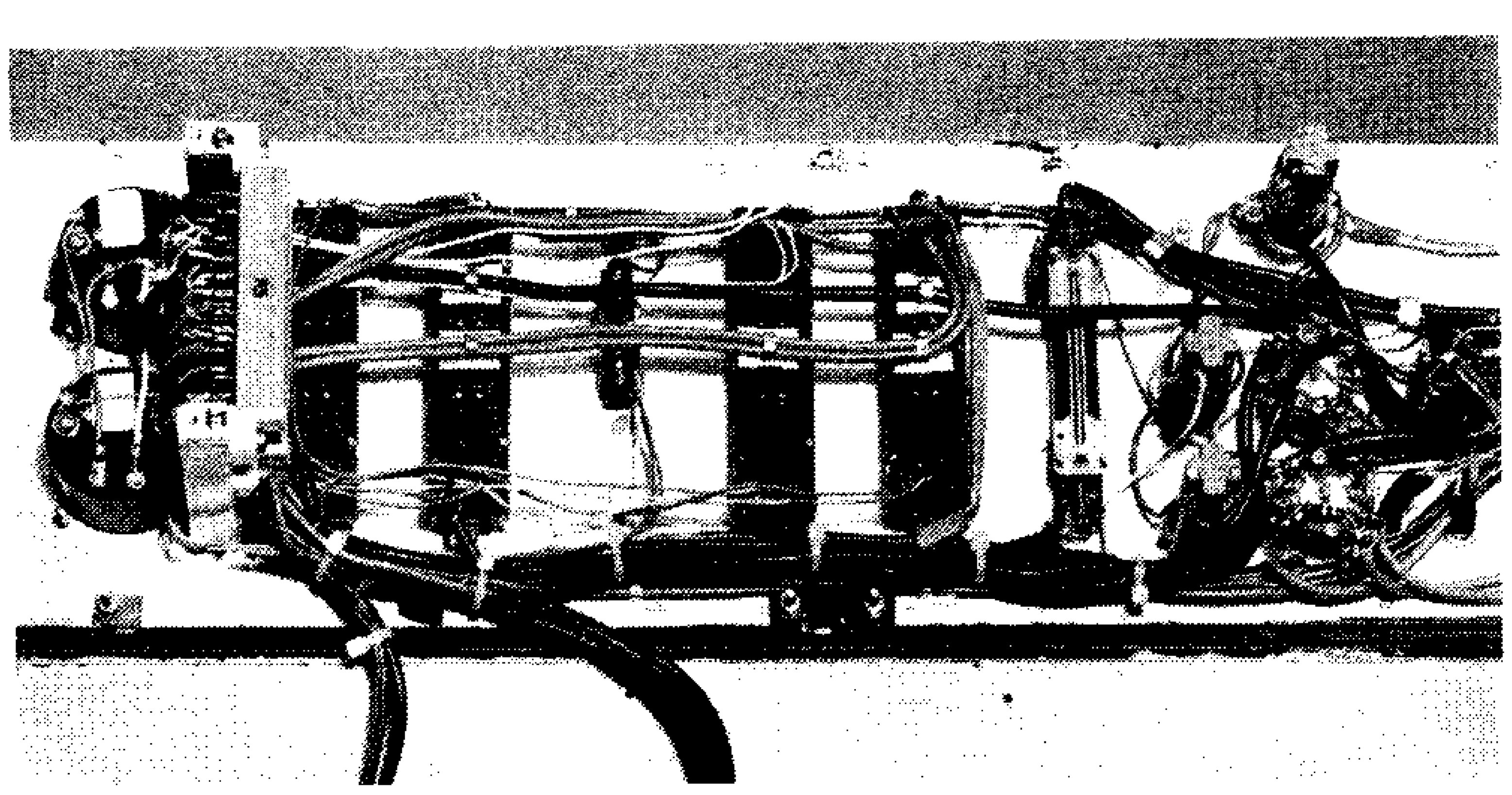
Fig. 18 (left). Showing underside of crossfader for left channel. The wiring to the right is identical but the connections from tags 11/23 to X and Y are omitted

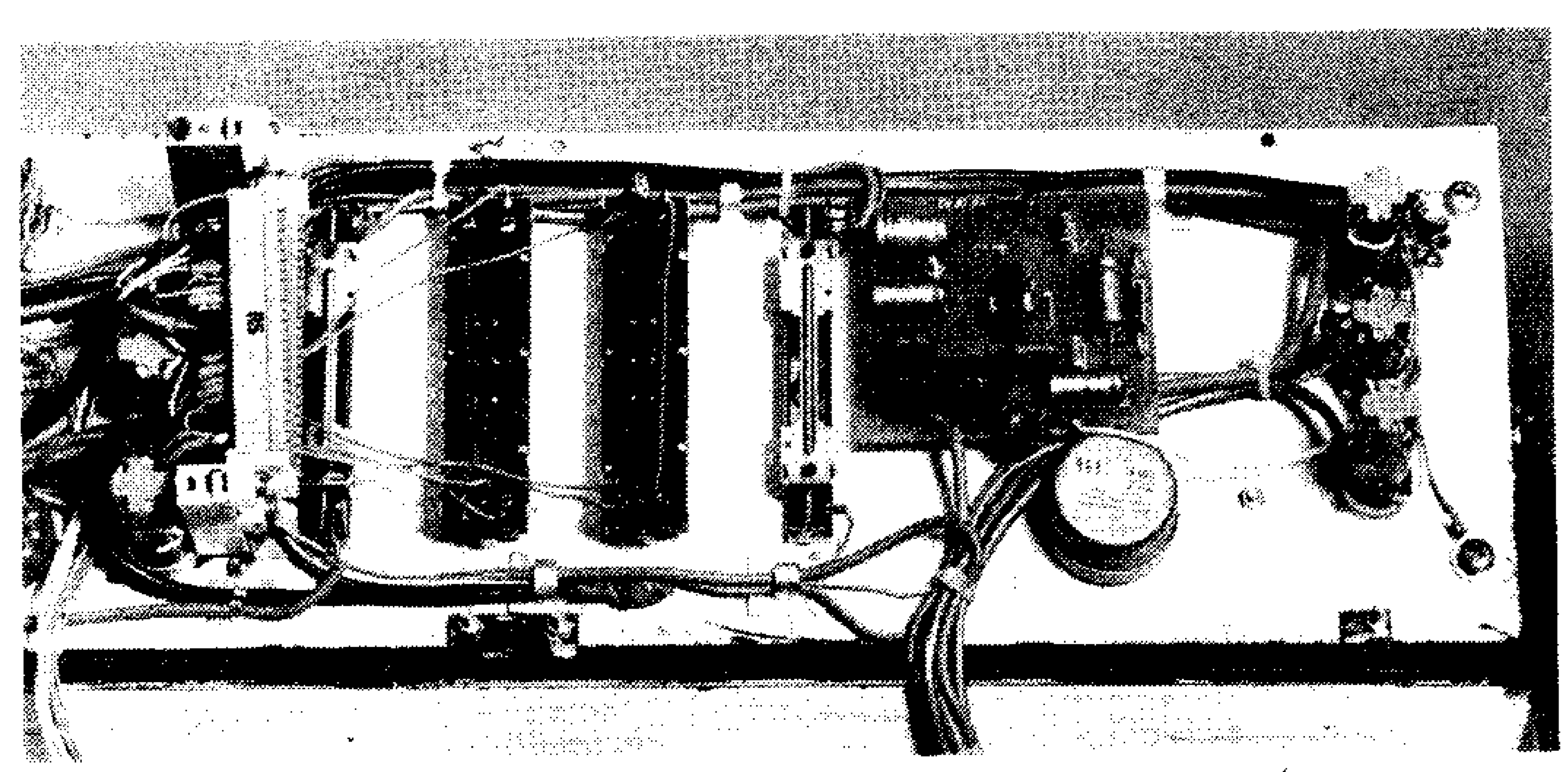


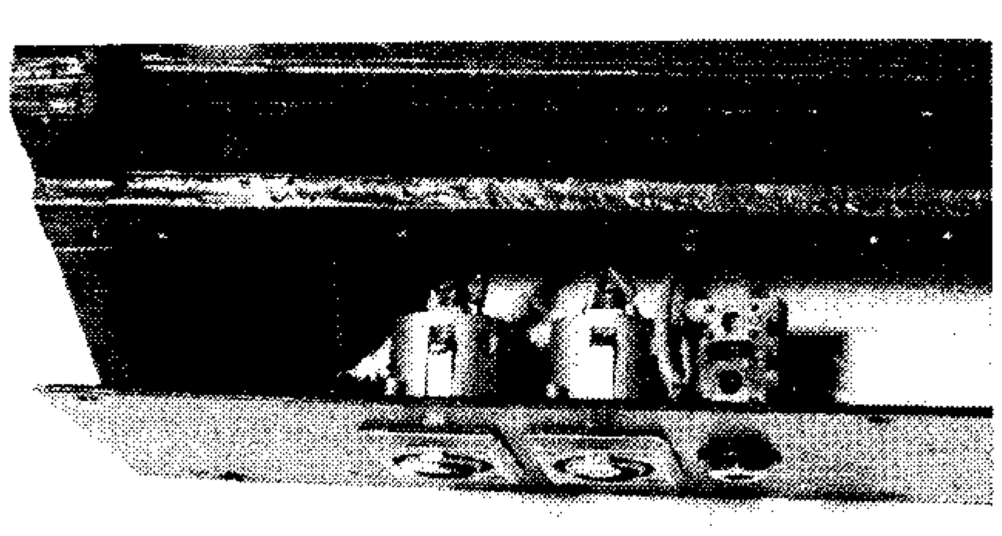


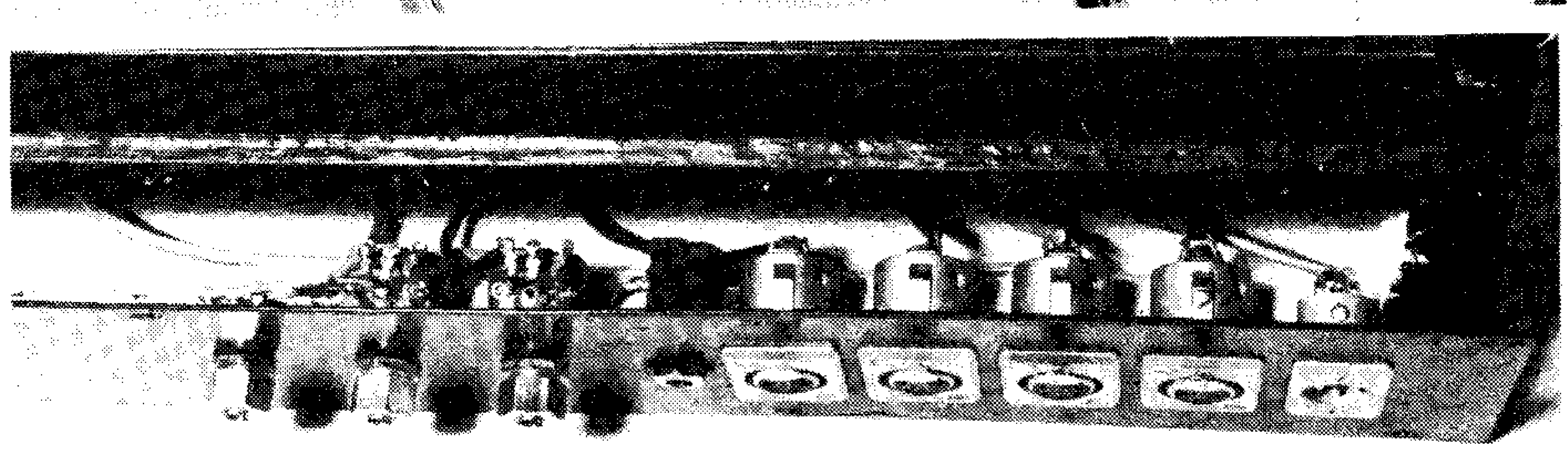


Showing interiors of turntable compartment (above); and (right) detail of relays and snubbers (see Fig. 15)









★

UK101 GRAPH PLOT

BY TOBY WALSH

THIS program produces a graph of a function (expressible in the form y=f(x) using standard BASIC notation) for a range of x values. It is self-scaling once it has been given the range of x, finding the lowest and highest y values. It also draws the lines x=0, and y=0, when they fall within the x or y values.

METHOD

On the UK101, reasonable resolution can be obtained using the graphics characters. The screen is 46 by 16 chars, but the graphics include 8 horizontal bars.

These bars can increase the resolution to 46 by 128 allowing a reasonable curve to be drawn.

The first problem encountered was how to change the function of x every time the program is run. The simplest answer is this:

100 PRINT " Please type : "
110 PRINT " 5000 Y=f(X) "
120 PRINT " GOTO 1234 "
130 STOP
1234 *program*

This is not ideal. The best answer is to make the program alter itself. Microsoft BASIC is memory efficient for the reason that the commands are abbreviated by the use of tokens.

What does a Basic line look like in memory? Consider this line:

10 Y=X

If the relevant section of memory is examined, the line is stored as follows:

14 3 10 0 89 171 88 0

The "14 3" in the first and second byte means the next BASIC line is stored at memory location 14 + 3★256 (=782 decimal). The "10 0" in the next two bytes indicates that this is BASIC line number 10 + 0★256 (=10 decimal). 89 is the ASCII code for Y, and 88 for X. So somehow 171 means "=", and 0 means the end of the line.

So far:

14 3	10 0	89	171	88	0
782	line 10	Y	=	X	END of line

A full list of tokens is given in Table 2 only those underlined are useful for the function of x.

TABLE 2: Tokens. Those underlined are used

128	END	151	PRINT	174	INT
129	FOR	152	CONT	175	ABS
130	NEXT	153	LIST	176	USR
131	DATA	154	CLEAR	177	FRE
132	INPUT	155	NEW	178	POS
133	DIM	156	TAB(	179	SQR
134	READ	157	TO	180	RND
135	LET	158	FN	181	LOG
136	GOTO	159	SPC(	182	EXP
137	RUN	160	THEN	183	COS
138	IF	161	NOT	184	SIN
139	RESTORE	162	STEP	185	TAN
140	GOSUB	163	+	186	ATN
141	RETURN	164	−	187	PEEK
142	REM	165	★	188	LEN
143	STOP	166	÷	189	STR$
144	ON	167	↑	190	VAL
145	NULL	168	AND	191	ASC
146	WAIT	169	OR	192	CHR$
147	LOAD	170	=	193	LEFT$
148	SAVE	171	>	194	RIGHT$
149	DEF	172	<	195	MID$
150	POKE	173	SGN	197 to 211 BASIC error codes	

Thus if we input the function of x, we can find the suitable line in memory and poke into it the function. The line which we look for is line 5000:

5000 ╫ ╫ ╫ ╫ ╫ ╫ ╫ ╫ ╫ ╫ etc.

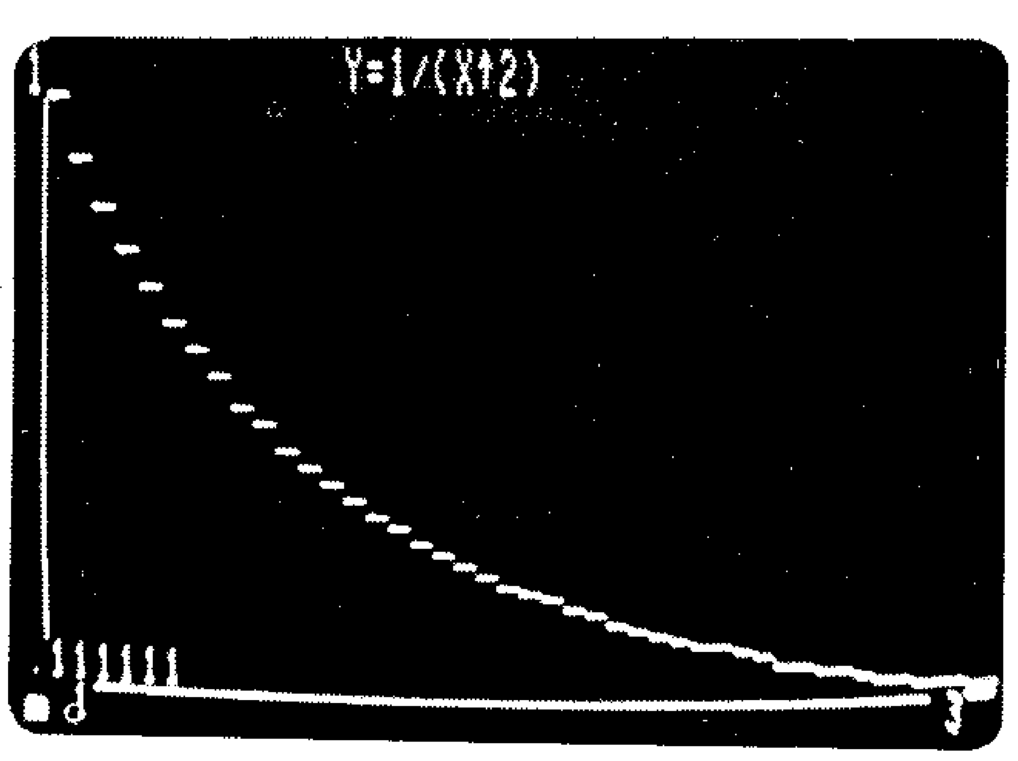
The ╫ symbols are looked for in memory. When they are found the function y=f(x) is poked in (the function *must* be in standard BASIC notation). The most convenient way to end a line is to make it a multi-line statement, so the colon and REM are both POKED in at the end of the line. We now have the function of our graph in the form:

5000 ***y=f(x)*: REM ╫ ╫ ╫ ╫ ╫ etc.**
5010 RETURN

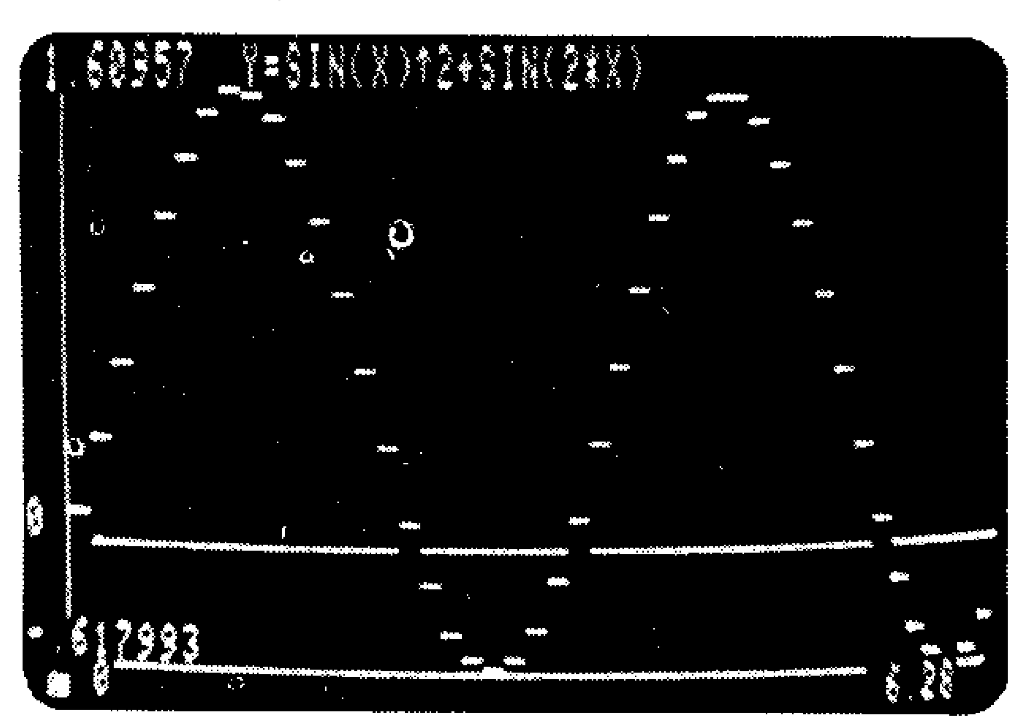
Values of the range of x are then inputed, and the highest and lowest values of y are found for scaling purposes. The graph can then be plotted using the graphic characters.

