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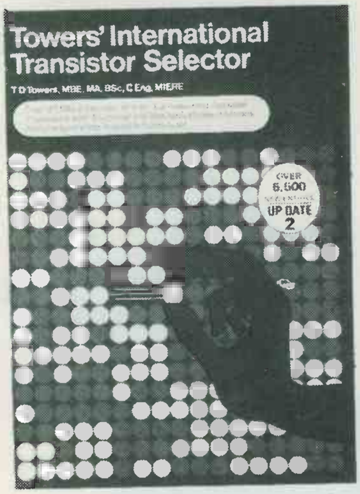

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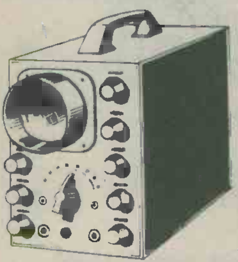

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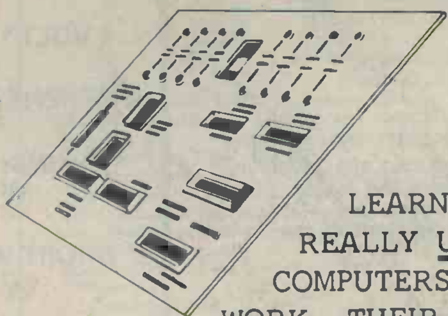

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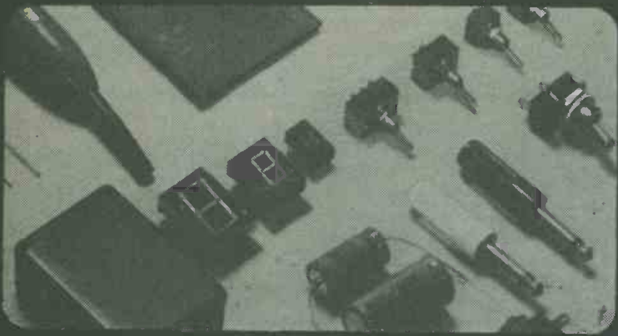

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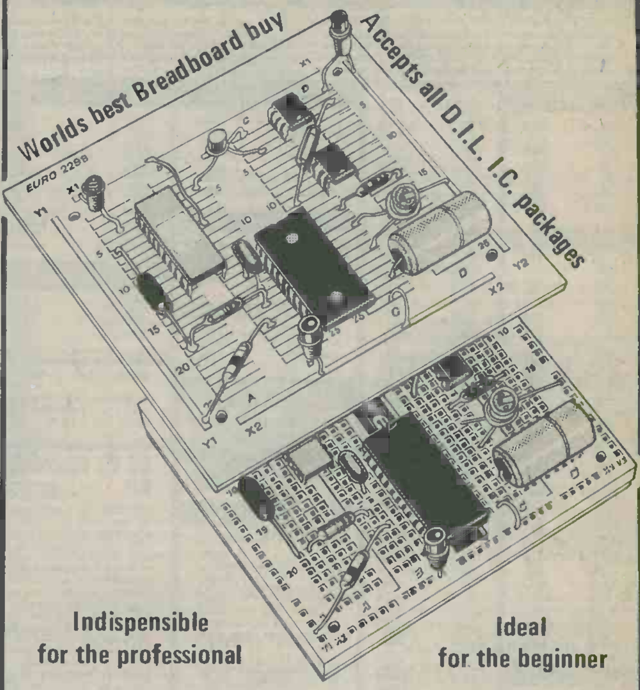

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7474	32p
7475	40p
7476	40p
7490	35p
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74LS107	40p
74LS123	69p
74LS125	50p
74LS132	79p
74LS138	69p
74LS151	75p
74LS153	75p
74LS155	65p
74LS161	78p
74LS163	90p
74LS164	90p
74LS168	190p
74LS174	99p
74LS175	99p
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4023	22p
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4039	290p

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4060	112p
4063	112p
4066	56p
4067	422p
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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
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4528	99p
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4531	150p
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4538	150p
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4572	46p
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Z80A DMA	2495p
Z80 S10/0	2995p
Z80A S10/0	3495p
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75325	325p
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8T97	175p

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

NEW! SPECIAL OFFER!

4K CMOS RAM (1K x 4) NS ONLY £6.95 (8 for £45)

The TC 5514P from Toshiba, CMOS equivalent of the 2114!

- Low Power Dissipation
- $10\mu W$/BIT (TYP). at 3.0V (STANDBY)
- $10\mu W$/BIT (TYP). at 5.0V (OPERATING)
- Data Retention Voltage 2V to 5.5V
- Single 5V Power Supply
- 18 PIN Plastic Package
- Full Static Operation
- Three State Output
- Input/Output TTL Compatible
- Fast Access Time 450NS.

Toshiba's TC5514P (industry type 6514) is a full static read write memory organised as 1024 words by 4 bits using CMOS technology. Ultra low power dissipation means it can be used as battery-operated portable memory system and also as a non-volatile memory with battery back-up. Operates from a single 5V power supply with static operation, hence no refresh periods and a much simplified power supply circuit design. Three state outputs simplify memory expansion for minimum data retention voltage is 2V, the battery back-up system needs only simple circuit. Toshiba's original C2MOS technology also means wide operating and noise margins. The TC 5514P is moulded in a dual-in-line 18 pin plastic package 0.3 inch in width.

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 generage 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. EPROM'S are ORG at EOOOH.

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 3½" x 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 parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MW 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 plus VAT

BOOKS

Please order books by reference no. and title, and add 50p post & packing for each book ordered.

21168	Active Filter Cookbook	£10.95
21440	Aviation Electronics 3rd Ed.	£6.75
21558	Audio IC Op Amp Applications 2nd Ed.	£5.95
21524	The Cheap Video Cookbook	£4.50
21398	CMOS Cookbook	£7.75
21539	Design of Active Filters with Experiments	£5.95
21537	Design of Op Amp Circuits with Experiments	£5.95
21545	The Design of Phased-Locked Loop Circuits with Experiments	£6.75
21686	Design of VMOS Circuits with Experiments NEW!	£5.95
21618	Electronic Telephone Projects	£4.95
21127	How to Read Schematic Diagrams 3rd Ed.	£4.25
21613	How to Use Integrated Circuits Logic Elements 3rd Ed.	£4.50
21527	IC Converter Cookbook	£10.50
21695	IC Op Amp Cookbook 2nd Ed.	£11.25
21416	IC Timber Cookbook	£8.50
21601	Instrumentation: Transducers and Applications	£8.95
21452	Learn Electronics Thru' Troubleshooting 2nd Ed.	£8.25
21694	LC Circuits	£4.46
21542	Logic and Memory Experiments Using TTL Integrated Circuits – Book 1	£7.50
21543	Logic and Memory Experiments Using TTL Integrated Circuits – Book 2	£7.50
21568	Linear IC Principles, Experiments and Projects 2nd Ed.	£7.50

BOOKS (continued)

21612	Oscilloscope Applications & Experiments	£6.75
21635	99 Practical Electronics Projects 2nd Ed.	£3.75
21599	Practical Low-Cost IC Projects 2nd Ed.	£3.50
21557	Practical RF Communication Data for Engineers and Technicians	£6.75
21482	Regulated Power Supplies 2nd Ed.	£7.50
21419	Security Electronics 2nd Ed.	£4.50
21621	Solar Heating	£5.25
21035	TTL Cookbook	£7.25
21103	Troubleshooting with the Oscilloscope 3rd Ed.	£4.50
21313	TV Typewriter Cookbook	£7.50
21339	Video Security Systems	£5.25
21521	Video Tape Recorders	£7.50

NEW TUNES SYNTHESIZER

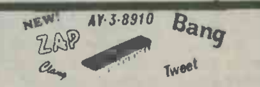
The AY3-1350 is a MOS microcomputer synthesizer of preprogrammed tunes for applications in toys, music boxes and door chimes. The standard device has a set of 25 different popular and classical tunes. In addition there are 3 chimes making a total of 25 tunes.

FEATURES

- Minimal external components.
- Automatic switch-off signal at end of tune for power saving.
- Envelope control to give organ or piano quality.
- Sequential tune mode.
- 4 door capability when used as door chime.
- Operation with tunes in external PROM if required (2708).
- Single supply (+ 5V) operation.
- Tunes include: STAR WARS, BEETHOVEN'S 9TH AND 5TH, JINGLE BELLS, YANKEE DOODLE, STAR SPANGLED BANNER, CLEMENTINE, GOD SAVE THE QUEEN, O SOLE MIO, WESTMINSTER CHIMES, and DESCENDING OCTAVE CHIME plus many more! with detailed specs and instructions.

£6.95

NEW AY-3-8910



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 plus 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.

NEW! FROM EXAR The XR2266 Decoder/Sense and Drive Chip for toy cars that DRIVE LIKE REAL ONLY £5.45!

This versatile 18-pin dual in-line IC combines both the decoder and the sense and drive functions to cut remote control car circuitry by at least a factor of two! Steering, lights, indicators, speed control – all from the new XR2266 at only £5.45!

NEW FROM SPRAGUE THE NEW ULN-2232A INTEGRATED MOTION DETECTOR The most SOPHISTICATED MOTION DETECTOR available!

- Automatic Timed Reset
- 120 Hz Rejection
- Two Sound Patterns
- Long Range Operation
- 100mW Audio Output
- Visible or Infra-red Response
- 14-Pin Dual In-line Clear Plastic Package

Combing I²L and Bipolar circuitry, the ULN-2232A Motion Detector is a complex optolinear IC which includes an on-chip photodiode, high-gain logarithmic and linear amps, extensive digital circuitry for sound generation and timing, and high-current output drivers. Add on five small capacitors, a speaker and power source and you turn this state-of-the-art device into a complete Motion Detector sensitive to small changes in light level as a function of time. DETAILED DEVICE DESCRIPTION AND APPLICATIONS INFORMATION INCLUDED WITH EVERY ULN-2232A.

ONLY £7.60!!

3½-DIGIT LIQUID CRYSTAL DISPLAY

with 'low bat' indicator

- High Contrast Ratio
- Wide Viewing Angle
- 0.5in Digit Height
- ULTRA low Power Consumption

LCD 106 . . . . £6.45

MUSIC FOR YOUR EARS

Bullet's Electronic Music Maker TM Kit has a single 28 Pin Microprocessor Chip with ROM that has been programmed to play the first 6 to 10 notes of the 25 popular tunes listed below. Each tune can easily be addressed individually or played sequentially at the push of a button. The 3 chime sequences are activated at any time by separate switch closures, so wehen used as a doorbell, one door can play songs while two others will play different chimes. The unit has a 5 watt audio Amp and will run on either 12 VAC or 12 VDC. Construction is very simple, works with any 8 or 16 ohm speaker, or horn speaker, (not included). Tunes can be remotely programmed using a single rotary switch, (not included), if desired. COMPLETE KIT £9.95. 240 V Transformer optional.

Tunes: Toreador * William Tell * Hallelujah Chorus * Star Spangled Banner * Yankee Doodle * America America * Deutschland Leid * Wedding March * Beethoven's 5th and 9th * Hell's Bells * La Vien en Rose * Star Wars Theme * Clementine * Marseillaise * O Sole Mio * Santa Lucia * The End * Blue Canube * Brahms Lullaby * Westminster Chime * Simple Chime * Descending Octave Chime * Augustine * Jingle Bells * God Save the Queen * Colonel Bogie.

LED BAR GRAPH AND ANALOG METER DRIVER

New from National LM3914. Drives 10 LED directly for making bar graphs, audio power meters, analog meters, LED Oscillators, etc. Units can be stacked for more LEDs. A super versatile and truly remarkable IC.

Special price Only £2.25
12 page data 25p.
Matching red bar display MV57164 £2.25
Data 25p

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 by post with ACCESS, include name, address and card no. written clearly. Please allow 4/6 weeks delivery on

Micro Circuits

DEPT. R.E.C. 2,
4 Meeting Street, Appledore,
Nr. Bideford, North Devon EX39 1RY.
Tel: Bideford (02372) 79507
Telex: 8953084

MOTORS

1.5-6VDC Model Motors **22p**. Sub. Min. 'Big Inch' 115VAC 3rpm Motors **32p**. 6 volt standard cassette motors new **£1.20**. 8 track 12V Replacement Motors **55p**. Cassette Motors 5-8VDC ex. equip. **70p**. Geared Mains Motors (240V) 2.5 rpm **75p**. 115VAC 4rpm Geared Motors **95p**.

SEMICONDUCTORS

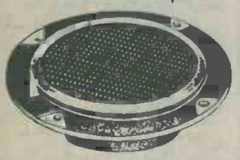
LM340 **80p**. BY103 **10p**. 2N5062 100V 800mA SCR **18p**. BX504 Opto Isolator **25p**. CA3130 **95p**. CA3020 **45p**. 741 **22p**. 741S **35p**. 723 **35p**. NE555 **24p**. 2N3773 **£1.70**. NE556 **50p**. ZN414 **75p**. BD238 **28p**. BD438 **28p**. CB4069 **15p**. TIL305 alpha numeric displays **£2.50**. TIL209 Red Leds 10 for **75p**. Man3A 3mm Led Displays **40p**.

PROJECT BOXES

Sturdy ABS black plastic boxes with brass inserts and lid. 75 x 56 x 35mm **65p**. 95 x 71 x 35mm **75p**. 115 x 95 x 37mm **85p**.

MOTOROLA PIEZO CERAMIC TWEETERS

No crossover required



2.5" Direct Radiating Tweeter, maximum rating 25 volts R.M.S. 100 watts across 8 ohms. Freq. range 3.8kHz-28kHz, **£3.65**

TOOL SALE

Small side cutters 5" insulated handles **£1**. Radio-pliers, snipe nosed insulated handles **£1**. Heavy duty pliers insulated handles **£1.10**. Draper side cutters spring loaded **£1**.

SWIVEL BASE VICES (with anvil)

With anvil, bench clamp, and plated parts, body smooth, lacquered finish. Jaw width 2", jaw opening 2¼" **£5.55 + £1.20 P&P**.

MORSE KEYS

Beginners practice key **£1.05**. All metal full adjustable type. **£2.60**

MINIATURE LEVEL METERS

1 Centre Zero 17 x 17mm **75p**. 2 (scaled 0-10) 28 x 25mm **75p**. 3 Grundig 40 x 27mm **£1.25**.

JVC NIVICO STEREO CASSETTE MECHANISM. Music centre type. Rev. counter, remote operation **£13.50 and £1.00 p&p**.

JUMPER TEST LEAD SETS

10 pairs of leads with various coloured croc clips each end (20 clips) **90p** per set.

TRANSFORMERS

All 240VAC Primary (postage per transformer is shown after price). MINIATURE RANGE: 6-0-6V 100mA, 9-0-9V 75mA and 12-0-12V 50mA **all 79p** each **(15p)**. 0-6, 0-6V, 280mA **£1.20 (20p)**. 6V 500mA **£1.20 (15p)**. 12V 2 amp **£2.75 (45p)**. 15-0-15V 3 amp Transformer at **£2.85 (54p)**. 30-0-30V 1 amp **£2.85 (54p)**. 20-0-20V 2 amp **£3.65 (54p)**. 0-12-15-20-24-30V 2 amp **£4.75 (54p)**. 20V 2.5 amp **£2.45 (54p)**.

TRIAC/XENON PULSE TRANSFORMERS

1:1 (gpo style) **30p**. 1:1 plus 1 sub. min. pcb mounting type **60p** each.

MICROPHONES

Min. tie pin. Omni, uses deaf aid battery (supplied), **£4.95**, ECM105 low cost condenser, Omni, 600 ohms, on/off switch, standard jack plug, **£2.95**. EM507 Condenser, uni, 600 ohms, 30-18kHz., highly polished metal body **£7.92**. DYNAMIC stick microphone dual imp., 600 ohms or 20K, 70-kHz., attractive black metal body **£7.75**. EM506 dual impedance condenser microphone 600 ohms or 50K, heavy chromed copper body, **£12.95** CASSETTE replacement microphone with 2.5/3.5 plugs **£1.35**. INSERT Crystal replacement 35 x 10mm **40p**. GRUNDIG electric inserts with FET preamp, 3-6VDC operation **£1.00**.

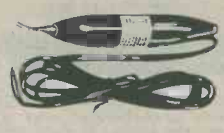
LIGHT DIMMER

240VAC 800 watts max. wall mounting, has built in photo cell for automatic swich on when dark **£4.50**

RIBBON CABLE

8 way single strand miniature **22p** per metre.

SPECIAL OFFER TAPE HEAD DEMAGNETIZER

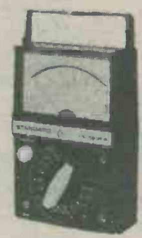


240VAC with curved probe suitable for reel to reel or cassette machines, **£1.95**.

STEREO FM/GRAM TUNER AMPLIFIER CHASSIS, VHF and AM. Bass, treble and volume controls, Gram. 8-track inputs, headphone output jack, 3 watts per channel with power supply. **£14.95** and **£1.20** p&p (CCT supplied).

MULTIMETER BARGAINS

Pocket Multimeter, 1,000 opv sensitivity. Ranges 1KV AC/DC Volts, 150ma DC current, resistance 0-2.5K, 0-100K, **£4.50**



20,000 opv., 1,000 volts AC/DC, DC current to 500ma, 5 ranges, resistance 4 ranges to 6 meg. Mirror scale, carrying handle, **£975**.

40kHz Transducers. Rec/Sender **£3.50** pair.

TELEPHONE PICK UP COIL

Sucker type with lead and 3.5mm plug **62p**.

RELAYS

Plastic Encap. Reed Relay, 0.1 matrix. 1k Ω coil,, 9-12VDC normally open, **35p**. Miniature encapsulated reed relay 0.1 matrix mounting, single pole make, operates on 12VDC **50p** each. Continental series, sealed plastic case relays, 24VDC 3pole change over 5 amp contacts, new **65p**. Min. sealed relay, P.C. mounting, 6-9vdc operation changeover 3 amp contacts, new **85p**. Metal Cased Reed Relay, 50 x 45 x 17mm, has 4 heavy duty make reed inserts, operates on 12VDC **35p** each. Magnets ½" long ⅛" thick with fixing hole, 10 for **40p**.

Dalo 33PC Etch Resist printed circuit maker pen, with spare tip, **79p**.

TERMS:

Cash with order (Official Orders welcomed from colleges etc). 30p postage please unless otherwise shown. VAT inclusive.

S.A.E. for illustrated lists

TMK500 MULTIMETER

TMK500 30,000 ohms per volt. IKV AC/DC., D.C. Current to 12 amps. Resistance to 60 meg in 4 ranges, mirror scale, with built in buzzer for continuity testing **£20.95**

YN360TR MULTIMETER

YN360 M/Meter. 20,000 ohms per volt. IKV AC/DC volts, 250ma dc current, 4 resistance ranges to 20meg, also has built in transistor tester with leakage and gain ranges. **£12.50**

CRIMPING TOOL

Combination type for crimping red blue and yellow terminations also incorporates a wire stripper (6 gauges) and wire cutter, with insultated handles only **£2.30**.

POWER SUPPLIES

SWITCHED TYPE, plugs into 13 amp socket, has 3-4.5-6-7.5 and 9 volt DC out at either 100 or 40 0mA. switchable **£3.45**. HC244R STABLISED SUPPLY, 3-6-7.5-9 volts DC out at 400mA max., with on/off switch, polarity reversing switch and voltage selector switch, fully regulated to supply exact voltage from no load to max. current £4.95.

AMPHENOL CONNECTORS

(PL259) PLUGS **47p**. Chassis sockets **42p**. Elbows PL259/SO239 **90p**. Double in line male connector (2XPL259) **65p**. Plug reducers **13p**. PL259 Dummy load, 52 ohms 1 watt with indicator bulb **95p**.

BUZZERS

MINIATURE SOLID STATE BUZZERS, 33 x 17 x 15mm white plastic case, output at three feet 70db (approx), low consumption only 15mA, voltage operating 4-15VDC, **75p** each. LOUD 12VDC BUZZER, Cream plastic case, 50mm diam. x 30mm high **63p**. Carters 12 volt Minimite Alarm sirens **£7.65p**. 12VDC siren, all metal rotary type, high pitched wail, **£6.25**.

TOOLS

SOLDER SUCKER, plunger type, high suction, teflon nozzle, **£4.99** (spare nozzles **69p** each).

All Antex irons still at pre increase prices, order now as new stock will be going up next month.

Antex Model C 15 watt soldering irons, 240VAC **£3.95**

Antex Model CX 17 watt soldering irons, 240VAC **£3.95**

Antex Model X25 25 watt soldering irons, 240VAC **£3.95**

ANTEX ST3 iron stands, suits all above models **£1.65**

Antex heat shunts **12p** each.

Servisol Solder Mop **50p** each.

Neon Tester Screwdrivers 8" long **59p** each.

Miyarna IC test clips 16 pin **£1.95**

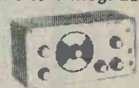
SWITCHES

Sub. miniature toggles: SPST (8 x 5 x 7mm) **42p**. DPDT (8 x 7 x 7mm) **55p**. DPDT centre off 12 x 11 x 9mm **77p**. PUSH SWITCHES, 16mm x 6mm, red top, push to make **14p** each, push to break version (black top) **16p** each.

Electrolytic Caps, can type, 2,200mfd and 2,200mfd 50VDC **35p** each.

RES. SUB BOX

Resistance Substitution Box. Swivelling disc provides close tolerance resistors of 36 values from 5 ohms to 1 meg. **£3.95**.



Signal Generator. Ranges 250Hz-100MHz in 6 Bands, 100MHz-300MHz (harmonics) internal modulator at 100Hz. R.F., output Max. 0.1vRMS. All transistorised unit with calibrating device. 220-240VAC operation, **£48.95**.

TAPE HEADS

Mono cassette **£1.75**. Stereo cassette **£3.90**. Standard 8 track stereo **£1.95** BSR MN1330 ½ track **50p**. BSR SRP90 ¼ track **£1.95**. TD10 tape head assembly — 2 heads both ½ track R/P with built in erase, mounted on bracket **£1.20**

PROGRESSIVE RADIO

31 CHEAPSIDE, LIVERPOOL 2.

ALL ORDERS DESPATCHED BY RETURN POST

TRANSISTORS

AC126	16p
AC127	16p
AC128	5p
AC153	11p
AC176	11p
AC188	10p
ACY20	30p
ACY21	20p
ACY28	22p
AD161/162 match pair	70p
AF119	35p
AF124	27p
AF126	27p
AF127	27p
AF139	23p
AF178	35p
AF180	35p
AF181	33p
AF239	35p
ASY60	35p
ASY63	4p
ASY73	35p
ASZ21	4p
AU110	£1.43
AU113	£1.18
AUY10	70p
BC107/A/B	6p
BC108/A/B/C	6p
BC109/B/C	6p
BC125B	3p
BC140	15p
BC141	11p
BC147/A/B/C	5p
BC148/A/B/C	5p
BC149/A/B/C/S	5p
BC154	7p
BC157/A	5p
BC158/A/B	5p
BC159/B/C	5p
BC171B	4p
BC172	6½p
BC172c	7½p
BC173	4p
BC177A	14p
BC178A/B/C	14p
BC179B	14p
BC182/AL	5p
BC182L	3p
BC183/A/AL/L/LC/B	3p
BC184L	5p
BC186	21p
BC187	8p
BC204	11p
BC212L/B	5p
BC213L	5p
BC213LA	3p
BC213LB	4p
BC214B	5p
BC214L	3½p
BC237A	7½p
BC238	5p
BC238B/C	7½p
BC239C	7½p
BC251	3p
BC257B	7½p
BC258B/C	7½p
BC259C	7½p
BC302	15p
BC304	15p
BC307	7p
BC308B/C	7½p
BC309B	7½p
BC327	5p
BC328	6p
BC338	5p
BC382L	7½p
BC384B	7½p
BC546	5p
BC547/A/B	5p
BC548/A/B/C	5p
BC549C	5p
BC556	5p
BC557/B	5p
BC558A	5p
BC559	5p
BC612L	4p
BCW71R	1p
BCX32	10p
BCX34	10p
BCX36	10p
BCY11	28p
BCY31	59p
BCY56	10p
BCY70	8p
BCY71	8p
BCY72	8p
BCY79B	15p
BCZ11	32p
BD113	57p
BD115	35p
BD(BRC)116	45p
BD132	15p
BD133	28p
BD135	25p
BD136	25p
BD137	28p
BD138	28p
BD137/8 mtch pr	60p
BD139	17p
BD140	26p
BD142	35p
BD156	50p
BD182p 70v 117w	44p
BD201	86p
BD202	64p
BD203	86p
BD204	86p
BD232	52p
BD233	20p

BD234	13p
BD235	35p
BD238	25p
BD239C	29p
BD242	30p
BD240	30p
BD243/B 65wT	30p
BD244A/C	30p
BD246	32p
BD253	44p
BD375	35p
BD437	35p
BD438	28p
BD677 60v 40w	50p
BD678 Pwr. Darl.	50p
BDX33B Pwr Dar	44p
BDX77	50p
BDY20	86p
BF115	18p
BF137	11p
BF167	18p
BF173	18p
BF178	23p
BF179	23p
BF180	12p
BF181	8p
BF182	18p
BF183	18p
BF184	18p
BF185	18p
BF194/A	5p
BF195/C/D	5p
BF196	5p
BF197	5p
BF198	5p
BF200	13p
BF224	4p
BF244C FET	7½p
BF245	6p
BF256	4p
BF256LB/LC	3p
BF257	20p
BF262	29p
BF263	29p
BF274	8p
BF324	3½p
BF336	16p
BF355	15p
BF394B	3p
BF451	6p
BF494	10p
BF495	5p
BF615	27p
BF617	27p
BFQ35	15p
BFQ37	15p
BFQ85	15p
BFR34A	36p
BFR38	68p
BFR86	19p
BFS21 FET pair	£3
BFS28 Dual MOS	50p
BFT30	15p
BFT31	15p
BFT39	15p
BFT41	15p
BFT60	6p
BFT61	15p
BFT70	15p
BFT71	15p
BFW10 FET	46p
BFW11 FET	46p
BFW30	15p
BFW31	15p
BFW57	18p
BFW58	18p
BFX12	23p
BFX29	15p
BFX30	16p
BFX37	16p
BFX84	20p
BFX85	14p
BFX88	20p
BFX89	20p
BFY39	20p
BFY50	15p
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2N3707	3p
2N3711	3p
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2N6292 80v 16w	30p
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2N6486 40v 75w	36p
2N6488 90v 75w	36p
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2SA360	34p
2SA367	56p
2SA518	38p
2SA634	80p
2SB56	18p
2SB75	25p
2SB77	25p
2SB135	25p
2SB136	25p
2SB156	60p
2SB175	20p
2SB176	20p
2SB187	25p
2SB457	25p
2SD315D	80p
40602 VHF Mosfet	36p
40235	50p
40250	36p
40250VI (2N3054 + Ht. sink)	40p
40316 40v, 50w	36p
40372 (2N3054 + Ht. sink)	40p
40349v2 160v 1w	30p
40394 60v 1w	30p
40409 + Ht. sink 90v 3w	40p
40410 + Ht. sink 90v 3w	40p
40633 NPN 40w	36p
40816	30p
40911 (2N6261 + Ht. sink)	40p

HUGHES

MICRO ELECTRONICS 400MW ZENER DIODES 200 IN CLEAR PLASTIC HINGED LID COMPONENT BOX £2.30

3V, 3.6V, 3.9V, 4.3V, 4.7V, 11V or 13V

STANDARD 0.25 WT. PRESETS

HORIZONTAL

100Ω	7p	10K	7p	270K	7p
220Ω	7p	15K	7p	470K	2½p
680Ω	7p	20K	7p	680K	7p
1K	7p	47K	7p	1M	7p
2K2	7p	75K	7p	2M2	7p
3K	7p	100K	7p	3M3	7p
5K	4p	220K	7p	5M	7p

VERTICAL

20Ω	7p	4K7	7p	250K	7p
60Ω	7p	5K	7p	270K	7p
100Ω	7p	10K	7p	470K	7p
220Ω	7p	20K	7p	500K	4p
500Ω	7p	22K	7p	680K	7p
1K	7p	25K	7p	1M	7p
2K2	7p	47K	6p	2M5	7p
2K5	7p	100K	7p	3M3	7p
3K	7p	220K	7p	4M7	7p

