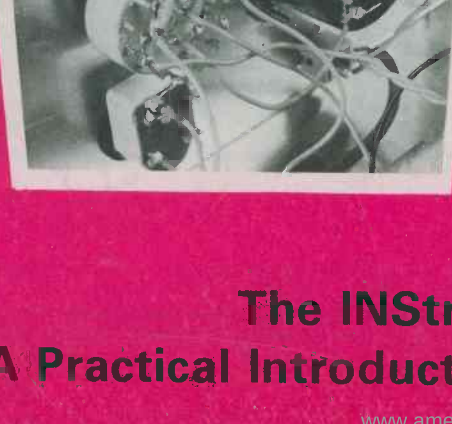
RADIO & ELECTRONICS CONSTRUCTOR

AUGUST 1980
55p

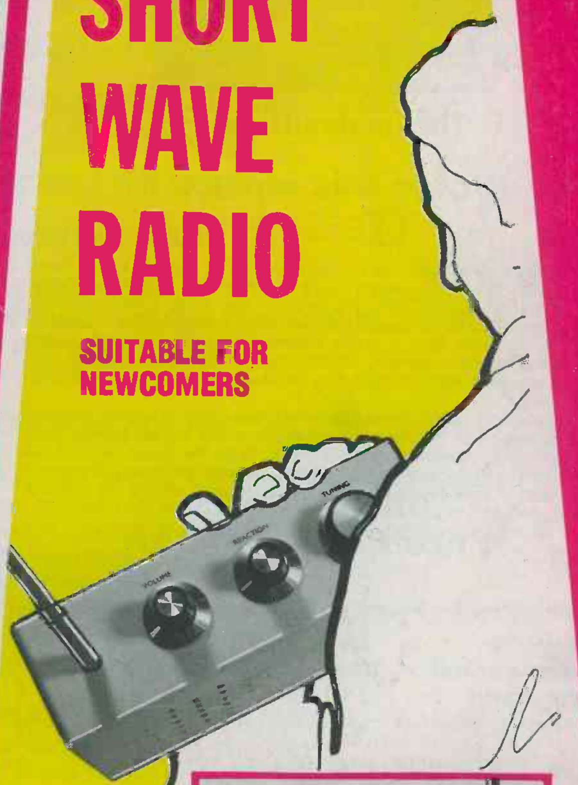
A·F· MILLIVOLT METER

A SMALL SELF-CONTAINED UNIT



PORTABLE SHORT WAVE RADIO

SUITABLE FOR NEWCOMERS



COVERS 25, 31, 41 AND 49 METRE BANDS

GREAT NEW SERIES

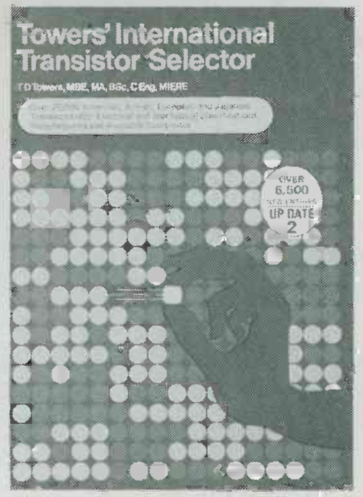
The INStructor – Part 1
A Practical Introduction To Microprocessors

ALSO ANNUAL INDEX

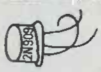
DIRECT SUPPLY SERVICE TO READERS

TOWERS INTERNATIONAL TRANSISTOR SELECTOR

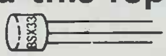
(NEW REVISED EDITION)



This is dead!



Would this replace it?



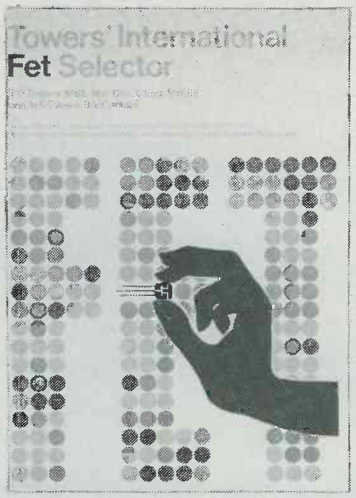
If it takes you longer than 1 minute to find out all about these transistors then you need a copy of TOWER'S INTERNATIONAL TRANSISTOR SELECTOR. It's one of the most useful working books you will be offered this year. And probably the cheapest!

In it, you will find a really international selection of 13,000 transistor types — British, Continental European, American and Japanese. And we think that they will solve 90% of your transistor enquiries.

Current and widely used obsolete types were carefully selected and arranged in Numero-Alphabetical order by an author who was uniquely qualified to do the job. With his compendium, all you need to know is the type number and you can learn all about a transistor's specification; who made it and where to contact them; or what to use to replace it.

Price **£10.35** inc P&P

TOWERS INTERNATIONAL FET SELECTOR



If you deal with field effect transistors, or fet's — whether as a student, a hobbyist, a circuit engineer, a buyer, a teacher or a serviceman — you often want data on a specific fet of which you know only the type number.

Specifications apart, you may be even more interested in where you can get the device in question. And perhaps more important still (particularly with obsolete devices), you may want guidance on a readily available possible substitute.

This fet compendium, a comprehensive tabulation of basic specification, offers information on:

1. Ratings
2. Characteristics
3. Case details
4. Terminal identifications
5. Applications use
6. Manufacturers
7. Substitution equivalents (both European and American)

The many fet's covered in this compendium are most of the more common current and widely-used obsolete types.

It is international in scope and covers fet's not only from the USA and Continental Europe, but also from the United Kingdom and the Far East (Japan).

Price **£4.00** inc P&P

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by T. D. Towers
MBE, MA, BSc, C Eng, MIERE
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Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that queries cannot be answered over the telephone, they must be submitted in writing and accompanied by a stamped addressed envelope for reply.

Correspondence should be addressed to the Editor, Advertising Manager, Subscription Manager or the Publishers as appropriate.

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OUR NEXT ISSUE WILL BE PUBLISHED EARLY SEPTEMBER

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.**

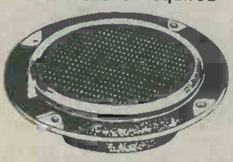
SEMICONDUCTORS

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 pre-amp, 3-6VDC operation **£1.00.**

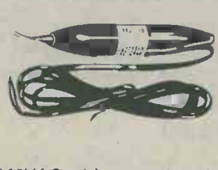
LIGHT DIMMER

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 insulated 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**

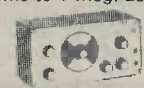
SWITCHES

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

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

DTL

930	55p
935	65p
937	55p
944	65p
946	55p
957	55p
962	55p
9099	90p

7400

7400	11p
7401	12p
7402	12p
7403	13p
7404	17p
7409	18p
7410	16p
7412	18p
7513	28p
7420	16p
7430	18p
7432	25p
7440	16p
7442	68p
7448	75p
7473	32p
7474	32p
7475	40p
7476	40p
7490	35p
7492	50p
7493	50p
7496	45p
74121	35p
74123	45p
74154	90p
74157	55p
74122	45p
74125	50p
74195	100p
74196	100p
74283	140p
74290	120p
74365	90p
74366	90p

74LS

74LS00	18p
74LS01	12p
74LS04	15p
74LS08	20p
74LS10	19p
74LS11	30p
74LS12	30p
74LS14	60p
74LS15	38p
74LS20	19p
74LS30	19p
74LS32	25p
74LS40	26p
74LS42	56p
74LS47	78p
74LS48	85p
74LS49	99p
74LS73	30p
74LS74	30p
74LS75	39p
74LS86	39p
74LS90	40p
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
74LS195	87p
74LS221	110p
74LS244	175p
74LS245	325p
74LS251	120p
74LS257	110p
74LS290	95p
74LS293	120p
74LS366	57p
74LS373	170p
74LS374	170p
74LS375	140p
74LS377	188p
74LS393	135p
74LS490	140p
74LS670	260p

CMOS

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

74C

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

LINEAR IC's

AY-3-1350	795p
AY-3-8910	825p
709	30p
723	33p
741	18p
ICL7106	595p
ICL7107	695p
ICL8038	295p
ICM7216A	1875p
ICM7216B	1675p
ICM7555	80p
LM301AM	30p
LM311	50p
LM318	75p
LM324	45p
LM339	45p
LM380	65p
LM1496	65p
LM1871	550p
LM1872	550p
LM3990	50p
LM3914	225p
LM3915	225p
LM13600	125p
NE555	18p
NE556	50p
RC4136	85p
SN76477N	175p
TBA810DAS	85p
TL071	55p
TL074	130p
TL082	75p
TL084	110p
TL490	175p
XR2206	325p
XR2207	375p

DIL SWITCHES

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

LOW PROFILE SOCKETS BY TEXAS — SALE

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

MEMORIES

2114 300 NS	275p
4116 200 NS	300p
4116 150 NS	395p
4315 (4k x 1) CMOS RAM 450 NS	995p
6514 (1k x 4) CMOS RAM 450 NS	795p

EPROMS

1702A	450p
2708 450 NS	425p
2716 5V 450 NS	995p
2532 32K 450 NS	2995p

UARTS

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

CHARACTER GENERATOR

RO-3-2513 UC	450p

KEYBOARD ENCODER

AY-5-2376	795p

FLOPPY DISK CONTROLLERS

FD1771 B-01 S/D Inverted Bus	2995p
FD1791 B-01 D/D Inverted Bus	4995p
FD1792 B-01 S/D Inverted Bus	3495p
FD1793 B-01 D/D True Bus	5495p
FD1794 B-01 S/D True Bus	3495p
FD1795 B D/D Inverted Bus, side select	5995p
FD1797 B D/D True Bus, side select	5995p

SUPPORT DEVICES

6520	495p
6522	795p
6532	895p
6551	1095p
6810	375p
6820	425p
6821	425p
6850	425p
6852	425p
8212	395p
8214	450p
8216	395p
8224	395p
8228	395p
8251	495p
8253	1125p
8255	495p
8257	1050p
8259	1325p
MC 144 12VL	797p
Z80 P10	595p
Z80 CTC	595p
Z80A P10	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 S10/0	2995p
Z80A S10/0	3495p
Z80 S10/1	2995p
Z80A S10/1	3495p
Z80 S10/2	2995p
Z80A S10/2	3495p

INTERFACE LINEAR

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

CPU'S

6502	795p
6504	795p
6505	795p
6800	695p
6802	995p
8080A	525p
8085A	1095p
Z80	795p
Z80A	995p
Z8001	12500p
Z8002	9500p
WD9000B	19900p

VOLTAGE REGULATORS

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

BIPOLAR ROMS

93448 512 x 8 40 NS	p.o.a.
93453 1k x 4 40 NS	p.o.a.
93451 1k x 8 45 NS	p.o.a.
93511 2k x 8 50 NS	p.o.a.

NEW! SPECIAL OFFER!
4K CMOS RAM (1K x 4) 450 NS ONLY £7.95! (8 for £50)
The TC 5514P from Toshiba, CMOS equivalent of the 2114!.

- Low Power Dissipation
- 10μW/BIT (TYP). at 3.0V (STANDBY)
- 10μW/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 ZULU II CLOCK KIT
X-RATED CLOCK!
WITH CALENDAR AND NOXtm CIRCUIT

ONLY £19.99
Custom high impact moulded case with ruby lens £4.99
P&P 82p plus VAT

X-TRA VALUE: All the components and high quality plated G-10 PC Boards are provided.
X-TRA CARE IN DESIGN: No wires between readout board and clock board. Large open layout.
X-CELLENCE IN IDEAS: 5 years of designed products for the amateur radio market.
X-CELLENCE IN INSTRUCTIONS: Clear step-by-step instruction with quality illustrations. The assembly manual is not a read-between-the-lines afterthought!
X-TRA FEATURES: There has never been a clock kit with so many features – at any price!
- Unit operates on either 12VAC or 12 VDC.
- On board QUARTZ XTAL TIMEBASE.
- Automatic BATTERY BACKUP. Never worry about power failures again!
- Reads true 24 HOUR TIME and 31 DAY CALENDAR.
- Unique NOXtm CIRCUIT activates readouts with a handclap or they can be turned on constantly.
- When used mobile readouts blank ignition is off.
- Special NOISE SUPPRESSION and battery reversal circuits.
- Bright ½" LEDs show hours, minutes and seconds.

Just clap your hands and the time appears for 5 seconds followed by the date for 4 seconds. A low cost 9V transistor battery provides stand-by power in the event of power failures up to 4 hours. With the addition of a low cost 12V 300MA transformer, the unit will work on AC.

SE 01 Sound Effects Kit NEW

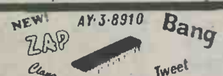
The SE-01 is a complete kit that contains all the parts to build a programmable effects generator. Designed around the new Texas Instruments SN 76477 Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noises, One Shot, and 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

NEW LM13600
PROGRAMMABLE DUAL OP TRANSCONDUCTANCE AMPLIFIER

New from National Semiconductor, the LM 13600 is programmable dual operation transconductance amplifier designed to be used as a fundamental building block in current controlled amplifiers, filters and oscillators. It can also be used in multiplexers, timers and even sample and hold circuits. It is well suited for use in electronic organs and music synthesizers, because it can modulate waveshapes with ease. The 16 pin LM 13600 is programmable over six decades, allowing it to function as a basic building block in a broad range of electronically programmable resistors and filters. A truly remarkable circuit.

ONLY £1.25 plus VAT Data 25p



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.

3½-DIGIT LIQUID CRYSTAL DISPLAY
with 'low bat' indicator

*1.8:8.8

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

LCD 106 . . . . £6.45

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

NEW ULTRASONIC SENDER RECEIVER KIT

TOTAL SECURITY! Completely invisible ultrasonic (23KHZ). Sound beam works like a photoelectric beam but is unaffected by light, heat or noise. Separate Transmitter and Receiver can be used from 6 inches to 25 feet! A solid object breaking the beam causes an output to go low that will sink up to 150MA to Drive a Relay, TRIAC, etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100MA. Use it for burglar alarms, object counters, automatic door openers, automatic door bells, electronic rat trap (?) and more.

ONLY £19.93 P&P 67p plus VAT

NEW LM 1871 RC ENCODER/TRANSMITTER LM1872 RC RECEIVER/DECODER

New from National. The LM 1871 is a complete six-channel digital proportional encoder and RF transmitter intended for use as a low power, non-voice unlicenced communication device at carrier frequencies of 27 MHz with a field strength of 10,000 uV/meter at 3 metres. In addition to radio controlled hobby toy and industrial applications, the encoder section can provide a serial input of six words for hard wired, infra-red or fibre optic communications links. Channel add logic is provided to control the number of encoded channels from three to six, allowing increased design flexibility. When used with the LM 1872 RC receiver/decoder, a low cost RF linked encoder and decoder system provides two analog and two ON/OFF decoded channels. Super versatile chip. Just out. Just look at the features – low current 9V battery operation – on-chip RF oscillator/transmitter – one timing capacitor for six proportional channels – programmable number of channels – regulated RF output power – external modulator bandwidth control – on-chip 4.6V regulator – up to 80 MHz carrier frequency operation.

LM1871 £5.50. LM1872 £5.50. Pair £10.50.
Data sheets 25p each.

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 WARBLE ALARM KIT

A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5-12 VDC and up to 1 amp (using 12VDC 8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker.

ONLY £4.99 P&P 67p plus VAT

NEW! 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!

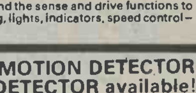
THE NEW ULN-2232A INTEGRATED MOTION DETECTOR
The most SOPHISTICATED MOTION DETECTOR available!

- 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!!

THE INCREDIBLE NEW MUSIC MACHINE KIT!
ONLY £9.95 plus 65p p&p, and VAT
As featured in BYTE, July ,79

Based on the new GI Tunes Synthesiser chip AY-3-1350, with 25 different popular and classical tunes PLUS 3 different chimes! Use it for a musical door bell (up to 4 doors!), mobile horn, toy or music box. Super easy to build, tunes include STAR WARS, BEETHOVEN'S 5TH and 9TH, JINGLE BELLS, YANKEE DOODLE, CLEMENTINE, GOD SAVE THE QUEEN WESTMINSTER CHIME and DESCENDING OCTAVE CHIMES – plus MANY, MANY MORE! Envelope control gives piano or organ quality AND you can play all the tunes in a Sequence! Works from 12V AC or DC or from mains via 240V transformer (not supplied).



Ordering Information. Unless otherwise stated, for orders under £50 add 50p p&p. Add 15% VAT to total. All devices are brand new, factory prime and full spec and subject to prior sale and availability. Prices subject to change without notice. Minimum telephone order using ACCESS is £10. If ordering by post with ACCESS, include name, address and card no. written clearly.

Micro Circuits

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

SALE SAVE-SAVE-SALE SA

GERM. DIODES

200 Mixed Diodes – mainly Germ OA81-91-1N34/60 GC61/62, etc. Case DO-7. Coded and uncoded – You to test – Value all the way! O/No. SJ127.

£1.00 per Pak.

SIL. DIODES

200 Mixed Diodes – mainly SILICON case DO-7 OA200/202. General purpose 200mA marked and uncoded – you to sort and test – Outstanding Value! O/No. SJ128.

£1.00 per Pak.

AUDIO AMPLIFIER

5 watt Audio Amplifier Module.

Special Clearance offer

O/No. AL20. £2.50

HEADPHONES

NEW Improved Lightweight Stereo Headphones including double headband and padded earcups – Impedance 8ohms – Frequency 30-18000HZ ALL Black O/No. 885. £4.00

As above but with coiled lead and rotary volume controls O/No. 884. £7.00

HEADPHONE ACCESSORIES

7 metre Headphone Extension Lead O/No. 136. £1.50

HEADPHONE JUNCTION BOX

Gives facility for using Stereo Headphones with amplifiers and radiogrammes which do not have a head phone outlet. TO CLEAR! O/No. 881. £1.20 each

ANTEX

Antex X25 Iron – 25watt soldering iron. OUR SUPER SALE PRICE Great reduction. O/No. 1931. £4.00

ST3 Iron Stand – Suitable for above – OUR Sale Price O/No. 1939. £1.25 each.

METERS

23mm Level Meter Special Sale Price O/No. 1320. **£1.00**

40mm V.U. Meter OUR SPECIAL PRICE O/No. 1321. **£1.50**

PLUGS & SOCKETS

Set of 4 1-metre Colour coiled leads with phono plug ends – ideal for audio and test use. Outstanding Value O/No. SJ122. £1.00 per Pak

1mm Plugs and Sockets in Red and Black. O/No. SJ123. 5 pairs £1.00

CAPACITORS

SJ11. 150 Capacitors mixed types and values	£0.50
SJ12. 60 Electrolytics all sorts mixed	£0.50
SJ13. 40 Polyester/polystyrene capacitors mixed	£0.50
SJ14. 50 C280 type capacitors mixed	£1.00
SJ15. 40 High quality electrolitics 100-470mfd.	£1.00
SJ16. 40 Low volts electrolitics mixed values up to 10v.	10.50

TRANSFORMERS

MINIATURE MAINS Primary 240v.

No.	Secondary	
2021.	6v-0-6v 100mA	£0.75
2022.	9v-0-9v 100mA	£0.75
2023.	12v-0-12v 100mA	£0.95
2035.	240v Primary 0-55v 2A Secondary	£5.50

BC108 FALLOUTS

Manufacturers out of spec on volts or gain or neither – Metal To18 case – You test. O/No. SJ124.

50 for £1.00

DIODES

300 IN4148 Type – uncoded Silicon Diodes Case Do-35 – you to test. O/No. SJ 129. £1.00 per Pak.

Silicon Fast Switch

NPN – like 2N706/2N2369 You select by test! O/No. SJ125. 50 for £1.00

GERM. TRANSISTORS

The last of the Germanium PNP – OC71-71-75 etc. Mullard Black/Glass Type – You test (5 could cost you that!) O/No. SJ126. 50 pcs £1.00

GERM. POWER TRANS.

AD149-OC26-AD140	£0.50 each
AD142-OC28-2N3614	£0.65 each

VERO PLASTIC CASE

Complete with lid and fixing screws. Finished white. Size: 72mm x 50mm x 25mm.

O/No. 173. **£0.35 each.**

NPN

BD131 TO-126-NPN untested. O/No. SJ84. 25 for £1.00

SCR's

TO66 SCR's 5 Amp – ALL GOOD – untested for volt – good yield 400 plus O/No. SJ130. 10 for £1.

AERIALS

FM Indoor Tape/Ribbon Aerial O/No. 107. 40p each

HI-FI CAR AERIAL

4-section fully retractable and locking SPECIAL PRICE O/No. 109. £1.40 each

STEREO 30

Complete 7 watt per channel Stereo Amplifier Board – includes amps, pre-amp, power supply, front panel, knobs, etc. PLUS transformer and real Teak Cabinet for that professional finish!

SPECIAL SALE PRICE

SAVING £5!

OUR PRICE £25.00

IC SOCKET PAKS

SJ36	14 8 pin	SJ41	6 22 pin	
SJ37	12 14 pin	SJ42	5 24 pin	
SJ38	11 16 pin	SJ43	4 28 pin	
SJ39	8 18 pin	SJ44	3 40 pin	
SJ40	7 20 pin			

ALL AT ONLY £1.00 each

VOLTAGE REGULATORS

Cast TO220

Positive		Negative	
uA7805	£0.65	uA7905	£0.70
uA7812	£0.65	uA7912	£0.70
uA7815	£0.65	uA7915	£0.70
uA7818	£0.65	uA7918	£0.70
uA7824	£0.65	uA7924	£0.70

TEXAS NPN

Texas NPN silicon transistors metal can – perfect and coded. 2S503 equals BC108 TO-18. O/No. SJ29. 50 off £2.50 100 off £4.00. 1,000 off £35.00

AUDIO ACCESSORIES

SJ75. FM coax cable – plain copper conduction cellular polythene insulated and plain copper braided PVC sheath – impedance 75ohms £0.10 per metre

SJ76. 1 Board containing 2 x 5 pin DIN sockets 180° 02-2 pin DIN loudspeaker sockets £0.30

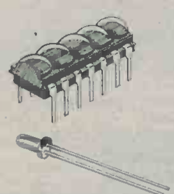
SJ77. A 5-pin DIN 180° chassis/normal socket incl. DPDT switch £0.20

DISC CERAMIC CAP

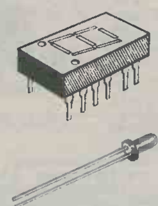
100 Disc Ceramic CAP. Mixed values covering complete range 3PF – 4,700PF. SUPER VALUE

O/No. SJ121. £1.00

BI-PAK'S OPTO BARGAIN OF THE YEAR!



Value at over £10. – Normal Retail – we offer you a pack of 25 Opto devices to include LED's Large and Small in Red, Green, Yellow and Clear. 7 Segment Displays both Common Cathode and Common Anode PLUS bubble type displays – like DL-33. Photo Transistors – similar to OCP71 and Photo Detectors – like MEL11-12. This whole pack of 25 devices will cost you just . . . **£4.00!**



AND we guarantee your money back if you are not completely satisfied.

Full data etc included

O/No. SJ120.

SWITCHES

Push-to-make. 6mm panel mounting.

O/No. SJ131. 5 for £0.50

Push-to-break as above

O/No. SJ132. 4 for £0.50

SILICON TRANS.

SJ25. 100 Silicon NPN transistors all perfect and coded – mixed types with data and equivalent sheet – no rejects £2.50

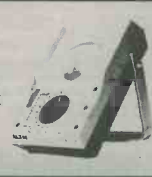
SJ26. 100 Silicon PNP transistors all perfect and coded – mixed types and cases, data and equivalent sheet £2.50

SJ27. 50 Assorted pieces of SCR's, diodes and rectifiers incl. stud types, all perfect – no rejects, fully coded – data incl. £2.50

PRECISION VOM MULTITESTER

20,000ohms/volts DC. Complete with test leads and Instructions. OUR SPECIAL OFFER PRICE

0/No. 1323 £11.00 each. Use your Barclay or Acess Card!



LED

2nd Quality Packs

1507. 10 Assorted colours and sizes	£0.65
S122. 10.125 RED.	£0.50
S123. 10.2 RED.	£0.50

LED CLIPS

1508/125 .125.	5 for £0.10
1508/2 .2.	5 for £0.12

TTL'S

SJ28. 20 TTL74 series gates – assorted 7401 – 7460 £1.00

SJ53. Mammoth IC Pak – Approx 200 pcs assorted fall-out integrated circuits including logic 74 series – Linear – audio and DTL many coded devices but some unmarked – you to identify £1.00

NPN TRANSISTORS

SJ68. 30 ZTX300 type transistors NPN pre-formed for P/C Board colour coded Blue – all perfect £1.00

SJ70. 25 BC107 NPN TO106 case perfect transistors code Green spot £1.00

SJ71. 25 BC177 PNP TO106 case perfect transistors code C1395 £1.00

SJ72. 4 2N3055 silicon power NPN transistors TO3 £1.00

MISCELLANEOUS

SJ20. 2 Large croc clips 25A rated – ideal for battery chargers, etc. £0.30

SJ21. Large 7½" Mains Neon Tester – screwdriver chrome finish £0.85

SJ22. Small pocket size Mains Neon Tester screwdriver. £0.55

SJ23. Siemens 220v AC relay DPDT contacts 10 amp rating – housed in plastic case £1.00

SJ24. Black PVC tape (⁵/₈) 15mm x 25m – strong tape for electrical and household use. £0.35 per roll

RESISTORS

SJ1. 200 Resistors mixed values	£0.50
SJ2. 200 Carbon resistors ⅛-¼ watt pre-formed	£0.50
SJ3. 100 ⅛ watt miniature resistors mixed values	£0.50
SJ4. 60 ½ watt resistors mixed values	£0.50
SJ5. 50 1-2 watt resistors mixed pot values	£0.50
SJ7. 30 2 10 watt wirewound resistors mixed	£0.50

POTENTIOMETERS

16173. 15 Assorted Pots	£0.50
SJ54. 20 Assorted Slider Pots.	£1.00
SJ56. 10 100K Lin Slider Pots 40mm.	£0.50
16186. 25 Pre-sets Assorted	£0.50
SJ49. 8 Dual gang carbon pots log and lin mixed values.	£1.00
SJ50. 20 Assorted slider knobs – chrome/black.	£1.00

ODDMENTS

16170. 50 metres asst. colours single strand wire £0.50

16187. 30 metres stranded wire mixed colours £0.50

16178. 5 Main slider switches assorted. £0.50

SJ76. 1 Board contaning 2 x 5-pin. DIN sockets 180 and 2 x 2-pin. DIN Loudspeaker sockets. £0.30

CASSETTES

SUPER VALUE and a GREAT SAVING !!! C120 Dindy Cassettes – Low noise – astounding value and sound. O/No. SJ32. 10 for £3.50

METAL SLIDERS

Metal Case Dual Slider Pots: 45mm travel

SJ65. 10K log	£0.25 each
SJ66. 100K lin	£0.25 each
SJ67. Chrome slider knobs to fit	£0.10 each

KNOBS

SJ62. 5 15mm chrome knobs standard push fit £0.50

SJ63. Instrument knob – black winged (29 x 20mm) with pointer. ¼" standard screw fit. £0.15

SJ64. Instrument knob – black/silver aluminium top (17 x 15mm). ¼" standard screw fit. £0.12

BI-PAK

Send your orders to Dept RC8, BI-PAK PO BOX 6 WARE HERTS.
SHOP AT: 3 BALDOCK ST. WARE HERTS.
TERMS: CASH WITH ORDER, SAME DAY DESPATCH, ACCESS, BARCLAYCARD ALSO ACCEPTED. TEL: (0920) 3182. GIRO 388 7006
ADD 15% VAT AND 50p PER ORDER POSTAGE AND PACKING

Complete Audio/Tuner Kits

Mk III FM Tuner series

Carriage for Mk III tuner £3 inc

•The Mark III series FM tuner has been updated, and now includes a centre zero tuning meter as standard. The instruction manual has been meticulously revised, enabling easy assembly by constructors of various levels of experience - a preview copy may be purchased for £1.00.