SOFTWARE IDEAL FOR MATHEMATICS DEMONSTRATION.

Some suggested graphs
1) Y=ABS(X) for x=−1 to 1
2) Y=−1★ABS(X) for X=−1 to 1
3) Y=SIN(X)↑2+SIN(2★X) for X=0 to 2★Pi
4) Y=1÷(X↑2) for x = 1 to 3



Left: Graph of y = 1/x². Note that the function must be keyed into the computer as if a BASIC statement in itself.



Right: A more complex, cyclic function. The Graph Plotter is self-scaling.

```
OK
LIST

 10 REM ***************************
 20 REM ****    GRAPH PLOT     ****
 30 REM ****    ==========     ****
 40 REM ****                   ****
 50 REM ****    by T.Walsh     ****
 60 REM ****    for a 8K       ****
 70 REM ****    Compukit UK101****
 80 REM ***************************
 100 FORA=1TO16:PRINT:NEXT
 110 PRINT"                   GRAPH PLOT"
 120 PRINT"                   =========="
 130 PRINT"                   by T.Walsh"
 140 PRINT:PRINT
 150 INPUT"  Type graph in form Y=f(X)";A$
 160 IFLEN(A$)>37THEN150
 170 FORA=2800TO3100
 180 IFPEEK(A)=35ANDPEEK(A+1)=35THEN210
 190 NEXT
 200 PRINT"   Program error":STOP
 210 Q=LEN(A$):LP=A
 220 A$=RIGHT$(A$,Q-2)
 230 W=0
 240 POKELP,89:POKELP+1,171
 250 FORA=1TOLEN(A$)
 260 W=W+1
 270 D$=MID$(A$,A,1)
 280 IFASC(D$)>47ANDASC(D$)<58THEN500
 290 IFD$="X"ORD$="("THEN500
 300 IFD$=")"THEN500
 310 IFD$=" "ORD$="."THEN500
 320 IFD$="+"THENZ=163:GOTO510
 330 IFD$="-"THENZ=164:GOTO510
 340 IFD$="*"THENZ=165:GOTO510
 350 IFD$="/"THENZ=166:GOTO510
 360 IFD$="↑"THENZ=167:GOTO510
 370 D$=MID$(A$,A,3)
 380 IFD$="SGN"THENZ=173:GOTO520
 390 IFD$="INT"THENZ=174:GOTO520
 400 IFD$="ABS"THENZ=175:GOTO520
 410 IFD$="SQR"THENZ=179:GOTO520
 420 IFD$="RND"THENZ=180:GOTO520
 430 IFD$="LOG"THENZ=181:GOTO520
 440 IFD$="EXP"THENZ=182:GOTO520
 450 IFD$="COS"THENZ=183:GOTO520
 460 IFD$="SIN"THENZ=184:GOTO520
 470 IFD$="TAN"THENZ=185:GOTO520
 480 IFD$="ATN"THENZ=186:GOTO520
 490 PRINT"Error in function":GOTO880
 500 POKELP+W+1,ASC(D$):GOTO530
 510 POKELP+W+1,Z:GOTO530
 520 POKELP+W+1,Z:A=A+2
 530 NEXT:POKELP+W+2,58
 540 POKELP+W+3,142
 550 F$="Y="+A$
 560 PRINT:PRINT" Enter the range of x (low";
 570 INPUT" then high)";LO,HI:PRINT:PRINT
 580 IFLO>HITHEN560
 590 X=LO:GOSUB5000
 600 YH=Y:YL=Y
 610 FORX=LOTOHISTEP(HI-LO)/46
 620 GOSUB5000
 630 IFY>YHTHENYH=Y
 640 IFY<YLTHENYL=Y
 650 NEXT
 660 FORA=1TO16:PRINT:NEXT
 670 FORA=1TO15
 680 POKE53261+64*(A-1),143
 690 NEXT
 700 FORA=54222TO54285
 710 POKEA,135:NEXT
 720 S=(HI-LO)/46
 730 IFHI>0ANDLO<0THEN2000
 740 IFYH>0ANDYL<0THEN3000
 750 FORB=1TO46:X=(B-1)*S+LO:GOSUB5000
 760 D=((Y-YL)/(YH-YL))*14+1
 770 X=B:Y=D+1:GOSUB1000:NEXT
 780 A$=F$
 790 FORA=1TOLEN(A$)
 800 POKE53279+A-LEN(A$)/2,ASC(MID$(A$,A,1))
 810 NEXT
 820 A=54221:A$=STR$(LO):GOSUB6000
 830 A$=STR$(YH):A=53259:GOSUB6000
 840 A$=STR$(YL):A=54155:GOSUB6000
 850 A$=STR$(HI):A=54264-LEN(A$):GOSUB6000
 860 POKE530,1:POKE57088,0
 870 IFPEEK(57088)=254THEN860
 880 POKE530,0:FORA=1TO39:POKELP+A-1,35:NEXT
 890 RUN
 1000 Z=54285:S1=INT((Y-INT(Y))*7+.5)
 1010 POKEZ-INT(Y)*64+X,128+S1:RETURN
 2000 A=53262+15*64+(ABS(LO)*46/(HI-LO))
 2010 POKEA,48
 2020 FORB=0TO15
 2030 POKEA-(B+1)*64,143
 2040 NEXT:GOTO740
 3000 A=54220
 3010 A=A-INT(ABS(YL)*15/(YH-YL)+.5)*64
 3020 POKEA,48
 3030 A=A+2
 3040 FORB=0TO45
 3050 IFPEEK(A+B)=143THENPOKEA+B,208:GOTO3070
 3060 POKEA+B,128
 3070 NEXT:GOTO750
 5000 ##############################################
 5010 RETURN
 6000 FORB=1TOLEN(A$)
 6010 POKEA+B,ASC(MID$(A$,B,1))
 6020 NEXT:RETURN
OK
```

LINES

100 to 160	Inputs function
170 to 540	Finds line 5000 in memory and pokes the function of x in
550 to 650	Inputs the low and high values of x and from these calculates the maximum and minimum y values
570 to 850	Plots graph
860 to 890	Waits for any key to be pressed and then returns line 5000 to its original format
1000 to 1050	Plots the horizontal bar
2000 to 2040	Plots the line X=0 [if applicable]
3000 to 3070	Plots the line Y=0 [if applicable]
5000 to 5010	Function of graph in form Y=f(X)
6000 to 6010	Pokes the contents of A$ into a part of the screen pointed to by the contents of A

IMPORTANT VARIABLES

HI	highest value of X
LO	lowest value of X
LP	position of line 5000 in memory
YH	highest value of Y
YL	lowest value of Y

NOTES

1) line 5000 should be retyped if the program is stopped halfway through
2) the function of X must be in standard Basic notation. Any error will mean that you will have to retype line 5000, and re-run the program.
3) all angles are in radians.
4) do not try to plot infinity [eg tan of a half of pi]

MICRO PROMPT

The hardware and software exchange point for PE computer projects

LISTLESS SOFTWARE

A method for protecting your BASIC from being LISTed by a spy has been sent in by *Mr. Mistry* of Bradford.

Add line zero to your program; which might be: **O REM**—*some program*—for example.

Then **POKE 769, 0** in Command Mode.

Any alteration to the listing, after this, will crash the system.

For return to normal, **POKE 769, 7**

PIECES OF EIGHT

Sir — I have decoded the memory block 2000–3FFF on my UK101 in the following way, while I use the decoding for I/O and an EPROM programmer, they could be used for other things:

IC23 (74LS138) seems to decode the whole 64K into 8K blocks most of which are not used. The unused pins can just be bent out and used to decode the 8K blocks, ie. pin 14 decodes 2000–3FFF
13 decodes 4000–5FFF
12 decodes 6000–7FFF
11 decodes 8000–9FFF
remembering that 1K EPROM, for example, would appear more than once in the 8K block selected.

To decode 2000 to 3FF into 8 × 1K blocks I soldered another 74LS138 onto IC22.
PIN 4 connects to Pin 14 (Y1) of IC23
7 (Y7) decodes 2000–23FF
9 (Y6) decodes 2400–27FF
10 (Y5) decodes 2800–2BFF
11 (Y4) decodes 2C00–2FFF
12 (Y3) decodes 3000–33FF
13 (Y2) decodes 3400–37FF
14 (Y1) decodes 3800–3BFF
15 (Y0) decodes 3C00–3FFF
I have transferred the Compukit Screen Edit tape to EPROM which runs at 2000–23FF, but does anyone know how to transfer the extended monitor?

J. Walton,
Newton,
Derbyshire.

It should be emphasised that material presented in Prompt has not necessarily been proven by us. Neither can compatability with *all generations* of the computer equipment to which it relates be guaranteed.

Software and hardware designs submitted should be accompanied by a declaration to the effect that it is the original work of the undersigned, and that it has not been accepted for publication elsewhere.

MADE FOR EACH OTHER

Sir—The Transam Triton microcomputer's on board memory ends at address 1FFF. This makes interfacing to Dr, Berk's EPROM programmer extremely simple, provided that it is the only off board memory in use. A0 to A10 from the EPROM board are connected to the corresponding address lines from the Tritom expansion socket and the board enable is connected to the Triton A13, which only goes high for addresses over 1FFF Hex. A10 goes high every time an address containing X4XX is accessed (X = don't care), but the board is not enabled until A13 is active, therefore A10 only becomes effective when we reach 2400, which is just what we want and locates the EPROM block directly following the RAM block. This allows both RAM and EPROM to be accessed under program control, and the Triton's monitor will accurately locate the end of the new RAM with its memory check procedure, which is needed for the correct operation of the basic interpreter.

Obviously A13 and A10 will also become active for addresses further up the map, but if the EPROM board is the only off board memory expansion, then higher addresses should never be accessed except under error conditions, in which case the RAM might be interfered with, but then, that would probably happen anyway under error conditions. Any other memory expansion would no doubt use the Triton motherboard which changes the problem completely.

Triton Socket	EPROM Board
MEMW	R/W
Ground	0 volts
Five volts not available from socket—wire to regulator	
A13	Pin 6, IC10 (enable)
A0	A0
—	—
—	—
A10	A10
D0	D0
—	—
—	—
D7	D7

One change must be made to the board, due to the fact that we are using a positive going address line rather than a zero going decode line for the $\overline{ENABLE}$. We therefore leave out the gate 1C8A which merely inverts the $\overline{ENABLE}$, and connect the Triton's A13 to pin 6 of IC10. this is easily done as the track on the top of the EPROM board nearest the l.e.d. is the track which connects the two. Cut the track or simply leave out the through board pin nearest the l.e.d., and connect the A13 signal to this track. Both pins 1 and 2 of 1C8 should then be connected via link L10 to +5 volts as it is bad practice to leave t.t.l. inputs floating.

The redundant gate (IC8A) can be put to use to give a very useful added facility.

As we are allowing the computer to select between the RAM and the EPROM by the use of the address line A10 rather than using a switch and doing it manually, we are getting the best use of the extra memory available. However, we are unable to try routines in RAM before burning them into EPROM as the computer sees them as two separate blocks of memory and internal calls or jumps will not work in both blocks (not with 8080 direct addressing). This can be overcome by using the redundant gate to invert A10 and selecting either the inverted A10 or the non-inverted A10 with a single pole changeover switch (Fig. 1). This effectively swaps the positions of the RAM and EPROM as far as the computer is concerned. Therefore a program can be developed and debugged in RAM at addresses between 2400 (Hex) and 27FF (Hex) which is normally the EPROM's address, then it can be burnt in and run in EPROM after the switch is returned to normal. All this without losing the advantage of simultaneous use of both blocks of memory.

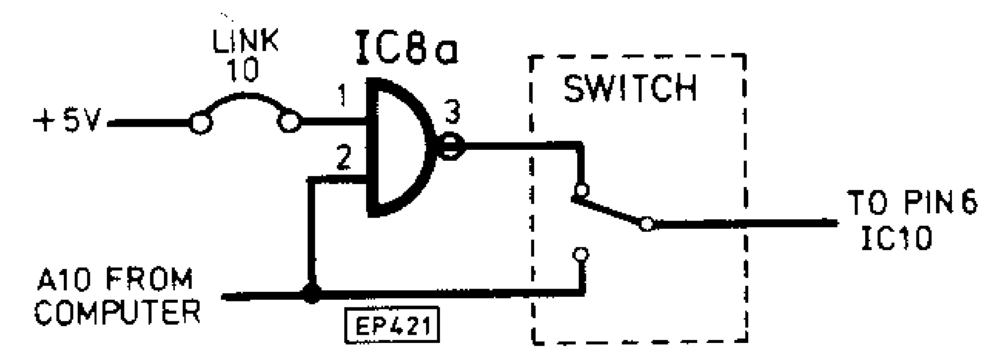


Fig. 1. Address inversion switch

Note that this is not suitable where a decode line has been used for interfacing, as the gate IC8A is already in use.

Iolo Davidson,
Hawling,
Gloucestershire

PREMIER SOFTWARE FOR UK101

Two software cassettes are available from *Premier Publications* of 12 Kingscote Road, Addiscombe, Surrey.

The first is called "Strategy Games Pack", and is Superboard compatible. It contains three well presented and compulsive games: Nine-In-A-Line, Square Solitaire, and Executive Jigsaw. The start of the tape loads in some utility machine code software to support these games.

The second tape is called "Utilities Pack" and comprises a range of subroutines which can be called up by the user's own main program, after which, any unused utility routines are removed.

A subroutine is included for screen location identification via a grid system. Another routine provides a precision random number generator with more linear distribution. There is also a "read data" routine which overcomes the need for a FOR-NEXT loop to find a particular datum. When GOSUB 30 is called, the piece of data is returned as Z$.

There is a kind of direct telewriting subroutine, a routine for driving the cursor around the screen, and much more useful software.

Premier publications: ✆ 01-656 6156.

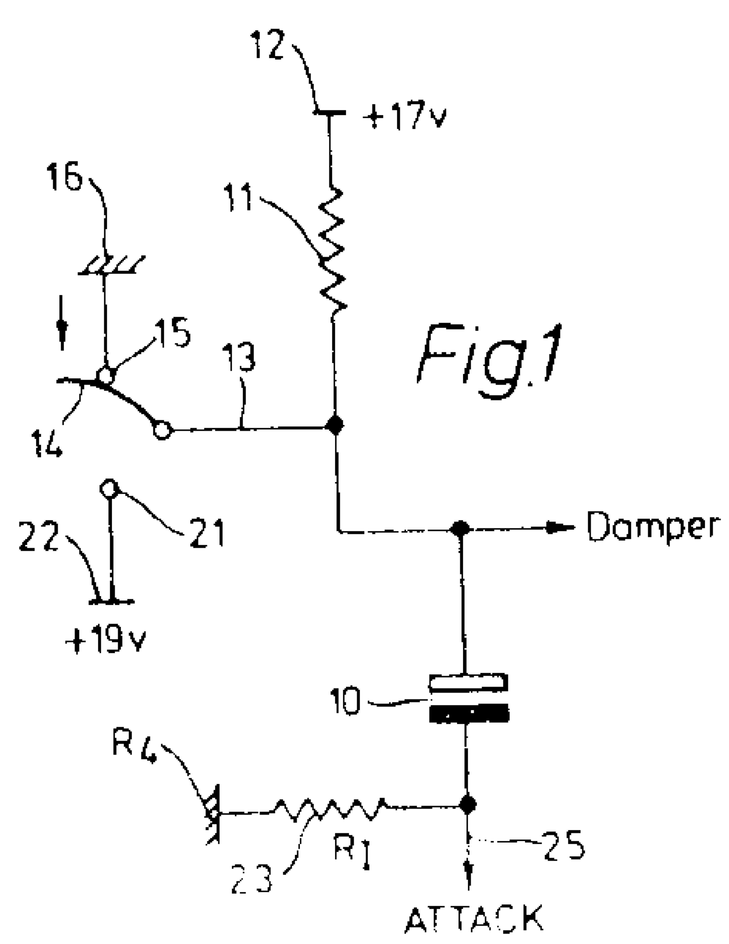
PATENTS REVIEW...

Copies of Patents can be obtained from: the Patent Office Sales, St. Mary Cray, Orpington, Kent. Price £1·25 each.

JOANNA

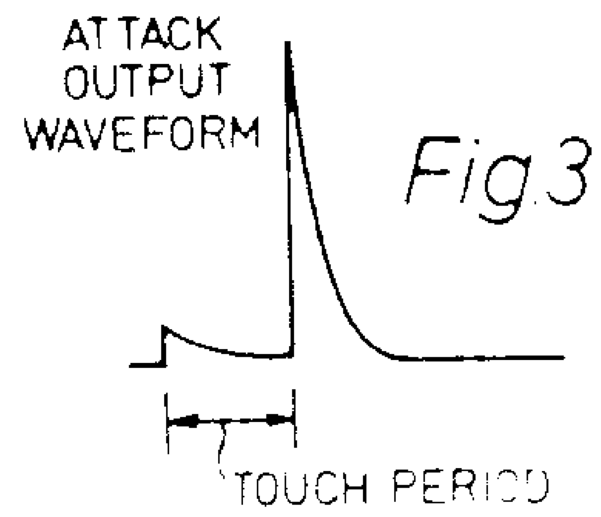
British Patent 1 559 371, dating back to May 1975, has been granted to Alan Boothman and covers the "PE Joanna". The actual patent title is however rather more formal: "Touch sensitive electronic key operated circuitry".