LARGE 0.5 TO 1 WATT PRESETS

1K	8p	22K	15p	250K	15p
5K	15p	100K	15p	680K	15p
10K	15p	220K	8p	1M	15p

Dual 500K 15p

CARBON SLIDER PRESETS

2K	5p	150K	5p	680K	5p
10K	5p	250K	5p	2M2	5p
20K	5p	500K	5p	5M	2½p
27K	5p				

DUAL POTENTIOMETERS

(C = CONCENTRIC, T = TANDEM) ¼" DIA. SPINDLE

LOG

4K7T Neg.	45p	50KT	25p	470KT	26p
5KT	45p	50KT Tapped	45p	500KC	12p
10KT	45p			820KC	45p
20KT	45p	100KT Tapped	45p	1MC	45p
22KT	11p or 29p			1MT Inv.	13p
		100KT	45p	2MC	13p
22KT Balance	45p	100KT Inv.	45p	2MT Inv.	13p
		220KT Neg.	45p		
25KT	45p				
50KT Inv.	25p	250KT	12p or 33p		
		250KT Inv.	13p		

LIN

10KT	40p	33KT	45p	250KT	23p
22KT	29p	100KT	56p		

4mm DIAM. SPINDLE

LOG		LIN	
10KT	45p	25KT	20p
47KT	45p	50KT	18p
		100KT	45p

DUAL WITH SWITCH

LOG ¼" DIAM. SPINDLE

10KC	55p	47KT	27p	500KT	26p
20KC	55p	100KT	27p	1MT	55p
22KT Inv.	55p	100KC.	55p		
22KT Tapped	30p	500KC L/AL	55p		

LIN

1KC	55p	5KT	55p	100KT	55p
2K5C	55p	100KC	28p		

4mm DIAM. SPINDLE 100KT 27p

CERMET TRIMMER PRESETS

47Ω	8p	4K7	17p	100K	17p
100Ω	17p	5K6	17p	220K	17p
220Ω	17p	6K8	17p	250K	17p
250Ω	17p	10K	17p	270K	17p
470Ω	17p	20K	17p	330K	17p
500Ω	17p	27K	17p	470K	17p
1K	17p	33K	17p	1M	8p
3K3	17p	47K	5p	1M5	17p
		50K	17p		

MULTITURN TRIMPOT 20p

20Ω	200Ω	1K5	10K
25Ω	250Ω	2K	50K
50Ω	500Ω	2K5	
100Ω	1K	5K	

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AA113	9p	OA5	25p
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CV7095	2½p	IN4150	2½p
CV7098	2½p	IN4151	2½p
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DC2845 Microwave	20p	IN4449	2½p
DOG53	11p	IN5456	15p
FSY28A	40p	5082 2900 RF Schotky Barrier	20p
HG1012	10p		
HS2091	11p		
MPN3401	30p		

RECTIFIERS

Type	Volt	Amp	Price
3052	200	3	11p
BY127	1250	1	4p
BY212	EHT		6p
BY235	600	1½	7½p
BY236	900	1½	7½p
BY238	1200	1½	9p
BY264	300	3	9p
BY265	600	3	11½p
BY266	900	3	15p
BY274	300	5	14½p
BY275	600	5	17½p
BY277	1200	5	27p
BY299	800	2	4p
BY1202	2kV	10mA	6p
BYX20-200	200	25	72p
BYX22-200	300	1½	25p
BYX38-300R	300	2½	48p
BYX38-600	600	2½	52p
BYX38-900	900	2½	60p
BYX38-1200	1200	2½	65p
BYX42-300	300	10	36p
BYX42-600	600	10	46p
BYX42-900	900	10	92p
BYX42-1200	1200	10	£1.07
BYX46-300R	300	15 Avalanche	£1.19
BYX46-400R	400	15 Avalanche	£1.75
BYX46-500R	500	15 Avalanche	£2.00
BYX46-600	600	15 Avalanche	£2.30
BYX48-300R	300	6	47p
BYX48-600	600	6	60p
BYX48-900	900	6	70p
BYX48-1200R	1200	6	92p
BYX49-300R	300	3	35p
BYX49-600	600	3	42p
BYX49-900R	900	3	47p
BYX49-1200	1200	3	60p
BYX52-300	300	40	£2.05
BYX52-1200	1200	40	£2.90
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E250C50	250	½	14p
LT102	30	2	15p
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MR856	600	3	24p
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IN4006	800	1	6p
IN4007	1250	1	6p
IN5059	200	1½	10p
IN5401	100	3	10p
IN5402	200	3	11p
IS138	800	½	2½p
IS921	100	½	8p
25G100	100	60	£4.35

NON POLAR TANTELUM CAPACITORS

.012/25v, .22/35v, .47/35v 22p

BRIDGE RECTIFIERS

Amp	Volt	Type	Price
½	1,600	BYX10	34p
1	140	OSH01-200	25p
0.6	110	EC433	20p
5	400	Texas	85p
2½	100	I.R.	40p
3¼	100	B40C 3200	58p
½	60V	BC30 C350	23p
2½	350V	9F2	70p
2½	500V	9E4	85p
1	400V	WO4	28p
1	400V	MDA104	29p
1	200V	WO2 Ex Equip	15p
1	50V	WO05	19p
1	800V	WO8	27p
1½	75V	IBIBY234	11½p
1½	150V	IBIBY235	15p
1	1000	W10	36p
3	50	KBS005	30p
3	100	KBS01	30p
3	200	KBS02	30p
3	400	KBS04	30p
3	600	KBS06	30p
Miniature	Meter	Type	34p

Thyristors

Amp	Volt	Type	Price
1	240	BTX18-200	35p
1	240	BTX30-200	35p
1	400	BTX18-300	41p
4	500	40506 with heatsink	58p
4	600	2N3228	36p
6.5	500	BT109/SCR957	71p
2	400	S2710D with heatsink	40p
8	100	S2800A	36p
4	600	C106M sensitive gate	36p
20	600	BTW92-600RM	£3.40
15	800	BTX95-800 Pulse Modulated	£1
0.8	50	2N5061	3p
0.8	200	2N5064	18p
3	600	T3N06C00	53p
3	100	T3N1C00	36p
110	20	72RC2A	£3
75	800	71CG80	£6
150	1000	151RA100	£10
150	1200	151RA120	£11
12	1000	CR121103-RB	£8
10	200	S2800B	54p
5	600	S5800M	44p
8	600	S112M	54p
5	400	S3700D	44p
4	50	S2060F	36p
7	400	S2620D	45p
7	600	S2620M	45p
BT 106		70p	
BT 121		70p	BT 107 £1

TRIACS

Amp	Volt	Type	Price
0.1	40	7W84	3p
25	100	BTX94-100	£2.25
25	1200	BTX94-1200	£5
6	200	T2500B/41014	54p
2.5	600	2N5757	44p
8	400	T2850D	72p

ZENER DIODES

4/500MW. BZY88, BZX97, etc. 5p
2v. 2v7. 3v. 3v3. 3v6. 3v9. 4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 9v1. 10v. 11v. 12v. 13v. 13v5. 15v. 18v. 20v. 22v. 24v. 27v. 30v. 33v. 43v.

1.3/1.5WT BZX61, BZY97, etc. 11p
2v4. 2v7. 3v. 3v6. 3v9. 4v3. 4v7. 5v6. 6v2. 6v8. 8v2. 10v. 11v. 15v. 18v. 27v. 33v.

2.5WT BZX70, etc. 13p
v75. 1v. 2v4. 3v6. 3v9. 5v6. 6v2. 7v. 7v5. 8v. 9v. 10v. 11v. 14v. 15v. (8p). 20v. 22v. 24v. 26v.

5WT BZV40, etc. 15p
3v3. 3v6. 3v9. 4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 8v7. 9v1. 10v. 11v. 12v. 15v. 33v. 68v. 120v.

10WT Z5D, ZX, etc. 20p
4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 11v. 12v. 13v. 16v. 18v. 21v. 22v. 33v. 36v. 39v. 68v. 150v.

BZY61 Laboratory Standard 400MW 7v5. Voltage Regulator Diode 12p

20WT BZY93, etc. 44p
8v2. 12v. 39v.

CONVERGENCE WIREWOUND POTENTIOMETER

5Ω	15p	20Ω	15p	120Ω	15p
7Ω	7p	30Ω	15p	300Ω	15p
15Ω	15p	50Ω	15p	500Ω	15p

KNOB ATTACHED POTENTIOMETER

Log.	150K	15p	25K	10p	330K	15p
Lin.	1K	15p	100K	15p	500K	15p
	10K	9p	220K	15p	1M	8p
	20K	15p	250K	15p		

WIREWOUND POTENTIOMETER

3	38p	250	38p	2K	30p	15K	38p
5	38p	300	38p	2K5	38p	25K	38p
8	38p	500	38p	3K	38p	30K	38p
30	38p	600	38p	5K	30p	50K	38p
50	38p	750	38p	6K8	38p	75K	38p
100	38p	1K	38p	7K5	38p	100K	30p
200	38p	1K5	38p	10K	30p		

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22K	22p	250Ω	22p
50K	21p	300Ω	22p
50K Inverse	11p	470Ω	22p
100K	22p	500Ω	22p
150K	22p	1K	22p
250K Rev.	21p	2K	22p
250K	10p	2K2	22p
470K	22p	5K	22p
500K	22p	10K	9p
1M	12p	15K	22p
1M5	12p	20K	12p
2M	22p	22K	19p or 22p
5M	26p	25K	16p
		30K	22p
		47K	17p or 24p
		50K	7p
		50K Tapped	7p
		100K	22p
		150K	22p
		200K	10p
		250K	9p or 22p
		470K	19p
		500K	9p or 21p
		1M	22p
		1M5	22p
		4M7	8p

4mm Diam. Spindle

LOG		LIN	
500Ω	22p	1K	22p
2K5	22p	2K2	22p
5K	17p	22K	22p
10K	22p	100K	22p
20K	22p	250K Tapped	10p
22K	22p		
22K Tapped	26p		
25K	19p		
47K	22p		
50K	22p		
100K	22p		
200K	22p		
250K	18p		
1M	17p		

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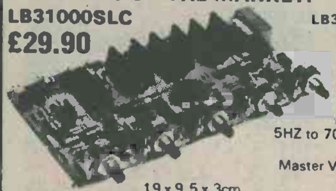

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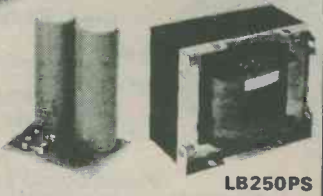

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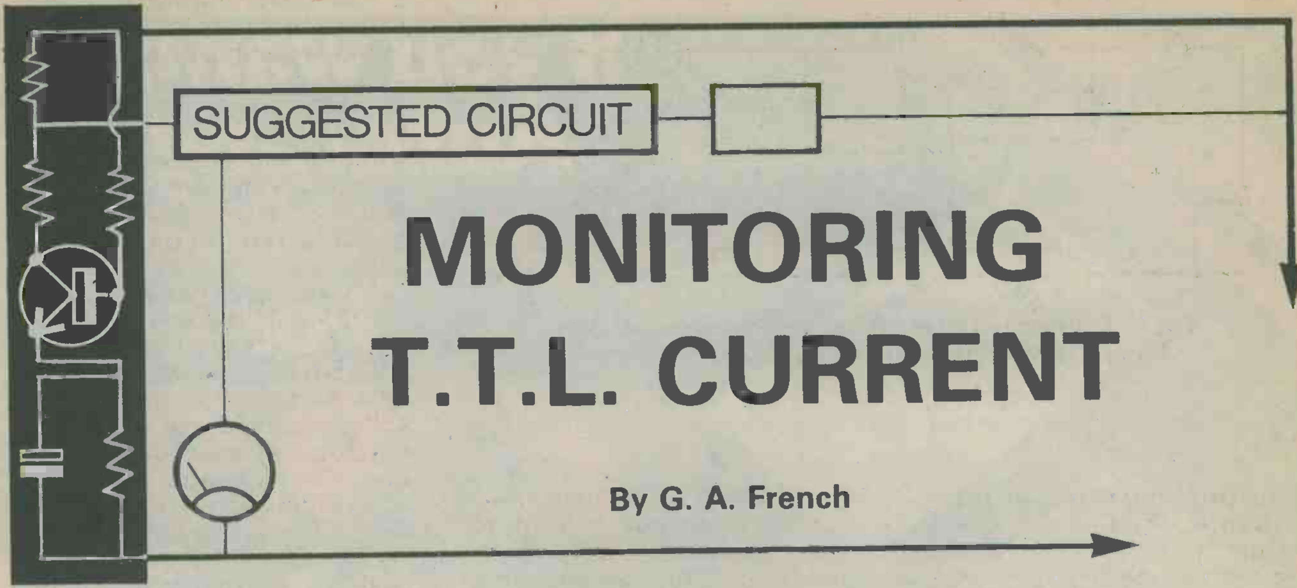


MONITORING T.T.L. CURRENT

By G. A. French

T.T.L. circuits and microprocessors require a stabilized 5 volt power supply and the common practice is to employ a monolithic voltage regulator, as shown in Fig. 1(a). The regulator produces a highly stable output voltage at a nominal level of 5 volts, and at a very low impedance. The circuit powered by the regulator is shown in Fig. 1(a) as a load.

LOAD CURRENT

In many cases it is desirable that a check be maintained on load current, and Fig.1(b) shows a current-reading meter inserted between the regulator output and the load to carry out this function. However, such a circuit would be quite unacceptable in practice due to the impedance presented by the meter and the voltage which must be inevitably dropped across it. The first of these effects would result in the supply impedance across the load being very much higher than that available at the regulator output; whilst the second would cause the voltage across the load to fall as load current increased. This second effect would be very noticeable if the current-reading meter were an analogue multimeter switched to a current range. Due to the universal shunt circuits employed in such multimeters, the voltage dropped across the meter at full-scale deflection current can be as high as 1 volt.

A possible alternative approach to measuring load current is to insert the current-reading meter between the unstabilized supply voltage and the input of the regulator, as illustrated in Fig.1(c). The meter will now indicate the load current plus the current required in the regulator i.c. to maintain the regulated output.

The author checked this scheme out in practice with the circuit of Fig.2, employing a positive 5 volt regulator type 78LO5 which has a maximum

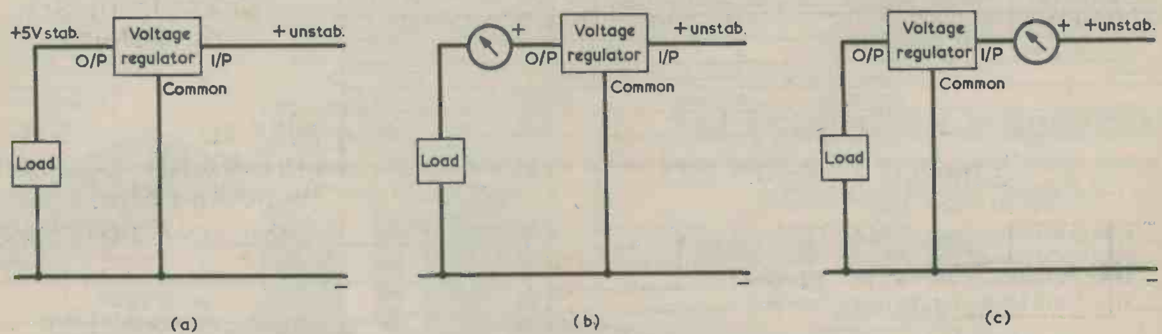


Fig.1(a). The normal method of applying a stabilized voltage of 5 volts to t.t.l. or microprocessor loads.

(b). Attempting to monitor load current by inserting a current-reading meter between the regulator output and the load would be unacceptable in practice.

(c). If the current-reading meter is inserted in series with the regulator input it will indicate load current plus internal current in the regulator.

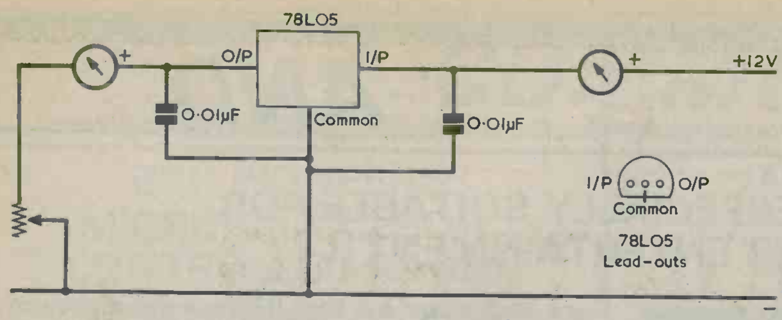


Fig.2. A practical test circuit to check correlation between regulator input and output currents.

output current rating of 100mA. The two 0.01 μF capacitors at the input and output of the regulator are the usual components required to maintain stability. The load is shown as a variable resistor. In practice, several variable resistors were employed to give load currents ranging from 10mA to greater than the 100mA maximum rating of the 78L05. This particular regulator does not, incidentally, have output current limiting. The unstabilized supply voltage was approximately 12 volts. The inset showing the 78L05 lead-outs is not the usual top view given for this device; in Fig.2 the lead-outs point towards the reader.

As had been anticipated there was little difference between the current indications in both meters for all load currents from 10mA to greater than 100mA. Indeed, the current indicated by the meter in the regulator input circuit could be considered as giving a perfectly adequate measure of regulator output current for most purposes likely to be envisaged. In consequence, the basic circuit of Fig.1(c) can be employed to check load current whilst still applying a regulated voltage at low impedance to the load. The unstabilized voltage should be sufficiently high to ensure that the regulator input voltage is at least 2 volts higher than the stabilized output voltage, taking into account any voltage dropped in the current-reading meter.

The same principle will be applicable with other fixed voltage regulator circuits offering output voltages or currents higher than are given with the 78L05. It would be wise, nevertheless, to make a quick check in this respect, using the simple testing circuit of Fig.2.

OVERLOAD WARNING

In some instances it may be necessary to have an indicator to give warning of excessive current in the load supplied by a monolithic regulator. At the same time, the use of a current-reading meter permanently tied to that regulator could be considered uneconomic. An overload warning indicator would be of particular value with the 78L05 and similar regulators which do not have output current limiting.

A warning circuit applicable to the 78L05 is shown in Fig.3. Here, LED1 is a red l.e.d., and it will start to glow when the voltage across it is around 1.7 volts. The input current to the regulator is passed through R1, and the voltage dropped across this resistor is applied to the l.e.d. via current limiting resistor R2. With R1 at 22Ω, the l.e.d. gives a noticeable glow when the input current reaches approximately 80mA. With higher values in R1 the l.e.d. commences to glow at the lower currents indicated in the diagram. To allow for the voltage dropped in R1, the unstabilized voltage should be at least 4 volts higher than the stabilized output voltage of 5 volts.

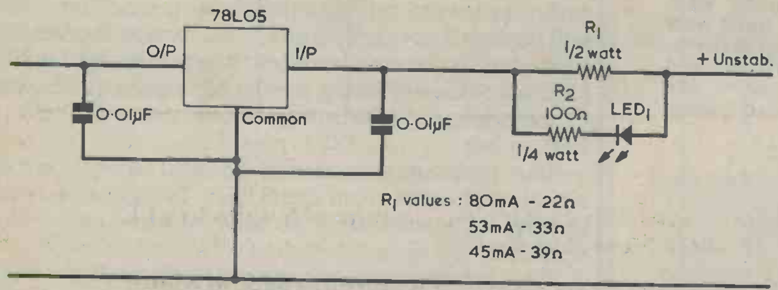


Fig.3. A circuit, applicable to the 78L05 regulator, which gives visual warning of excessive regulator output current.

NEWS . . . AND

CASSETTE ESPECIALLY SUITABLE FOR IN-CAR ENTERTAINMENT

Most car cassette players are, by their very nature, commercially-produced pieces of equipment lacking the sophistication of more expensive cassette recorders and players. One of the more obvious indications of this lack of sophistication is that cassettes played in cars tend to suffer from a loss of performance at high frequencies – in other words the music lacks "sparkle".

It is therefore important, when playing cassettes in cars, to choose a cassette that will in some way compensate for this loss in performance at high frequencies. Such a tape has been developed as an improvement over conventional ferric cassettes and this tape is called "ferrichrome".

3M manufactures a ferrichrome product – Scotch Master III tape – which is proving particularly successful as an in-car entertainment medium. Scotch Master III tape is a dual layer construction of a thin coat of Chromium Dioxide on top of super ferric oxide – hence the name "ferrichrome".

It is the presence of this top layer of chromium dioxide which gives Scotch Master III tape not only an extended response across the frequency band but in particular, results in a gain in performance at the higher frequencies. The result is a much clearer and more natural sound with, for instance, cymbals & percussion instruments.

The combination of both layers on the Scotch Master III tape – that is ferric oxide and chromium dioxide – is necessary in order that recordings can be made without the need for excessive bias (which would be necessary if the tape was coated only with chromium dioxide).

Scotch Master III cassettes can be recorded with the bias set either in the ferrichrome switch position (FeCr) or in the normal switch position but in both cases the recording may be played back in the normal switch position. This is particularly important if the cassettes are played in cars since there are very few car systems which give a FeCr switch position.

Ferric cassette tape performs particularly well in the low and mid-band areas, whilst chromium dioxide tape has a superior treble performance as well as a freedom from background hiss. By combining these two properties in developing Scotch Master III tape, 3M has developed an ideal tape for the special requirements of in-car entertainment.

3M has launched three new Scotch audio cassettes to replace the old Scotch Dynarange, Scotch High Energy and Scotch Chrome cassettes. These three new cassettes – Scotch Ferric, Scotch Superferric and Scotch Chrome – are available in retail outlets now.

RADIO NORFOLK'S VHF STEREO TRANSMISSIONS TO START

Radio Norfolk will be the first of the BBC's local radio stations to come on the air in stereo. The station will be heard over most of the county which gives it its name and in the northern half of Suffolk. Radio Norfolk's studios are being prepared in the county town of Norwich and local programmes will start on 11th September.

The frequency used will be 95.1 MHz and the signals will come from the BBC's Tacolneston transmitting station which is 10 miles south-west of Norwich.

The transmitter uses mixed polarisation which helps listeners using portable vhf radios or car radios and it is no disadvantage for listeners with stereo receivers which use outside aerials mounted horizontally.

. . . COMMENT

BBC PIONEERS MICROPROCCESOR CONTROLLED RADIO

BBC Research engineers are developing a way of sending extra signals along with medium and long wave radio broadcasts. The signals cannot be heard on an ordinary radio but new receivers of the future could make use of the signals to bring an end to the problems of tuning-in to crowded wavebands. Tuning could become entirely automatic, and the signals could do much more, like writing words and figures onto a small display panel on the radio set, giving you the name of the channel you are listening to or telling you the time, or giving you the news headlines at any time you choose.

The application that promises most for ordinary radio listeners is the way the system could one day be used to provide automatic tuning of radio sets. With a radio set of the future you might be able to demand say Radio 1 or Radio 4 and your radio set would search out the best signal for the particular service wherever you happen to be: and you might be able to preset your selection of radio programmes so that the receiver would automatically tune its way around the dial at the right time making sure that you did not miss any of the programmes you particularly wanted to hear. All of these tuning and display functions would be controlled by a microprocessor inside the radio receiver.

The VHF/FM system that the BBC is developing is capable of supporting a data rate of 1200 bits per second using a biphase signalling rate of 2400 baud. The BBC has shown that these signals could be very effectively placed on a subcarrier of 57kHz. The VHF system could carry very much more data than the medium/long wave system and as well as international discussion on standards there will have to be considerable discussion of potential applications with the receiver industry before the system could go into use. So don't expect to buy one of these new receivers for some years.

NEW PORTABLE CAPACITANCE METER

The new Model 820 portable capacitance meter from Havant Instruments Limited is an economical multi-range instrument combining digital accuracy with complete portability. Its ten ranges cover capacitances from 0.1pF to 1 Farad. Accuracy is 0.5% or 1% of full scale, and resolution down to 0.1pF, according to range.

In use the capacitor leads are simply inserted into a pair of slots and the capacitance is indicated on the clear 4-digit LED display. A flashing display provides overrange indication. Provision is also made for using jack plugs when measuring in-circuit capacitances.

The Model 820 is ideal for production line or laboratory use. It has a robust and attractive moulded case but weighs only 675g (1.51 lb). It will operate with rechargeable or disposable cells and there is provision for a charger. A tilt stand, spare fuse and 26-page operating manual are supplied.

Enquiries to: Mr. Frank Helmke, Havant Instruments Ltd., Unit 3., Westfields, Portsmouth Road, Horndean, Hants.

AMATEUR RADIO CLASSES

At the De Beauvoir School, Tottenham Road, London, N1 4BW, commencing 17th. September, 1980, a course especially designed for those candidates who have sat for the R.A.E. and failed, and others who do not wish to start all over again. A fully equipped workshop and amateur transmitting station is available with two tutors. Enrolling commences on Monday, 8th September, 1980, at the school, or details can be obtained from Senior Tutor, Fred Barns G3AGP.

At the Gosforth Secondary School, Gosforth, Newcastle upon Tyne, commencing in September, a course designed to prepare students for the RAE in May/June 1981 – it is also suitable for newcomers to the hobby.

Enquiries to the Principal, Gosforth Adult Association at the school.

CONSTANT CURRENT NI-CAD CHARGER

By

T. J. Johnson

•Charges up to 10 cells.

•Suitable for all normal Ni-Cads.

Most people are painfully aware of the high cost of replacing dry batteries in tranistor equipment, with even the humble PP3 costing 50p or more. The most common alternative to the continued purchase of batteries is to make use of a battery eliminator.

This is fine for equipment which need not be portable but, on the occasions when it is desired to carry the equipment around, trailing mains leads can pose a problem. Another solution, therefore, is to use chargeable cells, or Ni-Cads as they are commonly called. The main advantage of these cells is that, once the initial purchase has been made, there is no need to replace them for a very considerable period. Treated with care, a single cell can be expected to have a life of around 5 to 10 years or more, which is very respectable when the alternative costs of dry batteries over such a period are added up.

The disadvantage with Ni-Cads cells is the period of charging which is required when they run down. This is normally rather a long business since the usual time for a charge is about 10 hours. However, it is not too difficult to arrange matters so that the charging causes no inconvenience. It will be seen that the use of chargeable cells is well worth-while, despite the rather high initial outlay which, for instance, can be around £1.25 for a single U11 type cell.

CHARGING CURRENTS

A minor problem with Ni-cads is that different types require different charging currents, and the charging rates for four typical Ni-Cads is shown in theTable. The charging rate for a discharged cell is one-tenth of cell capacity for 14 hours. It would obviously be uneconomic to have a different charger for each type of cell and this point leads to the design to be described here.

TABLE

Ni-Cad Charging Rates

Battery Size	Capacity (Amps)	Charge Rate
PP3	0.09	9mA
HP7	0.5	50mA
HP11	2	200mA
HP2	4	400mA

The completed constant current charger, housed in its metal case

•Continuously variable output current.

The charger is capable of charging all the popular Ni-Cads which require a charging rate of up to slightly less than 1 amp. It may be used to charge any number of cells up to a maximum of ten. The cells are connected in series and must all be of the same type, as different types of cell may not be charged at the same time. The charging rate is selected by a continuously variable front panel control and is monitored by a meter. The charger has been designed with simplicity in mind and does not have any unnecessary extras.

THE CIRCUIT

The full circuit of the Constant Current Ni-Cad Charger is shown in Fig.1. The secondary of mains transformer T1 provides 18 volts r.m.s., which is then rectified by the bridge rectifier consisting of D1 to D4. Approximately 25 volts appears across the reservoir capacitor, C1. The l.e.d. and its current limiting resistor, R1, provide a simple indication that the unit is switched on.

A stable reference voltage of 10 volts appears

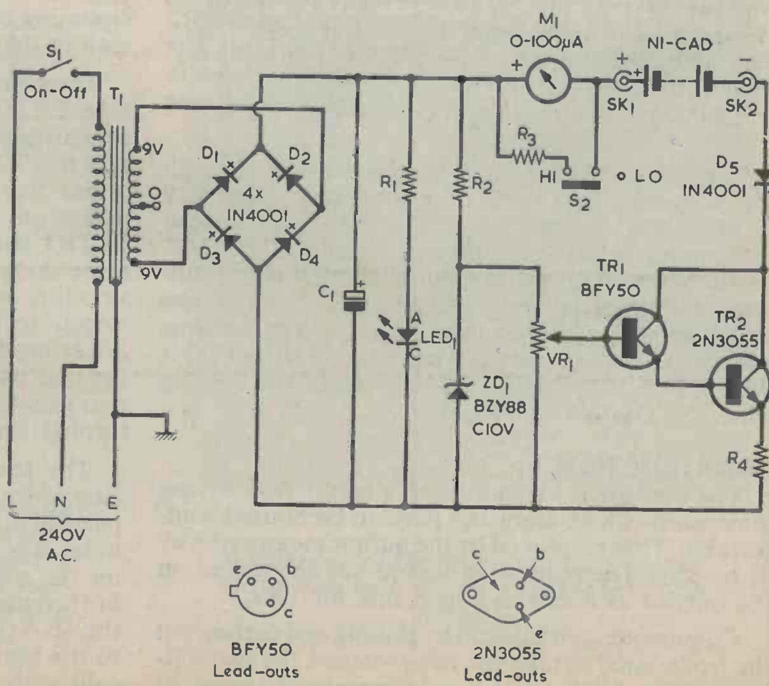
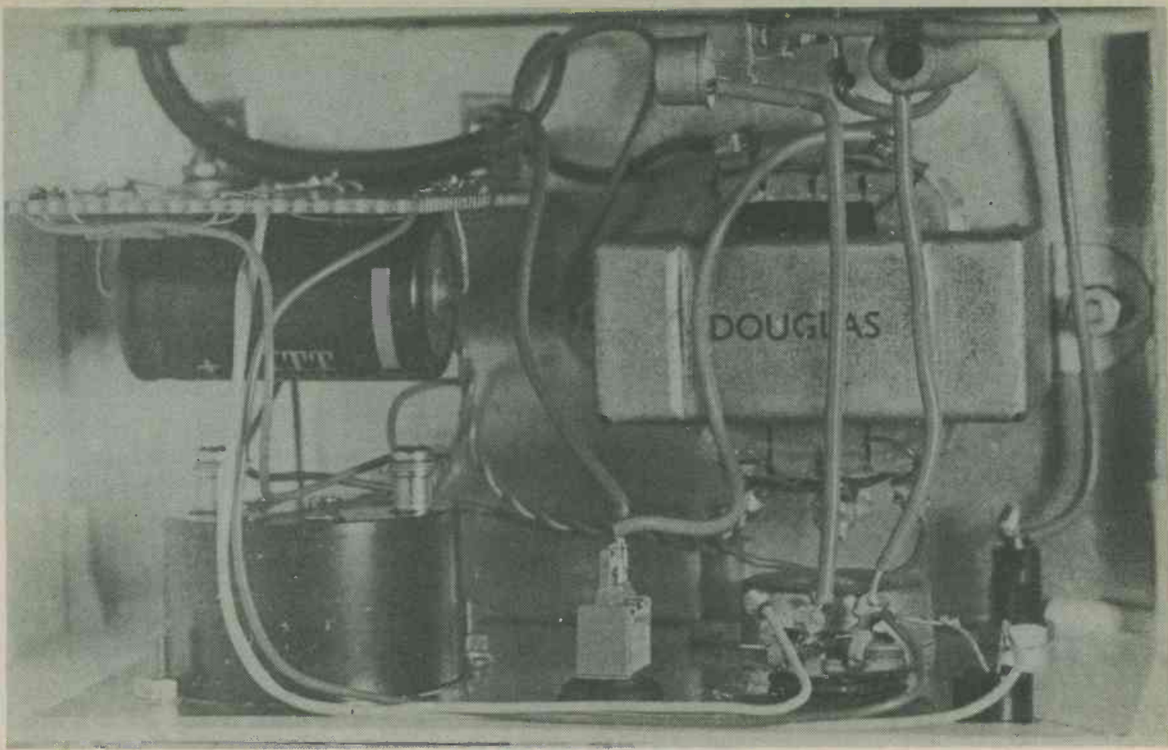


Fig.1. The circuit of the constant current charger. The meter shunt, R3, is made up by the constructor as described in the text.



Looking down inside the case. The power supply board, mounted vertically, is to the rear of the meter

across zener diode ZD1 and is applied across VR1. This control sets the charging current, with the voltage tapped off by its slider being applied to the input base of the Darlington pair given by TR1 and TR2. Since the voltage tapped off by VR1 slider is constant, and since a fixed voltage drop of about 1.2 volts appears between the base of TR1 and the emitter of TR2, a constant voltage appears across the emitter load resistor R4. The current flowing in this resistor is very nearly the same as the collector current of TR2 and, with a constant voltage across the resistor, the current which flows through it is constant also. So, in consequence, is the current flowing through the Ni-Cad cells being charged.

The 0-100mA meter M1 is inserted in series with the charging circuit so that the charging current may be measured. When S2 is in the "LO" position the f.s.d. meter indication is 100mA. Setting S2 to "HI" connects the shunt R3 across the meter and the full-scale deflection current then becomes 1 amp. The lower range is switched in when using low currents and when greater accuracy is required. Rectifier D7 is included to prevent the Ni-Cads from discharging when the unit is switched off.

CONSTRUCTION

The charger is assembled in a metal case having dimensions which allow the parts to be housed comfortably. That employed by the author measured 6 by 3½ by 3½in. The rear panel should not be painted on the outside as it acts as a heat sink for TR2.

Commence construction by drilling and cutting out the front panel to take the two switches, the two output sockets, VR1, LED 1 and the meter. S1 must, of course, be suitable for switching mains voltages, and the contacts of S2 must be rated as at least 1 amp d.c. This rules out sub-miniature slides switches, which are normally rated at less than 1 amp. The meter is the widely available type having a front face measuring 60 by 45mm. and which requires a circular panel cut-out with a diameter of 38mm. (1½in.). The 0-100mA movement has a nominal internal resistance of 0.5Ω. The l.e.d. may be fitted in a panel-mounting bush. The layout of the front panel can be seen in the photographs and in Fig.3.

The rear panel is next drilled, as shown in Fig. 3, to take TR2. This is mounted with a mica washer and insulating bushes to insulate it from the case. Connection to TR2 collector is made by way of a solder tag under the upper securing nut. In the prototype, extensions leads were employed for the connections to TR1 base, D5 anode and the upper end of R4, these leads being covered with sleeving. Some constructors may prefer to anchor these leads more closely to the components concerned, and a small 3-way tagstrip (with no tag earthed) may be fitted to the rear panel for this purpose. Also required in the rear panel is a hole for the mains leads, which will pass through a suitable grommet.

The few components which comprise the major part of the power supply section are assembled on a piece of 0.1in. plain perforated board having 21 by 28 holes. The layout for this is shown in Fig.2, and wiring on the underside of the board is indicated by the broken lines. Two small angle brackets are secured at the 6BA clear holes; when these brackets are secured to the bottom of the case the board will stand vertically with R1 at the top. Ensure that the brackets do

COMPONENTS

Resistors
R1 2.7kΩ ½ watt 5%
R2 1.2kΩ ½ watt 5%
R3 See text
R4 10Ω 10 watts 5% wire wound
VR1 100kΩ potentiometer, linear

Capacitor
C1 2,200μF electrolytic 40V. Wkg.

Transformer
T1 Mains transformer, secondary 9-0-9V at 1A

Semiconductors
TR1 BFY50
TR2 2N3055
D1 1N4001
D2 1N4001
D3 1N4001
D4 1N4001
D5 1N4001
LED 1 Red l.e.d.
ZD1 BZY88C10V

Switches
S1 s.p.s.t. toggle
S2 s.p.s.t. slide

Meter
M1 0-100mA. 60x45mm face

Sockets
SK1 4mm. insulated socket, red
SK2 4mm. insulated socket, black

Miscellaneous
Metal case (see text)
Insulating kit (for TR2)
Plain perforated board, 0.1in. matrix
3-core mains lead
2 metal brackets (see text)
Nuts, bolts, wire, etc.

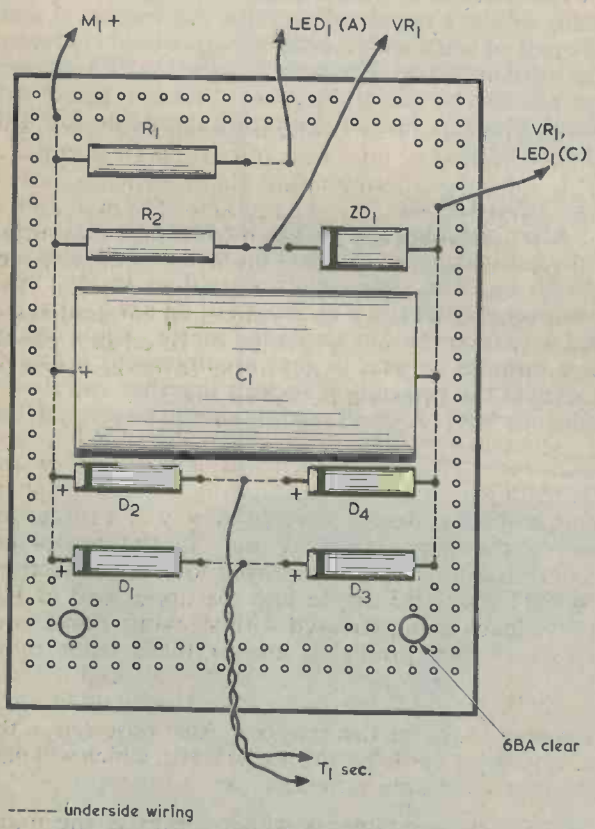
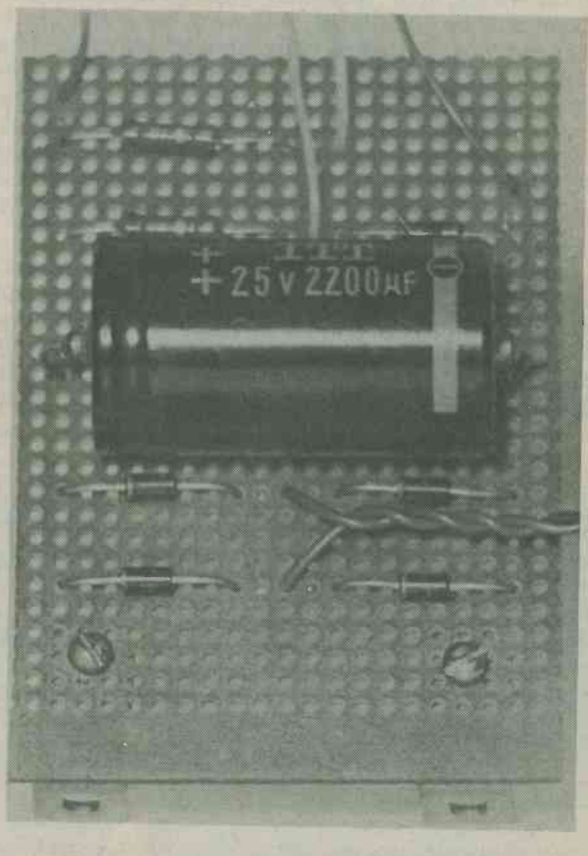
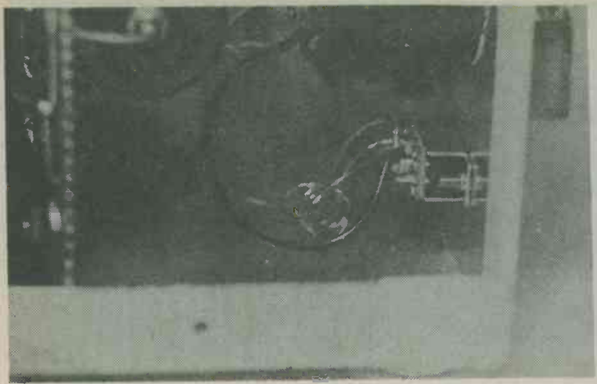
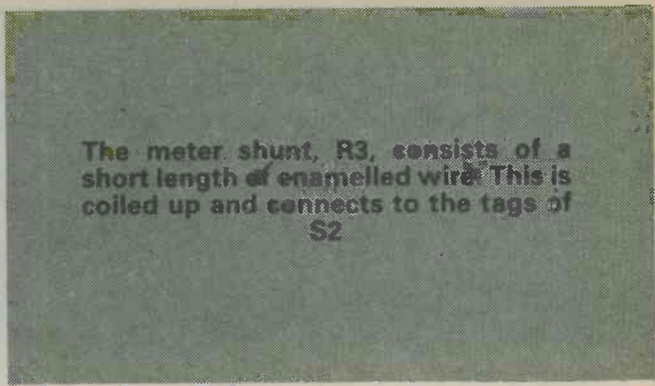


Fig.2. The power supply components are assembled on a plain perforated board. This is held upright inside the charger case by two small angle brackets fitted to the underside at the 6BA clear holes



A close-up of the power supply board. Note the two angle brackets at the bottom





The meter shunt, R3, consists of a short length of enamelled wire. This is coiled up and connects to the tags of S2

not come into contact with any of the wiring under the board. Attach the two wires from the rectifiers which connect to T1 secondary.

The bottom of the case may now be drilled to take the mains transformer, the power supply board and a small clamp to secure the mains lead inside the case. Again, layout can be judged from Fig.3 and the photographs. Take care to ensure that there is adequate clearance between the mains transformer tags and other components and wiring. A solder tag is fitted under the inside mounting nut of the transformer, and the earth wire of the mains lead connects to this tag.

The power supply board and all the other components with the exception of S2 may next be mounted. All the wiring, apart from that between the meter and S2 can now be completed, following Fig.2 and Fig.3. Stranded p.v.c. covered wire should be used. The shape of R4 may differ from type to type, but whatever type is employed its connecting leads should be bent so that its body is very close to the rear panel, without any risk of short-circuits between the resistor and the panel inside surface. The rear panel will then provide some dissipation of the heat generated in the resistor at high output currents.

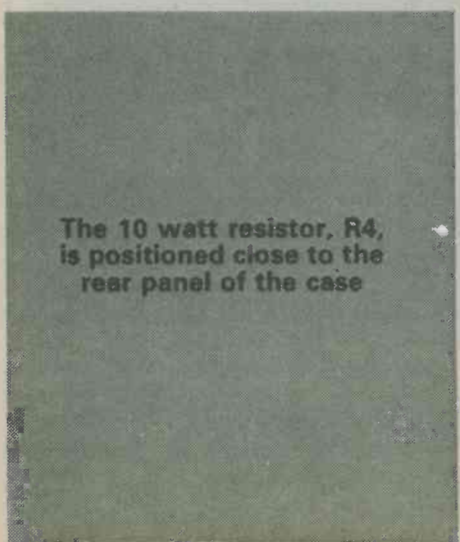
Connect two insulated wires about 2½in. long between the meter terminals and the two outside tags of switch S2. R3 is mounted on the switch tags, as illustrated in Fig.3. The value required in R3 is extremely small and, as such, no standard component is available. It thus has to be home-constructed. Take about 8in. or slightly more of 32 s.w.g. enamelled copper wire, tin both ends and solder to the switch tags as indicated in Fig.3. The switch is still not mounted in position yet and, in company with the 32 s.w.g. enamelled wire, it should be kept well out of the way of other wiring and connections to prevent accidental short-circuits. The 32 s.w.g. wire is not coiled up yet, as its length needs to be adjusted.

In the prototype the front panel was covered with white Fablon to provide a neat appearance. Lettering can be added, using Panel-Signs Set No. 4. A large diameter spun aluminium knob was fitted to enhance the appearance.

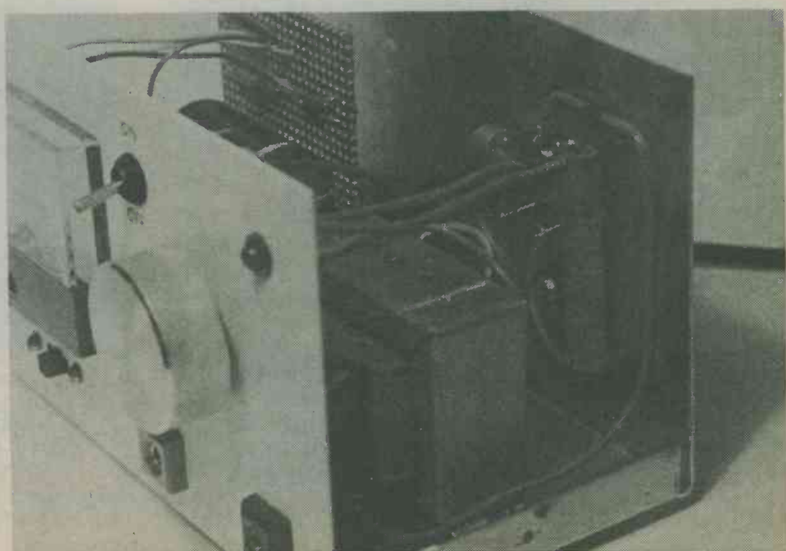
The method of connecting the charger to the Ni-Cads will be a matter of personal preference. A simple pair of leads with crocodile clips would represent the most universal approach. A standard PP3 connector will also be useful. Each set of leads is fitted with 4mm. plugs. A fuse of low rating should be fitted in the mains plug.

SETTING UP R3

After checking the wiring for errors, adjust VR1 fully anti-clockwise, connect the unit to the mains and switch on. The slide switch should be in the "HI" position, so that the 8 in. length of 32 s.w.g. enamelled wire is connected across the meter. Allow one or two minutes to pass in case a component is faulty. Connect the two output sockets together and slowly advance VR1. A small reading should be given in the



The 10 watt resistor, R4, is positioned close to the rear panel of the case



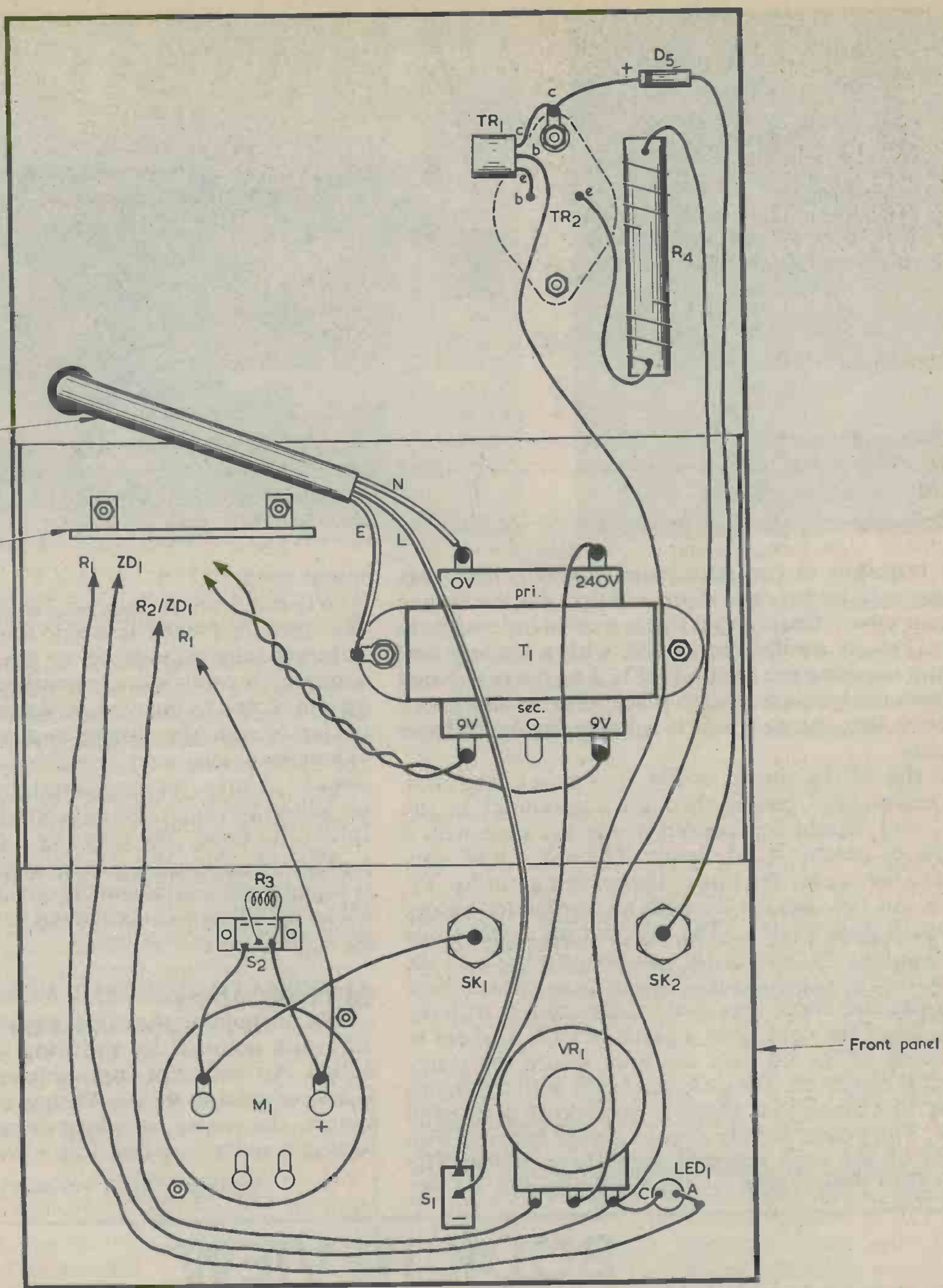
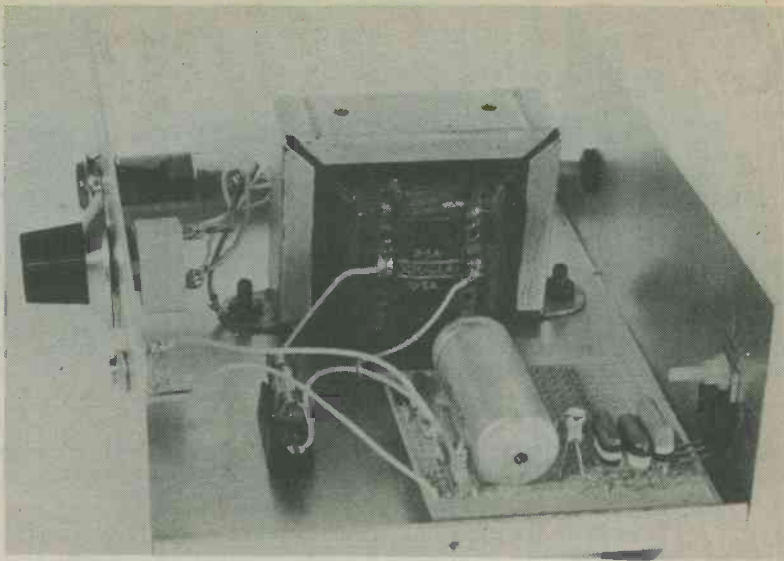


Fig.3. Wiring inside the case. The front and rear panels are shown opened out for purposes of illustration. Check with Fig.2 for connections to the power supply board. Switch S2 is not mounted in position until the correct value for R3 has been found

meter. Switch S2 to the "LO" position, whereupon the reading should increase considerably. (S2 was initially set to "HI" to provide protection for the meter in case a wiring error caused an excessive current to flow).

Continue to advance VR1 until the meter reads f.s.d., i.e. 100mA. Next, leaving VR1 as it is, put S2 to the "HI" position. The meter should now, within reasonable limits, give an indication of around 10mA on its scale. If the reading is high, as it almost certainly will be, switch off at S1, slightly reduce the length of 32 s.w.g. wire between the switch tags and try again. Repeat the process as necessary, until the correct reading is obtained. Remember that, if the meter gives a low indication, the length of 32 s.w.g. wire has to be increased. It is, in consequence, a lot easier to start with a longer length of wire than that which will be finally required! When the correct length of 32 s.w.g. wire has been found, one end is unsoldered from its switch tag, the wire is wrapped round a pencil

Side view of the power supply with the case lid removed



hole required in the rear panel for IC1 heat tab. Remove the board once more and drill out the hole in the rear panel. Ensure that this is a clean hole without burrs. Finally mount the board, with a second bolt and nut securing the heat tab of IC1 to the rear panel and with the insulating kit in place. Use an ohmmeter to check that the heat tab is reliably insulated from the case.

All the wiring shown in Fig. 3 is next completed. The mains lead passes through a grommet in the panel and should be secured inside the case with a plastic, or plastic-faced clamp. The earth lead connects to the solder tag under the securing nut for T1. Check out the tags for S1 with an ohmmeter before wiring to this switch. Tag positioning with some switches may vary from that shown in Fig. 3. If the mains transformer has tags at its upper end and there is any risk that these tags could make contact with the metal lid of the case, glue a piece of s.r.b.p. sheet to the inside of the lid over the area where the transformer is mounted. Take especial care with the mains wiring to ensure that there is no risk of accidental shock. The power supply should always be used with the lid of the case screwed securely in place. The mains lead should be properly terminated in a 3-pin mains plug.

When a 3.5mm. jack socket of open construction (i.e. not insulated) is used, the negative output is automatically connected to the metal case. If two insulated terminals are employed neither output will be connected to the case, and some constructors may prefer to use the power supply in this condition. When two insulated terminals are used and it is desired to have one connected to the case, a wire may be added between the appropriate terminal and the solder tag under the securing nut for T1.

After checking the power supply wiring for errors, it may be connected to the mains and switched on. Make sure that it is connected to the supplied equipment with correct polarity.

ALTERNATIVE OUTPUT VOLTAGES

The output voltage of the supply can be changed to 7.5 volts nominal by reducing the value of R2 to 4.7kΩ. An output of approximately 6 volts is given if R2 is reduced to 680Ω. With a 6 volt version of the supply, the mains transformer can be a component having a secondary rated at 9 volts and 1 amp.

BOOK REVIEW

A MICROPROCESSOR PRIMER. By E.A. Parr, B.Sc., C.Eng., M.I.E.E. 95 pages, 180 x 105mm. Published by Bernard Babani (publishing) Ltd. Price £1.75.

Seeking information on microprocessors by reading books on the subject is by no means the simplest of processes. Many books tend to assume that the reader is already familiar with the jargon or can easily accept the arbitrary nature of microprocessor operation. The microprocessor chip is a 40-pin device whose functions are unalterably designed into it. You don't know what lurks behind its pins and you have to accept that you must handle it using precisely the procedure detailed for it by its manufacturer if you are to obtain sensible results from it.

The book under review is expressly designed to ease the reader into the terminology of microprocessors and their basic simplicity. Indeed, the author refers to the analogy of the simplicity of the wood and the complexity of the trees in his Introduction. The book then proceeds to outline the operation of a simple theoretical computer and thereby leads the reader, at the end, to an actual machine, the Z80. A useful glossary of terms is also given.

This is a most helpful book. To quote from the author's Conclusion: "It was not the aim of this book to make the reader competent in the use of any particular microprocessor. The aim was to explain some of the basic concepts that are usually omitted from microprocessor descriptions."

This is page 30!

Calculating Resonance

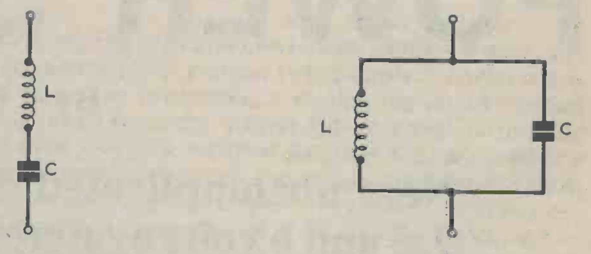
By
P. Rogers

Easy calculator key sequences for finding resonant frequency values.

One over two pi root LC
Gives you the resonant frequency!

This piece of doggerel is a well-tried method of remembering the equation for resonant frequency in a circuit containing inductance and capacitance. Basically, frequency is in Hz, inductance is in henrys and capacitance is in farads, and the equation applies to a series tuned circuit and to a parallel tuned circuit (provided that the latter has a Q factor greater than about 5).

In the pre-pocket calculator days the resonance equation could prove difficult and time-consuming to work out, partly because of the awkwardness of the units and partly because of the necessity to find the square root of LC. This normally involved the use of logs and there was the ever-present risk of picking up or losing a zero or getting the decimal point in the wrong place.



$$f = \frac{1}{2\pi\sqrt{LC}}$$

The series and parallel LC tuned circuits, and the equation which defines their resonant frequency

TABLE

RESONANT FREQUENCY

Units: Megahertz, microhenrys and picofarads, *or* Hertz, henrys and microfrads.

Key sequence to find f:

L X C = $\sqrt{x}$ 1/x X 159.2 =

Examples: 5μH and 200pF give 5.03MHz.
22H and 100μF give 3.39Hz.

Key sequence to find L:
f x^2 X C = 1/x X 25330 =
Examples: 20MHz and 3pF give 21.1μh
50Hz and 0.5μF give 20.3H.

Key sequence to find C:

f x^2 X L = 1/x X 25330 =

Examples: 15MHz and 2μH give 56.3pF.
40Hz and 1.3H give 12.2μF.

CALCULATOR SOLUTION

The resonance equation can, of course, be simplified, and it works out, for instance, as frequency being equal to 159.2 divided by the root of LC, where frequency is in MHz, inductance is in microhenrys capacitance in μF. The first set of units is excellent for r.f. resonance calculations whilst the second set covers a.f. resonance calculations.
r.f. resonance calculations whilst the second set covers a.f. resonance calculations.

Extracting L or C from the equation when frequency and the complementary C or L are known could be an even bigger headache as both sides of the equation had to be squared up. Again a simplification is possible and L is found to be equal to 25330 divided by the product of frequency squared and C. The same two sets of units are again applicable.

All these calculations can be undertaken with a pocket calculator having $\sqrt{x}$, x^2 and 1/x functions, and the key sequences are shown in the Table. There may be an "equals" in the sequences which is not needed with some calculators, but it will do no harm and it merely isolates the different parts of the calculation. Answers are intended to be accurate to 3 significant figures, which is more than adequate for most calculations of this nature.

9 VOLT 1 AMP POWER SUPPLY

The only control on the front panel is the on-off switch. In the prototype the output was available at a 3.5mm. jack socket, but insulated terminals can be fitted if preferred.

By I. M. Attrill

Neat uncomplicated design. Output options at 7.5 and 6 volts available. Fully regulated output with short-circuit protection.

An inexpensive fixed voltage power supply such as the unit described here can be extremely useful. The nominal output voltage is 9 volts, and the supply is therefore suitable for use when designing or testing most 9 volt battery operated equipment. It can also be employed for a specific item of equipment, such as a radio or cassette recorder, which has a power input socket. When portable operation is not required this can result in quite a considerable saving in battery costs, especially when the equipment has a high current consumption. The maximum output current of the supply is 1 amp, and this is more than adequate for most cassette recorders, cassette radios and other items of equipment which require a fairly high current.

The power supply can be modified to give a nominal output voltage of 7.5 or 6 volts, as is required by many radio and cassette units, and the altered voltage is obtained by changing the resistor values. (With a 6 volt output, a different mains transformer may also be employed). At any of the output voltages the supply is suitable for applications where good regulation and smoothing are required. The output voltage drops by only about 1 to 2% between zero and full loading. Noise on the output is only a few millivolts even at full output current, and it is only a fraction of a millivolt at output currents below around 100mA. The design incorporates output short-circuit current limiting.

CIRCUIT OPERATION

A fixed voltage monolithic regulator device is an obvious choice for incorporation in a single voltage supply, but such devices are readily available only with a few fixed voltage ratings, and these do not include 9 volts (or 7.5 or 6 volts). This is only a minor problem, however, as it is quite easy to increase the voltage available from a regulator device.

Fig. 1 (a) shows the basic method of employing a

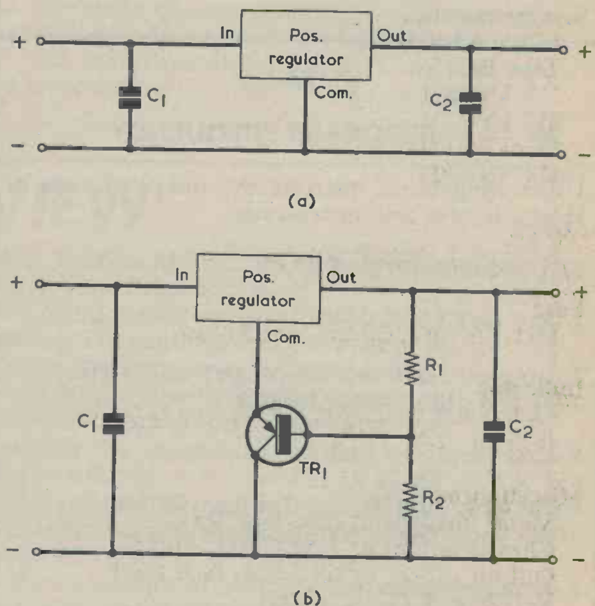


Fig. 1 (a) The basic method of connecting a positive monolithic voltage regulator (b) This circuit allows the regulated output voltage to be higher than the rated voltage of the regulator.

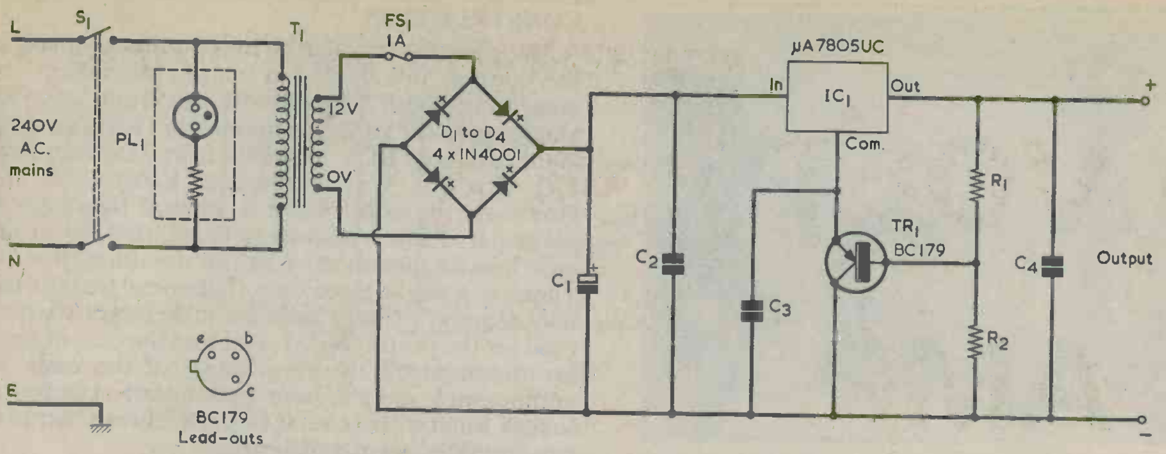


Fig. 2 The circuit of the 9 volt 1 amp power supply. The lead layout of IC1 is indicated in Figs. 3 and 4. Output voltages of 7.5 and 6 can be obtained if the value of R2 is altered.

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 15kΩ.
R2 8.2kΩ.

Capacitors
C1 1,000μF electrolytic, 25V. Wkg.
C2 0.22μF polyester type C280.
C3 0.1μF polyester type C280.
C4 0.1μF polyester type C280.

Transformer
T1 Mains transformer, secondary 12V at 1A.

Semiconductors
IC1 μA7805UC.
TR1 BC179.
D1 1N4001.
D2 1N4001.
D3 1N4001.
D4 1N4001.

Switch
S1 d.p.s.t., toggle rotary.

Fuse
FS1 1A fuse, 20mm. quickblow.

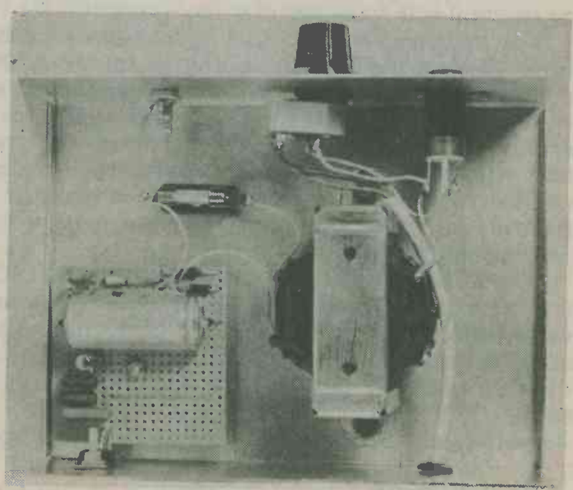
Indicator
PL1 Neon indicator with integral series resistor, 240 V a.c.

Miscellaneous
Metal instrument case (see text).
Chassis-mounting fuseholder, 20mm.
Output socket or terminals (see text).
Veroboard, 0.1in. matrix.
Control knob..
Mica washer, insulating bush (for IC1).
3-core mains lead.
Nuts, bolts, solder, etc.

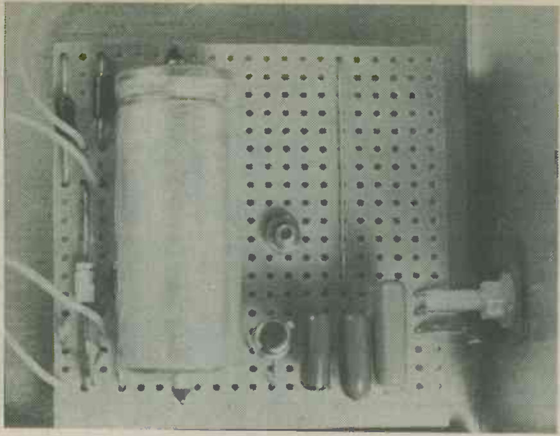
regulator. The regulator has three terminals only, the unregulated input voltage being applied to the input and common terminals, and the regulated output being taken from the output and common terminals. The only discrete components that are required are bypass capacitors across the input and output. These provide stability and improve transient response.

There are a number of ways in which the output voltage of the device can be increased, but they all involve raising the common terminal above the negative rail by a fixed voltage. For example, the output voltage of a 5 volt regulator can be increased to 9 volts by taking the common terminal 4 volts above the negative rail potential. What happens here is that the regulator is really stabilizing the output voltage at 5 volts above the potential of its common terminal.

Fig. 1 (b) shows the method of increasing the output voltage which is used in the present design. The output of the regulator is applied to the potential divider consisting of R1 and R2, and the junction of these two resistors connects to the base of the emitter follower transistor. Assuming that no base current



Layout of parts inside the case.



The Veroboard assembly. The voltage regulator heat tab is bolted to the rear panel of the metal instrument case.

flows in the transistor, the voltage at the regulator common terminal is then 0.6 volt higher (due to base-emitter voltage drop) than the voltage at the junction of the potential divider resistors. If R1 and R2 had equal values, half the output voltage (plus 0.6 volt) would be applied to the regulator common terminal and the regulated output would be approximately double the nominal output voltage of the regulator. Other boosts in output voltage will be given according to the ratio of the two resistor values. In practice, the simple relationship just described has to be modified slightly to take into account the base current in the transistor, and the actual values required in R1 and R2, which will be close to the values calculated with zero base current, are best determined by empirical means.

The full circuit of the power supply appears in Fig. 2. The regulator voltage boosting circuit is identical to the configuration shown in Fig. 1 (b), except for the addition of a third bypass capacitor, C3. IC1 is a 5 volt device and the specified values for R1 and R2 raise the output voltage to approximately 9 volts. There will be a small variation in output voltage between one unit and another due mainly to tolerances in the values of R1 and R2. The output voltage should be within a few hundred millivolts of 9 volts, though, and this will be close enough for all normal applications.

The regulator section of the circuit is fed by a conventional full-wave rectifier incorporating D1 to D4. The mains input is isolated by step-down transformer T1, and the rectified output is smoothed by the large value capacitor, C1. The unregulated input to IC1 should be at least some 2.5 volts higher than the regulated output voltage if the regulator is to function properly. With the present circuit the loaded voltage across the smoothing capacitor is typically a little over 12 volts, giving an adequate margin for reliable operation.

The fuse, FS1, is included despite the fact that ICI has output current limiting at a little over 1 amp and also incorporates thermal overload protection. The fuse gives protection in the event of a component failure ahead of the regulator or a regulator malfunction.

On-off switch S1 is the only control in the power supply and PL1 indicates when the mains supply is switched on. PL1 is a panel-mounting neon indicator with its own integral series resistor, and should be rated at 240 volts a.c.

CONSTRUCTION

The power supply can be made quite compact, and the author found that a metal instrument case measuring about 152 by 114 by 51mm. provided ample space for all the components. This is an instrument case type BC1, available from Harrison Bros., P.O. Box 55, Westcliff-on-Sea, Essex, SS0 7LQ. However, the constructor is advised to obtain the particular mains transformer to be used (or at least ascertain its dimensions) before obtaining the case. There is a slight possibility that some transformers may require a case which is a little larger than that used for the prototype. S1, PL1 and the output socket are mounted on the front panel of the case. The author employed a 3.5mm. jack socket as the output socket, but it will of course be perfectly in order to use two insulated terminals instead.

The photographs illustrate the internal layout inside the case. There are three items here, these being the mains transformer, the chassis-mounting fuseholder for FS1 and a Veroboard panel. Apart from the Veroboard panel, the positioning of these items is not critical. The mains transformer has a solder tag secured under one of its mounting nuts. The mounting bolt heads are below the case.

The wiring, including the Veroboard layout, is shown in Fig. 3. The Veroboard is of 0.1in. matrix and has 21 holes by 19 copper strips. There are no breaks in any of the strips. The single mounting hole is 6BA clearance.

With the exception of IC1, the components are soldered to the Veroboard in normal fashion. Be careful not to leave out the single link wire. The lead-out wires of IC1 are bent to the shape shown in Fig. 4 before it is soldered to the Veroboard, and this enables its heat tab to be bolted to the rear panel of the case. The regulator dissipates a few watts of power at full output, and the rear panel then provides the necessary heatsinking. The heat tab must be insulated from the rear panel, and this is achieved by using a mica washer and an insulating bush for the mounting bolt.

To locate the Veroboard correctly, place it in position on the bottom of the case with the heat tab of IC1 in contact with the rear panel. Using the Veroboard as a template, mark out the hole required in the case bottom. Remove the board and drill this hole 6BA clearance. Mount the board with a 6BA bolt and nut, using a spacing washer to keep the board underside clear of the bottom of the case. Now mark out the

Another view of the supply unit after completion. The legends on the front panel are taken from "Panel-Signs" Set No. 4.

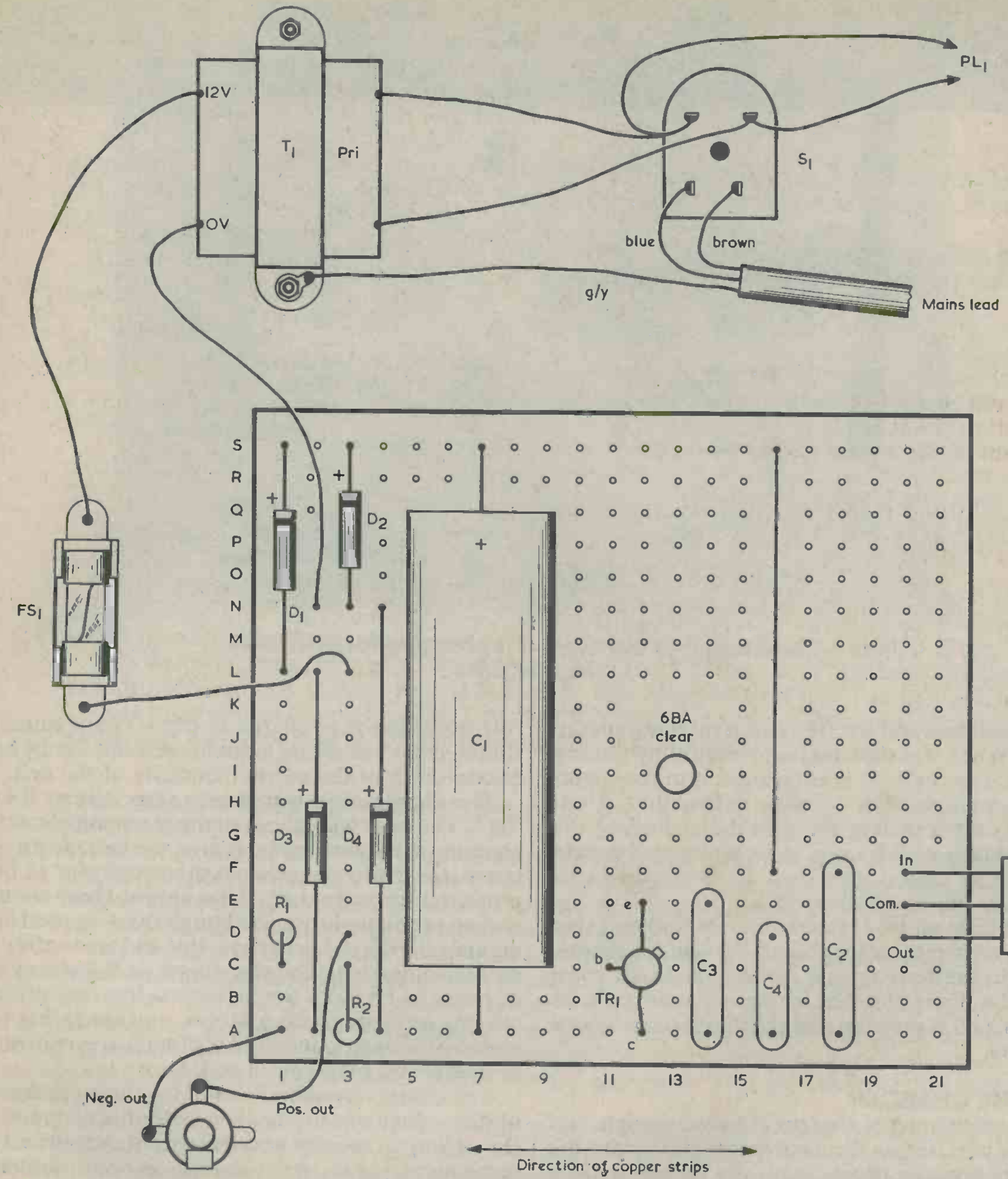


Fig. 3 Wiring up the power supply. There are no breaks in the Veroboard copper strips.

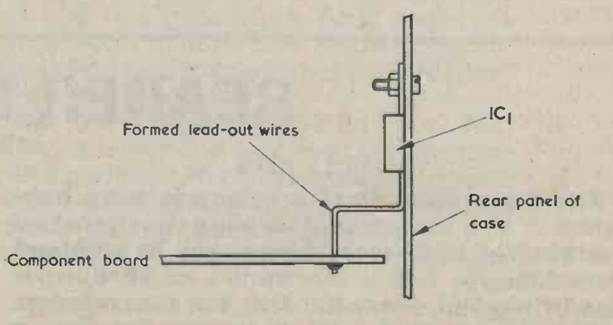


Fig. 4 The heat tab of IC1 is bolted to the rear panel of the case, which provides heatsinking. The tab should be insulated from the rear panel with a mica washer and plastic bush, which are not shown here.

The charger in use. Here it is charging four HP7 size Ni-Cad cells

to form a neat coil and the free end is then resoldered to its tag. When it is switched into circuit, by putting S2 to "HI", the current readings given in the meter should be multiplied by 10. The desirability of not fitting the switch during the process of finding the requisite length of 32 s.w.g. wire will now become apparent. The switch may next be mounted in its proper place on the front panel.

When setting up R3 it should be remembered that the mains connections to S1 and T1 will be accessible. All precautions against accidental shock must therefore be observed. The charger should only be used with its lid in place so that the mains connections are covered.

USING THE CHARGER

The constant current charger is now complete and is ready for use. Before connecting any Ni-Cads to the charger temporarily short-circuit the output sockets and set VR1 to the current required, as shown in the meter. Switch off and then, using the correct type of connecting leads, connect the Ni-Cads. Switch on, and the cells will be charging. Take care to connect the cells with correct polarity.

Charging rates for the most popular Ni-Cads are given in the Table. If an unfamiliar cell is obtained the rule-of-thumb is to charge at the 10 hour rate. This simply means charging a discharged cell for 14 hours at one-tenth of the current capacity of the cell.

The charger does get warm, especially at R4 and TR2. The heat will be particularly noticeable at high charging rates, but need not give rise to concern. As a check, the prototype was run continually for 11 hours at maximum current with the output short-circuited and no problems arose. Although the wire used in the making of R3 is fairly thin, this did not suffer any excessive heating. The dissipation in R4 is very near its rating of 10 watts. Some constructors may prefer to employ a resistor with a higher wattage rating here, say 15 or 20 watts, and the use of such a resistor would of course, be perfectly in order.

The charger can also be used for the measurement of low values of resistor. The output is connected to the unknown resistor and the output current set to a convenient value. A voltmeter is then connected across the resistor and the voltage taken after which, by application of Ohm's Law, the value of the resistor can be found. This procedure produces far more accurate results than are given with a conventional testmeter switched to a low ohms range. If a sensitive millivoltmeter is employed, extremely low values – less than an ohm – can be measured in this way. ■

READER SERVICES

ARTICLE KITS

Kits for a number of articles we have published in this magazine, including the 'Constant Current Ni-Cad Charger' above, can be obtained from Messrs. T & J Electronics of 98 Burrow Road, Chigwell, Essex IG7 4HB. For the complete list to date see their advertisement elsewhere in this issue.

P.C.B. SERVICE

Messrs. B. R. B. Printed Circuits of 109 Potter Street, Worksop, Notts. S80 0BY have instituted a p.c.b. service for suitable articles appearing in this magazine. The first of such articles – 'Two 20dB Amplifiers' will appear in our next issue.

RECENT PUBLICATIONS

ELECTRONICS FOR THE SERVICE ENGINEER, VOLUME 2. By Ian R. Sinclair, B.Sc., M.I.E.E. 279 pages, 240 X 180mm. Published by The Technical Press Limited. Price £4.95.

Ian Sinclair needs no introduction to the readers of this journal, and his series of articles, "Tune-In To Programs" and "DATABUS", have been appreciated by many seeking knowledge on programmable calculators and microprocessors.

In the work under review Ian Sinclair addresses himself primarily to the embryo service technician undertaking the improved City & Guilds of London Institute Course No. 224, which has replaced the popular Course No. 222 in the same subject area. The book will also have a wide appeal for any student in the subjects concerned as well as the amateur enthusiast.

The book is in three sections, the first of which deals with basic principles and circuitry. Items covered include measurements and readings, semiconductor devices, amplifiers, power supplies, LCR circuits, waveform generating and shaping circuits, and miscellaneous mechanisms and devices. The second section deals with domestic electronic equipment, with an emphasis on television, whilst the third examines industrial and telecommunications applications.

The book has a fully practical approach with emphasis on experiment and fault-finding, and with unnecessary mathematics and theory avoided. Exercises which involve the construction and evaluation of working circuits are also given.

This Volume 2 has been published before Volume 1 of the same title because the substitution of "C & G 224" for "C & G 222" has affected Part II of the full C & G Course much more than it has Part I. At the time of publication of Volume 2, the first Volume is nevertheless at an advanced state of preparation.

TEST GEAR PROJECTS. By Terry Dixon. 109 pages, 210 x 130mm. Published by PAPERMAC. Price £3.95.

This book is No. 4 in the series "Electronic Projects" published by PAPERMAC, the non-fiction paperback imprint of The Macmillan Press. The three preceding titles in this series are "Cost-effective Projects Around the Home", "Projects for the Car and Garage" and "Audio Circuits and Projects".

The present book is mainly intended for the amateur who requires simple and relatively inexpensive test equipment to check projects which he has built and also to locate any faults which prevent their functioning. More than thirty home-constructed projects are described in the book, including power supplies, signal injectors, a reference oscillator, noise generator, a logic probe, multimeter, capacitance, bridge, transistor tester, oscilloscope calibrator and an oscilloscope dual trace adapter.

The book is written with the newcomer in mind and the author takes pains to explain practical problems and requirements in any project where these are of importance. Particularly helpful is the approach towards component availability, a matter which can bedevil even the most advanced home experimenter.

ELECTRONIC HOUSEHOLD PROJECTS. By R.A. Penfold. 102 pages, 180 x 105mm. Published by Bernard Babani (publishing) Ltd. Price £1.75.

More than twenty electronic devices which can be used in the home are dealt with in this book by its well-known author, and they range from a very simple fuse checker to a timer incorporating five i.c.'s and two transistors. Each project is presented in the same form. The circuit is given, accompanied by a detailed description of its operation together with practical points to be observed in its construction, after which the full component requirements are listed.

The book is divided into three sections, the first of which deals with household gadgets. These include a telephone amplifier, a telephone repeater, an intercom and two timers. The second section describes gadgets which can be used around the house, such as an ultrasonic remote control, a Christmas tree lights flasher and a model train controller. Alarm circuits appear in the third section and include a burglar alarm with optional exit and entry delays, a baby alarm, a smoke/gas detector and a freezer alarm.

The INS

Part 2

This month we give for the INStructor p final step in which chip is plugged into

Construction is simple, thanks to the use of the Eurobreadboard. The photographs show details of the board but a more useful guide is Table 1, which is a wire-by-wire list of all the interconnections. The Table assumes, however, that the i.c's will be in certain fixed positions, so we have to attend to that first. A lot of the connections involve the use of wire links from one Eurobreadboard hole to another. Make sure that you use only *single strand wire,* because stranded wire can catch in the spring clips of the Eurobreadboard and could cause no end of trouble. As was stated last month, I employed "bell wire" obtained from Maplin Electronic Supplies.

EUROBREADBOARD

If you look at the Eurobreadboard you will see that there are four sections of 5-hole rows identified as A, B, C and D. The rows are numbered from 1 to 25, and all 5 holes in each row are connected together. Around the periphery are 4 rows of holes labelled Y1, X1, X2 and Y2. All the holes in each of these rows connect together. In Table 1 references are made to rows of holes but not to the particular holes in each row to which connections are made. The holes which are used in each row become evident as assembly proceeds, and the major requirement is that connections are made to the correct rows, with space left for the INS8060. In this project, the top of the board is row Y1, and the bottom is row Y2. This orientation may cause the "Eurobreadboard" label in the middle to be upside-down with some boards.

We don't, at this stage, plug in the INS8060. MOS i.c's generally don't take kindly to being plugged into open-circuit sockets, so that the 8060 goes in last of all. Keep it in its bit of plastic

TA

EUROBREA

Position	Connections
A1	None
A2	None
A3	LNK B24
A4	27K X1; LNK A25
A5	LED/R Y1
A6	LED/R Y1
A7	LED/R Y1
A8	LED/R Y1
A9	None
A10	None
A11	None
A12	None
A13	None
A14	None
A15	None
A16	LED/R Y1
A17	0.015μF Y1; 1K A21
A18	1K A21
A19	None
A20	LNK X1
A21	1K A17; 1K A18; 0.015μF Y1
A22	LED Y1; 2K2 B22
A23	LED Y1; 2K2 B21
A24	LED Y1; 2K2 B24
A25	P.B.Sw. SIN; LNK

Position	Connections
B1	LNK Y1; LNK B3
B2	None
B3	LNK B1 LNK B4
B4	LNK B3
B5	LED/R earth; LNK C17
B6	LED/R earth; LNK C15
B7	LED/R earth; LNK C13
B8	LED/R earth; LNK C11
B9	LED/R earth; LNK D11
B10	LED/R earth; LNK D13
B11	LED/R earth; LNK D15
B12	LED/R earth; LNK D17
B13	LNK X1
B14	LNK B25
B15	LNK C3
B16	4K7 B23
B17	None
B18	LNK X2
B19	LNK D10
B20	None
B21	2K2 A23
B22	2K2 A22; LNK D
B23	LNK X1; 4K7 B16; 27K B25
B24	2k2 A24; LNK A3
B25	P.B.Sw. RESET; LNK B14; 27K B23

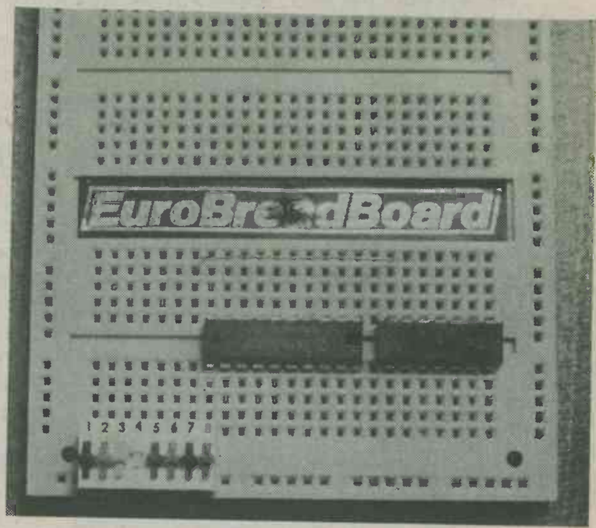
Structor

By Ian Sinclair

A PRACTICAL INTRODUCTION TO MICROPROCESSORS

e constructional details
project, taking it to the
h the microprocessor
o the Eurobreadboard.

channel, and it'll come to no harm while you wire up the rest of the circuit. We start by inserting the buffer i.c. 74LS240 with its pin 1 in row C9 and its pin 11 (diagonally opposite) in row D18. The 74LS132 goes in next, with its pin 1 on line C1 and pin 8 on line D7. This puts the end of this i.c. close to the end of the 74LS240, but they will both fit without trouble because there is a spare row between.



The first step consists of fitting the two t.t.l. i.c.'s and the octal switch. Do not rely on the "Eurobreadboard" label for orientation, but ensure that the Y1 line is at the top. The switch is fitted with its numbers uppermost.

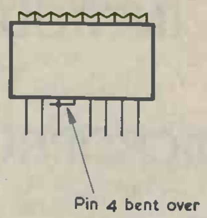
ABLE 1

DBOARD WIRING

Position	Connections
C1	LNK X1
C2	LNK C24
C3	LNK B15
C4	None
C5	None
C6	None
C7	LNK Y2; LNK (earth bar) C18
C8	None
C9	LNK D10
C10	LNK D22
C11	LNK B8
C12	LNK D23
C13	LNK B7
C14	LNK D24
C15	LNK B6
C16	LNK D25
C17	LNK B5
C18	LNK (earth bar) C7
C19	LNK X1; 27K C25; 27K C24
C20	None
C21	None
C22	None
C23	None
C24	0.0068μF C25; LNK C2; 27K C19
C25	P.B.Sw. GO; 0.0068μF C24; 27K C19; 0.1μF X2

Position	Connections
D1	LNK X1
D2	None
D3	None
D4	None
D5	LNK X1
D6	LNK D10
D7	LNK B22
D8	None
D9	LNK X1
D10	LNK C9; LNK B19; LNK D6
D11	LNK B9
D12	LNK D21
D13	LNK B10
D14	LNK D20
D15	LNK B11
D16	LNK D19
D17	LNK B12
D18	None
D19	LNK D16
D20	LNK D14
D21	LNK D12
D22	LNK C10
D23	LNK C12
D24	LNK C14
D25	LNK C16

Fig.1. One of the pins of the octal switch is bent over and soldered to a neighbouring pin. This enables the row of pins to be inserted in the Y2 line.



Next to be fitted is the octal switch. This is inserted into D18 to D25 and the corresponding holes along the Y2 row. Remember that its numbers should be uppermost and that the Y1 row is the top of the board. One of the switch pins on the lower side will need to be bent over and soldered to the adjacent pin on either side because there is no hole in the Y2 row for it. The pin is shown bent over in Fig.1. Take care with the soldering, as an untidy solder joint will prevent the switch from bedding down level on the Eurobreadboard. All the lower pins of the switch are now at the same potential as the Y2 line.

Fit a bare wire to run between C7 and C18, using the holes closest to the Eurobreadboard label. This is an earth bus and the data l.e.d. series resistors will be soldered to it. At the corners fit small link wires between lines Y1 and X2 and between lines X2 and Y2. These three lines are the earth and negative supply rail. X1 is the positive 5 volt supply rail.

The other bits of hardware which now have to be fitted are the push-button switches and the l.e.d.'s. As they come the Maplin push-button switches don't plug into the Eurobreadboard so that you'll need to solder on short stubs of wire, preferably a bit thicker than the 0.6mm. bellwire we're using for links. Fig.2 shows what's needed, the length of wire beyond the solder joint being about 8mm. The SIN push-button connects between the lowermost A25 hole and the adjacent X2 hole, the RESET push-button between the lowermost but one B25 hole and the adjacent X2 hole, and the GO push-button between the second C25 hole from the top and the adjacent X2 hole. Fig. 3 shows their relative positions for future reference.

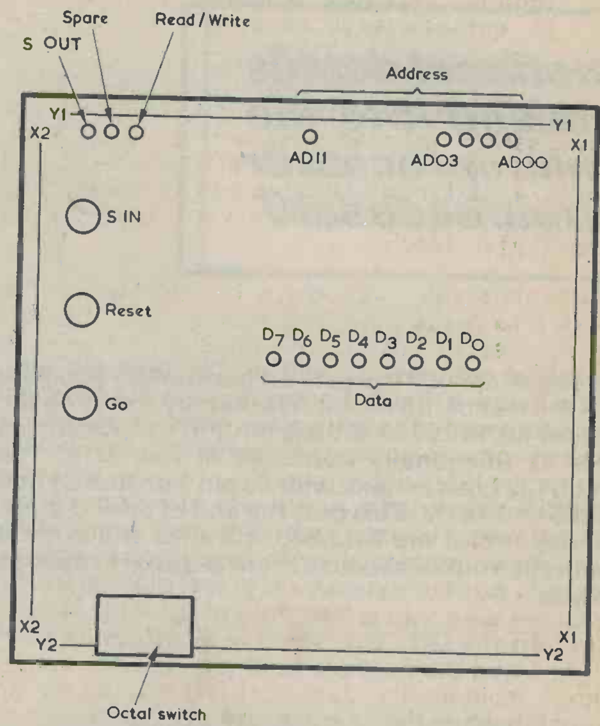


Fig.3. The general layout of the press-button switches, octal switch and l.e.d.'s

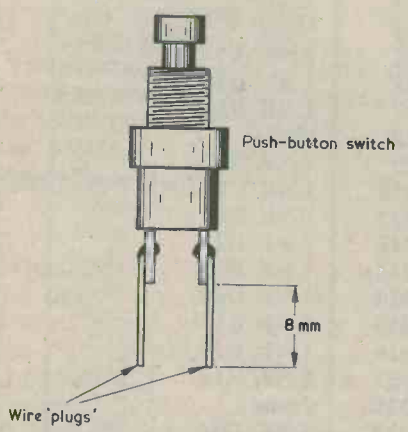


Fig.2. Short stubs of wire are soldered to the tags of the push-button switches. These wires are inserted in the Eurobreadboard holes.

L.E.D. FITTING

The eight data l.e.d.'s need to have limiting resistors soldered to them. Any value between 1.5kΩ and 3.3kΩ is usable, but the 2.2kΩ resistor specified here gives a good compromise between brightness and voltage drop. The resistor is soldered to the cathode of each l.e.d. in the manner shown in Fig.4, the wires being cut as shown. The l.e.d. anode leads are then inserted in the lowermost B hole, as indicated in Table 1, and the resistor is soldered to the earth bus between holes C7 and C18. Slip a piece of paper under the bus wire whilst soldering to it to prevent blobs of solder getting onto the Eurobreadboard, where they may be difficult to dislodge afterwards. Make sure that you've correctly identified the anode and cathode leads of the l.e.d.'s before soldering the resistors to them and take care not to overheat the l.e.d.'s. It is necessary to use subminiature l.e.d.'s, incidentally, otherwise you'll have difficulty packing them all in.

The five address l.e.d.'s have the 2.2kΩ limiting resistor connected to the anode lead, as shown in Fig.5. The limiting resistor is then inserted into the uppermost hole in A5 to A8 and in A16, the l.e.d. cathode lead being inserted in the adjacent, or nearby, hole in the Y1 row.

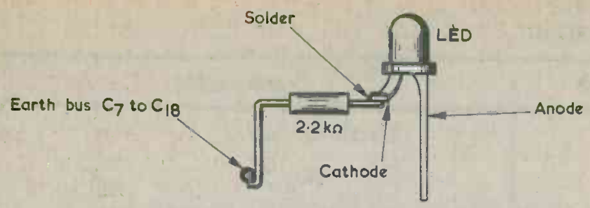


Fig.4. The data l.e.d.'s have their series limiting resistors soldered to their cathode leads, as shown here.

There are three further l.e.d.'s which do not have series resistors soldered to them. Their anodes plug into the uppermost holes at A22, A23 and A24, and their cathodes into corresponding Y1. holes. Their series resistors are plugged in as indicated in Table 1.

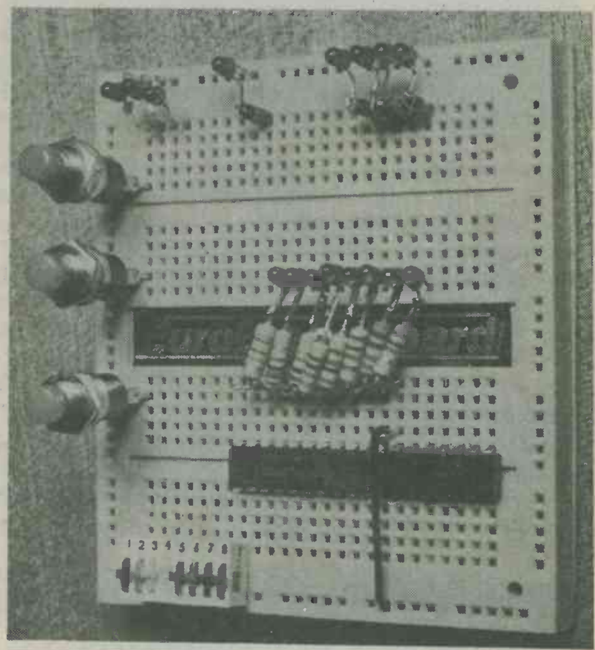
At this stage, it's a good idea to test all the l.e.d.'s to make sure that they all operate correctly. Before this can be done, a link wire is required between C7 and the Y2 hole immediately below it. This wire passes over the 74LS132 i.c. Connect the negative terminal of a 4.5 volt battery or a 5 volt power pack to line Y2, and connect a lead whose bared end can be inserted in the Eurobreadboard holes to the positive terminal. If you're using a power pack make quite sure the voltage does not exceed 5 volts because two of your i.c.'s are already in place. Insert the positive wire into a free hole of B5. This should light up the DO l.e.d., the one which is on your right when the board is held with line Y1 uppermost. Incidentally, data switch 1 should be on your left when the board is in this position, so that the row of data l.e.d.'s is arranged in the same way as the row of switches.

Test all of the data l.e.d.'s in the same way, by plugging the positive supply lead in the appropriate data socket rows, and then plug the positive lead into line A5 to test address l.e.d. ADOO. Follow this by checking the other address l.e.d.'s and, finally the three l.e.d.'s whose series resistors end up as B21, B22 and B24.

MAIN WIRING

Once all the l.e.d.'s have been checked, the board is ready for the mainwiring. This is best done by referring to Table 1, which lists each connection including the ones you've already made. What does need a bit of attention at this stage is leaving a space for the INS8060. This is a wide i.c., and it will cover three columns of holes in the A section and two columns of holes in the B section. The photograph shows the position it takes up. Because of this, it will be necessary to use the "outer" holes only and route wires round the i.c. and not across it. The wires which have to be particularly watched are the connections between the INS8060 and the 74LS240 buffer. String each of these out to the X1 line, round and back to their places at the buffer. You can, if you like, use solid-core ribbon cable, but I find the preparation of this stuff takes longer than simply using separate strands of single-core wire.

Table 1 is easy enough to follow. Each socket line letter and number is shown, then the component which is plugged into it (apart from the i.c.'s) followed by the socket letter and number to



The eight data l.e.d.'s have their series resistors soldered to an earth bus wire which passes across the surface of the board between rows C7 and C18. The remaining l.e.d.'s are positioned as indicated in Table 1. Make sure that all series resistors are in circuit before testing the l.e.d.'s. The three push-button switches are on the left.

which the other end of the component connects. Where there are two connections to a line both are shown in the Table with a semicolon between them, so that the Table shows each connection which is made. Each wire link is inserted into one separate hole of the Eurobreadboard, there's no need to try to squeeze two wires into one hole. Link wires are indicated as "LNK" and capacitors by their values, Resistors follow the convention "2K2" for "2.2kΩ" and so on.

Since each hole to which a connection is made has been listed, there is a double check on the wiring. This is particularly useful when the component is a wire link, because one wire link looks

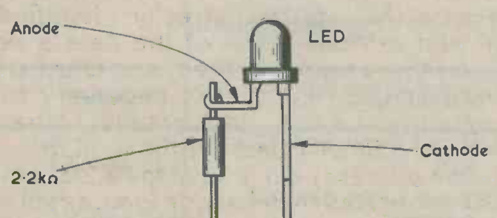


Fig.5. The address l.e.d.'s have the series resistor soldered to the anode leads.

TABLE 2
INS8060 Inputs

Input	Pin on 8060	Point on Board	Connections
NENIN	3	B18	Earth on X2
NHOLD	6	B15	Gate output
NRST	7	B14	RESET switch (27K to X1)
CONT	8	B13	+5V on X1
SENS-A	17	B4	Earth on Y1
SENS-B	18	B3	Earth on Y1
SIN	24	A4	SIN switch (27K to X1)
XIN	37	A17	1K to A21; 0.015μF to Y1

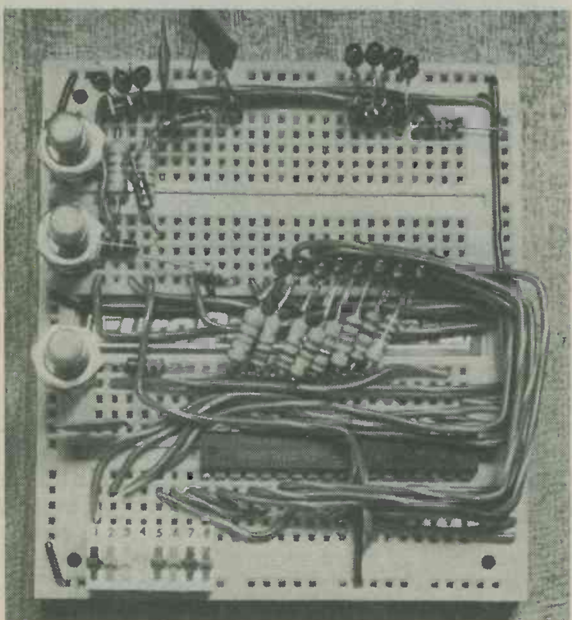
pretty much like another. Check each connection as you make it and then do a double check by tracing each connection back when you come to the socket hole at the other end. Again, all references to "top" and "bottom" of the board apply to the board with line Y1 at the top. In this position the lettering on the INS8060 will be right way up whilst the lettering on the other two i.c.'s is upside-down. You can of course hold the board any way round for wiring, but this is the standard working position. Make sure that you check the Y1 to X2 and X2 to Y2 earth links, which are not listed in the Table.

FITTING THE 8060

Now take a deep breath, and check all of your connections again. There are quite a lot of connections around the INS8060 which are not used, but these are all for outputs. It's important that no inputs are left without connections, so Table 2 gives a list of the INS8060 inputs, with both the i.c. pin numbers and the Eurobreadboard numbers. You can use this list as a safety check to ensure that all of the 8060 inputs are connected somewhere. Tables 3 and 4 show switch and l.e.d. postions respectively.

If all is well, the only task that's left is to mount the INS8060 into place. Start by preparing the socket holes to receive the INS8060. Using a capacitor or a 1 watt resistor which has a fairly thick lead-out, poke the wire into each and every socket-hole which the INS8060 will use. This makes quite certain that there will be no stiff springs which might cause the INS8060 to jam. I had no trouble with any of mine, but there's always a chance, and at around £8 or more a throw, you just don't take risks.

The next set of steps is VERY IMPORTANT. Prepare a wire link and use it to join line X1 to one of the Ylines – it doesn't matter which Y line. This ensures that there are no voltage differences across the board, and makes it ready to receive the INS8060. Remember now that the INS8060 is a MOS i.c. Nylon carpets, plastic rulers and other static generators are things which spell sudden death to MOS chips unless you follow these instructions exactly, so make sure that you know what you have to do before you start. I've never lost an i.c. through static damage, and there's no reason why you should. The precautions that used to be recommended, like chaining yourself to waterpipes, are not needed, and all that are required here are just a few elementary precautions.

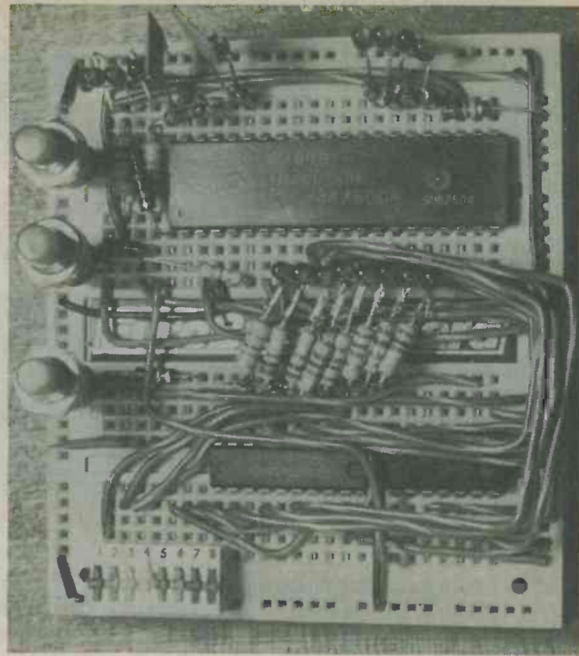


Here, the Eurobreadboard is complete except for the microprocessor chip. The wiring must be routed as shown to leave plenty of space for the chip.

TABLE 3
Switch Positions

Function	Position
SIN	A25 and X2
RESET	B25 and X2
GO	C25 and X2

Turn the Eurobreadboard so that you can easily locate pin 1 of the 8060 into line B20 of the Eurobreadboard, and check that you can recognise pin 1. Now wash your hands. No. I'm not kidding – with your hands moist, the chances of electrostatic discharges are much less. Open the plastic pack of the INS8060 and slide out the i.c., preferably using a pair of tweezers on its flat body. DON'T LET YOUR FINGERS TOUCH THE PINS. Pick up the i.c., using the tweezers, or with a thumb and forefinger at each end. Place the INS8060 in its correct position in the Eurobreadboard, but don't try to plug it in yet. Check first that it's the right way up. Once you're sure that all is well, push the INS8060 *gently* into the Eurobreadboard socket holes, pressing with a thumb at each end, and rocking the i.c. gently to help it on its way. It should slip in easily, but if it doesn't, pop it out again, using a pencil in the groove of the Eurobreadboard under the i.c. This groove is a feature of the Eurobreadboard which is most useful, as it enables us to remove i.c.'s easily. Ease out the socket holes again with a wire lead,



The Eurobreadboard complete with the INS8060 plugged in place. This i.c. must not be removed from its protective packaging before the precautionary instructions in the text have been read.

TABLE 4

L.E.D. Positions

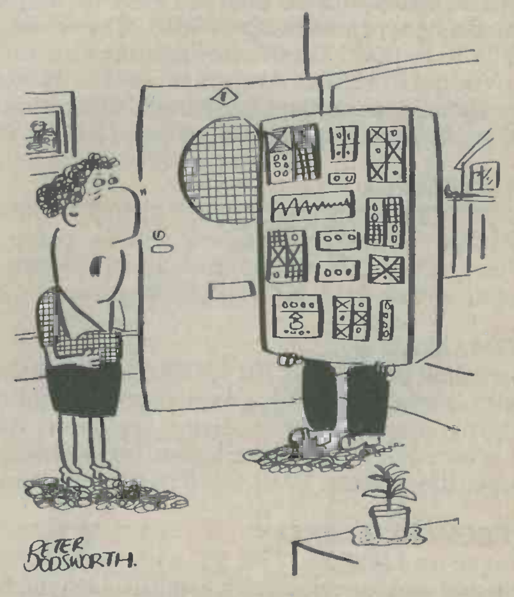
Function	Position
AD00	A5 and Y1 (R)
AD01	A6 and Y1 (R)
AD02	A7 and Y1 (R)
AD03	A8 and Y1 (R)
AD11	A16 and Y1 (R)
READ	A22 and Y1
SPARE	A23 and Y1
SOUT	A24 and Y1
DB0	B5 and earth bar (R)
DB1	B6 and earth bar (R)
DB2	B7 and earth bar (R)
DB3	B8 and earth bar (R)
DB4	B9 and earth bar (R)
DB5	B10 and earth bar (R)
DB6	B11 and earth bar (R)
DB7	B12 and earth bar (R)

Note: "R" indicates combination of l.e.d. and resistor.

and then try the INS8060 once more, This time, the INS8060 should fit like the proverbial glove.

That finishes the construction, and you're now the proud owner of the INStructor project. Next month we'll start INStructing.

(To be continued)



"Must you bring your work home with you?"

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

●VENEZUELA

Radio Frontera, San Antonio on **4760** at 0235, OM with a ballad all about unrequited love, OM announcer in Spanish. The schedule of this seldom heard station is from 0900 to 0300 but the closing time can vary up to 0320. The power is 1kW.

Radio Mundial Bolivar, Bolivar on **4770** at 0243, local pops – both music and songs on records, OM announcer. This one operates from 1000 through to 0400 and the power is 1kW.

Radio Libertador, Caracas on **3245** at 0140, OM with a sporting commentary in Spanish. The schedule is from 1000 to 0400 and the power is 1kW.

●ECUADOR

Radio Difusora del Ecuador, Guayaquil on **4765** at 0240, OM announcer in Spanish, local pops on records. Scheduled from 2300 to 0400, the power is 5kW.

●COLOMBIA

Radio Guatapuri, Valledupar on a measured **4814** at 0247, OM with a newscast of world and local events in Spanish. This one can vary in frequency anywhere between **4814** up to **4818**. The schedule is from 0930 to 0600 but the closing time also varies!

La Voz del Cinaruco, Arauca, on **4865** at 0258, OM with a sports commentary in Spanish. Operating on a 24-hour schedule, this one has a power of 1kW.

●GUATEMALA

Radio Mam, Cabrican on **4825** at 0250, OM with folk songs rendered complete with a piano and rhythm section, OM announcements in Spanish. The schedule is from 2200 to 0300 and the power is 1kW.

●ROMANIA

Bucharest on **11940** at 2015, OM and YL (male and female) announcers with announcements, followed by a programme all about science lessons in Romanian schools – all in the English transmission for Europe, timed from 1930 to 2030 on this channel.

●CZECHOSLOVAKIA

Prague on **11990** at 1730, YL with station identification and announcements in English. I listened with great interest after "This is the Afro-Asian Service of Radio Prague" to a newscast slanted towards the interests of listeners in the target areas. This programme is timed from 1730 to 1825.

●USSR

Moscow on **11630** at 1746, YL with station identification and "This is the African Service of Radio Moscow", followed by a newscast of internal Russian affairs. This particular transmission is timed from 1700 to 1800 I gathered and it was also logged further up the band on **11800**.

●BULGARIA

Radio Sofia on **15310** at 2110, OM and YL alternate with replies to letters from listeners resident in the African continent. According to their schedule, this English transmission is timed from 2030 to 2130.

●HUNGARY

Radio Budapest on **15160** at 2120, YL with an English programme intended for Europe and timed from 2100 to 2130 – all about the various facilities available for young people in Hungary, both educational and recreational.

●SPAIN

Madrid on **11840** at 2110, OM with announcements in the English programme for Europe (2010 to 2115) which also included a programme about Spanish rural life, its music and some of its songs – including one sung when slaughtering a pig!

●PORTUGAL

Lisbon on 21530 at 1610, YL with a newscast followed by announcements of the various schedules of English programmes radiated by Radio Portugal to respective areas of the world, this one to the Middle East from 1600 to 1630. All this was followed by a news commentary, mainly of internal affairs and recent events in Portugal.

●ITALY

Rome on **7275** at 1940, YL with the news in the English programme directed at the U.K., scheduled from 1935 to 1955. Beginners can easily identify Rome – it has a bird-song interval signal. So has Wellington in New Zealand – but that is the song, cry or chime (take your pick) of the N.Z. Bellbird – quite different from the warblings of the Radio Rome songster.

●PAKISTAN – 1

Radio Pakistan on **11675** at 1735, YL with the news in English, mainly about internal affairs, in the

"World Service" to the U.K. Station identification was then followed at 1745 by announcements and programmes in Urdu, also directed to the U.K.

●CHINA
Radio Peking on **11575** at 1820, OM announcing programmes in the Chinese transmission to Europe, this programme including some Chinese classical music which I find particularly appealing. Station identification and a programme in French followed at 1830.

Radio Peking on **11600** at 1500, OM and YL with station identification in Russian "Govorit Peking" (Here is Peking). Needless to say the transmission was promptly jammed – no prizes awarded for identifying the jammers!

●PAKISTAN – 2
Logged since the above Radio Pakistan logging was typed, Islamabad may also be heard at 1605 on **21485**, at which time a newscast in English read at slow-speed was heard. Consisting mostly of items dealing with internal events and affairs, this transmission is timed from 1600 to 1615 on this channel and is aimed at the Middle East and Africa.

●IRAN
Kalamabad on **15084** at 2020, OM in Persian in a Home Service 1 transmission consisting mainly of local-style music. The frequency is correct – it is **15084.** I measured it!

●SAUDI ARABIA
Riyadh on **15060** at 2025, OM with songs, local-type music in a relay of the Arabic Domestic Service, to be heard on this channel from 1500 through to 2300. Address your QSL's to P.O. Box 570, Riyadh.

●MADAGASCAR
Radio Nederlands Relay on **15220** at 2055, OM's with a discussion about recent events in Holland with respect to various charitable foundations that apparently flourish there. According to schedule, this English programme for Central and West Africa is timed from 2030 to 2130.

●INDIA
AIR (All India Radio) Delhi on **15165** at 2105, OM with a newscast of local events in English, station identification followed by a talk about life in, and around, the Indian Ocean. Also logged in parallel on **15105.** This was all in the General Overseas Service to the U.K. and Western Europe, timed from 2045 to 2230.

●U.S.A.
WINB Red Lion on **15185** at 2013, OM with a religious talk and YL with hymns, all in English.

●E. GERMANY
Radio Berlin International on **7260** at 1940, YL with a newscast in the English transmission for Europe, scheduled from 1930 to 2015 according to announcements.

●UGANDA
Kampala on a measured **5026.5** at 1834, YL's with songs in vernacular, local-style African music.

●ANGOLA
Emisora Regional do Lobito on a measured **7001** at 1930, OM with a talk in Portuguese, just barely heard under a welter of amateur morse interference.

●MOROCCO
Rabat on **15335** at 1037, YL with songs in Arabic, local-type music. Also logged in parallel on **15360** but the former channel providing the best signal here in the U.K. This was a transmission in the Domestic Service Network 'A'.

●RWANDA
Kigali on **3330** at 1940, at which time they were broadcasting a religious service which included the hymn 'Onward Christian Soldiers' – all in French. This was a programme in the Home Service which is scheduled on this frequency from 0300 to 0600 (Sundays until 0900), 0900 to 1200 (Saturdays and Sundays through to 2100) and from 1330 to 2100. The power is 5kW.

●MOZAMBIQUE
Maputo on **3210** at 1950, light music Palm Court style, OM with ballads in Portuguese. This is the 'A' programme of Radio Mozambique and is scheduled here from 0255 to 0430 and from 1700 to 2210, all in Portuguese. There is one snag for listeners however, the frequency can vary at times from **3206** to **3216.** The power is 100kW.

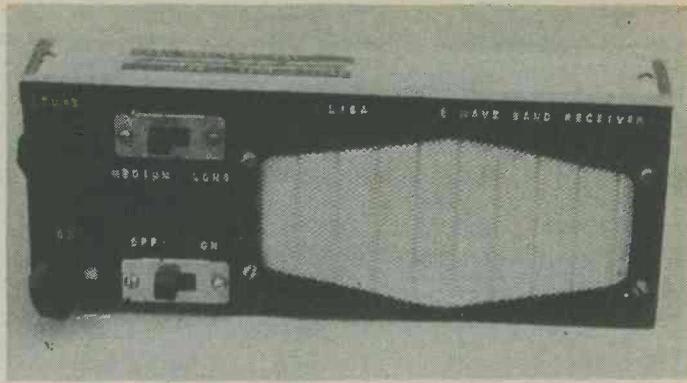
●SWEDEN
Stockholm on **21700** at 1410, pops on records in a request programme, also answers to listeners queries in an English programme for North America and South Asia which according to their schedule is aired from 1400 to 1430 daily.

●NORWAY
Oslo on **21730** at 1420, OM with a newscast in Norwegian of happenings in various localities in and around Norway. This programme was heard on a weekday. If you listen on this channel from 1400 to 1430 on a Sunday, there is a programme in English entitled 'Norway this Week' – always very interesting.

●EGYPT
Cairo on **17670** at 1425, songs and local-style music in the all-Arabic General Programme, listed on this channel from 1300 to 1830.

"It gone wrong, no more can I get the Home, Light, Sunsvall, Hilversum, Athlone, Kalundborg, Alhouse, Brason . . ."

'LISA' 2-BAND PORTABLE



The assembled receiver in its home-constructed case.

Part 1

By Sir Douglas Hall, Bt., K.C.M.G.

*Ingenious reflex design. *Uses 3 transistors only.

*Full coverage of medium and long waves.

This medium and long wave receiver. "Lisa", uses a variant of the author's Spontaflex Super Alpha circuit, and the name derives from "LIttle Super Alpha". Its selectivity is such that it can provide complete separation between two stations with 24 metre spacing around 270 metres when, in the author's home, it is midway between the two transmitters, both of which are only 12 miles distant. One signal is an immensely powerful one whilst the other is that provided by an independent local station.

"Lisa" covers the whole of the medium and long wave bands, and its case measures about 8½ by 3½ by 1½ in. only. A fresh PP6 battery can be expected to give about 100 hours' use at around 2 hours per day. A 6.2 volt zener diode in the receiver circuit allows fairly consistent results to be obtained until the battery voltage falls to 6.5 volts. The initial cost is reduced by the use of a home-made tuning drive and home-wound coils, together with the omission of a variable tuning capacitor.

The practical design of the receiver is based on a specific 4Ω elliptical speaker, the dimensions of which just fit into the layout employed. Details of this speaker are given later in this article under the heading "Components".

CIRCUIT DESIGN

The circuit diagram is given in Fig. 1, which shows the two sections of the wavechange switch, S1 (a) (b), in the medium wave position. The signal is picked up by tuned winding L2 whose inductance is varied by a ferrite rod which passes into it by a controlled amount to provide permeability tuning. The tuning capacitance is provided by the 68pF capacitor C4, whereupon the inductance to capacitance ratio is high over the entire medium wave band. The received signal passes to the base of TR1 which, at r.f., functions as an emitter follower and which feeds into the base of another emitter follower, TR2. Base bias for TR2 is given via r.f. choke L1 and R3. C2 bypasses R3 both at r.f. and at a.f. TR1 and TR2 thus form a Super Alpha pair and the emitter of TR2 feeds into detector D1, this being a low impedance diode which has its impedance lowered still further by the forward current passing through it from TR2 and R4.

The detected a.f. across D1 is now passed back to TR2 which, at audio frequencies, functions as a common base amplifier with the 39kΩ resistor R1 as its collector load. The amplified a.f. signal is then coupled back to the base of TR1 via R2 and L2, with C1 and C5 bypassing any residual r.f. signal. R2 also provides base bias for TR1, which now acts as a common emitter audio frequency amplifier. Because TR1 has a high HFE – typical examples of 2N3663's in the author's possession show a figure of about 150 – and because only about 200μA passes through the transistor, the input impedance at its base is much higher than is usual with a common emitter amplifier. Consequently, there is a reasonable match to the a.f. signal across R1, and TR2 is able to maintain its voltage amplification. The collector of TR1 couples to the large winding of T1, and there is little loss across the series variable resistor, VR1. The other winding of T1 connects to the base of TR3, which gives further and final amplification as a high gain common emitter amplifier. R5 provides base bias for this transistor.

Reaction (or Q multiplication, to use a modern name for a very old device) is provided by way of the coupling coil L3, the positive feedback path to the negative rail being from the emitter of TR2 through C6, the coupling coil, part of VR3, the section of VR2 track between its slider and VR3 slider, and C8. VR3 is adjusted to equalise reaction settings on medium

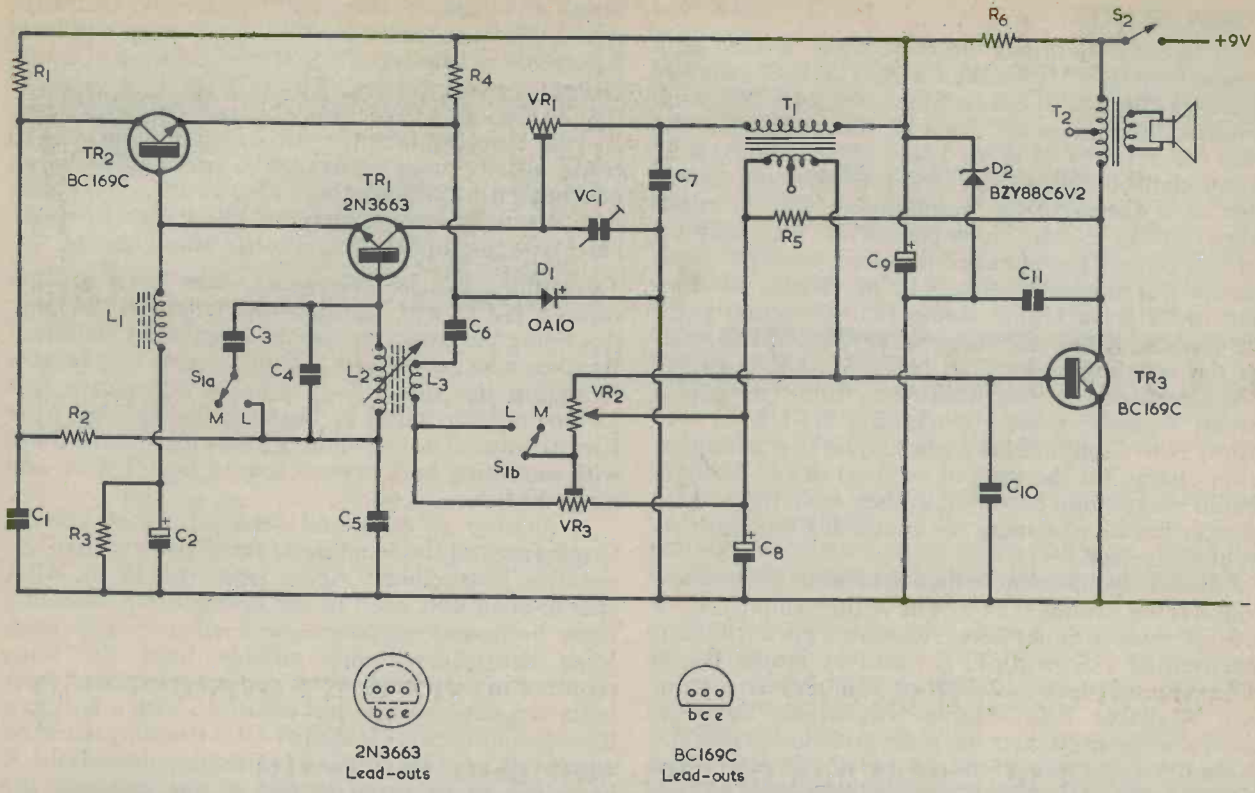


Fig. 1. The circuit diagram of the receiver. TR1 and TR2 are in a reflex circuit, and both transistors amplify at a.f. as well as at r.f.

and long waves. The reaction feedback current increases as VR2 slider approaches the slider of VR3. When the slider of VR2 is adjusted in the opposite direction a continually reducing resistance is applied across the small winding of T1 until, at the minimum reaction setting, this winding is virtually short-circuited and no a.f. signal can pass to the base of TR3. Thus, VR2 functions as a true volume control as well as a reaction control. VR1 and VC1 are set up such that a fairly constant critical reaction point can be maintained throughout the medium wave band without any adjustment in VR2. When the required station is tuned in, VR2 may then be adjusted to reduce volume as required. The presence of resistance in the collector circuit of TR1 causes the receiver to oscillate more readily at the high frequency end of the band than at the low frequency end, but this tendency can be overcome by judicial setting up, once and for all, of VR1. This setting up still does not, however, cover the situation at the extreme high frequency end of the band, around 200 metres, where oscillation can still occur too readily after VR1 has been correctly adjusted for the remainder of the band. The problem is overcome by the addition of a few picofarads, contributed by VC1, across VR1. The trimmer employed for VC1 should be a type having a minimum capacitance not greater than 3pF.

On medium waves, the pre-set potentiometer VR3 has two complementary effects on the operation of VR2: the track between VR3 slider and L3 is in series with VR2 and affects the setting at which VR2 approaches the oscillation point, and the track between VR3 slider and C8 shunts the section of VR2 in the feedback path and can make the onset of critical reaction more gradual. When VR3 is finally adjusted a large part of the overall travel of VR2 is available for purposes of reaction and volume control.

When S1 (a) (b) is set to long waves, C3 is connected in parallel with C4 and the tuned winding L2, thereby lowering the resonant frequency. Also, the track of VR3 between its slider and L3 is short-circuited. This is because a higher level of feedback is required on long waves. VR3 is adjusted to match the medium wave reaction setting to that given, without VR3, on long waves.

Looking inside the receiver with the case cover removed. The 19-way tag-strip is on one side of the speaker magnet and the ferrite rod tuning assembly on the other side.

COMPONENTS

As already mentioned, the receiver is designed around a specific 4Ω speaker. This is an R.S. Components 4Ω elliptical speaker, Stock No. 248-785, with nominal dimensions of 5 by 3 in. (the actual dimensions are 5 3/8 by 2¾ in. or 136.6 by 70.1 mm). R.S. Components do not supply to individuals but readers who have access to the company by way of radio shops, college electronic departments, etc., may be able to obtain the speaker required through these channels. It may alternatively be purchased retail by mail order from Home Radio (Components) Ltd., 215 London Road, Mitcham, Surrey, CR4 3HD, who list the speaker under Cat. No. LS162A. Another possible source is Ace Mailtronix Limited, Tootal Street, Wakefield, West Yorkshire, WF1 5JR, who supply R.S. Components parts subject to a minimum order charge (at the time of writing) of £2. Readers should make quite certain that they have the correct speaker before obtaining the remaining components for the receiver.

Another component which has also been mentioned is the trimmer, VC1. The author employed a 2 to 20pF mica trimmer here. A suitable mica trimmer, specified as 1.5 to 20pF, is listed by Home Radio (Components) Ltd. A 2 to 10pF film dielectric trimmer, available from Maplin Electronic Supplies, could also be used, and the main criterion is that the minimum capacitance should be not greater than 3pF.

The home-wound coil unit for L2, L3 requires a special grade 4 in. by 3/8 in. ferrite rod, and this can be obtained from Amatronix, 396 Selsdon Road, South Croydon, Surrey, CR2 0DE. The transistor type 2N3663 specified for TR1 can be obtained from Electrovalue Limited, 28 St. Judes Road, Englefield Green, Egham, Surrey, TW20 0HB. It is essential that D1 be an OA10, and this can be supplied by Bi-Pak Semiconductors. An ex-equipment OA10 could also be used, if available, provided it is not overheated by desoldering. VR2 is a 2.5kΩ 1 watt wire-wound potentiometer, and this should be a Colvern type, as supplied by Electrovalue Limited.

Another R.S. Components item used in the receiver is a 28-way tagstrip with a length of 194 mm., this being cut down to various lengths, as required. Readers with access to R.S. Components may be able to obtain this directly. A suitable alternative is a 28-way tagstrip with ¼ in. tag spacing, available from Electrovalue. The two slide switches are standard size with mounting hole centres spaced by 1 1/8 in. and tapped 6BA.

A number of 6BA and 4BA screws of varying lengths are required and these are all dealt with in this month's instructions. Apart from the 1¾ in. 4BA cheese-head bolt used in the tuning drive assembly these bolts may all be cheese-head or round-head. Most constructors may already have the bolts required in their spares box and some of the shorter bolts can, if necessary, but cut down with a hacksaw from longer ones. A length of 4BA studding could be employed in place of the 1¾ in. tuning drive bolt. A knob has to be fitted to this at one end and the thickness of the studding can be increased to ¼ in. by, say, wrapping and soldering a strip of thin copper foil around it.

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 39kΩ
R2 12kΩ
R3 3.9kΩ
R4 39kΩ
R5 470kΩ
R6 1kΩ
VR1 22kΩ pre-set potentiometer, 0.1 watt horizontal.
VR2 2.5kΩ potentiometer, wire-wound, 1 watt (see text).
VR3 2.2kΩ pre-set potentiometer, 0.1 watt horizontal.

Capacitors
C1 1,000 pF silvered mica or ceramic.
C2 64μF or 68μF electrolytic, 3 V. Wkg.
C3 820 pF silvered mica or ceramic.
C4 68 pF silvered mica or ceramic.
C5 1,000 pF silvered mica or ceramic.
C6 0.01μF polyester.
C7 1,000 pF silvered mica or ceramic.
C8 10μF electrolytic, 3 V. Wkg.
C9 1,000μF electrolytic, 10 V. Wkg.
C10 0.1μF polyester.
C11 0.047μF polyester.
VC1 2-20pF trimmer (see text).

Inductors
L1 2.5 mH r.f. choke (Repanco).
L2, L3 see text.
T1 Driver transformer type LT44 (Eagle).
T2 Output transformer type LT700 (Eagle).

Semiconductors
TR1 2N3663 (see text).
TR2 BC169C.
TR3 BC169C.
D1 OA10 (see text).
D2 BZY88C6V2.

Speaker
LS1 4Ω, 5 x 3 in. elliptical (see text).

Switches
S1 d.p.d.t. slide (see text).
S2 d.p.d.t. slide (see text).

Miscellaneous
Ferrite rod, 4 x 3/8 in. (see text).
9 volt battery type PP6.
Battery connector.
28 s.w.g. enamelled wire (for L2, L3).
2 knobs.
Nuts, bolts, washers (see text).
Materials for receiver assembly and case (see text).

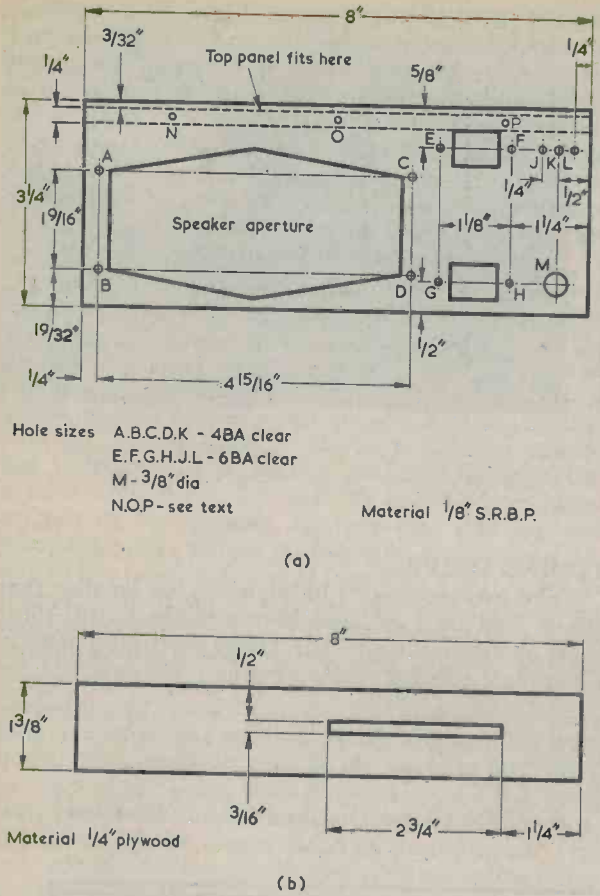


Fig. 2 (a). The front panel of the receiver as seen from the rear (b). The top panel. The permeability tuning assembly is fitted with a pointer, the end of which travels inside the slot in this panel.

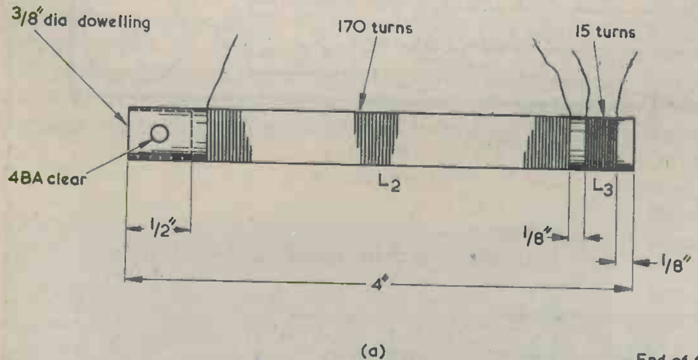
CONSTRUCTION

Construction starts by cutting out a piece of 1/8 in. thick s.r.b.p. ("Paxolin") to form a rectangle 8 in. long by 3¼ in. wide. The rear of this panel is shown in Fig. 2 (a). Next, cut out the speaker aperture and drill all the holes except holes J and L. Holes A, B, C and D will be used for mounting the speaker. The two slide switches are fitted so that the metal covers appear on the front side of the s.r.b.p. panel, with their bodies passing through the two rectangular cut-outs. These cut-outs are not dimensioned, as switch sizes vary with different makes. Holes N, O and P are for thin woodscrews which will later secure the top panel in place.

Next cut out the top panel illustrated in Fig. 2 (b), including the rectangular slot shown. The material is ¼ in. plywood. The panel can then be put on one side for the time being.

The coil unit is tackled next. Take a piece of Fablon or Contact measuring 4 by 4 in., and remove a ¼ in. strip of the backing paper along one edge. Wind the Fablon into a tube around the ferrite rod so that the exposed ¼ in. strip of adhesive is wound on last and secures the tube. The tube should be made such that the ferrite rod can slide freely inside it without any wobble. Make several tubes, if necessary, until one giving a really good fit is achieved.

Next, as in Fig. 3 (a), wind on 15 turns of 28 s.w.g. enamelled wire with each turn touching the next and starting at the point indicated in the diagram. This coil is L3. Leaving a gap, as shown, wind on 170 turns of the same wire, in the same manner and in the same direction. This is L2 and its end should come at a point about 5/8 in. from the end of the tube. The ends of the two windings should be held in place with Sellotape. Cut a ½ in. length of wooden dowelling with a diameter of 3/8 in. and insert it into the end of the tube as shown. It should be a good fit, and it will probably be necessary to initially put a turn or two of Sellotape around it to make it so. Drill a 4BA clear hole through the tube and dowelling, passing through the centre of the dowelling. Put the now completed coil on one side.



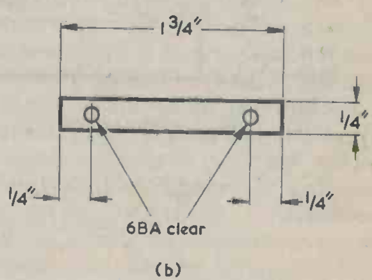
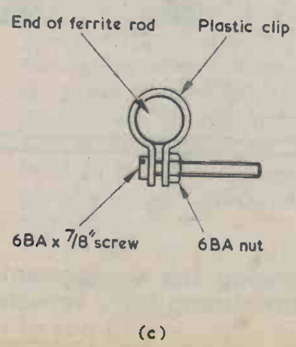
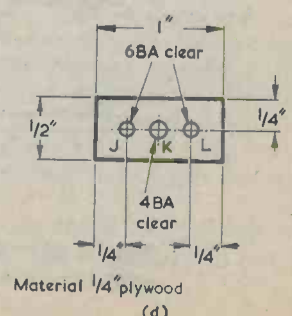
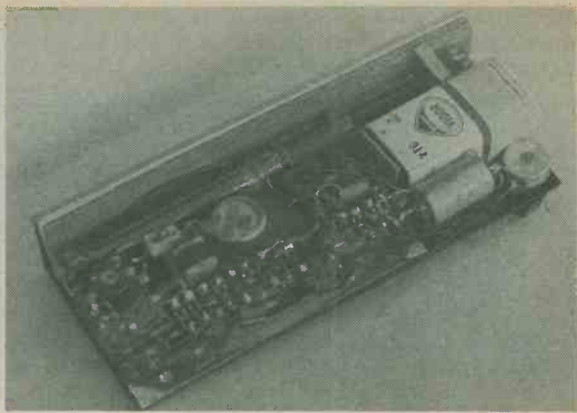


Fig. 3 (a). L2 and L3 are home-wound. Details are given here (b). Cutting out and drilling the plastic item which provides a clamp for the ferrite rod (c). The clamp fitted to the ferrite rod (d). Two of these pieces are used in the tuning drive assembly.





Another view of the interior of the receiver.



Cut a piece of pliable plastic to the dimensions shown in Fig. 3 (b). This forms a clip which is secured around one end of the ferrite rod as shown in Fig. 3 (c), using a 6BA bolt and nut. Do not use a metal clip as a substitute!

TUNING DRIVE

Take two pieces of ¼ in. plywood not smaller than about 2 in. by 1 in., and in one of these drill three holes as shown in Fig. 3 (d). Using the drilled piece as a template, drill a corresponding three holes in the

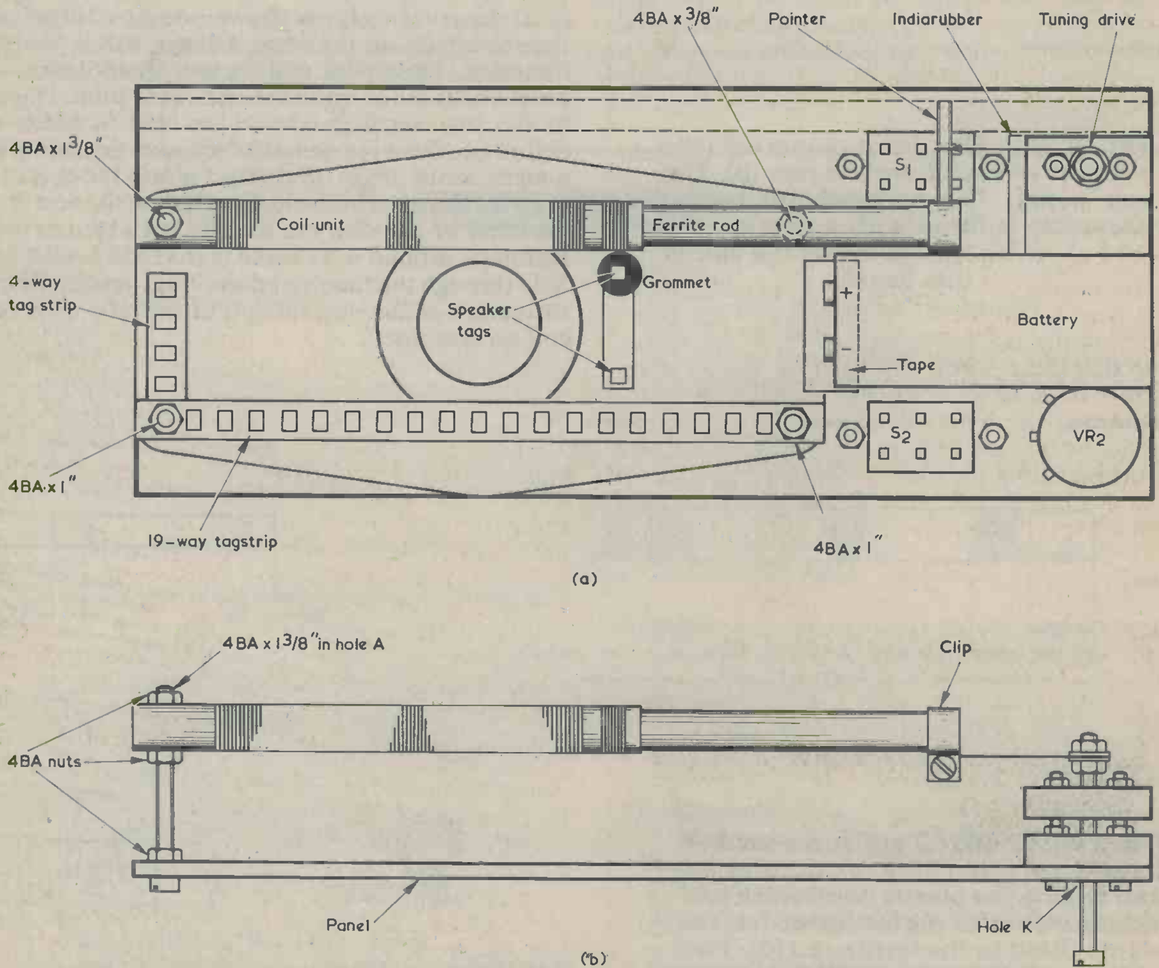


Fig. 4 (a). Mounting the components on the front panel (b). Side view showing how the tuning drive spindle causes the ferrite rod to be drawn in and out of the coil unit.

other piece, then cut down both pieces to the size shown in Fig. 3 (d). The reason for starting with the larger size pieces is to avoid the risk of splitting during drilling. Using a ¼in. drill, countersink the centre hole in each piece to a depth equal to the thickness of a 4BA nut. Hammer a 4BA nut into the countersunk hole of each piece. The nuts will be found to fit tightly. Using one of the two pieces of wood as a template, drill out the holes J and L in the panel of Fig. 2 (a).

Turn next to Fig. 4 (a). Fit the speaker over a piece of metal speaker gauze and secure it with four 4BA bolts and nuts. The speaker tags should be in the position indicated. The bolts may be cheese-head or round-head, and the bolt at each hole should have the length indicated in the diagram. Cut a 21-tag section from the 28-way tagstrip. Remove the two outside tags, to leave a 19-tag section, and drill the holes left to take 4BA bolts. Cut a 5-tag section from what remains of the tagstrip, remove one end tag and enlarge the hole to take a 4BA bolt. Fit second 4BA nuts to the bolts at B and D (see Fig. 2 (a)) to act as spacers, and fit the 4-way tagstrip and the 19-way tagstrip as shown in Fig. 4 (a). The short strip is under the long strip at hole B, and the long strip should have its underside covered with p.v.c. insulating tape for insulating purposes. Lock the strips in place with a third nut at B and another at D. The spacing nuts should be adjusted so that the top nuts are flush with the ends of the bolts. Next fit S1, S2 and VR2. Four short 6BA bolts will be required for the two switches, and these can be cheese-head or round-head. The bolts are passed through the threaded mounting holes and the securing nuts are on the underside of the panel.

Details of the slow motion tuning drive assembly are given in Fig. 4 (b) and Fig. 5. Take one of the wooden items of Fig. 3 (d) and, with its 4BA nut away from the panel, bolt it to the panel of Fig. 2 (a) as shown in Fig. 5. The two 6BA bolts employed may be cheese-head or round-head. Take the other item of Fig. 3 (d) and, with its 4BA nut towards the penel, pass it over the two 6BA screws. Hold the second piece so that there is about 3/16 in. between the two and screw in a 1¾ in. cheese-head 4BA bolt, this passing through both the 4BA nuts in the two wooden pieces. Screw in until only about 3/8 in. of the 4BA bolt protrudes from the front of the panel and then fit extra 6BA nuts over the end of the two 6BA bolts. Tighten these last two nuts until it is difficult, but just

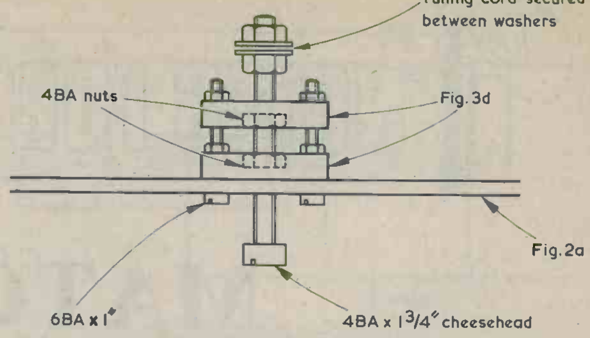


Fig. 5. Details of the tuning drive spindle and the manner in which it is mounted to the front panel.

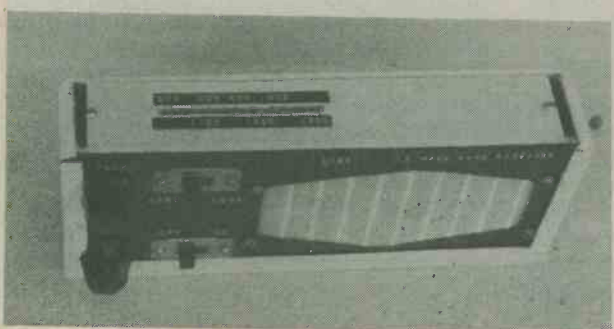
possible, to turn the bolt head with the fingers. A normal ¼ in. knob, with grub screw, can be fitted directly onto the cheese-head of the 4BA bolt, and the tension given by tightening the 6BA nuts as just described will then be about right. The tension can, in any case, be adjusted by slightly tightening or loosening the two outside 6BA nuts.