Mark III A series 'Reference series' tuner modules ....£171.35 inc.
Mark III B series 'Hyperfi' modules, with switched IF BW, pilot cancel decoder ....£198.95 inc.

A matching synthesiser unit will be made available later this year, and can be retrofitted to either version. All versions include digital frequency readout/clock, VU deviation meters, 6 preset stations, 10 turn pot manual tuning, toroidal PSU, output level adjustment, 110/240v AC input. Full alignment service available.

Power Amplifier

Style and performance - with a real 'belt and braces' PSU design.

After a couple of preview comments, it seems that many of you are waiting to hear about the matching HMOSFET power amplifier for the Mk III tuner. Well, it's out at last - complete with twin toroidal PSUs for comfortable 80W RMS per channel, over 100W peak, but limited by thermal shutdown of the HMOS. 10W-100W log LED output peak indicator, DC offset protection and switch-on pause relay. AC or DC input coupling, direct or relay protected output terminals. The works.
Only one version of this item: Complete kit ....£178.25 inc. Carr. £5.

Preamplifier

More features and facilities, thanks to DC switching and control design

Previewing the most comprehensive audio preamplifier yet...... DC switching of 7 inputs, plus two tape in/outs. 2 low pass, 2 high pass active filters, genuine volume related loudness, 1dB channel matching, with DC volume, balance, bass and treble controls. Suitable for bus/remote control, tape dubbing, switched monitor etc. 80dB S/N+, THD -75dB or better. Pluggable PU equalization boards, tone control override. Price for complete unit about £149 ex VAT.

Radio/Audio/Communications Modules

LW-MW-SW-SW DC tuned and switched

91072- All switching of bands by a single pin to gnd. Varicap tuned, with LO output for synth. MW/LW version or MW/LW plus 1 or 2 SW bands MW/LW: £15.58 or +1SW £16.73

VHF Tunerheads

Europes largest stock range for broadcast and communications. Probably also the world's — details in the catalogues and PL. Specials are also supplied in the region 30-220MHz.

Pilot Cancel PLL Stereo decoders

Again, Europe's widest range of stereo decoders including pilot cancel PLL types. The pic shows the 944378 - pilot cancel including post decoder 26/38kHz filtering and muting preamp output

944378-2 £26.45

Switched bandwidth FM IF strips

Broadcast FM IF strips for all occasions, including the new 911225 - with diode switched narrow filter option, ultra linear phase ceramic filters, 84dB S/N, and 0.04% THD (40kHz deviation). Plus usual things like AGC, AFC, dev. mute, level meter drive. £23.95 (supplied in screen can with 0.1 edge connection system) Also the 7230 hyperfi series - as the 911225, but with slope controlled AFC that operates in conjunction with signal level - and an extra IF amp stage for DXing.

Various digital frequency displays

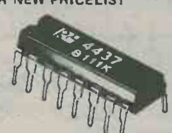
The World's largest range of receiver DFMs is now joined by the DFM7 (shown) - and L shaped version of the DFM3 with remote display mount connector possibility. 1kHz SW resolution with 455kHz or 10.7MHz offsets, 100Hz res up to 3.9999MHz, and VHF to 299.99 MHz in 10kHz steps : £41.75

Semiconductors

Radio/Communications ICs

FOR COMPLETE LISTINGS — SEE OUR NEW PRICELIST

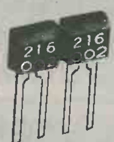
CA3089E	2.11	HA1197	1.61	SD6000	4.31
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38
HA11225	2.47	TBA651	2.53	MC1350P	1.38
HA12412	2.81	TDA1090	3.51	KB4412	2.24
KB4420	1.95	TDA1220	1.61	KB4413	2.24
TBA120S	1.15	TDA1083	2.24	KB4417	2.53
KB4406	0.80	TDA1062	2.24	MC3357P	3.16



SL1610	1.84	SL1626	2.80
SL1611	1.84	SL1630	1.86
SL1612	1.84	SL1640	2.17
SL1613	2.17	SL1641	2.17
SL1620	2.50	SL6600	4.31
SL1623	2.80	SL6640	3.16
SL1624	3.77	SL6690	3.68
SL1625	2.50	MC1496	1.44

VARICAP DIODES........
A section from our PL:

BA102	0.35	16:1 ratio AM tuning	
BB204	0.41	KV1215 9v triple	2.93
BB105	0.41	KV1211 9v dual	2.01
BB109	0.31	KV1225 25v triple	3.16
MVAM2	1.93	BB212 9v dual	2.25



POWER MOSFETS

100W PA's made simple

Since pioneering the 100W complementary MOSFET technique - Hitachi have developed a range of output devices and drivers that ought to revolutionise opinions and attitudes towards the design of all LF amplification systems. We have a new 48 page application note (£1.50 inc) and complete sets of parts, modules and now the new complete PA system (see above).

2SK133	120v N-ch 100W MOSFET	£6.33	2SJ48 Pch complement	£6.33
2SK135	160v N-ch 100W MOSFET	£7.29	2SJ50 Pch complement	£7.39
PA101B	Kit for 100W MOSFET PA less Heatsink £16.10. (£23 inc heatsink/bkt)			

ULTRA LOW NOISE PU PREAMPLIFIER

The HA12017 is the last word in PU preamps, and general low noise audio design. It is an SIL IC, with 86dB S/N in RIAA configuration, 10v RMS output capability, 0.002% typ THD at 10v RMS output (imagine the overload margin !!). It comfortably supercedes discrete circuit designs in terms of price/performance, and takes the art beyond the TDA1042's capabilities. (Replaces HA1457) £1.80 each - or an RIAA applications PCB with two ICs for £5.75. Complete with Rs&Cs £9.95.

Radio Control ICs

We have various RC ICs, including NE544 NE5044, and two new ones from OKI

KB4445 - 4 channel dig.prop. FM TX IC. 30mW out (amplifyable) -£2.30 inc
KB4446 - 4/5 ch. dig. prop FM RX IC. Suits KB4445 or RCME syst. £2.65.
KB4445/6 pair: £4.75. New 8 page data sheet 35p + SAE. More RC ICs in list

CMOS, LPSNTTL, TTL, MPU: Listings in the new pricelist.

Most CMOS is available in low volume - also LPSN. Standard linears and TTL OK.

Things like ICM7216B, ICL8038, 8080A, 6800P, 2708, NE555,NE556, etc

Coming Soon..........

Contain yourselves, RF fans ! Not yet ready for a full launch until autumn, but previewed here:-

SSB transceiver system : 10kHz to 1000MHz !!

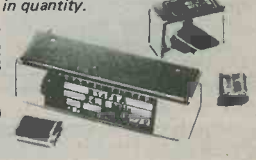
A modular VLF to UHF SSB TX/RX system at last. With the correct first mixer, the basic PCB covers 10kHz to 1000MHz - using LO fed from ext. source (Our 2 IC Mullard synth for instance) and RF PA for TX OP. 0.2uV basic sensitivity in HF, Typ cost for HF synth SSB RX will be less than £200. Add an RF PA for full TRX for another £50. See one in our foyer, and marvel.

Components

Crystal Filters

Most popular types are available ex-stock, and in quantity.

10.7MHz	25kHz Channel spacing 8pole	£16.67
	12½kHz ..	£17.82
	2.4kHz SSB	£19.78
	Monolithic dual roofing filter	£2.30
34.5MHz	1.3dB loss, 80dB stopband HF first filter in synth. RX	£36.80
RC XTALS	FM pairs (no spilts)	£3.74
	AM pairs ..	£3.57
USB/LSB	Xtals for 10.7SSB filter	£2.88 ea



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The most efficient warning sounders yet

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SCM81101 : 17p, KT5 : 16p - or 29p/pair

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CM172: 13mm, 12hr, alarms,timer etc £14.32 each
CM174: 13mm, 12hr, min/sec stopwatch £14.32 ea
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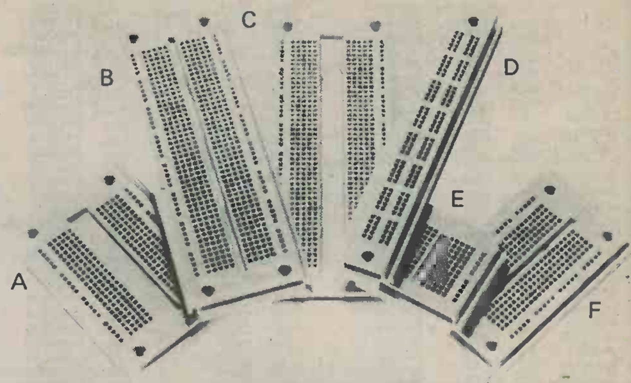

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Various voltages up to 500v
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5K, 6K8, 8K2 PFD, .01, .015, .022, .03, .033, .04, .047 MFD at 2½p
.05, .068, .1 MFD at 5p
.15, .2, .22, .33, .47, .68, 1, MFD at 8p

PLASTIC/POLY CAPACITORS

Various voltages up to 500v
4.7, 12, 15, 18, 22, 24, 27, 33, 39, 47, 50, 56, 82, 100, 120, 150, 180, 200, 220, 250, 280, 330, 375, 390, 400, 470, 500, 560, 680, 750, 820 PFD at 3p
1, 1.3, 1.5, 1.8, 2, 2.2, 2.5, 2.7, 3, 3.3, 3.9, 4.7, 5, 5.6, 6.8, 7.5, 8.2 NF. .01, .013, .015, .02, .022, .03, .033, .047, .05, .056, .061, .066, .068, .069, .075, .08, .1MFD. All at 2p
.12, .13, .15, .2, .22, .25, .27 MFD. All at 5p
.3, .33, .47 MFD. All at 5½p
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5K6, 6K, 6K8, 8K2 PFD, .01 MFD at 21p
.01296, .015, .01944, .03, .033 MFD at 40p
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MINIATURE 0.1 WATT PRESET

HORIZONTAL

100	5p	2K2	5p	220K	5p
220	5p	4K7	5p	250K	5p
300	5p	10K	5p	270K	5p
470	5p	22K	5p	470K	5p
500	4p	47K	4p	1M	5p
1K	5p	100K	5p	3M3	5p

VERTICAL

47	5p	2K2	5p	47K	2½p
100	5p	2K5	5p	50K	2½p
150	5p	4K7	5p	68K	5p
220	5p	6K8	5p	100K	5p
470	5p	10K	5p	220K	5p
680	5p	15K	5p	330K	5p
1K	5p	22K	5p	470K	5p
				1M	5p

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10CΩ, 1k2, 9k1
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BA145	2½p	OA79	11p
BA148	12p	OA81	3½p
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BAX14	2½p	OA200	2½p
BAX54	8p	OA202	2½p
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FSY28A	40p		
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
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LT102	30	2	15p
M1	68	1	5p
MR856	600	3	24p
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SKE4G	200	6	30p
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SR400	400	1½	10p
IN3254	400	1	4p
IN4002	100	1	3½p
IN4004	400	1	4½p
IN4005	600	1	6p
IN4006	800	1	6p
IN4007	1250	1	6p
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IS138	800	½	2½p
IS921	100	½	8p
25G100	100	60	£4.35

5k1 5wT wirewound, pack of 20 85p
200Ω 5wT wirewound, pack of 5 23p

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
3½	100	B40C 3200	58p
½	60V	BC30 C350	23p
2½	350V	9F2	70p
2½	500V	9E4	85p
Miniature	Meter	Type	34p
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	600	KBS06	30p

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

BT 106 70p BT 107
BT 121 70p £1

TRIACS

Amp	Volt	Type	Price
0.1	40	7W84	3p
25	100	BTX94-100	£2.25
25	1200	BTX94-1200	£5
6	400	T2500B	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. 9v. 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.

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3 VOLT
10MFD 10p

16 VOLT
2.2MFD 9p
3.3MFD 9p
4.7MFD 10p
22MFD 9p
47MFD 18p

20 VOLT
0.22MFD 9p
47MFD 18p

25 VOLT
0.47MFD 11½p
1MFD 11½p
10MFD 9p
22MFD 18p
47MFD 22p

11½p types are mil. spec. miniature cubes

35 VOLT
0.033MFD 3½p
0.1MFD 8p
0.22MFD 6p
0.47MFD 6p
1MFD 8p
3.3MFD 12p
4.7MFD 9p

40 VOLT
0.15MFD 11½p
0.33MFD 11½p
0.47MFD 11½p
0.68MFD 11½p
1MFD 11½p
1.5MFD 11½p
2.2MFD 11½p

50 VOLT
2.2MFD 11p

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710	28p
724	20p
741 OP Amp	16p
747	44p
930DC	4p
933DC	4p
936DC	4p
937DC	4p
946DC	4p
949DC	4p
953—42300 Trip .2 Innand	4p
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963DC	4p
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74L10	25p
74H10	26p
7411	8p
5413	16p
7414	39p
7417	18p
7420	11p
74S20	50p
74S22	18p
7425	18p
7426	16p
5430	12p
7430	11p
74L30	11½p
7432	13p
54/7437	13p
7438	14p
74H40	26p
7442	26p
74LS42	40p
7445	42p
7450	11p
74H50	26p
7451	7½p
7454	11p
74L54	11½p
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74L72	25p
5473	12p
7473	17p
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7474	13p
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CD4514	£1.45
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LM326 Volt Reg.	20p
LM340T6 6v Reg.	36p
LM343 Amp	4p
LM1303N	65p
LM/MC1458N	19p
LM3900 Quad Op. Amp	36p
MC830P	4p
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MC846P	4p
MC862P	4p
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SLIDE POTENTIOMETERS

Dual Tandem – 60mm Track

LOG		LIN	
1K	45p	1K	45p
5K	45p	5K	29p
10K	45p	10K	45p
22K	25p	22K	25p
47K	24p	50K	29p
100K	24p	100K	45p
220K	45p	250K	22p
1M	22p	500K	45p
2M	22p	1M	45p
		2M	30p

10K Balance 24p
220K Semilog, 2 taps per track 45p
40mm track 100K Log 24p

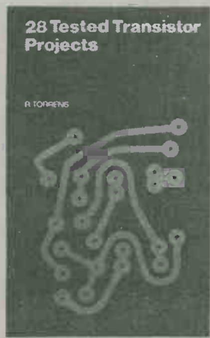
SWITCHED POTS

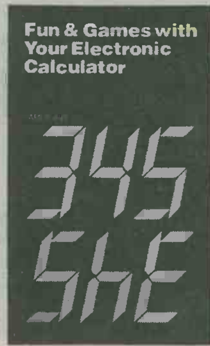
¼" Diam. Spindle

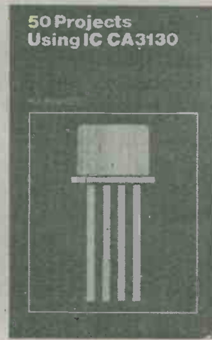
LOG		LIN	
4K7	25p	1K	40p
5K	10p	5K	40p
10K	40p	10K	40p
20K	26p	22K	40p
22K Tapped	26p	25K	30p
22K	26p	50K Tapped	40p
47K	25p	50K	18p
50K	12p	100K	40p
100K	40p	500K	39p
220K	40p	1M	40p
250K	12p or 23p		
470K	18p		
500K	29p		
1M	26p		
2M	24p		
2M Inv.	24p		
5M	26p		

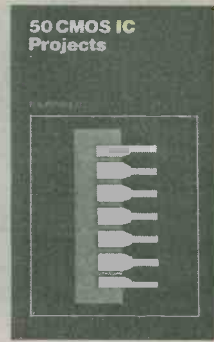
4mm Diam. Spindle

LOG		LIN	
1K	40p	500Ω	40p
2K5	40p	1K	40p
4K7	40p	2K5	40p
5K	40p	5K	40p
10K	30p	10K	40p
15K	40p	22K	19p
22K	40p	25K	19p
25K	19p	50K	18p
47K	40p	100K	40p
50K	40p	220K Tapped	40p
100K	40p	250K	17p
250K	18p	500K	17p
500K	18p	1M	17p
1M	17p		









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SUGGESTED CIRCUIT

Multi-Option Siren

By G. A. French

Electronic sound generating circuits are, of course, nothing new and are frequently encountered in security equipment for the purpose of giving an alarm. To give maximum effect the audible signal produced should be modulated in some way and it can, for instance, consist of a steady tone which is continually turned on and off. Alternatively, the audible signal may have its frequency continuously altered, and such frequency modulation is normally the most effective in catching the attention of people in the vicinity.

There can be differences of opinion concerning the modulation rate and range of a frequency modulated alarm signal, and this article describes a tone generator in which modulation rate and depth, as well as the frequency being modulated, are all capable of wide and continuous adjustment. The effects produced range from warbling notes to the rousing sound given with some American sirens. Adjustment is carried out by means of three 1MΩ potentiometers, each being in series with a 100kΩ fixed resistor. Constructors wishing to design an alarm signal generator for serious security requirements can make up the circuit to be described and set it up to give the effect they particularly favour. Each potentiometer and its series 100kΩ resistor can then be replaced by a single fixed resistor of the appropriate value.

MODULATION

The circuit employs two ICM7555 i.c.'s, one of which oscillates at an audio frequency whilst the other oscillates at a much lower frequency and modulates the frequency of the first. It is a simple matter to modulate the frequency of an ICM7555 when it is running as a multivibrator, as is made clear in Fig.1. This shows the ICM7555 connected as a standard astable multivibrator with its pins 7, 6 and 2 connected to the two external timing resistors and capacitor. During each multivibrator

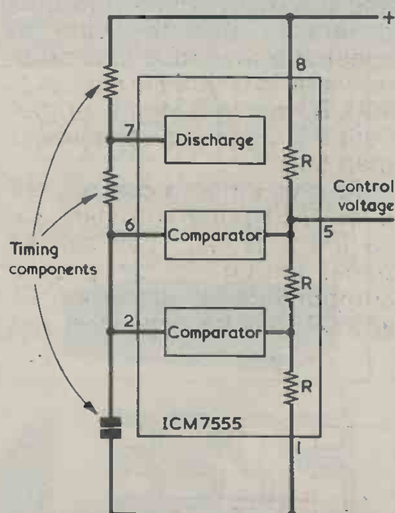


Fig.1. The internal comparators in the ICM7555 take their reference voltages from an internal potential divider. When running as an astable multivibrator, oscillator frequency can be varied by applying externally derived voltages to pin 5.

cycle the capacitor charges to two-thirds of the supply voltage and discharges to one-third of the supply voltage.

Controlling operation inside the i.c. are two voltage comparators connected to pins 6 and 2, and these obtain their reference voltages from the three equal value internal resistors designated R. The junction of the two upper resistors is taken out to pin 5, a pin that is not normally used. If this pin is taken positive by an external connection the multivibrator frequency falls because the capacitor has to charge to a voltage greater than two-thirds of the supply voltage and also has to discharge over a voltage range greater than that which previously applied. Should pin 5 be taken negative, charge and discharge times are reduced and the multivibrator frequency increases.

The full circuit of the siren is given in Fig.2, and in this diagram IC2 is the audio tone generator. The timing components are R4, R5, VR3 and C3, and frequency is adjusted by means of VR3. Assuming that the i.c. is not frequency modulated the highest frequency available is above 2kHz and is given when VR3 inserts zero resistance into circuit. The lowest frequency, produced when VR3 inserts full resistance, is below 300Hz. The output of the i.c. appears at pin 3 and drives the speaker, LS1, by way of TR1.

IC1 has a similar timing circuit with the exception that the

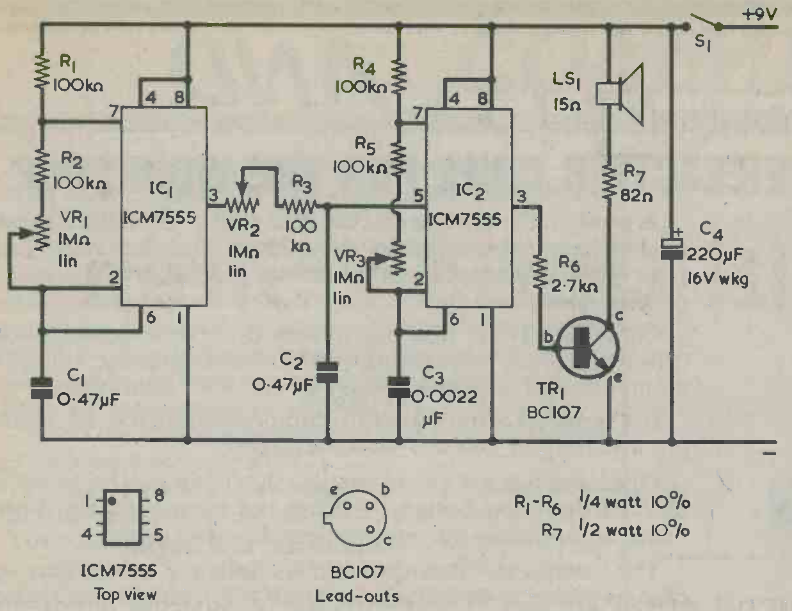


Fig.2. The circuit of the multi-option siren. VR1 provides control of modulating frequency, VR2 of modulation range and VR3 of the modulated audio frequency.

capacitor, C1, has a much higher value than has C3 in the IC2 circuit. The range of frequencies given by adjusting VR1 is from 10.3Hz to 1.4Hz. An important point with this i.c. is that VR1 is in both the charge and discharge paths for C1 so that, when it inserts resistance values above some 200kΩ, the charge and discharge periods in the multivibrator cycle are roughly comparable in length. So, similarly, are the periods when the output at pin 3 is in the high and in the low state. No connection is made to pin 5 of IC1.

The output at pin 3 of IC1 is applied via VR2 and R3, to pin 5 of IC2, and thereby modulates the frequency of the latter. The degree of modulation is smallest when VR2 inserts maximum resistance and is greatest when VR2 inserts zero resistance. Capacitor C2 smooths the voltage at pin 3 of IC1 and causes the abrupt changes of voltage at this pin to be altered to gliding voltage transitions at pin 5 of IC2.

SPEAKER CIRCUIT

As already mentioned, the a.f. output at pin 3 of IC2 is passed to TR1, which drives the loudspeaker. In the interests of battery economy, resistor R7 is inserted in series with the speaker and the prototype circuit employed a 15Ω speaker and an 82Ω resistor. The speaker produces quite a loud audible signal, which will catch the attention under normal domestic conditions. A slightly louder signal may be given if the speaker has a higher impedance and R7 a lower value, and the main criterion here is to ensure that the sum of speaker impedance and resistor value is slightly in excess of 90Ω. R7 can be a $\frac{1}{4}$ watt component if it is given a value lower than 50Ω.

To give smooth control, the three 1MΩ potentiometers are all linear types. They can be panel mounting or pre-set components, as preferred. C1 and C2 may be polyester, and C3 polyester or polystyrene. The current drawn from the 9 volt battery by the circuit of Fig.2 is approximately 40mA. The circuit may be assembled in any conventional manner and layout is not critical.

After the circuit has been completed, the effects of adjusting the three potentiometers will soon become apparent. A little experimenting here can then be carried out to find the frequency modulated tone which the constructor finds most preferable.

For some applications it will be desirable to feed the tone to an a.f. amplifier. In this instance, R6, R7, TR1 and LS1 are not required and may be omitted from the circuit. So also may C4, as the two i.c.'s on their own can run from an unbypassed 9 volt supply. The signal from IC2 is then coupled to a simple attenuator, as shown in Fig.3, which will offer an output of about 1 volt peak-to-peak for application to the amplifier. The current drawn from the supply by the two i.c.'s on their own will be about 0.2mA only.

■

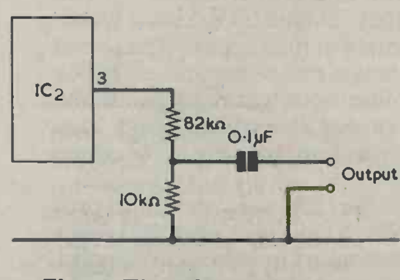
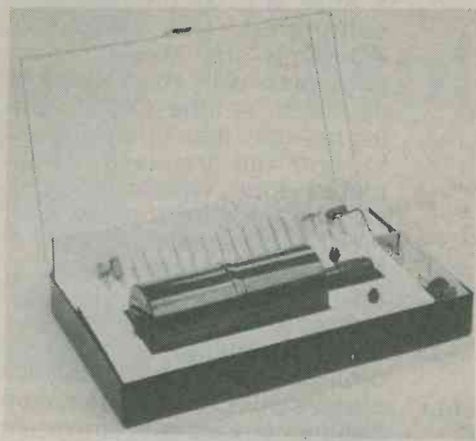


Fig.3. The siren can feed an a.f. amplifier by way of the output attenuator shown here.

NEWS ... AND

POWERFUL MINIATURE ELECTRIC DRILL FOR THE WORKSHOP



A powerful miniature electric drill with a 3mm chuck capacity has been introduced by West Hyde Developments Ltd., Unit 9 Park Street Industrial Estate, Aylesbury, Bucks, for precision work.

Called the Titan, this high quality drill has a well-balanced cylindrical body measuring just 114mm long by 44mm in diameter, and is light and easy to use with either hand.

It is supplied complete with a comprehensive tool kit, enabling a variety of tasks to be undertaken.

Operating on a 12V dc supply, the Titan can be powered direct from a car battery or from the normal mains supply using an optional, purpose-designed power supply.

The complete Titan drill kit, including a useful carrying case, is priced at £19.50 excluding VAT. The optional power supply costs £13.50 excluding VAT.

'FREAK OUT AND SPACE WALK' BY SATELLITE

On Saturday 7 June viewers to BBC 2 were able to watch a live transmission from Glencoe in Scotland that followed the progress of two teams of climbers up two perilous rock climbs called 'Freak Out' and 'Space Walk'. It certainly made thrilling television but the broadcast could lay claim to other links with space because BBC engineers used it for an experimental comparison between a satellite vision link, hired from Ferranti, and a conventional ground-based network.

Glencoe is far away from any existing permanent radio-link collection points and to get the signals to the Television Centre in London needed a seven-hop link using no less than six BBC link vans perched on hilltops right across Scotland. This carried the signal back to the BBC's Kirk o'Shotts station between Glasgow and Edinburgh where it was fed into the permanent vision contribution network to London.