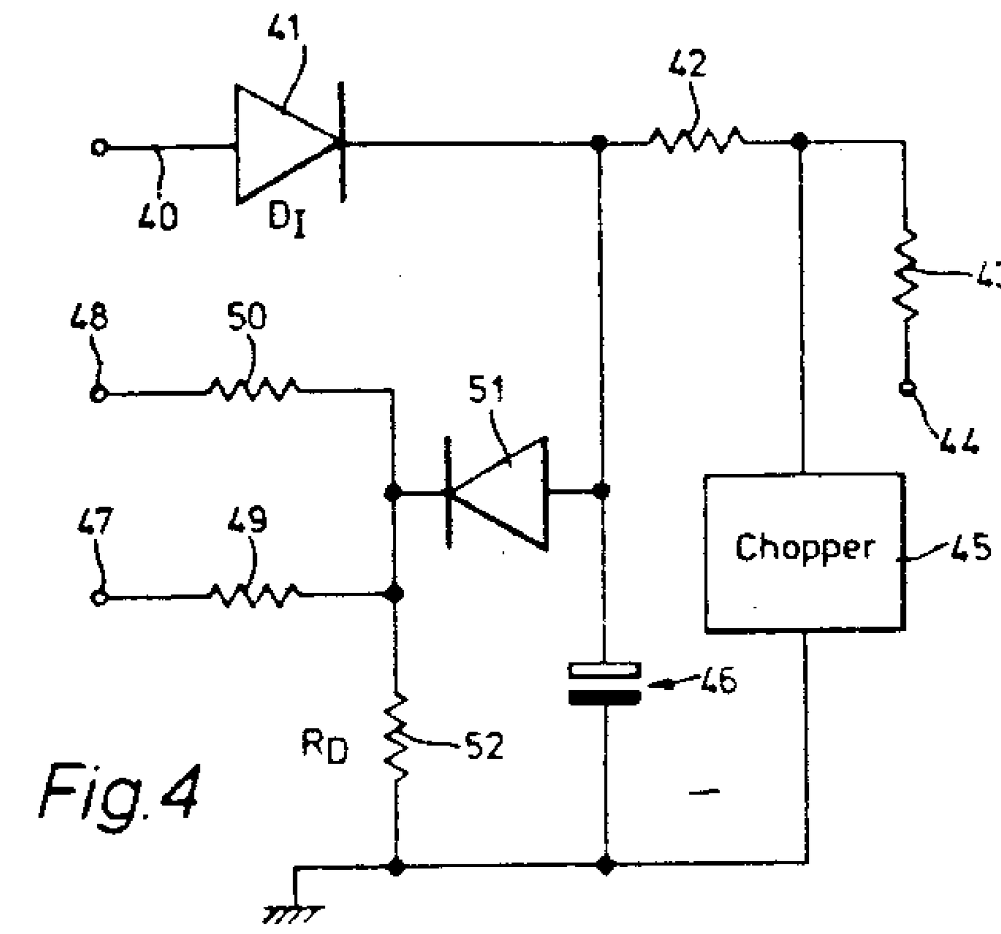
As the inventor points out in the patent introduction, past electronic keyboard instruments have suffered from the disadvantage that there is a lack of touch sensitivity i.e. the quality of a note is not affected by the manner in which the controlling key is struck. The PE Joanna offers a fair degree of touch sensitivity and Figure 1 shows the basic circuit. Capacitor 10 of capacitance



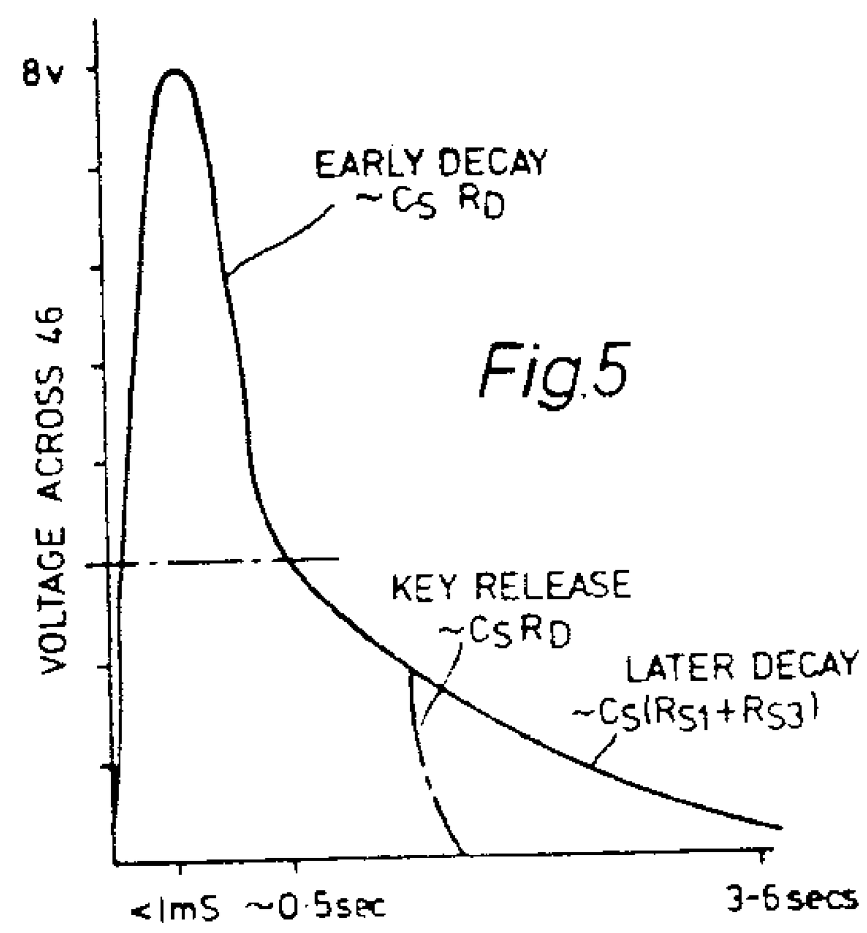
CT is connected via resistor 11 of resistance RT to voltage rail 12 at +17 volts. The junction of resistor 11 and capacitor 10 is connected to the pole of a keyboard switch 14. This pole is biassed to earth terminal 15, but finger pressure connects it to higher rail 22, at +19 volts. So when the keyboard switch is depressed the capacitor charges at rate CT.RT and to level related to the time of depression. The other side of capacitor 10 is connected via resistor 23, of value RI, to earth. A line from the junction of resistor 23 and capacitor 10 delivers a variable attack pulse signal to a circuit for controlling the decay characteristic of a tone drive signal.

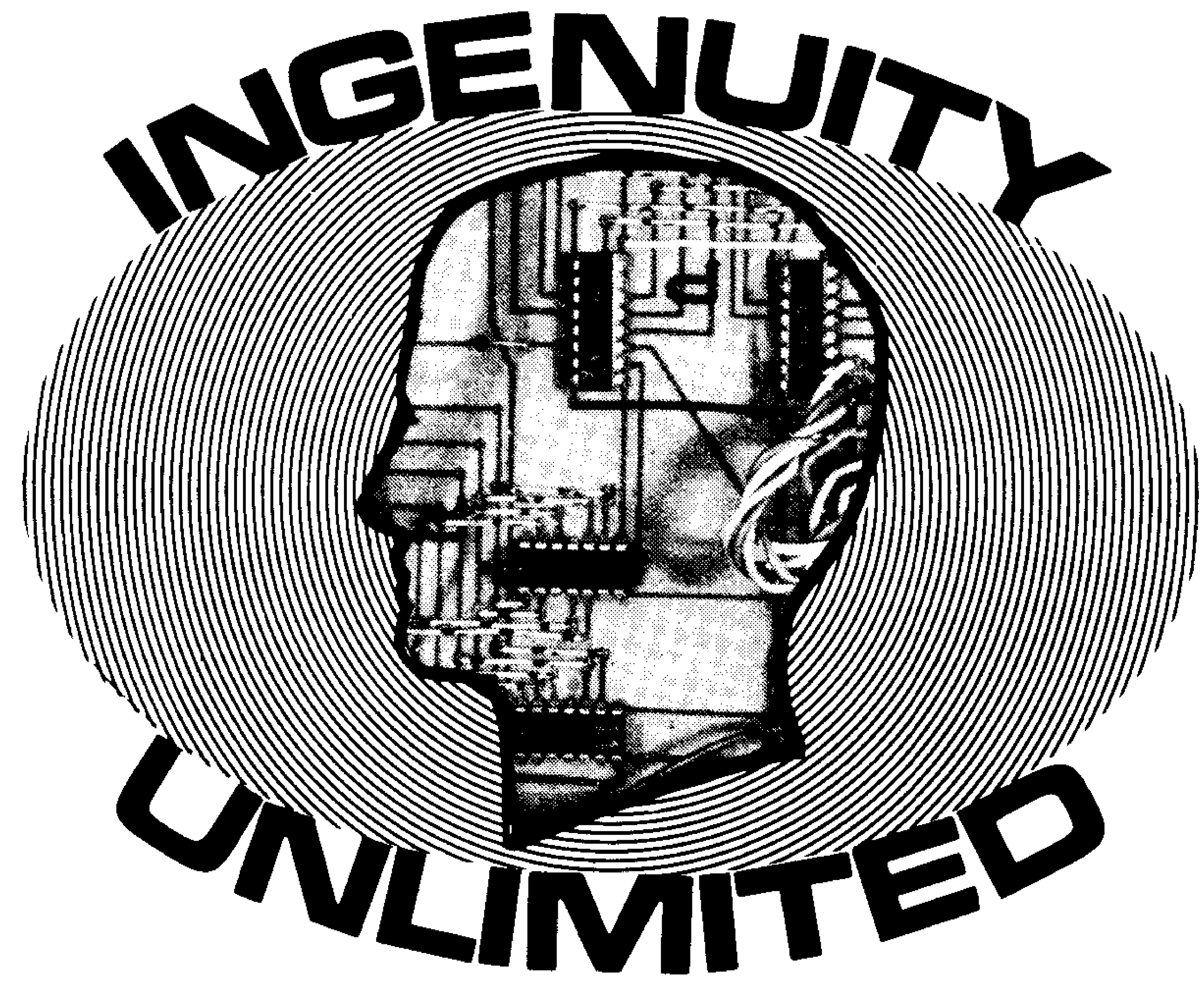
Figure 3 shows an idealised attack pulse output characteristic. There is a relatively insignificant initial positive excursion, a larger signal at the end of the touch period when the capacitor is driven directly by the voltage on line 22, and decay via resistor 23. Attack level is thus proportional to the time taken to depress the key and therefore to the average speed of depression. This approximates the hammer velocity of a piano keyboard.





The attack pulse from junction 25 of Figure 1 is fed to a wave shaping circuit shown in Figure 4. The incoming pulse charges capacitor 46 to produce a curve characteristic as idealised in Figure 5. The decay period is in two parts; the first is fast (but slower than the attack pulse) and the second is relatively slow. Figure 4 also shows damper control input 48 which is connected to the junction of capacitor 10 and resistor 11 in the attack pulse circuit of Fig. 1. Damper diode 51 holds the voltage across capacitor 46 at near zero until the voltage from line 22 is applied to raise the cathode of diode 51.





A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

Why not submit *your* idea? Any idea published will be awarded payment according to its merits.

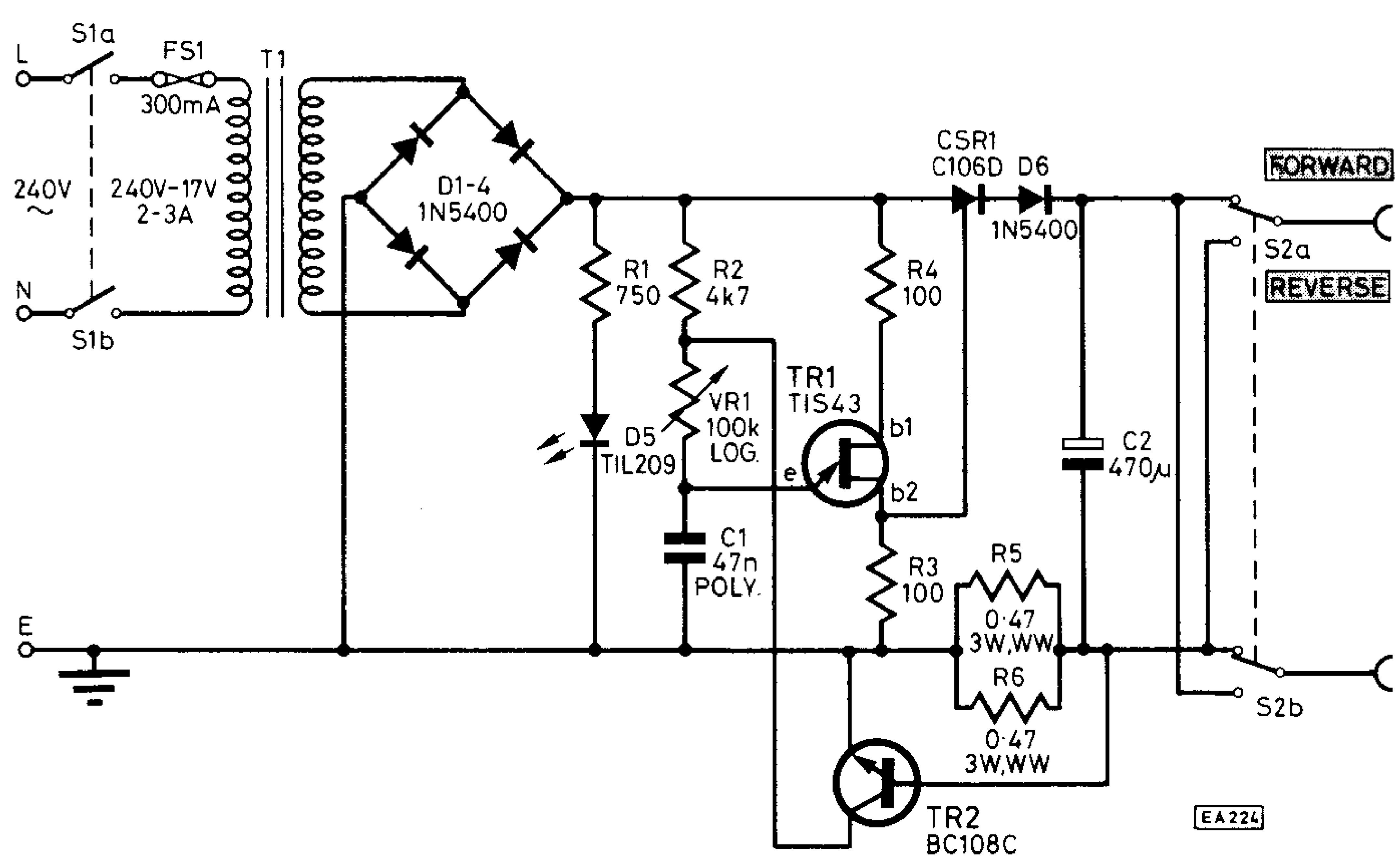
Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

Each idea submitted must be accompanied by a declaration to the effect that it has been tried and tested, is the original work of the undersigned, and that it has not been offered or accepted for publication elsewhere.

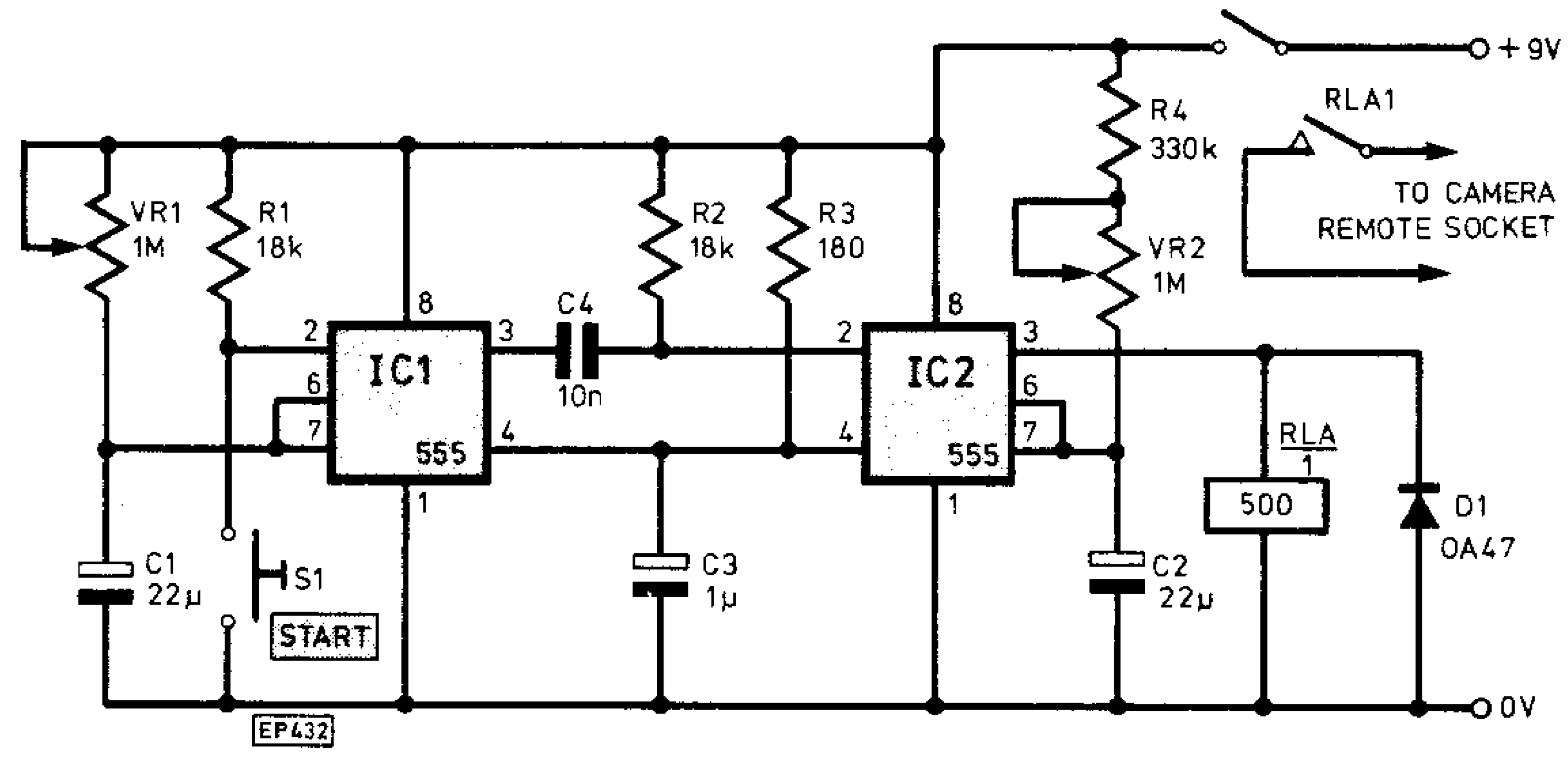
MODEL TRAIN CONTROLLER

THE circuit shown is that of a model train controller. The mains input is transformed to 17V a.c. and fully rectified by D1–D4. Speed is controlled by a unijunction time delay circuit, and varied using VR1. The pulses developed across R3 are used to fire the thyristor. The specified thyristor should be used; this was purchased from Maplin. The over-current protection formed by R5, 6 and TR2, is a standard overload device. The given resistor values cause it to cut out at a mean current of about 1·6–1·7A. Capacitor C2 and Diode D6 are included for quiet smooth running of motors. L.e.d., D5 was incorporated as an on/off indicator; a neon may also be placed across the supply. A suitable transformer is the 2A multitapped type also available from Maplin. All metal work should be earthed and the thyristor mounted on a small heat sink.