Take a rubber band with an unstretched length of about 3 in. and slip it over the 4BA bolt at hole A (Fig. 2 (a)). Then fit the coil assembly to this bolt as shown in Fig. 4 (b). Loop a piece of nylon cord over the 6BA bolt which tightens the plastic clip on the ferrite rod. Fully insert the ferrite rod into the coil tube so that the bolt takes up the position shown in Fig. 4 (a). (The end of the bolt, acting as a tuning pointer, will slide in the slot of the top panel of Fig. 2 (b) when the latter is fitted later). Pass the free end of the rubber band over the 6BA bolt on the ferrite rod clip so that the band holds the rod fully in the coil. Take the nylon cord round the 4BA bolt in a clockwise direction for a couple of turns, fit two 4BA nuts and washers at the end of the 4BA bolt and trap the nylon cord between the washers. The rod can now be withdrawn or allowed to return into the coil by rotating the 4BA bolt, the nylon cord wrapping around the 4BA bolt inside the two 4BA nuts and washers which secure its end. The tuning drive is now assembled and it will be found that about 5 turns of the 4BA bolt are needed to give the required travel for the rod.

Details of wiring will be given in Part 2 next month, and there are a few small matters to clear up before concluding the present article. These all concern details shown in Fig. 4 (a). First of all, a rubber or p.v.c. grommet with a ¼ in. centre is passed over one of the speaker tags. This ensures that the ferrite rod will not foul the battery when the latter is fitted later. The grommet may be trimmed with a pair of scissors to give it the desired shape, if necessary. A piece of p.v.c. insulating tape is passed over the speaker frame edge to prevent any intermittent contact between the metal case of the battery and the speaker frame, which can give rise to noise. Also, the battery will be held in place, later, against the body of VR2 by a piece of pencil indiarubber pushed between it and the top panel.

The item of Fig. 2 (b) is not fitted yet and will be secured in place after wiring has been carried out.

(To be concluded)



The end of the ferrite rod clamping bolt appears inside the slot in the top panel of the receiver, and functions as a tuning scale pointer.

'NOTES FOR NEWCOMERS'

MATCHING TRANSFORMERS

By
R. J. Caborn

Impedances are proportional to the square root of turns ratio.

Nowadays we use transformers most frequently for the mundane job of stepping alternating voltages up or down. For instance, we may use a step-down transformer to convert the 240 volt a.c. mains to 6 volts for supplying semiconductor equipment, as in Fig. 1. What is the ratio between the number of turns of wire in the primary and the number of turns in the secondary? This is very easy to work out as the number of turns is directly proportional to voltage. It is 240:6 (i.e. 240 volts to 6 volts), which reduces to 40:1.

IMPEDANCE MATCHING

In the old days of valves (not so old, really, as quite a few hi-fi buffs are returning to the use of valves in their amplifier) transformers were also employed for the more esoteric function of impedance matching. An a.f. output valve feeds a loudspeaker by way of an impedance matching transformer.

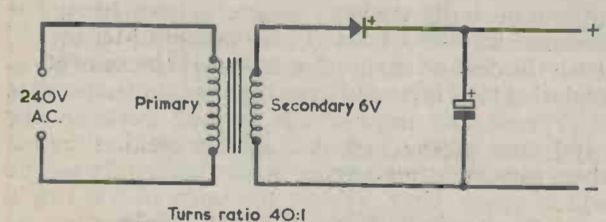


Fig. 1. A typical transformer application. The 6 volt secondary feeds a half-wave rectifier circuit for the supply of low voltage equipment

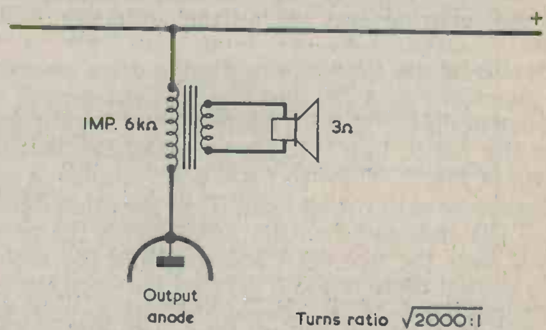


Fig. 2. In this circuit the transformer has to present an impedance of 6kΩ at its primary

Now, an a.f. output valve works at much higher voltages and lower currents than does an output transistor, and a typical output valve could offer optimum power with minimum distortion if it is loaded by an impedance of, say, 6kΩ. You can't get speakers with an impedance of 6kΩ and so the valve is coupled to a practical speaker by way of an impedance matching transformer. Let's say we're going to use a 3Ω loudspeaker, as shown in Fig. 2.

So, the speaker presents an impedance of 3Ω to the transformer secondary and we want the transformer primary to present an impedance of 6kΩ to the output valve anode. The ratio of impedances is 6,000 to 3 or, simplifying, 2,000:1. Should our transformer have a step-down turns ratio of 2,000:1? It quite definitely should not. It should, instead, have a step-down turns ratio of the square root of 2,000:1 or (getting out the calculator) 44.7:1. In practice, 45:1 would be adequate.

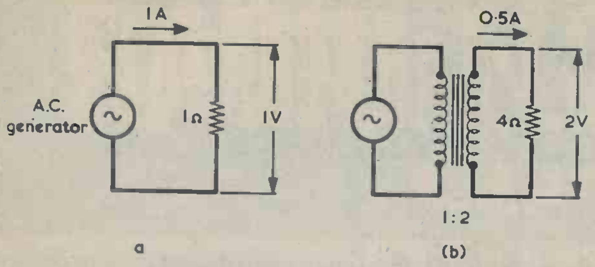


Fig. 3(a). The a.c. generator causes 1 watt of power to be dissipated in the 1Ω resistor

(b). The same power is dissipated in a 4Ω resistor when the generator is followed by a 1:2 step-up transformer

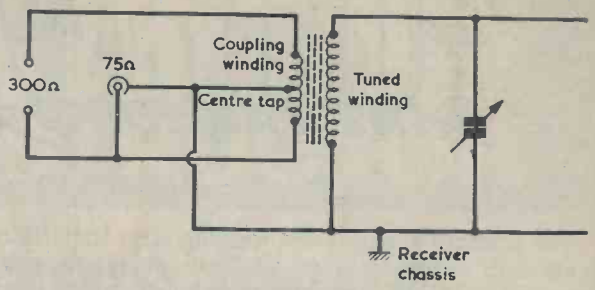


Fig. 4. Communications receiver aerial input circuit catering for 75Ω coaxial and 300Ω twin-line aerial feeders

SQUARE ROOT

This ruling applies to any transformer which is matching one impedance to another. The turns ratio is equal to the square root of the impedance ratio. To understand why this should be so it is helpful to take an example using simple figures. Let's imagine that we have an audio frequency a.c. generator which gives of its best when it feeds into a 1Ω load, as in Fig. 3(a). When the generator produces a voltage (r.m.s.) of 1 volt the current flowing in the load has to be 1 amp. The power dissipated in the load? This is 1 volt times 1 amp, or 1 watt.

In Fig. 3(b) we have the a.c. generator feeding via a step-up transformer into a 4Ω load. According to our square root rule, the transformer should have a step-up ratio of 1 to the square root of 4, or 1:2. Let's give it that ratio and see what happens when our a.c. generator once more produces an output voltage of 1 volt. This voltage is stepped up by the transformer to 2 volts, and 2 volts across 4Ω causes a current of 2 divided by 4, or 0.5 amp to flow. The power dissipated in the 4Ω load is therefore 2 times 0.5, or 1 watt. So, by using a 1:2 step-up transformer we have the same generator voltage and load power situation that we had in Fig. 3(a). The generator produces a voltage of 1 volt, and 1 watt is dissipated in the 4Ω load.

If you like to take this a little further, you can see that if there is a secondary current of 0.5 amp in the 1:2 transformer, the primary current must be 1 amp. So far as the generator is concerned it could just as well, in terms of voltage and current, be working into a 1Ω load as into a 4Ω load with a 1:2 matching transformer inbetween.

An interesting matching transformer situation is given in the input circuits of many communications receivers. These can have an input socket for 75Ω coaxial aerial feeders and two terminals for 300Ω twin-line feeders. These two input impedances are catered for by the input coupling coil circuit shown in Fig. 4. Both halves of the coupling coil have the same number of turns. The 300Ω input connects to the outside ends of the coil, and the 75Ω input to the centre-tap and one end. 300Ω divided by 75Ω is 4, and so the coil, with its 2:1 turns ratio, copes with an impedance ratio of 4:1. ■

AMATEUR RADIO SATELLITES (AMSAT)

International Body Proposed

Report by Arthur C. Gee

The primary organisation looking after the affairs of amateur radio satellites, has been, during the past few years, AMSAT, short for Amateur Satellite Corporation. Based in Washington, U.S.A., and the Goddard Space Flight Centre, it has been responsible for the building and launching of the most recent OSCARS – Orbital Satellites Carrying Amateur Radio.

Following the initiative taken by their present President, Tom Clark, W3IWI, who raised the question "An AMSAT for the 80's" in an article of that title in a recent AMSAT Newsletter, and subsequently introduced the subject at an Open Forum at the last AMSAT AGM, the suggestion was made that in view of the fact that national AMSAT Groups – 'affiliates' as they were called – had been formed in a number of countries, to cater for local groups, a parent body should be set up to correlate the activities of these local groups, so that duplication of activities should not take place, funds could be apportioned between various projects, future policy on a world wide basis could be determined and so on. This idea, which was formulated following the last AMSAT AGM, held in the Goddard Space Flight Centre, was approved by the AMSAT Board of Directors at their meeting in April last, and they agreed that the AMSAT-UK Group should host an exploratory meeting to be held at the University of Surrey, Guildford, England, in September, to endeavour to set up such an organisation.

Accordingly arrangements have been made for an international conference to be held at the University of Surrey from September 19th to 23rd to which over 160 societies and personalities interested in amateur satellite activities have been invited. These societies are not only those interested in amateur radio satellite communications, but represent a much wider field of satellite interest such as weather satellite reception, scientific satellites, computer and data orientated satellite communications, etc. So far, amateur radio satellites, particularly the more recent ones, have been primarily intended for communication pruposes, but there is a trend to propose future satellite projects cover a much wider field. In fact, future 'amateur' orientated satellites may have no communication facilities at all, but be used solely for scientific and educational pruposes. Britain's first amateur satellite, UOSAT, which is being built at the University of Surrey, is primarily educational. It will carry a number of HF radio beacons, enabling individual radio amateurs and science groups in schools and technical colleges to study the changing effects of the ionosphere on radio wave propagation. A slow scan type T.V. camera for weather picture studies is also proposed as well as a magnetometer for the study of the earth's magnetic fields.

All due credit must be given to those American workers, who pioneered the first of the OSCARS, but one must not forget that workers in Canada, Germany, Australia and Japan contributed both in design studies and constructional work, these projects. The purpose of AMASAT INTERNATIONAL is to insure adequate correlation of such activities in the various countries concerned in future satellite projects of this type. France has plans for an OSCAR type project, as of course has the USSR, which has already launched and operated at least two amateur radio satellites. Concerning Russia's future plans for amateur radio satellites, we read with interest in the current issue of the "Journal of the International Amateur Radio Union, Region 1 Division," the following:-

From "RADIO" January, 1980. "The successful operation of radio amateur satellites "RS1" and "RS2" has been an inspiration to the creators of their on-board equipment – enthusiasts from the DOSAAF volunteer space technology laboratory. Now in 1980, the windows of the laboratory are again lit up late at night, on-board translator equipment is being perfected, different types of telemetry are being tested, and new directions in amateur space communication are being explored. One of these new directions may be communications using an automatic operator installed in a satellite. A prototype of such an operator, "Robot", has already been created in the laboratory and was shown at "TELECOM-79" in Geneva. Not only does it conduct a communication, acknowledging receipt of the call sign of the correspondent and assigning a serial number to the contact, it keeps a "log" and if there is interference it sends QRM (call sign of correspondent not received) or QRZ (call detected but both call signs not received). "Robot" even has a bulletin board where necessary information may be entered and transmitted during contacts".

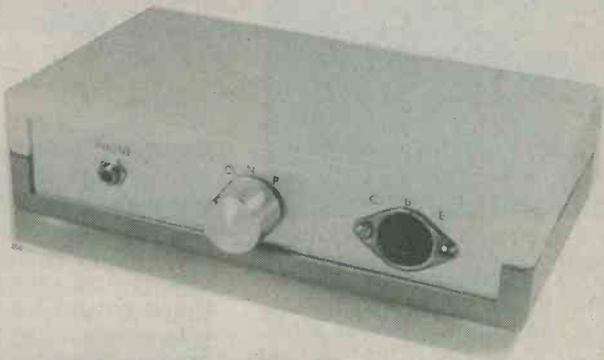
Besides these projects, rumours are current that Italy is planning an amateur radio satellite project and no doubt Japan will enter the field sooner or later, as she has already contributed equipment to current constructional projects. So there is a very real "International" involvement in the Amateur Space Programme nowadays.

Delegates to the University of Surrey meetings will be able to visit the University Space Laboratories and see UOSAT under construction. A visit has also been planned to the SRC Appleton Laboratories at Ditton Park and to the Satellite Signal Reception Centre at Winkfield. A dinner and theatre visit has been arranged at Guildford, so the delegates will be able to enjoy something more than just their deliberations, during their visit to this country. An Open Forum will be held on one of the days of the conference, so that those who are not delegates but are interested enough to come to the meetings, will be able to express their own individual views on the "Future of AMSAT". It should certainly prove to be a most interesting occasion. ■

RADIO & ELECTRONICS CONSTRUCTOR

IN NEXT MONTH'S ISSUE

GO-NO GO TRANSISTOR TESTER



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CROWBAR PROTECTION CIRCUIT

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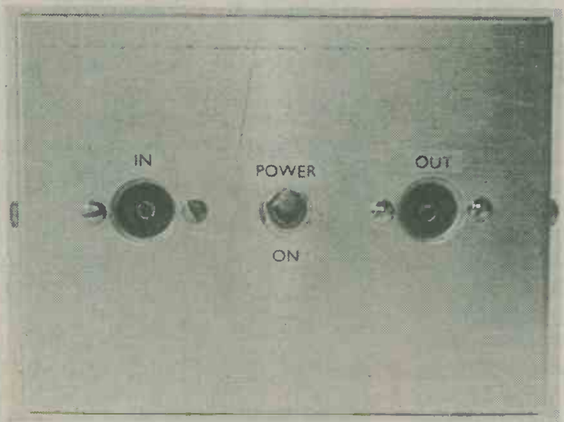

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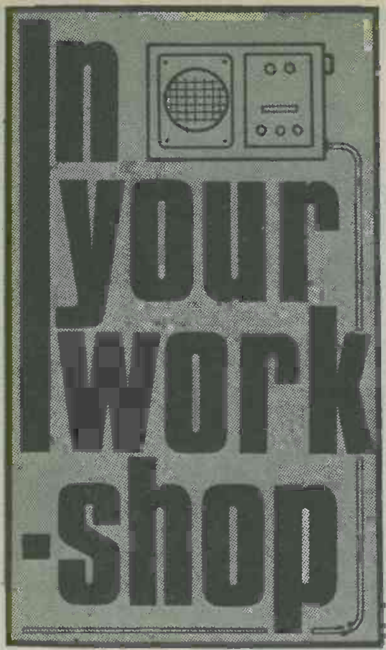


IN-SITU OHMMETER

Electronic ohmmeter gives true readings for circuit resistances on printed boards.

"The trouble with servicing," pronounced Dick indistinctly as he munched away at a Mr. Kipling Viennese Split, "is that there's so much guesswork involved in trying to locate the part which has gone faulty."

"Nonsense," retorted Smithy. "Fault-finding is strictly a matter of logical deduction."

He poked the last piece of a pork pie into his mouth and chewed contentedly.

"Plus luck," added Dick.

Smithy swallowed the remnants of the pork pie.

"It's not a question of luck," he loftily corrected his assistant. "Although I will agree that a little intuitive reasoning can be very helpful."

Dick snorted irritably.

"Well, take this week," he resumed, "when I was trying to find a fault in a music centre. In the end, all that was wrong was a measly little 27kΩ resistor which had gone high, but it was difficult to check the values of the resistors with my testmeter switched to ohms because there were so many silicon devices in the circuit. It was absolutely bristling with transistors, diodes. and i.c.'s"

IN-SITU OHMMETER

"You'll have no trouble checking circuit resistances from now on," observed Smithy.

"As I was saying," went on Dick, ignoring Smithy's remark, "I used an ordinary multimeter switched to an ohms range. If I applied its test leads to any resistor on the board I could quite likely get a misleading reading because there would be the risk that I was connecting the test prods across some silicon junction in the circuit. Say, across a diode or across a base-emitter or base-collector junction in a transistor." (Fig.1.)

"After today," stated Smithy, "that's no problem."

"I don't get you," replied Dick, puzzled. "All I know is that, with this music centre, I had to darned well unsolder one end of the 27kΩ resistor before I could finally measure its resistance reliably."

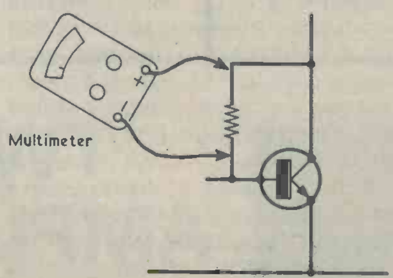


Fig.1. Silicon junctions can produce incorrect ohmmeter readings if the ohmmeter causes the voltage across a resistor being checked to rise to forward conducting level. Here, a multimeter switched to an ohms range could give a falsely low resistance indication because of the base-collector junction of the transistor.

"All that's in the past," Smithy repeated. "In the future you'll be able to measure circuit resistances on printed boards without worrying at all about any silicon junctions the resistors may happen to be connected to. Or, at least, you'll be able to do so up to values of 100kΩ. Now, why do you run the risk of getting misleading resistance readings with an ordinary multimeter?"

"Because," said Dick, "the multimeter can cause the voltage dropped across a resistor being tested to be higher than 0.6 volt, whereupon any forward biased silicon junction which happens to be connected across that resistor will cause the meter to give a falsely low indication."

"Exactly," confirmed the Serviceman. "And, because of that, I've made up a special ohmmeter which is specifically intended for measuring the values of resistors whilst they're still soldered to a printed board, and which eradicates all worries about any silicon devices which may be connected to those resistors. It doesn't of course, guard against incorrect readings when other *resistors* are connected to the one you're checking, but it completely removes the silicon junction bogy. I might as well spend what's left of our lunch break explaining how the ohmmeter works, but first perhaps you could get me a spot more tea to wash down that pork pie."

Eagerly, Dick picked up Smithy's disreputable tin mug and took it over to the Workshop sink, alongside which were ranged the motley culinary effects of the Workshop. Returning, he replaced the fully charged mug alongside Smithy who drank from it deeply.

"Ah, that's better," he said, wiping his lips with the back of his hand. "Now, if you'll come over here, I'll give you the basic thinking behind this ohmmeter of mine."

As Dick picked up his stool and carried it over to Smithy's bench, the Serviceman pulled his note-pad towards him and proceeded to sketch out a circuit. (Fig.2.)

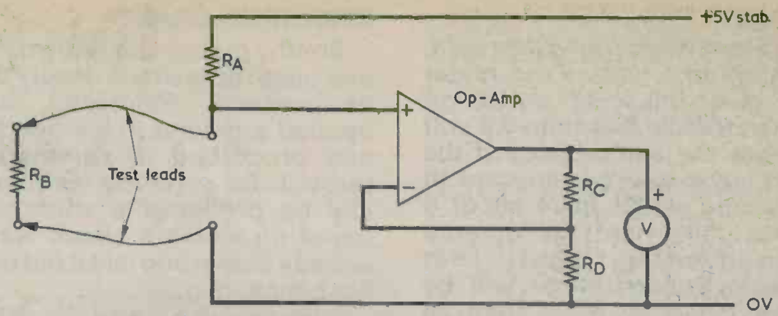


Fig.2. If, in this basic ohmmeter circuit, the voltmeter gives an f.s.d. indication when the voltage across test resistor RB is much lower than 0.6 volt, the ohmmeter can be used to measure circuit resistances without any worry about false readings due to silicon junctions.

"That looks very simple," commented Dick, looking at Smithy's sketch.

"It is simple," agreed Smithy. "All that we have here is an operational amplifier whose voltage gain is controlled by the negative feedback resistors, RC and RD. The output voltage of the op-amp is measured by a voltmeter. Connected to the non-inverting input is the tap in the potential divider consisting of RA and RB, and this divider is connected to a stabilized positive 5 volt rail."

"I think I can see the idea behind this arrangement," said Dick quickly. "Would I be correct in saying that RA is a resistor of known value, whilst RB is the unknown resistor you're measuring?"

"You would be," confirmed Smithy. "Provided that the voltage across RB is a lot lower than the stabilized 5 volts, the voltage dropped across it will be almost exactly proportional to its resistance. That voltage, after amplification by the op-amp, will then be indicated by the voltmeter."

"Stap me," said Dick enthusiastically, "I can see it all now! All you've got to do is to arrange things so that the voltage across RB is always below that at which a silicon junction passes forward current and you're home and dry! You can apply the test leads to any resistor on a printed circuit board and you'll always get an accurate indication of resistance regardless of any silicon devices which may be connected to the resistor."

"That's the idea in a nutshell," stated Smithy. "The circuit has to be set up so that the maximum resistance which can be measured and which, incidentally, corresponds to a full-scale deflection in the voltmeter, produces a voltage drop across the test leads which is lower than that at which a silicon junction conducts."

"There should be no difficulty there," said Dick with conviction. "I should imagine that all you have to do is to ensure that the voltage drop across the test resistor doesn't exceed, say, 0.4 volt."

FORWARD VOLTAGE

"That," confessed Smithy ruefully, "is just what I thought, too, when I first started working on my ohmmeter design. I originally planned to have the f.s.d. voltmeter reading correspond to about 0.4 volt across the test resistance. After all, we *do* talk about the voltage drop across a forward biased silicon junction as being of the order of 0.6 volt. I thought that 0.4 volt would be well below the level at which any silicon junction passed forward current."

"Wasn't it?"

"By no means," said Smithy. "When I started checking things out in practice I found that the junctions in some silicon transistors and some silicon diodes started to pass a few odd microamps at forward voltages not much higher than 0.3 volt. These currents were pretty small but they were still sufficient to cause significantly false readings near f.s.d. in the circuit with test resistances of the order of 5kΩ or more."

"Blimey," said Dick, impressed. "I wouldn't have thought you'd have had any trouble with forward voltages as low as 0.3 volt."

Smithy shrugged his shoulders.

"Neither did I. Still, the problem was there. In the end I decided to play things safe and I finally designed the ohmmeter so that it gives an f.s.d. resistance indication in the meter when the voltage across the test resistance is less than 0.2 volt. With a voltage figure as low as that, resistance readings could surely not be affected by any parallel silicon junctions."

"Well, *that* voltage should certainly ensure that no silicon junction in the circuit could pass forward current."

Dick looked down at Smithy's sketch.

"Hang on a minute," he went on. "There's something I've just noticed."

"What's that?"

"Are the op-amp and the 5 volt stabilized supply turned on all the time?"

"After the ohmmeter has been switched on, yes."

"And do you just pick up the two test leads and connect them to the resistor you're going to check?"

"That's right."

"Well, blow me," expostulated Dick, "during the periods when the test leads are not connected to anything, the full stabilized 5 volts is passed to the non-inverting input of the op-amp."

"So?"

"From what you've just said, the op-amp causes the meter to give full-scale deflection when there's less than 0.2 volt across the test resistor. If the test leads aren't connected to anything you'll have all of 5 volts going into the op-amp non-inverting input. That means the voltmeter will be overloaded by more than 25 times!"

"Things won't be as bad as all that," chuckled Smithy. "To start off with, the op-amp output can't go higher than its positive supply. But, in fact, I've incorporated a voltage limiting circuit around the voltmeter to prevent the current which flows through it rising to more than 60% over its f.s.d. value. When the test leads are open-circuit the voltmeter needle does go up to and rest against the end stop at the maximum end of the scale, but the extra current that passes is not sufficient to harm any normal meter coil or movement. However, I think that I can now answer any further queries more easily if I show you the full circuit."

CIRCUIT DIAGRAM

Smithy picked up his tin mug and once more drank deeply of its contents. Refreshed, he opened a drawer in his bench and proceeded to rummage through its contents. Eventually he produced a sheet of paper on which a circuit was already drawn and laid it out on his bench. (Fig.3.)

"Here we are," he announced proudly. "This is the full circuit of the ohmmeter. The op-amp is a standard job, and I chose an LF351 which has an input resistance of a million megohms. It doesn't have a CMOS input so you don't have to be quite as careful with it as you would be with a CMOS device, although it would still be wise to solder to the input pins with an earthed soldering iron. The stabilized 5 volt supply is given by a positive 5 volt regulator type 78L05, which has a maximum output current of 100mA. RA in the previous circuit consists now of whichever range resistor, from R1 to R5, is switched into circuit by S1."

"I see," said Dick, studying the circuit, "that on Range 1 the range resistor is 270Ω and that the ohmmeter reads from zero to 10Ω."

"That's right," confirmed Smithy. "On Range 1 the voltmeter reads f.s.d. for a test resistance of 10Ω and proportionately less for lower values of test resistance. On each range, the range resistor is 27 times the f.s.d. value of the test resistance."

"Why 27 times?"

"The figure is not particularly important," said Smithy. "It's simply that 27 is the lowest figure in the E12 series of preferred resistor values which gives an f.s.d. voltage of less than 0.2 volt across the test resistor. There's no point in using range resistors with out-of-the-way values when readily obtainable values can be employed. When the test resistor has a value which gives an f.s.d. reading in the meter the voltage across it is one twenty-eighth of 5 volts, which works out at about 0.18 volt. Which is, of course, well below the level at which we can expect a silicon junction to start conducting."

Why," asked Dick, "have you

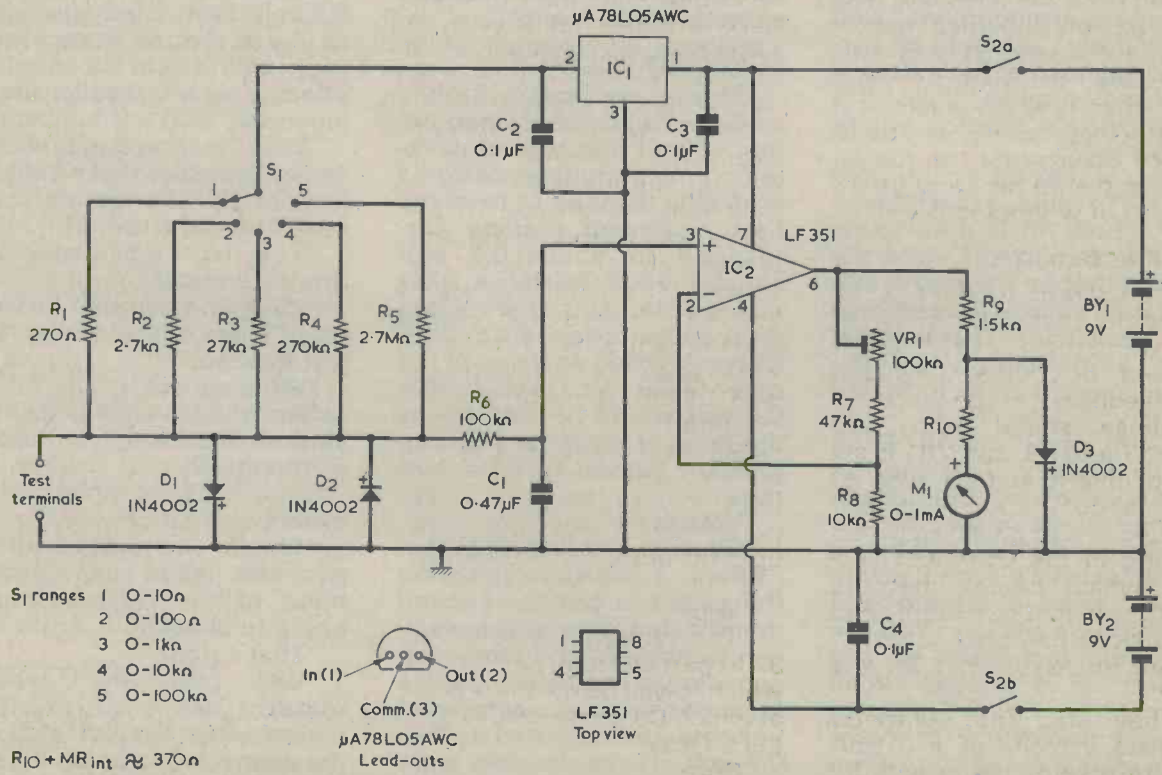


Fig.3. The full circuit of Smithy's in-situ ohmmeter. In the inset showing the voltage regulator pinout, the lead-outs point towards the reader.

got the two diodes, D1 and D2, across the test terminals?"

"They're to limit voltages at the non-inverting input of the LF351," explained Smithy. "D2 is the more important of the two. One of the requirements of the LF351 is that its inputs must not go negative of the negative supply voltage or the device will be destroyed. Diode D2 prevents any input voltage which may be picked up on the test leads going more than about 0.6 volt negative of the centre supply rail so it gives stacks of protection in that respect. Diode D1 performs the less important task of limiting possible input voltages by about 0.6 volt in the positive direction. It also prevents a high positive input excursion when no test resistor is connected."

"Humph," grunted Dick. "Hey, what's this? You've got the upper test terminal connecting to the non-inverting input through a 100kΩ resistor. *And* there's a 0.47µF capacitor across the i.c. input!"

"True," grinned Smithy. "These two components slow down the rising voltage at the non-inverting input when the test terminals are disconnected from a test resistor. As I said just now, the meter needle then goes beyond full-scale deflection. The 100kΩ resistor and the 0.47µF capacitor ensure that the meter needle comes up against the top-of-scale end-stop nice and gently instead of whanging over!"

METER CIRCUIT

"That seems to clear up all the points in the input circuit of the op-amp," said Dick. "Except, of course, the negative feedback components."

"Those," stated Smithy, "are VR1, R7 and R8, and VR1 is set up to give a voltage gain of round about 10 times. Actually, it's adjusted to give the correct reading in the voltmeter section, which means that the resistors in that part don't need to be close tolerance types."

"Are those resistors R9 and R10?"

"They are. The voltmeter consists actually of a 0-1mA current-reading meter with R9 and R10 in series."

"You haven't," objected Dick, "given R10 a value."

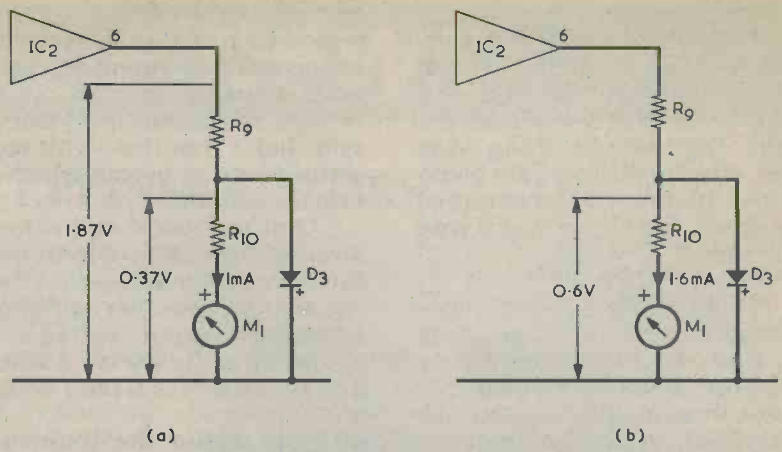


Fig.4(a). When meter M1 passes an f.s.d. current of 1mA the voltages dropped in the voltmeter section of the ohmmeter circuit are as shown here.
(b). If the i.c. output voltage rises sufficiently, diode D3 conducts and limits the current in the meter to 1.6mA.

"Yes I have. If you look at the circuit more closely you'll see a note which says that R10 plus the internal resistance of the meter should be approximately equal to 370Ω. If you use a 0-1mA meter which has an internal resistance of 100Ω then R10 should be 270Ω. The popular panel mounting meters which require a panel cut-out hole of 1½ inch diameter have internal resistances of 170Ω nominal. With these, R10 should be 200Ω to give an overall resistance of 370Ω."

"And does D3 prevent excessive current passing through the meter?"

"It does," confirmed Smithy. "Let's assume that all the resistances here are at their exact values. The total resistance between the op-amp output and the centre zero voltage rail will then be 1.5kΩ plus 370Ω, to give 1,870Ω. Right?"

"Right!"

"So, at f.s.d. in the meter, we've got 1mA flowing through 1,870Ω, This corresponds to a voltage at the op-amp output of 1.87 volts." (Fig.4(a).)

"Yep."

"The voltage across the 370Ω part will then be 0.37 volt, which is well below the voltage at which D3 starts to fully conduct. Okay?"

"Sure."

"Now, if we open-circuit the test terminals the op-amp output voltage rises, fairly slowly because of the presence of the 100kΩ resistor and the 0.47µF capacitor at the non-inverting input, until the diode starts to conduct fully. Normally, this will be at around 0.6 volt. This means that the current flowing in the 370Ω section will be 0.6 volt divided by 370Ω, which works out at about 1.6mA. So the meter is passing 60% more current than its f.s.d. value. This won't cause any damage to a normal meter movement." (Fig.4(b).)

"That seems fair enough," said Dick. "What about the op-amp output voltage?"

"That voltage can continue to go positive," said Smithy. "But the op-amp output current will be limited to something like 4 to 5mA by the presence of R9."

"You've certainly," commented Dick appreciatively, "anticipated most of the things which can happen in this circuit."

Smithy took a gargantuan draught from his mug.

"I like to cover all the eventualities I can think of," he remarked modestly. "Although I must admit that two things took me mildly by surprise when I was checking out the circuit in lash-up form before making it up properly."

"What things were those?"

"The first was what I mentioned just now. I found that I had to work to an f.s.d. voltage across the test resistor which was much lower than the 0.4 volt figure, I had originally planned on. As you now know, I finally settled on an f.s.d. voltage which was lower than 0.2 volt. The second thing was that, despite the low gain given to the op-amp by the negative feedback, the circuit was a wee bit lively."

"Lively?"

"That's right, lively," confirmed Smithy. "In other words it had a slight tendency towards instability. You get this sometimes when you use an op-amp in the non-inverting mode, because the output is then in phase with the input. In this case, the input circuit takes in all the range resistors and, even, the output of the 5 volt regulator. To avoid instability it's desirable to keep the op-amp output components away from the input components. All this means in practice is that you just ensure that VR1, R7, R8, R9 and R10, together with their wiring, aren't closely intermingled with the other components and wiring. In addition, C2 and C3 should be mounted close to IC1, and it helps if matters are arranged so that C3 is fairly close to IC2 as well. The other bypass capacitor, C4, should also be fairly near IC2. C1, which should be a polyester capacitor, by the way, is similarly best mounted close to IC2. Component layout is not critical if you just remember those few requirements."

COMPONENT TOLERANCES

"Do you need any close tolerance components?"

"That," said Smithy, "is really up to anyone who's making up the ohmmeter. Ideally, R1 to R4 inclusive should be 2% or, better, 1%. However, you could use 5% resistors if you're prepared to accept a little inaccuracy in readings. There's a small built-in inaccuracy which can't be avoided in a simple circuit like this, anyway. If the voltage across the test resistor is to be *truly* proportional to the resistor value, then a constant current should flow through it. In this circuit the current in the test resistance isn't *quite* constant. If the test resistor has a resistance which is at f.s.d. level the voltage across the series range resistor is a little more than 4.8 volts. When the test resistor is near zero the voltage across the range resistor is nearly 5 volts."

"You're assuming also," said Dick, "that the 5 volt regulator gives an output which is exactly 5 volts."

"That's true," admitted Smithy. "Actually, the output can vary by 4% between different regulator devices, although whatever output voltage is provided will vary by a maximum of only 0.4% with different loads."

"What about the tolerance for R5?"

"You'll *have* to use 5% here," said Smithy, "unless you have access to a secret store where they have resistors of greater than 1MΩ in tolerances of 2% or 1%. In any case, the range resistor of 2.7MΩ is approaching the limit at which the circuit offers really accurate results. With the consequence that, using my design, the maximum test resistance which can be measured is 100kΩ. When you're setting up the ohmmeter after you've built it you require a known test resistor for any of the ranges from 2 to 4 inclusive. You could, for instance, use a 1kΩ test resistor, preferably close tolerance, and select Range 3. After that, you merely adjust VR1 for an f.s.d. reading in the meter, and the ohmmeter is set up on all ranges."

"And battery consumption?"

"Ye gods," returned Smithy with a touch of irritation, "when you were born you didn't have a silver spoon in your mouth, you had a stainless steel indestructible question mark! Okay, battery current then. Well, the current drawn from the lower 9 volt battery is only that required by the op-amp, and it's around 1.5mA. The upper battery current is that required by IC2, IC1, the range resistors and the voltmeter circuit. With a high range selected and the test terminals short-circuited the upper battery current is around 3mA. It is only when you switch to Range 1 that the current from the upper battery rises appreciably, and it goes up to about 21mA or so, with some 18mA flowing in R1."

Smithy turned his gaze on his assistant.

"Any more questions?"

"Why, no," replied Dick in a slightly embarrassed tone. "Should there be?"

"I can think of two."

"Gosh, can you? I must be slipping! What are those, Smithy?"

"The first," said Smithy, "consists of offset voltage inside the op-amp. You may find that the meter needle doesn't go exactly to zero when the test leads are short-circuited. You can clear this effect, if it occurs, by a slight adjustment to the zero-adjust button on the meter movement, but this should only be done on Ranges 2, 3, 4 or 5. After that you may find that the meter gives a very small forward reading when the test terminals are short-circuited on Range 1. This is merely due to the ohmmeter detecting the very low resistance in the test leads you are using and is simply ignored. Now, what should the second question be?"

Dick pondered for a moment.

"I've got it," he said suddenly. "What sort of case should the ohmmeter be housed in?"

"Good," said Smithy, pleased. "Even if I have to prompt you, you can still find the correct question! And the answer is that the ohmmeter can be housed in an all-plastic case or in a plastic case with a metal front panel. When there is a metal front panel it should be made common with the centre zero voltage supply rail. I've indicated this connection by a chassis symbol in my circuit diagram."

FINISHING OFF

And with these words, Smithy reached into the cupboard under his bench and produced a smart plastic case on the front panel of which were mounted a 5-way rotary switch, a toggle on-off switch, a 0-1mA meter and two test terminals.

Smithy drained his tin mug. "But there's one very important thing that has to be attended to before we even think of getting down to servicing again."

"What's that, Smithy?"

Smithy thrust the mug at him.

"More tea!" ■

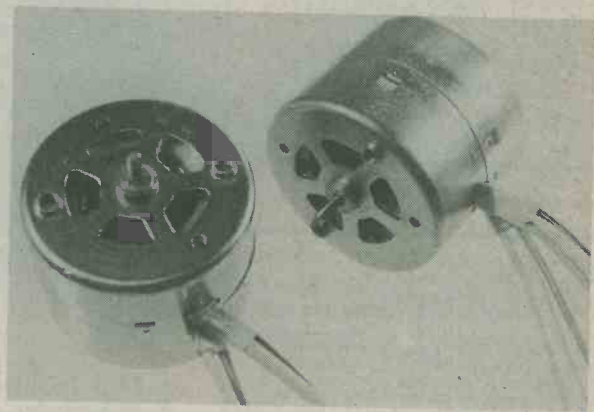
TRADE NEWS

STEPPING MOTORS

New unipolar stepping motors have been added to the products manufactured by Symot Limited, 22A Reading Road, Henley-on-Thames, Oxon, RG9 1AG. These motors are designated the 204/SI range, and the photograph gives two views of the model PC204 from that range.

Because the position and speed of a stepping motor can be accurately determined by the electrical impulses fed to it, the device is becoming increasingly important in instrumentation and industrial applications. The unipolar construction is claimed to offer considerable advantage in applications where a cost-effective interface between a mechanism and its controlling electronics is sought. Unipolar stepping motors are simple to drive and are particularly suitable for systems where feedback techniques are too expensive. These motors are already widely used in paper chart and magnetic recording systems, and in many machine control applications.

A typical specification for a Symot stepping motor can include 12 volt d.c. operation, a maximum speed of 4,500 r.p.m. and 7.5° step angle.



Two views of one of the new Symot range of stepping motors. These are capable of small discrete amounts of shaft rotation, and enable an electronic circuit to control mechanical movement without servo feedback.

EASAMS LIMITED

A company whose name keeps cropping up more and more frequently in the releases is EASAMS Limited. EASAMS is a member of the GEC-Marconi group and is deeply involved with naval projects both in the U.K. and overseas. Based in Camberley, Surrey, this expanding company has just taken over 4,000 square feet of office space in Federated House, St. Thomas Street, Weymouth. Perhaps the most spectacular of its present activities is the work being carried out for the Royal Navy on the Seabed Operation's Vessel, and the staff at Weymouth will be particularly involved here.

A six-man team from EASAMS is assisting the Royal Navy in the development of the Seabed Operations Vessel, or SOV for short. The team, integrated with Navy staff, is undertaking engineering management and project control functions of those aspects of SOV for which the Director of Underwater Weapon Projects (Navy) is responsible. EASAMS is also investigating and assessing the operational performance of the SOV system.

The Seabed Operations Vessel will have a comprehensive fit of search sonars and is designed to carry out research of the seabed using a towed unmanned submersible for search purposes. In addition the vessel will have the capability to deploy divers to considerable depths using saturated diving techniques. The ship is fitted with accurate surface and sub-surface navigation systems from which an output is coupled to its Dynamic Positioning System. This enables the vessel to steer to a pre-selected position and maintain the position for an indefinite period.

We shall keep an eye open for future news concerning this particular deepwater development.

BACK NUMBERS

For the benefit of new readers we would draw attention to our back number service.

We retain past issues for a period of two years and we can, occasionally, supply copies more than two years old. The cost is 73p, inclusive of postage and packing.

Before undertaking any constructional project described in a back issue, it must be borne in mind that components readily available at the time of publication may no longer be so.

Radio Topics

By Recorder

The continually reducing cost and size of silicon chip circuitry continues at break-neck speed, and the latest wonder to emerge on the scene is a credit card incorporating an integrated circuit.

Introduced by SGS-ATES and known as the XCARD, it consists of a 17 x 8 non-volatile memory in a credit card style package. Of the 136 bits, 100 represent credit units whilst the other 36 are used for security, control and testing.

ELECTRONIC CREDIT CARD

The consumer buys a card with the memory cells erased, i.e. with 100 credit units. The point of sale terminal writes into some of these cells as the credit is used. When the card is completely exhausted the card reader withholds the goods and services and the card is simply thrown away.

It is stated that the XCARD system benefits both consumer and vendor. For the former the XCARD replaces loose change and broken machines; for the latter the XCARD means payment in advance, reduced maintenance, no money left in machines to tempt thieves and high immunity against fraud.

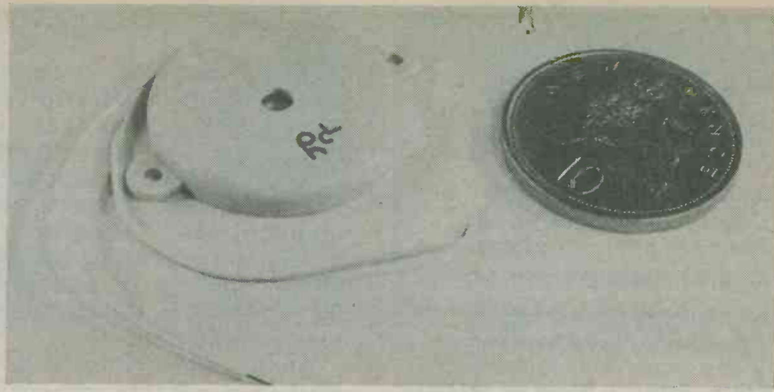
The possibility of fraudulent misuse is avoided by 100% testing, a plastic tab (which must be removed to insert the card into the point of sale reader) to prevent resale of used cards, and the security code in the memory. This code identifies the card vendor, and should the memory be erased to restore credit the code will be erased and the card rendered useless.

The card was designed by SGS-ATES in collaboration with SIP (Societa Italiana per l'Esercizio Telefonico – the Italian telephone concessionary). Originally intended for payphones, the XCARD will find applications in similar low-cost frequently used automatic machines.

The card has seven connection points, these being for address code input, clock input, programming signal input, output, supply, ground and protection fuse. The block diagram for the card shows a phase generator coupled to the clock input, an 8 bit shift register, column and row decoders, a 17 X 8 bit matrix, program logic and output buffer. One row of the matrix is written with an 8 bit word at manufacture. After writing this word, which is the security key, the write circuits to this row are destroyed by blowing an on-chip fuse and it is not possible to mend this fuse. If an attempt is made to erase the card in order to regain its credit value, the security key will also be erased. Since the service point is designed to check for a valid security key before providing services there is complete protection against fraudulent use of the card.

Further information on the XCARD can be obtained from SGS-ATES (United Kingdom) Ltd., Walton Street, Aylesbury, Bucks.

One of a range of miniature piezo-ceramic "sound-transducers" recently introduced by Toko. These highly efficient transducers offer a high acoustic output with low drive currents and are available from Ambit International



PIEZO RESONATOR

Shown in the photograph alongside a 10p piece (which, for the benefit of overseas readers, has a diameter of about 1.1in.) is a miniature piezo-ceramic "sound-transducer" from a range recently introduced by Toko. These transducers can be employed for all types of electronic equipment requiring acoustic information of function or malfunction, including alarms and keyboard entry verification circuits.

The transducers are available as unmounted discs or, as in the photograph, in plastic enclosures. The units offer high outputs at their resonant peaks whilst still exhibiting broadband responses. Drive currents can be as small as 1mA only.

The devices, together with full specifications, applications and drive circuit details, can be obtained from Ambit International, 200 North Service Road, Brentwood, Essex, CM14 4SG.

VOLTAGE CONVERTERS

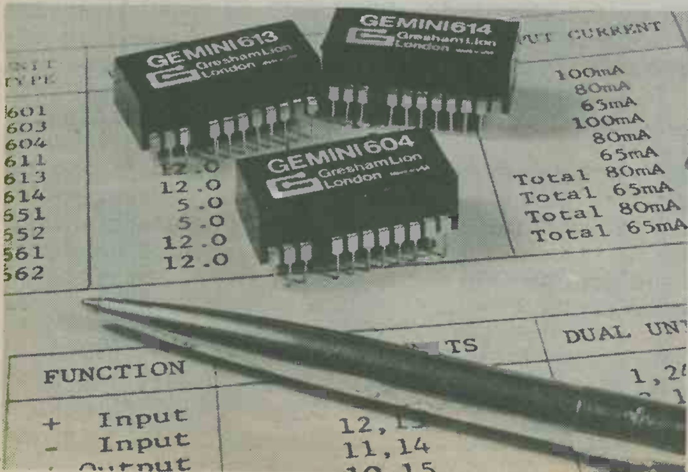
Three of a new range of 1 watt d.c. to d.c. converters can be seen in the second photograph. These are all encapsulated in 24 pin d.i.l. packages and are intended to provide alternative voltage supplies in equipment having basic 5 volt or 12 volt rails. Output current capability is of the order of 65 to 100mA depending on which converter in the range of 10 is employed.

These have been introduced by Gresham Lion Limited, of Gresham House, Twickenham Road, Feltham, Middlesex, TE13 6HA, and are an extension to Gresham Lion's existing range of GEMINI converters. The new models are to be known as the GEMINI 600 Series.

Because units from this series will fit into standard i.c. sockets and printed board drilling patterns, on-board power conversion systems can be assembled economically and quickly. The devices are suitable for automatic insertion techniques, and may be flow-soldered after insertion.

Although the devices are very small, they have all the features of much larger modules. They are available with single and dual outputs, have output regulation, are fully isolated and have protection against short-circuits. The initial range currently available is intended for input voltages of 5 or 12 volts nominal. There are five possible output configurations for each input, including 5 volt, 12 volt and 15 volt, as well as dual positive and negative 12 volt and 15 volt. All outputs are regulated to 5%.

A high reliability is claimed for the units and a minimum mean time between failures of 100,000 hours is quoted. Load regulation is only 150mV from zero to full output current and output ripple is a maximum of 30mV peak-to-peak. Output current limiting ensures that short-circuit currents are only 150% of full load current.



Three of the new range of GEMINI d.c. to d.c. converters manufactured by Gresham Lion Ltd. With a 1 watt power capability, these provide alternative supply voltages on boards having basic 5 volt or 12 volt supplies.

BBC STANDARDS CONVERTERS

BBC Television is International Television. The BBC sells programmes overseas and buys them. For a fee, the BBC will process one company's signals and send them on to someone else. These facts are all made possible by BBC television standards converters, for which the Corporation is justly renowned.

At the end of last year the BBC Designs Department, led by John Astle, completed the first of two new standards converters for the Television Centre in London. The new converter translates television pictures, in either direction, between the 525 line 60 field NTSC system used in North America and Japan to the European 625 line 50 field standard with either PAL or SECAM colour. Using extra coders and decoders it can convert between any two of the world's television standards. By exploiting fundamental work carried out by Chris Clarke and his team at the BBC Research Department and by using digital techniques, the converter takes information from 16 lines spread over 4 television fields as the basis for the most sophisticated and accurate conversion that has ever been achieved. Furthermore, the process even reduces noise in the picture.

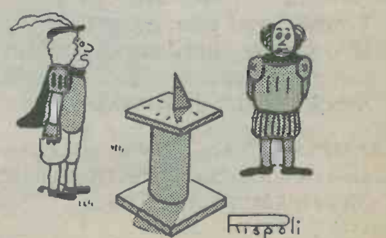
The converter first decodes the incoming television signal using comb filter decoders. Next, it samples the components of the incoming signal and digitally stores the instantaneous values for four fields. Finally, it redistributes the picture information to suit the needs of the output standard by calculating new values from the stored samples. The programme and the coefficients that control calculation of one standard from another are stored in EPROM's.

The process of redistributing the picture according to the changed number of lines and fields per second is called interpolation. The large amount of storage and the relatively complex arithmetic in the new converter allow it to take full advantage of the basic Research Department studies of the interpolation process. As a result, the interpolation process provides pictures that are free of judder and flicker and do not have the twinkling effects that were previously associated with sharp horizontal edges. The interpolation process is equally good irrespective of the input and output standards. Colour and luminance are treated separately and, by using the optimum apertures for the luminance and colour signals, the output has less video noise than the input.

Another feature is a microprocessor monitoring unit which checks the operation of important points in the converter and reports any faults on a visual display unit along with an indication of the action needed. And the converter does not need to be told the television standard of the input, it can work that out for itself!

The BBC produced the world's first electronic standards converter in 1968, ready for the Olympic Games in Mexico. Three similar converters were built and, though they still provide reliable service, the new equipment achieves far better quality and does not need daily attention by skilled engineers. ■

"Have you got one with a digital display?"



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(Continued on page 63)

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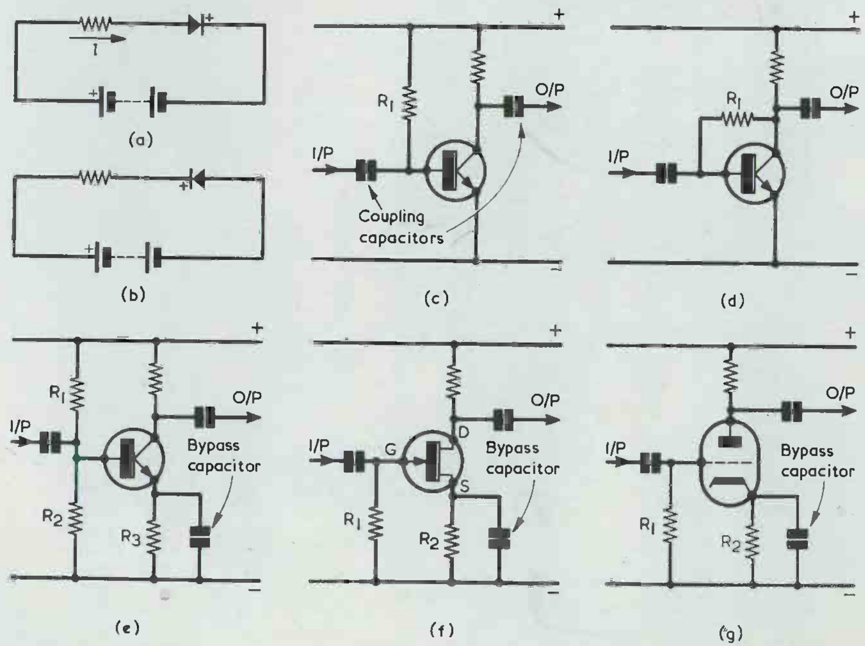

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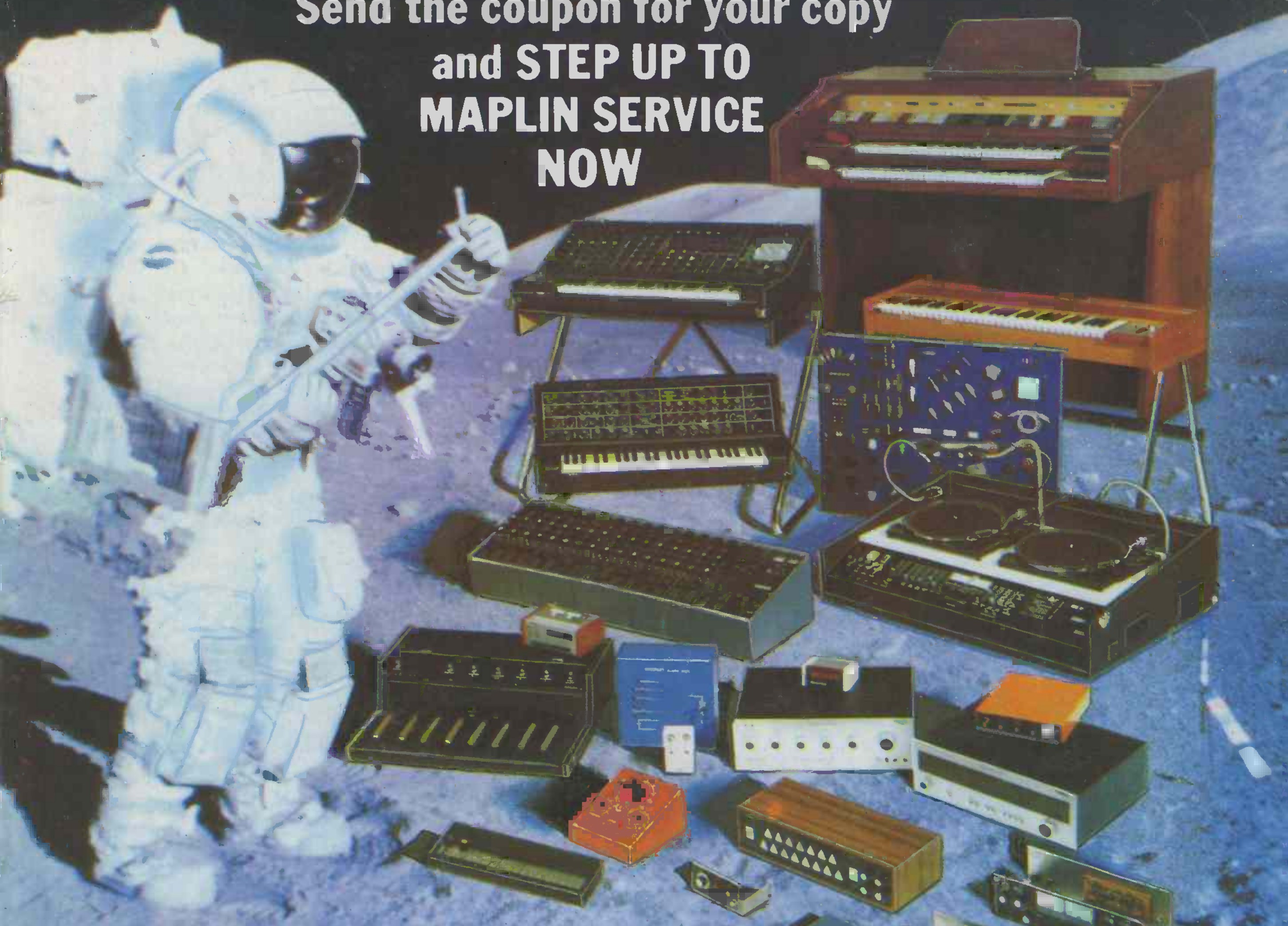

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