By way of comparison the signals were also sent directly from the BBC Colour Mobile Control Room in Glencoe to the OTS satellite 22,300 miles above the equator. From there they travelled directly back to the Ferranti ground station in Poynton, Manchester, then to the BBC's Broadcasting House in Manchester by ground-based radio link and thence into the contribution circuits to London.

The transportable satellite up-link at Glencoe was completed ahead of schedule by Ferranti to meet the programme deadline. The up-link used a 250 watt travelling-wave-tube amplifier in the 14GHz band. The down-link, from the Orbital Test Satellite (OTS), was in the 11GHz band and both ground stations used a 3 metre dish. The quality of the two signals compared very well and the comparisons made at Manchester and London provided just the kind of information that will be needed to plan future satellite OB links.

BBC 2 viewers saw only the signals from the ground-based network. On this occasion the satellite circuit was simply used for comparison purposes.

BARBARA WINDSOR USES R/C DEVICE IN TV SERIES

A device intended to protect radio-controlled models from unwanted interference, the PP1M 4CH 'Fail-safe' made by Chromatronics of Coachworks House, Harlow, Essex, played a key part in a scene from Southern Television's highly successful 'Worzel Gummidge' series, in which Saucy Nancy, played by Barbara Windsor, appeared to zoom through the streets at high speed. The secret of Saucy Nancy's 'magic' propulsion was a radio-controlled trolley concealed under Miss Windsor's voluminous garments, and the 'Fail-safe' device was designed to prevent the trolley (and Miss Windsor) from careering out of control in the event of some unforeseen interference.

Chromatronics originally developed the 'Fail-safe' device to protect radio-controlled model aircraft, which can fly at over 100 miles per hour, weigh up to 25 pounds and cost many hundreds of pounds, from the potentially catastrophic accidents that can occur in the event of fading or interference of the type caused by illegal Citizens' Band transmissions. In operation, it stops the control 'servos' from going berserk if normal radio control is disturbed.

. . . COMMENT

With this issue a great new series commences – The INStructor, written by our well-known contributor Ian Sinclair.

The INStructor is a low cost assembly which provides a practical introduction to microprocessors and what microprocessors do. It is not a computer, but it is a working circuit which allows microprocessor working to be followed, one program step at a time. Its name is derived from the microprocessor i.c. used, the National Semiconductor INS8060.

Build the INStructor and you will gain invaluable microprocessor experience.

Newer readers of this magazine may like to know that Ian Sinclair wrote an important 9 part series – 'Tune-In To Programs' which guided readers through programming using nothing more complicated than a readily available programmable calculator. The back numbers containing the articles are still obtainable from our sales department.

NEW RANGE OF SOLDERING IRONS

S & R Brewster Ltd, of 86-88 Union Street, Plymouth have announced the introduction of two new large soldering irons under the Model number K.

The K500 TC, is a 500 watt temperature controlled soldering iron having a 1¼ inch diameter tip and is ideal for all the largest work considered possible for use with an electric soldering iron, it is probably the largest and most powerful electric soldering iron on the market at present and is ideal for things like car radiators, large commutator terminals on motors, tin plate work, and all other items requiring a large amount of heat.

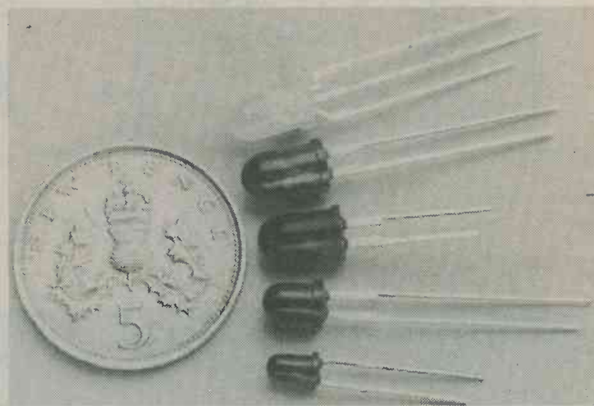
Priced at £22.00 ex works, it is an ideal easy to use replacement for the old fashioned iron in the fire type of soldering iron.

The K200 is a non controlled version of the above iron and is suitable where similar work is done but the extra facility of a stable temperature is not required.

The K200 is priced at £18.00 ex works, and is distinguishable from the K500 by the fact that the K500 has a blue handle and the K200 has a brown handle.

Both irons are available in both 240 volts and 110 volts, so covering most uses.

THE SHARP RANGE OF L.E.D. LAMPS



The range of L.E.D. Visible Lamps manufactured by SHARP Corporation covers three sizes – 3mm, 4mm and 5mm diameter.

Three colours are available – red, green and yellow – and the range covers 'Normal' and low power devices plus high luminosity versions.

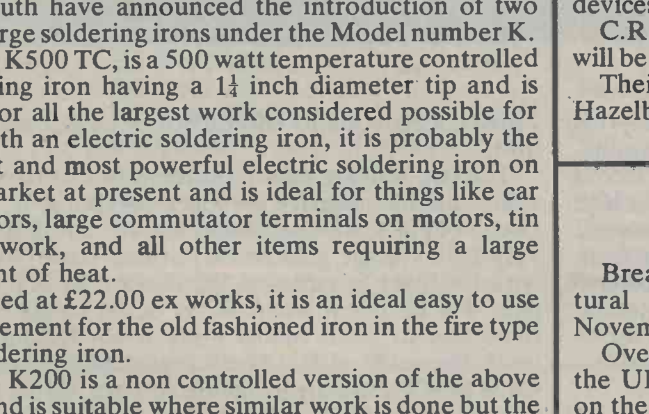
C.R.P. Electronics will carry extensive stocks and will be offering the devices at very competitive prices.

Their address is – C.R.P. Electronics Ltd, 13 Hazelbury Crescent, Luton LU1 1DF.

BREADBOARD '80

Breadboard '80 will be held at the Royal Horticultural Halls, London SW1 from 26th – 30th November.

Over 11,000 hobbyists and dealers from all over the UK attended Breadboard '79. Capacity crowds on the Saturday necessitated the closure of the show for a time in order that numbers could be controlled. To overcome this problem and at the request of exhibitors and visitors Breadboard '80 will have one late night (Thursday, November 27) and a Sunday opening this year, providing more time and opportunity for electronics enthusiasts to visit the show and select and buy their 'kits and bits'.



"Have you a pocket calculator that calculates what people have in their pockets?"

Remote Volume Attenuator

By
T. K. Wong

D.C. switching circuit attenuates both stereo channels.

The unit described here provides the facility for remotely reducing the volume of an audio reproduction system, be it a radio, tape recorder or stereo amplifier. The prototype was designed for use with an f.m. tuner so that programme material which was not to the author's taste could be reduced in volume from the usual listening position. It was particularly intended to lower the volume during commercial breaks, a feature which readers who listen a lot to commercial stations will also agree is a desirable one.

CIRCUIT DESIGN

There were five basic requirements to be satisfied before the practical circuit was designed. First, there should be a high input impedance to prevent loading of the signal source. Second, the output should be at low impedance so that it could feed a range of amplifier input impedances without problems. Third, the circuit should have a normal voltage gain of around unity, this reducing by about 20dB (a ratio of 10:1) when the volume is reduced. Fourth, the method of reducing the volume should be by a purely d.c. signal, thereby ensuring that there would be no hum pick-up problems with the leads passing to the remote switch. Finally, signal quality should not be degraded by the unit.

The two voltage gain requirements can be met by using suitable negative feedback components. In the circuit of Fig.1, which assumes that the amplifier has a very high voltage gain and input resistance, the gain with feedback is equal to R2 divided by R1. Unity gain will be given when R2 is equal to R1, and a reduction to 20dB below unity when R2 has one-tenth the value of R1. Some means of changing the value of R2 remotely by means of a d.c. signal had to be devised, and the requisite switching could be carried out with a relay, a bipolar transistor, an f.e.t. or a diode. The author chose the diode method, which in practice performs extremely well.

The unit is intended for stereo systems and the working circuit of one of the channels is given in Fig.2. Amplification is provided by TR1, whose operating point is set up by R2, R3 and R4. If diode D1 is ignored, negative feedback is controlled by R2 and R1, which perform the same functions as did the similarly identified resistors in Fig.1. In Fig.2, however, the single transistor does not have the high gain and input resistance associated with the amplifier of Fig.1, and the values of the two resistors are chosen to

Fig.1. Typical operational amplifier circuit with negative feedback. Voltage gain is equal to R2 divided by R1.

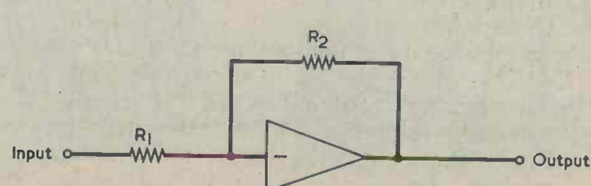
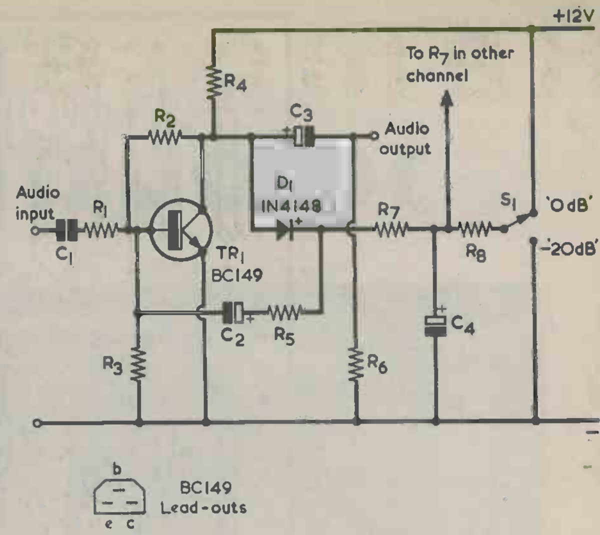


Fig.2. The circuit of one channel of the volume attenuator. S1 is the remote switch. R8, C4 and the switch are common to both channels.



COMPONENTS

Resistors
(All ¼ watt 5%)
R1 2-off 120kΩ
R2 2-off 150kΩ
R3 2-off 47kΩ
R4 2-off 2.2kΩ
R5 2-off 15kΩ
R6 2-off 150kΩ
R7 2-off 22kΩ
R8 3.3kΩ

Semiconductors
TR1 2-off BC149
D1 2-off 1N4148

Capacitors
C1 2-off 0.22μF polyester.
C2 2-off 2.2μF electrolytic, 16 V. Wkg.
C3 2-off 4.7μF electrolytic, 16 V. Wkg.
C4 220μF electrolytic, 16 V. Wkg.

Switch
S1 s.p.d.t. slide

Miscellaneous
3-core cable
Perforated board (see text)
Solder, wire, etc.

give an approximate gain of unity under practical conditions. When D1 is brought into consideration it can be seen that it has no effect when the remote switch, S1, couples R8 to the positive rail. This is because the collector of TR1 is negative of the positive rail and the diode is reverse biased. Setting S1 to connect R8 to the negative rail causes the diode to be forward biased, whereupon current flows through R4, the diode, R7 and R8. The forward biased diode brings a second feedback loop into circuit, the feedback components being R5 and C2. Since the value of R5 is one-tenth of the value of R2, the voltage gain provided by the transistor falls to approximately one-tenth of its previous value.

A problem with this circuit arrangement is that of switching thumps when the remote switch is operated. The thumps have been reduced significantly in amplitude by slowing down the switching action with R8 and C4. This causes the audio signal to be distorted for a very short period when the circuit switches from one level to the other, but this effect is considered to be slight when the advantage of being free from loud and hard selling commercials and pop jingles is considered. Switching thumps could, incidentally, be reduced by adjusting the value of C3 so as to roll off the low frequency response at the input of the following amplifier. Normally, this will mean reducing the value of C3.

The input impedance of the unit is about 120kΩ, and it is intended to work with tuner output voltages of 0.5 volt r.m.s. or less. It can handle 1 volt r.m.s. signals with less than 0.1% distortion at 1 kHz, and there are no noise problems.

CONSTRUCTION

The circuit can be constructed in any of the usual forms and its layout is not particularly critical. The author assembled the two stereo channels on a piece of plain perforated board of 0.1in. matrix having 18 by 20 holes. This is shown in Fig.3. The small size of the board will make it possible for it to be fitted inside many tuners. A 12 volt supply with negative chassis connection is required, and this may be already available in some tuners. The current consumption of the

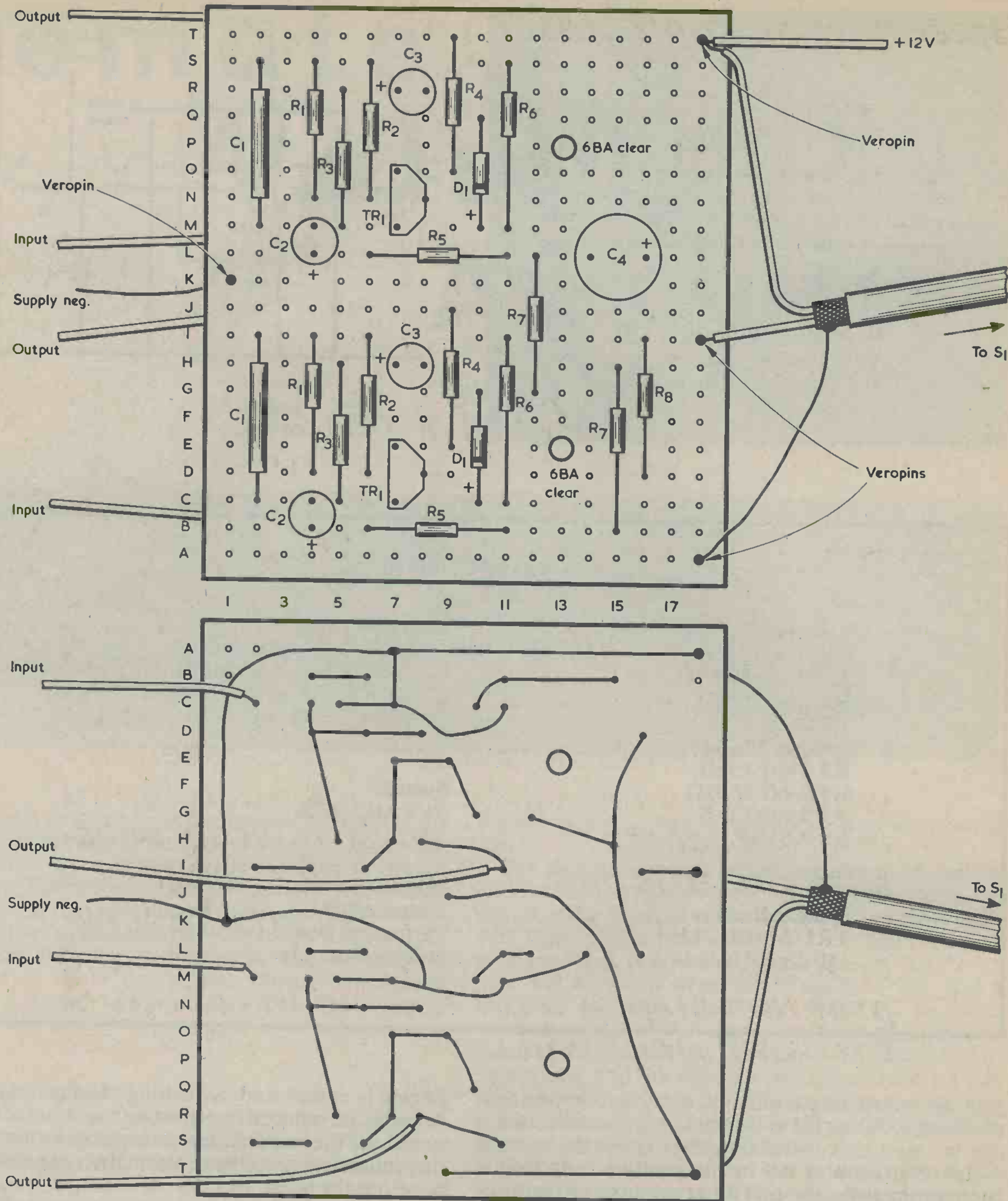


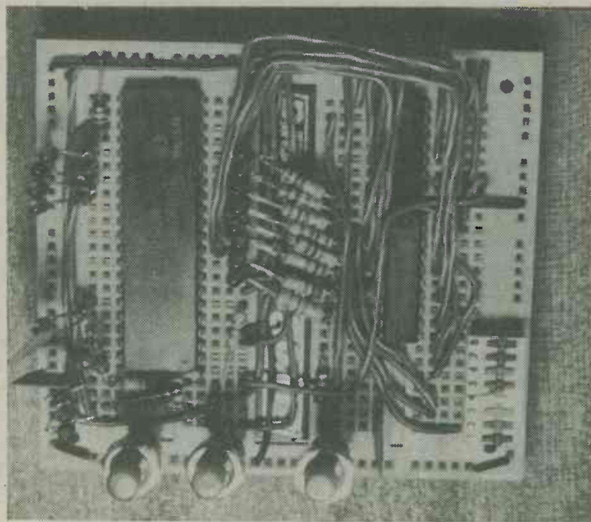
Fig.3. A suitable layout for the volume attenuator unit, employing perforated board. Take care to connect S1 correctly at the remote position; an incorrect connection can cause the 12 volt supply to be short-circuited.

unit is quite small, being about 7mA. The attenuator circuit could be connected into the tuner by inserting it between the tuner output and the output socket. If the tuner has a 5 pin DIN output socket, the unused two pins and the chassis connection could take the connections to the remote switch. Alternatively the switch lead can be soldered to pins on the perforated board, as in Fig.3, and the switch lead taken out through a hole in the tuner rear panel.

A slide switch mounted in a small plastic case is employed for S1, and its positions are appropriately marked "OdB2" and "–20dB". Any available 3-core cable can be used for the interconnection, and the author employed thin 2-core screened cable with the braiding connecting to the negative rail. This cable can conveniently be hidden under the carpet or run along the skirting board to the usual listening position. ■

Great new microprocessor series . . .

The INStructor



A PRACTICAL INTRODUCTION TO MICROPROCESSORS

Part 1
By
Ian Sinclair

The INStructor is a low cost assembly which provides a practical introduction to microprocessors and what microprocessors do. It is not a computer, but it is a working circuit which allows microprocessor working to be followed, one program step at a time. Build the INStructor and you will gain microprocessor experience.

The INStructor is a practical introduction to the microprocessor, arranged so that it blows neither your pocket nor your mind. The name is derived from the microprocessor i.c. which we've used, the National Semiconductor INS8060. This is an up-to-date version of the chip which used to be called the SC/MP, but don't think that you can use one of the old SC/MP Mark I i.c.'s if you happen to have one around, because it won't do! This one is the SC/MP Mk.2, INS8060, and it can also appear under another title, ISP 8A/600N made by Signetics.

GETTING INTO MICROPROCESSORS

Up till now, getting into microprocessors has needed a fair bit of destruction of piggy-banks, plus a lot of mental determination. Quite apart from the fact that you feel a bit lost when the kit you've assembled doesn't do anything (possibly because of a faulty p.c.b.) the instruction books which come with some microprocessor development kits seem to be designed for readers who have already been through it all. This one is really different, although its obviously not intended for the raw beginner to electronics. There are only three i.c.'s, the microprocessor, a set of gates, and one buffer. At the time of writing, the INS8060 could be obtained for under £9, not cheap but not really expensive for what it is, and prices of such components are tending to fall.

It pays, incidentally, to shop around because there can be striking differences between prices of the same components at different places. You will find, if you are thoroughly bitten by the microprocessor bug, that a lot of retailers advertise a wide range of i.c.'s but can't supply them. If you are going to order a decent amount, £20 or more, then it is often useful to make use of the large stockists.

A component which was found awkward to get

Inventory of Parts

Semiconductors

1-off 74LS132
1-off 74LS240
1-off INS8060
16-off subminiature l.e.d.'s (see text)

Resistors

(All $\frac{1}{4}$ watt or less, 5%)
2-off 1kΩ
16-off 2.2kΩ
1-off 4.7kΩ
4-off 27kΩ

Capacitors

1-off 0.0068μF
2-off 0.015μF
1-off 0.1μF

Hardware

3-off push-button switches (see text)
1-off d.i.l. octal switch (see text)
Single core wire (see text)
1-off Eurobreadboard

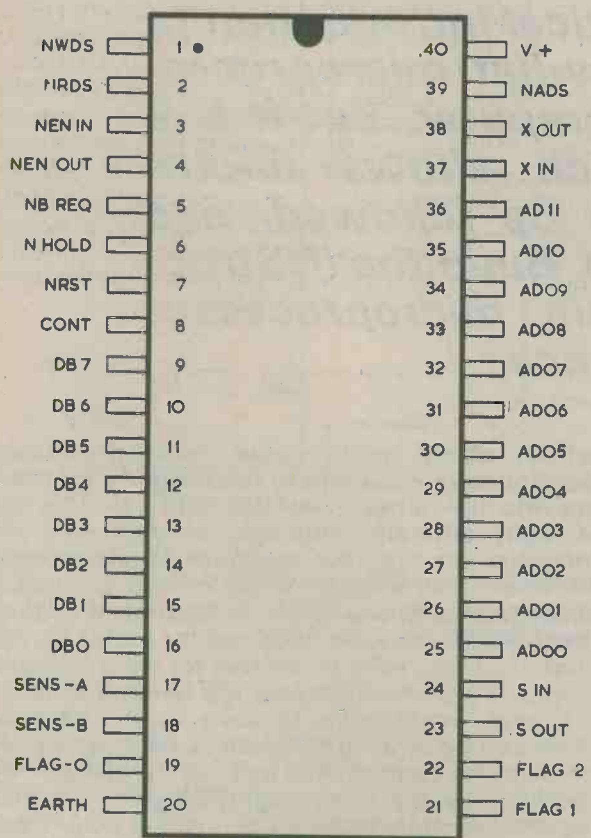


Fig.1. The pinout for the INS8060. The meaning of some of the letter symbols is explained in the text.

hold of was the 74LS240 buffer. A supplier may advertise this i.c. but not actually have any, so it can be well worth the price of a phone call to check before you part with any money. One supplier, who shall be nameless, was still unable to supply one after three month's wait.

The main item of hardware which makes it all possible is the Eurobreadboard which acts as the base for the system, and into which everything is plugged. It offers excellent value as a breadboard and has uses way beyond the present project. One of the aims of the exercise is to use, as far as possible, parts which can be resold or reused for other things later when you become an expert or, if not, settle for sticking to 1 watt amplifiers.

NOT A COMPUTER

Having got over the message that this is a low-cost introduction to a microprocessor which won't leave you with too much expensive hardware if you decide to pack it in, what's the INStructor about? Let's be quite clear about this – it isn't a computer, nor is it one of those high-price units which needs three weeks of study before you can get it to add two numbers. It's just a very simple way of finding out by practical work what a microprocessor can do. We've used the INS8060 because it's ideal for this sort of work – the old SC/MP title meant Simple low Cost-effective Microprocessor. Of all the microprocessor i.c.'s in use at present, the INS8060 offers more facilities in one package than any other; the nearest rival is the Motorola 6802. This enables the whole range of microprocessor action to be demonstrated at low speed without a huge number of supporting chips. In addition, the 8060 has a nice simple set of program instructions – simple, that is, compared to the 6800 or Z80.

The other important i.c. is a buffer. This i.c. is a form of remote-controlled switch, and it has to be used because of the way in which a microprocessor is organised. An 8-bit microprocessor deals with eight binary digits (hence bit – binary digit) at a time, a group often called a byte. Now you might think that you would need eight input pins and eight output pins to deal with this, but in fact you don't because the microprocessor is organised so that the eight bits are either coming in or going out, never both at the same time. Microprocessors therefore use only eight pins, called the data pins, to take bits in (called reading) or to deliver outputs (called writing) to or from the microprocessor. This is where the buffer comes in. In the INStructor project, we feed the data bits, in groups of eight, into the microprocessor from switches – these being contained in an octal d.i.l. switch which plugs into the Eurobreadboard. Now, these switches are set by hand, and we simply couldn't operate them as fast as the microprocessor can switch from reading inputs to writing outputs. We could therefore have the rather nasty situation where a switch was setting one of the data input pins to logic 0, and the microprocessor was busy trying to connect the same pin to logic 1, which is 5 volts positive. In a battle like this, the microprocessor *never* wins, they aren't all that cheap. The buffer i.c. sits between the switches and the microprocessor and acts to keep the two isolated until the microprocessor is reading data. At that time, a pulse

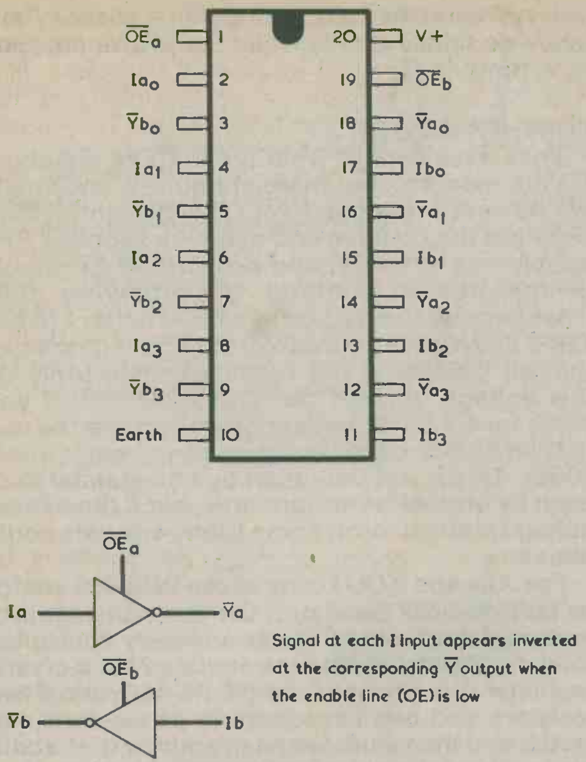


Fig.2. The pinout for the 74LS240.

from the INS8060 operates the buffer, and connects the buffer outputs to its inputs; for all the rest of the time they are kept separated.

The type of buffer we've used is an inverting buffer type 74LS240, and we'll have to explain that choice as well. The octal d.i.l. switch has eight s.p.s.t. individual switches with the numbers 1 – 8 identifying them on the switch body. Each switch closes when its operating slider is moved towards its number. Now the important thing to consider is what happens when an input to the buffer is open-circuit. For the t.t.l. buffer i.c.'s which are mostly used these days, open-circuiting an input is equivalent to connecting that input to logic 1, or 5 volts positive. This isn't a reliable method when high operating speeds are required, but is reasonable at the low speeds we'll be using here. The buffer has eight inputs and one contact of each switch is connected to one buffer input. The remaining contact of each switch connects to earth. When a switch is open, then, the buffer input to which it connects is high, at logic 1, and the buffer output, because it inverts, is low at logic 0. When the switch is closed, because its slider has been moved towards its number, the corresponding buffer input goes low and the buffer output goes high. So, switch slider moved towards the number delivers logic 1 to the microprocessor, switch slider moved away from the number delivers logic 0. From now on we shall say that when the slider is towards its number it is "up", and when it is away from its number it is "down".