R. Hayes,
Brough,
N. Humberside.



TIMER FOR CINE-CAMERA



THIS circuit will act as a self-timer for a cine-camera with electromagnetic trigger. Two 555 monostables in cascade will give a delay time of 0–25 seconds to allow the cameraman to get into the action area. After this period the output of IC1 will go low, and trigger IC2. IC2 output is now high, and the relay energised closing RLA1 contacts. The timing components used for IC2, will give a time period of between 8 and 35 seconds. Capacitor C3 provides a negative going pulse with switch on. This ensures that both the monostables go immediately to their off-condition, that is pins 3 are low.

Odd Björkli,
Muruvik,
Norway.

TORPEDO GAME

THIS game is designed so that a target moves across a l.e.d. display. The object of the game is to send a torpedo along a 'Torpedo display' perpendicular row of l.e.d.s to intercept the target at D12.

The target moves from the left to the right, at an adjustable speed, which is controlled by VR1. The target length is also adjustable by S3, a single pole three way switch (or a single pole centre off):

Position 1 of the switch gives a target length of 1.

Position 2 of the switch gives a target length of 2.

Position 3 of the switch gives a target length of 3.

The torpedo is triggered off by push-to-break switch S2. When it has travelled down its row of l.e.d.s, it loads the shift register (IC3) with a new code ready for the next fire instruction. Because of this, a torpedo cannot be fired while one is already in motion. If the torpedo, by the operator's skill, hits the target at the cross point of D12, everything stops with it still lit. To cancel this hold situation there is a clear switch (S1), which is a push-to-make switch.

Like the target, the torpedo also has a speed or rate control, and is preset by VR2.

Both l.e.d. sets only have one current limiting resistor each, as shown. This is because all the l.e.d.s are never on together at one time. This allows all the anodes to be wired together in each display set.

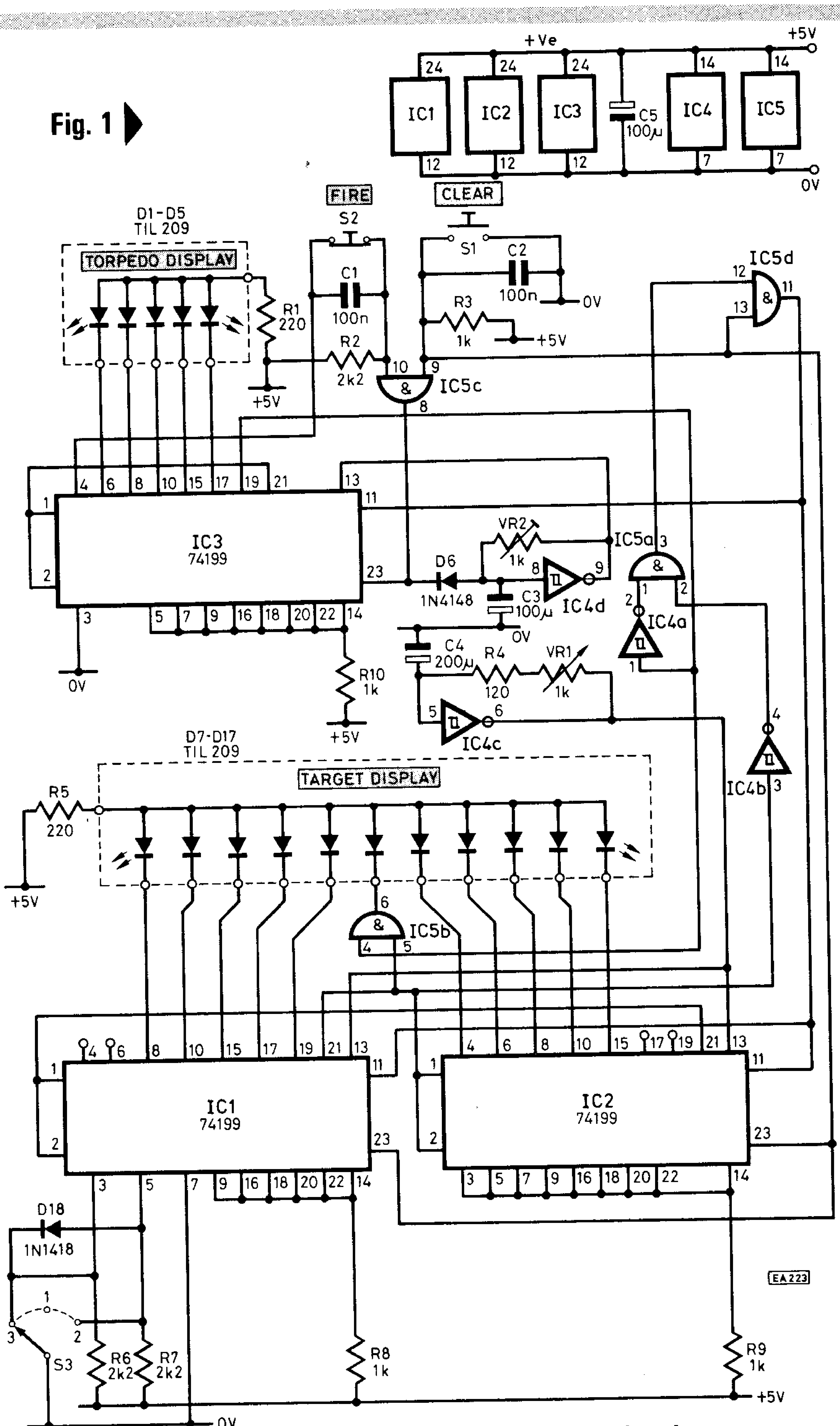
The process of making the target travel along the row is done by shifting data along two 8 bit shift registers (IC1/2) wired in series. When the clear switch is pressed data is entered into the shift registers by the parallel inputs A—H as shown. (Note: IC5-7408.)

When the clock inputs to the registers are enabled, the code stored shifts along the data lines. The rate at which the data is shifted along is determined by the SN7414 (IC4) oscillator frequency. The shift sequence is shown in the table.

The game requires a current of 200mA at 5V.

M. Crisp,
Semmington,
Wilts.

Fig. 1



	IC1								IC2							
Inputs	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
Data	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1

Fig. 2

Outputs Displayed

Clock	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1
10	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1

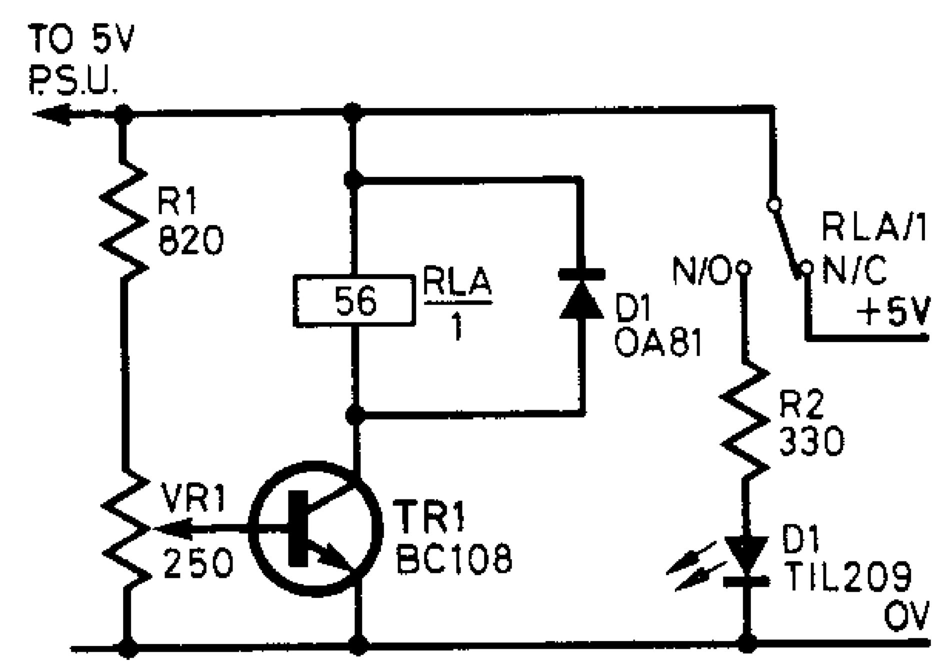
Fig. 3

TTL PROTECTION

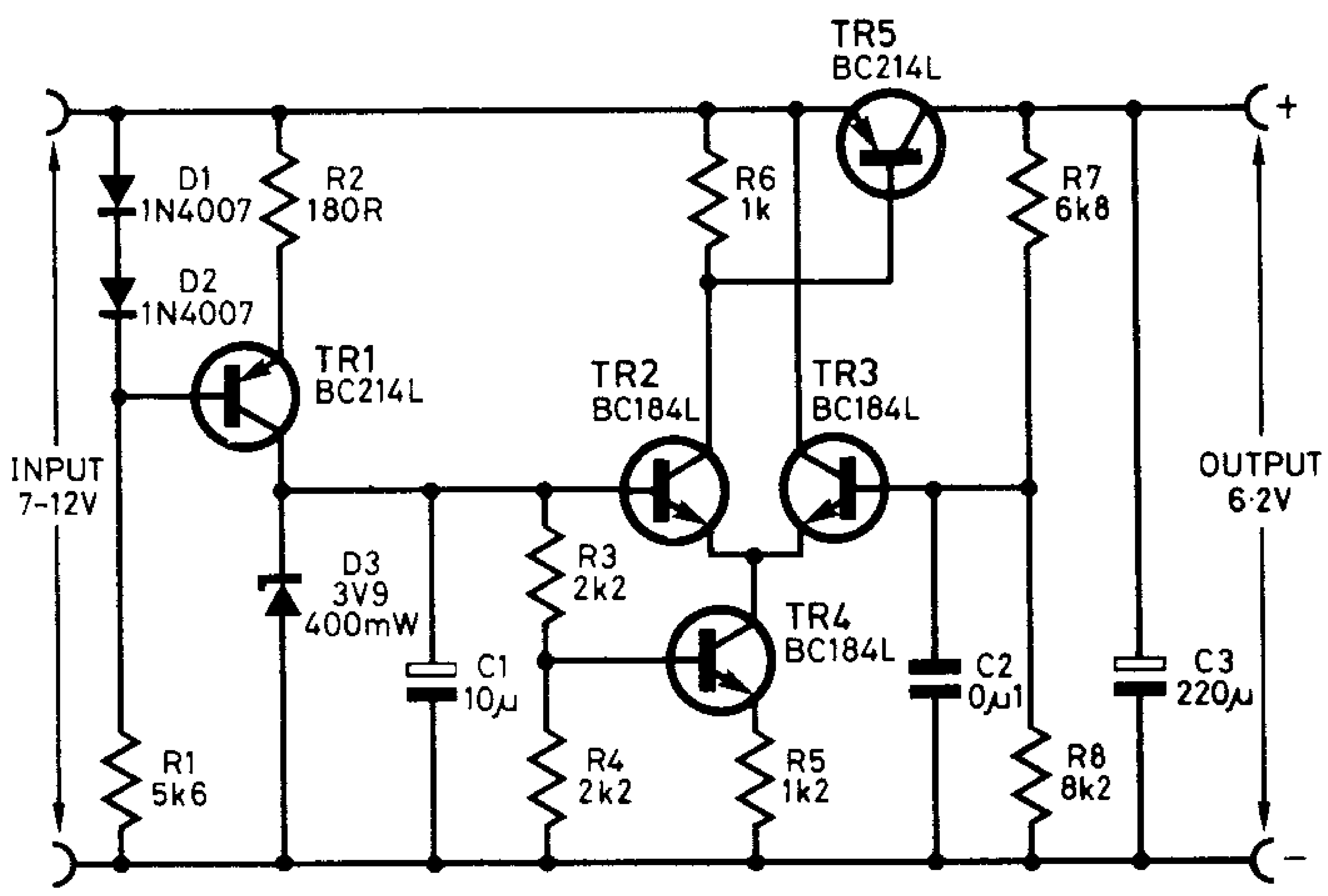
THIS circuit was devised to protect TTL when running them in soak test situations from a variable stabilised power supply, and there is a possibility that someone might alter the output voltage—possibly causing a lot of damage.

The idea is very simple, and the unit is inserted in the power lines. R1 and VR1 apply a potential to the base of TR1 such that with a nominal 5V supply, the transistor is just biased off. Should this voltage increase, TR1 switches on, opening the relay contacts, switching off the output supply, and lighting the indicator D1.

J. Piper,
Liskeard,
Cornwall.



EA213



6V REGULATED SUPPLY

EA214

THIS simple circuit was built to supply a regulated 6V to circuitry requiring around 50mA, from a 9V battery. It has better regulation than a simple Zener, and the quiescent current (about 5mA) is not so dependent upon battery voltage. It's principle advantages are a variable output voltage, set by the values of R7 and R8. A pre-set could be used if precise adjustment is required and the ability to operate with a very small regulated-to-unregulated voltage differential. For the current stated it will operate down to a battery voltage of about 6·5V, for lower currents it is even less.

The circuit action is as follows: TR1 and associated components feed a constant current to the Zener, D1. The Zener voltage is fed to one side of a comparator consisting of TR2 and TR3, current fed by TR4. The other side of the comparator is fed by the potential divider R7 and R8 from the regulated voltage, so at balance the voltage across R8 must equal the Zener voltage. The comparator controls TR5, the series regulator, to achieve this. C3 is the output decoupler, C2 prevents h.f. instability.

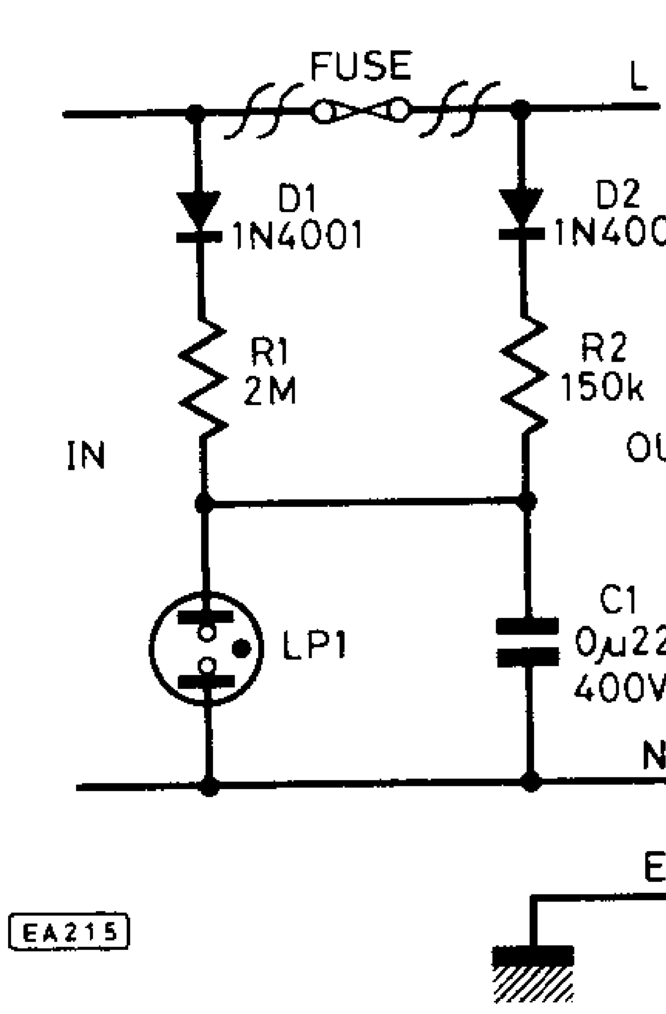
A. J. Flind,
Taunton,
Somerset.

FUSE FAILURE INDICATOR

THIS circuit was developed to indicate at a glance which fuse in my disco had blown without having to check each fuse in turn. It is useful in many applications such as on a distribution board. It can be modified to operate at lower or higher voltages or if a switch replaces the fuse one can tell if a unit is just switched off or unplugged as well e.g. a television.

With the fuse intact the neon bulb lights up with R2 dropping the mains voltage to the firing voltage of the neon. When the fuse is blown C1 charges via R1 until it reaches the neon firing voltage and then discharges through it, thus making it flash until the fuse is replaced or the appliance is unplugged.

K. A. Rochfort,
East Carleton,
Norwich.



EA215

Enter the 80's with SAXON

STEREO DISCO SYSTEMS
WITH LIGHT SHOW & DISPLAY

All systems complete with loudspeakers, leads, & 2 years warranty

STANDARD CENTAUR 100W
£299 incl. VAT — Deposit **£60**
12 mth @ **£24** or 24 mth @ **£14**

SUPER CENTAUR 200W
£399 incl. VAT — Deposit **£80**
12 mth @ **£32.03** or 24 mth @ **£18.75**

GXL 200W with PDF BINS (illus)
£489 incl. VAT — Deposit **£99**
12 mth @ **£39.16** or 24 mth @ **£22.91**

CUSTOM CENTAUR 400/600W
with four PDF 100A Bins
£899 incl. VAT — Deposit **£167**
12 mth @ **£72.19** or 24 mth @ **£42.25**

MINI DISCO 100W
MONO
£249 inc. carr. & VAT — Dep. **£50**
12 mth @ **£19.98** or 24 mth @ **£11.70**

20% DEPOSIT CREDIT TERMS

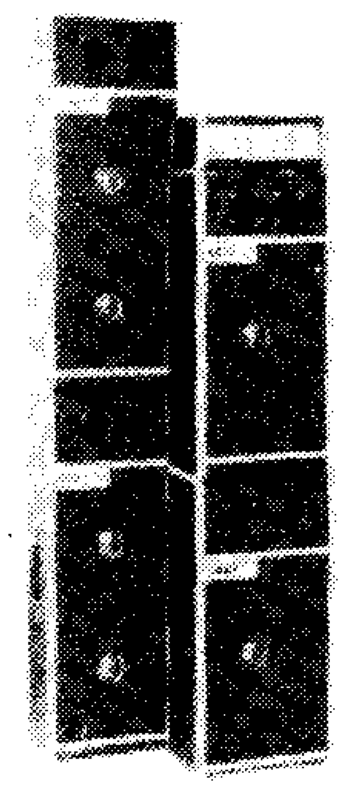
- Headphone monitor/cue light
- Full mixing/crosstape
- Tape & mic inputs
- Top Quality
- 4 channel soundlight

CARRIAGE ON COMPLETE SYSTEMS IN U.K. **£19**

P.A SYSTEMS
C/W LOUDSPEAKERS

100 WATT
£229 inc. VAT
Dep. **£46**
or 12 mth @ **£18.38**
or 24 mth @ **£10.76**

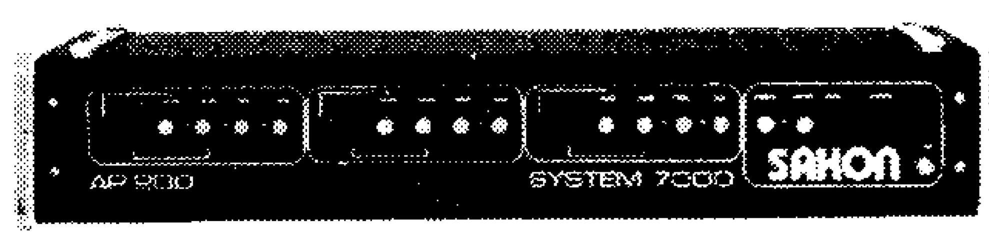
- Four mixing inputs & master
- Bass & treble controls
- Sturdy construction
- Twin Piezo cabinets



200 Watt £348.15 inc. VAT — Dep. **£70.15**
- Twin 200W cabinets — 12 mth @ **£27.92**
- Six inputs—three channels — 24 mth @ **£16.34**

JUST PLUG IN AND GO!!

AP100 AMPLIFIER £67.50
AP200 AMPLIFIER £119



SAXON ENTERTAINMENTS
333 WHITEHORSE ROAD
CROYDON
SURREY CR0 2HS
Tues-Sat 9am-5pm

ALL MAIL & CREDIT ENQUIRIES TO CROYDON TO ORDER
Send cheque/crossed POS or Telephone (01) 684 6385
Access/Barclaycard. Telephone orders accepted
For Credit Sales & Enquiries Ring
SUE ABEGG ON (01) 684 8007/0098

£30 FREE!

Vouchers with our new catalogue over 200 items of disco systems, lighting and accessories. Send **£1.00** now.

EXAMPLES:

Fuzz lights	**£26.75**
Projectors from	**£55.50**
Strobes	**£35-£220**
Rope lights 8 mt	**£59**
Disco stands	**£29.75**
Echo chambers	from **£77.50**
100W speaker	**£29.50**
10 way chaser	**£199**
100W twin horn	**£125**
800W spot bank	**£55**

Mixers, mics, amplifiers, goosenecks, light units, bubble machines, mirror balls, helicopters, bins, consoles, and much more.

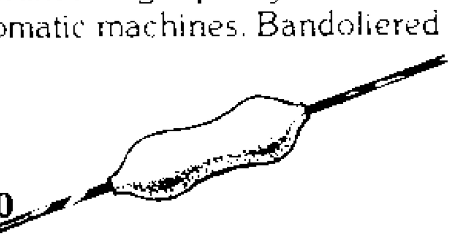
AND IF WE HAVEN'T GOT IT – WE'LL GET IT!

Full range of Pluto, D.J. Lightomation products in stock
Send £1 now for your catalogue – worth £30!!!

PARNDON ELECTRONICS LTD.

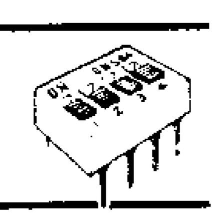
Dept. No. 21 44 Paddock Mead, Harlow, Essex, CM18 7RR. Tel: 0279 32700

RESISTORS: ¼ Watt Carbon Film E24 range ± 5% tolerance. High quality resistors made under strictly controlled conditions by automatic machines. Bandoliered and colour coded.
£1·00 per hundred mixed. (Min 10 per value)
£8·50 per thousand mixed. (Min 50 per value)
Special stock pack. 60 values. 10 off each **£5·50**



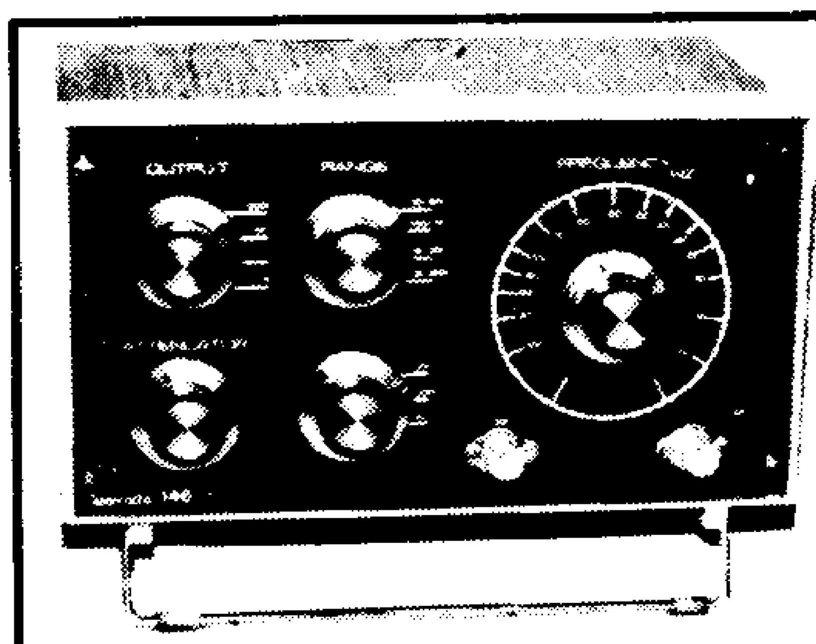
DIODES: **IN4148** 3p each. Min order quantity – 15 items.
£1·60 per hundred

DIL SWITCHES: Gold plated contact in fully sealed base – solve those programming problems.
4 Way **86p** each. 6 Way **£1·00** each. 8 Way **£1·20** each.



DIL SOCKETS: High quality, low profile sockets.
8 pin – **10p**. 14 pin – **13p**. 16 pin – **15p**. 18 pin – **19p**. 20 pin – **25p**.
22 pin – **29p**. 24 pin – **35p**. 28 pin – **39p**. 40 pin – **57p**.

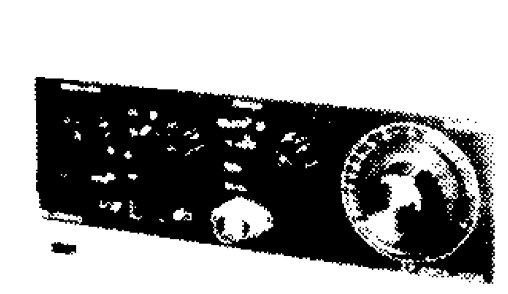
ALL PRICES INCLUDE V.A.T. & POST & PACKING — NO EXTRAS
MIN. ORDER – U.K. £1.00. OVERSEAS £5. CASH WITH ORDER PLEASE



LOW COST
AUDIO SIGNAL GENERATORS

(Sine & Square Waves)
10Hz-100kHz
Very low distortion (×0015%)
£41.40 (or in kit form) £35.65
p.p. and ins. £2

Model 146
ALSO
Model AO113. Sine/Square. 1 volt into 600 . Dist .02%. **£31.60** (Kit version **£26.50**) p.p. £1.



TELERADIO ELECTRONICS
325 Fore Street, Edmonton, London N9 OPE
S.A.E. for leaflets . . . Closed all day Thursdays . . . **01-807 3719**

DT-400S are designed and manufactured by SAFGAN in ENGLAND.

SAFGAN Presents DT-400 series from £159 + VAT
HIGH QUALITY DUAL TRACE OSCILLOSCOPES
A BRITISH PRODUCT EVERYONE CAN AFFORD

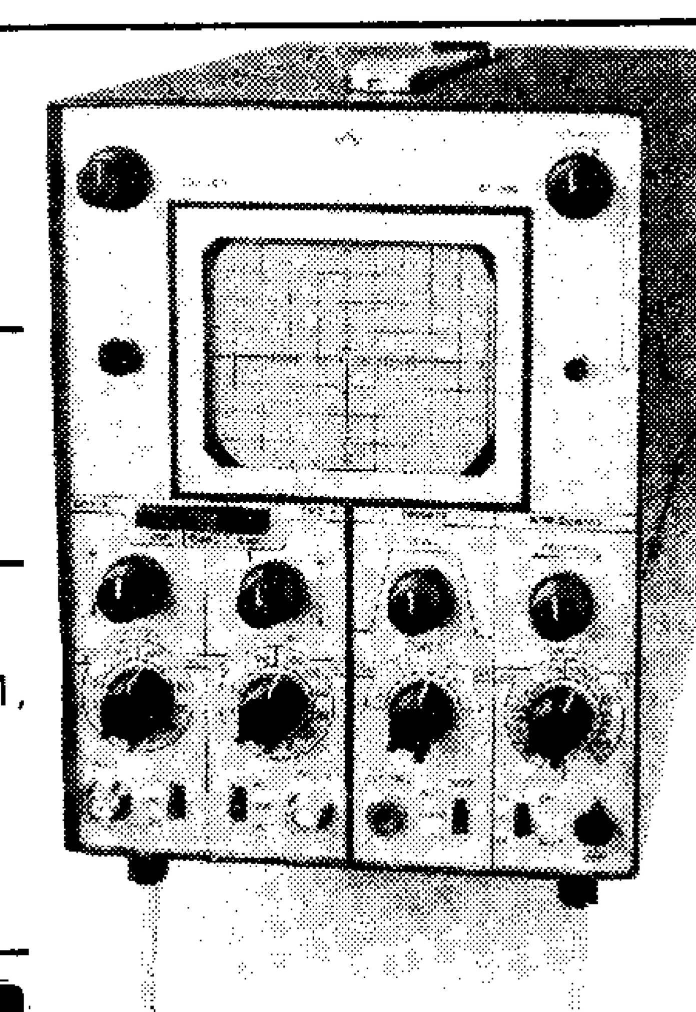
Model DT-410	4" CRT	5mv/div	10MHz	@ **£159** + VAT
Model DT-412	4" CRT	5mv/div	12MHz	@ **£172** + VAT
Model DT-415	4" CRT	5mv/div	15MHz	@ **£185** + VAT

SPECIFICATION FOR ALL MODELS

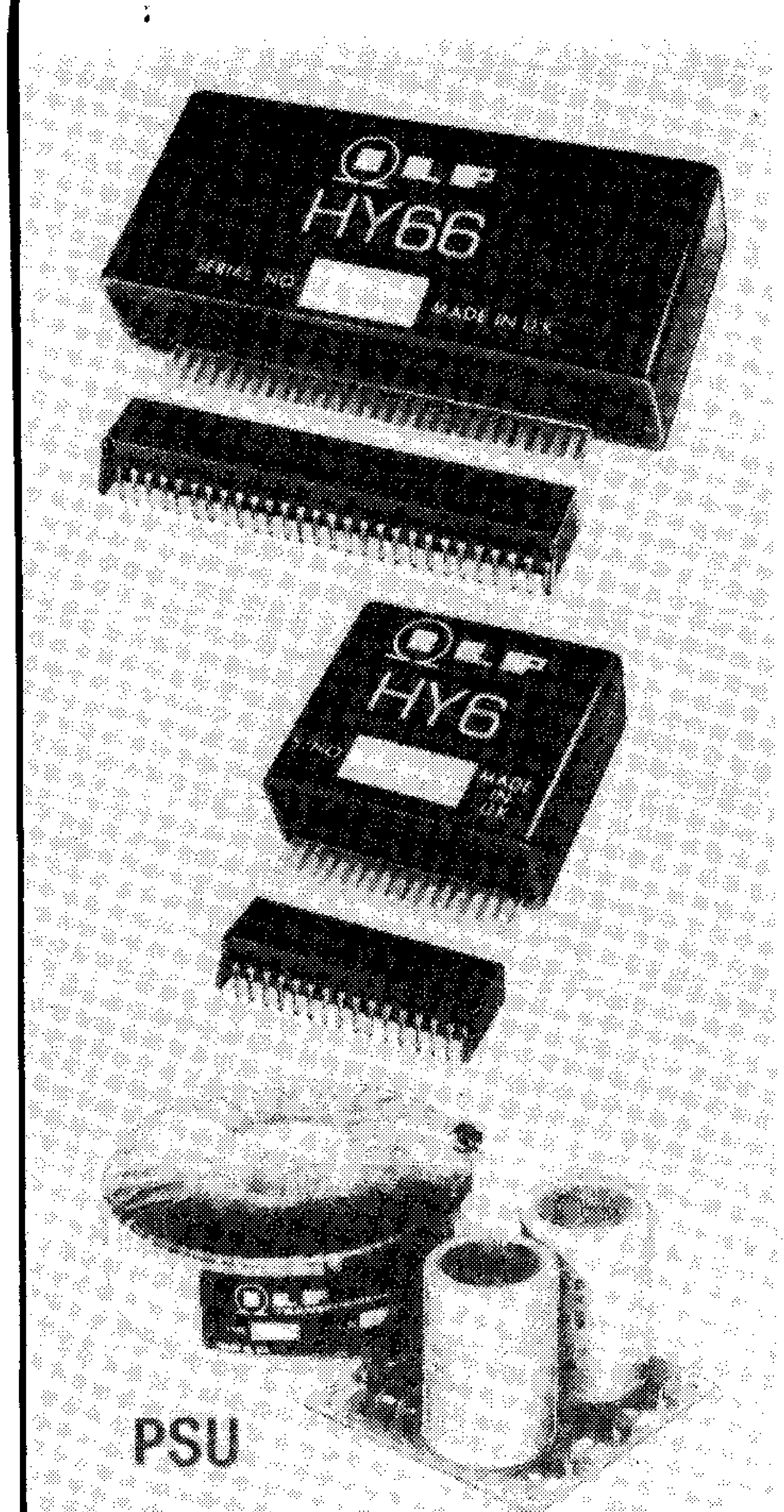
★ CH1, CH2: 5mv/div-20v/div in 12 cal steps. (1M +22pF)
★ BANDWIDTH: 10MHz (DT-410), 12MHz (DT-412) 15MHz (DT-415)
★ TIME BASE: 0.5us/div-200ms/div in 18 cal steps ×5 Expansion to 100ns/div ×5 Multiplier to 1s/div
★ XY FACILITY: Matched inputs X=CH1, Y=CH2
★ TRIGGER: Level Control, ± slope Bright Line AUTO, NORMAL, TV Triggering CH1, CH2 0.5 div; EXT Trig 100mv
★ Z Modulation. CAL output/probe compensation
★ Graticule blue ruled 8 × 10 div (6.4 × 8cm²)
★ Size: H215mm W165mm D280mm Weight 4.5kg
PROBE (X1-REF-X10) **£11.50** + VAT

ORDERS TO: **SAFGAN ELECTRONICS LTD.** (Goods + 15% +£3 P&P)
56 BISHOPS WOOD, ST. JOHNS, WOKING, SURREY GU21 3QB
OFFICIAL GOVERNMENT AND EDUCATIONAL ORDERS ACCEPTED. DISTRIBUTORS REQUIRED/PLEASE ENQUIRE.

TEL: WOKING 69560 OR WOKING 66836



DT-400 SERIES



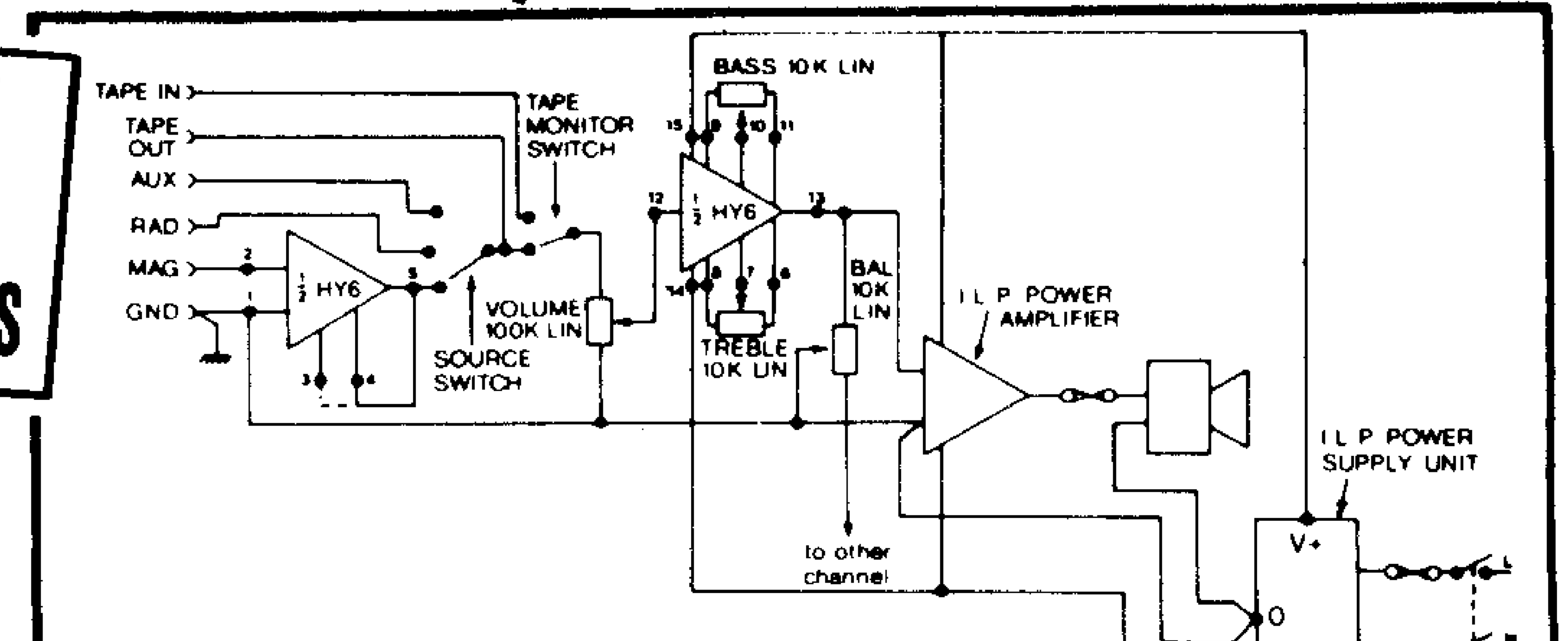
NO QUIBBLE 5 YEAR GUARANTEE
7-DAY DESPATCH ON ALL ORDERS
BRITISH DESIGN AND MANUFACTURE
FREEPOST SERVICE

NEW PRE-AMPS

HY6 (mono) and **HY66** (stereo) are new to I.L.P's range of advanced audio modules. Their improved characteristics and styling ensure their being compatible with all I.L.P power-amps both MOSFET and BIPOLAR, giving you chance to get the best possible reproduction from your equipment. HY6 and HY66 pre-amps are protected against short circuit and wrong polarity. Full assembly instructions are provided. Mounting boards are available as below.
Sizes – **HY6** – 45 x 20 x 40 mm. **HY66** – 90 x 20 x 40 mm.
Active Tone Control circuits provide ±12dB cut and boost.
Inputs Sensitivity – Mag. PU. –3mV: Mic – selectable 1-12mV: All others 100mV. **Tape O/P** – 100mV: **Main O/P** – 500mV: **Frequency response** – D.C. to 100KHz – 3dB.