USE OF SWITCH

This switch and buffer arrangement, then, is used to set the inputs to the microprocessor. The switch is going to come in for a lot of use and, because its sliders are very small, it's worth while looking for a method of operating the switch reliably without breaking fingernails. I found an old propelling pencil which fitted the hollow part of each slider perfectly; other possibilities are ball pens or tweezers. It's well worth while finding something suitable, because it will save a lot of frustrations when lots of different settings are being used one after another.

The settings of the switch form a binary number or code, with slider number 1 setting the most significant bit (bit 7, as the micro-lads call it) and slider number 8 setting the least significant bit (bit 0). The binary number which is being set is simply read in order of sliders 1 to 8 (up) or 0 (down) in each place. Reading out information also makes use of the binary code, which is the only thing that microprocessors understand. You'll find microprocessor kits with hexadecimal (scale of 16) keyboards, but these include circuits or programs which convert each key action into binary and convert the binary output of the microprocessors into hexadecimal figures. There are no such mysteries here, you can see exactly what is being fed in and what is coming out.

The outputs are read by l.e.d.'s. Many MOS devices can't summon up enough current to operate an l.e.d., but the INS8060 can pass a respectable milliamp or two without its output voltage being too greatly affected. Each l.e.d. needs a current limiting resistor in series, and this would place a bit of a strain on the number of contact points on the Eurobreadboard unless we did a bit of soldering. As you'll see from the practical diagrams next month, we've tried to arrange these l.e.d.'s so that their signals are easy to understand. Eight l.e.d.'s are used for the readout of the data signals, and the connections are made to the contacts at the data pins of the microprocessor. When we're feeding signals into the microprocessor, then, these l.e.d.'s will indicate the same binary number as the input octal switch – there's something wrong, like crossed lines, if they don't. When the microprocessor is providing

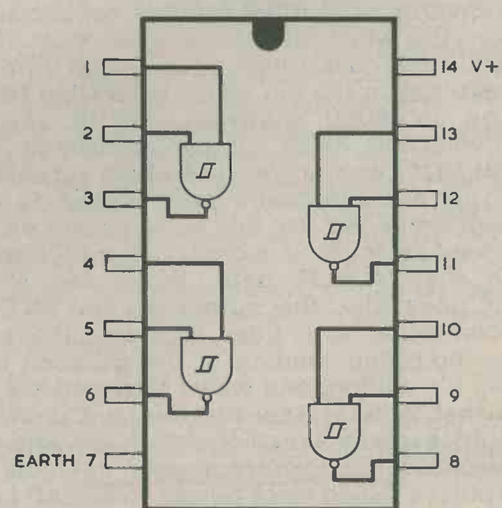


Fig.3. The pinout for the 74LS132 quad NAND gate.

an output (writing) the l.e.d.'s will not usually show the same binary number as is set up by the switches.

There are a few other l.e.d.'s as well. We'll use five l.e.d.'s with limiting resistors, to indicate what is happening on the address lines of the INS8060. There are twelve of these address lines, and we'll use l.e.d.'s to indicate what is happening on the lowest four, AD00 to AD03, and the highest one, AD11. When the mocroprocessor is operating, an address number will appear on these lines for each complete step of the program. The first address, reasonably enough, is No.1, with all the lines except AD00 at zero, and AD00 at logic 1. Written as a binary number, this is 000000000001 (eleven 0's and a 1). Most of the numbers we will be using will involve only the lowest four bits, so that we shall not write out all twelve bits all the time.

Three other l.e.d.'s are used. One is attached, with its resistor in series, to the pin labelled SOUT. The use of this one forms the subject of some work we'll be doing later, so we won't go into details here. The second l.e.d. of this lot, though, is the READ/WRITE indicator, and it's also tied up with the third i.c. on the board, the 74LS132 quad NAND gate. The third l.e.d. is a spare, which can be hooked up to various places as and when we need it.

SCHMITT TRIGGER GATE

Now there's a very good reason for using the 74LS132 in the circuit rather than the more familiar 74LS00. The 132 is what's called a Schmitt trigger gate. That means that a slow-changing waveform at its input will generate a very fast-changing output, with no oscillation. A stage like this is essential when mechanical switches are used to provide pulses, and there's one switch, the GO switch, which is of this class. It may seem a bit of a waste to use a set of four Schmitt gates when only one is essential, but we'll make more use of the i.c. than appears at first sight.

Returning to the READ/WRITE l.e.d., this one is fed from the output of one of the NAND gates of the 74LS132. One input of this gate is connected to +5V, so that the gate operates simply as an inverter. The other input is connected to the same line which feeds the enable inputs of the inverter. This line is driven by an output from the microprocessor, the pin which is labelled NRDS on the INS8060 diagram. NRDS means Negative-active ReaD Strobe; translated into English, that's a negative pulse which appears on the pin just as the microprocessor is ready to read data signals in. We use this pulse to turn on the buffer so as to feed signals in, and also to switch the 74LS132 gate. When the NRDS output goes low, the output of the 74LS132 gate connected to it goes high and the l.e.d. glows, indicating reading. If the INS8060 isn't reading it's writing, and we've arranged the circuit so that, when you see that this l.e.d. is off, the microprocessor isn't reading data in, it's writing it out. Because the microprocessor operates by using pulses, called clock pulses, the READ l.e.d. glows only during the READ time, and goes out during the remainder of each cycle. At the clock rate we've used, though, which is as slow as is possible with the built-in clock pulse generator, you can't see the l.e.d. extinguish – so that you'll see it go fully out only when the microprocessor is writing.

FURTHER INPUTS

That takes care of what the outputs are about for the moment, but there are quite a few inputs we haven't mentioned yet. The straightforward ones are the positive and negative supplies. The supply has to be 5V, and a stabilized 5V supply is the easiest method of supplying this. I've operated the unit from a 4.5 V battery (a No. 1289) and it gave no trouble, but I can't guarantee that all INS8060's will operate satisfactorily on this voltage, though three of mine did. If you settle for a 4.5 volt battery operation use the unit in brief bursts, because the current drain is about 60mA. This is not very high by t.t.l. standards or even by bicycle lamp standards, but if the battery voltage starts to drop some funny answers could appear.

The XIN and XOUT pins of the INS8060 are for its built-in clock oscillator. On the high-cost professional stuff which needs a closely controlled clock frequency these pins are used for a crystal oscillator. We can use a simple RC network of two resistors and two capacitors (a phase-shift network), and the values we shall employ give about as slow a clock rate as is possible with the built-in oscillator. The values are 1kΩ and 0.015µF, and these work with all the INS8060's I used. If your micro seems reluctant to do anything and all other connections are OK, then smaller value capacitors here might just do the trick.

Of the other inputs, one is a simple push-button connection to the SIN (Serial INput) at pin 24. We've arranged a "pull-up" resistor here, so that this pin is at logic 1 unless the push-button switch (labelled SIN) is pushed to make the input zero. More on this later, as promised.

The next push-button input is to the NRST pin, number 2 on the 8060. The N, as usual, means negative-active, and the whole set of letters means that this pin has to be taken to logic 0 to reset the microprocessor. It's another of the advantages of the 8060 that all its registers are set to zero by this simple action; some microprocessors have a complex reset action which makes resetting a much more complicated business. Once again, we've used a pull-up resistor to make certain that the pin voltage rises to logic 1 when the push-button switch is open, and also to protect this input from excessive voltages.

The last of the push-button switches is a bit more complicated, and it is very important. Normally, a microprocessor zips through the work it has to do pretty quickly, too quickly for us to follow what is happening. This GO switch operates a pin which is labelled NHOLD, and it allows us to operate the microprocessor step by step. As usual, N means low-to-operate, and when this pin is held at logic 0 the microprocessor simply "holds", so that it stops operating at one stage in the cycle. The stage at which it stops is important – it's when the microprocessor is ready to read information in, or is writing data out. Holding just at this stage lets us take our time over entering data or looking at the readout l.e.d.'s, and makes it possible for our very simple circuitry to work. Not all microprocessors

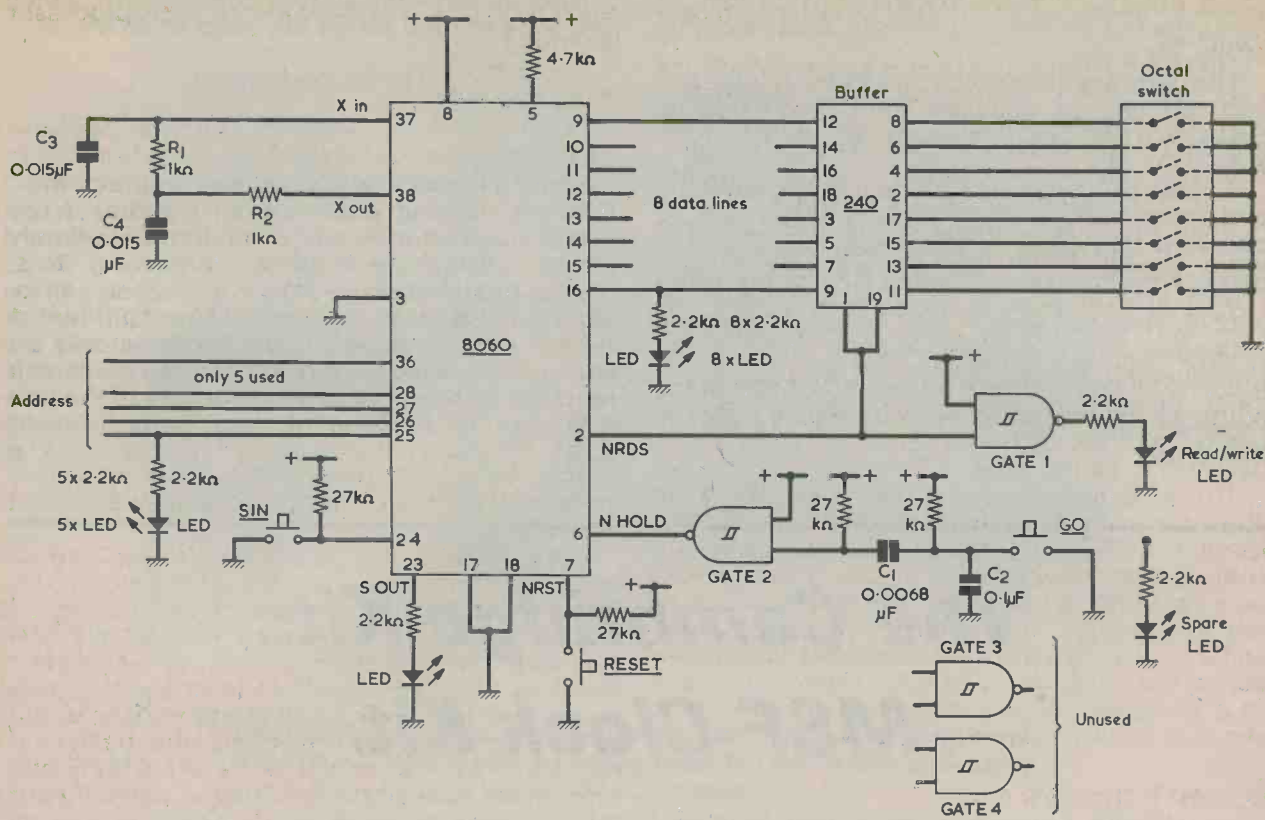


Fig.4. The INStructor circuit. The INS8060 pins are not shown in order and where several identical circuits are used (as, for example, data lines) only one sample is given. Power supply connections are not shown. This circuit is for checking purposes only, the actual connections are made following the Table which will be given in Part 2.

will hold in this manner, which is just another of the many factors which make the INS8060 so suitable for our application.

The GO button uses one of the 74LS132 gates to generate a short positive pulse. The idea is this. With the GO button released, both inputs of gate 2 of the 74LS132 are at logic 1, so that the output of this gate is at logic 0. This holds the NHOLD pin at logic 0, and the microprocessor obediently stops working at the read/write stage of its cycle. When the GO button is pressed, one side of capacitor C1 is taken to earth. Since the 27kΩ resistors on either side of it had kept the capacitor discharged, pressing the GO button causes the gate 2 input to go momentarily to earth potential, after which C1 charges via the left-hand 27kΩ resistor. The gate is switched over for as long as it takes the capacitor to charge. This time is fairly critical; it has to be long enough to allow the microprocessor to start running again, but not so long that it allows it to have two stabs at each program step. The value of C1, 0.0068μF, and the 27kΩ resistor values, are suitable for the clock frequency given by the components R1, R2, C3 and C4. Faster clock rates will need correspondingly shorter time constants in the GO circuit. The values are not *too* critical, though, and there is no need to experiement with the value of C1 unless trouble arises during testing. If the microprocessor absolutely refuses to step on when the GO button is pressed, use a larger value of capacitor for C1. If it moves several steps on for each operation of the GO button, use a smaller value for C1. How do we know about the steps? More on this later, when construction is finished.

The only minor point left is the 0.1μF capacitor, C2, across the GO button contacts. The GO switch, like all mechanical switches, will suffer from contact bounce. This means that when you press the button the contacts close then bounce open again one or more times before they finally close continuously. The result is that the switch generates several pulses which, of course, cause the microprocessor to take an equal number of program steps. The 0.1μF capacitor suppresses these unwanted pulses without interfering with the single wanted pulse – the capacitor discharges at once when the switch points close, but can't charge instantly when the points open during the contact bounce.

COMPONENTS

An inventory of parts required for the project accompanying this first article of the series, and some comments need to be made concerning these.

The all-important INS8060 is available from a number of sources including Greenbank Electronics, 92 New Chester Road, New Ferry, Wirral, Merseyside, L62 5AG, and Newbear Computing

Store, Bone Lane, Newbury, Berks, RG14 5SH. So far as the t.t.l. i.c.'s are concerned, these *must* be of the 74LS type.

The parts are assembled on a Eurobreadboard, and this can be obtained from David George Sales, r/o 74 Crayford High Street, Crayford, Kent, DA1 4EF.

Sixteen red subminiature l.e.d.'s are required, and those used by the author are type WL32K, obtained from Maplin Electronic Supplies. The three push-button switches are Maplin type FH59P, and the d.i.l. octal switch is Maplin type XX27E. The octal switch is not listed in the Maplin catalogue current at the time of writing and was introduced in the Maplin News Letter for March 1979. Single-core interconnecting wire is also required, and I used a 10 metre pack of Maplin Bell Wire.

Next month – the start of construction, giving you a bit of time for all the parts to arrive.

(To be Continued)

LATE ITEM

Since this article was prepared for the printer I have learnt that push-button switches (code SRM) suitable for insertion into Eurobreadboard are available from Watford Electronics, 33/35 Cardiff Road, Watford, Herts, and these can be used instead of the switches type FH59P (which require wire extensions). The SRM switches are changeover, whereas a push-to-make function is required with the INStructor, and one of the pins will need to be clipped or bent away from the board. ■

The Cambridge Kits MSF Clock Kit.

A Review by T. F. Wetherley

The MSF Transmissions on 60kHz provide a very accurate time signal. To the casual listener the signal seems to be a series of second pulses. When viewed on an oscilloscope it is seen that the gaps between the bleeps are either "long" (200ms) or "short" (100ms). These gaps carry the time information in the form of a binary code which when decoded gives the correct year, month, day date, hours and minutes, correct at the start of the next minute (Table).

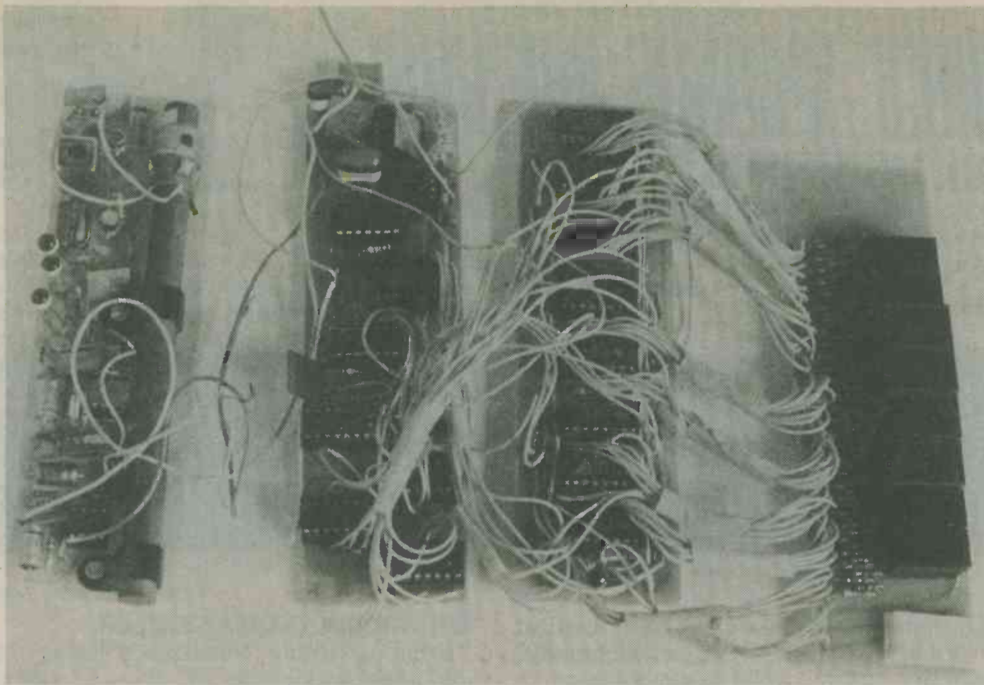
The MSF clock kit produced by Cambridge Kits enables the home constructor to produce a reliable clock which uses this code to display the date hours' minutes and seconds. This kit is indeed complete since it contains the four circuit boards, components, wire, nuts and bolts, a case, comprehensive instructions and circuit diagrams. This is a refreshing change since many of today's "kits" leave the case and "hardware" to be supplied by the builder.

TABLE

The information is sent as follows using the following abbreviations: U = units, T = tens, Y = year, Mon = month, D = date, W = weekday (Sunday = 0), H = hour, M = minute and 1,2,4,8, show the BCD weighting. The bits for each second are:

00 fast code	10	20 YT1	30 DT2	40 HT1	50 MU2
01 fast code	11	21 YU8	31 DT1	41 HU8	51 MU1
02 fast code	12	22 YU4	32 DU8	42 HU4	52 0
03 fast code	13	23 YU2	33 DU4	43 HU2	53 1
04 fast code	14	24 YU1	34 DU2	44 HU1	54 1
05 fast code	15	25 MonT1	35 DU1	45 MT4	55 1
06 fast code	16 leap	26 MonU8	36 W4	46 MT2	56 1
07 fast code	17YT8	27 MonU4	37 W2	47 MT1	57 1
08 fast code	18 YT4	28 MonU2	38 W1	48 MU8	58 1
09 fast code	19 YT2	29 MonU1	39 HT2	49 MU4	59 0

DUT1 is the difference between universal time and time based on the earth's rotation.



The four boards which make up the Cambridge Kits MSF clock kit. The r.f. board can be recognised by the ferrite rod aerial mounted at one edge.

The four boards are the rf board, the logic board, the decoder board and the display board (see photo) which when interconnected make the clock.

The rf board is the 60kHz receiver and construction is straightforward. Since the receiver uses two mosfet transistors the instruction sheet suggests unplugging the iron before soldering the transistors to the board. For testing and tuning I used a 'scope on the output.

iron is essential as is thin solder, 22s.w.g. or finer. The constructional hints suggest a solder sucker and I found mine invaluable, as also was a magnifying glass. Full circuit diagrams are supplied together with useful suggestions for expanding the data available.

I "mod"ed the clock in two ways. Firstly I put the i.c.'s in sockets (a personal prejudice) and I used a much larger case. This enabled me to build in a 12 volt power supply. Care was taken to place the transformer away from the ferrite antenna since the magnetic field could affect reception.

The Cambridge Kits MSF clock display. The figures indicate date, hours, minutes and seconds.

The logic board receives the digital data from the rf board. The signal is clocked into a series of shift registers. When a minute pulse is received the registers are reset. Thus at the end of each minute they contain the digital information in the correct sequence. This information is passed to the decoder board from whence it is routed to the display board and displayed on the seven segment displays.

While the construction can be described as straightforward care must be taken with the soldering. A fine

To sum up I found the kit complete and well documented. It was easy to build provided that care was taken. The completed clock is impressive in use. Cambridge Kits are to be congratulated in bringing MSF accuracy to the home constructor at a reasonable price. Their address is Cambridge Kits, 45 Old School Lane, Milton, Cambridge.

■

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

It is just about now that some signals from the East and Far East should reach these shores as the 'season' for reception of these areas of the world commences and slowly builds up to the peak period – which is usually sometime in December.

In the three months period November to January more real Dx is logged by enthusiasts than at any other time of the short wave listeners year – mine ends in March with the close of the Eastern 'season'.

Those interested in receiving all this Dx should start serious operations around the middle of September by listening on the 60 metre band from around 1530 GMT until 1600 GMT, at which time many of the Far Eastern transmitters close down. Also search the band at 2200 when some of these stations sign-on.

A good yardstick for Eastern reception conditions is Radio Singapore on **5010** (just above MSF on **5000**) or on the parallel channel of **5052.** Generally speaking, should Radio Singapore be coming through quite well around 1530 GMT, then the prevailing conditions are good for the reception of other transmitters in the area.

This will now be the appropriate time to visit other frequencies used by the various Eastern and Far Eastern stations, hopefully starting to make the various entries in the logbook. In ascending frequency order try **4750** Lhasa, **4759** Kunming, **4774** Jakarta, **4775** Kabul, **4815** Peking, **4820** Calcutta, **4830** Bangkok, **4835** Kuching, **4860** Delhi, **4870** Colombo, **4883** Peking and **4944** Hanoi.

If you are successful with most of those, why not try the more difficult **4725** Rangoon, **4856** Palembang, **4950** Kuching, **4985** Penang or **5040** Rangoon. Difficult by reason of surrounding interference. If you think you are that good – try **4990** for Changsha in Hunan Province – if you can 'get under' Yerevan on the same channel!

AROUND THE DIAL

From habit, I always head this section of the article as shown but perhaps I should alter it to something like 'Along the Scale' or even 'Among the Digitals', or how about 'From Dial Reading, to Graph Conversion' – or simply 'Stations Heard' – for the moment however I will deal with the various loggings around the dial!

●NETHERLANDS ANTILLES

Bonaire (Radio Nederlands Relay) on **21640** at 1804, OM with a newcast of world affairs in Arabic intended for the Middle East.

●NETHERLANDS

Lopik on **15220** at 1904, OM with a Dx programme in English for African consumption, followed by some items about various communication receivers available on the market these days. The programme ended at 1920.

●SWITZERLAND

Berne on **9535** at 1814, YL (YL = Young Lady) announcer with various announcements, station identification in English, announced target areas, timecheck for 1815 followed by the 'Dateline' programme in English.

●JAPAN

Tokyo on **15135** at 1849, OM with a talk all about some new Japanese products in an English programme for Europe which ended at 1900.

●CANADA

Montreal on **15325** at 1907, OM with news of Canadian political affairs and sporting events – perhaps these should be grouped under the same heading! – in an English programme for Europe from 1900 to 1930.

●ECUADOR

Radio Nacional Espejo, Quito, on a measured **4679** at 0250, OM in Spanish with a talk about local events, announcements, identification at 0300 then a religious talk. The schedule is supposedly around the clock but quite often operates from 1100 to 0600. The power is 5kW.

Radio Nacional Progresso, Loja, on **5060** at 0215, OM station identification in Spanish, light orchestral music, YL with song – quite a change from the eternal LA (Latin American) type pops. The schedule is from 1030 to 0415 this closing time being variable. However, this station has been reported opening at 1200 and closing at 0648 on occasions. It all adds to the fun you understand! The power is 5kW.

●MOZAMBIQUE
Radio Mozambique, Maputo, on **4925** at 1908, OM with a talk in Portuguese. This channel carries the B Programme in Portuguese and vernaculars from 0255 to 0600 and from 1600 to 2210, the power being 20kW. The frequency has been known to vary to **4926** on occasions.

●PERU
Radio Loreto, Iquitos, on **5050** at 0218, OM with announcements in Spanish followed by a rousing march rendered by a military band, the whole transmission being wiped out by commercial interference a few moments later. The schedule of Radio Loreto is from 1100 to 0650 and the power is 2kW.

●COLOMBIA
La Voz del Cinaruco, Arauca, on **4865** at 0232, OM with announcements in Spanish, OM's with a discussion about Latin American sporting events and the results. The schedule of this one is around the clock and the power is 1kW.

●EGYPT
Cairo on **7050** at 1806, YL with news of Egyptian local affairs in the Arabic programme 'Voice of the Arabs'. Once resident in Cairo, I often recall partaking of one of the local delicacies – corn on the cob roasted over a slow fire of camel-dung – it tasted a lot different than you would think – the cob, not the fire!

●KUWAIT
Radio Kuwait on **11665** at 1830, YL with a newscast in English followed by the local weather forecast and that for the immediate areas. Recorded 'pops' U.K. style in the English programme, announced to Europe and closing at 2100.

●TURKEY
Ankara on **15220** at 1440, local music programme, some with songs by YL in a Turksih programme for those abroad.

●PAKISTAN
Radio Pakistan, Islamabad, on **21485** at 1513, OM with news of domestic affairs in Urdu. Also logged in parallel on **21755**. I trust they are still using these channels by the time this appears in print – Radio Pakistan is apt to change frequencies more often than I change my shirt – and that is frequently!

●INDIA
All India Radio (AIR) Delhi on **11620** at 1900, OM with station identification followed by the news in English, mainly about Indian affairs and events. The programme also included an interesting talk on the Indian Navy and local ship building – including details of some 'wooden-walls' constructed for the British Navy in days of yore.

●VATICAN
Vatican City on **7250** at 1935, OM with a programme describing some of the recent journeys of the Pope, the events that took place and the hopes achieved. Programmes from this station, on many differing channels, are mostly of a religious nature but many of the broadcasts are quite instructive.

●SOUTH KOREA
Seoul on **6480** at 1744, YL with songs in Korean, OM announcer in a programme presumably for overseas consumption.

●AFGHANISTAN
Kabul on **4740** at 1835, OM announcer in vernacular, dance music records 1950 style. Kabul has been popping up all over the place since the Soviet invasion, some of the transmitters being based within the USSR borders.

●KENYA
Nairobi on **4804** at 1902, dance records big-band style, OM announcer in English. This is the Home Service in English, the schedule being from 0255 (Sundays from 0330) to 0630 and from 1300 to 2010 (Saturdays until 2110). The power is 1kW and if you can log this one during any early evening around 1830 then you will find that the prevailing conditions are good for reception of most African stations during the period.

●GABON
Franceville on **4830** at 1904, African-style music, YL's with songs, local pops in vernacular at 1915. The schedule is from 0430 to 0700 and from 1700 to 2300 but the closing time can vary from as early as 2100. The power is 20kW.