HY6 mono £5.60 + 84p VAT Connectors included
HY66 stereo £10.60 + £1.59 VAT Connectors included
B6 Mounting Board for one HY6 78p + 12p VAT
B66 Mounting Board for one HY66 99p + 15p VAT

COMPATIBLE WITH ALL ILP MODULES



SCHEMATIC BLOCK DIAGRAM OF HY6 PRE AMP, WITH STEREO CONNECTION SHOWN

- **DISTORTION TYPICALLY 0.005%**
- **S/N RATIO – 90dB (Mag. P.U. – 68 dB)**
- **38 dB overload margin on Mag. P.U.**
- **LATEST DESIGN HIGH QUALITY CONNECTORS**
- **ONLY POTS, SWITCHES AND PLUGS/SOCKETS NEED ADDING**
- **NEEDS ONLY UNREGULATED POWER SUPPLY ±15 to ±60v**

NEW POWER SUPPLY UNITS

IN A RANGE OF 11 MODELS USING LATEST TOROIDAL TRANSFORMERS

Of the eleven power supply units which comprise our current range, nine have toroidal transformers made in our own factory. Thus these I.L.P power supply units are space-saving, more efficient and their better overall design helps enormously when assembly building. All models in the range are compatible with all I.L.P amps and pre-amps with types to match whatever I.L.P power amps you choose.

PSU30 ±15V at 100mA to drive up to 12 x HY6 or 6 x HY66	**£4.50** + 0.68p VAT
● *THE FOLLOWING WILL ALSO DRIVE I.L.P PRE-AMPS*	
PSU36 for use with 1 or 2 HY30's	**£8.10** + £1.22 VAT
● *ALL THE FOLLOWING USE TOROIDAL TRANSFORMERS*	
PSU50 for use with 1 or 2 HY60's	**£9.75** + £1.46 VAT
PSU60 for use with 1 HY120	**£9.75** + £1.46 VAT
PSU65 for use with 1 MOS120	**£9.75** + £1.46 VAT
PSU70 for use with 1 or 2 HY120's	**£13.61** + £2.04 VAT
PSU75 for use with 1 or 2 **MOS120**	**£13.61** + £2.04 VAT
PSU90 for use with 1 HY200	**£13.61** + £2.04 VAT
PSU95 for use with 1 **MOS200**	**£14.75** + £2.21 VAT
PSU180 for use with 1 HY400 or 2 HY200	**£23.02** + £3.45 VAT
PSU185 for use with 1 or 2 **MOS200**	**£24.20** + £3.63 VAT

1971-1980
TEN YEARS OF PLANNED PROGRESS

When, in 1971, Ian L. Potts founded his now world-famous company, he saw the need for a different and more rational approach to exploiting to the full, the potential that lay in modular construction. New thinking was badly needed. The result was a range of modules revolutionary in concept. The rightness of this new thinking is shown by the size of the company today, its new factory, its vast exports, its acceptance by constructors as *the* modules to build with. The range grows bigger and better. Exciting new lines (in no way conflicting with existing ones) are well past drawing board stage. This is why I.L.P are simply ahead and staying there.

★ **Freepost facility**
When ordering or writing about I.L.P products, you do not need to stamp the envelope. Mark it FREEPOST plus the code shown in the address below. We pay the postage for you.

★ **TO ORDER** Send cheque or money order payable to I.L.P Electronics Ltd and crossed. Or pay by ACCESS or BARCLAYCARD. Cash payments must be in registered envelope; if C.O.D. payment is wanted, please add £1.00 to TOTAL value of order.

BRITAIN'S FASTEST GROWING MODULE SUPPLIERS

To: I.L.P ELECTRONICS LTD. CANTERBURY CT2 7EP

Please supply ....

.... Total purchase price £ ....

I enclose Cheque ☐ Postal Orders ☐ International Money Order ☐

Please debit my Access/Barclaycard Account No. ....

....

NAME ....

ADDRESS ....

....

Signature ....

ALL U.K. ORDERS DESPATCHED POST FREE

I.L.P ELECTRONICS LTD.

FREEPOST 2 Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.
Telephone (0227) 54778 [Technical (0227) 64723] Telex 965780

Available also from MARSHALLS, WATFORD ELECTRONICS and certain other selected retailers

TRANSFORMERS + VAT 15%

CONTINUOUS RATINGS

All voltages given are at full load

30 VOLT RANGE (Split Sec)

Pri 220/240 Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V or 15V-0-15V.

Ref.	Amps ←		Price	P&P
112	.5	1 15V	**2.90**	0.90
79	1	2 O	**3.93**	1.10
3	2	4 N	**6.35**	1.10
20	3	6 L	**7.39**	1.31
21	4	8 Y	**8.79**	1.31
51	5	10 ←	**10.86**	1.52
117	6	12	**12.29**	1.67
88	8	16	**16.45**	1.89
89	10	20	**18.89**	1.89
90	12	24	**21.09**	2.24
91	15	30	**24.18**	2.39
92	20	40	**32.40**	O.A.

50 VOLT RANGE (Split Sec)

Pri 220/240V Voltage available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 240V-0-20V or 25V-0-25V.

Ref.	Amps ←		Price	P&P
102	.5	1 25V	**3.75**	0.90
103	1	2 O	**4.57**	1.10
104	2	4 N	**7.88**	1.31
105	3	6 L	**9.42**	1.52
106	4	8 Y	**12.82**	1.73
107	6	12 ←	**16.37**	1.89
118	8	16	**22.29**	2.39
119	10	20	**27.48**	O.A.
109	12	24	32.88	O.A.

MAINS ISOLATORS (SCREENED)

Pri 0-120; 0-100-120V (120, 220, 240V) Sec 60-55-0-55, 60 twice, to give 55, 60, 110, 115, 120, 125, 175, 180, 220, 225, 230, 235, 240.

Ref	VA	Price	P & P
*07	20	**4.84**	0.91
149	60	**7.37**	1.10
150	100	**8.38**	1.31
151	200	**12.28**	1.31
152	250	**14.61**	1.73
153	350	**18.07**	2.12
154	500	**22.52**	2.47
155	750	**32.03**	O.A.
156	1000	**40.92**	O.A.
157	1500	**56.52**	O.A.
158	2000	**67.99**	O.A.
159	3000	**95.33**	O.A.

*Pri 0-220-240V Sec 115 or 240V. State sec. volts required.

CASED AUTO TRANSFORMERS

240V cable in 115V USA flat pin outlet.

VA	Price	P & P	Ref
20	**6.55**	1.03	**56W**
75	**8.50**	1.31	**64W**
150	**11.00**	1.31	**4W**
250	**13.39**	1.67	69W
500	**20.13**	1.89	67W
1000	**30.67**	2.65	84W
2000	**54.97**	O.A.	95W

AUTO TRANSFORMERS

Voltages available 105, 115, 190, 200, 210, 220, 230, 240. Voltage for step up or step down.

Ref.	VA	£	P & P
113*	15	**2.73**	0.81
64	80	**4.41**	1.10
4	150	**5.89**	1.10
53	350	**10.08**	1.31
67	500	**12.09**	1.91
84	1000	**20.64**	2.39
93	1500	**25.61**	O.A.
95	2000	**38.31**	O.A.
73	3000	**65.13**	O.A.
80S	4000	**84.55**	O.A.
57S	5000	**98.45**	O.A.

*0, 115, 220, 240.

12 OR 24V OR 12-0-12V

Pri 220-240 volts

Ref	Amps 12V	Amps 24V	Price	P&P
111	0.5	0.25	**2.42**	0.52
213	1.0	0.5	**2.90**	0.90
71	2	1	**3.86**	0.90
18	4	2	**4.46**	1.10
85	5	2.5	**6.16**	1.10
70	6	3	**6.99**	1.10
108	8	4	**8.16**	1.31
72	10	5	**8.93**	1.31
116	12	6	**9.89**	1.52
17	16	8	**11.79**	1.80
115	20	10	**15.37**	2.39
187	30	15	**19.72**	2.39
226	60	30	**40.41**	O.A.

60 VOLT RANGE (Split Sec)

Pri 220/240V Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24-0-24V or 30V-0-30V.

Ref.	Amps ←		Price	P&P
124	.5	1 30V	**4.27**	1.10
126	1	2 O	**6.50**	1.10
127	2	4 N	**8.36**	1.31
125	3	6 L	**12.10**	1.31
123	4	8 Y	**13.77**	2.12
40	5	10 ←	**17.42**	1.89
120	6	12	**19.87**	2.12
121	8	16	**27.92**	O.A.
122	10	20	**32.51**	O.A.
189	12	24	**37.47**	O.A.

CONNECTORS

Thorn, Cannon, Plessey, Bendix, Greenpar now available.

Soldering Iron – 25W to BS spec. **£1·75** +30p P&P + VAT.

100W Solder Gun bulb for spot on vision and joints **£7·50** + P&P 70p + VAT.

De-solder Pumps – Spring loaded with quick action button release for one handed working. **Large £5·10** + P&P 35p + VAT. **Small £4·75** + P&P 30p + VAT. Replacement tips. **Small 65p** + VAT. **Large 86p** + VAT.

Bridge Rectifier

100V	25A	**£2.80**
200V	4A	**.52**
200V	4A	**.75**
400V	4A	**.98**
400V	6A	**£1.44**
500V PM7A6	12A	**£3.75**

P & P 17p VAT 15%

20,000 ohm/V Multimeter mirror. Scale ranges AC/DC to 1000V DC current to 250ma. Resistance to 3 M Ohms 5"×3½×1¼ **£14·36.** P.&P. £1·00. VAT 15%.

AVO TEST METERS

8 MK5	**£106.40**
71	**£43.10**
73	**£58.60**
MM5 minor	**£36.90**
Wee Megger 500V (WN4/3)	**£87.00**
TT169 in circuit transistor tester	**£45.00**
EM272 316KΩ per volt	**£67.10**
DA116 digital	**£108.90**
BM7 Megger	**£58.60**

All Avos Meggers and accessories available P&P £1·32 15% VAT

Antex Soldering Irons 15W, 25W **£4.58. Safety Stand £1.75** P&P 52p each.

NEW RANGE TRANSFORMERS

0-36-48 twice to give 36-0-36 48-0-48V, 60V, 72V, 84V, 96V.

Amps	Ref	Price	P.&P.
0.5	430	**4·88**	0·76
1	431	**8·12**	0·99
2	432	**13·35**	1·31
3	433	**16·17**	1·40
4	434	**20·65**	2·11
5	435	**29·30**	2·47
6	436	**36·69**	O.A.
8	437	**40·03**	O.A.

15V Range 0-C Tap (7·5V-0-7·5V)

171	500mA	**2·30**	0·52
172	1A	**3·26**	0·92
173	2A	**3·95**	0·90
174	3A	**4·13**	0·99
175	4A	**6·30**	1·10

U4315 Budget Meter 20Kv/Ω Ranges to 1000V, 2·5A AC/DC 500K Res. In steel case **£15·85** P&P £1·32

SPECIAL OFFER Multimeter (20KΩB/V with combined audio/I.F. test oscillator at 1KHz. and 465 KHZ. AC/DC to 1000 volts. DC current to 500 MA resistance to 1M size 160 · 97 · 40mm **£8·50.** P&P £1·00. VAT 15%

Burglar Alarm – Ultrasonic 20ft range no. installation costs. Key operated; built in siren (external can be added). Looks like a speaker. **£98·00** £2·00 P&P - VAT.

TRANSFORMERS END OF LINE OFFERS

30-Isolator 240V:240V 200VA **£4·54** £1·04

M616 – 240V: Screen 1) 13-0-13 1A. 2) 12V 150ma **£1·50** 60p

M489 – 240V: 1400V @ 150ma 6.3V @ 4A. **£5·50** £1·04

M708 – 6K to 3Ω matching transformer 5W **90p** 40p

M679 · 120V · 2; 36V 1 6A **£3·00** 78p

M865 – 100V Line to 4Ω 10 watts **£1·90** 60p

M1020 – 0-240V 12-0-12V @ 50ma **75p** 41p

M1126 – 120/240V: 9-0-9V @ 1A **£1·79** /1p

Split Bobbin Type – 0-12-15-20-24-30V. Ref 009 – 1 Amp **£2·98.** P. & P. £1·10. Ref 010 – 2 Amp **£4·65.** P. & P. £1·10 open frame fixing. Other types available.

ABS Plastic Boxes: inset brass nuts, slots to take P.C. cards (boards) flush fitting lid.

PBI – 80mm × 62 × 40 **80p**	P&P
PB2 – 100mm × 75 × 40 **90p**	33p
PB3 – 120mm × 100 × 45 **£1.04**	+ VAT
PB4 – 215mm × 130 × 85 **£2.68**	

"Educational" Meters (Moving coil) 0-10A. 0-15V. 0-30V. - Free standing large scale easily read meters with top screw terminals for quick connections.

Size 75 × 78mm scale **£4·50** P&P 66p + VAT

Plus in Save Batteries – Plug into 13 amp socket 3-6-7.5,, 9-12V @ 100ma to 400ma **£4.60** + P&P 60p + VAT.

PANEL METERS

43mm · 43mm		82mm · 78mm	
0-50μA	**6.20**	0-50μA	**6.70**
0-500μA	**5.95**	0-500μA	**6.70**
0-1mA	**5.95**	0-1mA	**6.70**
0-30V	**5.95**	0.30V	**6.70**

VU ind. Panel 48mm × 45mm or 40mm × 40mm 250μA fsd. **2·60**

SV041 Edge VU centre zero fsd **£2·60**

Carriage 76p VAT 15%

Metal Oxide Resistors ¼W 5% **£1·00** per 100. A bargain. Use instead of Carbon Film! In 100's only. 30p P&P + VAT.

390Ω/470Ω/510Ω/560Ω/820Ω/1K/1K1/1K2 1K6/1K8/2K/2K4/3K/16K/20K/22K/24K/47K/82K/ 100K/110K/120K/130K/180K/220K/270K/300K

SCREENED MINIATURES

Ref	mA	Volts	£	P&P
238	200	3-0-3	**2·83**	0·63
212	1A, 1A	0-6, 0-6	**3·14**	0·90
13	100	9-0-9	**2·35**	0·44
235	330, 330	0-9, 0-9	**2·19**	0·44
207	500, 500	0-8-9, 0-8-9	**3·05**	0·85
208	1A, 1A	0-8-9, 0-8-9	**3·88**	0·90
236	200, 200	0-15, 0-15	**2·19**	0·44
214	300, 300	0-20, 0-20	**3·08**	0·90
221	700(DC)	20-12-0-12-20	**3·75**	0·90
206	1A, 1A	0-15-20-0-15-27 ×2	**5·09**	1·10
203	500, 500	0-15-27-0-15-20×2	**4·39**	1·10
204	1A, 1A	0-15-27-0-15-27×2	**6·64**	1·10
239	50	12-0-12	**2·88**	0·43
234	500	6	**2·19**	0·44

Send 20p stamp for catalogue

Prices correct 1·8/80

Barrie Electronics Ltd.

3, THE MINORIES, LONDON EC3N 1BJ

TELEPHONE: 01–488 3316/7/8

NEAREST TUBE STATIONS: ALDGATE & LIVERPOOL ST

J. BIRKETT

(Partners: J. H. Birkett. J. L. Birkett)

Radio Component Suppliers

25 The Strait, Lincoln. LN2 1JF

SINCLAIR NI-CAD BATTERY CHARGER @ **£3.30.**
SUB-MINIATURE MULLARD DISC CERAMICS 1000pf 63v.w. @ **25p** doz.
MULLARD TYPE 808 FILM TRIMMERS 4pf, 8pf, 20pf, 60pf All **15p** each.
SOLDER-IN FEED THRU's 6.8pf, 27pf, 300pf, 1000pf, All **20p** doz.
EDDYSTONE TRANSMITTING VARIABLE CAPACITOR 30+30pf (60pf) @ **£2.20.**
SPECIAL VISCONAL CAPACITORS 0.05uf 1Kv @ **25p,** 0.0005uf 25Kv @ **40p,** 0.05uf 10Kv @ **50p,** 0.0005uf 75Kv @ **75p.**
ELECTROLYTICS 16+16uf 450v.w., @ **25p,** 50+50uf 450v.w. @ **40p.**
AIR SPACED MINIATURE VARIABLES 250+250pf (500pf) @ **85p.**
50. BC 107-8-9 METAL TRANSISTORS Assorted untested @ **60p.**
VERNITRON FM4 10.7MHz FILTERS @ **50p,** 3 for **£1.**
SUB-MINIATURE AIR SPACED TRIMMERS 10pf @ **20p** each.
VHF-UHF FETS BF 256C @ 4 for **75p,** E304 @ **30p,** 4 for **£1.**
MINIATURE 12 WAY CERAMIC TAG STRIPS @ **15p,** 21 Way @ **20p.**
3 GANG VARIABLES 10+10+10pf @ **75p.**
2N918 VHF TRANSISTOR @ **25p, STRIPLINE** BF 362 @ **25p.**
ERIE RED CAP MINIATURE DISC .01uf 100v.w. @ **5p** each.
10.7MHz CRYSTAL FILTERS Bandwidth ±7.5KHz @ **£5.**
TRANSMITTING PRE-SET BUTTERFLY VARIABLE CAPACITORS 25×25pf @ **50p,** 38×38pf @ **60p,** 38×38pf Wide Spaced @ **65p.**
X BAND GUNN DIODES with data @ **£1.65.**
H.P. HOT CARRIER DIODES 5082-2800 @ **40p** each.
X BAND MULTIPLIER DIODES @ 6 for **£1.**
3/16" COIL X FORMERS with core @ 6 for **25p.**
TTL I.C's House Coded 7400 @ **10p,** 7410 @ **10p,** 74L00 @ **10p,** 7453 @ **10p,** 7430 @ **10p,** All at 6 for **50p.**
VHF WIRE ENDED R.F. CHOKES 30U.F., 25 for **50p.**
PAPER CAPACITORS 10uf 370VAC size 5½"×2½"×1½" @ **£1.50.**
NKT 274 or NKT 214 PNP TRANSISTORS @ 6 for **50p.**
50. OC 71 TRANSISTORS untested @ **75p.**
80 METRE CRYSTALS 10X Type 3642.5KHz, 3750KHz. Both **40p** each.
144MHz 10X CRYSTALS 8010KHz, 8050KHz Both **40p** each.
B7G GLASS CRYSTALS 327.56KHz, 327.86KHz, 10.025MHz, Dual Type 20.1875MHz +20.2375MHz Wire ended. All at **50p** each.
3 GANG VARIABLES Air Spaced 365+365+365 SM Drive @ **95p.**
VHF SIGNAL TRANSISTORS 2N918 @ **25p,** 2N5179 @ **50p,** 2N5180 @ **50p, AF239** @ **50p,** 2N4123 @ **15p.**
UHF POWER MODULE 50mW Input 2.5 Watt Out 420-480MHz 13 Volt 50 Ohm Type BGY 22C with data @ **£12.50.**
VERY USEFUL HF-VHF POWER TRANSISTORS 587BLY 27MHz to 70MHz SSB, FM 40 Watt 24 Volt with data @ **£3.**
BLY55 175MHz 4 Watt 12 Volt with data @ **£2.50.**
BLY97 24 Volt 175MHz 4 Watt with data @ **£3.**
BFR64 470MHz 13 Volt 3 Watt with data @ **£4.**
VHF POWER TRANSISTORS Unmarked good 2N3866 @ 3 for **75p.**
2GHz STRIPLINE NPN TRANSISTORS @ **£1** each.
5GHz LOW NOISE STRIPLINE with data sheets @ **£3.**
PIN DIODES FOR TRANSMIT-RECEIVE IN MOBILE RADIOS Pass 1 Amp RMS with data @ **40p** each.
500MTR REEL OF OVC CABLE 13 Strand .019 @ **£10.** Carr. Paid.
SUB-MINIATURE COIL FORMERS with core Dia. 4mm 9mm Long @ **7p.** 6 for **35p.**
MIKE INSERTS TYPE YA8548 @ **40p** each.
HIGH POWER VHF TRANSISTOR 45 Watt 175MHz 28 Volt FM or SSB 5 watt Drive 570 BLY with data @ **£8.20.**

Postage 30p. Orders over £3 post paid.

Rapid Electronics

- **Guaranteed same day Despatch**
- **Quality Product**
- **Vast Stocks**
- **Free Catalogue**
- **Competitive Prices**

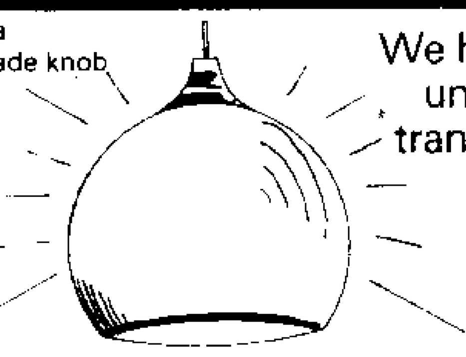
Pack			Pack		
A10	10 PP3 battery leads	**50p**	F11	10 BC108 trans.	**90p**
A72	10 3.5mm jack plugs	**80p**	F26	10 2N3704 trans.	**80p**
A73	10 3.5mm jack sockets	**80p**	F27	10 2N3819 trans.	**190p**
A74	10 Std. jack plugs	**130p**	H11	20 1N4002 diodes	**75p**
A75	10 Std. jack sockets	**170p**	H50	20 OA91 diodes	**110p**
A84	10 5 pin 180 DIN plug	**120p**	H60	100 1N4148 diodes	**180p**
A85	10 5 pin 180 sockets	**100p**	H70	5 C106D thyristors	**200p**
C20	10 Min. slide switch	**130p**	J10	20 0.2in. red LEDs	**170p**
C30	10 Push to make sw.	**130p**	J15	50 0.2in. red LEDs	**400p**
C31	10 Push to break sw.	**170p**	J20	100 0.2in. red LEDs	**750p**
C40	Pair Ultrasonics	**350p**	J30	20 0.2in. green LEDs	**280p**
C32	Subminn. SPST toggle	**60p**	J50	20 0.2in. yellow LEDs	**280p**
C33	Subminn. DPDT toggle	**80p**	J80	4 FND500 CC displays	**350p**
C50	20 Texas 8 pin sockets	**170p**	K5	5 741 op amps.	**90p**
C51	20 Texas 14 pin sockets	**200p**	K40	1 LM324 op amp.	**50p**
C52	20 Texas 16 pin sockets	**220p**	K20	5 CA3140 op amps.	**225p**
E10	Resistor kit. 10 ea value ¼W 4.7Ω 1M.650 resistors	**480p**	K85	5 NE555 timers	**110p**
			L8	5 4011 CMOS	**130p**
E34	10 10u 25V radial elec	**50p**	L9	4013 CMOS	**40p**
E37	10 100u 25V radial	**75p**	L11	4017 CMOS	**75p**
E44	10 1u 35V tantalum	**100p**	L19	4049 CMOS	**45p**
E54	10 0.1 C280 polyester	**50p**	M20	Dalo pen	**80p**

- **For quality components at competitive prices by return of post Rapid Electronics must be your first choice!**

All prices include VAT. Please add 50p postage and packing. Send SAE for our complete catalogue.

Rapid Electronics Limited
Hillcroft House, Station Road, Eynsford, Kent

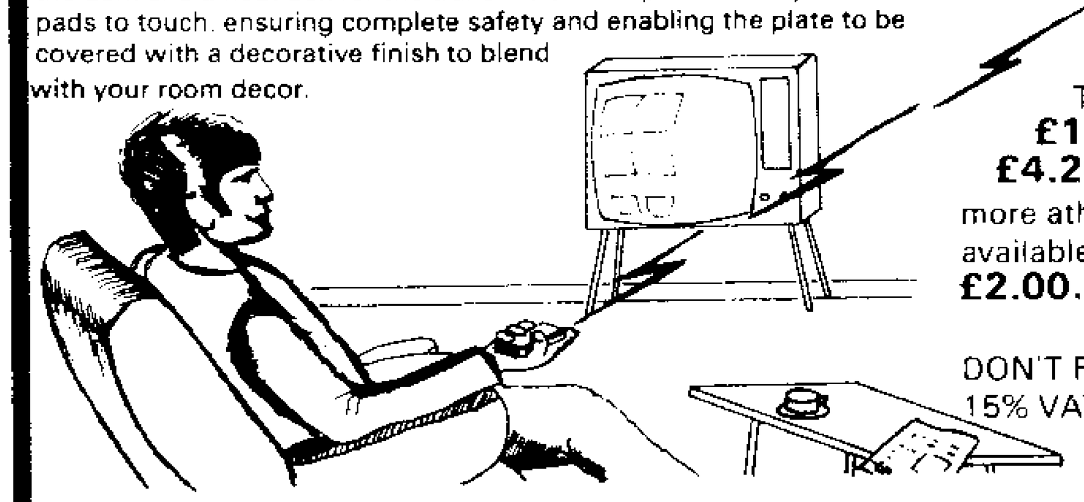
AND NOW A DIMMER THAT MAKES TOUCH DIMMERS OBSOLETE



Two years ago TK Electronics launched a touchdimmer kit, the TD300K, which made knob controlled dimmers obsolete. This was such a great success that many magazines and more retailers soon produced similar designs. SO THAT OTHERS MAY FOLLOW, TK have designed a touch dimmer kit with an Infra Red Remote Control, enabling you to switch and control the brightness of your lights from the comfort of your armchair etc. (as well as manually by touching the frontplate or by using the TDE/K extension kit).

As with all our kits, these units come complete with all components, **including** RFI suppression, frontplate, a neon to help you find the switch in the dark and a neat box for the transmitter. The plastic frontplate has no metal pads to touch, ensuring complete safety and enabling the plate to be covered with a decorative finish to blend with your room decor.

We have designed the light dimmer unit to fit a standard wall box, the transmitter to fit your hand and the price to fit your pocket.



In two years' time everyone will be selling remote control dimmers but you can have your TDRK300K kit NOW for only **£14.30** for the dimmer unit and **£4.20** for the transmitter. For the more athletic of you, the TD300K is still available at **£6.50** and the TDE/K at **£2.00**.

DON'T FORGET to add 40p P&P and 15% VAT to your total purchase.

NEW REMOTE CONTROL KITS

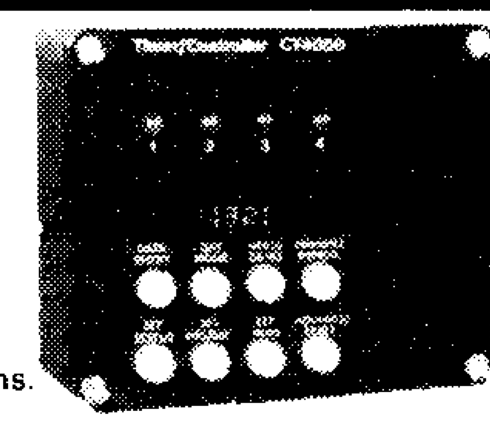
MK6	– Simple Infra Red Transmitter – A pulsed infra red source which comes complete with a hand held plastic box. Requires a 9V battery.	£4.20
MK7	– Infra Red Receiver – Single channel, range approximately 20 ft. Mains powered with a triac output to switch loads up to 500W at 240V ac, can be modified for use with 5-15V dc supplies and transistor or relay outputs.	£9.00
•Special Price•	MK6 and MK7 together. Order as RC500K	£12.50
MK8	– Coded Infra Red Transmitter – Based on the SL490, the kit includes two IR LEDs, measures only 8×2×1.3 cms. Requires a 9V (PP3) battery.	£5.90
MK9	– 4 Way Keyboard – for use with the MK8 kit, to make a 4-channel remote control transmitter.	£1.90
MK10	– 16 Way Keyboard – for use with the MK8 kit, to generate 16 different codes for decoding by the ML926 or ML928 receiver (MK12 kit).	£5.40
MK12	– 16 Channel IR Receiver – for use with the MK8 kit with 16 on/off outputs which with further interface circuitry, such as relays or triacs, will switch up to 16 items of equipment on or off remotely. Outputs may be latched or momentary depending on whether the ML926 or ML928 is specified. Includes its own mains supply. Size 9×4×2 cms, excluding transformer.	£11.95

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES. 40p P&P MAIL ORDER – CALLERS WELCOME BY APPOINTMENT. Send s.a.e. with all enquiries.

TK Electronics

(P.E.), 11 Boston Road, London W7 3SJ. TEL. 01-579 9794

CT4000 CLOCK/APPLIANCE TIMER KIT

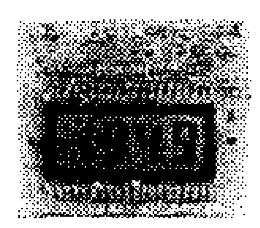


The CT4000 has been designed to preset the state (on or off) of four outputs at four times per day for up to 7 days in advance, enabling the unit to control tape recorders, appliances, central heating, lights, etc. The times are set on a 0.1" high red LED display by means of a keyboard and the output states are displayed on four LEDs. Each output can switch up to 20mA at 9V. For mains loads use our Solid State Relay Kit (MK2). The kit includes a PCB, keyswitches, I.C., 4 digit LED display, transformer, plus all other components and a screen printed and drilled box which can also accommodate up to 4 Solid State Relay Kits.

£25.25

Size: 10×12×4.5 cms. Colour: Black.

D.V.M. THERMOMETER KIT



Based on the ICL 7106. This Kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0.5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3mA 9V supply. (PP3 battery) Closing date 31.12.80.

SPECIAL OFFER £17.50

INTEGRATED CIRCUITS

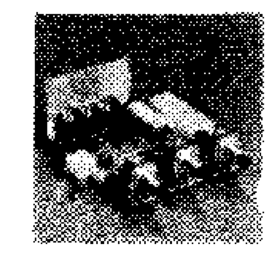
555 Timer	21p
741 Op. Amp.	19p
AY-5-1224 Clock	£2.60
AY-5-1230/2 Clock/Timer	£4.50
AY-3-1270 Thermometer	£8.20
ICL7106 DVM (LCD drive)	£7.00
LM377 Dual 2W Amp.	£1.45
LM379S Dual 6W Amp.	£3.50
LM380 2W Audio Amp.	80p
LM382 Dual low noise Preamp	£1.00
LM386 250mW low voltage Amp.	75p
LM1830 Fluid Level Detector	£1.50
LM2907 f-v Converter (8 pin)	£1.40
LM2917 f-v Converter (14 pin)	£1.60
LM3909 LED Flasher/Oscillator	60p
LM3911 Thermometer	£1.20
LM3914 Dot/Bar Driver	£2.10
MM74C911 4 digit display controller	£6.50
MM74C915 7 segment-BCD converter	96p
MM74C926 4 digit counter with 7 seg. o/p	£4.50
S566B Touchdimmer	£2.50
S9263 Touchswitch 16-way	£4.85
SN76477 Complex Sound Generator	£2.52
TBA800 5W Audio Amp.	68p
TBA810AS 7W Audio Amp.	£1.00
TDA1024 Zero Voltage Switch	£1.20
TDA2020 20W Audio Amp.	£2.85
ZN1034E Timer	£1.80

All ICs supplied with data sheets.
Data Sheets only. **10p** each device.

DISCO LIGHTING KITS

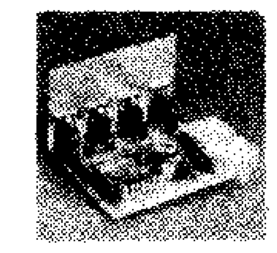
Each unit has 4 channels (rated at 1KW at 240V per channel) which switch lamps to provide sequencing effects, controlled manually or by an optional opto-isolated audio input.

DL1000K



This kit features a bi-directional sequence, speed of sequence and frequency of direction change being variable by means of potentiometers. Incorporates master dimming control. **£14.60**

DLZ1000K



A lower cost version of the above, featuring unidirectional channel sequence with speed variable by means of a preset pot. Outputs switched only at mains zero crossing points to reduce radio interference to minimum. **£8.00**

Optional Opto Input DLA1 **60p**

24 HOUR CLOCK/APPLIANCE TIMER KIT

Switches any appliance up to 1KW on and off at preset times once per day. Kit contains: AY-5-1230 IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triac, PCBs & full instructions.

CT1000K Basic Kit	£14.90
CT1000KB with white box (56/131×71mm)	£17.40
Ready Built	£22.50

Codespeed Electronics

P.O. BOX 23, 34 SEAFIELD ROAD, COPNOR, PORTSMOUTH, HANTS., PO3 5BJ

New, full spec. devices

SPECIAL OFFER
LED ALARM CLOCK MODULE with bright 0.7" LED display and switched alarm output. Just add mains transformer and time setting switches for operational clock. At the special price of **£4.99** whilst stocks last. With data sheet. Cat. No. 205.

SOUND EFFECTS MODULE Brand new, designed for 'Spaceman' toy. Gives 5 audio/visual programs. Requires 8 ohm speaker (not supplied). **85p** Cat. No. 108.

SIMULATED LASER CANON for spaceman toy. LED on moulded 6" lead with mini jack plug. Fits socket on Sound Effects Module. Only **20p** each.

GIANT LED DISPLAY Common cathode, non-multiplexed super 4 digit LED clock display. Lots of other uses too. Only **£3.95** each. Cat. No. 204.

DIGITAL MULTIMETER CHIP Builds into high accuracy dvm or panel meter. Requires additional circuitry, with data and circuit. MM5330 only **£3.55**. Cat. No. 404.

POLARIZING FILTER MATERIAL 0.006" thick plastic film. Any size cut – even 1 sq. inch. Max. width 19", any length. Only **3p** per sq. inch. Cat. No. 701.

DIGITAL ALARM CLOCK CHIP MM5316 alarm clock chip. With data **£2.35**. Cat. No. 203.

LED DISPLAYS Red, common anode. 0.3" digits with crisp, bright segments. 14 pin DIL package. Super value at **52p**. Cat. No. 313.

MINI 8 DIGIT LED DISPLAY 8 digit, 7 segment calculator style display. Common cathode, multiplexed, with 0.1" high digits. **99p** each. Cat. No. 312.

20 KEY KEYBOARDS Calculator keyboards, excellent key action. 20 keys per board. 2 keyboards for **99p**. Cat. No. 101.

Untested Items

FLUORESCENT CALCULATORS Manufacturers rejects. Most repairable but no guarantees. 10 function with full memory. With 'repairing calculator' info. **£2.50**. Cat. No. 107.

SATISFACTION GUARANTEED ON ALL ITEMS OR FULL CASH REFUND
POST AND PACKING PLEASE ADD 40p (OVERSEAS ORDERS ADD £1)
LOTS MORE GOODIES IN OUR CATALOGUE, SEND MEDIUM SIZED SAE FOR YOUR *FREE* COPY

V.A.T. PLEASE ADD 15% TO THE COST OF YOUR ORDER (INCLUDING POST AND PACKING).

MAINS INTERCOM

NO BATTERIES NO WIRES

ONLY **£37.99** PER PAIR + VAT £5·70

The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ¼-mile on the same mains phase. On/off switch. Volume control, with 'buzzer' call and light indicator. Useful as inter-office intercom, between office and warehouse, in surgery and in homes. P. & P. £1·85. Also F.M. 2 channel "touch" model **£49·95** + VAT £7·50 + P&P £1·95.

NEW AMERICAN TYPE CRADLE
TELEPHONE AMPLIFIER

£18.95 + VAT £2·85 + P & P £1·25

Latest transistorised Telephone Amplifier, with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume control, conversation recording, model at **£20·95** + VAT £3·15. P&P £1·25.