●EQUATORIAL GUINEA
Radio Ecuatorial, Bata, on **5005** at 1910, OM's with a discussion in vernacular. The schedule is from 0430 to 0630, from 1000 to 1600 and from 1700 to 2140 (Saturdays until 2300). Formerly on **4926** this one has a power of 5kW.

●TANZANIA
Dar-es-Salaam on **5050** at 1912, YL in Swahili in the Commercial Service which operates on this channel from 1300 to 2015. The National Service is on this frequency from 0300 to 0500 entirely in Swahili. The power is 10kW.

●GUATEMALA
Radio Mam, Cabrican, on **4825** at 0241, OM with announcements in Spanish, marimba music, more announcements. Station identification at 0245, short musical interlude then more talk. In fact more talk than music! Radio Mam broadcasts in Spanish and the local vernacular (Mam) from 2200 to 0300 and the power is 1kW.

●VENEZUELA
Radio Yaracuy, San Felipe, on **4940** at 0227, YL with a love song in Spanish, OM with identification at 0230 and commercials. The schedule is from 1000 to 0400 and the power is 10kW.

●BRAZIL
Lins Radio Clube, Lins, on **3225** at 0247, OM announcements in Portuguese, male voice choir with ballads. The schedule is from 0730 to 0400 and the power is 1 k W. Radio Occidente, Tovar, Venezula, is also on this channel but in Spanish and it closes at 0200.

Good hunting and listening to you all.

Relay Reverse Voltages

By
T. Osborne

Even the humble relay can produce its quota of fun.

One of the common sights in an electronic circuit incorporating a relay is the arrangement shown in Fig. 1. When the transistor turns on, its collector current flows through the relay coil and causes it to energise. Almost always a diode is connected across the relay coil as shown, and we are usually informed that the function of the diode is to suppress high back-e.m.f. voltages in the relay coil when it de-energises. Without the diode these high voltages could damage the transistor.

What happens in the relay coil is that, when the relay is energised, the coil has a steady magnetic field about it. When the transistor cuts off, the lines of force in the field collapse rapidly to induce in the coil for a short period a voltage of reverse polarity to that which originally created the field. If there is no resistive load across the coil the induced voltage can be much higher than the original supply voltage for the coil and the transistor.

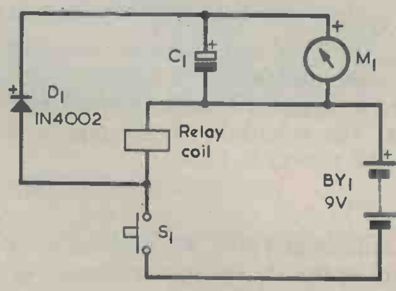


Fig. 2. The reverse voltages are purposely encouraged to form in this circuit and they cause the capacitor to charge via the rectifier. Voltages well in excess of 9 volts can be produced across the capacitor

BACK-E.M.F. CIRCUIT

You can check for yourself that this reverse voltage does exist, and have a little fun in the process, by knocking up the simple circuit of Fig. 2. In this the relay coil should have a resistance of 300Ω or more. The battery is a 9 volt type having a fair current capability such as a PP9. S1 is a press-to-make push button and it should preferably be a type which can be quickly pressed and released.

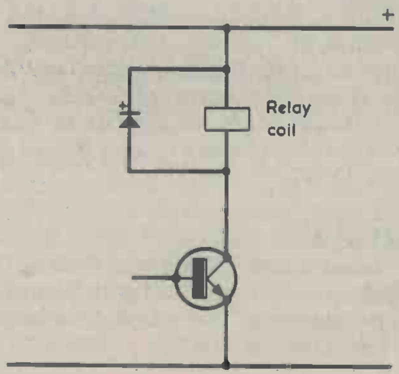


Fig. 1. A typical relay energising circuit. The diode across the coil prevents the formation of high reverse voltages when the transistor turns off

D1 is a 1N4002, as shown, or any other silicon rectifier having a p.i.v. rating of 100 volts or more. C1 is an electrolytic capacitor with a working voltage of 100 volts or more and any capacitance between 20μF and 50μF. Meter M1 is your testmeter switched to give an f.s.d. reading of 50 volts or 100 volts.

After having wired up the circuit, simply press and release S1 very quickly and see how high a voltage reading you can build up in the meter. When S1 is pressed the rectifier is reverse biased, but when S1 is released the lower end of the relay coil swings positive and charges C1 via the rectifier. The voltage across C1 will gradually increase with each operation of S1, and you can try your skill at producing as high a voltage as possible.

The voltage which can be obtained depends to some extent on the meter resistance, and a meter with a sensitivity of 10,000Ω per volt will allow a higher voltage reading than one with a sensitivity of only 1,000Ω per volt. With my 20,000Ω per volt meter switched to a 100 volt range I was able to get a voltage reading of well over 40 volts from the 410Ω coil of a Maplin "Open Relay".

One final point. If you've made up the circuit in lash-up form keep your fingers well away from the connections to S1. Otherwise you might find yourself at the receiving end of a surprisingly hefty jolt!

IN OUR NEXT ISSUE

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Portable Short Wave Radi

✶Suitable for newcomers.

✶Employs only one i.c. and one trans

✶Covers 25, 31, 41 and 49 me

This simple short wave set will provide good reception of the stronger broadcast transmissions in the range of 5 to 14MHz (60 to 21.5 metres) and takes in the 25,31,41 and 49 metre broadcast bands. The radio is self-contained, having an internal battery supply, telescopic aerial and loudspeaker. An output socket for a crystal earphone or high impedance (2,000 or 4,000Ω) magnetic headphones is also provided. The set is of the t.r.f. (tuned radio frequency) type, which means that the circuit is uncomplicated and requires no alignment when completed. Further simplification is achieved by the use of an inexpensive audio power amplifier i.c. Construction of the set is very straightforward and should not be difficult even for a newcomer to electronics.

THE CIRCUIT

As can be seen from the circuit diagram of Fig.1 the receiver has only two active components, these being the Jfet transistor TR1 and the integrated circuit IC1. The former provides all the r.f. amplification and the latter gives all the a.f. gain.

A plug-in coil, L1, is employed for signal reception, and the winding between its pins 5 and 2 is tuned by VC1. Normally, the aerial would be coupled by a coupling winding to this tuned winding but, since only a relatively short telescopic aerial is employed, it can be connected direct to the tuned circuit. The tuning capacitor VC1 is adjusted for station selection and the received signals are passed to the gate of TR1. So far as bias is concerned, the gate is biased by the tuned

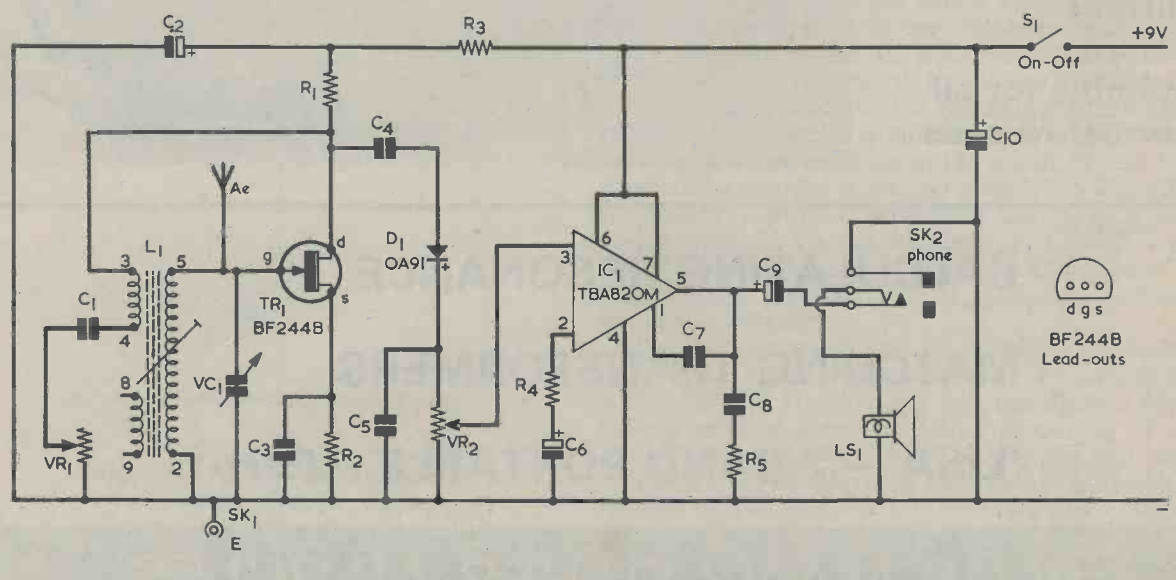
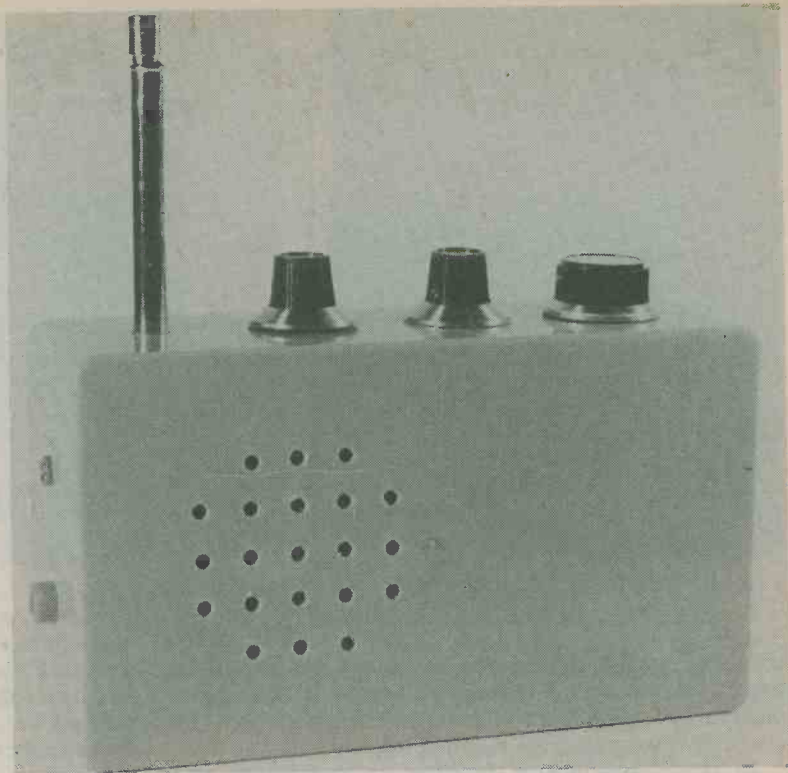


Fig.1. The portable short wave radio has a very simple circuit and employs only one transistor and one integrated circuit. Coverage is from 60 to 21.5 metres. No connections are made to pins 8 and 9 of coil L1.

io By R.A. Penfold

sistor.

etre bands.



The completed radio. The telescopic aerial passes through the top panel, on which are mounted the volume control and on-off switch, the regeneration control and the tuning control.

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 470Ω
R2 1kΩ
R3 560Ω
R4 10Ω
R5 1.8Ω
VR1 10kΩ potentiometer, linear.
VR2 5kΩ or 4.7kΩ potentiometer, log, with switch S1

Capacitors
C1 470pF ceramic plate or polystyrene.
C2 100μF electrolytic, 10V. Wkg.
C3 0.1μF polyester type C280.
C4 0.047μF polyester type C280.
C5 0.047μF polyester type C280.
C6 220μF electrolytic, 10V. Wkg.
C7 270pF ceramic plate.
C8 0.1μF polyester type C280.
C9 100μF electrolytic, 10V. Wkg.
C10 100μF electrolytic, 10 V. Wkg.
VC1 See text.

Inductor
L1 Miniature dual-purpose coil, Green, range 4, valve usage (Denco).

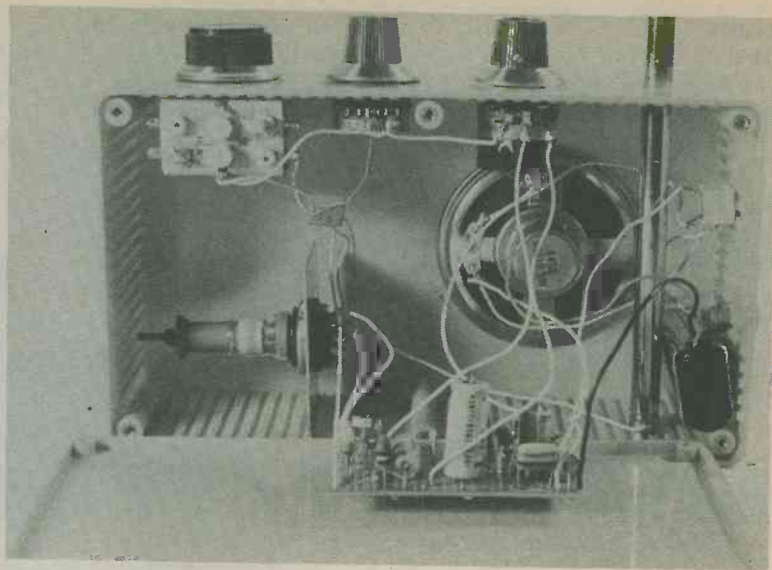
Semiconductors
TR1 BF244B
IC1 TBA820M
D1 OA91

Switch
S1 s.p.s.t. toggle, part of VR2

Sockets
SK1 insulated wander socket
SK2 3.5mm. jack socket (see text)

Speaker
LS1 miniature speaker, 40-80Ω

Miscellaneous
Telescopic aerial (see text)
Plastic case (see text)
Veroboard, 0.1in. matrix
9 volt battery type PP3 (see text)
Battery connector
B9A valveholder
18 s.w.g. aluminium (for coil bracket)
3 control knobs
Nuts, bolts,



A view inside the receiver with the rear panel removed. The Veroboard is pictured outside the case.

winding, whilst the source is biased by R2, with bypass capacitor C3 connected across it. R1 is the drain load for TR1, and the supply to this part of the circuit is decoupled by R3 and C2.

A very considerable increase in sensitivity and selectivity is produced by regeneration. The amplified r.f. signal at the drain is coupled back to the tuned winding by way of the winding between pins 3 and 4 of the coil, the regeneration circuit being completed by d.c. blocking capacitor C1 and VR1, the regeneration control potentiometer. If VR1 is adjusted to insert into circuit too low a resistance the amount of regeneration provided is too great and the TR1 circuit bursts into oscillation at the frequency selected by the tuned circuit. If, however, VR1 is adjusted so that regeneration is just below the oscillation level the resultant positive feedback causes the tuned circuit to have a very high efficiency, allowing it to pick up weak signals which would otherwise be missed and also to tune more effectively between signals having closely spaced frequencies.

Also connected to the drain of TR1 is the detector circuit comprising C4, D1 and volume control VR2. Despite the lack of a d.c. return path for the diode this circuit works very effectively in practice. The detected audio frequency signal appears across VR2 and any remanent r.f. is bypassed to the negative rail by C5.

The audio signal tapped off by the slider of VR2 is passed to the input pin of IC1, which is a TBA820M. This is a versatile i.c. which is specifically designed for low power applications. It has a low quiescent current consumption of the order of about 4mA only at 9 volts and, unlike many audio i.c.'s, it will work well at low supply voltages down to about 3 volts. No d.c. blocking capacitor is required at the input to the device; in fact it is important that no such capacitor be employed here because a d.c. path to the negative rail is required in order to bias the i.c. input.

C7 is a frequency compensating component which ensures stability in the i.c., and it also attenuates the higher audio frequency response. In the present application the full audio bandwidth is not required and a certain amount of treble cut has the beneficial effect of reducing background noise. R5 and C8 form a Zobel network which also aids the stability of the circuit. C9 is the d.c. blocking capacitor at the output and it couples to the speaker via a break contact of the jack socket, SK2. This contact automatically cuts out the speaker when headphones or an earphone is plugged in. The amplifier provides an output power of about 100mW to the high impedance speaker.

In IC1 an internal negative feedback circuit incorporating a 6kΩ resistor couples to its pin 2, and this pin should connect to the negative rail via a discrete external resistor and a d.c. blocking capacitor. These are R4 and C6 respectively. The voltage gain of the i.c. is approximately equal to 6,000 divided by the resistance, in ohms, of the external resistor. In the present circuit, where a high audio gain is required, R4 is given the low value of 10Ω, whereupon the actual a.f. voltage gain is about 600 times.

On-off switching is provided by S1, which is ganged with VR2. C10 is the main supply bypass capacitor. The quiescent current consumption of the receiver is about 5mA, this rising to some 20 to 30mA at high volume levels. The prototype receiver employed a PP3 battery, but a larger PP6 battery can be used instead if a longer battery life is required.

An earth socket, SK1, is provided and this connects to the negative rail of the receiver circuit.

COMPONENTS

Some comments are needed concerning the components required. The telescopic aerial employed was the type available from Maplin Electronic Supplies which has a closed length of 176mm. and an extended length of 1.1 metres. (Maplin have now replaced this with a 54in. aerial which will be equally suitable. – Ed.) VC1 can be any air-spaced variable capacitor having a maximum value between 350 and 400pF. A suitable component is a single gang Jackson type "O" with a value of 365pF. Another capacitor which may also be used is a 2-gang Jackson type "OO" 176 plus 208pF component, with the two sections connected in parallel to give 384pF. This is the variable capacitor employed in the prototype. If the capacitor has integral trimmers these should be adjusted to give minimum capacitance. Should difficulty be experienced in obtaining the coil specified for L1 it may be purchased direct from the manufacturer at Denco (Clacton) Ltd., 357 Old Road, Clacton-on-Sea, Essex, CO15 3RH. The BF244B specified for TR1 is available from several suppliers, including Greenweld, 443 Millbrook Rd., Southampton, SO1 0HX. The loudspeaker can be any miniature type having an impedance between 40 and 80Ω. The jack socket required for SK2 is a 3.5mm. socket with a break contact. The author used an insulated socket, but an open socket is easier to obtain and this type is shown in the wiring diagram of Fig.4. The receiver is assembled in any plastic case which has sufficient space for the components and battery. A plastic case with outside dimensions of 190 by 110 by 60mm. was used for the author's receiver, and this is a little larger than is absolutely necessary. The electrolytic capacitors can have higher working voltages than are shown in the Components List.

CONSTRUCTION

The main features of construction are illustrated in the photographs. The three controls are mounted along the top panel of the plastic case leaving sufficient space for the telescopic aerial. VC1 is furthest away from the aerial, VR1 is next to VC1 and VR2/S1 is nearest the aerial. The aerial is mounted by a 4BA bolt passed through a hole drilled in the bottom of the case, a 4BA solder tag for connection being fitted between the bottom of the aerial and the inside surface of the case. If VC1 is a Jackson component, it will have three 4BA tapped holes on its front plate for mounting purposes. Three appropriately positioned 4BA clear holes are then drilled in the top panel and the capacitor mounted by means of three short 4BA bolts with spacing washers between the panel and the capacitor body. It is very important to ensure that the bolts are short and that their ends do not pass more than marginally inside the front plate of the capacitor. If they do they can irreparably damage the fixed or moving vanes. A much simpler method of mounting the capacitor is to glue it in place with a good quality adhesive, whereupon a single hole of about 14mm. diameter is all that is required.

The miniature loudspeaker will almost certainly have to be glued in position, as these are not usually supplied with mechanical mounting arrangements. The glue should be applied only around the periphery, taking care that none gets on to the speaker cone or surround. Before mounting the speaker a matrix of holes is drilled in the front panel to act as a speaker grille. The two sockets are mounted on the side of the case, with SK2 above SK1.

The coil, L1, plugs into a B9A valveholder which is mounted on an L-shaped bracket made of 18 s.w.g. aluminium having the dimensions shown in Fig.2. After cutting out the 19mm. hole for the valveholder, the positions of the two 6BA clear holes on either side are marked out with the aid of the valveholder itself. The bracket is mounted on the base panel of the case towards the left, as seen from the rear. As supplied, the coil has its adjustable core fully screwed down for packing purposes. For correct frequency coverage, the core should be unscrewed so that about 10mm. of metal thread protrudes from the coil former. The battery can be positioned to the right of the telescopic aerial, again as viewed from the rear.

With the exception of C1, the small components are wired up on a piece of 0.1in. matrix Veroboard having 15 copper strips by 26 holes. Details are given in Fig.3. First, the board has to be cut out from a larger size, after which the eight breaks in the strips are made. The two mounting holes are next drilled

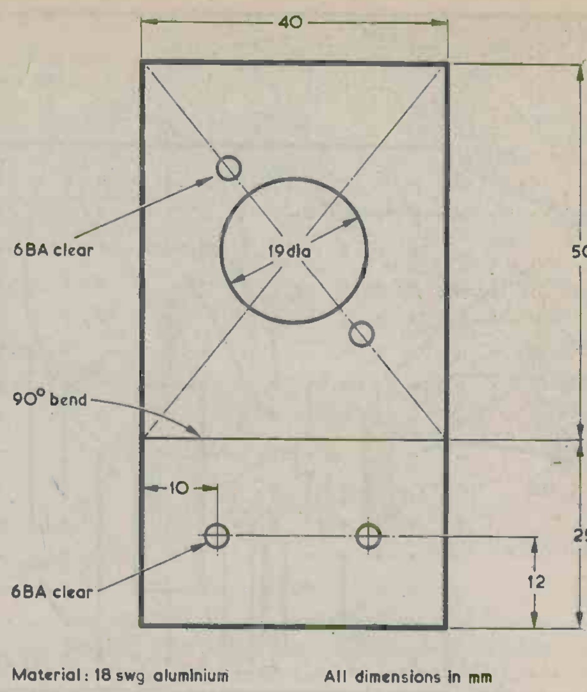


Fig.2. The valveholder into which coil L1 is plugged is mounted on an aluminium bracket. The dimensions of the bracket are given here.

On the left hand end panel are fitted the jack socket and, below it, the earth socket.

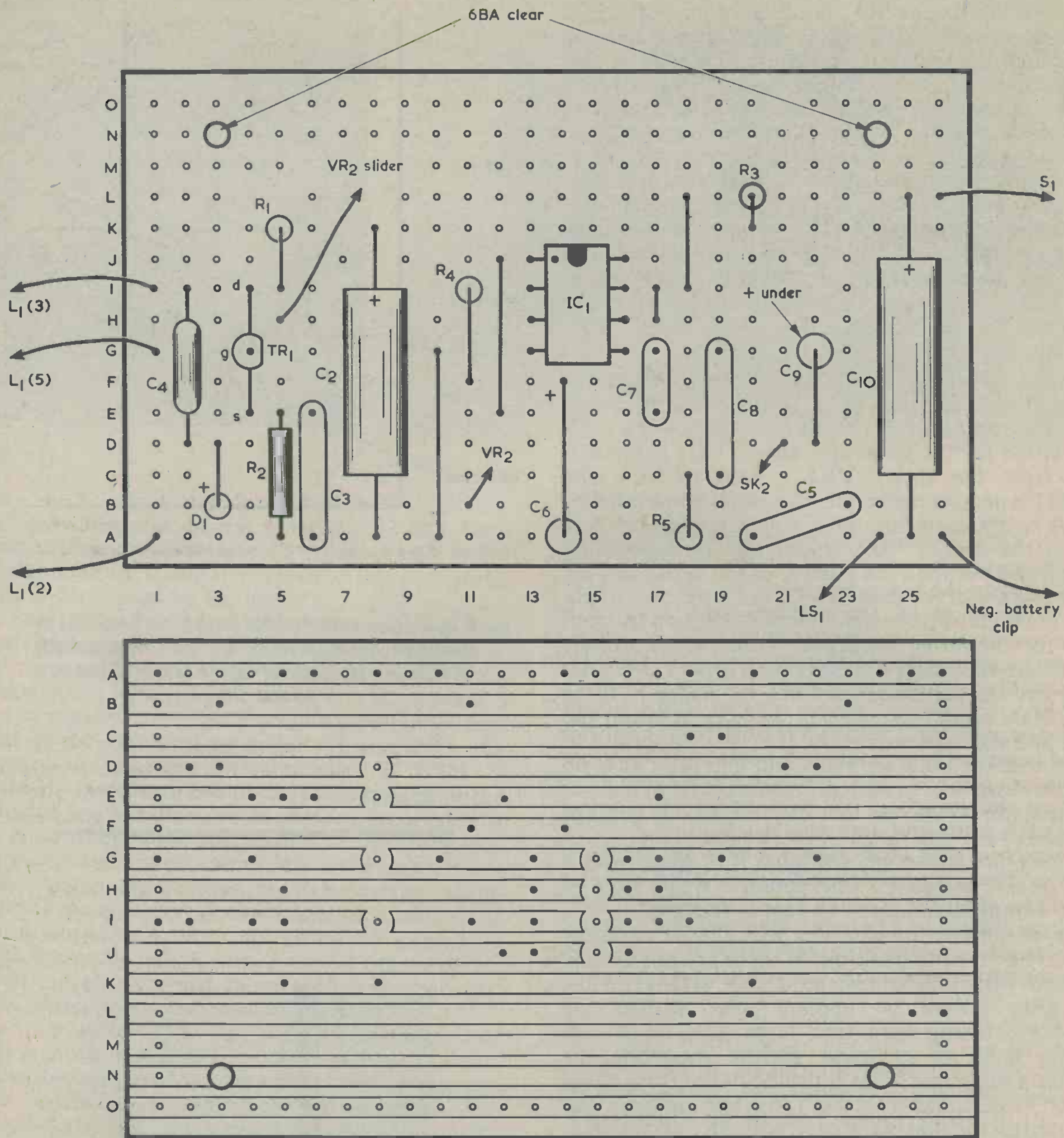
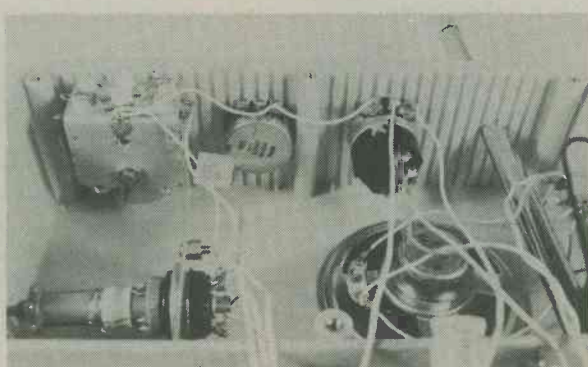
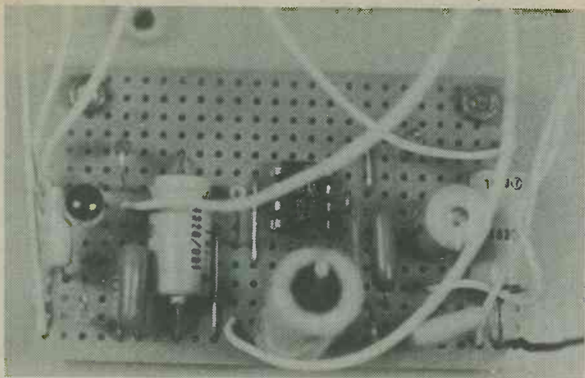


Fig.3. The component and copper sides of the Veroboard assembly.



Looking up at the wiring to the top panel controls.



The Veroboard module. With the exception of C1, all the small components are mounted on this board.

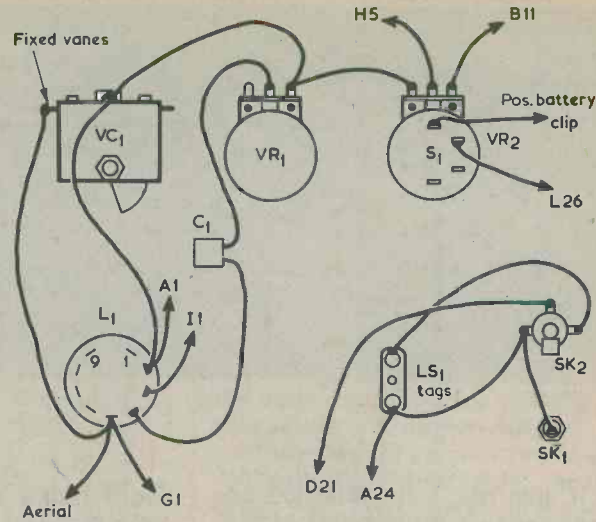
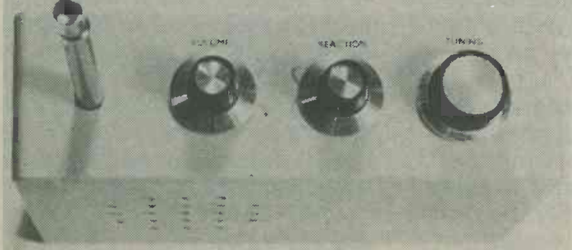


Fig.4. The wiring external to the Veroboard. The letter and number references apply to the Veroboard holes in Fig.3.

out, and then the components are soldered in place. The solder joints for D1 lead-outs should be made fairly quickly as this is a germanium device which can be damaged by excessive heat. Connections from the board to the external components are made with thin flexible p.v.c. covered wire. Leads which are a little too long can be soldered to the board, these being cut to the required length when their remote ends are connected. The board is mounted on the base panel of the case, between the coil bracket and the aerial, using 6BA bolts and nuts with spacing washers between the board underside and the interior surface of the case. These washers prevent mechanical strain on the board when the bolts and nuts are tightened up. The board is oriented so that C4 is nearest the coil bracket and it should be positioned so that no components are fouled when the back of the case is screwed on.

Fig.4 shows the remaining wiring in the receiver. The letter and number references in this diagram apply to the appropriate holes in the Veroboard. Wiring should be kept reasonably short and direct.



Looking down on the top panel. The legends alongside the controls are taken from Panel-Signs, Set No.4

USING THE SET

The volume and tuning controls are, of course, used in the normal way. The regeneration control, VR1, may be unfamiliar to many readers, and it is essential that it be correctly adjusted if good results are to be obtained. When this control is set fully anti-clockwise it is unlikely that any stations will be received except, perhaps, at very low volume. As VR1 is advanced clockwise more stations will be received and volume will increase. The improvement will continue until a point is reached where oscillation occurs, causing heterodyne whistles of varying pitch to be heard as the set is tuned across transmissions. VR1 should be adjusted so that it is just short of the threshold of oscillation. It is best not to take the regeneration level as close to oscillation as is possible since, although this will give optimum sensitivity and selectivity, the tuning can become very critical and audio quality may be poor. The regeneration should be just slightly backed off from this point. It is necessary to re-adjust the regeneration control for optimum performance if the tuning control is adjusted through more than a few degrees. The adjustment of the regeneration control will soon become familiar after a little experience. Volume control VR2 is set up for the desired volume level after tuning and regeneration have been adjusted.

It is possible to obtain a considerable improvement in signal strengths by connecting SK1 to an earth. This does not have to be a proper earth, and a piece of wire about 1 metre long plugged into SK1 will give a surprising increase in signal volume. The earth facility can be especially useful when propagation conditions are poor and give rise to weak signals. The added wire is not really necessary if an earphone or headphones are plugged in, since the phone lead then gives the same effect.

■

Radio Topics

By Recorder

If, like me, you obtained an inexpensive multimeter at the very start of your interest in radio and electronics, it can come as quite a shock to find how lost you are without such an instrument when confronted with the simplest of electrical repairs.

Whilst visiting my daughter recently, she volunteered the fact that her hair curler heating outfit had ceased to work. Whereupon her husband produced the offending heater and we proceeded to work on it there and then. Without, I should add, benefit of a meter or any other electrical indicating device.

You almost certainly know the sort of curler heater I mean. The plastic hair curlers are placed over several rows of vertical metal pillars and there is a mains-driven heater element under the baseplate on which the pillars are mounted.

LONG WAY ROUND

As soon as we started I felt as though I had almost lost one of my senses. The first thing to check in a situation like this is the fuse in the mains plug. But how do you check a cartridge fuse without a continuity tester? What we did was to take the fuse out of its plug and fit it in the plug for the television receiver. The fact that the TV worked then indicated that the fuse was all right. After that the fuse had to be returned to the curler heater plug and the original TV fuse refitted in its own plug.

Following the fuse, the obvious things to look for were poor connections both at the plug and at the heater. Everything seemed to be satisfactory there but a surprisingly long time elapsed before we finally satisfied ourselves on this point.

I was fortunate enough, then, to be visited with inspiration. My son-in-law produced a short length of insulated wire and I next plugged in the curler heater with its own switch turned off and the switch at the mains plug turned on. I touched the two ends of the wire against the tags of the curler heater switch and was rewarded with a fat spark as the wire completed the mains circuit to the heater element. I also obtained a spark with the curler heater switch turned on, whereupon the obvious fault was that the heater switch itself was open-circuit.

I must emphasise that this is a dangerous way of finding a fault and one which should never be undertaken out in the open or in anything other than dry conditions on a carpeted wooden floor. Temporarily short-circuiting the switch brought the curler back into full use again and that, for the time being, was that.

But the whole episode took about an hour and a half. It would probably have required less than five minutes to locate that faulty switch with a testmeter switched to an ohms range.

On returning home after my visit I knocked up a small continuity tester comprising a PP3 battery, an l.e.d. and a series 2.2kΩ resistor. Hardly the most impressive of test equipment, but it takes up very little space, is robust and will certainly be invaluable if, on future visits, I am confronted with any more electrical repairs.

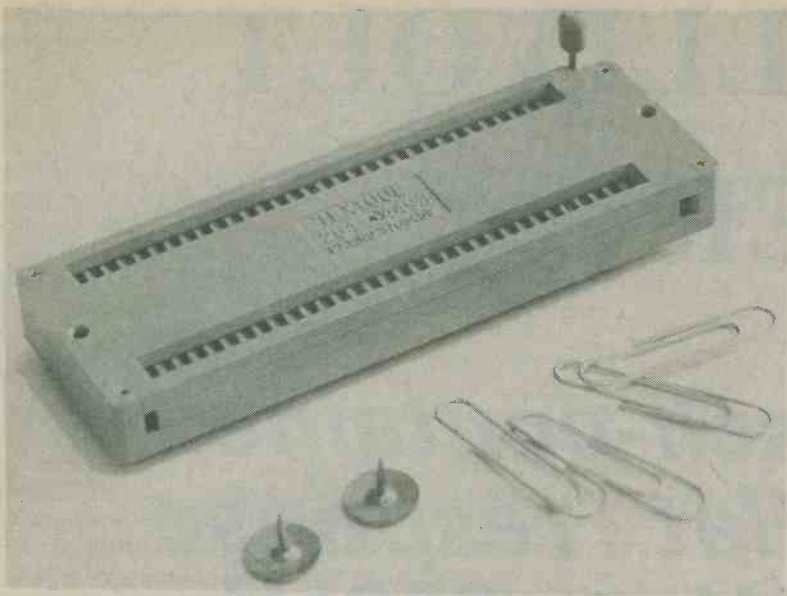
ZIP SOCKETS

Inserting a d.i.l. integrated circuit into some i.c holders is not always the easiest of tasks, and it can become almost traumatic if, say, the i.c. concerned is a 40-pin microprocessor chip. The i.c. holder shown in the accompanying photograph overcomes all insertion problems and enables i.c.'s to be plugged in without the slightest risk of damaging or bending any of the pins.

It is one of a range of multipin integrated circuit sockets introduced by BFI Electronics Limited, 516 Walton Road, West Molesey, Surrey, KT8 0QF, and is mainly intended for use with l.s.i. devices in test equipment or development breadboards. These sockets will accept 28 (0.4in. pitch), 42 and 64 pin devices with no insertion pressure, thus eliminating damage and distortion as can occur when pins are forced into sockets operating on the spring contact principle.

The "ZIP" (Zero Insertion Pressure) socket has a tiny lever at one end which is coupled to an internal cam. The device is simply dropped into the socket, after which the lever is flicked up to clamp the pins positively inside the socket. This protects the pins from damage and ensures good electrical connection. When the lever is released the device may be removed without force.

Other types of "ZIP" sockets are available for 14, 16, 18, 20, 22, 24, 28 and 40 pin devices. All have enlarged apertures and a special clamping feature which automatically compensates for different pin



This "ZIP" i.c. holder, manufactured by BFI Electronics Limited, offers zero insertion pressure. The i.c. is simply dropped into the socket and the lever at the end is then moved to lock all the i.c. pins to its internal contacts.

thicknesses, bent pins or irregular spacings.

Designed for printed circuit mounting, the "ZIP" receptacles are ideal for high volume hand testing, since replacement time and fall-out due to mechanical damage are virtually eliminated. Using one socket, a single test station can process literally millions of devices before the socket has to be replaced.

ENERGY

Everybody is energy-conscious these days and any means by which energy may be saved is rightly commended. It is worth noting that some small changes in the energy scene have occurred over the last two decades, and have been brought about by the humble transistor.

So far as mains powered equipment is concerned the transistor must have saved a considerable amount of energy. An old valve monochrome TV set used to draw about 160 watts from the mains supply whereas a current semiconductor TV requires only some 40 watts. You used to hear tales about the Electricity Generating Board standing by for the extra load when a very popular television show came on the air. Low power TV sets have now made those stories things of the past.

The transistor has caused quite a different state of affairs so far as battery operated equipment is concerned. The old family radio usually ran from the mains; nowadays it is operated from a dry battery because of the convenience of portability. The power consumed by a transistor radio is much lower than that required by the old mains set, but the overall picture here is by no means as clear as a simple comparison in terms of volts and amps would indicate.

A dry battery is an exceptionally inefficient device. A 9 volt battery may, for example, be capable of supplying a current of 30mA for 100 hours. This corresponds to 270 milliwatts for 100 hours, or 27 watt-hours. Very much more than 27 watt-hours would have been expended in preparing the raw materials for the battery and in manufacturing it.

Many pocket calculators use rechargeable batteries, and those with l.e.d. readouts must consume quite a sizeable current when they are switched on. It seems desirable that transistor radios should, as a standard feature, now be produced with rechargeable batteries in the same way as pocket calculators are. The simpler calculators and their charging "mains adaptors" are currently very cheap indeed, and it could even be that the calculator has opened up the way for similarly cheap radios with rechargeable batteries and charging "adaptors".

Apart from energy conservation, the savings in running costs would be more than welcome. If you haven't bought any dry batteries recently, you might find yourself in for a surprise if you take a look at present prices! ■

"Why the short lead?"
"Oh that's to save electricity!"

A.F. MILLIVOLT METER

By
M. V. Hastings

Small self-contained unit. Flat response from 20Hz to 200kHz. 1MΩ input impedance. Measures 0-10mV, 0-100mV and 0-1,000mV r.m.s.

The millivolt meter has only two controls, those being the on-off switch, and the attenuator and battery check switch

When making tests for gain, noise and frequency response on audio equipment it is frequently found that an ordinary multimeter switched to an a.c. volts range is quite inadequate for measuring purposes. Signal levels of only a few millivolts are often involved and these can only be accurately measured with an oscilloscope or an a.f. millivoltmeter. Oscilloscopes and commercially produced millivolt meters can be complex and expensive. A simple home-constructed millivolt meter, such as the one to be described, can on the other hand be built at quite low cost and will give a perfectly adequate performance for most amateur requirements.

The millivolt meter has three ranges: 0-10mV, 0-100mV and 0-1,000mV (1V). It can measure a.f. voltages of as little as a few hundred microvolts with reasonable accuracy, it has an input impedance of about 1MΩ and its frequency response is virtually flat from 20Hz to 200kHz. The high input impedance ensures minimal loading of the circuit under test and the frequency performance makes it suitable for measuring audio frequency responses. Power is obtained from a small 9 volt battery, and a battery check facility is included in the instrument.

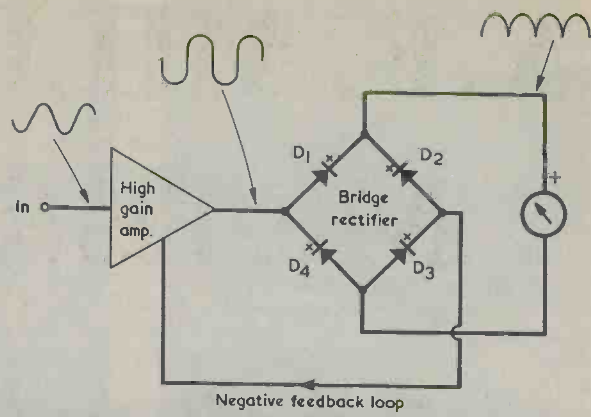


Fig.1. Showing how negative feedback may be used to overcome the effect of forward voltage drop in the rectifier diodes in series with the meter

LINEAR SCALING

At first sight it might be considered that an a.f. millivolt meter would merely require an amplifier whose output was applied to a moving-coil meter by way of a rectifier circuit. In practice, however, it is necessary to incorporate semiconductor diodes in the rectifier circuit and the forward voltage drops in these (about 0.15 volt for germanium and about 0.6 volt for silicon) would result in readings that are hopelessly non-linear.

The problem of forward voltage drop can be eradicated by including the rectifier circuit in an amplifier negative feedback loop, as shown in Fig.1. In this diagram the amplifier has a very high voltage gain and its output is coupled back through a full-wave rectifier and meter circuit to an inverting input. Assume that the amplifier input to which the signal is applied is non-inverting and that it is being taken from zero to a positive voltage. As soon as the input goes fractionally positive the amplifier output will swing highly positive until the forward voltage drops in diodes D1 and overcome. These diodes will then become conductive and the amplifier gain will be controlled by the negative feedback loop. Similarly, for a fractional negative voltage at the input the output will swing negative until the forward voltage drops in D2 and D4 are overcome, whereupon amplifier gain is once more controlled by the negative feedback. When a sine wave input is applied, the amplifier output swings very quickly from conduction in one pair of diodes to conduction in the other pair of diodes as the sine wave passes through each zero crossing point. The result is the waveform shown in Fig.1 at the amplifier output.

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated.)
R1 8.2kΩ
R2 1.8MΩ 10%
R3 2.2MΩ 10%
R4 3.3kΩ ½ watt 2%
R5 330Ω ½ watt 2%
R6 36Ω ½ watt 2%
R7 470Ω
R8 1MΩ
R9 12kΩ
R10 1kΩ pre-set potentiometer, 0.1 watt, horizontal
R11 4.7kΩ
R12 2.2kΩ
R13 100kΩ

Capacitors
C1 100μF electrolytic, 10V. Wkg.
C2 100μF electrolytic, 10V. Wkg.
C3 0.1μF polyester, type C280
C4 10μF electrolytic, 10V. Wkg.
C5 0.1μF polyester, type C280
C6 22μF electrolytic, 10V. Wkg.
C7 10μF electrolytic, 10V. Wkg.

Semiconductors
IC1 LF351
TR1 BC650
TR2 BC650
D1-D4 0A91
D5 1N4001

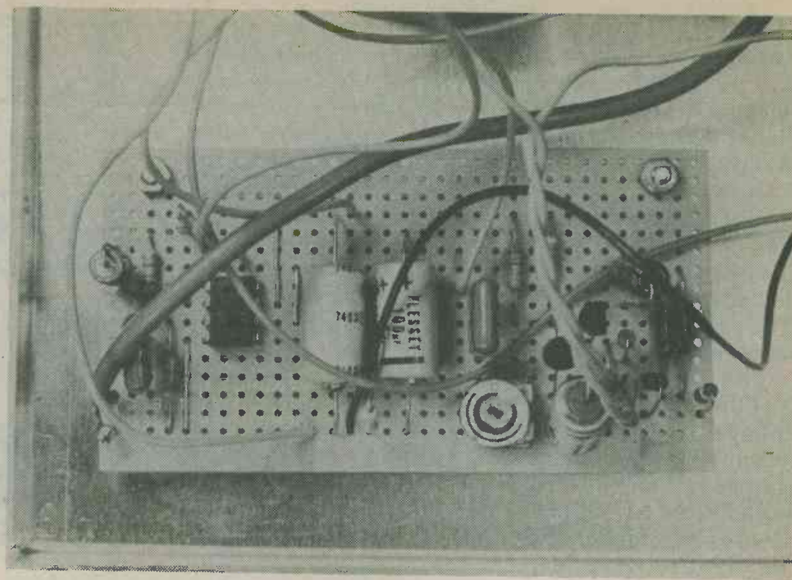
Switches
S1(a)(b) 3-pole 4-way rotary
S2 s.p.s.t. toggle, rotary

Meter
M1 0-100μA meter, 60 x 45mm.

Socket
SK1 3.5mm. jack socket

Miscellaneous
Metal instrument case (see text)
4 cabinet feet
2 control knobs
9-volt battery type PP3
Battery connector
Veroboard, 0.1in. matrix
3.5mm jack plug
Test prod
Crocodile clip
Screened lead
Nuts, bolts, wire, etc.

The Veroboard assembly. This is mounted to the case bottom by means of 6BA bolts and nuts with spacing washers



The current through whichever pair of diodes is conductive passes through the meter, producing a full-wave rectified voltage across it. The meter is then capable of indicating the amplitude of the signal at the amplifier input, and the overall circuit overcomes the effect of the forward voltage drops in the diodes.

FULL CIRCUIT

The full circuit of the millivolt meter appears in Fig.2. IC1 is an input buffer stage which provides the necessary high input impedance for the instrument. Its output is coupled back to its inverting input, giving 100% negative feedback and unity voltage gain.

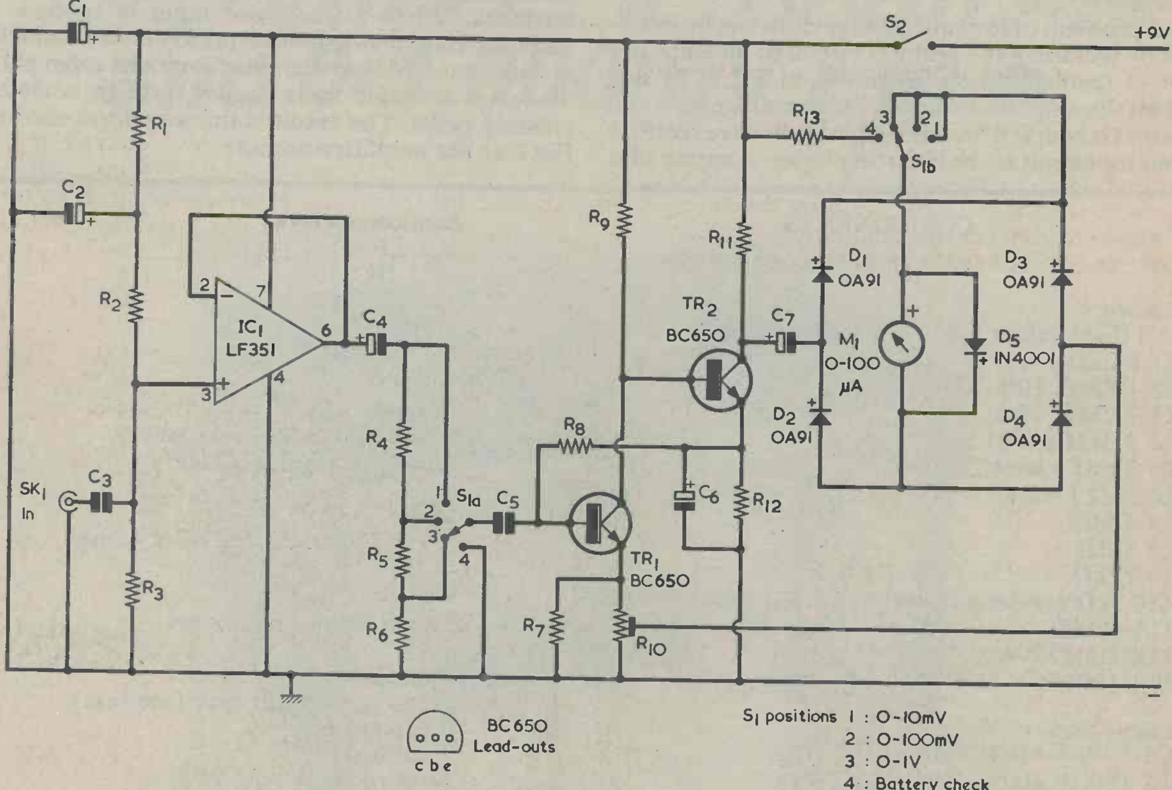


Fig.2. The circuit of the millivolt meter. IC1 is a unity gain input buffer amplifier, and TR1 and TR2 comprise a high gain amplifier with negative feedback from TR2 collector via the meter and rectifier circuit to TR1 emitter. R10 is adjusted to provide the correct overall gain and meter indication

The input signal is fed via C3 to the non-inverting input, which is biased to approximately half the supply rail voltage by the potential divider consisting of R2 and R3. R1 and C2 decouple this divider from the positive rail. The input impedance of IC1 is extremely high, whereupon the input impedance of the instrument itself is equal to R2 and R3 in parallel, which calculates as 0.99MΩ. The input impedance reduces slightly at the higher frequencies due to stray capacitances in the input and test lead wiring and the input capacitance of IC1.

The bifet device type LF351 is chosen for IC1 for two main reasons. One reason is its low noise level and the other is its high slew rate of 13 volts per microsecond. It must be borne in mind that, on the 1 volt range, the input stage may have to handle signals of up to 2.8 volts peak-to-peak at frequencies of several hundred kilohertz. The standard 741 i.c. and similar devices have slew rates of only 0.5 volt per microsecond and would be quite inadequate for handling such signals.

The output from IC1 is coupled via C4 to the 3 stage attenuator consisting R4, R5, R6 and S1(a). This gives attenuation factors of 1, 10 and 100 and, since the following circuitry has an f.s.d. sensitivity of 10mV r.m.s., the attenuator ranges are 10mV, 100mV and 1,000mV f.s.d. The attenuation is in a low impedance part of the circuit and there is no need to provide any frequency compensation to take up the effects of stray capacitance.

The output from the attenuator passes through C5 to TR1 and TR2, which are in a direct coupled common emitter amplifier circuit. The negative feedback path from TR2 collector is through C7, and the rectifier and meter circuit, back to R10 in the emitter circuit of TR1. R10 controls the amount of feedback and the current which flows in the meter and is set up, after the instrument has been built, to give the desired sensitivity.

Diode D5 is connected across the meter to protect it from gross overloading. However, the protection provided is for currents well above f.s.d. level and the same care should be taken to ensure that all readings are within f.s.d. level as would be observed with any other instrument having an analogue readout.

S1(b) connects the meter into the rectifier circuit on the three measuring range positions. On the fourth position it couples the meter positive terminal to R13, whereupon the meter gives a reading of battery voltage with an f.s.d. indication of approximately 10 volts. Since the negative terminal of the meter couples to the negative rail via D4 and R10, across both of which a small voltage will appear, and since R13 is not a close tolerance component, the battery voltage indication is approximate only. The point is not of great importance as only comparative readings are required. The reading given with a new battery should be noted, and the battery should then be replaced later when the reading has dropped by about 2 volts.

The current consumption of the complete circuit is only about 3mA so that, with normal usage, the PP3 9 volt battery should have a relatively long life.

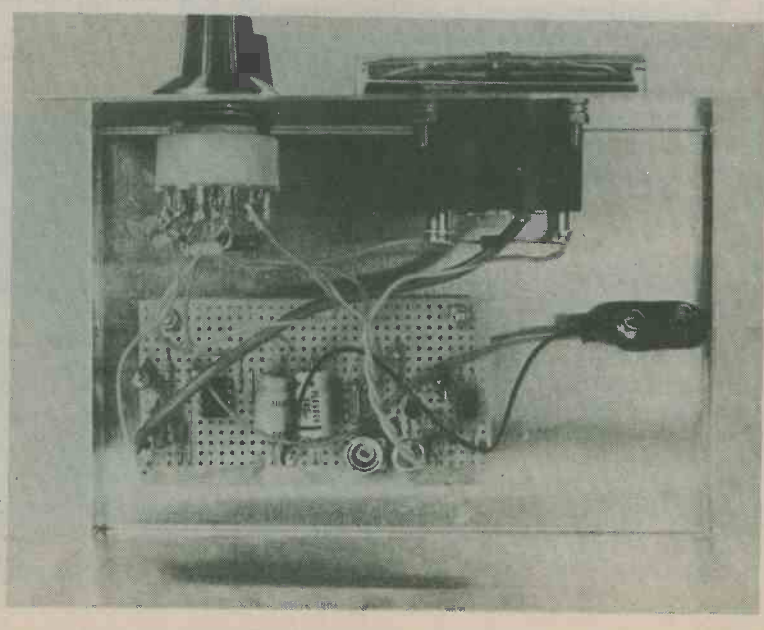
CONSTRUCTION

The prototype is housed in an instrument case which measures 6 by 4 by 3½in. high. This is a case type BC2 available from Harrison Bros. The very simple front panel layout can be seen in the photographs. S1 is mounted to the right, above S2, and the meter is mounted to the left above jack socket SK1. The latter should be a type having an open construction, as opposed to a socket with an insulated body, since the chassis connection for the instrument is provided by its mounting bush and nut. The meter employed requires a circular cut-out in the front panel of 38mm. (1½in.) diameter. This should be made first, after which the positions of the four small mounting holes can be marked out with the aid of the meter itself.

Most of the components are mounted on a piece of 0.1in. Veroboard having 33 holes by 16 copper strips. The Veroboard layout is shown in Fig.3 and the remaining component wiring in Fig.4.

The Veroboard panel is cut out from a larger size with a small hacksaw and the two mounting holes then drilled. The dozen breaks in the copper strips are next made, after which the components and link wires are soldered in place. Diodes D1 to D4 are ger-

Layout inside the case. The Veroboard module is mounted to one side, leaving adequate space for the battery



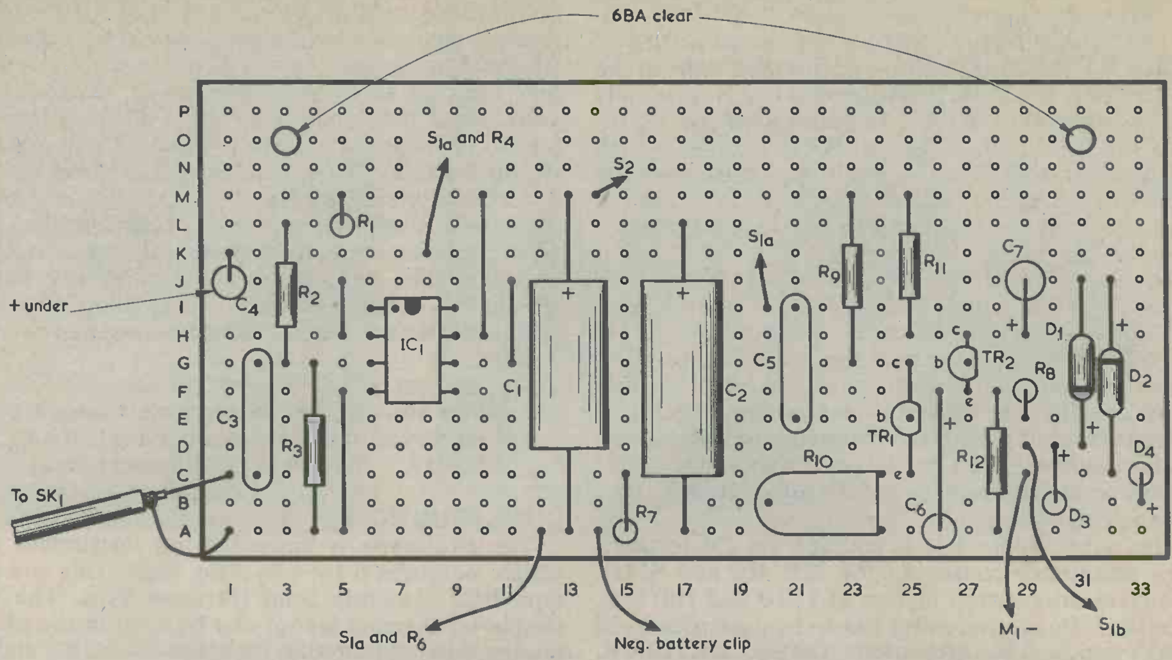


Fig.3. A 0.1in. Veroboard accommodates most of the components employed in the millivolt meter

Wiring to the front panel components

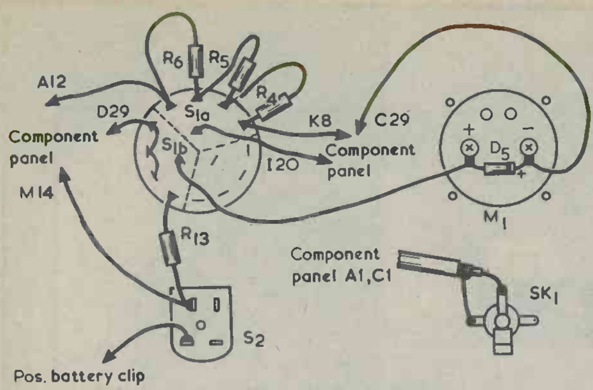
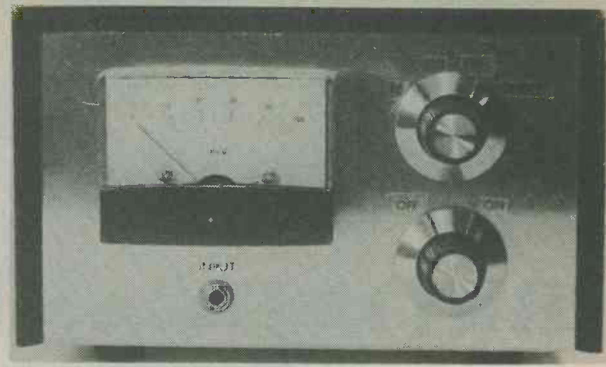


Fig.4. The remaining components are connected to the front panel controls. The letter and number references apply to the corresponding holes in the Veroboard



Input socket SK1 is mounted below the meter on the front panel. The attenuator switch is positioned above the on-off switch

manium types and should not be subjected to excessive heat during soldering. IC1 is not a MOSFET device and does not require any special handling precautions.

Leads of the appropriate length connect from the board to the front panel components, as indicated. To prevent instability, a screened lead must be employed between the Veroboard and the input jack socket. A Veropin can be inserted in the board to take the braiding connection. Alternatively a short bridging lead can be used between the board and the braiding.

The completed board is mounted on the bottom of the case with the mounting holes toward the front. Spacing washers are required on the mounting bolts to keep the board underside clear of the case bottom.

The wiring shown in Fig.4 can then be completed. As will be seen, R4, R5 and R6 are soldered to the tags of S1(a). Care should be taken not to overheat these three resistors when soldering in case this causes shifts in their values. S1 is a 3-pole 4-way switch with only 2 of the poles used. Confirm the positioning of the inner and outer tags with a continuity tester before wiring to this switch as relative tag positioning may differ from that shown in the diagram.

The test lead for the millivolt meter will normally consist of a short length of flexible screened wire connected to a jack plug which fits into SK1. The braiding will connect to a short lead and crocodile clip which clips to the chassis of the equipment under test, and the centre conductor to a test prod. Other types of test lead can of course be made up.

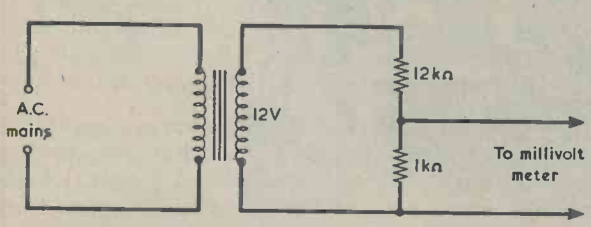


Fig.5. A calibrating voltage for setting up the millivolt meter may be obtained from a number of sources. One method of providing the voltage, illustrated here, is described in the text

CALIBRATION

After the instrument is completed, it has to be set to the correct sensitivity by adjusting R10. An a.f. signal of known amplitude is applied to the instrument with S1 at one of the attenuator settings, after which R10 is adjusted for the corresponding meter reading. The input voltage should have an amplitude equal to at least half the meter f.s.d. indication and preferably one which is close to f.s.d.

Before checking out the millivolt meter or embarking on any calibration set R10 so that its slider is at the end of the track which connects to the emitter of TR1. This is fully clockwise in the upper view of Fig.3. The millivolt meter then has minimum sensitivity. Set S1 to the required attenuator position with the known calibration signal applied to the input, and then slowly advance R10 slider until the meter gives the appropriate reading. The unit is then ready for use. Avoid taking R10 slider very close to the earthy end of its track, i.e. the end which connects to the negative rail, as this could cause high currents to flow in the meter and the potentiometer track.

The calibrating voltage of known amplitude can be obtained from a number of sources. An excellent choice would be an a.f. signal generator having an accurately calibrated output. If a more simple type of a.f. signal generator is used it will probably be necessary to measure its output and this can be done with a test meter switched to a low a.c. volts range. The signal generator is set to give a measured output of 1 volt r.m.s., and the millivolt meter is set up on its 1 volt range.

Another means of obtaining a calibrating signal voltage consists of using a mains transformer having a low voltage secondary. A typical example is shown in Fig.5 in which a transformer with a nominal secondary voltage of 12 volts is connected to a potential divider consisting of a 12kΩ and a 1kΩ resistor in series. The voltage across the 1kΩ resistor will be one-thirteenth of that across the secondary. If the measured secondary voltage is found to be, say, 12.5 volts r.m.s., then the voltage across the 1kΩ resistor will be 0.96 volt r.m.s. This voltage can be used for calibrating the millivolt meter on its 1 volt range. ■

FIRST WOMAN BROADCASTER EVER

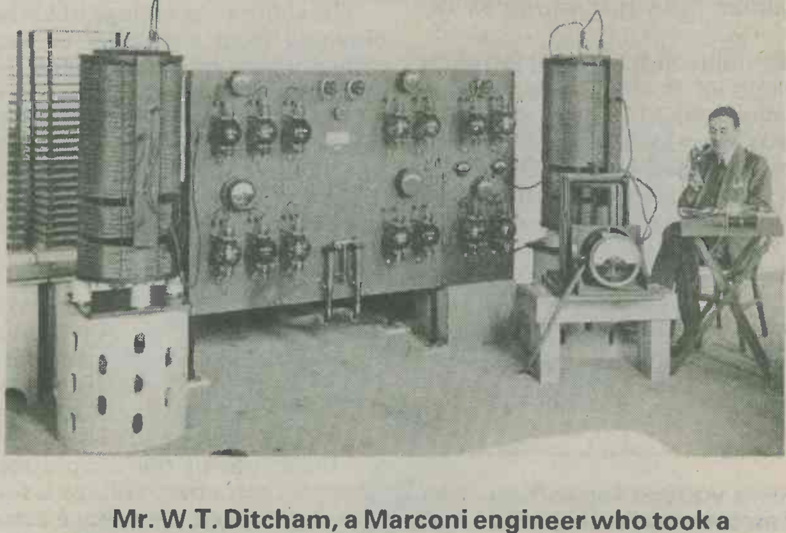
Miss Winifred Sayer, first ever woman broadcaster, photographed at the time of her historic transmissions in 1920 from the Marconi Works in Chelmsford. (Courtesy Marconi)

By
T. Neville

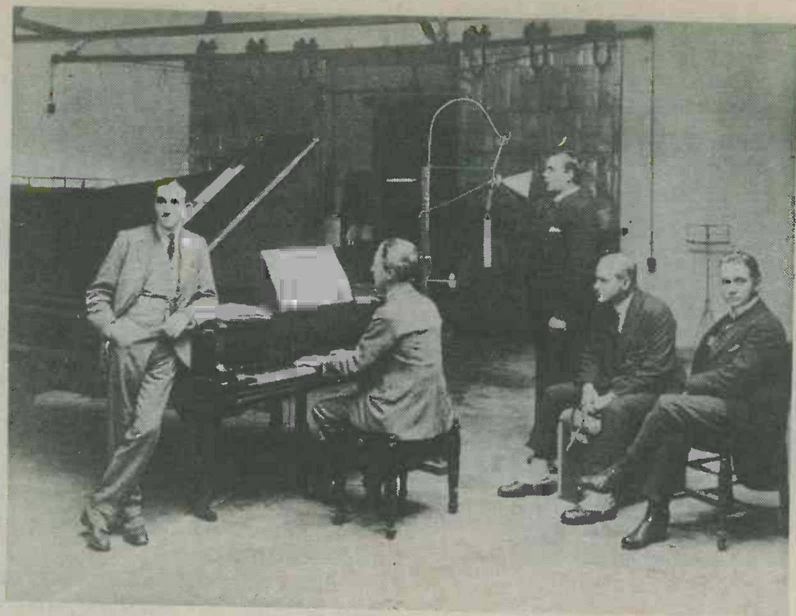
1980 marks the 60th anniversary of early radio history.

The very first woman radio broadcaster in the world, Mrs. Winifred Collins, nee Sayer, celebrated the 60th anniversary this year of her historic achievement and was presented with the silver Marconi Medal to commemorate the event by Sir Robert Telford, Managing Director of GCE-Marconi Electronics.

Mrs. Collins and her husband Felix, both over 80 years old, returned to the place, now the premises of Marconi Communication Systems Limited, where during February and March 1920 she had taken part in the earliest experiments in broadcasting. Mrs. Collins also visited the spot where, later that year, Dame Nellie Melba and Lauritz Melchior, both international opera stars, performed their early broadcasts. Mrs. Collins reminisced about attending the Melba broadcast and seeing Dame Nellie kick away the carpet which had been laid out because it spoiled the acoustics.



Mr. W.T. Ditcham, a Marconi engineer who took a leading part in the broadcasts, using the 6 kilowatt transmitter employed in the telephony experiments



Tenor Lauritz Melchior singing in a later broadcast experiment in 1920. Leaning against the piano on the left is W.T. Ditcham

60 YEARS BACK

In 1920 Captain H.J. Round of Marconi's Wireless Telegraph Company, forerunner of today's GEC-Marconi groupof companies, was granted a licence to experiment with wireless telephony. Wireless telegraphy had been in use for some years, notably at sea, and morse messages between ships and Marconi land stations around the coast of the United Kingdom were commonplace. The war of 1914-1918 had increased tempo of experiments and innovation, and telephony, the use of voice transmission, had been proved to work in much the same way as morse telegraphy.

Captain Round decided to try "broadcasting" voice transmissions in 1920 to see if they could be picked up by stations around Britain. He therefore ordered all the Marconi stations to listen out and report on anything they heard on 2,800 metres, the Poldhu, Cornwall, station wavelength, "between 1100 and 1130 and between 2000 and 2300 Greenwich Mean Time for two weeks starting February 23rd, Saturday night and all Sunday excepted". The broadcasts were to consist of readings and news items presented by Mr. W.T. Ditcham, a Marconi engineer who had already carried out the first transatlantic voice transmissions to Canada from Ireland.

To vary the programme, Round decided to try out both singers and musical instruments and he asked Mr. E. Cooper, another Marconi who was a tenor in a local goup, "The Funnions", to get a team together.

The group that Cooper organised included a local oboist, Mr. A.V.W.B.Beeton, a clarinettist, Mr. W. Highby, and Miss Winifred Sayer, who also sang with "The Funnions". All these men and the lone woman, Miss Sayer, were the first broadcasters in the world in

One of the unsolicited reports from radio amateurs in the United Kingdom which confirmed the value of the experiments. Mr. E. Gage of Gloucester sent this card on 3rd. March 1920. (Courtesy Marconi)

Mrs. Winifred Collins and her husband Felix pictured at home in Chelmsford in 1980 with souvenirs of her radio broadcasts of 60 years before

their particular field. Miss Sayer, who later that year married and became Mrs. Collins, sang three times during the fortnight and was paid ten shillings a time.

The programmes went ahead as planned, unannounced except to the Marconi land stations. Their success was immediate, and unsolicited reception reports were sent in by large numbers of radio amateurs as far away as Norway and Portugal. The transmissions were also reported by many ships at sea up to 1,500 miles away.

Broadcasting, after this successful start, had a very rapid development. In January 1922 the Marconi Development Section at Writtle, now Marconi Research Laboratories, opened "Station 2MT Writtle", to broadcast from 8 p.m. to 8.30p.m. each Tuesday. A little later a second station, the famous "2LO", opened at Marconi House, Strand, London.

On 15th November 1920 the British Broadcasting Company Limited, which had been formed earlier that year, took over the operation of "2LO" and broadcasting came of age.

Mrs. Collins settled down to married life in Chelmsford. Whilst her husband pursued his career as a civil servant and rose also to the rank of Superintendent of Special Constabulary, Mrs. Collins raised a family. She came out of obscurity twice to recall those far-back days for Leslie Baily's "Scrap Book for 1920" and for "Late Night Extra", both for the BBC.

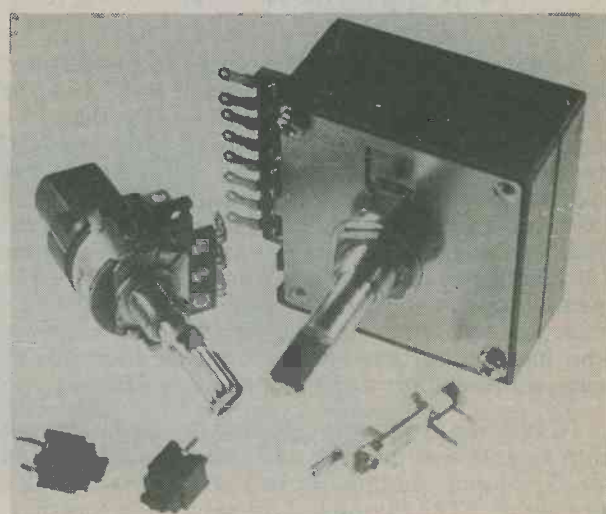
Now, on the 60th anniversary of the world's first broadcasts, Mrs. Collins' well deserved true position in radio history is being put before the public. ■

NEW PRODUCTS

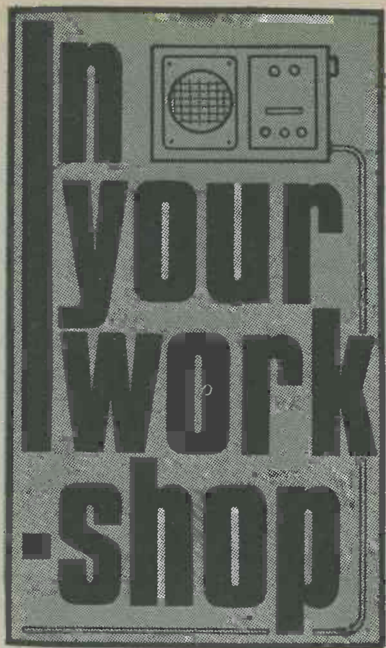
Now available from Ambit International, 200 North Service Road, Brentwood, Essex, CM14 4SG, are a full range of ALPS components including switches, potentiometers, moving-coil meters and loudspeakers. The accompanying photograph shows just a few of the items in the new range. Working clockwise from bottom left, the components are two miniature keyboard switches, a rotary potentiometer with push-pull on-off switch, a 7-bit rotary encoder and a miniature multi-turn trimpot.

Ambit are also adding to their existing large stocks of high capacitance ratio tuning diodes by stocking the new KV1235 and KV1236 sets of diodes from Toko. The KV1235 is a matched triplet set of diodes and the KV1236 is a matched pair. These are supplied in a unique "snap-apart" packaging with which matched diodes are physically joined together until required, whereupon they may be easily separated.

The new diodes have a guaranteed 16.8:1 tuning capacitance ratio with only 1 to 9 volt d.c. bias. A typical swing is from 25pF to 500pF (20:1).



A selection of potentiometers and switches in the ALPS range, now being marketed by Ambit International.



4-BAND WAVECHANGE SWITCHING

Tracing push-button switching circuitry

"What you have to remember," stated Smithy, "is that when one button goes down another button comes up."

His assistant Dick looked disconsolately at the service manual spread out before him. It showed the circuit of the 4-waveband radio with which he had been struggling for nearly an hour until, in desperation, he had called in the aid of Smithy. The set refused to work on the f.m. band and it was only after painstaking continuity checks around the push-button wavechange switch printed board assembly that Smithy had finally been able to trace the snag. Once it had been located the fault was quite infuriatingly obvious. Smithy ran Dick's soldering iron over a hair-line crack in the copper of the printed board and the set was immediately returned to full f.m. operation. Such are the vagaries of servicing. Expenditure in effort on the set: some one and three-quarter man-hours. Replacement item: 0.01 pence worth (plus VAT, of course) of 60:40 solder.

"Those push-button wavechange switch circuits really have me beat," sighed Dick.

"As I say," replied Smithy, "what you have to remember with them is that when you push one button down another button comes up."

"It's all very well saying that," retorted Dick bitterly. "But when you look at the circuit of the set, all you can see are sections of the push-button wavechange switch peppered all over the diagram. They're in everywhere, amongst the coils, the padding capacitors, the ferrite aerial, everywhere."

"Dispersing the sections of the switch throughout the circuit makes things much clearer."

"Clearer?"

"Of course," said Smithy. "If you drew all the wavechange switch sections in one block and had lines going from this to all the circuit points that are switched, the circuit would look like Clapham Junction!"

"Well, I still think these wavechange switching circuits are very hard to understand," retorted Dick with certainty. "For instance, we've just got this set working again, but I simply haven't got the faintest clue as to how the vavechange switching worked."

PUSH BUTTONS

Smithy looked at his watch.

"We've already spent quite enough time on this set," he remarked. "I don't feel like devoting further time to explaining how its wavechange switching works."

"Oh, come on, Smithy. It won't take you long and it will help me in sorting out any future circuits of the same type I have to work on."

Smithy hesitated.

"If I'd had a better idea," went on Dick quickly, "of how to sort out push-button wavechange switching circuits I might have even been able to clear up this one myself and not call you in."

Smithy cast a despairing look towards the electric light bulb which hung over his assistant's bench.

"All right then," he conceded. "If my giving you this gen improves your future servicing performance then my time will, I suppose, be well spent."

"I'm certain it will be."

Smithy glanced at Dick irritably.

"Don't push it," he remarked. "Anyway, the set we've been looking at has the sort of wavechange switching circuit you're liable to encounter in many sets covering long waves, medium waves and f.m. However, it has one interesting oddity in that it also has a short wave band which covers 5.6 to 6.3MHz only, which takes in the 49 metre broadcast band. Now, the f.m. front-end employs an r.f. amplifier transistor and a mixer-oscillator transistor in quite a standard circuit, and we don't need to look at that front-end in detail because all the wavechange switching is external to it. It is when we start looking at the long, medium and short wave switching that things begin to get involved." (Fig.1.)

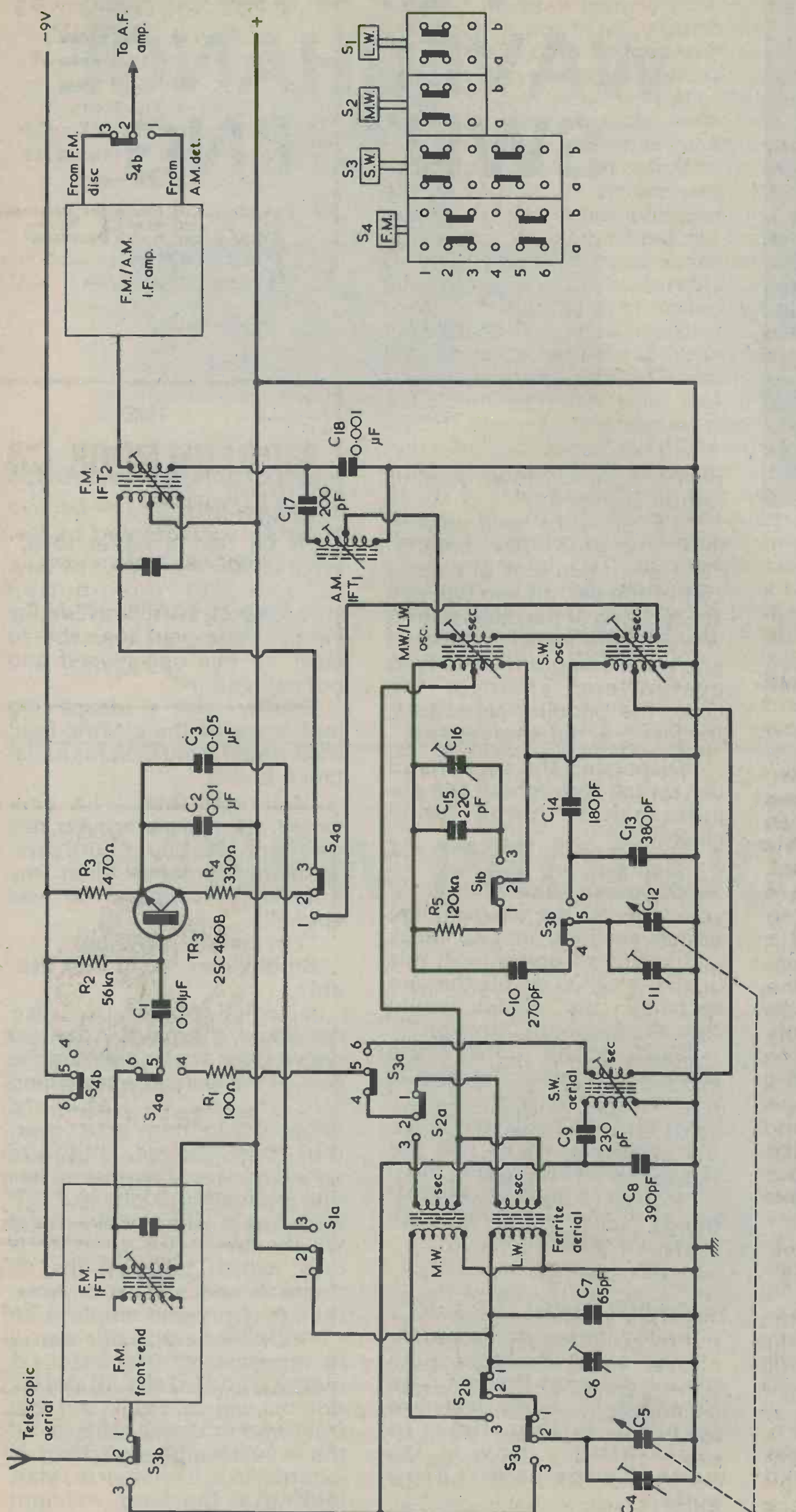


Fig. 1. Push-button wavechange switching circuit for a 4-waveband radio. The two variable capacitors are ganged with a further two variable capacitors in the f.m. front-end which are not shown. This is a simplified version of the switching circuit employed in the Ferguson Model 3188 transistor portable radio.

"Fair enough," said Dick, settling himself comfortably on his stool. "Kindly explain the involvements!"

"I will," replied Smithy irately, "if you would just belt up for a minute. These involvements are the sort of thing you encounter in many medium and long wave switching circuits. Now, let's start off by looking at the circuit as a whole. The circuit has been drawn to show the situation when the f.m. button is pressed down and all the other buttons are up. So, the individual switch sections spread throughout the diagram correspond to the f.m. button down and the other three buttons up. The diagram includes the switch assembly itself and, as you can see, the contacts on the f.m. and short wave parts are numbered 1 to 6, and those on the medium and long wave parts 1 to 3. The switch parts are themselves labelled S1 to S4, and are subdivided into (a) and (b)."

"Let's trace the circuit with the f.m. button pressed," said Dick keenly, his interest now fully aroused.

"As you like," said Smithy obligingly. Now that he was launched on his subject he had completely forgotten his annoyance with his assistant. "Before I do, though, I have to remind you that the f.m. intermediate frequency is 10.7MHz, and that the a.m. intermediate frequency is 470kHz. Both frequencies are amplified by a common f.m.-a.m. i.f. amplifier. Let's start tracing! The first part's dead easy. Starting at the telescopic aerial, this is coupled into the f.m. front-end by contacts 1, 2 and 3 of S3(b), which are shown in the position given by the short wave button when it's up."

"Hey, hang on a minute!" interrupted Dick. "There's something queer already. If having the short wave button up connects the aerial to the f.m. front-end, the aerial will connect to the f.m. front-end on medium and long waves as well."

"So what?" replied Smithy. "You don't use the telescopic aerial on medium and long waves, you use the ferrite rod aerial."

"Oh yes, of course," said Dick. "I'd forgotten about that. Carry on, Smithy!"

"The next easy bit," stated Smithy, "is at contacts 4, 5 and 6 of section S4(b). This switch section simply applies power to the f.m. front-end and obviously does so only when the f.m. button is down. Incidentally, this receiver has the positive supply rail instead of the negative rail at chassis potential, which makes things a little topsy-turvy if you're used to circuits where the negative rail connects to chassis."

"I can cope with that," said Dick. "I see that contacts 4, 5 and 6 of S4(a) connect the first f.m. i.f. transformer inside the front-end to the base of TR3 via a 0.01μF capacitor, and that contacts 1, 2 and 3 of S4(a) connect the collector of TR3 to the second f.m. i.f. transformer. That seems to be clear enough. TR3 is acting as a common emitter amplifier between the first and second 10.7MHz i.f. transformers."

"Correct," said Smithy. "And the transistor is called TR3 because TR1 and TR2 are inside the f.m. front-end. Right, that's dealt with three of the contact sections on the f.m. push-button."

"The fourth one is on the right," broke in Dick excitedly. "It connects the output of the 10.7MHz f.m. discriminator at the end of the common i.f. amplifier to the a.f. amplifying stages. Hey, this push-button switch business isn't so hard after all! The f.m. discriminator output only goes to the a.f. stages when the f.m. button is pushed down. Press any of the other three buttons and the f.m. button goes up to connect the 470kHz a.m. detector output to the a.f. stages."

"You're getting the hang of things," said Smithy approvingly. "These push-button wavechange switches are a bit like exercises in simple logic. We want the a.m. detector output to go to the a.f. stages on short, medium and long waves, and we *could* fit contact sections to these three buttons to do just that. But it's a lot easier to use a single contact section on the f.m. button alone, because that button *has* to go up when any of the other three buttons is pushed down."

"I see what you mean."

"Well," went on Smithy, "that clears up what goes on in this circuit when we select the f.m. band. From now on, we can forget about the f.m. front-end because we know that on short, medium and long waves contacts 4, 5 and 6 of S4(b) cut the supply to the front-end, and contacts 4, 5 and 6 of S4(a) uncouple its i.f. output from the base of TR3. Also, contacts 1, 2 and 3 of S4(a) disconnect the collector of TR3 from the second 10.7MHz i.f. transformer. These last two contact sections do something else around TR3 when the f.m. button goes up, and we'll be able to see what that is in a minute."

SHORT WAVES

"Let's see what takes place," said Dick eagerly, "if we press the short wave button."

"Okay. Well, the first thing that occurs then is that contacts 1, 2 and 3 of S3(b) connect the telescopic aerial through C9 to the tuned winding of the short wave aerial coil. Also, contacts 1, 2 and 3 of S3(a) connect that tuned winding via C9 to the tuning capacitor, C5, and its parallel trimmer, C4. Capacitor C8 is now across the variable capacitor and this, in company with C9 will be effective in producing the limited tuning range of 5.6 to 6.3MHz which is given with this particular set." (Fig.2(a).)

"That's two of the short wave push-button switch sections used up," said Dick. "What about the remaining two?"

Smithy studied the diagram. "Contacts 4, 5 and 6 of S3(b)," he announced, "couple the remaining gang of the tuning capacitor, C12, to the tuned winding of the short wave oscillator coil. The two fixed capacitors, C13 and C14, ensure that the oscillator tuning has the same sort of limited frequency range as has the aerial tuning." (Fig.2(b.)

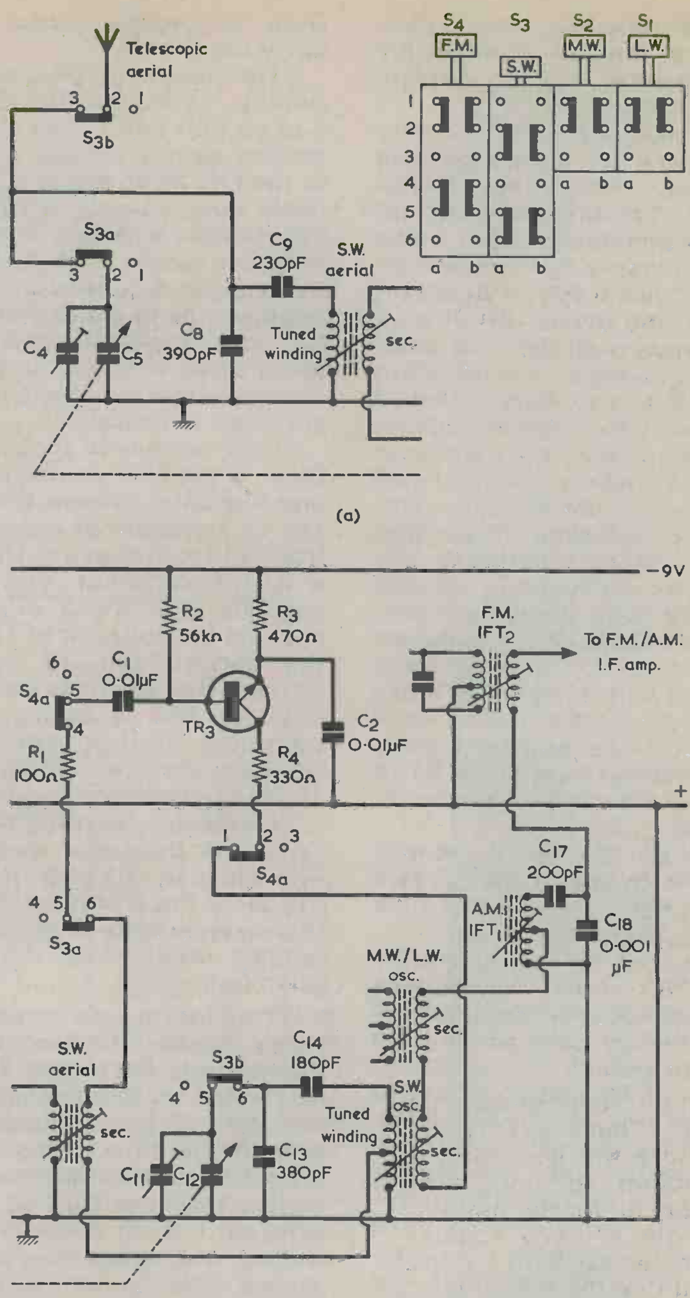


Fig.2(a). When short waves is selected, the aerial circuit is changed as shown here

(b). The corresponding changes in the oscillator circuit and around TR3

"There's a tap in that oscillator tuned winding," said Dick, "and it connects to the coupling winding on the short wave aerial coil."

"That's correct," confirmed Smithy. "To make things easier, untuned coupling windings can be referred to as 'secondary' windings. So the bottom end of the aerial coil secondary goes to the tap in the oscillator tuned winding. The top end of that aerial coil secondary is now taken by contacts 4, 5 and 6 of S3(a) and the low value resistor, R1, and then via contacts 4, 5 and 6 of the f.m. button, S4(a), to the base of – would you believe it? – our old friend TR3!"

"Blimey," said Dick, scratching his head. "That was an i.f. amplifier transistor for f.m. just now."

"I know," grinned Smithy. "Another thing is that contacts 1, 2 and 3 of the f.m. button S4(a) now take the collector of

TR3, via the series 330Ω resistor, R4, to the lower end of the short wave oscillator coil secondary."

Dick shivered.

"There's something unnatural here," he complained. "I'm not at all certain I like this one little bit."

"We persevere," continued Smithy inexorably. "As you can see, the upper end of the short wave oscillator coil secondary connects to the lower end of the medium and long wave oscillator coil secondary. And the upper end of *that* secondary connects to the first 470kHz a.m. intermediate frequency transformer. Which, by the way, happens in this set to have a single winding rather than the two windings you normally associate with a transformer."

Smithy beamed at his bemused assistant.

"Do you," he went on gently, "see what has happened?"

Dick's brow furrowed deeply as he struggled with the implications of the circuit. Suddenly, he thumped the bench with his fist.

"Why, of course, of course!" he called out. "It's sticking out a mile! TR3 is now acting as the mixer-oscillator in conjunction with the short wave aerial and oscillator coils!"

"That's it," chuckled Smithy, pleased. "That's exactly it. If you ignore the secondary of the medium and long wave oscillator coil for the moment, you've got a pretty standard a.m. mixer-oscillator circuit here. All that the medium and long wave oscillator coil secondary does is to insert some series impedance in the collector circuit of TR3. This won't, of course, stop the short wave oscillator circuit from working."

But Dick was still perplexed.

"It's a very neat switching arrangement indeed," he remarked after some further thought. "But why have it in the first place?"

"Because," said Smithy, "in an a.m.-f.m. radio you normally need one more i.f. amplifying transistor for f.m. than you do for a.m. With this circuit TR3 provides that transistor when f.m. is selected. On a.m. it is switched in instead as the a.m. mixer-oscillator."

Dick absorbed this information.

"Very crafty," was his final comment. "Very crafty indeed."

MEDIUM WAVES NEXT

"Shall we do medium waves now?" queried Smithy.

"Yes please."

Now that he had mastered the dual functioning of TR3, Dick was patently avid for further information.

"We'll next," stated Smithy, "press down the medium wave button. Once again we set in motion a little bit of switching logic. When we press the medium wave button down, up pops the short wave button. Contacts 1, 2 and 3 of S3(a) disconnect the short wave aerial tuned winding from tuning capacitor C5, contacts 4, 5 and 6 of S3(b) disconnect the short wave oscillator tuned winding from the other gang, C12, and contacts 4, 5 and 6 of S3 (a) disconnect the secondary of the short wave aerial coil from the base of TR3. So we can now forget all about the short wave coils. The only bit of short wave inductance staying in circuit is the secondary of the short wave oscillator coil, and this remains in series with the secondary of the medium and long wave oscillator coil. That short wave secondary won't stop the medium and long wave coil from oscillating."

"Let's begin with the aerial."

"Okeydoke. Well, this will be the medium wave ferrite aerial winding. There are only two contact sections on the medium wave switch.

When the medium wave button goes down, contacts 1, 2 and 3 of S2(b) connect the medium wave ferrite aerial tuned winding, via contacts 1, 2 and 3 of the short wave S3(a), which is now up, to the tuning capacitor C5. So that's got the medium wave aerial tuned circuit all set up. Just like that. The top end of the medium wave aerial secondary couples via contacts 1, 2 and 3 of S2(a), and contacts 4, 5 and 6 of S3(a), which is also up, to the base of TR3. The bottom end of the secondary connects to a tap in the tuned winding of the medium and long wave oscillator coil, whereupon you've got the same mixer-oscillator

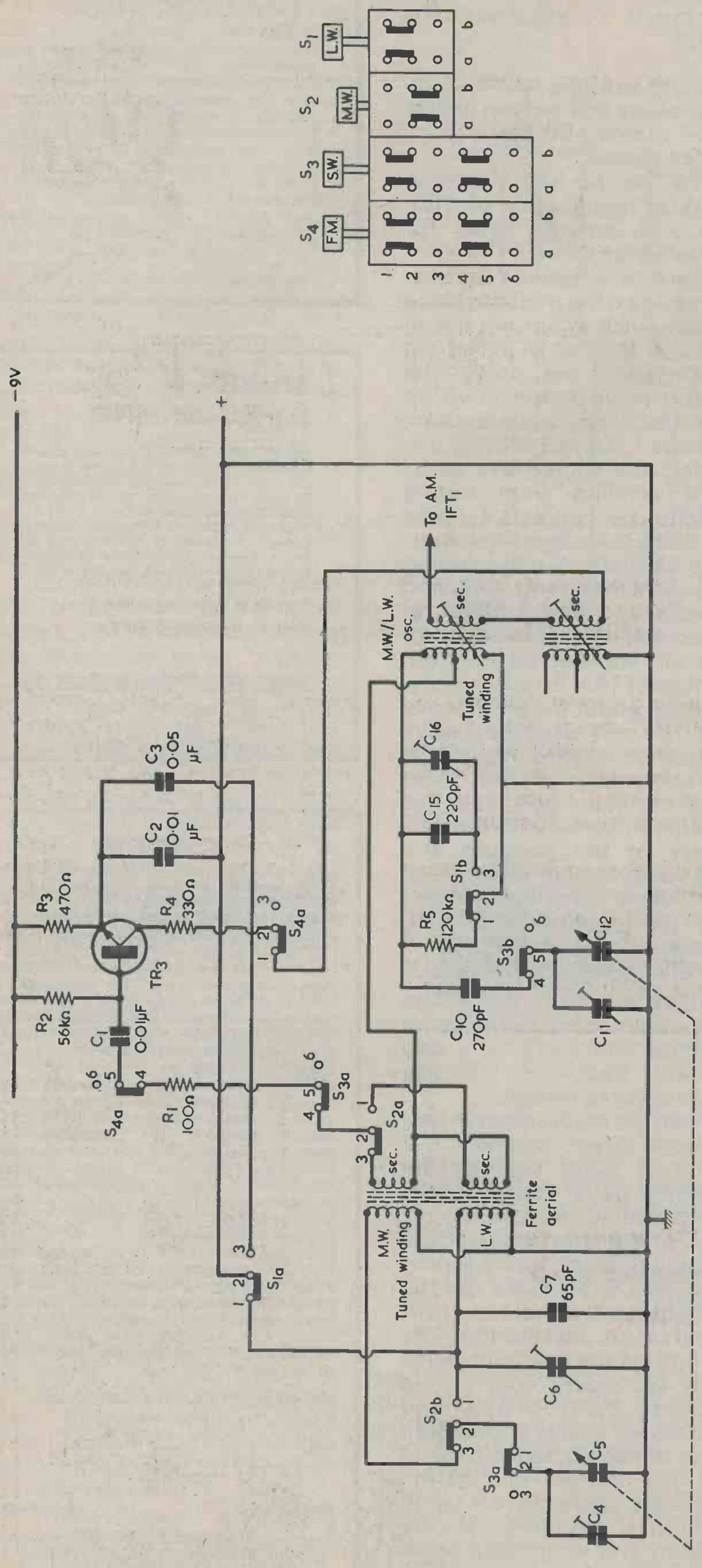


Fig.3. Switching to medium waves brings in the medium wave ferrite aerial and oscillator coils

transistor set-up that we saw just now for short waves." (Fig.3.)

"The oscillator coil is tuned by C12 in series with C10," said Dick slowly.

"That's right. C10 is a padding capacitor. I should have mentioned that contacts 4, 5 and 6 of S3(b) complete that little circuit."

"The long wave contact sections do something too," stated Dick suspiciously.

"Gee Whiz," grinned Smithy. "Where, for instance?"

"Well," said Dick, "the contacts of S1(b) connect a 120kΩ resistor across the oscillator tuned winding."

"That's to damp down the oscillator a bit. Oscillator efficiency needs to be reduced slightly on medium waves."

"Oh."

There was silence for a moment.

"Also," said Dick, "the contacts of S1(a) short-circuit the long wave aerial tuned winding."

"That prevents absorption effects on medium waves. If the long wave tuned winding is left tuned by its self-capacitance and, in this circuit, by C6 and C7, it can well become resonant at a frequency in the medium wave band, and this would upset medium wave tuning. Okay?"

"Yep. I'm still not too happy about that 120kΩ resistor, though."

FINALLY LONG WAVES

"I'll do something about that very shortly," promised Smithy. "All right to go onto long waves?"

"Yes please."

"The long wave button goes down on long waves," said Smithy, "Whereupon the medium wave button comes up. The contacts of the medium wave S2(b) connect the long wave aerial tuned winding to the tuning capacitor, C5, and the contacts of the medium wave S2(a) couple the long wave aerial secondary to the base of TR3. With the consequence that the long wave aerial inductances are selected even before we start looking at what the contacts on the long wave button switch do themselves. If we

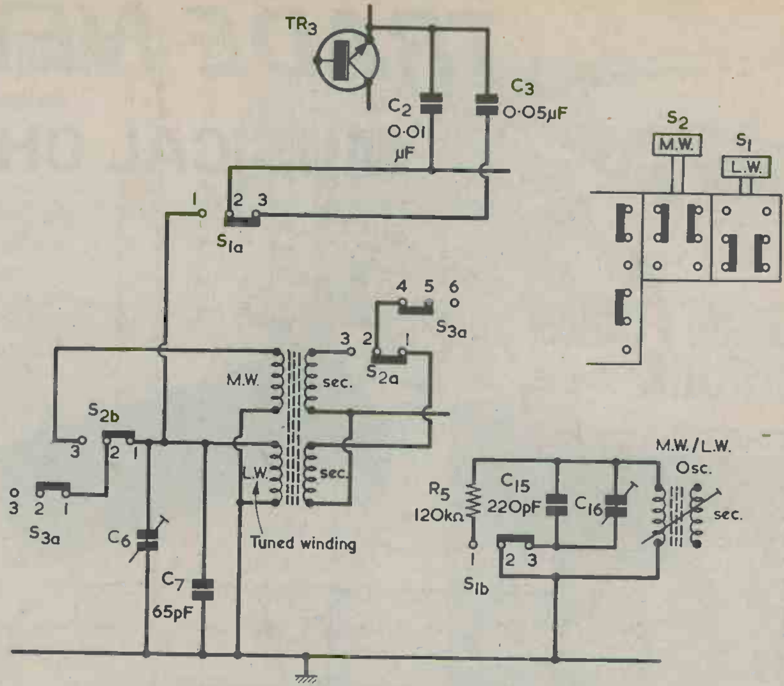


Fig.4. Circuit changes, in switching from medium to long waves, are brought about by the two contact sections of S2 and the two contact sections of S1

look at S1(a) we see that this takes the short off the long wave aerial tuned winding and, instead, causes an extra 0.05μF of bypass capacitance, given by C3, to be connected between the emitter of TR3 and chassis. The other section, S1(b) connects C15 and trimmer C16 across the medium and long wave oscillator tuned winding, whereupon this extra capacitance causes the oscillator coil to run at the lower frequencies needed at long waves. It also disconnects that 120kΩ resistor you've been on about." (Fig.4.)

"Hah!"

"The outcome of this switching is that the mixer-oscillator stage is now all set up for long wave operation. The long wave aerial coil is selected, extra capacitance has been added across the oscillator tuned circuit to bring it down in frequency, and TR3 still functions as the mixer-oscillator."

Dick cast an enquiring glance at the Serviceman.

"That 120kΩ resistor?" queried Smithy.

Dick nodded.

"Well," said Smithy, "because of the added capacitance in the oscillator tuned circuit, oscillator efficiency won't be as high on long waves as on medium waves unless something is done about it. The most obvious measure is the inclusion of the 120kΩ resistor on medium waves. This reduces oscillator efficiency on medium waves so that it is more comparable with oscillator efficiency on long waves. The circuit constants will be designed such that oscillation on medium waves without the 120kΩ resistor could be excessive. The second thing that's done is to add the 0.05μF bypass capacitor to TR3 emitter on long waves. This will make TR3 just a little more efficient at long waves, which is the whole object of the exercise."

Smithy placed the flat of his hand over the service diagram circuit.

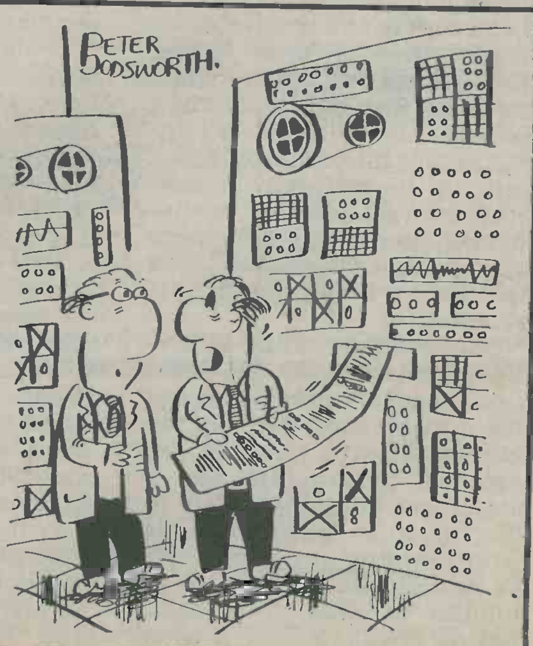
"And that," he stated with an air of finality, "is the lot."

NORMAL SERVICE

"Well thanks, Smithy," said Dick appreciatively, "for explaining all that. I can see the whole switching set-up clearly now. Even when you know what the switch contacts do, the switching process is still quite complex though, isn't it?"

"It is," agreed Smithy, "but it is better to look at a complicated circuit and be able to trace it out than it is to look at that circuit with the feeling that it is something which is simply beyond you. Some complicated electronic circuits have to be unravelled carefully. The process may be slow, but if you *can* do it then *you* are the master of that circuit."

With which words of wisdom Smithy left his assistant and returned to his own bench, to catch up yet again with work which had been interrupted by Dick's endless quest for knowledge. ■



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TRADE NEWS

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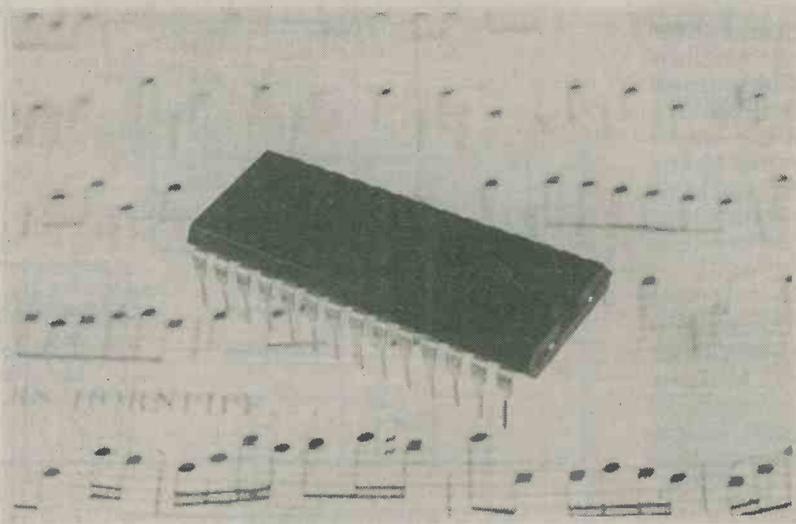

The General Instrument Microelectronics AY-3-1350 tunes synthesiser. In its standard form this is programmed to play up to 25 short tunes and 3 chimes, but other options are available including a single tune of 251 notes.

The 28-pin i.c. with the musical background in the photograph is the General Instrument Microelectronics AY-3-1350 tunes synthesiser, and it can be programmed to generate up to 28 different tunes. It operates from a single 5-volt supply and is suitable for use in toys, musical boxes, door chimes and other novelty products. Based on a standard General Instrument Microelectronics microcomputer circuit, it is normally mask-programmed during manufacture. Its repertoire consists of popular or classical tunes selected for their international acceptance.

The standard circuit is pre-programmed with 25 short tunes plus 3 simple chimes, but this may be altered to suit the application. It is possible, for instance, to program just a single tune consisting of up to 251 notes. In addition to its programming options, the AY-3-1350 can operate in a number of different modes, making it suitable for a wide variety of applications. In a door chime installation it can be connected to play any one of 25 pre-selected tunes from the front door bell push, with one of 5 tunes from the back door. In addition a third bell push can be wired to play a simple chime.

The device also has applications in low cost paging systems, where key personnel are each allocated one tune. A brief tune played over loudspeakers in a noisy factory would be much easier to recognise than a spoken name.

The circuitry may be connected so that there is virtually no power consumption in the stand-by condition, apart from minimal transistor leakages. When any bell push is activated the circuit "powers up", plays a tune and then automatically powers down again to conserve batteries.

With the addition of an external ROM or PROM the standard AY-3-1350 will play almost any tune or tunes desired. These could be 28 tunes averaging 8 notes each or one tune of up to 251 notes. This would provide about 1 to 2 minutes' worth of music. For significant production runs General Instrument Microelectronics state that they can integrate the external tunes into the main synthesiser to give a 1-chip system.

The pitch, tone and speed of tunes played by the AY-3-1350 can be set independently by simple external components. These may be either pre-set or brought out as potentiometers for user control. Either switch closures may be used to trigger the device or a capacitive touch switch can be employed.

The pre-programmed tunes in the standard circuit include "Toreador", "William Tell", "Hallelujah Chorus", Beethoven's 5th, "Star Wars", "Santa Lucia" and "God Save The Queen". The manufacturers are General Instrument Microelectronics Limited, Regency House, 1-4 Warwick Street, London W1R 5WB.

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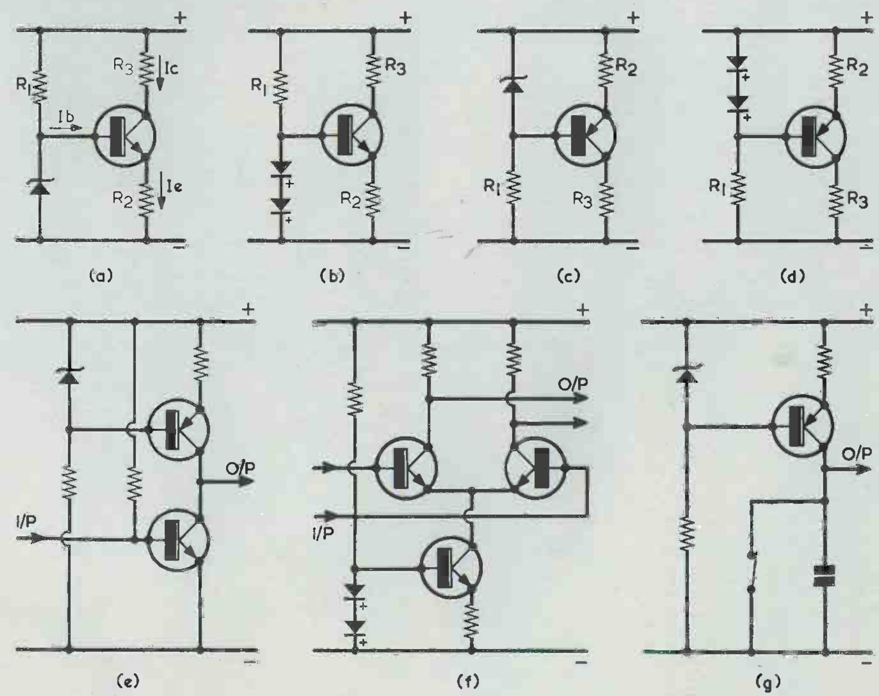
CONSTANT CURRENT GENERATOR

There are a few electronic circuit devices which can produce what is virtually a "constant current", and a very commonly encountered arrangement is shown in (a). This incorporates a high gain n.p.n. transistor. The voltage at the transistor base is held constant by the zener diode and, since there is a fixed voltage drop across the transistor base-emitter junction, the voltage across R2 becomes constant as well. The emitter current is the sum of the collector current and the base current. The base current is very much smaller than the collector current, and it can be assumed that the emitter and collector currents are equal.

R2 is given a value which causes the required constant current to flow in the emitter circuit. R3 is the load and a constant collector current will flow in it for all values from zero to the highest resistance which, taking into account the maximum voltage available for it, allows the constant current to flow.

An alternative means of providing the fixed voltage at the transistor base employs two or more forward biased silicon diodes, as in (b). The circuits of (c) and (d), which use a p.n.p. transistor, provide a constant current to the negative rail.

In (e) a constant current generator forms the collector load of a common emitter amplifier, and gives it an extremely high voltage gain. The constant current generator in (f) provides the common emitter load for a long tailed pair at the input of a differential amplifier. The constant current is shared between the two input transistors. In (g) the constant current generator charges a capacitor when the switch opens, producing a linearly rising ramp voltage.



(a) (b) (c) (d) (e) (f) (g)