DOOR ENTRY SYSTEM

No house/business/surgery should be without a DOOR ENTRY SYSTEM in this day and age. The modern way to answer the door in safety to unwanted callers. Talk to the caller and admit him only if satisfied by pressing a remote control button which will open the door electronically. A boon for the invalid, the aged, and busy housewife. Supplied complete d.i.y. kit with one internal Telephone, outside Speaker panel, electric door lock release (for Yale type surface latch lock); mains power unit, cable (8-way) fo 50 and wiring diagram. Price £59·95 + VAT £9·00 + P&P £1·95. Kit with two Telephone **£69·95** + VAT £10·50 + P&P £2·15

10-day price refund guarantee on all items

WEST LONDON DIRECT SUPPLIES (PE 1)
169 KENSINGTON HIGH STREET
LONDON, W8

F. BROWN & CO.

Kits available:

KS 100 F.M. Receiver **£5.31.**

KS 200 F.M. Transmitter **£7.36.**

KS 240 3×1000W Sound to Light Unit **£13.63.**

Also in stock a wide range of Components, Breadboards, Loudspeakers, Soldering Irons etc.

Stockists for Vero, S.C.S., Ice Meters, Expo Drills, Eagle, Bulgin, Weller, Babani Books.

Prices include VAT, 25p P&P per kit

"SPECIAL OFFER"
250V Mullard Caps, 10 EA .001, .01, .1uf. **70p** incl. P&P.

F. Brown & Co.,

Dept. M.O./P.E.,
45 George IV Bridge,
Edinburgh EH1 1EJ.

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.
(B) That you have enclosed the right remittance.
(C) That your name and address is written in block capitals, and
(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

RECEIVERS AND COMPONENTS

BRAND NEW COMPONENTS BY RETURN

Electrolytic Capacitors 16V, 25V, 50V.
0·47, 1·0, 2·2, 4·7 & 10 Mfds. — **5p.** 22 & 47—**5½p.** (50V—**6p**). 100—**7p.** (50V—**8p**). 220—**8p.** (50V—**10p**). 470—**11p.** (40V—**16p**). 1000/15V—**15p.** 1000/25V—**18p.** 1000/40V—**35p.**

Subminiature bead Tantalum electrolytics. 0·1, 0·22, 0·47, 1·0 @ 35V, 4·7 @ 6·3V — **14p.** 2·2/35V, 4·7/25V—**15p.** 10/25V, 15/16V—**20p.** 22/16V, 33/10V, 47/6V, 68/3V & 100/3V—**30p.** 15/25V, 22/25V, 47/10V—**35p.** 47/16V—**80p.**

Subminiature Ceramic Caps. E12 Series 100V. 2% 10 pf. to 47 pf.—**3p.** 56 pf. to 330 pf.—**4p.** 10% 390 pf. to 4700 pf.—**4p.**

Vertical Mounting Ceramic Plate Caps. 50V. E12 22 pf. to 1000 pf. E6 1500 pf. to 47000 pf.—**2p.**

Polystyrene E12 Series 63V. Horizontal Mntg. 10 pf. to 820 pf.—**3p.** 1000 pf. to 10,000 pf.—**4p.**

Miniature Polyester 250V Vert. Mtg. E6 Series. ·01 to ·068—**4p.** ·1—**5p.** 15, 22—**6p.** ·33, ·47—**10p.** ·68 — **12p.** 1·0 — **15p.** 1·5 — **22p.** 2·2 — **24p.**

Mylar (Polyester) Film 100V. Vertical Mounting. ·001, ·0022, ·0047—**3p.** ·01, ·022—**4p.** ·04, ·05, 0·1—**5p.**

Miniature Film Resistors Highstab. E12 Ser. 5%. 0·125W mixed carbon/metal 10Ω to 1MΩ—**1p.** 0·25W Carbon 1Ω to 10MΩ (10% over 1M0Ω)—**1p.** (E24 Series av. in ¼W C. Film 1Ω to 5M6Ω). 0·25W, 0·5W & 1·0W Metal Film 10Ω to 2M2Ω—**2p.**

1N4148—**2p.** 1N4002—**4p.** 1N4006—**6p.** 1N4007—**7p.** BC107/8/9, BC147/8/9, BC157/8/9, BF194 & 7—**10p.** 8 Pin i.c's. 741 Op. amp.—**18p.** 555 Timer—**24p.** Dil Holders 8 pin—**9p.** 14 pin—**12p.** 16 pin—**14p.** LED's. 3 & 5mm. Red—**10p.** Green & Yellow—**14p.** Grommets for 3mm.—**1½p.** 2 pce. holders 5mm.—**2½p.** 20mm. Q.B. Fuses ·15, ·25, ·5, 1, 2, 3 & 5A—**3p.** 20mm. Anti Surge 100mA. to 5·0A—**5p.** 20mm. Fuseholders P.C. or Chassis Mtg.—**5p.** Solid A1. knobs 15mm.—**25p.** 25mm.—**35p.** 30mm.—**50p.** 400mW Zener diodes E24 series 2V7 to 33V—**8p.**

Prices VAT inclusive Post 15p. (Free over £5.00).

THE C. R. SUPPLY CO.
127, Chesterfield Rd., Sheffield S8 0RN.

BOURNEMOUTH/BOSCOMBE. Electronic components specialists for 3 years. Forresters (National Radio Supplies) Late Holdenhurst Rd. Now at 36, Ashley Rd., Boscombe. Tel. 302204. Closed Weds.

CLEARANCE PARCELS: Transistors, Resistors, Boards, Hardware, 10lbs only **£5.80!** 1,000 Resistors **£4.25,** 500 Capacitors **£3.75.** BC108, BC171, BC204, BC230, 2N5061, CV7497 Transistors 10 **70p,** 100 **£5.80.** 2N3055, 10 for **£3.50.** S.A.E. Lists: W.V.E. (2), 15 High Street, Lydney, Gloucestershire.

YOUR OWN P.C.B's & FRONT PANELS
EASILY MADE, NO COMPLICATED PROCESSES

Full details S.A.E.
Drafting packs: pcb **£1.80;** panel **£2.25.** Processing packs: pcb (3" × 4") **£3.72,** panel (5" × 6") **£3.48.** Drills, etchant, pcb board and all materials available.

WE ALSO SUPPLY R.S. QUALITY COMPONENTS

LYNWOOD ELECTRONICS
20, Stourcliffe Avenue,
Bournemouth, BH6 3PT.

SMALL ADS

The prepaid rate for classified advertisements is 28 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £9.50 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Practical Electronics and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser to check both prices and availability of goods before ordering from non-current issues of the magazine.

TURN YOUR SURPLUS Capacitors, transistors, etc., into cash. Contact COLES-HARDING CO., 103 South Brink, Wisbech, Cambs. 0945-4188. Immediate settlement.

DO YOU WANT TO MAKE YOUR OWN P.C. BOARD?

We will supply 1/16th E.G. board with 1 oz. copper from stock. Just write for the size required.

P.C. Board – Single sided per sq. ft. **£2.00.** Double sided per sq. ft. **£2.50.** Dry film laminated with negative resist. – Single sided per sq. ft. **£4.75.** Double sided per sq. ft. **£5.50.** Etching crystals per lb. **£1.35.** Dalo pen complete with spare tip **£1.20.** U.V. light box 10" × 6" **£45.00.** P.C.B. etching etc. trays. **£1.50.**

Postage 30p per item under £20, overseas at cost. VAT export nil, other add 15% to total order.

DON'T DELAY, SEND TODAY to:

PANELECTRONICS LTD.,
Eastern Way, Bury St. Edmunds, Suffolk.
Tel. 4348.

BALLARD'S OF TUNBRIDGE WELLS have moved to 54, Grosvenor Road, no lists. S.A.E. all enquiries phone Tunbridge Wells 31803.

8 PAGE LIST FREE – thousands of different items, all at cut price. Send SAE to PC Electronics, Thornhill, Romsey Road, Whiteparish, Salisbury.

SERVICE SHEETS

SERVICE SHEETS from **50p** and S.A.E. Catalogue **25p** and S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

G.T. TECHN. INFO. SERVICE
76 Church St., Larkhall, Lanarks ML9 1HE

Any single service sheet £1 + large SAE
1,000s of sheets/manuals always in stock.
Sole suppliers of all T.V. Repair Systems
Giant Diagram Manual for Washing Machines
Single tubs/twin tubs/auto – only **£13.50**
Repair Data any named T.V. **£5.50** (with circuits, etc. **£7.00**). SAE for newsletter, bargain offers etc.

Phone 0698 883334 after 4pm.

BELL'S TELEVISION SERVICES for Service Sheets on Radio, Tv, etc **£1.00** plus S.A.E. Colour TV Service Manuals on request. S.A.E. with enquiries to B.T.S. 190 Kings Road, Harrogate, N. Yorkshire, Tel: (0423) 55885.

BOOKS AND PUBLICATIONS

ANY SINGLE SERVICE SHEET £1/L.S.A.E. Thousands different repair/service manuals/sheets in stock. Repair data your named T.V. £6, (with circuits £8). S.A.E. Newsletter, pricelists, quotations. AUS (PE), 76 Churches, Larkhall, Lanarkshire. (0698 883334).

SOFTWARE

THE ZX80 MAGIC BOOK £4.75

For machines with 1-3K RAM. New edition 3 contains 20 plus programs including one which allows you to make music with your ZX80, and games such as Moon Lander, Hammurabi, Othello, Hexpawn and Animals. Also sections on How it Works. Plotting. Using USR. Converting other BASICs, and Hardware Notes including circuits for static and dynamic memory extensions and I/O.

TIMEDATA LTD.,
57, Swallowdale, Basildon, Essex.

COMPUKIT 4K Alien Invaders Cassette £2.00. Steven Hall, 14 Christchurch Lane, Lichfield, Staffs.

INVASION. Exciting M/C game for UK101 with free pools predictor. Both use under 4K. Send £2.50 for tape to Mr. A. Pettitt, 2, Caburn View, Firle, Lewes, Sussex.

ZX80 GAMES-MAZE (1 & 1I), Battleships, Pontoon, Slot Machine, Maths Quiz, Guess The Number, all on one cassette. Send £6.50 to P. Bramwell, 87 Anderson Crescent, Great barr, Birmingham B43 7ST.

EPROM SINGLE/TRIPLE Rail Fast Programming Service. 2516 (2716), 2532, 2758, 2508; 2708, 2716, 2704. £2/1K, earasing 60p/memory, P&P 40p. Petron Electronics, 1 Courtlands Road, Newton Abbot, Devon TQ12 2JA (Dept. PE).

COMPUKIT SOFTWARE, word processor, calendar diary, editor mailing list, line renumber, 10000 Baud cassette routine etc. S.A.E. for details N.V. Davies, 11 Holloway Haverfordwest, Dyfed.

EDUCATIONAL

TELEVISION COMPUTER & RADAR SYSTEMS SERVICING

TWO YEAR full-time Modular Diploma course to include a high percentage of practical work.

- ELECTRONIC PRINCIPLES
- MONO TV & CCTV
- COLOUR TV & VCR
- DIGITAL TECHNIQUES
- COMPUTERS & MICROPROCESSORS
- RADAR

Each of the above Modules are 12 weeks in duration. Individual Modules can be arranged for applicants with suitable electronics background.

Tuition fees (UK & Overseas) £400 per Module. ? Computer Module £500.

Next session starts January 5th.

(Also available 2½ year course in Marine Electronics & Radar.)

Prospectus from:

LONDON ELECTRONICS COLLEGE

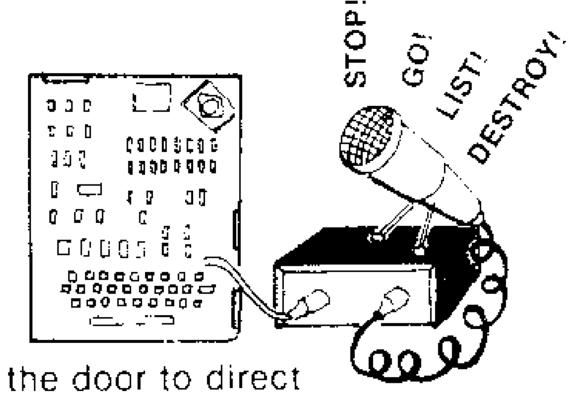
Dept: PEAA, 20 Penywern Road, London SW5 9SU. Tel: 01-373 8721.

CAREERS in Marine Electronics. Courses commencing September and January. Further details, the Nautical College, Fleetwood FY7 8JZ. Tel. 03917 79123.

PLEASE MENTION PRACTICAL ELECTRONICS WHEN REPLYING TO ADVERTISEMENTS

BIG EARS

SPEECH INPUT FOR YOUR COMPUTER!



BIG EARS opens the door to direct man-machine communication. The system comprises analogue frequency separation filters, preamps and signal conversion, together with a quality microphone and extensive software.

Words, in any language, are stored as "voice-prints" by simply repeating them a few times in "learn" mode. Using keyword selection techniques, large vocabularies can be constructed.

Use **BIG EARS** as a front end for any application: data enquiry, robot control, starwars — the possibilities are unlimited...

BUILT, TESTED & GUARANTEED **£45**

Also available:

COLOUR MODULATOR

- R G B inputs, PAL/UHF output
- Unlimited colour combinations
- TTL etc interface details supplied
- 1000's already in use!

KIT: only £12 **Built & Tested: only £18**

— please add VAT at 15% to all prices
— Barclay/Access orders accepted by telephone

WILLIAM STUART SYSTEMS Ltd
Dower House, Billericay Road, Herongate, Brentwood, Essex CM13 3SD.
Telephone: Brentwood (0277) 810244

£99 SYNTHESISER DIY. Professional results easy build. SAE. Dewtron, 254 Ringwood Road, Ferndown, Dorset. BH22 9AR.

DIGITAL WATCH BATTERIES. Any sort **75p** each + p.p. Send S.A.E. or 15p with number or old battery to Disclec. Y. 511 Fullbridge Road, Werrington, Peterborough PE4 6SB.

PRACTICAL ELECTRONICS P.C.B.'s

Jun. 80	Mastertune EP343 **£3.80** (Not plated through) Greenhouse Temp. Control EP358 **£1.90**
Jul. 80	Tape Slide Synch EG353 **£1.28**
Sept. 80	DISCO deck EP365 **£3.26** Sound Gen. EC14 **£2.53**
Oct. 80	Disco deck AE202 **£3.11** Cine frame Counter EG408 **98p**
Nov. 80	Disco desk EA208 **£2.97**, EA218 **£2.85** tinned connectors EA220 **£1.18.** Set of 5 pcb's **£12.50**
Dec. 80	Set of 3 pcb's for Microtune, solder resist coated. DESIGNER APPROVED **£11.50**

For full list and current pcb's please send SAE. Pcb's also produced to customers own masters. Trade enquiries welcomed. Please write for quote. CWO Please. **Postage.** — Please add 30p postage and packing to complete order. Europe 65p.

PROTO DESIGN
14 Downham Road, Ramsden Heath
Billericay, Essex CM11 1PU
Telephone 0268-710722

PRINTED CIRCUIT BOARDS. Glass Fibre tinned and Drilled Prototypes to batch runs. Quick turn-round, competitive prices. Send S.A.E. for quotations. R.D. Electronics, 12, Whiteoaks Road, Oadby, Leicester. 0533 716273.

TEMPERATURE GAUGES. 0-120°C black dial, chrome bezel. Remote sensor on 38" capilliary, snap fitting in 55mm hole. £1.85 (incl. P&P) L.E.M. Services, 239 Rugby Road, Leamington Spa, Warwickshire. 0926-20622.

THE SCIENTIFIC WIRE COMPANY
PO Box 30, London E.4

ENAMELLED COPPER WIRE				
SWG	1lb	8oz	4oz	2oz
8 to 29	2.76	1.50	0.80	0.60
30 to 34	3.20	1.80	0.90	0.70
39	3.40	2.00	1.10	0.80
40 to 43	4.75	2.60	2.00	1.42
47	8.37	5.32	3.19	2.50
48 to 49	15.96	9.58	6.38	3.69
SILVER PLATED COPPER WIRE				
14 to 30	6.50	3.75	2.20	1.40
TINNED COPPER WIRE				
14 to 30	3.85	2.36	1.34	0.90

Prices include P&P, VAT and wire Data.
SAE for list. Dealer enquiries welcome.
Reg office 22 Coningsby Gardens.

RUSSIAN AC/DC MULTIMETERS. famous type U4324, guaranteed, fibreboard storage case. £17 (multiples £16.50). Fantastic specification for price. Doska Chess Supplies, 29, Farnham Way, Poulton-le-Fylde, Lancs.

VIDEO MUSIC

The amazing **Videograph**, as featured recently in Electronics Today International, links your Hi-Fi with any Colour TV to produce a Fantasia of hypnotic visual effects. The system displays stereo music as brilliantly coloured waveforms against an ever changing background. For the technically-minded, a square-wave signal generator is built-in, permitting advanced demonstrations of transient response etc. Truly the ultimate accessory for any Hi-Fi system!

DIY KIT ONLY £33.95
Case & Controls **£15.95**
or READY BUILT **£69.95**

All prices include VAT and postage

WILLIAM STUART SYSTEMS Ltd
Dower House, Billericay Road, Herongate, Brentwood, Essex CM13 3SD.
Telephone: Brentwood (0277) 810244

UNCOMPLETED SYNTHESISER. Boards, pots, switches, knobs, PSU's, info. etc. Sophisticated machine. Phone Gavin McCutcheon on East Kilbride 32459 for details.

BURGLAR ALARM EQUIPMENT. Latest Discount Catalogue out now! Phone C.W.A.S. Alarm 0274 682674.

ZX80 SINCLAIR built with manual and PSU £65 o.n.o. Adams, 'Norwood', Merion Street, Trecynon, Aberdare, Mid-Glam.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Practical Electronics for ....

insertions. I enclose Cheque/P.O. for £ ....

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Practical Electronics)

NAME ....

ADDRESS ....

....

Send to: Classified Advertisement Manager
PRACTICAL ELECTRONICS
GMG, Classified Advertisements Dept., Room 2337, King's Reach Tower, Stamford Street, London SE1 9LS. **Telephone 01-261 5846**
Rate:
28p per word, minimum 12 words. Box No. **60p** extra.

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

INDEX TO ADVERTISERS

PLEASE MENTION

PRACTICAL ELECTRONICS

WHEN REPLYING TO ADVERTISEMENTS

Published approximately on the 15th of each month by IPC Magazines Ltd., Westover House, West Quay Road, Poole, Dorset BH15 1JG. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand – Gordon & Gotch (A/sia) Ltd; South Africa – Central News Agency Ltd.
Subscriptions INLAND and OVERSEAS £10.60 payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex.