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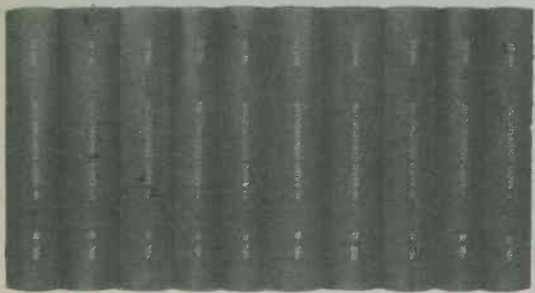

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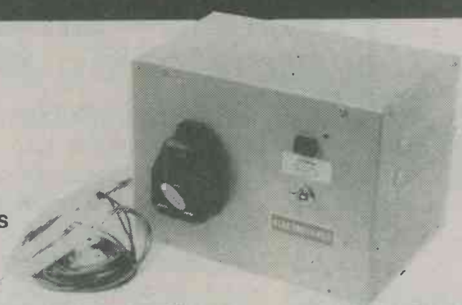

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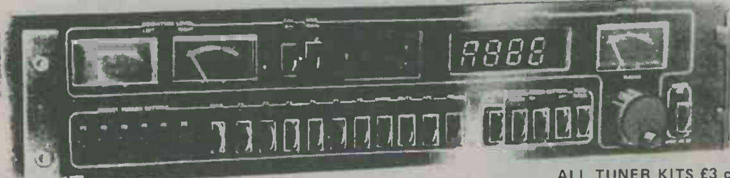

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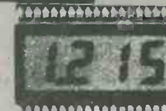

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*Various other DFM systems described in our catalogue part 2 - including a one chip solution to providing digital display of FRG7 kHz dial, combined with clock/timers etc.*

## PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved enviromental sealing. £37.00+ *£2.96vat.

## VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design - but using standard 3rd OT crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +£3.90vat .

## ETI - REMCON RADIO CONTROL

A tried and tested RC system with a full set of supporting hardware from a well known manufacturer. Please send for details - and watch our ads for further news of developments in RC products.

## Radio and Audio Modules : The biggest range/ best specs:

**EF5801/3/4** 6 stage varicap tunerheads with LO feed and various levels of sophistication. New 5804 include pin AGC loop 'on board'. 5801:£17.45+£2.18vat - 5803:£19.75+£2.47vat 5804:£24.95 +£3.18vat. *Frequencies in 40-180MHz on appcn.*

**EF5402** 4 stage varicap with TDA1062, compound FET/Bipolar input stage, low noise, balanced mixer, pin agc, osc output. A worthy successor to the 5400. £10.75+£1.34vat

*The 5402 is available centred on a wide range of frequencies from 30MHz to 180MHz. Non standard units £14.75+£1.84 - 3 weeks.*

**8319** 4 stage varicap tunerhead from Larsholt using MOSFET RF and mixer stages. New temperature compensated oscillator for wide ranges of ambient temperature £13.45+£1.68vat

**7252** Complete Larsholt FM tuner less stereo decoder. £26.50+£3.31vat

**7253** Stereo FM tunerset from Larsholt with FET head. (as 7252)

**944378** Hyperfi stereo decoder. The very best. £19.95+£2.49vat

**911223** Pilot cancel stereo decoder, priced to make the MC1310 as obsolete as it now deserves to be.£12.50+£1.56vat

**Inotec 1**-A fully DC tuned and switched LW/MW/FM stereo tuner to interface with synthesiser control etc.A first! Details OA

## COMPONENTS for Radio and Audio ICs, HMOS etc.

The list is too long to attempt here, but AMBIT specializes in all types of semiconductor for radio reception, including devices operating from DC to 5GHz. New low cost SBL1 diode ring mixers (equiv case MD108 etc) -first with HMOS fets, now with a PCB for DC amplifier, and offset sense and protection relay for speakers. See catalogue and updates for most info, pse send an SAE for information on anything you cannot find in catalogues.

| Radio ICs | cost | +vat | Stereo ICs | cost | +vat | AF power ICs | cost | +vat |
|---|---|---|---|---|---|---|---|---|
| CA3089E | 1.94 | 24 | MC1310P | 1.50 | 19 | LM380N | 1.00 | 12 |
| CA3189E | 2.45 | 30 | uA758 | 2.20 | 27 | TBA810AS | 1.09 | 14 |
| HA1137W | 2.20 | 27 | CA3090A | 2.75 | 34 | TDA2002 | 1.95 | 24 |
| SN76660 | 0.75 | 9 | HA1196 | 3.95 | 49 | TBA820M | 0.75 | 9 |
| TDA1090 | 3.35 | 42 | HA11223 | 4.35 | 54 | from the general list: | | |
| TDA1083 | 1.95 | 24 | KB4437 | 4.35 | 54 | LEDs:all colours and | | |
| TDA1220 | 1.40 | 17 | KB2224 | 2.75 | 34 | low prices | | |
| SL6640 | 2.75 | 34 | Preamp ICs/switches | | | 2SJ48/2SK134 HMOS | | |
| MC3357 | 3.12 | 39 | TDA1028 | 3.50 | 44 | 9.90 +£0.80 vat(Pair) | | |
| HA1197W | 1.40 | 17 | TDA1029 | 3.50 | 44 | Signal fets/transistors and | | |
| MC1496 | 1.25 | 16 | TDA1074 | 4.14 | 52 | TOKO COILS & FILTERS! | | |
| LM373/4 | 3.75 | 49 | KB4438 | 2.22 | 28 | | | |

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering .

## TTL:Standard AND LP SchottkY

All prices listed in pence *

| | 'N' | 'LSN' | | 'N' | 'LSN' | | 'N' | 'LSN' | | 'N' | 'LSN' | | 'LSN' |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7400 | 13 | 20 | 7455 | 35 | 24 | 74126 | 57 | 44 | 74185 | 134 | | 74377 | 124 |
| 7401 | 13 | 20 | 7460 | 17 | | 74128 | 74 | | 74188 | 275 | | 74378 | 93 |
| 7402 | 14 | 20 | 7463 | | 124 | 74132 | 73 | 78 | 74190 | 115 | 92 | 74379 | 130 |
| 7403 | 14 | 20 | 7470 | 28 | | 74133 | | 29 | 74191 | | | 74368 | 37 |
| 7404 | 14 | 24 | 7472 | 28 | | 74136 | | 40 | 74192 | 105 | 180 | 74390 | 140 |
| 7405 | 18 | 26 | 7473 | 32 | 38 | 74138 | | 60 | 74193 | 105 | 180 | 74393 | 140 |
| 7406 | 38 | | 7474 | 27 | 38 | 74139 | | 60 | 74194 | 105 | 187 | 74395 | 139 |
| 7407 | 38 | | 7475 | 38 | 40 | 74141 | 56 | | 74195 | 95 | 137 | 74396 | 133 |
| 7408 | 17 | 24 | 7476 | 37 | 38 | 74142 | 265 | | 74196 | 99 | 110 | 74398 | 180 |
| 7409 | 17 | 24 | 7478 | | 38 | 74143 | 312 | | 74197 | 85 | 110 | 74399 | 150 |
| 7410 | 15 | 24 | 7480 | 48 | | 74144 | 312 | | 74198 | 150 | | 74445 | 92 |
| 7411 | 20 | 24 | 7481 | 86 | | 74145 | 65 | 97 | 74199 | 160 | | 74447 | 90 |
| 7412 | 17 | | 7482 | 69 | | 74147 | 175 | | 74247 | | 90 | 74490 | 140 |
| 7413 | 30 | | 7483A | | 110 | 74148 | 109 | 191 | 74248 | | 90 | 74668 | 110 |
| 7414 | 51 | | 7484 | 97 | | 74150 | 99 | | 74249 | | 93 | 74670 | 249 |
| 7415 | | 24 | 7485 | 104 | 99 | 74151 | 64 | 84 | 74251 | | 90 | | |
| 7416 | 30 | | 7486 | | 40 | 74153 | 64 | 54 | 74253 | | 105 | | |
| 7417 | 30 | | 7489 | 205 | | 74154 | 96 | | 74257 | | 108 | | |
| 7420 | 16 | 24 | 7490 | 33 | 90 | 74155 | 54 | 110 | 74258 | | 153 | | |
| 7421 | 29 | 24 | 7491 | 76 | 110 | 74156 | 80 | 110 | 74259 | | 420 | | |
| 7422 | 24 | 24 | 7492 | 38 | 78 | 74157 | 67 | 55 | 74260 | | 153 | | |
| 7423 | 27 | | 7493 | 32 | 99 | 74158 | | 60 | 74261 | | 353 | | |
| 7425 | 27 | | 7494 | 78 | | 74159 | 210 | | 74266 | | 40 | | |
| 7426 | 36 | 27 | 7495A | 65 | 99 | 74160 | 82 | 130 | 74273 | | 124 | | |
| 7427 | 27 | 29 | 7496 | 58 | 120 | 74161 | 92 | 78 | 74275 | | 312 | | |
| 7428 | 35 | 32 | 7497 | 185 | | 74162 | 92 | 130 | 74279 | | 52 | | |
| 7430 | 17 | 24 | 74100 | 119 | | 74163 | 92 | 78 | 74283 | | 120 | | |
| 7432 | 25 | 24 | 74104 | 63 | | 74164 | 104 | 130 | 74290 | | 90 | | |
| 7433 | 40 | 32 | 74105 | 62 | | 74165 | 105 | | 74293 | | 95 | | |
| 7437 | 40 | 24 | 74107 | 32 | 38 | 74166 | | | 74295 | | 120 | | |
| 7438 | 33 | 24 | 74109 | 63 | 38 | 74167 | 20 | | 74298 | | 100 | | |
| 7440 | 17 | 24 | 74110 | 54 | 54 | 74168 | | | 74324 | | 157 | | |
| 7441 | 74 | | 74111 | 68 | | 74169 | | 200 | 74325 | | 242 | | |
| 7442 | 70 | 99 | 74112 | | 38 | 74170 | 230 | 200 | 74326 | | 247 | | |
| 7443 | 115 | | 74113 | | 38 | 74172 | 625 | | 74327 | | 237 | | |
| 7444 | 112 | | 74114 | | 38 | 74173 | 170 | | 74352 | | 100 | | |
| 7445 | 94 | | 74116 | 198 | | 74174 | 87 | 120 | 74353 | | 100 | | |
| 7446 | 94 | | 74118 | 83 | | 74175 | 87 | 110 | 74362 | | 715 | | |
| 7447 | 82 | 89 | 74119 | 119 | | 74176 | 75 | | 74365 | | 49 | | |
| 7448 | 56 | 99 | 74120 | 115 | | 74177 | 78 | | 74366 | | 49 | | |
| 7449 | | 99 | 74121 | 25 | | 74180 | 85 | | 74367 | | 43 | | |
| 7450 | 17 | | 74122 | 46 | 57 | 74181 | 165 | 350 | 74368 | | 49 | | |
| 7451 | 17 | 24 | 74123 | 48 | 73 | 74182 | 160 | | 74373 | | 77 | | |
| 7453 | 17 | | 74124 | | 137 | 74183 | | 210 | 74374 | | 77 | | |
| 7454 | 17 | 24 | 74125 | 38 | 44 | 74184 | 135 | | 74375 | | 60 | | |

### VOLTAGE /PSU REGULATORS

| | |
|---|---|
| 7800 series | 95p |
| 7900 series | £1 |
| 78M series (TO220 pack) | 90p |
| 78LCP series | 35p |
| 78MGT2C | 175p |
| 79MGT2C | 175p |
| 723C | 65p |
| NE550A | 73p |
| L200 | 195p |

### MAINS FILTERS

| | |
|---|---|
| 1Amp IEC | 4.83 |
| 6Amp IEC | 5.83 |
| 5A wirein | 3.87 |

All BS approved

Requests for the next issue of the catalogue now being "booked" for despatch immediately it is ready (about November). Please send 50p to reserve a copy. (Part 3)

IMPORTANT: ALL OSTS PRICES EXCLUDE VAT - CURRENTLY 8% - BUT MAY BE CHANGED BY THE TIME YOU READ THIS. PLEASE REMEMBER TO ADD VAT, and 25p POSTAGE !!

## CD4000 CMOS

| | | | | | |
|---|---|---|---|---|---|
| 4000 | 17p | | | | |
| 4001 | 17p | 4059 | 563p | 4522 | 149p |
| 4002 | 17p | 4060 | 115p | 4527 | 157p |
| 4006 | 109p | 4063 | 109p | 4528 | 102p |
| 4007 | 18p | 4066 | 53p | 4529 | 141p |
| 4008 | 80p | 4067 | 400p | 4530 | 90p |
| 4009 | 58p | 4068 | 25p | 4531 | 141p |
| 4010 | 58p | 4069 | 20p | 4532 | 125p |
| 4011 | 17p | 4070 | 20p | 4534 | 614p |
| 4012 | 17p | 4071 | 20p | 4536 | 380p |
| 4013 | 55p | 4072 | 20p | 4538 | 150p |
| 4014 | 95p | 4073 | 20p | 4539 | 110p |
| 4016 | 52p | 4075 | 20p | 4541 | 141p |
| 4017 | 80p | 4076 | 90p | 4543 | 174p |
| 4018 | 80p | 4077 | 20p | 4549 | 399p |
| 4019 | 60p | 4078 | 20p | 4553 | 440p |
| 4020 | 93p | 4081 | 20p | 4554 | 153p |
| 4021 | 82p | 4082 | 20p | 4556 | 77p |
| 4022 | 90p | 4085 | 82p | 4557 | 386p |
| 4023 | 17p | 4086 | 82p | 4558 | 117p |
| 4024 | 76p | 4089 | 150p | 4559 | 388p |
| 4025 | 17p | 4093 | 50p | 4560 | 218p |
| 4026 | 180p | 4094 | 190p | 4561 | 65p |
| 4027 | 55p | 4096 | 105p | 4562 | 530p |
| 4028 | 72p | 4097 | 372p | 4566 | 159p |
| 4029 | 100p | 4098 | 110p | 4568 | 281p |
| 4030 | 58p | 4099 | 122p | 4569 | 303p |
| 4031 | 250p | 4160 | 90p | 4572 | 25p |
| 4032 | 100p | 4161 | 90p | 4580 | 600p |
| 4033 | 145p | 4162 | 90p | 4581 | 319p |
| 4034 | 200p | 4163 | 90p | 4582 | 164p |
| 4035 | 120p | 4174 | 104p | 4583 | 84p |
| 4036 | 250p | 4175 | 95p | 4584 | 63p |
| 4037 | 100p | 4194 | 95p | 4585 | 100p |
| 4038 | 105p | 4501 | 23p | | |
| 4039 | 250p | 4502 | 91p | | |
| 4040 | 83p | 4503 | 69p | | |
| 4041 | 90p | 4506 | 51p | | |
| 4042 | 85p | 4507 | 55p | | |
| 4043 | 85p | 4508 | 248p | | |
| 4044 | 80p | 4510 | 99p | | |
| 4045 | 150p | 4511 | 149p | | |
| 4046 | 130p | 4512 | 98p | | |
| 4047 | 99p | 4513 | 206p | | |
| 4048 | 60p | 4514 | 260p | | |
| 4049 | 55p | 4515 | 300p | | |
| 4050 | 55p | 4516 | 125p | | |
| 4051 | 65p | 4517 | 382p | | |
| 4052 | 65p | 4518 | 103p | | |
| 4053 | 65p | 4519 | 57p | | |
| 4054 | 120p | 4520 | 109p | | |
| 4055 | 135p | 4521 | 230p | | |

## Micromarket

| 6800 series | | | | | |
|---|---|---|---|---|---|
| 6800P | 6.50 | 8216 | 1.95 | 2114 | £10 |
| 6820P | £6 | 8224 | 3.50 | 2708 | £ |
| 6850P | 2.75 | 8228 | 4.78 | **Development** | |
| 6810P | £4 | 8251 | 6.25 | MEK6800 | £220 |
| 6852 | 3.65 | 8255 | 5.40 | TK80 | £306 |
| **8080 series** | | **MEMORIES** | | AMI, Signetics | |
| 8080 | 6.30 | 2102 | £1 70 | TI, Intersil, | |
| 8212 | 2.30 | 2112 | £3 40 | Harris etc OA | |
| | | 2513 | £7 54 | | |
| | | 4027 | £5 78 | | |

### MISC. LSI/Scalars/DVMs

NE555 30p NE556 78p NE558 180p
LM3909 72p 95H90DC /320MHz 7 80p
11C90DC /650MHz £14 00
ICM7216BIPI 8 decade 10MHz DFM/timer with direct LED drive and all counter features £19.82

| | |
|---|---|
| ICM7217AIBI 4 decade programmable cnt | £9 50 |
| ICM7207 clock pulse generator IC | £4 95 |
| ICM7208 7 decade counter/display driver | £14 95 |
| ICM7106CP LCD DVM IC (3½ digit) | £9 55 |
| ICM7106CPK LCD DVM KIT | £24 80 |
| ICM7107CP LED DVM IC | £9 55 |
| ICM7107CPK LED DVM KIT | £20 65 |
| SP8629 divide by 100.200MHz scalar | £4 20 |
| MSL2318 divide by 100 to 175MHz min divide by 10 to 45MHz min | £4 20 |

PLEASE REMEMBER TO ADD 8% VAT TO ITEMS LISTED UNDER OSTS

## LINEARS non consumer

| | | | |
|---|---|---|---|
| **BIMOS** | | LM324N | 71p |
| CA3130E | 84p | LM339N | 66p |
| CA3130T | 90p | LM348N | 186p |
| CA3140E | | LM3900N | 60p |
| CA3140T | 72p | 709HC to5 | 64p |
| CA3160E | 90p | 709PC dil | 36p |
| CA3160T | 99p | 710HC to5 | 65p |
| **Op amps** | | 710PC dil | 59p |
| LM301AH | 67p | 723CN | 65p |
| LM301AN | 30p | 741CH to5 | 66p |
| LM308H | 121p | 741CN 8dil | 27p |
| LM308N | 97p | 747CN | 70p |
| LM318H | 279p | 748CN | 36p |
| LM318N | 224p | NE531T | 120p |
| | | NE531N | 105p |

## OPTO 7 seg displays

**0.43" High Efficiency HP:** 233p

5082 7650 red CA
5082 7653 red CC
5082 7660 yellow CA
5082 7663 yellow CC
5082 7670 green CA
5032 7673 green CC

**0.3" Standard HP** 147p

5082 7730 red CA
5082 7740 red CC

**0.5" Fairchild**

| | |
|---|---|
| FND500 red CC | 150p |
| FND507 red CA | 150p |

**Current news:** Work continues apace on our HMOS PA kit, and by the time this is published - we expect to be about to launch the product in a style that matches the Mark III system. The unit uses separate transformers and power supplies, and includes a DC offset sensing circuit combined with slow switch-on using a relay. We introduce the HyperFi FM IF with this advert - and a separate leaflet is available on request with an SAE. All new pricelist revision also available with an SAE. The Mullard DC controlled tone/volume and switch ICs with a 'more than HiFi' specification are in stock at last - together with reams of data (over 50 pages now). Also, RC enthusiasts will be interested to learn that we are supplying parts for various kits now.

**Terms:** CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Access facilities for credit purchases.

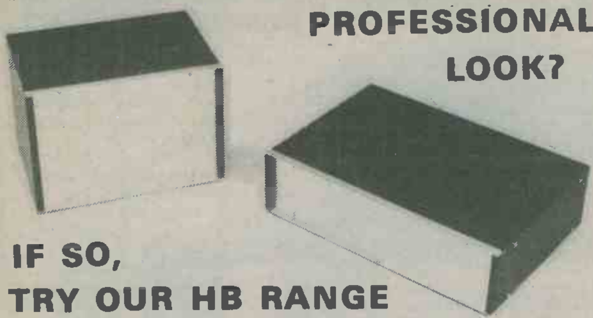
**Catalogues:** Ambit. Part 1 45p. Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p. All inc PP etc. Full data service described in pricelist supplements.

**Hours/phone:** We are open from 9am -7pm for phone calls. Callers from 10am to 7pm. Administrative enquiries 9am to 4.30pm please (not Saturdays) Saturday service 10am to 6pm.

AMBIT catalogues are guaranteed to contain the most up-to-date and best informed comment on modern developments and advances in the field of radio and audio. There is no competetive publication that even approaches the broad range of parts/information on modern techniques.

**ambit® international** 2 Gresham Road, Brentwood, Essex.

## DO YOUR PROJECTS LACK THE PROFESSIONAL LOOK?



## IF SO, TRY OUR HB RANGE

Instrument cases to give any project a professional look. The four separate top, bottom and end panels are made of black p.v.c. coated steel. Front panel and top and bottom trim are satin anodised aluminium for a neat finish; back panel is in plain aluminium. The whole case, including screws, comes in a flat package and may be assembled in minutes.

DIMENSIONS IN INCHES

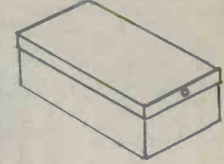
| Model | Width | Depth | Height | Price |
|---|---|---|---|---|
| HB1 | 9 | 6 | 3 | £4.87 |
| HB2 | 9 | 6 | 4½ | £5.27 |
| HB3 | 9 | 6 | 6 | £5.63 |
| HB4 | 12 | 8 | 3 | £5.98 |
| HB5 | 12 | 8 | 4½ | £6.80 |
| HB6 | 12 | 8 | 6 | £7.26 |

## ALUMINIUM BOXES

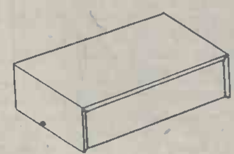
Aluminium box with lid and screws.

| Model | Length | Width | Height | Price |
|---|---|---|---|---|
| AL1 | 3 | 2 | 1 | 52p |
| AL2 | 4 | 3 | 1½ | 62p |
| AL3 | 4 | 3 | 2 | 72p |
| AL4 | 6 | 4 | 2 | 81p |
| AL5 | 6 | 4 | 3 | 94p |
| AL6 | 8 | 6 | 2 | £1.27 |
| AL7 | 8 | 6 | 3 | £1.43 |

(Dimensions in inches)



## INSTRUMENT CASES



BC Range consists of black P.V.C. coated steel top cover with bevelled front edge, u-shaped aluminium chassis and two fixing screws.

| Model | Length | Width | Height | Price |
|---|---|---|---|---|
| BC1 | 6 | 4½ | 2 | £1.61 |
| BC2 | 6 | 4 | 3½ | £1.74 |
| BC3 | 8 | 5½ | 2½ | £1.99 |
| BC4 | 10 | 6½ | 3 | £2.60 |

(Dimensions in inches)

### ELECTROLYTICS

| Axial | | Radial | |
|---|---|---|---|
| 1/25v | 4p | 1/50v | 4p |
| 10/25v | 4p | 10/50v | 4p |
| 22/16v | 4p | 22/25v | 4p |
| 100/10v | 5p | 33/63v | 5p |
| 100/16v | 6p | 47/16v | 5p |
| 220/25v | 7p | 100/35v | 6p |
| 330/25 | 8p | 220/16v | 6p |
| 470/6.3v | 8p | 220/63v | 8p |
| 470/16v | 8p | 330/25v | 8p |
| 1000/16v | 16p | 470/6.3v | 8p |
| 1500/25v | 20p | 470/16v | 8p |
| 2200/10v | 20p | 1000/25v | 16p |
| 3300/16v | 25p | 1000/35v | 20p |
| 4700/10v | 30p | | |
| 15000µF 10v CAN | | | Price: 50p |

### LINEAR I.C,s

| | | | |
|---|---|---|---|
| LM741 | 18p | SN76660N | 75p |
| TAA350 | £1.00 | SN76013 | £1.20 |
| TBA120A | 50p | SN76023N | £1.20 |
| TBA820 | 80p | SN76033N | £1.20 |
| T706 BPC =TBA641 | £1.00 | SN76110N | 75p |
| | | SN76131N | £1.30 |

### TRANSISTORS

| | | | | | |
|---|---|---|---|---|---|
| AD161/2 MP | 60p | BC183A | 8p | BF194 | 8p |
| BC107 | 8p | BC207B | 10p | BF195 | 8p |
| BC108A | 8p | BC212L | 6p | BF198 | 10p |
| BC148 | 6p | BC213LB | 6p | BF200 | 13p |
| BC149C | 7p | BC308 | 10p | BFY50 | 12p |
| BC149S | 8p | BC338 | 8p | BU208 | 90p |
| BC171B | 8p | BC547 | 10p | TIP32B | 25p |
| BC172B | 7p | BD183 | 70p | 2N2906 | 10p |
| BC182LB | 8p | BF137 | 10p | 2N3055 | 55p |

### DIODES

| | | | |
|---|---|---|---|
| BZY 88C 6v2 | 5p | BZY 88C 20v | 5p |
| BZY 83C 6v2 | 5p | BZY 88C 22v | 5p |
| BZY 88C 7v5 | 5p | BZY 79C 68v | 5p |
| BZX 83C 7v5 | 5p | 1N914 | 3p |
| BZY 88C 8v2 | 5p | 1N4148 | 2p |
| BZX 79C 9v1 | 5p | 1N4150 | 2p |
| BZY 88C 10v | 5p | 1N4004 | 4p |
| BZY 88C 15v | 5p | 1N4005 | 5p |
| OA91 | 3p | | |

### HORIZONTAL SUB-MIN PRESETS

100 ohms, 1k, 10k, 470 ohms, 4k7, 22k, 47k. Price: 4p each

### TANTALUM BEAD CAPACITORS

| | | | |
|---|---|---|---|
| .22/35v | 6p | 10/16v | 8p |
| .33/35v | 6p | 15/16v | 8p |
| .47/35v | 6p | 22/6.3v | 8p |
| 6.8/35v | 6p | 47/6.3v | 8p |

### TTL

| | | | | | |
|---|---|---|---|---|---|
| 7401 | 8p | 7438 | 25p | 74107 | 16p |
| 7402 | 8p | 7441 | 25p | 74122 | 25p |
| 7404 | 9p | 7442 | 34p | 74123 | 42p |
| 7405 | 9p | 7447 | 25p | 74151 | 32p |
| 7406 | 16p | 7450 | 9p | 74153 | 29p |
| 7409 | 9p | 7486 | 14p | 74154 | 35p |
| 7410 | 6p | 7490 | 32p | 74164 | 35p |
| 7412 | 12p | 7491 | 18p | 74175 | 35p |
| 7416 | 14p | 7492 | 23p | 74192 | 33p |
| 7420 | 9p | 7493 | 18p | 74193 | 38p |
| 7430 | 9p | 7495 | 45p | 74194 | 33p |
| | | 74196 | 36p | | |

### MIXED PACKS OF COMPONENTS

60 Polyester Caps. Price: £2.00
100 Electrolytic Caps. Price: £3.00
Approx. 500 resistors. Price: £2.50

Standard Rotary Potentiometers. Single with ¼ inch white nylon shaft. Values: 5k log, 10k log, 50k log, and 250k log. Price: 19p each

Standard Rotary Potentiometers. Dual with ¼ inch metal shaft. Values: 25k log, 50k log, and 500k log. Price: 50p each

4mm Banana plugs Red and Black. Price: 11p each
4mm Banana sockets Red and Black. Price: 12p each
8 section Telescopic Aerial with swivel. 38 inches fully extended. Price: 60p
Anti-surge fuses 20mm 2amp. Price: 5p
4 inch long Heatsink, undrilled, black anodised. Price: 65p
Four buttoned pre-set control panel for vari-cap tuners. Price 85p

Single sided, copper clad, printed circuit board. 2⅝ x 8¼ Price: 10p
4½ x 9 Price: 25p

25 Mixed Rubber Grommets Price 16p

16mm screw-on cab. feet. Set of four Price: 5p

14mm square self adhesive feet. Set of four Price: 15p

Din Plugs 5 pin 180° Price 10p
Din Sockets 5 pin 180°. Standard metal type Price: 10p

Magnetic earpieces with 3.5mm plug Price: 12p

Reed Switches Price: 5p
Wire Neons 90 volts Price: 4p

75mm diam. 15 ohm Speaker Price: 60p

125mm x 78mm Oval 50 ohm Speaker Price: 75p

Latchswitch 2p 2w Price: 10p
DPDT Slide Switches Price: 12p

Green Phono Plugs Price: 6p

Bridge Rectifiers
W005 50v 1A Price: 25p
W04 400v 1A Price: 28p

Red L.E.D.s .2 inch Price: 8p

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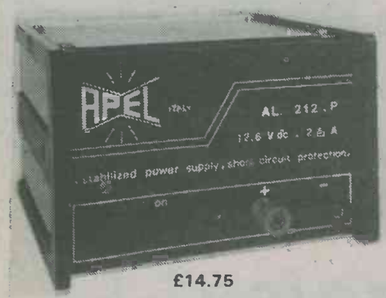


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| LOAD REGULATION | <0,3% 0÷2,2 Amp |
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| WEIGHT | 2,330 Kg. |

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| | |
|---|---|
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| OUTPUT CURRENT RANGE MAX | 3 Amp |
| LOAD REGULATION | < 5% 0-2,8 Amp |
| RIPPLE | 10mV 2,8 Amp |
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| OUTPUT CURRENT MAX | 2,5 Amp |
| LOAD REGULATION | <0,3% 0÷2,2 Amp |
| RIPPLE | <5mV 2,2 Amp |
| DIMENSIONS (mm) | W140 × H90 × D140 |
| WEIGHT | 1,490 Kg. |
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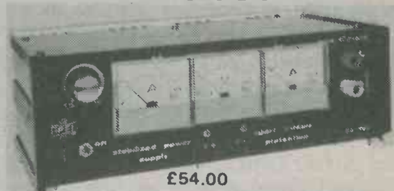

**£54.00**

| | |
|---|---|
| INPUT VOLTAGE | 220 V ac ± 10% 50-60 Hz |
| OUTPUT VOLTAGE RANGE | ± 1,7 ± 15 V dc |
| OUTPUT CURRENT RANGE MAX | 3 Amp |
| LOAD REGULATION | < 0,2% 0-2,8 Amp |
| RIPPLE | < 3mV 2,8 Amp |
| DIMENSIONS (mm) | W270 × H90 × D155 |
| WEIGHT | 4,140 Kg. |

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# A.M. NOISE BLANKER

By John Baker

## How to remove interfering noise spikes in a.m. radio receivers.

Although a.m. noise blanker circuits are only rarely encountered and may possibly be completely new to many readers, they have been in use in high quality communications receivers for many years now. Conventionally, this type of circuit consists of an analogue gate fitted into the i.f. amplifier chain, and the gate breaks the signal path during a noise pulse. The signal to trigger the circuit is either obtained from a point in the i.f. circuitry ahead of the gate, or is produced by a separate and comparatively simple wideband receiver unit.

It can be quite difficult to fit a blanker of this type into a receiver which is under construction, and it will often be virtually impossible to fit one into a ready-built receiver. A slightly different approach has therefore been tried by the author and it works quite well in practice. It consists of placing the gate between the detector output and the a.f. amplifier input, the blanker trigger signal being extracted from the i.f. input to the detector. Adding the blanker to most receivers should be a reasonably straightforward operation, but it should only be undertaken by experienced constructors who fully understand what they are doing. It should not be undertaken by beginners.

Results obtained by the author have been very acceptable, and the blanker is certainly far superior to the more usual noise limiter type of circuit. The blanker is not only suitable for use in communications equipment but can be used with any normal solid-state a.m. superhet where noise pulses are a problem. The main proviso is that the intermediate frequency fed to the receiver detector should be in the range of some 455 to 470 kHz. For reasons which are explained later, the blanker cannot be used with c.w. or s.s.b. receivers having highly selective i.f. amplifiers.

### BLOCK DIAGRAM

The basic arrangement of the system is outlined in the block diagram of Fig.1. The a.f. input, which

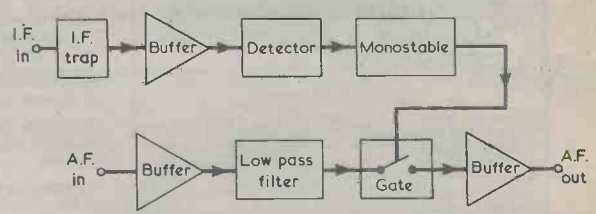
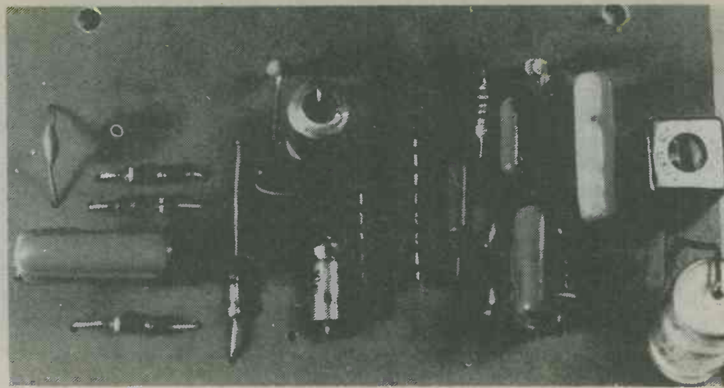



*Fig. 1. Block diagram illustrating the mode of operation of the noise blanker*

is taken off after the receiver detector, is passed via a buffer amplifier to an active low pass filter circuit. This filter has a turnover frequency of about 15kHz and does not therefore have any very noticeable effect on the audio signal. However, in company with the r.f. filtering components in the receiver detector circuit it slows up the rise of any noise spikes on the audio signal and provides a small delaying effect. This gives the next stage, the gate, time to cut off the signal before the noise pulse reaches a significnt amplitude. The audio output from the gate is returned to the receiver a.f. amplifier by way of another buffer amplifier.

The i.f. trigger signal, extracted from the receiver i.f. output before the detector, is first taken to an i.f. trap which rejects the main i.f. signal. This is necessary as it would otherwise be possible for the normal input signal to be of sufficient amplitude to continuously operate the gate and blank the audio signal. Noise spikes will produce frequencies at the i.f. output which are well away from the intermediate frequency and which will not be blocked by the i.f. trap. After the i.f. trap is a buffer amplifier, which feeds a detector stage. At the start of a noise spike the detector produces an output

*The noise blanker components are assembled on a small printed board. Where possible, this should be installed in the a.m. receiver close to the detector stage*



signal of suitable form to trigger the monostable multivibrator which follows it, whereupon the multivibrator gives an output pulse of a predetermined length. The gate is opened whilst the pulse is present, so that the a.f. signal is blanked for the pulse duration. The monostable pulse length is set to about 10mS or so, and this was found to be adequate to deal with any noise spike that was encountered.

It is, of course, essential that the monostable be triggered very quickly by the noise spike and that the circuit should act extremely quickly once triggered. The speed is achieved because the noise input pulse will contain strong components at quite high frequencies, giving therefore a fast rise time. The buffer amplifier, detector and monostable multivibrator have very fast operating speeds, allowing the noise spike to be blanked at an early instant.

## FULL CIRCUIT

Fig.2. shows the complete circuit of the a.m. noise blanker. As will be apparent, the circuit is based on the KB4423 i.c., which is the only active device in the circuit. The KB4423 is actually intended for f.m. noise blanker applications, but it can be readily adapted for other uses such as the present one.

The audio input signal is coupled to the buffer amplifier inside the i.c. via d.c. blocking capacitor C11, with R1 and R2 providing bias for the i.c. amplifier. The resistive elements of the low pass filter are R3 and R4, and the capacitive elements are C3 and C4. Pin 3 is the input of a unity gain amplifier and it is biased from the output of the buffer amplifier by R3 and R4. C3 functions as a bootstrap capacitor, and the overall result is an active filter having a roll-off of 12dB per octave.

The signal is internally coupled to the analogue

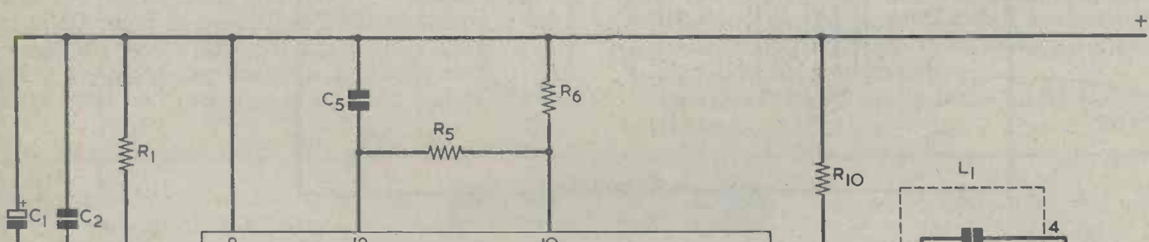
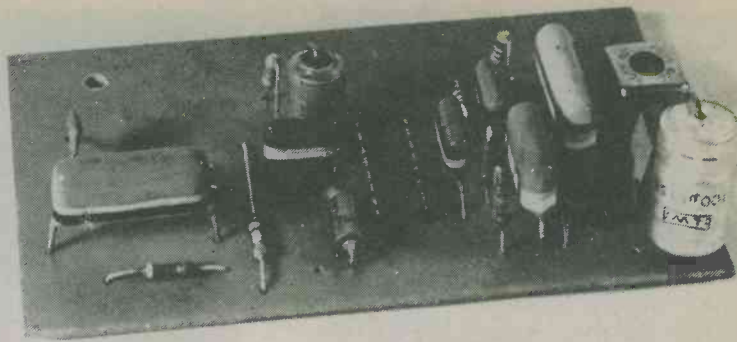



*Fig. 2. The circuit of the noise blanker. There are no internal connections to pins 2 and 5 of L1*

Another view of the printed board. The input, output and supply wires were not connected to this when these photographs were taken



gate, with the series combination of R7 and C7 connected to its output. These are voltage sustain components and their purpose is to maintain the output voltage of the gate at whatever level it happened to have when the gate cut off the a.f. signal. They prevent the gate from itself generating an output signal of any significant proportion due to the blanking action.

A buffered audio output signal is available at pin 6, and is extracted by way of d.c. blocking capacitor C6. There is unity gain (plus or minus 1dB) between the audio input and output of the i.c., and input signals more than 1.5 volts r.m.s. can be handled without serious distortion being introduced.

The i.f. input signal is coupled to its input buffer

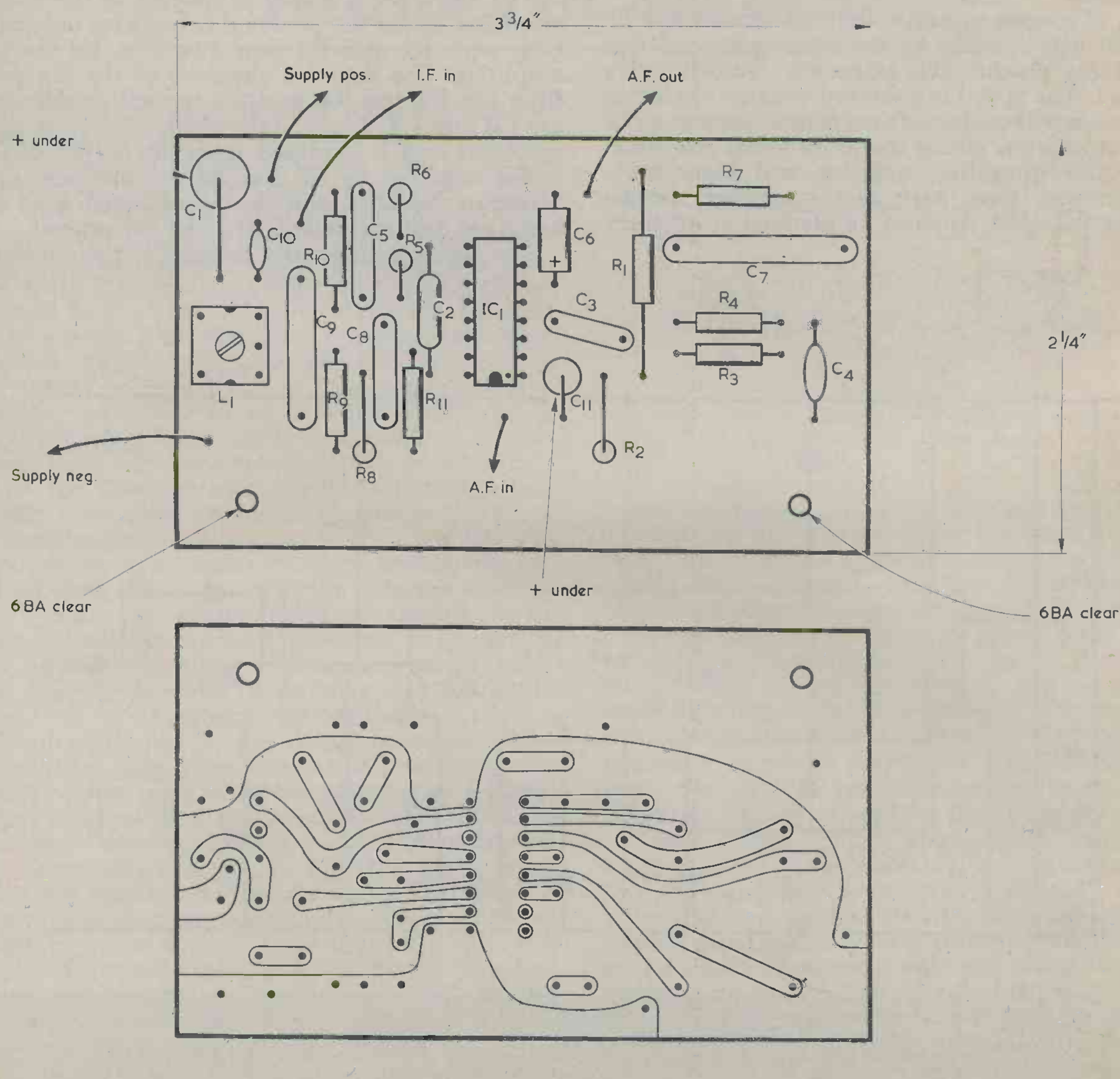



Fig. 3. The blanker circuit is assembled on a small printed circuit board. This is reproduced actual size here

stage through d.c. blocking capacitor C10 and the i.f. trap, the latter being shown as L1. The capacitor in parallel with the coil is an integral component supplied with the coil unit and the two form a parallel rejector tuned circuit which can be tuned to any intermediate frequency in the normal 455kHz to 470 kHz range. R10 and R11 bias the i.f. buffer amplifier.

C8 and R8 are part of the detector circuit and, to some extent, control its sensitivity. C5, R5 and R6 are also part of the detector stage, and in an f.m. noise blanker application would be part of the noise a.g.c. circuitry. In the a.m. application they are in some respects superfluous, but they must be included to give proper and stable operation.

C9 controls the monostable pulse length, with R9 functioning as a current limiting resistor. Normally, the monostable time constant would also be controlled by a resistor connected between pin 11 and the negative supply rail but since, in order to obtain a sufficiently long monostable pulse, C9 is at about its highest maximum practical value, it is necessary in the present circuit to omit the resistor.

C1 and C2 are supply decoupling capacitors. The circuit requires a nominal supply potential of about 12 volts, but will operate satisfactorily over a supply range of 8 to 18 volts. The supply voltage must not exceed 18 volts under any circumstances, whilst below 8 volts it is likely that the circuit will cease to function correctly. The current consumption of the blanker is approximately 20mA at 12 volts.

The i.c. type KB4423 is available from Ambit International, as also is the coil assembly specified for L1.

## CONSTRUCTION AND USE

The blanker is assembled on a printed circuit board having the dimensions shown in Fig.3, where it is reproduced actual size. The preparation and drilling of this board follows normal practice. It should be noted that the holes for the mounting lugs of L1 need to be drilled somewhat larger than the remaining component holes. For greatest accuracy, the holes for the pins and lugs of this component may be marked out with the aid of the coil assembly itself. The connection to the negative lead of C1 is made via the two mounting lugs of the coil assembly.

Fig.4 (a) shows a typical a.m. detector circuit, whilst Fig.4 (b) illustrates the method of connecting the blanker into this circuit. The added load resistor has the same value as the volume control in the receiver, which now takes the a.f. output from the blanker circuit. It would be possible to simply insert the blanker between the slider of the volume control and the following a.f. amplifier, but this would mean that the blanker output was always given the full a.f. amplification of which the receiver is capable. The arrangement shown in Fig.4 (a) and (b) gives the better performance.

Provided that the voltage is within the requisite limits, the blanker may take its power from the receiver supply rails. It will work with negative or positive earth systems, but in the case of the latter it will be necessary to reverse the polarities of C6 and C11.

It should be possible to fit the unit into non-standard circuits since the i.f. take-off point does not appear to be critical. Good results are given, for instance, by taking the i.f. input from the collector of the last i.f. amplifier transistor, and it was even found that just satisfactory results were given by taking the input from the collector of the first i.f. amplifier. However, taking the input from the i.f. feed to the receiver detector will in many instances be the best approach as the secondary of the last i.f. transformer will either be untuned or, if tuned, will have a tap for the detector. Adding the blanker will then have the least detuning effect on the receiver i.f. amplifier.

The blanker will almost certainly not work with a highly selective c.w. or s.s.b. receiver. The problem here is that the high-Q elements of the i.f. filter tend to increase the duration of noise pulses by a considerable amount. Also, to obtain a wide-band i.f. input it is necessary to couple the blanker into the i.f. amplifier at some point ahead of the i.f. filter; this can be very difficult with most sets of this type since the high-Q filter appears at the output of the mixer transistor.

It will probably be found at first that spurious

### COMPONENTS

*Resistors*
(All ¼ watt 5%)
R1 68kΩ
R2 120kΩ
R3 4.7kΩ
R4 4.7kΩ
R5 15kΩ
R6 1kΩ
R7 4.7kΩ
R8 1kΩ
R9 390Ω
R10 91kΩ
R11 22kΩ

*Capacitors*
C1 100µF electrolytic, 25V. Wkg.
C2 0.1µF type C280
C3 0.01µF type C280
C4 1,500pF ceramic plate
C5 0.22µF type C280µ
C6 10µF electrolytic, 16V. Wkg.
C7 0.22µF type C280
C8 0.01µF type C280
C9 0.47µF type C280
C10 100pF ceramic plate
C11 10µF electrolytic, 16V. Wkg

*Inductor*
L1 coil assembly type YMCS2A740AAE (Toko-Ambit)

*Integrated Circuit*
IC1 KB4423 (see text)

*Miscellaneous*
Materials for printed circuit board
Wire, etc.

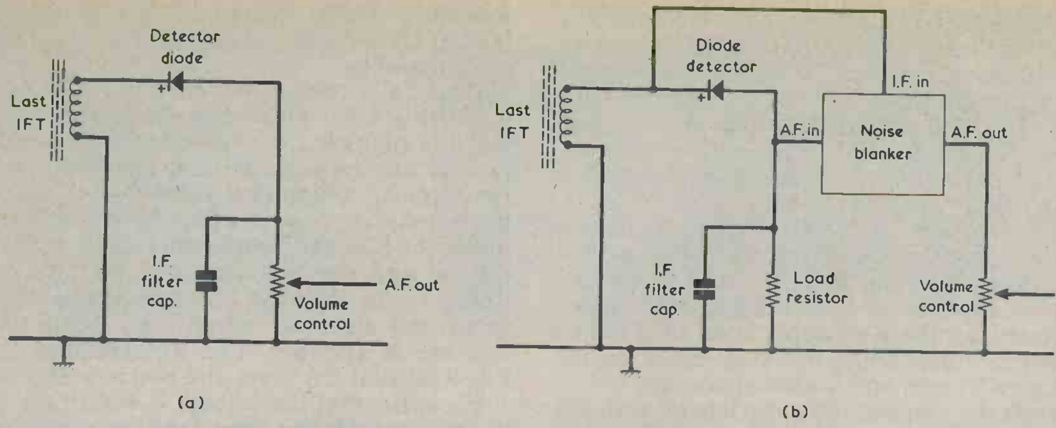



*Fig. 4(a). Typical a.m. detector circuit. In some receivers the diode may be connected with opposite polarity and there may be a further i.f. filter capacitor and resistor between the diode and the volume control, but these factors do not alter the method of connecting the noise blanker circuit*

*(b). The volume control is replaced by a fixed resistor of the same value, and the noise blanker a.f. input is taken from this resistor. The a.f. output of the blanker couples to the receiver volume control*

and continuous operation of the blanker occurs on reasonably strong signals. This is due to the main i.f. signal breaking through the i.f. trap, and by adjusting the core of L1 it should be possible to completely clear up the problem.

The blanker will not, of course, produce a perfect output signal from an input containing noise spikes. But it will give a considerable improvement since the short gaps in the signal will be barely audible whereas the noise spikes can be very trying on the operator's ears, particularly when using headphones. Also, the blanker can only suppress noise pulses picked up in the r.f. and i.f. stages of a set. It obviously cannot deal with noise spikes produced in the a.f. stages due to mains or power supply wiring. ■

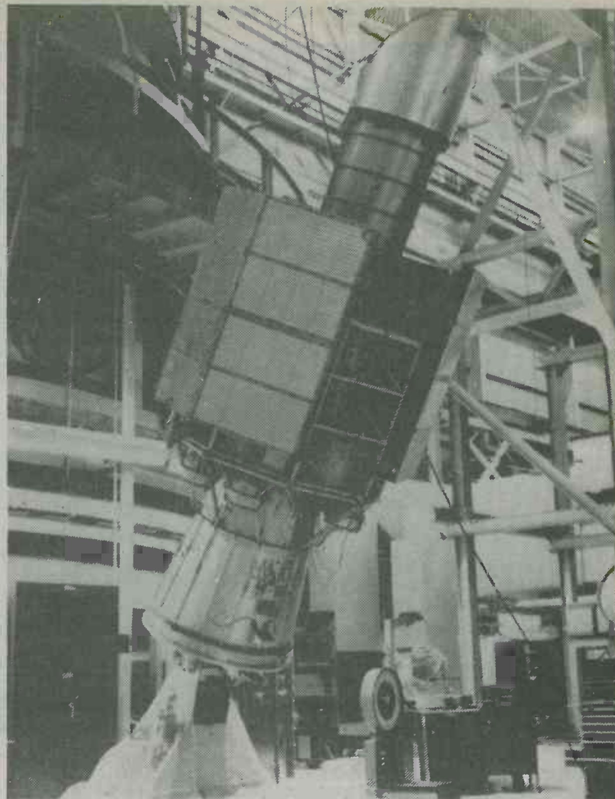
# THE SCIENTIFIC SATELLITE

By Arthur C. Gee

The European Space Agency's Satellite, IUE, has been used recently by a team of European astronomers, to observe a Supernova. Supernovae represent the final explosive stage in the life of certain stars. These phenomena are very rare and are only observed about once every 30 years in our galaxy. Although several are known to occur every year in the universe, most are barely visible because they lie in distant galaxies.

*The antenna at Villefranca, which will receive signals from the IUE satellite in the S band*

# I.U.E. observes a Supernova



*The IUE satellite. The 1.3 metre long telescope can be seen protruding from its upper end*

The supernova currently under observation was discovered by an American amateur astronomer on the 19th April last. Its existence was confirmed two days later by Dr. Franco Ciatti of Asiago Observatory, near Vicenza in Italy. It is the brightest supernova observed from the earth since 1971. Observations with the IUE satellite were started immediately at the European Space Agency's tracking station at Villafranca near Madrid, where Dr. Nino Panagia of the Radio Astronomy Laboratory, Bologna, began analysis of the data.

Preliminary results of the analysis, show absorption of the ultraviolet emission of the supernova, characteristic of the interstellar gas in our galaxy and that of the supernova. In addition, the data showed rapid changes in the supernova as the disrupted star expands and cools. At the same time, the expansion itself is giving rise to modification of spectral features, which is also characteristic of stars which are exploding. The flexible mode of operation of the scientific satellite IUE, was a key factor in enabling this unexpected event to be promptly observed and shows the advantages of this mode, which is based on that used at conventional optical observatories on the ground.

The Scientific Satellite IUE is a joint project of the European Space Agency, the United Kingdom Science Research Council and NASA. It contains a telescope of 45cm diameter aperture and spectroscopes for ultraviolet astronomical spectrography. IUE stands for International Ultraviolet Explorer, and this satellite is part of a programme undertaken by the agencies mentioned above to provide an orbital ultraviolet observatory which when placed in geosynchronous orbit can be used by observers at a ground station in much the same way as if it were a ground-based observatory. The scientific aims of this project are to obtain a wider knowledge of the stellar atmosphere and the interplanetary medium and of celestial objects in other galaxies in general.

The IUE satellite is an octagonal structure, built by NASA, with a telescope 1.30 metres long protruding from the top. The payload comprises the telescope, which has an aperture of 45cm and an echelle spectroscope. Two detector cameras record the stellar spectrum, the images then being transmitted to the earth by a camera linked with the spectrograph.

The European Space Agency's contribution to the programme consisted in the construction at Villafranca, of one of the two ground stations used for this project and the supply of the space craft's solar array. The other ground station is at the Goddard Space Flight Centre and was built by NASA.

The ESA ground station comprises an observatory, a computer centre and a tracking, telemetry and telecommand complex. The computer centre will, as well as processing data, prepare the necessary telecommand orders to modify the satellite's attitude, focus on a particular star or galaxy and change spectrograph apertures, etc. A 15 metre diameter parabolic dish antenna receives telemetry signals in the S band. Telecommand control is made via VHF.

The IUE satellite constitutes an observatory in space which, by virtue of its method of exploitation, will be open to astronomers worldwide.

The IUE satellite was successfully launched on January 26th, 1978. The first observations with it by an European team took place in the following February, from the Villafranca station. They enabled a star in our galaxy, viz, Capella, to be located and observed for the first time in the complete ultraviolet spectrum. According to the observatory, this bright star is surrounded, like our own Sun, by a chromosphere where important chemico-gaseous reactions take place.

The latest accomplishment of this satellite in observing the supernova mentioned above, is yet another example of the value this sophisticated project is proving to the ground-based astronomer and shows what a valuable tool radio and electronic techniques now enable him to construct. A far cry from his earlier optical telescopes no doubt, but none the less useful. ■

# NEWS . . . AND

## JENSEN TOOLKITS FROM TOOLRANGE

Jensen are world leaders in tool kit technology and already supply electronics tool kits for most US Aerospace and Electronics companies, as well as the American Army, Navy and Air Force. Their most popular kit shown here, the JTK 17 must be the world's top selling tool kit and is now available in the UK through Toolrange Ltd., of Upton Road, Reading. The JTK 17 is the result of many years experience and includes virtually every standard tool required in the field for adjustment and repair work. Designed for maintenance of electronic equipment, communications, radar, computers and office machines of all kinds, the JTK 17 is just one of a large range of Jensen tool kits and cases shortly to be available ex-stock from Toolrange.

## PROGRAMME CUTS FOR BBC LOCAL RADIO

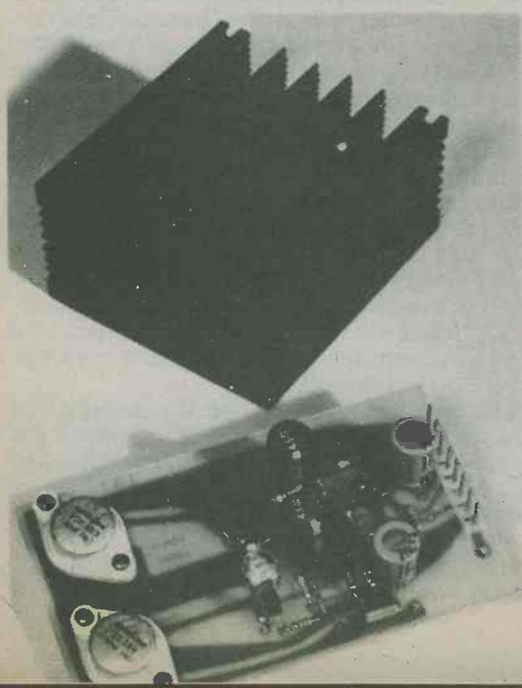
The Managing Director of BBC Radio, Aubrey Singer, told Local Radio Managers and Chairmen recently that the BBC was committed to the expansion of the BBC Local Radio network as quickly as possible within the financial resources available.

But in order to maintain and build on a high quality BBC Local Radio service within the finance likely to be available, he asked all the Managers to reduce their broadcasting hours for an eight month experimental period starting in September. There will be no reduction in BBC Local Radio programme budgets.

Explaining the reasons for this cut in output, Aubrey Singer said: "I believe there is an opportunity to concentrate on making a first class job of what we in the BBC do best in Local Radio. I think that BBC Radio as a whole with its network and local components, will serve the listeners best in consequence, because it won't be spreading its resources too thinly over too large an area."

Aubrey Singer stressed his belief that BBC Public Service Radio must have local services saying:

"I believe that much of the future of modern radio lies in exploiting and developing Radio's ability to be much more local, up to date and interactive than any other medium can hope to be at present, and I thought that BBC Local Radio's achievement during the various weather and industrial upsets of this past winter was quite magnificent. I believe that a Network Radio service, without local roots, would risk becoming extinct as locally-based competition spreads and grows in strength. However, I do think it is possible to believe passionately in BBC Local Radio yet also to believe that there are practical limits on how much of it there can sensibly be."



## HMOS POWER AMPLIFIER

Ambit's PA100 uses complementary MOSFET output stages to achieve a uniquely fast and accurate DC amplifier that is suited to servo and audio amplification applications at power levels up to 100 watts RMS.

The use of power MOSFETs enables far simpler drive circuitry than with conventional bipolar stages, whilst at the same time offering power bandwidths up to 300kHz plus, and harmonic distortion of less than 0.01% in the audio range.

Power Mosfets also mean far greater reliability through their inherent freedom from thermal runaway and secondary breakdown, as well as being suitable to drive types of load that bipolar amplifiers regard as potentially hazardous (ie

Further details may be obtained from Ambit International Ltd., 2 Gresham Road, Brentwood, Essex.

# . . . COMMENT

## WITH CHIPS?

The answer must be 'yes', for the manufacturer who fails to exploit the potential of microprocessors will do so at his peril. The advent of the 'chip' has brought computer capability into the devices and machines that are part of everyday life. It is only twenty years since the first integrated circuit was developed and only six since the first microprocessors appeared. Already it has revolutionised established industries such as the watch industry and created new ones, e.g. pocket calculators, and is likely to transform current office practice in a few years.

Inevitably, most chips are still absorbed by the computer industry itself. Never the less, the consumer and business product sectors are already using large quantities — particularly in entertainment products, watches and calculators.

It is against this background that the Economist Intelligence Unit has published its latest Special Report — No. 67 *Chips in the 1980s* (£40) to cover, specifically and in layman's language, the application of microelectronic technology to consumer and business markets.

The report concludes that central to applications in the 1980s will be single chip microcomputers, that the faster chips are applied the more uses they will generate, and futurist concepts will be a reality in a decade whether in telephoning the oven or the direct debiting of grocery bills from the supermarket checkout.

## PRIVATE TV STATION IN THE HIGHLANDS

At long last the villagers of Acharacle in western Scotland are getting good pictures on their colour TV sets. This is all due to the ingenuity and enterprise of a local butcher. BBC World Service reported:

The trouble was that while the sweep of mountains cut by deep glens makes this part of Scotland as beautiful to look at in reality as it appears on postcards and chocolate boxes, it is a landscape that is an almost impossible obstacle race for television and radio transmission signals.

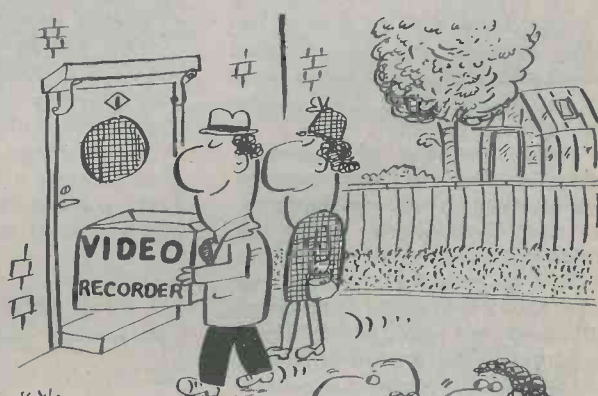
At this point the local butcher, Duggie Cameron, decided to build an aerial himself that would pick up the television signals from the Isle of Mull and relay them to the TV sets of his fellow villagers. He had no engineering training and had to teach himself what he needed to know. He explained how he adjusted his home-made, hill-top aerial to ensure that the village below got the best reception — signals with his wife, and her sister at Acharacle, were arranged so that if the transmitter was working correctly they waved to him with bright yellow household dusters.

Duggie Cameron's success has led the Home Office to grant to Acharacle's community council a licence to build and operate this, the first private colour TV transmitter in Britain.

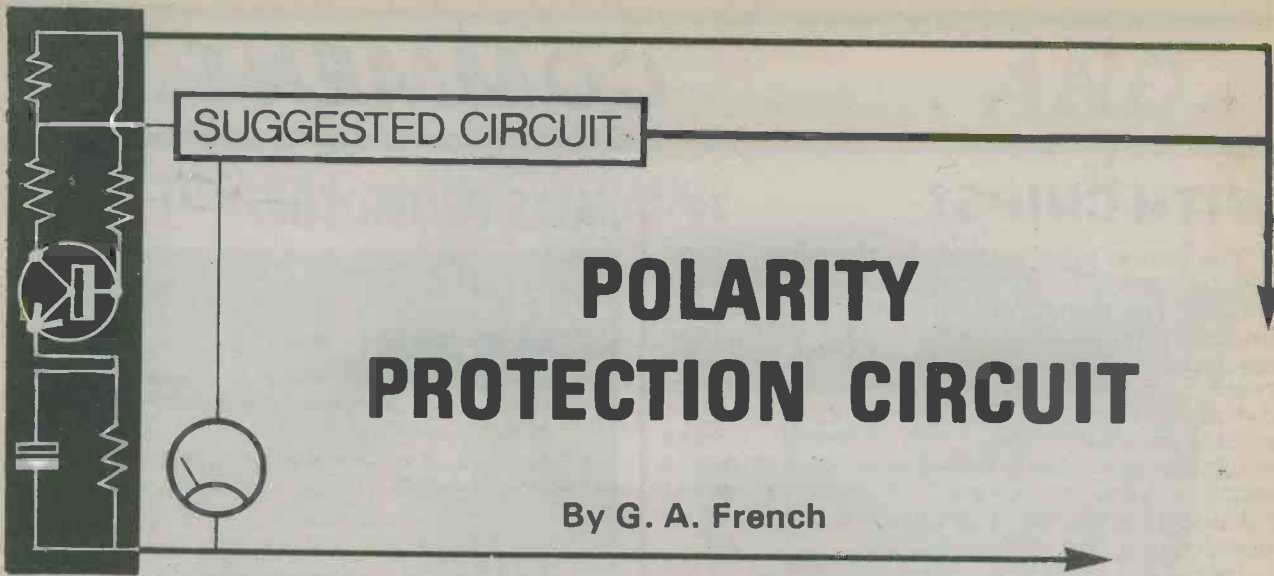
## SALES PROMOTING

Sound & Vision Communications of 23 Redan Place, London W.2. have recently completed a ten minute audio visual programme for Antiference Limited of Aylesbury. The presentation uses slide/tape techniques where standard 35mm slides are projected in sequence onto a screen, in time with a pre-recorded soundtrack.

Antiference Limited are using the programme to project the Company's corporate indentity and product range, particularly in its overseas markets. Indeed at its first showing in Kuwait last month, an audience of well over one thousand people attended and now Sound & Vision Communications have transferred the presentation onto video cassette, in order to extend the programmes usage to direct selling situations.




*"Return the lawnmower Fred, we've got something else to borrow!"*




# POLARITY PROTECTION CIRCUIT

By G. A. French

A frequently unconsidered aspect of battery operated electronic equipment is that it is in many cases quite possible to cause damage to components in the equipment if the battery is accidentally connected with incorrect polarity. There may, for instance, be electrolytic capacitors wired across the equipment supply rails, and these can become unserviceable if a reverse voltage is applied to them for any appreciable time. The same applies to CMOS integrated circuits. A further point is that semiconductor circuits contain many p.n. junctions which act as forward biased diodes with a reversed supply potential, resulting in the flow of unexpectedly high currents. As was pointed out by Smithy of "In Your Workshop" in the last April issue, an innocuous voltage regulator circuit comprising a zener diode and an emitter follower resolves into two forward biased silicon diodes in series when the supply applied to the regulator has reversed polarity!

Further, the risk of having a battery connected with reverse polarity, even if only momentarily, can rise considerably when the equipment concerned is to be handled by unskilled persons. All these factors lead to the desirability, with equipment which can definitely be damaged by a reverse supply voltage, of incorporating a protection circuit. Such a circuit must be reliable and also very simple.

A suitable circuit for protecting equipment drawing currents of up to 90mA from battery supplies of 9 volts or less is discussed in this article. It requires a minimum of components and, for the 9 volt application, has the minor disadvantage that the transistor incorporated has to be selected. With a 7.5 volt battery supply, nearly all transistors of the type specified will be suitable, whilst all transistors will be suitable at lower battery supply voltages.

## BASIC OPERATION

The simplest method of protecting battery equipment from reverse supply voltages is to insert a small silicon rectifier in one of the supply leads, as in Fig. 1. Here, the diode is inserted in the negative input and it is assumed that the on-off switch is in the positive input. In practice, the on-off switch may be in either one or both of the supply input lines. It does not matter how the on-off switch is connected but it is necessary for the transistor protection circuit, shortly to be described, to be inserted after the on-off switch. The load, in Fig. 1, represents the circuitry of the protected equipment.

The series diode can be a 1N4001 or similar, and it passes a negligibly low leakage current when the battery is incorrectly connected. A disadvantage with the diode is that it drops a forward voltage of about 0.6 volt (rising to typically 0.8 volt at 90mA), thereby reducing the voltage available for the load. For many applications this voltage drop may not be serious, but in others it could restrict performance, particularly with low voltage equipment, as the battery voltage falls with age. In consequence, it is of advantage to examine alternative protection circuits if these give smaller voltage drops and do not introduce too many complications.

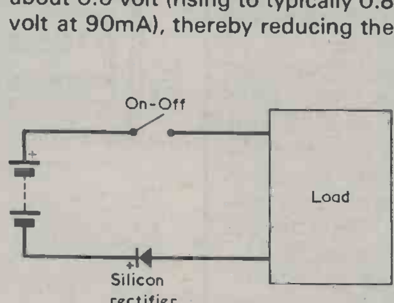



*Fig. 1. Protection against connecting a battery with incorrect polarity to equipment can be provided by simply connecting a rectifier in series with one of the supply lines*

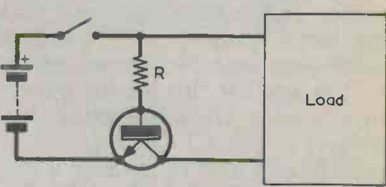



*Fig. 2. Using a transistor for polarity protection. The voltage drop across the transistor is much lower than that across a rectifier*

A protection circuit incorporating a small n.p.n. silicon transistor appears in Fig. 2. When the on-off switch is closed a base bias current flows into the transistor turning it hard on. It is an easy matter to find a value for R which causes the emitter-collector voltage of the transistor to be about 0.1 volt, or even less, at the current drawn by the load. If the transistor is a high gain type the bias current flowing through R can be a small fraction of the load current, resulting in only a slightly increased drain on the battery.

In Fig. 3(a) the battery is connected to the transistor circuit with incorrect polarity and, at first sight, the transistor appears to be functioning quite adequately as a protective device. Its emitter-base junction is obviously reverse biased and its collector couples via the load

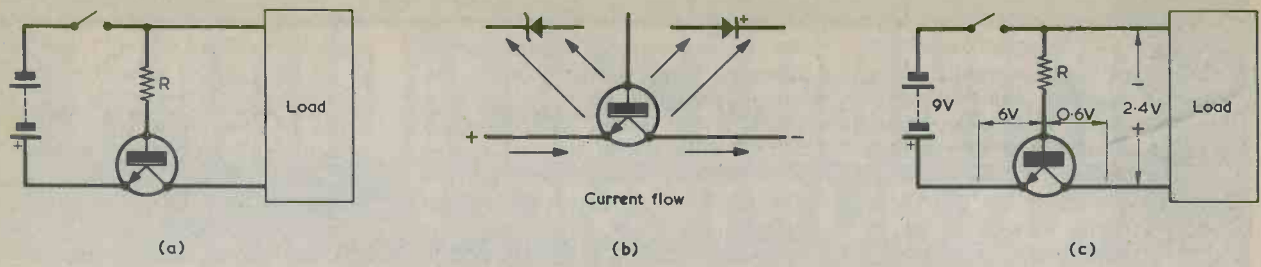



*Fig. 3. (a). Connecting a battery with incorrect polarity to the transistor circuit*

*(b). Under the polarity conditions resulting, the emitter-base junction functions as a zener diode and the base-emitter junction as an ordinary diode. If the supply voltage is sufficiently high, current flows as indicated*

*(c). Voltage situation which could exist with a wrongly connected 9 volt battery and a transistor whose emitter-base zener voltage is 6 volts*

to a negative supply. On the face of it, the transistor should not allow any current to pass.

But a silicon transistor does not perform quite as obligingly as this. The reverse biased emitter-base junction now acts like a zener diode, as illustrated in Fig. 3(b). As with a zener diode it passes no current until the voltage across it reaches the zener level, whereupon it conducts heavily. Also, with the polarity situation now given, the base-collector junction becomes a forward biased silicon diode. If the zener voltage level has been reached, the transistor becomes a zener diode in series with an ordinary diode and current flows in the direction indicated. (This current is "conventional current", assumed to flow from positive to negative.)

Fig. 3(c) shows the situation given when a 9 volt battery is wrongly connected and the protection transistor has an emitter-base zener voltage of 6 volts. This voltage is dropped across the emitter-base junction and a further 0.6 volt is dropped across the base-collector junction, allowing all of 2.4 volts to be applied to the load with reverse polarity. If the 9 volt battery were new, with a terminal voltage of around 9.6 volts, 3 volts would be applied to the load.

## ZENER VOLTAGES

It is obvious that, if the transistor polarity protection circuit is to be of use, the transistor must have an emitter base zener voltage at least equal to or greater than the nominal battery voltage. A transistor with a zener voltage of 9 volts will then just cope with a 9 volt battery, even when this is new and gives 9.6 volts. A transistor having a zener voltage of 7.5 volts will be suitable with a 7.5 volt battery. A 6 volt zener voltage is satisfactory for a 6 volt battery, and so on. If the zener

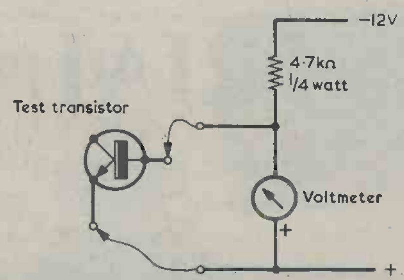



*Fig. 4 A simple test rig for determining emitter-base junction zener voltage*

voltage is higher than the nominal battery voltage the situation improves.

A silicon n.p.n. transistor having an acceptably high gain, a maximum collector current rating of 100mA and a reasonably high zener voltage performance is the BC107B. Most data sources for this transistor quote a maximum reverse emitter-base voltage of 5 volts, and so the zener voltage must be higher than this figure. The author checked a batch of these transistors and found that 65% had zener voltages between about 7.5 and 8.5 volts, 25% were at 9 volts or just over and that 10% were between 10 and 11 volts. No zener voltage was lower than 7.5 volts. If the transistor protection circuit is to be used with a 9 volt battery it is definitely necessary to select a BC107B whose zener voltage is 9 volts or more. It would be wise to check the zener voltage for use with a 7.5 volt battery or, perhaps, even with a 6 volt battery, but the probability is that virtually all BC107B transistors will be suitable.

Fig. 4 shows a test circuit for finding the emitter-base zener voltage. The voltmeter is a multimeter with a sensitivity of 10,000 Ω per volt or better and it is switched to a suitable voltage range. It indicates the zener voltage when the test transistor is connected as shown.

The circuit as so far developed is shown in Fig. 5(a) with the transistor being a BC107B (which has been selected for zener voltage if necessary). The value of R has next to be determined. As a rough guide,

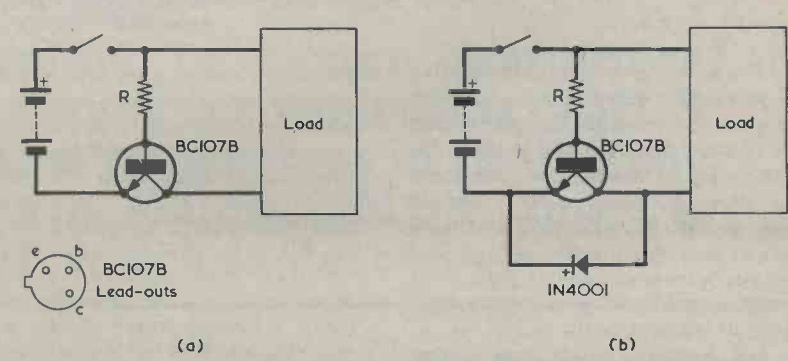



*Fig. 5(a). The polarity protector may employ a BC107B (after selection, if necessary). This is suitable for load currents up to 90mA*

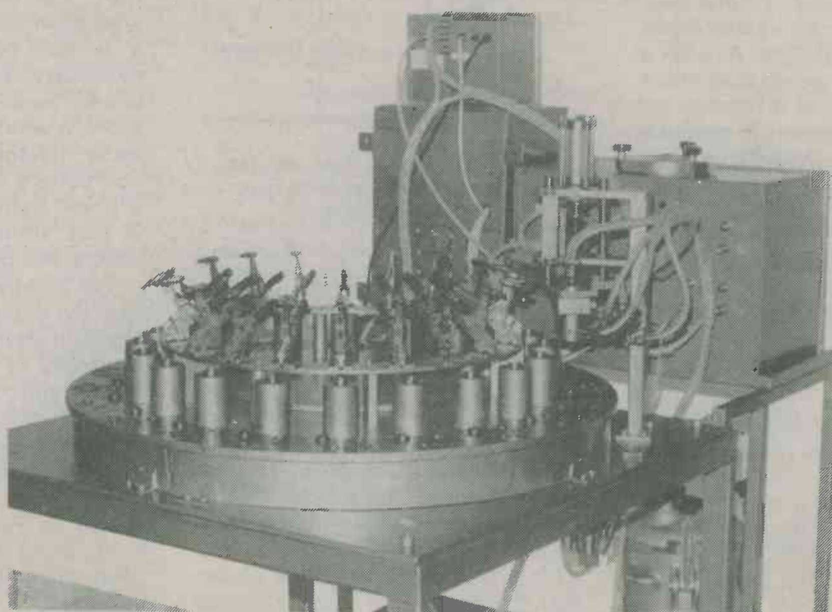
*(b). A rectifier is added to reduce switch-on current surge in the transistor if the supplied equipment has a high value electrolytic capacitor or capacitors across its supply rails*

the transistor will exhibit a voltage drop of 0.1 volt between its emitter and collector if the current flowing through R is about one-thirtieth of the load current. To take an example, let us assume a battery voltage of 9 volts and a load current of 20mA. One-thirtieth of 20mA is 0.7mA, and the voltage across R will be 9 volts minus 0.6 volt dropped in the emitter-base junction of the transistor, or 8.4 volts. From Ohm's Law, R calculates as 8.4 volts divided by 0.7mA, which equals 12k Ω. After the circuit has been assembled, the voltage across the transistor emitter and collector on load should be checked. If desired, the value of R can then be experimentally varied about the calculated figures to arrive at a final value which gives a satisfactory voltage drop across the transistor at a reasonably low battery current through R. In all instances likely to be encountered, R may be a ¼ watt component.

As a final point, some equipment will have high value electolytic capacitors connected across its supply rails, causing a heavy charging current pulse to flow through the transistor immediately after switch-on. The risk of damage to the transistor can be alleviated by adding the diode of Fig. 1 across it, as in Fig. 5(b). After the on-off switch is closed the diode bears the brunt of the electrolytic charging current until the voltage applied to the load reaches battery voltage minus 0.6 volt. The transistor then takes over, causing the load voltage to rise further, up to the battery voltage less 0.1 volt. The diode carries out no other function in the circuit and, even with its inclusion, the component count is only three.

■

# INDUSTRIAL NOTE



*Semi-automatic rotary machine produced by Alpha Automation for speaker magnet assembly at the Batley works of Fane Acoustics*

The above photograph illustrates a semi-automatic rotary machine employed at the Batley works of Fane Acoustics Limited for the fixing of loudspeaker magnets to their housings. The magnets are glued in position and this work was previously carried out by six personnel dealing with each magnet and housing assembly on a one-off manual basis.

The machine which now carries out the operation has a 19-position pneumatically driven rotary table which indexes round one position at a time.

The magnet assemblies are loaded by one operator at the starting station on the table and, at a later step, a transfer arm lifts up the magnet and a metered amount of adhesive is injected into the housing. The transfer arm then lowers the magnet back onto the table, which indexes round to enable the next assembly to be treated.

After the injection of the adhesive a second operator pulls down a verticle toggle clamp onto the magnet. This holds the magnet firmly in place under pressure, the pressure also speeding the curing of the adhesive. The magnet assemblies then continue to index round. At the starting point the glued assembly is removed by the first operator and a new assembly fitted. When the photograph was taken all the toggle clamps were in the up position.

The Fane Acoustics rig is one of around 80 special-purpose machines which have been built in the last seven years by Alpha Automation Limited, Prospect Works, Broadstone Way, Tong Street, Bradford, from whom further details may be obtained.

Apart from any other advantages, the reduction in the labour force required to handle the magnet assemblies has enabled Fane Acustics to recoup their capital outlay on the new equipment in less than 12 months.

# TOP BAND FERRITE AERIAL UNIT


*The Top Band active ferrite aerial unit. This incorporates a buffer amplifier to convert the high impedance signal voltages across the aerial coil to a low impedance suitable for coupling to a short wave receiver. The aerial above the case is free to be rotated*

## By R. A. Penfold

## *Directional reception on 160 metres*

The type of aerial normally employed with a short wave receiver for operation on the 1.8 to 2.0MHz amateur band (160 metres or "Top Band") is a substantial long wire. Obviously, circumstances do not always allow the installation of an aerial of this nature, and an alternative must then be sought. A common solution is simply to use a short length of wire which is erected in any convenient space. Such an aerial gives only a comparatively low signal level, although this can at times be an advantage, particularly when there are several strong signals on the band which could overload the receiver and cause severe cross-modulation.

### FERRITE AERIAL

Another method is to use a ferrite rod aerial similar to those employed in medium and long wave portable receivers. The efficiency of ferrite aerials tends to diminish at high frequencies, but Top Band is only just beyond the high frequency limit of the medium wave band (which ends at a little over 1.6MHz) and so such an aerial can still have an acceptable efficiency. It also has the advantage of being directional.

The ferrite rod aerial could be used in the purely passive circuit arrangement of Fig. 1. The coil has a variable tuning capacitor in parallel to bring it to a resonance at the appropriate frequency, and a low impedance coupling winding, or a tap in the tuned winding, matches the aerial to the low input impedance of the receiver. The whole of the tuned winding could not, of course, be connected to the receiver aerial input as the very heavy damping would prevent the circuit from working at all.

Because of the step-down matching, the signal level provided by the aerial to the receiver is very small. Results would be considerably improved if the high signal voltages across the ferrite aerial tuned winding could be applied to a buffer amplifier having a high input impedance and a low output impedance suitable for coupling to the receiver aerial input.

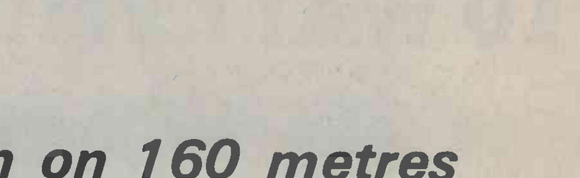



*Fig. 1. A tuned ferrite aerial coil can be coupled via a low impedance coupling coil to the aerial input of a short wave receiver. Signal strength with this arrangement is low*

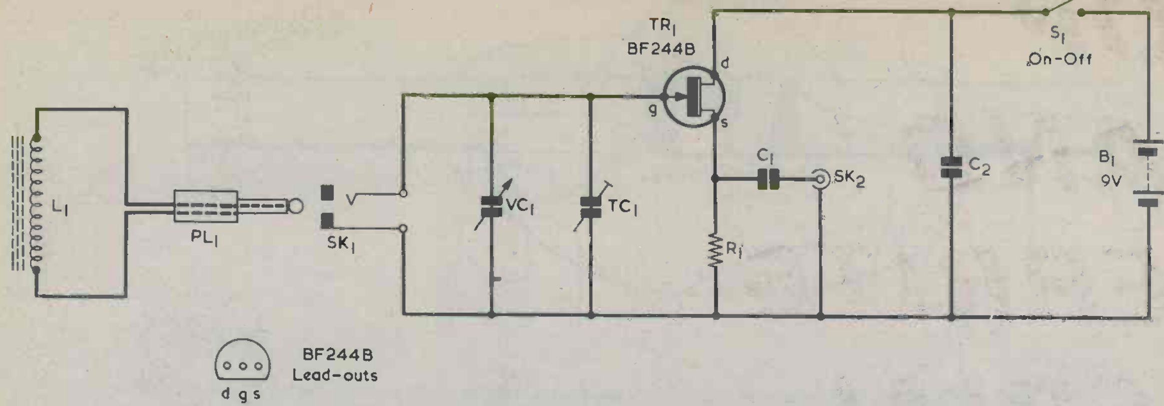



*Fig. 2. A much greater signal strength is achieved by using the active circuit shown here. The relatively high signal voltages across the ferrite aerial tuned circuit are applied directly to the gate of an f.e.t., producing only slightly attenuated signals from the f.e.t. source at low impedance. This is the circuit of the Top Band ferrite aerial*

Fig. 2 shows the circuit of the buffer amplifier and this, in conjunction with the ferrite aerial, provides an active aerial circuit. The whole of the aerial tuned winding, together with its parallel tuning capacitance, is applied to the gate of the field-effect transistor, TR1. The gate has a very high input impedance which places very little loading on the aerial tuned circuit. The transistor is employed as a source follower, and the output signal at its source is at a low impedance which is capable of matching into the aerial input of a normal short wave receiver. A source follower gives virtually unity voltage gain, so that the high signal voltages across the aerial tuned winding are applied at low impedance to the receiver input.

Looking at the circuit in more detail, L1 is the ferrite aerial coil and VC1 the tuning capacitor. TC1 is adjusted to allow VC1 to tune over the desired 1.8 to 2.0MHz range. In practice, the tuning range extends slightly beyond these limits. The f.e.t. gate is biased to the negative rail by L1, and its source couples to that rail via R1. C1 provides d.c. blocking at the output, whilst C2 is a supply bypass capacitor. Power is obtained from a small 9 volt battery of PP3 size. Current consumption is only 3mA, whereupon useful battery life is relatively long.

The aerial is affixed to a 3.5mm. jack plug, the coil being connected to the plug contacts. The plug fits into a 3.5mm. jack socket mounted on the top of the case which houses the f.e.t. source follower amplifier and the other components. This arrangement gives a neat and inexpensive swivel mounting for the aerial, which can be oriented freely to any direction whilst its coil remains continually in circuit. The aerial rod may be rotated to peak a wanted signal or to null an interfering signal.

## COMPONENTS

*Resistors*
R1 330Ω ¼ watt 5%

*Capacitors*
C1 0.01µF ceramic plate
C2 0.033µF ceramic plate or type C280
VC1 25pF variable, type C804 (Jackson)
TC1 10-60pF trimmer, ceramic (see text)

*Inductor*
L1 Ferrite aerial (see text)

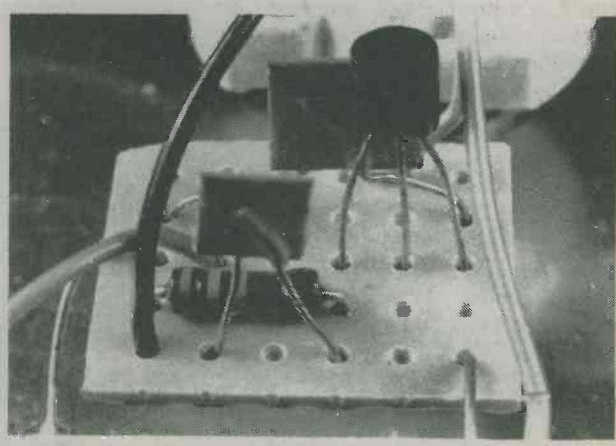
*Transistor*
TR1 BF244B

*Switch*
S1 s.p.s.t. subminiature toggle

*Sockets*
SK1 3.5mm. jack socket
SK2 coaxial socket, flush-mounting

*Plug*
PL1 3.5 jack plug (see text)

*Miscellaneous*
Case (see text)
9-volt battery type PP3
Battery connector
Control knob
Veroboard, 0.15in. matrix
Coaxial plug
Coaxial cable
Nuts, bolts, wire, etc.



*A small piece of Veroboard accommodates the buffer amplifier components*

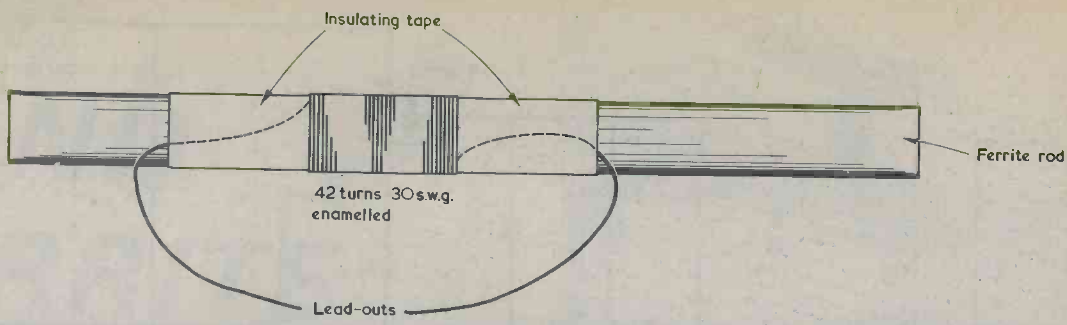



*Fig. 3. Details of the ferrite aerial coil. As is explained in the text, the length of the rod, within limits, is not critical*

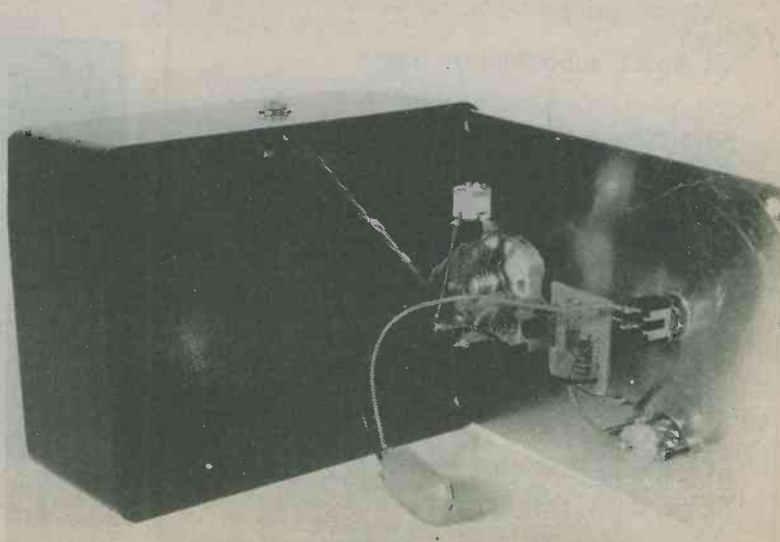
## AERIAL COIL

The ferrite rod should have a diameter of 9.5mm., and it can have any length between 90 and 200mm. As is to be expected, better results are given by a long rod than by a short rod. The aerial coil consists of 42 turns of 30 s.w.g. enamelled wire close-wound in a single layer, as shown in Fig. 3. The winding starts approximately 30mm. from one end of the rod, a band of insulating tape being used to hold the first lead-out wire in place while the coil is being wound. When the winding has been completed, a second band of tape holds the finishing lead-out wire in position, and also prevents the winding from springing apart. Ordinary F14 grade ferrite rod, as used for medium and long waves, will operate reasonably well up to 2MHz. It is probable that somewhat improved results would be given by F16 grade ferrite. (A 200mm. by 9.5mm. F16 grade ferrite rod is available from Ambit International).

The jack plug should have a fairly long plastic cover, such as the "Plastic Barrel" type listed by Maplin Electronic Supplies. Most plastic jack plug covers are convex at the top and it is necessary to file the top flat and then file a groove to take the aerial. The aerial is glued to the cover using a good quality gap-filling adhesive such as an epoxy type.

The author drilled two 1mm. holes on opposite sides of the cover, passed the coil lead-outs through these and then connected the coil lead-outs to the plug terminals. However, screwing on the cover would then cause the lead-outs to be twisted together, and so they are very lightly twisted together in the opposite direction before screwing on the top, whereupon they become untwisted again and can be lightly drawn out through the 1mm. holes. The operation is rather fiddling and requires some patience if the wires are not to short-circuit together or break, and constructors may prefer to use an alternative method. One approach could consist of soldering thin p.v.c. covered flexible wires to the plug terminals, passing these out through the hole at the cover top after this has been screwed on. The two p.v.c. covered wires can then rest in grooves filed for them in the plug top whilst the aerial is glued to the plug cover. When the glue has set the p.v.c. covered wires are finally soldered to the coil lead-out wires, shortening as necessary.

*Most of the parts are mounted on the front panel. There is ample space for the PP3 battery which can, if desired, be secured in any convenient position by means of a simple home-made clamp*



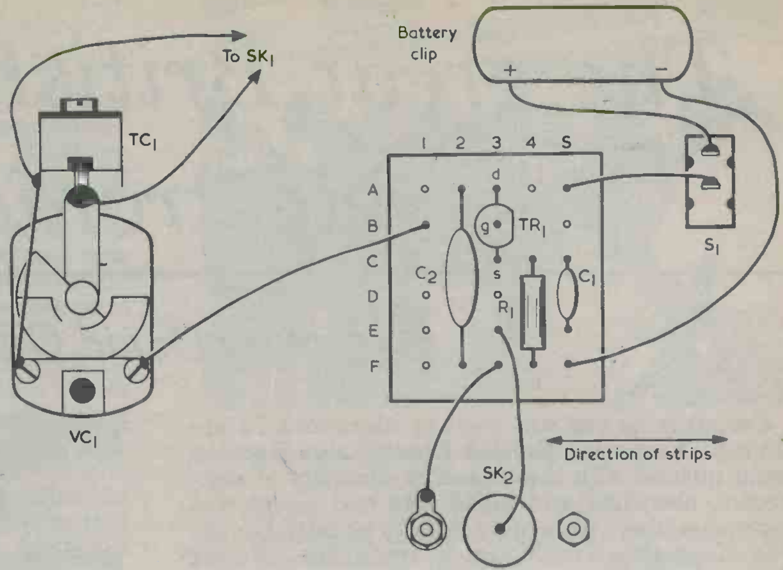



*Fig. 4. Wiring up the Top Band ferrite aerial. There are no breaks in the Veroboard copper strips*

## CONSTRUCTION

The components and battery are housed in an all-plastic case or in a plastic case having a metal front panel. Although the components can be accommodated in a very small case, the use of such a case is not advisable as it would be physically unstable with the ferrite rod fitted at its top. The case used by the author was plastic with an aluminium front panel and measured approximately 130 by 100 by 50mm.

The jack socket is mounted at the centre of the case top, as shown in the photographs. The tuning capacitor VC1 is mounted towards the right on the front panel with the on-off switch to its left. The flush-mounting coaxial output socket is mounted below the on-off switch. This socket requires two 6BA clear holes in the front panel; the large hole required for the body of the socket should be cut first, after which the positions of the two 6BA clear mounting holes can be marked out with the aid of the socket itself. A solder tag is mounted under the 6BA securing nut nearer VC1.

TR1, C1, C2 and R1 are assembled on a small piece of 0.15in. Veroboard having 5 holes by 6 strips, as shown in the wiring diagram of Fig. 4. The final connections to the board should be those coupling it to S1, socket SK2 and the moving vanes of VC1. These connections should be made with stout single strand connecting wires which are no longer than is necessary. These connecting wires will then suffice to hold the very light Veroboard assembly in position, and no other means of mounting the board is needed. With the author's prototype, VC1 moving vanes take up their connection to the negative rail by way of the metal front panel of the case. If an all-plastic case is used an extra wire should be added between the solder tag at SK2 and the moving vanes tag of VC1.

TC1 is mounted by soldering one of its tags to the moving vanes tag of VC1, and by connecting its other tag to VC1 fixed vanes by a short straight length of stout wire. The author employed a 10-60pF ceramic trimmer here, but this is not a critical component and any trimmer having a minimum value of 10pF or less and a maximum value of at least 40pF will be equally suitable.

## USING THE AERIAL

The aerial unit is connected to the short wave receiver aerial input by way of a length of coaxial cable. If the receiver does not have a coaxial input socket, the centre conductor of the coaxial cable should connect to the receiver aerial terminal, and the braiding to the receiver earth terminal. The coaxial cable should be as short as can be reasonably arranged, and certainly no more than 1 metre in length.

Set up TC1 such that VC1 tunes to a signal roughly in the centre of the 160 metre band (i.e. at about 1.9MHz) when its vanes are at approximately half maximum capacitance. No further setting-up is required.

The signal level obtained from the aerial unit will not be equal to that given by a good long wire antenna, but it should be at least as good as the signal level given with a simple wire aerial. The aerial is not highly directional so far as maximum signal strength is concerned, and maximum strength is given when the rod is broadside on to the direction of the signal. On the other hand, the aerial has a relatively sharp null characteristic, and gives a significant reduction in the strength of a signal when it is pointed in the signal direction. This effect is useful in reducing the strength of any signal, including interference from television sets, which is hampering reception of the desired transmission. It will be necessary to adjust VC1 to peak received signals each time the receiver's tuning is significantly altered. ■

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**DUE TO THE RECENT INCREASE IN VAT, READERS SHOULD CHECK WITH ADVERTISERS FOR CURRENT PRICES**

# *The great British electronics bazaar*

## *Report by David Gibson*

Certainly no one who went to Alexandra Palace to visit **The Great British Electronics Bazaar** could quarrel with the title. The diversity of electronics, electrical and allied bits and pieces was enormous (there were more than 70 stands). On one side of an aisle was **Manx Electronics**, offering closed circuit TV systems with cameras ready and working for £195, on the other side **Gould-Advance** showed oscilloscopes, DMMs and other measurement equipment. The Gould Alpha IV was priced at £105.

Competition for the Gould DMM was the Fluke 8022A DMM which boasts liquid crystal readout and only makes a modest £89 hole in your pocket.

Well known names in both professional and amateur circles were in attendance **Ambit International**, for example, laid emphasis on its direct digital readout LSI frequency counters. These give direct readout of frequency on all wavebands; LW/MW/SW and FM. Paul Prior, Ambit's chief engineer kept stand visitors happy with demonstrations and explanations — and then kept a seminar audience happy with a lecture on "Consumer Radio Technology in the '80s".

An electromechanical influence was exerted by **Electroni-Kit.** Space-age "creepy-crawlies" streaked up and down the stand causing great interest. Star attractions here included a Star Squid, Lunar Inchworm and a Martian Frog. These battery-driven electromechanical novelties could be extremely useful as the basis for some very novel radio control items. Often it's the mechanical side that is the problem, and here it was — solved. Not too expensive, either. A Crater Crab could be yours for only £6.95 (pick it up just behind the battery, and watch those nippers!).


*Paul Prior explaining technical advantages of Ambit equipment*

*Demonstration of the virtues of the new GE 100 Mk II*

Congratulations to **Chromasonic Electronics.** They put literature in the Press Room and also made sure that a liberal assortment of helpful circuitry was available in printed form for enthusiasts to make off with. There was an IC booklet which gave details and circuitry for a variety of chips, mostly audio, complete with all relevant specs and a pinout diagram. Two ZN414 ICs were offered for £1.

**Stevenson** had one of the busiest stands in the exhibition. The company has really got going in the past 18 months and recently opened a new shop (callers welcome says boss man Mr C. Stevenson) in College Road, Bromley, Kent. Visitors who managed to get to the front of the stand were rewarded with a free catalogue that covered just about every component used in Amateur / hobbyist circles.

Bargain hunters were in luck. Complete infra red alarm systems (with all optics and filters) were on offer for as little as £4.50p a pair. During the last hour of the exhibition, **AMP** decided to avoid unnecessary energy expenditure in carrying all unsold items to the van — so grinning **AMP** salesmen announced loudly that they were "open to offers" on all items.

Biggest bargain attraction of the show came from one, Charles Cream, managing director of **Cream Electronics** (they're at 9 Orchard Way, Chigwell Essex). He rushed across to Heathrow to collect a batch of miniature frequency meters and got them back to the exhibition before the show closed. These little units give a digital readout of frequency from 10Hz to 50MHz, measure only 100 x 32 x 120mm and cost just £14.99p at the Bazaar.

Powered by an internal battery, these four-figure readout units have a range switch that allows 7-digit accuracy. Charles Cream confessed happily: "I've sold 60 already."

Integrated circuit holders seem to be sold differently these days — per pin cost. **Brandauer** were offering IC sockets at 1.5p per pin. But down the aisle another company showed 28-pin IC holders for 23p. The Woolworth "Pick-n-Mix" approach was taken up by some exhibitors. One offered 50 capacitors for £1. Some poor soul won £500 worth of components, and all because be bought a raffle ticket for 10p (OK, so now you gotta build something!).

The **CDS** stand showed 741 op amps at 8 for £1, microswitches at 20p, and 556 dual timer ICs at only a miserly 40p — which is almost cheaper than fuses.

**Lektrokit**, who market a range of very useful solderless breadboards, attracted a number of visitors who tried their hands at guiding a wire ring along another wire. Winners got a free Lektrokit breadboard. Visitors could also purchase the famous Maplin catalogue from this stand, thus saving the cost of postage.

Computers were in evidence on a number of stands. **Transam**, for example, showed the Triton computer, designed by Mike Hughes. A new 10in. monitor was on show at a price of only £69. On show for the first time was the Executive 1000 which is basically a Triton computer. It's an 8k machine that literally just plugs into the mains and your own TV set to start you in computing, claimed Transam's top man, Graham Clifton.

One stand you just couldn't miss — with your ears, was **Bi-Pak**. Long famous for their audio amplifier modules, Bi-Pak decided it was about time unbelievers heard the units in action for themselves. I shall never, again doubt, that if **Bi-Pak** say it's 35 Watts; it surely is 35 Watts! The stand highlighted not just the power audio side, but also the additional units such as a 10-channel monographic equaliser. A spokesman informed that one visitor admitted that he just couldn't build a comparable unit for the same money. Complementing the wide range of **Bi-Pak** equipment, was an enormous display of component offers. "Bags of opportunities" is probably the best way to describe them.

Old favourites, **Heathkit**, showed numerous items in kit form. Their electronic weather station provoked great interest. Just the one package gives a digital readout of time, date, temperature, wind direction, rising/falling indicator, barometric pressure (in both inches and millibars), wind peak, wind averaging and other things I just didn't write down. If you need all this information, then it will cost you £351.64p for the kit which includes weather sensors for fitting outside to measure windspeed and direction etc.

**Catronics** offered anti-tvi torroids at 35p, which seems a small price to pay for getting rid of tvi. For the Ham fraternity, the stand showed the very new all mode 2 metre transceiver; yours for a mere £548. Also on display, the beautiful Trio TS-180S all solid state h.f. s.s.b. transceiver. It runs from 13.8V and gives up to 200W p.e.p. input on all bands from 1.8Mhz to 30MHz. It has all mod cons, such as digital readout, built-in memory and two internal microcomputers. An enquiry about the price brought a hint of something above £800. Come back 6V6's and 807's, all is forgiven!


*A rare occasion when the Stevenson stand was less busy*

Accompanying the exhibition were the seminars. These ran virtually continuously throughout the day. A number of top names in Hobbyist circles came along to lecture enthusiastic audiences on a favourite topic. Mike Hughes spoke on Microprocessors and gave a practical demonstration.

The lectures covered a very wide range of interests. John Thornton-Lawrence advised on "How to become a Radio Amateur", while Richard Monkman and Tim Orr gave a very interesting lecture on "Electronic keyboard instruments". Their demonstration brought forth sounds hitherto considered physical impossibilities. Other seminars included computer programming, Teletext, designing and making your own p.c.b's (very good and very practical), and getting started in electronics construction.

For the bookworms, **Bernard Babani (Publishing) Ltd.** offered an enormous range of inexpensive publications packed with useful circuitry. Semiconductor manufacturer **Fairchild** exhibited various data books from a wide range. Most expensive publication to be found was the IC Master. It lists almost all ICs and their equivalents — and costs £49.50p.

**The Amateur Bulk Buying Group** showed an Ultrasonic burglar alarm system complete with NiCads at £7.50p. The physical appearance of this equipment was quite enough to scare any would-be felon.

**Grove House Electronics** caused quite a stir among youngsters by showing funny little glass things with metal pins sticking out of one end and marked, mysteriously, "Mullard DK91". And so it went on. Another stand was charging a few pence for some long, thin magnifying lenses — just right for visitors with long, thin eyes.

**The Great British Electronics Bazaar** was a great success. The organisers have already booked Alexandra Palace for next year, when the Bazaar will run for three days: Friday, July 20, Saturday 21st, and Sunday 22nd inclusive.

**EDITOR'S NOTE**

We apologise to our contributor for substantially curtailing his report due to pressure on space.

# SILICON DIODE

By J. K. Owen

## Low current voltage generator gives safe indications of rectifier breakdown voltage

When choosing a silicon rectifier for a given application, the first thing to be determined is the maximum p.i.v. rating of the device. This, provided the type number is known, can be obtained from a number of sources including the manufacturer's published data.

However, most constructors will have noticed the number of "surplus" devices currently available, some type-marked, some unmarked, and some marked with "house numbers" for which data is not readily available.

Also, even with regular branded types the data published is necessarily conservative, sometimes surprisingly so, so that a device with a quoted p.i.v. of, say, 200 volts may in fact withstand a very much higher reverse voltage. As an instance of this, a number of 1S111 rectifiers, for which the quoted p.i.v. is 225 volts, have successfully withstood reverse voltages of 1kV, and have been used to rectify the full a.c. mains voltage of 240 which, with the conventional capacitor input circuit, develops a p.i.v. across the rectifier of nearly 700 volts.

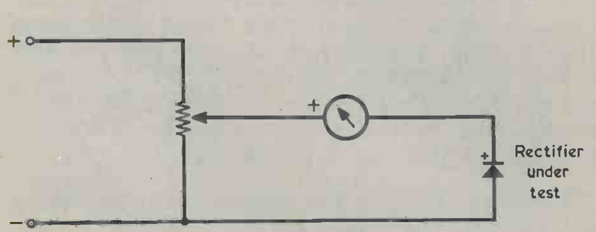



*Fig. 1. The basic circuit. The rectifier under test is connected with reverse polarity via a series microammeter to the potentiometer. The slider of this is slowly taken positive until the meter indicates a small current. The voltage tapped off by the potentiometer is then the breakdown voltage, or p.i.v., of the rectifier*

### CHECKING P.I.V.

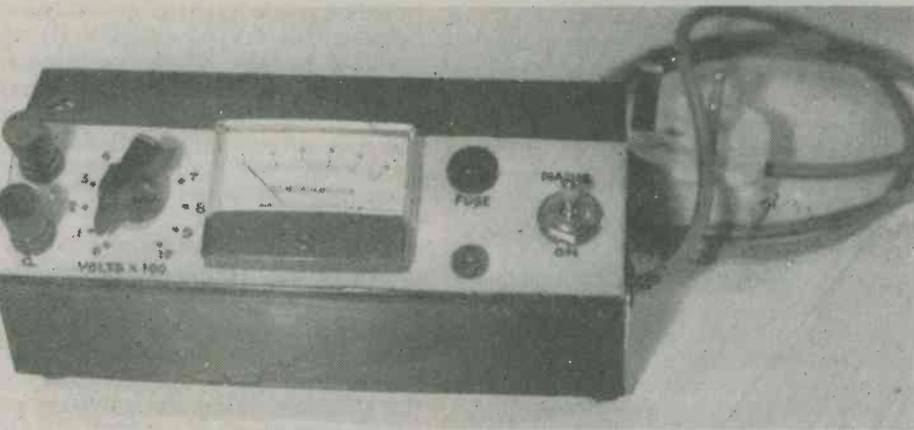
The method of checking the maximum p.i.v. of a rectifier is basically simple. As is shown in Fig. 1, the rectifier is connected — with reversed polarity, of course — in series with a suitable microammeter across a source of variable voltage. The voltage applied to the rectifier and microammeter is increased until the meter commences to indicate a leakage current. This voltage is then the maximum p.i.v. of the rectifier and , since only a very low reverse current flows, the rectifier is not damaged by the test. It would be prudent to allow a reasonable safety factor when subsequently using the rectifier in a working circuit, and the factor chosen depends upon the views of the constructor employing the rectifier. The author would suggest 85%, so that a device which started to leak at 1kV could be installed in a circuit with a p.i.v. of 850 volts, or 300 volts r.m.s. in an a.c. rectifier circuit with a capacitor input.

There are of course various methods of obtaining the necessary variable voltage, but one of the most convenient — and certainly by far the safest — is a transistor oscillator followed by a voltage multiplier. The multiplier can use the well-known Cockroft and Walton circuit.

The full circuit is shown in Fig. 2, and this is intended for checking silicon rectifiers only. It is not suitable for checking other types of semiconductor rectifier. It will be seen that, in place of the continuously variable voltage supply shown in Fig. 1, the voltage is obtained in increments of 100 volts up to a maximum of 1kV. It is perfectly feasible to go beyond 1kV, but this was considered a reasonable maximum.

The meter has a full-scale deflection of 50$\mu$A and is connected into the circuit via a 20M$\Omega$ series resistor, giving an f.s.d. of 1kV. This method of connection protects the meter in the case of a faulty rectifier, and it means that the voltage indicated by the meter should be subtracted from the voltage indicated by the switch position to arrive at

# P.I.V. TESTER




*The prototype p.i.v. tester. From left to right on the top panel are the two insulated terminals for the test rectifier, the voltage selector switch, the meter, the fuse (upper) and neon indicator (lower) and the on-off switch*

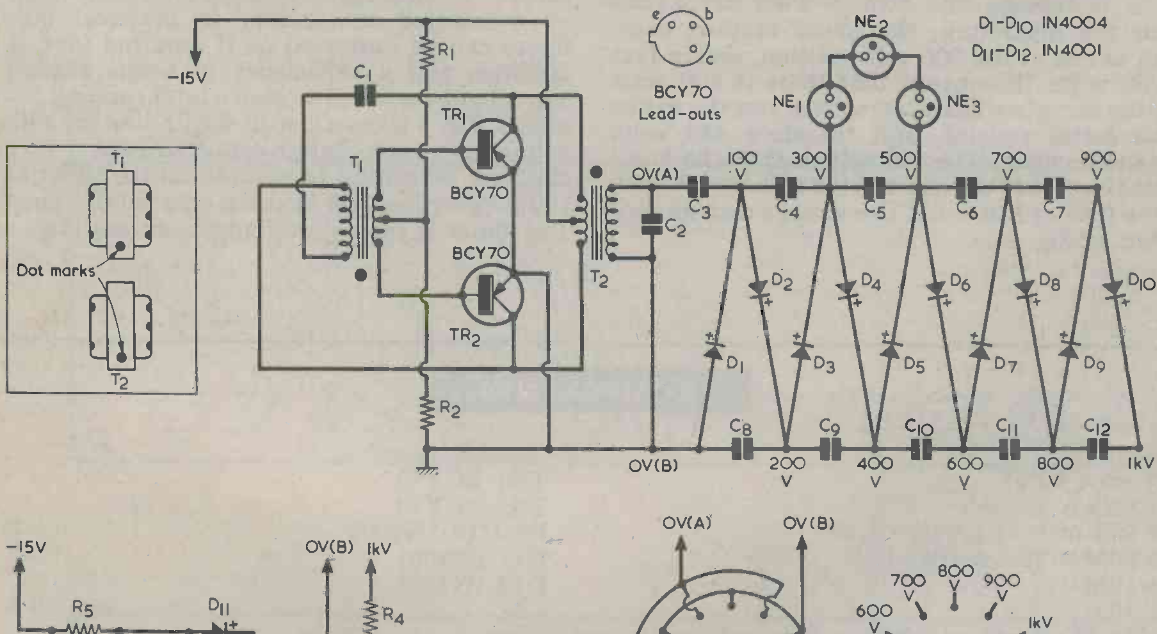



*Fig. 2. The complete circuit diagram. The transformers T1 and T2 need to be connected in the correct "sense", as indicated by the dot marks in the circuit and in the inset. The voltage selector switch is advanced from the zero volts position until a small current indication is given in the meter*

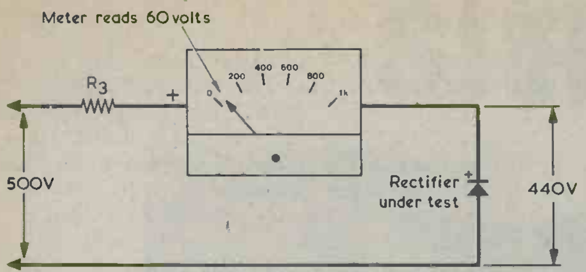



Fig. 3. If, when S1(a)(b) selects 500 volts, the meter gives an indication equivalent to 60 volts, the remaining 440 volts appears across the rectifier under test

the actual voltage across the rectifier. If the voltage indicated by the meter were, say, 60 volts the meter would give an indication of 3μA (the first 1½ divisions on the scale of the particular meter used in the prototype).

An example will clarify the process. Suppose that, in advancing the switch from zero volts towards the maximum, the meter reading commences to rise at the 500 volt position, and in fact reads 60 volts, this means that there is 500 volts across the complete chain, 60 volts across the meter and its series resistor, and therefore 440 volts across the rectifier. The 440 volts is then the maximum p.i.v. of that device, and the safe limit would be 440 x 0.85 or 375 volts. The voltage distribution is shown in Fig. 3.

## VOLTAGE SELECTION

The test voltage is selected by a 2-pole 11-way switch wired as shown in Fig. 2. S1(a) progressively switches the cathode of the rectifier under test (via the meter and series resistor) from zero volts to 1kV positive, while S1(b) alternately switches the anode between the OV(A) and OV(B) points. While it is possible to take all the voltages from one "Zero" point, this could cause the square wave voltage from the secondary of T2 to be superimposed on the d.c. voltage. If, for instance the OV(B) point was used, the square wave voltage would be superimposed when selecting the "odd" voltages along the top rail.

The switch is a standard 2-pole 12-way component with adjustable end stop set for 11-way operation. It is essential that the switch wafer action be break-before-make as otherwise the output voltage from T2 will be momentarily short-circuited each time the switch is operated, as also will be two of the voltages along the rectifier chain. A suitable switch can be made up from RS Components standard (not miniature) "Maka-Switch" parts. These are available from Home Radio.

The output voltage is stabilized by three series-connected 70 volt neons, which can be connected across any of the 200 volt differential points whereupon they serve to stabilize the whole chain. In Fig. 2 they are shown connected to the 300 and 500 volt points. Three times 70 equals 210 volts, of course, which is an error of only 5% and which can be considered satisfactory in practice; but the figure can be improved on if required (and if the facilities and a sufficiency of neons exists!) by selecting three neons to give a total running voltage of 200. Fig. 4 gives a circuit for finding the running voltage of a neon. Before connecting the neon to be checked, be careful to ensure that the slider of the 100kΩ potentiometer is at the zero voltage position. The slider is then slowly advanced until the neon

## COMPONENTS

*Resistors*
(All ¼ watt 10%)
- R1 2.2kΩ
- R2 100Ω
- R3 20MΩ (see text)
- R4 10MΩ
- R5 15Ω

*Capacitors*
- C1 0.1μF disc ceramic, 25V. Wkg.
- C2 3,300pF polystyrene, 160V. Wkg.
- C3-C12 0.1μF type C280, 250V. Wkg.
- C13 470μF electrolytic, 25V. Wkg.
- C14 470μF electrolytic, 25V. Wkg.

*Transformers*
- T1 Driver transformer type LT44 (Eagle)
- T2 Driver transformer type LT44 (Eagle)
- T3 Miniature mains transformer, secondary 12-0-12V at 50mA

*Switches*
- S1 2-pole 11-way rotary, break-before-make (see text)
- S2 d.p.d.t. toggle

*Semiconductors*
- TR1 BCY70
- TR2 BCY70
- D1-D10 1N4004
- D11 1N4001
- D12 1N4001

*Neons*
- NE1-NE3 neon bulbs, miniature wire-ended

*Fuse*
- FS1 1A cartridge fuse, 20mm.

*Meter*
- M1 0-50μA

*Miscellaneous*
- Red insulated terminal
- Black insulated terminal
- Panel mounting fuse holder, 20mm
- Pointer knob
- Materials for printed board
- 3-core mains lead
- Material for case
- Nuts, bolts, wire, etc.

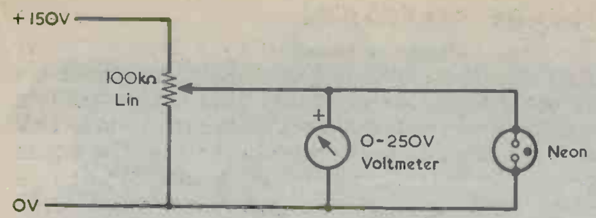



*Fig. 4. Although this is not essential, some constructors may wish to select neons for running voltage. A suitable test circuit is shown here. Take care not to advance the potentiometer slider too far towards the positive end of the track*

"strikes". This could be around 90 volts, as indicated by the meter, but immediately after striking the voltage across the neon will fall to its running voltage. Make a note of this voltage and select three neons giving a total running voltage as near to 200 as possible. Be careful also, once a neon has struck, not to advance the 100k Ω potentiometer slider too far positive as there is then a danger of the neon burning out as well as damage to the potentiometer due to excessive current.

On the prototype instrument one of the three neons is brought out to the front panel, being mounted in a small rubber grommet. It serves as a pilot-light and also as an assurance that the rectified high voltage is actually available!

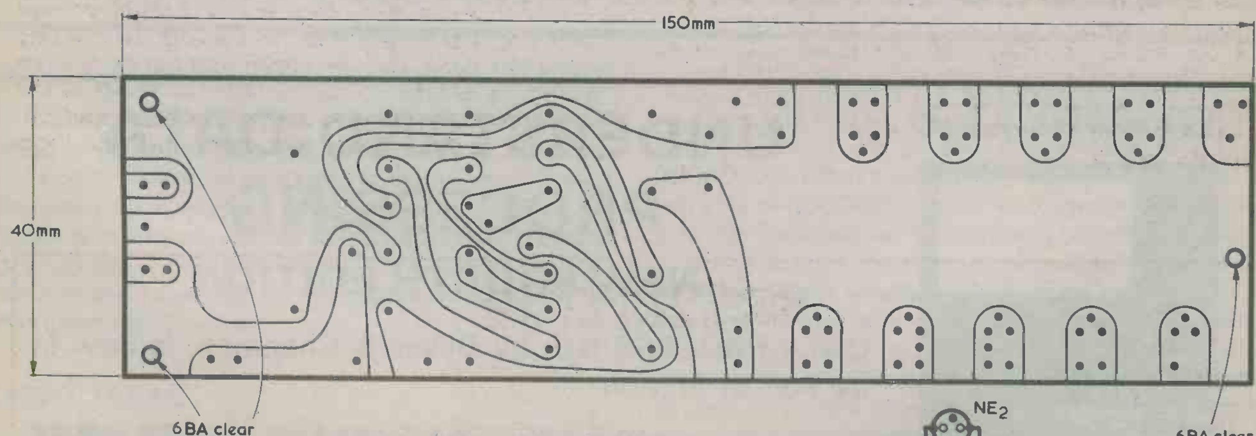
## ON-OFF SWITCHING

The unusual method of connecting the mains On-Off switch enables the high voltage chain to be discharged in the "Off" position. It will be seen that, in this position, the 1kV point is connected via R4 and the mains transformer primary to the OV(B) point. The time constant is such that the voltage is reduced to virtually zero in a small fraction of a second.

As far as the oscillator is concerned, the only points to watch are the connections to the two LT44 transformers, T1 and T2. As is indicated in the inset diagram of Fig. 2, there is a dot mark at the appropriate end of each transformer, and the dots appear alongside the transformers in the circuit diagram. It is necessary for the two transformers to be connected into the oscillator circuit with correct "sense", and this will be achieved if the dot indications are followed. The transformers employed in the prototype had connection spills for direct soldering to a printed circuit board. The oscillator produces a square wave of about 100 volts across the secondary of T2 at a frequency of about 350Hz.

The oscillator power requirement is 15 volts at about 30mA, so that the simple mains power shown is suitable. A battery supply could be used, if preferred.

The printed circuit board employed in the prototype is reproduced full size in Fig. 5. Apart from the three mounting holes, all the holes in this board are 1mm. diameter. The lugs of the two os-



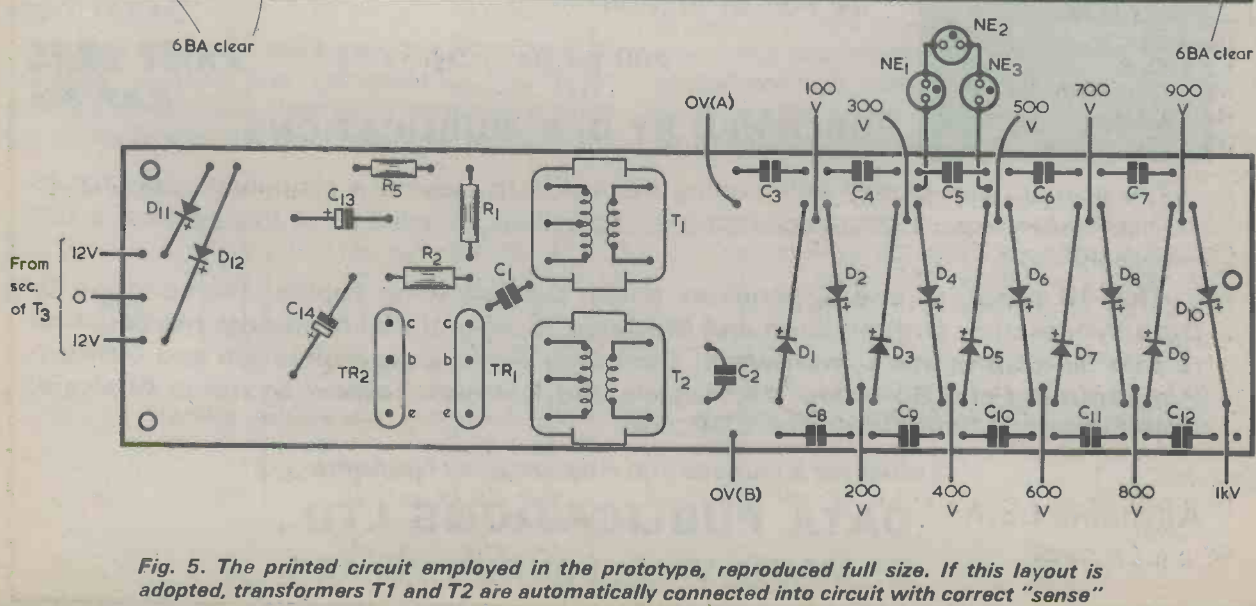
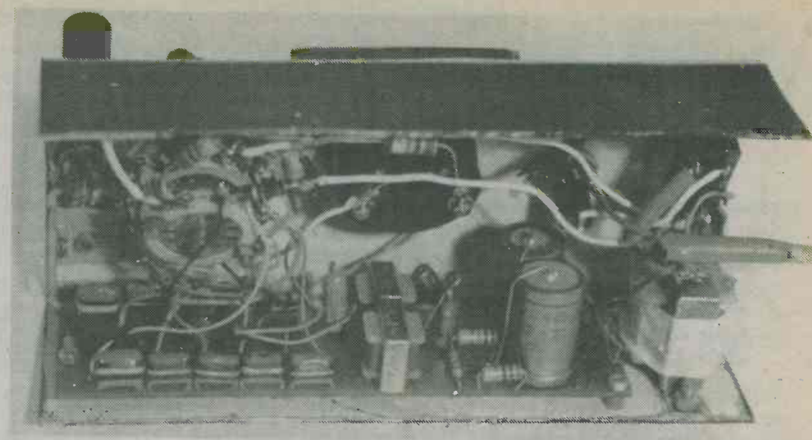




*Fig. 5. The printed circuit employed in the prototype, reproduced full size. If this layout is adopted, transformers T1 and T2 are automatically connected into circuit with correct "sense"*



*Layout is not critical. In the author's unit the printed circuit board and mains transformer are secured to the rear panel of the case. The remaining large components are mounted on the top panel*

cillator transformers are bent flat against the bottom of the laminations, and their wiring spills are passed through the appropriate holes in the board and then soldered to the copper. This is sufficient to hold the transformers in position. Correct "sensing" of the transformers is automatically ensured when the printed board layout of Fig. 5 is used. R3 and R4 are not on the printed board. R3 is wired between S1(a) and the meter, and R4 is wired between S1(a) and S2. R3, incidentally, may consist of two 10MΩ resistors in series. A small tagstrip can be used for wiring up the three neons.

As is shown in the photographs, the prototype is housed in a home-made aluminium case. This must be large enough to take all the components, and the author's case measured approximately 185 by 80 by 60mm. The meter employed by the author was a 0-50μA instrument with an internal resistance of 1,250 Ω and a front face size of 60 by 45mm.

The tester is supplied by a 3-core mains cable, and the aluminium case must be reliably connected to the mains earth. The positive supply rail after rectification is also earthed to the aluminium case. The printed board is mounted on one side of the case with three 6BA bolts and nuts, using metal spacing washers between the copper side of the board and the inside of the case. The board takes up its positive supply by way of one of these spacing washers.

■

# DATABUS

# HOW MICROPROCESSORS WORK

**PART 2** **By Ian Sinclair**

## *The second in our 12-part series which really explains microprocessors*

As we learned in Part 1, a microprocessor by itself is pretty useless, just a 40-pin hunk of silicon. One of the essential additions to the microprocessor to make up a working system is a memory i.c. of some sort. The newcomer to microprocessing usually finds the variety of memory i.c's a bit bewildering, so that we'll use this part to explain what's what in the memory business.

### TWO TYPES

To start with, there are two quite distinct types of memory, volatile and non-volatile. A volatile memory is one which loses all its stored digits when the power is shut off. If, for example, you have the number 10110010 stored in a volatile memory, then switching off causes the outputs to go to 00000000. What's worse, you can't be sure that it will stay at 00000000 when you switch on again — it rather depends on the circuitry inside the chip.

A non-volatile memory, on the other hand, keeps its stored digits whether power is on or not. This is the type of memory which is needed for essential bits which must not be lost under any circumstances. For example, a microprocessor which is used to control a teleprinter will have a program stored in a non-volatile memory. The program is essential because without it nothing can happen, pressing a key would have no effect because the instructions to the microprocessor aren't there. This

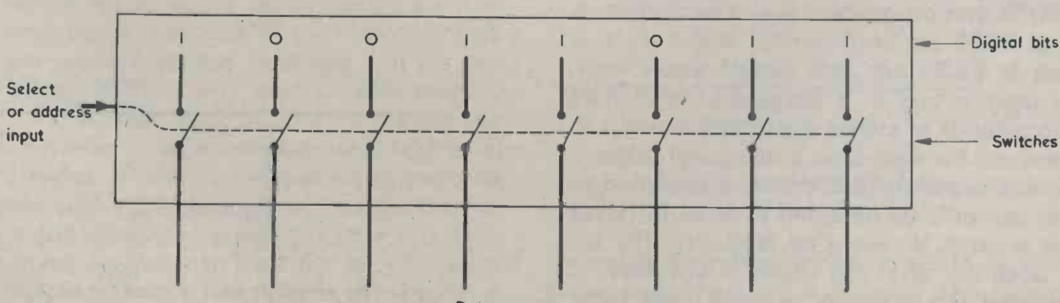



*Fig. 1. Illustrating a 1-byte memory. When the select or address terminal is activated, the bits stored in the memory are connected to the eight output (data) terminals*

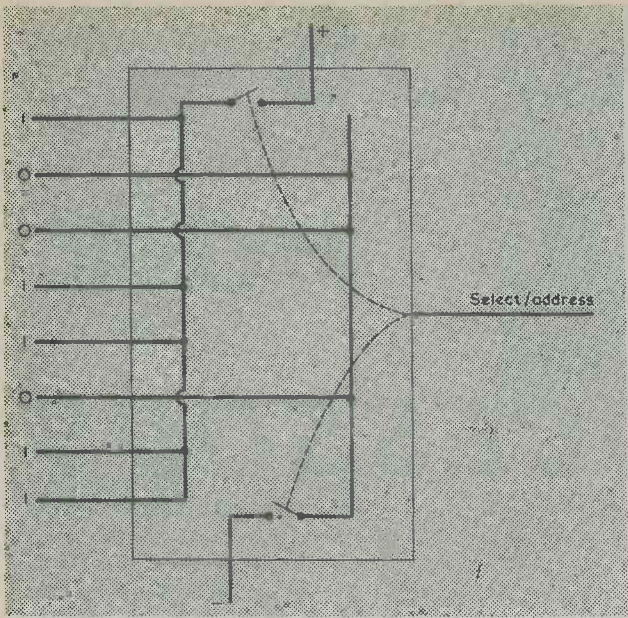



*Fig. 2. Principle of the mask-programmed ROM. Each output can be connected to 1 or 0, and the connections are permanent. The output is, in this example, switched on by a select/address signal at a separate pin*

program would therefore be stored in a non-volatile memory, so that whenever the microprocessor circuit was switched on, the program instructions would start to operate. Pressing a key now operates the machinery, because the microprocessor can carry out the instructions which specify what has to be done when that key is pressed. Remember that programs, instructions, and the results of pressing keys only ever have the result of creating a stream of binary digits, always in groups of eight bits that we call a byte, though large computers operate in two byte or larger units.

## ROM

Now there's a set of initials you have to get used to. ROM stands for Read-Only-Memory, and it refers to a type of non-volatile type of memory, the kind we use for permanent storage. Why read-only? If we are to preserve the stored bytes in the read-only memory, we must be sure that nothing that the microprocessor did could ever cause even one digit in the ROM to change. One of the things about this branch of electronics that sets it aside from ordinary linear circuits is that programs have to be perfect. A program that is 99 per cent perfect won't work; a program that is 99.99 per cent perfect won't work. One single digit wrong in a program, which may consist of thousands of stored digits, will cause it to fail. We have to be sure that nothing can alter a stored program, therefore, and the i.c. is designed so that the bits can only be detected at outputs, never altered. This is what is meant by read-only. The act of reading does not alter the digits in any way.

It's rather like the action of a really good tape-player which has no record circuits, only replay. Playing the tape doesn't change the tune, and there's nothing in the machine which can. Unlike the tape, though, the ROM can't be worn away mechanically.

The ROM story doesn't end here, because there are a fair old variety of ROMs to sort out. One type is called the mask-programmed ROM. This type is manufactured with its digit bits in place! To be more precise, there are internal connections inside the ROM, put there by the manufacturing process, which ensure that a specified load of bytes will be read out. Because the jigs for making the internal connections have to be made for each different lot of stored bytes (usually a program, but not always), these ROMs are extremely expensive to design, and the expense is only worthwhile if you want a few hundred thousand. If, of course, it's a ROM that everyone needs or wants, this is the cheapest way of making it, like any other integrated circuit.

A typical example of a mask programmed ROM is the character generator, which stores the digital bits that make up instructions to a microprocessor to trace out a character (alphabet, numbers, symbols) on a TV screen. Unless we suddenly change our alphabet, no one's going to go bankrupt making these chips!

How do you know what you want in a mask-programmed ROM? The answer is that you don't until you've tried it out, and so we need ROMs that we ***can*** write digits into, but which won't change afterwards. That way, we can check that everything works, unplug the ROM which we've used and send it to the manufacturer with a request for a couple of million mask-programmed ROMs. ROMs like this are called PROMs (Programmable Read-Only-Memories), because it's possible to write a set of program digits into the memory, but only by a method which doesn't take place accidentally. One popular type of PROM is the fusible-link PROM. This uses, as the name suggests, a set of minature fuse links, with one end of each connected to the positive supply. When the PROM is manufactured all of these links are intact, so that all the digits which can be read out of the memory are 1s. To program this ROM, the "fuses" are blown wherever we need a 0. The "fuseblowing" operation needs a lot more current than the microprocessor could pass, so that there is no risk of any more zeros being created during normal use. Once blown, of course, a "fuse" can't be repaired (or even seen!) so that you have to be sure of your program.

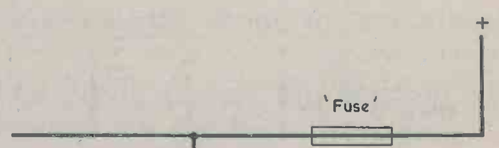



*Fig. 3. The principle that is used for each bit of a fusible-link PROM. When the fuse is intact the output is 1. When the fuse is broken the output is 0. Selection switching is omitted in this illustration*

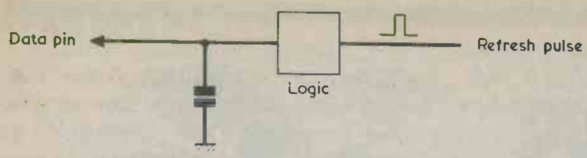



*Fig. 4. Principle of dynamic memory. A 1 input charges the capacitor, and the logic circuits detect the charge and keep the capacitor charged by refresh pulses. A 0 input leaves the capacitor discharged, and the logic circuits do not deliver refresh pulses*

Another category of PROM, very popular for one-off uses, is the ultra-violet erasable type. This type of PROM is erased by shining UV light through a clear "window" on the chip. Once erased, covering the window protects against accidental erasure. The PROM then has to be programmed by writing the same digits into the same parts over and over again. The time that is needed to do this ensures that the stored digits are protected because it's most unlikely that any normal use of the PROM would result in wrong information being written in — for one thing, it would have to be a major error to have signals being sent to the PROM instead of taken from it!

The ROMs and PROMs represent a very expensive sort of memory, because they consist of integrated circuits which have to be bought, wired into a circuit, and which will have to be changed if different information is needed. It makes sense to have some instructions stored in this way, if these instructions are to be used everytime the microprocessor is switched on.

This isn't true of all programs, though. If we use a computer in a small business, analysing orders, keeping stock, checking sales, there are some jobs which are done monthly rather than weekly — working out sales commissions, for example. Like anything else, these tasks need programs, but it would be very expensive to keep these programs as ROM chips. The solution is to use ROM only for the essential operation program — the one which lets the operator use the computer. The rest of the programs are stored on magnetic tape, punched cards, paper tape, magnetic discs or whatever. Whenever they are needed, the program bits which are preserved in this way are read into the computer, to be stored in memory chips which permit recording (writing) as well as reading.

## RAM

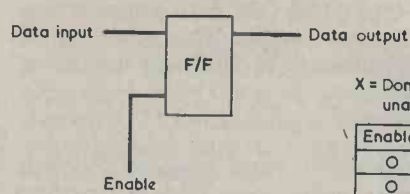
RAM stands for Random Access Memory. The name is unfortunate, because all the memory chips we use have random access, meaning that we can get hold of a bit from any part of the memory without having to read each bit in turn. It's like the difference between a tape recorder with fast wind and one without. If you've no fast wind, you just have to play each tape through to find the bit you want. With fast wind and a tape counter you have random access — you can find the bit you want quickly.

The correct name for this type of memory is a read-write memory. It's a volatile type, with all the stored digits lost when the power is switched off. The stored information can be changed at will, or stored for as long as is needed provided the power is on.

There are two RAM types. The dynamic RAM stores for a limited time only, and needs a "refresh" signal to preserve the information for a longer period. This "refresh" signal is a repeated pulse into one pin of the chip, and can be taken from a counter circuit or, in some cases, from the microprocessor itself. Dynamic RAMs are cheap, but the need for a refresh pulse is a nuisance — another bit of circuitry and another lot of tracks on the printed board. Static RAMs are more popular for just that reason, no refresh pulses are needed, no special circuits, just storage for as long as power is applied.

RAMs can be constructed using flip-flops or capacitors. The capacitor type, as the name suggests, uses large numbers of miniature capacitors in i.c. form. When a capacitor is charged, it is storing a logic 1 signal; when discharged it stores logic 0; but the storate is not perfect. Any capacitor will gradually leak its charge and a memory consisting of capacitors will usually be a dynamic type, needing refreshing. Refreshing consists of recharging the charged capacitors, and leaving the others alone.

The system used for static RAMs is the flip-flop, often using MOS transistors in i.c. form. The type of flip-flop used for this job has a data input, an output and an "enable" input. Fig 5 shows the action in symbols. With the enable input low a logic signal at the input is ignored, it has no effect on the flip-flop action because it is not gated in. The output, on the other hand, remains at the voltage, 0 or 1, at which it was previously set. When the enable input is taken




X = Don't care - output is unaffected by input

| Enable | Data in | Data out |
|---|---|---|
| 0 | 1 | X |
| 0 | 0 | X |
| 1 | 1 | 1 |
| 1 | 0 | 0 |

*Fig. 5. Principle of static RAM. Each flip-flop can be set to 1 or 0 at its output (the writing operation), and the output can be connected to output lines for a read operation*

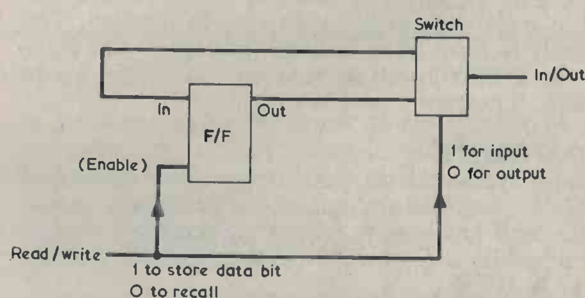



*Fig. 6. Using a single terminal for both input and output of a RAM memory*

*(Continued on Page 41)*

# SHORT WAVE NEWS
## FOR DX LISTENERS

By Frank A. Baldwin *Times = GMT* *Frequencies = kHz*

● **RWANDA**
Kigali on **3330** at 1910, rhythmic local-style music on drums and percussion instruments in the Home Service programme, scheduled here from 0300 to 0600 (Sunday until 0900), 0900 to 1200 (Saturday and Sunday through to 2100) and 1330 to 2100. The power is 5kW and the channel is subject to commercial interference.

● **CAMEROON**
Radio Bertoua on **4750** at 0446, OM with song in vernacular, local-type music, OM announcer. The schedule is from 0430 to 0730 and from 1630 to 2200 mostly in French but with local programmes from 2100 to 2200 and in English from 1830 to 1845 and also on Sunday from 0615 to 0645. The power is 20kW.

● **GUINEA**
Conakry on **4910** at 0456, OM with songs in vernacular, local orchestral music. The schedule of this one is from 1230 through to 0730 and the power is 18kW.

● **NIGERIA**
Lagos on **4990** at 0500, local news in English read by YL announcer after station identification. The schedule is from 0430 to 1000 and from 1700 to 2305. This is the National Programme in English and vernaculars. The power is 20kW.

Lagos on **11900** at 0522, YL's chants, drums, OM announcer in vernacular.

● **GHANA**
Accra on a measured **3366** at 1854, music in the Arabic style with announcements in English. The schedule is from 0530 to 0805 (Saturday and Sunday until 0900) and from 1600 to 2305, all in English. The power is 10kw.

● **SAO TOME**
Radio Nacional da Sao Tome on a measured **4807** at 2050, OM announcer in Portuguese, guitar music with local-style orchestral accompaniment. The schedule is from 0530 through to 2300 and the power is 10kW.

● **FINLAND**
Helsinki on **15270** at 2139, OM with the English programme to Europe, North and North West Africa, scheduled here from 2130 to 2200.

● **NORWAY**
Oslo on **9590** at 1404, OM with a local newscast in the English programme 'Norway This Week', scheduled from 1400 to 1430 Sundays only.

● **NETHERLANDS**
Hilversum on **9715** at 0625, OM with identification at sign-off of the English programme to North America (West Coast) scheduled from 0530 to 0625.

Hilversum on **11740** at 2030, OM with identification and world news in the English programme for Central and West Africa, scheduled from 2030 to 2120.

● **MADAGASCAR**
Radio Nederlands Relay on **11730** at 2030, in parallel with the above, same target areas.

● **ITALY**
Rome on **11810** at 0534, interval signal, OM with identification and the Arabic programme to Arabia and Egypt, scheduled from 0535 to 0555.

● **VATICAN CITY**
Vatican on **11700** at 1950, YL with Rosary to Europe and Africa, scheduled from 1945 to 2005.

● **CZECHOSLAVAKIA**
Prague on **11990** at 1818, OM with the English programme to Africa, scheduled from 1730 to 1825.

● **SPAIN**
Madrid on **9630** at 0614, OM and YL with announcements and identification at the end of the English programme for North America, scheduled from 0515 to 0615.

● **PORTUGAL**
Lisbon on **9740** at 2045, OM with identification and programme details in the English programme for Europe, scheduled from 2030 to 2100.

● **ALBANIA**
Tirana on **9500** at 0700, YL with identification and the news in the English programme for Australia, scheduled from 0700 to 0730.

● **ISRAEL**
Jerusalem on **21565** at 2012, YL with identification in 'Editorial Comment', in an English programme for Europe, scheduled from 2000 to 2030. Also logged in parallel on **21675**.

● **IRAN**
Teheran on a measured **9138** at 2044, OM with the Persian (Farsi) programme (a relay of the Domestic Service) to Europe, North Africa and North America, scheduled from 2030 to 0230.

● **PAKISTAN**
Karachi on **21730** at 0613, OM with identification and sign-off at the end of the Arabic programme for the Near and Middle East, scheduled from 0515 to 0615.

● **AUSTRALIA**
Melbourne on **21680** at 0544, OM with a turf racing commentary in the English programme scheduled here from 0001 through to 0930.

● **CHINA**
Radio Peking on **7480** at 1825, OM and YL with the Persian (Farsi) programme to Iran and Afghanistan, scheduled from 1800 to 1830.
Radio Peking on **7470** at 2050, OM with the English programme for Europe, scheduled here from 2030 to 2130.
Radio Peking on **15100** at 2125, OM with the English programme for North and West Africa, scheduled here from 2030 to 2130.

● **CHINA — REGIONAL**
Nanning on **4915** at 2202, YL with a talk in Chinese. The schedule is from 2105 to 0005 and from 0845 to 1605.

● **ECUADOR**
HCJB Quito on **15295** at 2133, OM and YL with announcements then 'DX Party Line', a programme for Dxers, in English.
HCJB Quito on **21480** at 2000, OM with identification in English and 4 'pips' time-check. Unlisted channel.
Radio Nacional Espejo, Quito, on a measured **4679** at 0320, OM and YL with announcements in Spanish, short excerpts of classical music. The schedule is around the clock, although it has been reported sometimes closing at 0600, and the power is 5kW.
Sistema de Emisora Atalaya, Guayaquil, on a measured **4781** at 0336, Latin American type dance music, OM announcements in Spanish. Previously on **4790**, this one is scheduled from 1000 to 1330 and from 0100 to 0500 and the power is 5kW.

● **BRAZIL**
Radio Emisora Rural, Santarem, on **4765** at 0230, OM song in Portuguese, local pops, after identification. The schedule is from 0800 to 0400 and the power is 10kW.
Radio Borborema, Campina Grande, on **5025** at 0410, OM with a love song in Portuguese. The schedule is from 0830 to 0500 and the power is 1kW. Sometimes identifies as "A Princesa do Sul".
Radio Educacion do Para, Belem, on **5045** at 0252, OM with a ballad in Portuguese, LA (Latin American) dance music. The schedule is from 0900 to 0600 and the power is 10kW.
Radiobras, Brasilia, on **15270** at 2059, OM with identification in English and requesting reports.

● **COLOMBIA**
Radio Guatapuri, Valledupar, on **4815** at 0345, OM with identification, commercials, local pops. The schedule is from 0930 to 0600 (closing time is variable) and the power is 10kW.
Radio Cinco, Villavicencio, on **5040** at 0515, OM with identification, jingles, commercials, OM with love song in Spanish. The schedule is around the clock and the power is 3kW.

● **COSTA RICA**
Emisora Radio Reloj, San Jose, on **4832** at 0648, OM with announcements in Spanish, studio clock loudly ticking in the background, local music, sambas etc. The schedule of this one is around the clock and the power is 1kW.

● **VENEZUELA**
Radio Tachira, San Cristobal, on **4830** at 0348, local-type dance music, OM with announcements in Spanish.

● **PERU**
Radio Andina, Huancayo, on a measured **4996** at 0406, YL with plaintive Andean song, guitar-type backing, OM with announcements and commercials. The schedule is from 0930 to 0500 (times are variable) and the power is 1kW.
Radio Huancavelica, Huancavelica, on **4885** at 0400, OM with full identification after 3 chimes, local-style folk music. This one has a schedule from 1100 to 0500 and the power is 1kW.

● **JAPAN**
Tokyo on **21610** at 0634, OM with identification and a local newscast in the Swedish programme for Europe, scheduled from 0630 to 0645.

## DATABUS — No. 2 (Continued from Page 39)

to logic 1, the logic signal at the input sets the flip-flop so that the same signal now exists at the output. This is the "write" action of the memory, storing a bit which exists at the input. This action will take a definite time, less than half a microsecond.

There's just an additional complication. If we had one input and one output for each bit, memory chips would have more pins than a pincushion. The design is changed, therefore, so that there is just one input/output terminal, and the enable (or read/write) terminal. This is done by adding gates which are controlled by the signal at the enable terminal. With the enable voltage set for reading out, the output of the flip-flop is connected to the IN/OUT terminal, and the input is not used. When the enable voltage is switched over, the input of the flip-flop is connected to the IN/OUT terminal and the output is unused — this comparatively simple scheme halves the number of connections which would have to be made, and ensures that we can't try to read and write at the same time.

Because all of these circuits can be made in i.c. form, the additional complications of adding the gates make very little difference to the cost of producing the circuit, far less than the cost of producing a package with more pins, for example. The whole of microprocessor design is based on this idea of making more complicated i.c.'s so that less circuitry is needed outside the i.c., and nothing illustrates this better than a study of how we select a bit stored in memory — next month!

# THE "DORIC" 9 WAVEBAND PORTABLE

## Part 2

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

### BUILDING THE AMPLIFIER UNIT

We next consider the amplifier and speaker unit. This is designed as part of the receiver as a whole, but it can be used on its own with the short wave receiver described last month or as an amplifier in its own right. In the latter instance the short wave receiver should be connected to it as the low impedance input of the amplifier will otherwise be inoperative. This low impedance is provided by the transformer, T1, in the receiver. Although the amplifier uses a separate and larger battery, the on-off switch ganged with the amplifier volume control also turns off the short wave receiver.

### AMPLIFIER CIRCUIT

the circuit of the amplifier appears in Fig. 4. Despite the fact that Class A amplification is used, a "sliding bias" arrangement allows the current drawn to vary with the amplitude of the signal, as with Class B. Up to about 500mW audio output can be obtained. The average battery current at a good volume level is of the order of 20 to 30mA. At peaks up to 200mA may be drawn momentarily.

The upper 3.5mm. jack plug, when inserted in the upper receiver socket, breaks the receiver 9 volt supply. Switch S3 is then able to turn the receiver

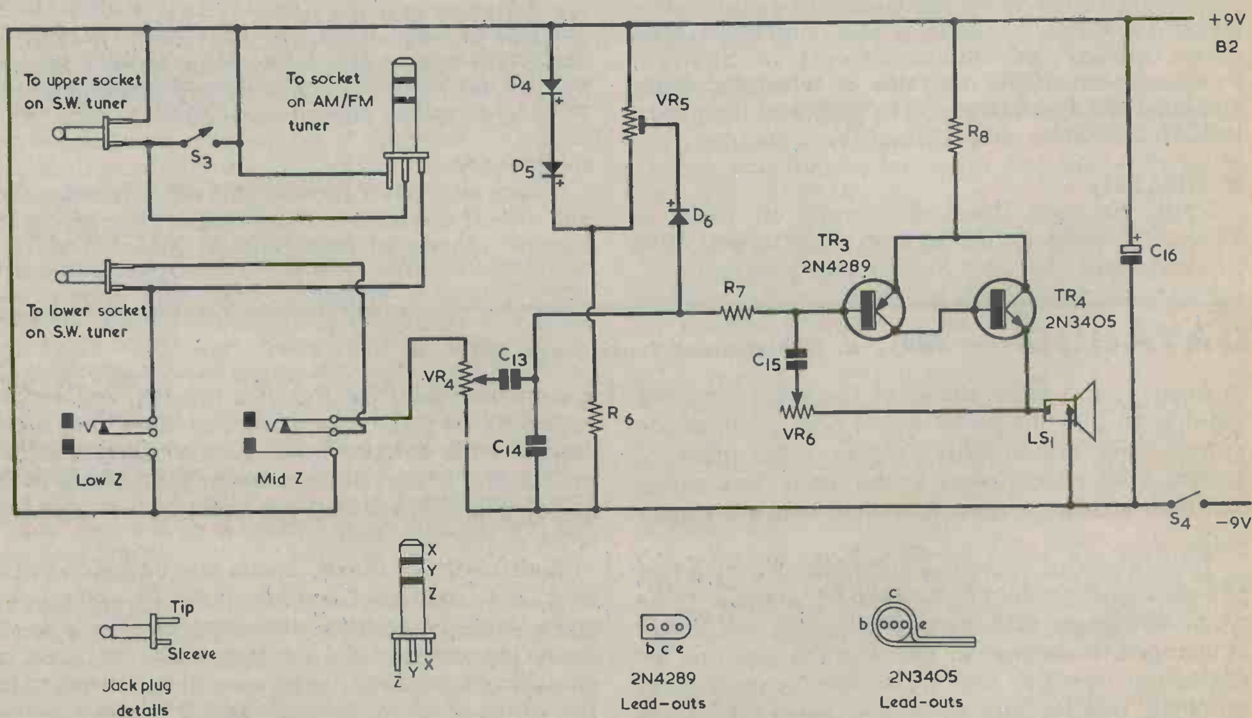



*Fig. 4. The circuit of the amplifier and speaker unit. This may be used in conjunction with the short wave receiver described last month or as an amplifier in its own right*

*The amplifier with the short wave receiver fitted into place*

## COMPONENTS

*Resistors*

(All fixed values ¼ watt 10%)

- R6 10kΩ
- R7 10kΩ
- R8 3.3 Ω
- VR4 22kΩ potentiometer, log, with switches S3 and S4, type P20 (Electrovalue)
- VR5 4.7 Ω pre-set potentiometer, 0.25 or 0.3 watt, horizontal
- VR6 220kΩ potentiometer, linear, type P20 (Electrovalue)

*Capacitors*

- C13 0.47μF polyester
- C14 1,000pF silvered mica or ceramic
- C15 0.01μF ceramic
- C16 1,000μF electrolytic, 10V. Wkg.

*Semiconductors*

- TR3 2N4289
- TR4 2N3405 (Electrovalue)
- D4 1S44
- D5 1S44
- D6 1S44

*Switches*

- S3 s.p.s.t. toggle, part of VR4
- S4 s.p.s.t. toggle, part of VR4

*Speaker*

- LS1 15 Ω 5in. round

*Sockets*

- 2-off 3.5 jack sockets

*Plugs*

- 2-off 3.5mm. jack plugs
- ¼in. stereo jack plug (see text)

*Miscellaneous*

- 8-way tagstrip (see text)
- 9-volt battery type PP9
- Battery connector
- Materials for "chassis" and case

on and off. Switch S4 is the amplifier on-off switch. These two switches constitute the d.p.s.t. switch which is on the amplifier volume control.

The audio signal at the lower 3.5mm. jack plug is passed via the "Mid-Z" amplifier jack socket to the volume control, VR4. It is then applied to the "sliding bias" network consisting of C13, D6, R7 and VR5. C13 is charged by D6 to a voltage dependent on signal amplitude, and thereby increases the negative bias on the p.n.p. transistor, TR3, to the level needed to handle the signal. The bias operating point is set up by VR5, the voltage across which is stablized by the silicon diodes D4 and D5. TR3 collector connects directly to the base of output transistor TR4, which is an emitter follower feeding the speaker. VR6 and C15 provide tone control by frequency selective negative feedback, whilst R8 gives a measure of negative feedback at all frequencies.

The large stereo jack plug shown in Fig. 4 will connect to the a.m./f.m. tuner, whose description will commence next month. For the time being, it may merely be noted that it offers a switch-on facility similar to that at the upper 3.5mm. jack plug, and an audio output coupling to the lower 3.5mm. jack plug. The stereo plug should be a type having a body diameter of about ½in., such as the Electrovalue type P4.

When the amplifier has been completed and its wiring checked, VR5 should be set so that its slider is at the positive end of its track. This is fully anticlockwise as shown in the wiring diagram of Fig. 6. No input signal is applied to the amplifier. A new battery is connected to the amplifier with a testmeter switched to a high current range (since it is being used with an untested piece of equipment) in series with one of the battery leads. If the initial reading shows that it is safe to do so, the testmeter is switched to a suitable lower range and the slider of VR5 slowly adjusted from the anti-clockwise setting until the meter reads 12mA. This is a once and for all adjustment, and the meter may then be removed. No other setting up is required.

## CONSTRUCTION

The dimensions of the various sections of the amplifier are shown in Fig. 5, and it should be pointed out here that these are dependent upon the actual dimensions of the receiver as built and the speaker. The height of the speaker panel and the internal height of the case are shown as 5½in. The receiver slides into the case and, fi its height is in practice slightly greater than 5½in., the corresponding dimensions in Fig. 5 should be amended accordingly. It is assumed that a standard modern 5in." round speaker will be employed with a 4½in. cone. Some of the older nominal "5in." speakers may require modifications to the dimensions shown in Fig. 5. Since it is, in any case, necessary to use the speaker for marking out, any possibility of errors here will be automatically cancelled out.

The item of Fig. 5(a) is cut out, both in Formica and in ¼in. plywood, with minor variations between the two. The plywood panel is immediately behind the Formica panel, and since the Formica will be visible it should have a colour considered suitable by the constructor. The author used white Formica. The Formica has two ⅜in. holes for mounting VR4 and VR6, whilst the plywood has rectangular apertures which allow it to be passed over the bodies of these two controls. The speaker aperture in the Formica takes the front frame of the speaker, i.e. the speaker aperture corresponds to the outer periphery of the speaker frame, and the speaker is used a template to mark out the outline required.

The Formica aperture is cut out with a fretsaw, and the piece removed should be retained as it will be used later. The speaker aperture in the plywood is a circle of 2 3/16in. radius. When fitted later, the speaker body is passed through the plywood aperture. The 4½ by 2in. rectangular aperture is common to both Formica and plywood, and provides access for the short wave receiver controls. After the Formica and plywood outlines have been intitally cut out the two pieces are secured together with a single woodscrew (not shown in Fig. 5(a)) situated between the speaker and receiver control apertures. The screw helps to ensure that the two sections mate accurately when cutting out the 4½ by 2in. aperture. It will, of course, be necessary to disassemble the Formica and plywood items for some of the cutting out operations. The two panels will also need to be disassembled so that the wooden item shown in Fig. 5(b) may be secured to the plywood panel.

The small Formica panel in Fig. 5(b) takes the "Low-Z" and "Med-Z" jack sockets and is later

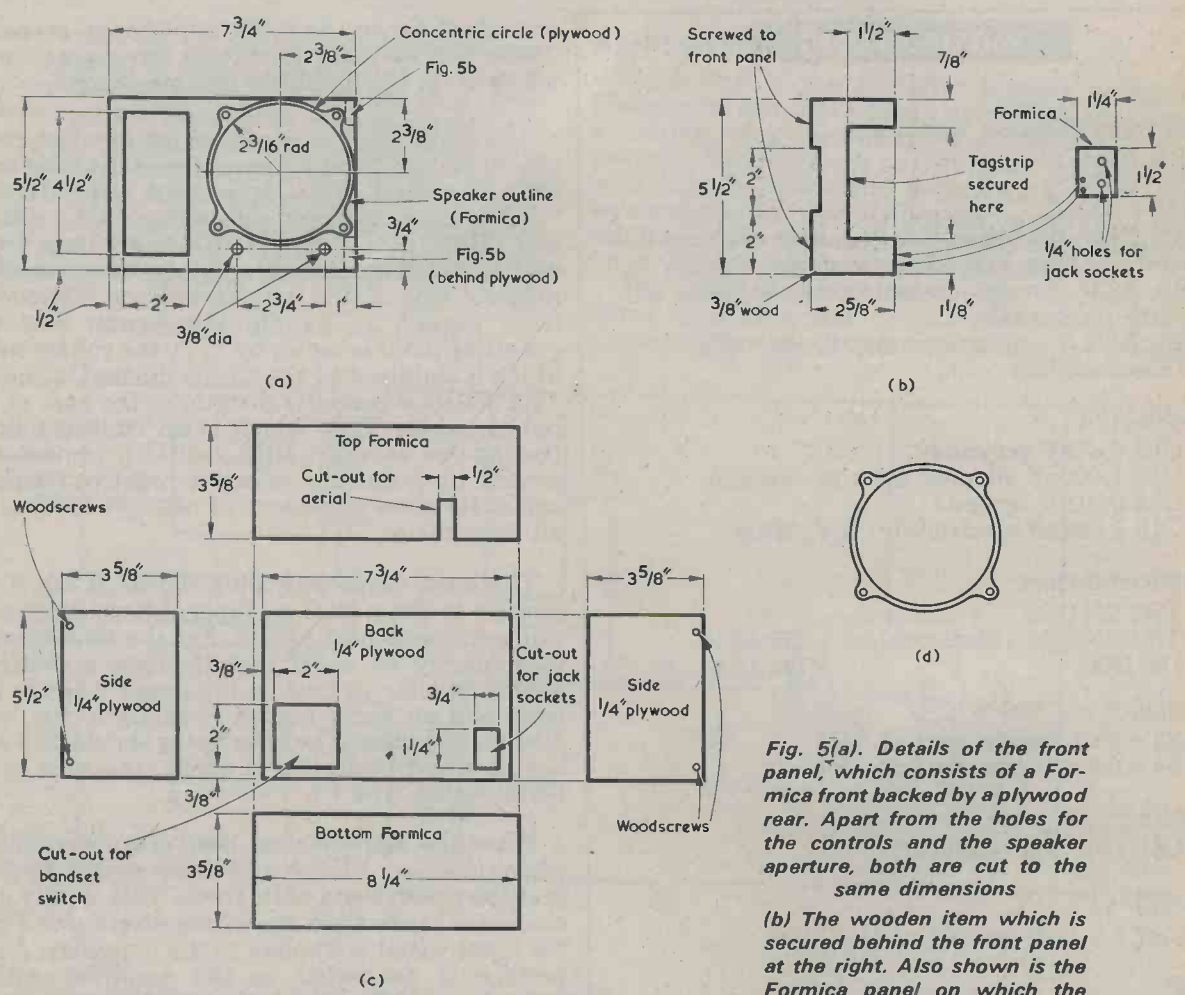


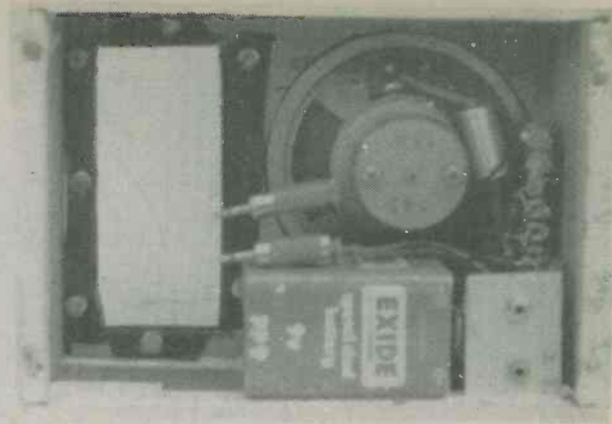

*Fig. 5(a). Details of the front panel, which consists of a Formica front backed by a plywood rear. Apart from the holes for the controls and the speaker aperture, both are cut to the same dimensions*

*(b) The wooden item which is secured behind the front panel at the right. Also shown is the Formica panel on which the jack sockets are mounted*

*(c) The amplifier case. The four woodscrews in the sides are at the front of the case*

*(d) Formica ring which, covered with Fablon or Contact, is screwed over the front of the speaker frame*

*Internal view of the amplifier, showing the two jack plugs for the short wave receiver*

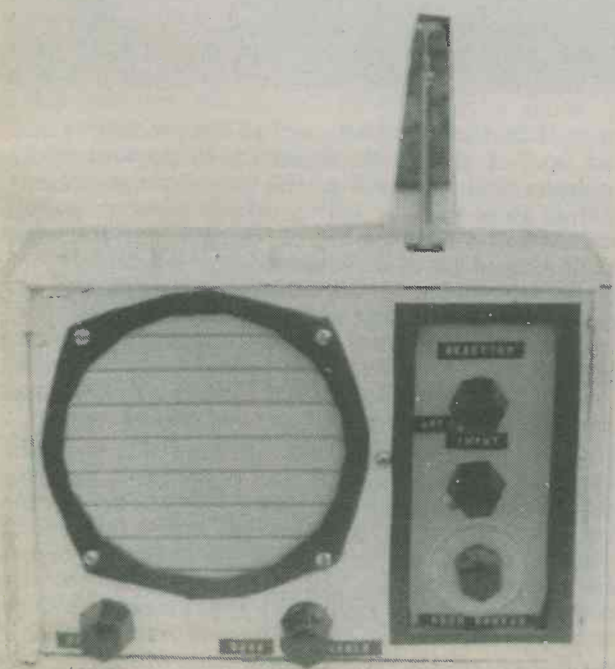



fitted to the $1\frac{1}{8}$in. "foot" of the wooden piece of Fig. 5(b) by the two woodscrews at the points indicated. When it is mounted the jacks will be at the back of the amplifier.

A suitable case is shown in Fig. 5(c). The top two sides and bottom are secured together and then covered with Contact or Fablon of a suitable colour. The amplifier panel of Fig. 5(a) should be a comfortable but not binding fit in this framework and it is inserted from the rear, the four woodscrews in the two sides preventing it from passing right through. The short wave tuner is fitted behind the amplifier panel with its three controls appearing in the $4\frac{1}{2}$ by 2in. aperture. The back is held in place by four small solder tags screwed to the rear edges of the two sides so that they are free to swivel. When the back is in place it should hold the front panel firmly against the four woodscrews due to the presence of the short wave tuner and the PP9 battery bearing against the back of VR6. It is best to fit the four woodscrews after completion of the amplifier and the case framework, so that the best position for them may be found. They should certainly be fitted after the Contact has been applied to the top, sides and bottom. A cut-out for the receiver aerial is required in the case top and its position should be taken from the receiver, as constructed. Similarly, the position of the cut-out in the back for the amplifier jack sockets should be taken from these, as assembled. The back of the receiver case is also covered with Contact or Fablon.

The piece of Formica cut out for the speaker aperture in Fig. 5(a), may now have four holes drilled in it corresponding with those in the speaker frame. A concentric circle having a diameter of $4\frac{3}{8}$ in. (or as large as it can be conveniently made) is then cut out, and the resultant ring covered with Fablon or Contact. See Fig. 5(d). A piece of metal speaker gauze is cut out so that its outline is just slightly smaller than that of the ring and the speaker is finally mounted by four screws passing through the holes in the ring the speaker gauze and the holes in the speaker frame.

Since the fitting of the ring and the gauze is cf a finishing-off nature, some constructors may prefer



*The amplifier and receiver assembly with the telescopic aerial partly extended*

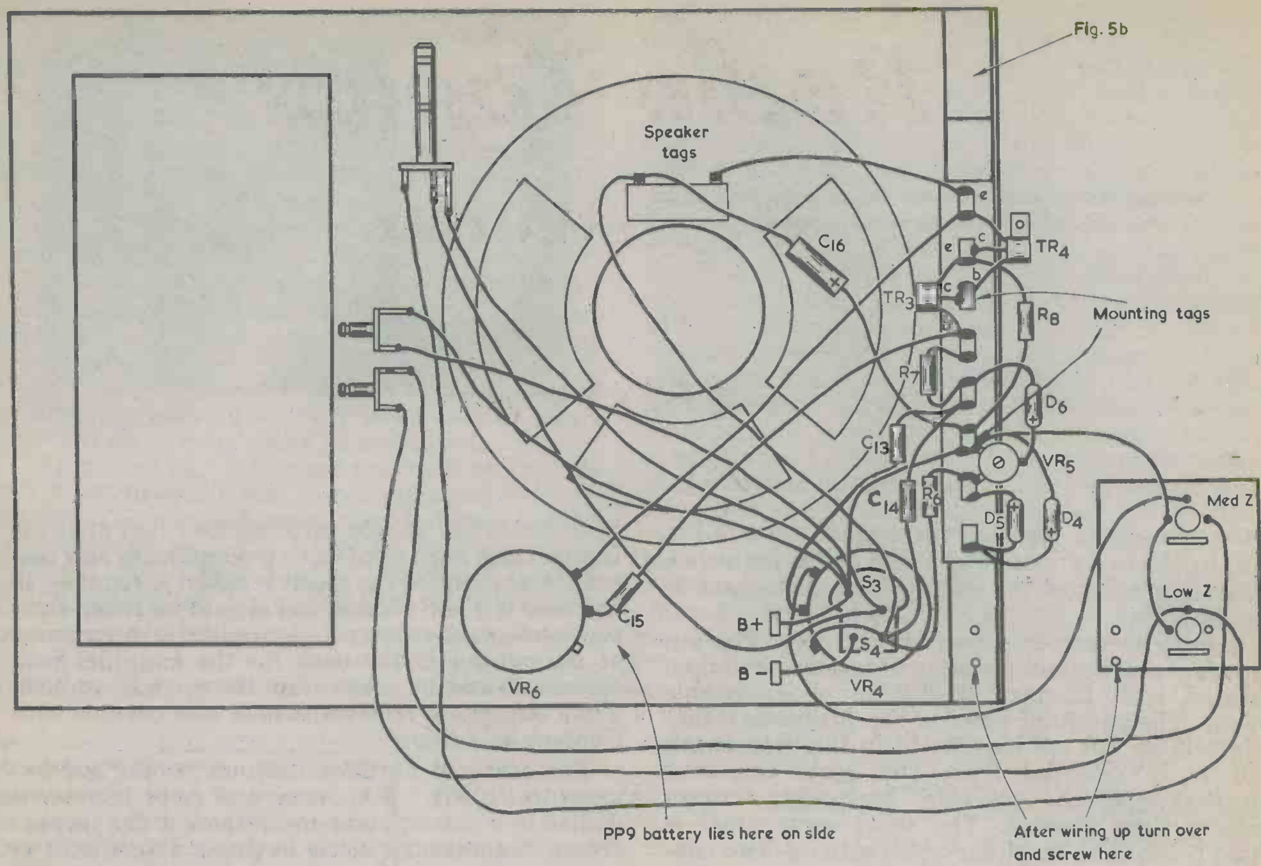



*Fig. 6. The amplifier wiring. The tagstrip is shown here as being flat but, if the type specified is employed, the tags are vertical to the surface on which they are mounted*

to make this the final operation to be carried out, doing it after wiring and checking out. In this instance the speaker may be temporarily held in place by means of two screws fitted at opposite holes in its frame.

## WIRING

Amplifier wiring is carried out as shown in Fig. 6. The 8-way tagstrip is secured to the wooden item of Fig. 5(b), as indicated in that diagram. This tagstrip can be cut from the 28-way R.S. Components "Standard" tagstrip which provided the 10-way tagstrip for the short wave receiver, and the two mouting tags should be at the positions shown in Fig. 6.

After the wiring to the two jack sockets has been completed, the Formica panel on which they are mounted is turned round and secured to the piece of Fig. 5(b) by means of two woodscrews.

The two 3.5mm. jack plugs will be inserted into the receiver jack sockets when this is fitted in the case. The stereo jack plug is not needed until the a.m./f.m. tuner to be described next month is added, and it should be taped up to prevent short-circuits and kept out of the way for the present. When it is used it will protrude through a hole made centrally in the top of the case, and the wires to it should be of a corresponding length.

Before wiring to S3 and S4, confirm the appropriate switch tags with a continuity tester.

When all wiring has been completed, take care to ensure that VR5 is adjusted as already described before connecting the 9 volt battery, VR5 is then set up.

The amplifier may now be tried out with the receiver, the two 3.5mm. jack plugs being inserted in the corresponding receiver sockets. Turn on the receiver and then turn on the amplifier on-off switch. The switch on the receiver may now be left on as the receiver supply will be controlled by the amplifier switch. However, the receiver switch must be turned off if it is removed from the amplifier, as its PP3 battery will otherwise run down. ■

# Radio Topics

## By Recorder

**********

In the dim distant days of yore I used to play around with valves, and I considered that these were the finest things going. Valves improved with the years and got smaller and smaller, offering the most appeal in their 7-pin B7G and 9-pin B9A envelopes. Most electronic items were run from the mains in those days, and one of the most common components was the 6.3 volt mains heater transformer. These 6.3 volt heater transformers have virtually disappeared completely now, although I see that there is one still lurking in the Electrovalue lists.

Then along came transistors which were of course the greatest thing since sliced bread, and these opened up vast new possibilities in the constructional field. First in the arena were the germanium types, which lent themselves mainly to amplifying applications. Next appeared silicon planar transistors, the forerunners in terms of production know-how of our present integrated circuits. Delightful devices these were and still are, with collector leakage current in the order of microamps and their abrupt switch-on characteristic at a base-emitter voltage of around 0.65 volt.

### LOGIC DEVICES

The switching capabilities of silicon transistors make them ideal for basic logic applications, even though they have long been superseded by logic i.c.'s specifically intended for the job. The first logic i.c.'s to really flood the hobby market were those in the 7400 series but, for some reason, I was never attracted to these. Perhaps it was the necessity for a 5 volt stabilized supply which put me off, after having been spoiled by making up experimental circuits which could be simply clipped to a PP9 battery.

But the later CMOS logic has changed the situation completely. CMOS devices will operate from any supply voltage within their ratings, they draw negligible current and they have a pleasing symmetry in their input and output voltages. It can be a real pleasure to dream up CMOS circuits and then find that they function perfectly when built up in practice.

I have been lucky with CMOS i.c.'s insofar that I have never had one break down on me due to high static voltages. When they first became available the warnings against improper use were dire indeed, and it is certainly impressive to receive through the post devices whose pins are fully and firmly short-circuited together with metal foil. (Somebody in one mail-order house got the wrong message last year, and I received a batch of CD4011's cocooned in metal foil. When I removed the foil I found that it had nowhere been in contact with the i.c. pins, which were embedded in a chunk of polystyrene ceiling tile! Still, the thought was there).

Perhaps my luck has been due to the fact that I nearly always use i.c. holders for the CMOS devices I play around with. The holders are initially wired up, and the circuit fully checked visually, before the CMOS i.c. goes in. And, of course, I can always remove the i.c. later without any difficulty if I want to try it in another circuit.

If you are new to CMOS you should not be scared off by tales of possible damage due to high static voltages. Always, of course, use a soldering iron having a bit which is reliably connected to earth. Risks are highest if you haven't got your own work-room or workshop. Should you be working in a living room or bedroom having a nylon carpet you may unknowingly be storing up surprisingly high static voltages in your body when you walk across it. My own work-room has got good old-fashioned linoleum on the floor, which may partly explain my lack of CMOS breakdowns.

Sometimes, the suppliers of CMOS i.c.'s are rather niggardly in the amount of metal foil they put over the pins, and this seems to shrivel up and diminish in size if you take it off and then apply it to the pins of another i.c. for protection. There's a simple answer to this problem, though. You can get a lifetime supply of metal foil in a single carton of aluminium cooking foil from your local Boots! ■

### REPEATER INTERFERENCE

**Those readers who heard the appalling and offensive interference with the Crystal Palace Repeater GB3LO last year, will be gratified to hear that the offenders were located and severely fined, due mainly to the efforts of local radio amateurs.**

**From a recent issue of the Radio Society of Great Britain's monthly journal "Radio Communication", we learn that the offenders were fined £100 for transmitting without a licence, £200 for causing deliberate interference, £30 witnesses' costs, £75 costs and £50 costs towards legal aid, a total of £455 each.**

**We trust this successful prosecution will be a deterrent to others who may contemplate similar interference with repeaters, a form of vandalism which was becoming increasingly prevalent last year.**

In your workshop

# DEAD STEREO CHANNEL

*Sometimes you can get too technical . . .*

"This chap," said Dick chattily, "went into the bar with a duck under his arm."

Smithy, leaning back on his stool against the outside wall of the Workshop, grunted.

"And the barman said," went on Dick, " 'why do you come in here with that pig?' "

Smithy reached up and adjusted his handkerchief, knotted at each corner, so that it covered his sparse locks more effectively. The bright August sun shone down brilliantly on the pair.

"So the chap said," continued Dick, " 'That's not a pig.' "

Alongside Smithy a stream of ants had organised themselves into a continuous raiding party: one line of the insects disappeared busily through a crack in the battered Workshop dustbin whilst a second line, burdened with morsels of Mr. Kipling's Apple Pies, shreds of ham and crumbs of Sunblest Thick Sliced Loaf, reappeared through a further crack. The local hymenopterous community always profited greatly from the debris of Dick's and Smithy's lunches.

"Whereupon the barman replied," concluded Dick triumphantly, " 'I was talking to the duck!' "

There was silence for a long moment.

"Go on," prompted Smithy.

"That's it," replied Dick. "That's the joke."

"Is it?" snorted Smithy. "Then it must be the most awful joke I've ever heard."

He pondered on the dreadfulness of the joke.

"Ever," he repeated with finality.

## RECORD PLAYER

"Dash it all," protested Dick aggrievedly, "I'm only trying to brighten things up a bit. Don't forget that we'd planned to have our annual day out today. Just think of it, we could be away from the Workshop, out in the fresh air and indulging in all manner of healthy pastimes."

"I know, I know," agreed Smithy gloomily. "It's just our luck that a pile of jobs came in late yesterday which we had to get repaired today."

"Well, we got them nearly all cleared up this morning."

"True," said Smithy, looking at his watch. "Well, our lunch break is pretty well over, so let's get what's left finished off now."

As the pair entered the relative gloom of the Workshop, they stumbled until their eyes readjusted after the sunny glare of the world outside. They looked around them bemusedly.

"Stap me, there's only one job left," said Dick excitedly as he peered at the 'For Repair' rack. "It's just a record player."

Quickly, he took a stereo record player from the rack and carried it over to his bench. He then returned, picked up the two speakers and placed these also on his bench. He plugged the speakers into their sockets at the rear of the record player case and connected the power lead to one of the mains sockets at the rear of his bench. He next examined the front panel controls. Each of the stereo channels had its own separate volume and tone controls, these being brought out at two pairs of concentric knobs.

"The volume and tone controls aren't ganged," he remarked. "That's a bit unusual, isn't it?"

"It is a bit," agreed Smithy. "However, a few stereo players are like that, particularly some of the early ones. Any ticket on it to say what's wrong with it?"

"Nope."

"Oh well," said Smithy resignedly, "once more we'll have to start from scratch. Try out a record on it."

Dick reached to the shelf above his bench and took down a battered 12 inch disc, which he set on the turntable. He switched on the record player, started the turntable and then placed the pick-up stylus on the lead-in groove of the record. At once the right hand channel of the record became audible from the right hand speaker, and Dick was able to control the volume and tone by means of the right hand channel controls. But the left hand channel was completely dead, offering no sound whatsoever at any setting of its volume and tone controls.

"Humph," said Smithy. "This shouldn't be too difficult to sort out. Have a look inside the cabinet for obvious faults whilst I go and get the service manual."

Dick switched off the record

player, removed its mains plug from the bench socket and, after securing the pick-up arm in place by means of its clip, stood the player on its side. He removed the base of the cabinet and looked inside.

"Everything looks all right, Smithy," he announced. "There's nothing silly like a wire off, or anything like that."

"Fair enough," called out Smithy from the filing cabinet. "You'd better get the printed board out."

After some fiddling, Dick was able to remove the printed circuit board and lay it out on the bench, still connected to the speaker sockets and to the pick-up. Also connected to the board were two wires from the gram motor.

"I've got the board out," said Dick, "and the input and output leads are just long enough to reach. There's a couple of leads from the gram motor, too. What are they for, Smithy?"

Smithy, returning from the filing cabinet, opened the service manual for the record player and glanced at its circuit. (Fig. 1).

"They're supply leads," he replied shortly. "The gram motor has a secondary winding on it so that it acts as a mains transformer as well as a motor. Which is, of course, quite an old money-saving design feature in players like this one."

He put the service manual on Dick's bench.

"What do we do next?" asked Dick.

"Seeing that the left hand channel is completely dead," said Smithy, "we might as well kick off with a few simple voltage tests. You can begin by checking that the left hand channel amplifier is getting a supply voltage. Then check the voltage on the output emitters. That's the usual practice with amplifiers like this which have got emitter follower output stages. Those output emitters should be sitting at about half the supply voltage. If they're not then we've got a good lead to the actual fault."

"Okeydoke," said Dick obligingly. "Let's get hitched to the mains again."

He pulled his testmeter towards him, switched to a 0-50 volt d.c. range, then refitted the record player mains plug into the bench socket. After consulting the service manual he located the positive supply rail for both the channel amplifiers, then found the positions of the circuit prints to which the output emitters of each channel connected. He switched the player on.

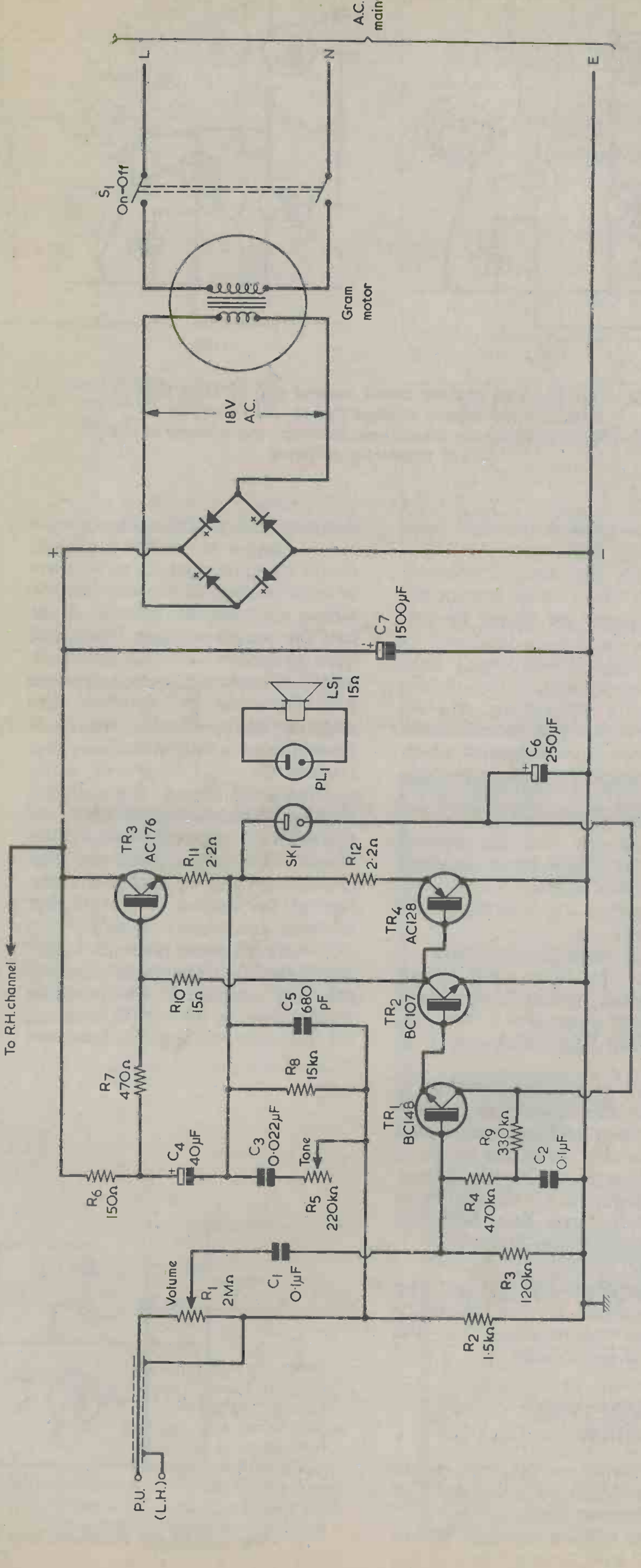



*Fig. 1. Circuit of the left hand channel amplifier and the power supply of the stereo record player serviced by Dick and Smithy. The circuit of the right hand channel amplifier is identical. The speaker connects to the amplifier output by way of a DIN plug and socket. This circuit is based on the Marconi Model 4031 record player*

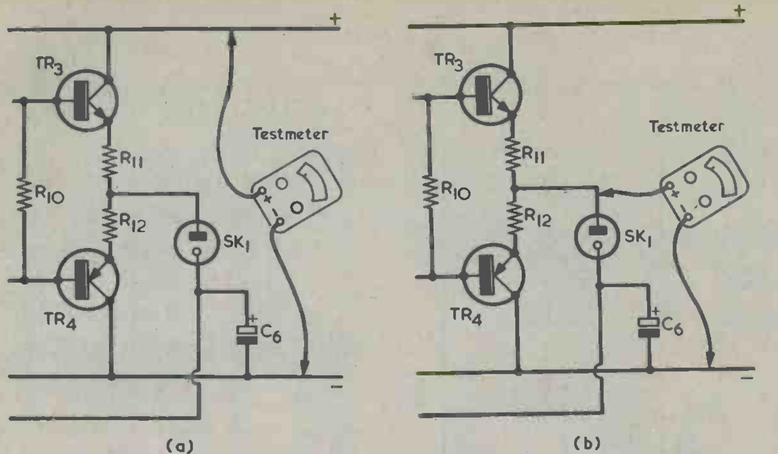



*Fig. 2(a). The first routine check carried out by Dick was to measure the supply voltage fed to each channel*
*(b). The second routine check was to check the voltage at the output transistor emitters*

"I'll start off with the right hand channel first," he announced. "Seeing that it's the channel which is working, it'll give us an idea of the sort of voltages we should be getting."

"That's good thinking," said Smithy approvingly. "One of the charms of servicing stereo amplifiers is that you normally have a serviceable channel against which you can compare the channel that's not working."

Dick applied his testmeter prods between chassis and the positive rail of the right hand channel amplifier. (Fig. 2(a).)

"I'm getting 22 volts here," he called out.

"Good," commented Smithy.

"I'll do the right hand output emitters next," stated Dick, moving his positive test prod. "Ah yes, there's about 10.5 volts there." (Fig. 2(b).)

"Which," commented Smithy, "is just about what should be there."

"Left hand channel next," said Dick cheerfully. "Well, the left hand channel is getting a supply voltage because there's 22 volts once more on the positive rail. And now I'll do the output emitters. Blimey!"

"What's up?"

"We've struck oil first go! The output emitters are just below 22 volts, and they're about 21 volts positive of the chassis."

## HALF-VOLTAGE PROVISION

Dick switched off the record player and glanced expectantly at the Serviceman.

"Have a look at the circuit diagram," said Smithy. "One of the delightful things about these simple record players is the fact that their circuit designers get up to all sorts of neat dodges to ensure that the output emitters do actually sit at half the supply voltage. What you have to look for is a d.c. feedback loop between the output emitters and an early transistor in the amplifier chain. Usually, the feedback loop goes back to the very first transistor."

Dick examined the circuit diagram and scratched his head.

"Well," he said eventually, "there's a negative feedback loop given by R8 and C5 back to the bottom of the volume control. Is that the loop you mean?" (Fig. 3.)

"That's an ***audio*** feedback loop," stated Smithy. "The resistive part of the loop consists of the potential divider given by R8 and R2 in series. C5 increases the negative feedback at the higher audio frequencies and gives the amplifier a bit of top cut. The tone control consisting of R5 in series with C3 also gives top cut. As the resistance inserted by R5 decreases in value there is increasing negative feedback of high frequencies via C3."

"It's funny," mused Dick, "how the feedback is applied to the bottom of the volume control."

"Yes, that is slightly unusual," agreed Smithy. "As you can see, the earthy side of the pick-up is not returned to chassis but to the junction of R8 and R2. This means that the feedback voltage is applied to the lower end of the parallel combination of the pick-up and the volume control. Still, that's of no real interest to us at present because, as I said just now, this feedback loop is not a d.c. one."

"Why isn't it?"

"Because there's a capacitor which isolates the loop from the first transistor so far as d.c. is concerned. That capacitor is C1. So we must look elsewhere for the d.c. feedback loop. As a matter of fact, it's rather a novel one in this record player."

"Where is it?"

"The loop," said Smithy, "goes from the output emitters through the speaker, then through R9 and R4 to the base of the first transistor. It's completed by way of R3, which couples the base of the first transistor to chassis."

Dick frowned.

"I don't quite see how it works."

"You'll find it easier if I redraw the circuit."

Smithy pulled Dick's bench notepad towards him and, taking a pen from his pocket, sketched out the feedback circuit. (Fig. 4).

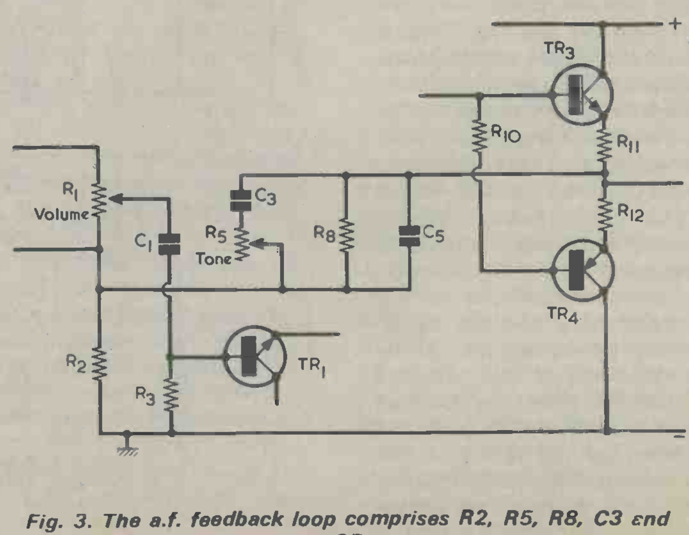



*Fig. 3. The a.f. feedback loop comprises R2, R5, R8, C3 and C5*

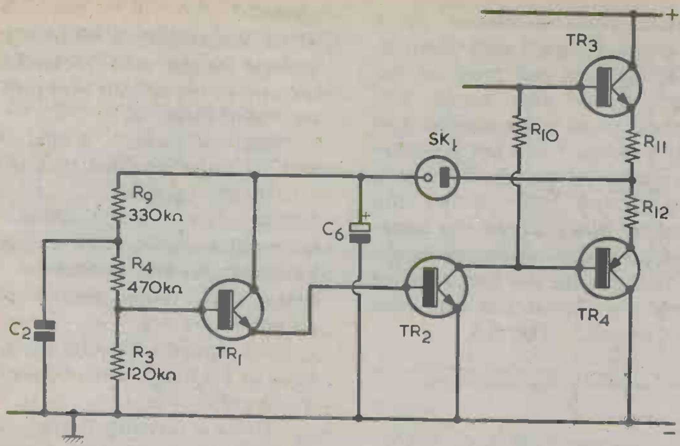



*Fig. 4. The d.c. feedback loop. The output emitters couple via the speaker, which has a negligibly low resistance, to the potential divider chain given by R9, R4 and R3*

"As you can now see," he went on, "TR1 is a simple emitter follower feeding directly into the base of TR2. TR2 is a common emitter amplifier coupling to the output transistor bases, and it also provides the phase reversal needed for the negative feedback to work. If TR1 base goes positive, so also does the base of TR2. The collector of TR2 then goes negative, as do the output emitters. Simple, isn't it?"

"It is, now you've redrawn the circuit. How do you get the half-voltage effect at the output emitters?"

"The output emitters stabilize at a voltage which is governed by the values of R9, R4 and R3. TR1 and TR2 are both silicon transistors, so what will be the voltage on TR1 base when both transistors are conductive?"

"There'll be 0.6 volt across the base-emitter junction of TR2," said Dick slowly, "and another 0.6 volt across the base-emitter junction of TR1. This means that TR1 base will be 1.2 volts positive of chassis." (Fig. 5).

"That's right," confirmed Smithy. "Let's assume for the moment that the current flowing through R9 and R4 is merely that needed to take TR1 base 1.2 volts positive of chassis. In other words, we'll say that the same current flows through the three resistors, R9, R4 and R3. Very conveniently for us R3 happens to have a value of 120kΩ. If we get 1.2 volts across this 120kΩ resistor we can expect to get 4.7 volts across the 470kΩ resistor R4, and another 3.3 volts across the 330kΩ resistor R9. This means that, when the output emitters go sufficiently positive to take TR1 base 1.2 volts positive of chassis, they have to go up to 1.2 plus 4.7 plus 3.3 volts. Okay?"

"Well, yes."

Dick took up Smithy's pen and scribbled down the voltages on his note-pad.

"Those voltages add up to only 9.2 volts," he said after a moment. "But when I checked the output emitters in the serviceable right hand channel of this record player I got a reading of 10.5 volts."

"Ah yes," agreed Smithy. "But we've been assuming that the same current flows through R9, R4 and R3. In practice, a slightly higher current flows in R9 and R4, this being the small base bias current needed by TR1 to keep it conductive. This base current means that the output emitters have to go slightly higher than the 9.2 volts

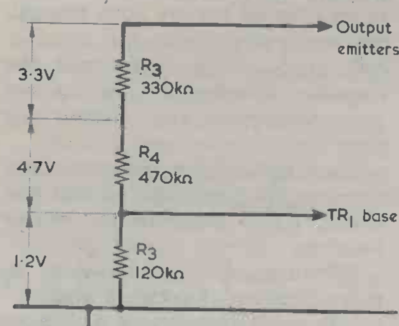



*Fig. 5. Assuming that the same current flows through R9, R4 and R3, the voltages across these resistors are as shown here. In practice, a somewhat greater current (due to base current in TR1) flows through R9 and R4, resulting in slightly increased voltages across these resistors*

given by working to resistor values only, and in practice they go up to around 10.5 volts."

## FEEDBACK LOOP CAPACITORS

"I see what you're getting at," said Dick. "What are those capacitors C6 and C2 for?"

"C6," stated Smithy, "completes the a.f. drive circuit from the output emitters to the speaker. Although this capacitor has a very low reactance at a.f., that reactance is by no means zero at the lower audio frequencies, which means that a small proportion of those frequencies will be passed on to R9. C2, coupling to the junction of R9 and R4, ensures that these low frequencies do not find their way to the base of TR1."

"That seems fair enough," said Dick. "I suppose we'd better start looking a bit further into this faulty left hand channel now."

"Right," replied Smithy briskly. "The first thing to do is to check the values of R9, R4 and R3. To make sure that there are no external effects which can upset ohmmeter readings, first unplug the left hand speaker to isolate R9, and then check each resistor with the testmeter prods one way round and then the other way round. This will guard against false low readings due to semiconductor junctions. For instance, the base-collector junction of TR1 is across R9 and R4, and this could give funny ohmmeter indications. The higher ohmmeter reading at each resistor will be the correct one."

Dick switched his testmeter to a high ohms range and proceeded to check the values of R9, R4 and R3. He found that R9 had its correct value of 330kΩ that R4 was similarly correct at 470kΩ and that R3 also lived up to its colour coding and, very properly, had a value of 120kΩ.

Smithy frowned.

"No joy there," he commented. "Just confirm that C2 isn't short-circuited. If it is, it would prevent any bias voltage getting to the base of TR1 and that would cause the present fault to appear."

Obligingly, Dick applied his testmeter prods to the capacitor. But there was no evidence of a short-circuit here.

"We'll just do another quick check before we get further involved," Smithy stated. "Do a quick ohmmeter check on TR1 and TR2. Just to make certain that neither of them is open-circuit or something like that."

"How d'you mean, do an ohmmeter check on them?"

"Switch your testmeter to a lowish ohms range," said Smithy, "put the negative test prod on the transistor base and apply the positive test prod to the emitter and collector in turn. If you get a similar forward meter reading in each case then you know that neither the base-emitter junction nor the base-collector junction has gone open-circuit. You can do the test without removing the transistors from the amplifier circuit." (Fig. 6.)

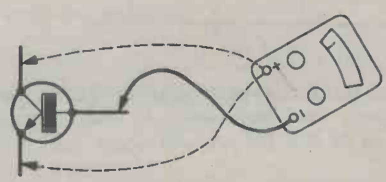


*Fig. 6. Open-circuit junctions in an n.p.n. transistor can be detected by applying to the transistor base the negative test prod of a multimeter switched to an ohms range, and then applying the positive test prod to the emitter and collector in turn. In each case the meter should indicate a low resistance (but not zero resistance because of the forward voltage drop in the transistor junctions)*

"I don't get this," objected Dick stubbornly. "Why does it have to be the negative testmeter lead which goes to the base?"

"Because," explained Smithy, "both transistors are n.p.n. types. If they'd been p.n.p. types you'd connect the positive test lead to the base. Don't forget that when a conventional multimeter is switched to an ohms range the positive terminal of its internal battery goes through the meter circuitry to the negative test prod of the meter and the negative terminal of the battery goes through to the positive test prod."

Dick carried out the ohmmeter tests on the transistors to find that these gave satisfactory meter readings.

"There's nothing showing up there, Smithy," he stated firmly.

"Then we'll have to do a bit more digging," replied Smithy a little irritably. "I can't see us finding anything more with simple ohmmeter checks so we'd better carry on to voltage readings. Turn the power on again, Dick."

Dick turned on the record player mains switch.

"Let's get back to where we were earlier on," he said. "I'll check the voltage on the output emitters again."

He returned his testmeter to a voltage range and rechecked the voltage at the output emitters of the left hand channel.

"Still the same," he said, "they're still 21 volts positive of chassis."

"Try the base of TR1," suggested Smithy. "The voltage indicated may be a little lower than it should be because of the resistance of the meter but there should still be something there."

Dick applied his test prod to the base of TR1 and looked down at the meter. (Fig. 7(a).).

"There's nothing there."

"Not even," asked Smithy, "a tiny voltage?"

"Nary a sausage!"

"Try the collector of TR1."

Dick moved his positive test prod to the transistor collector. (Fig. 7(b).)

"Still nothing. Hey, wait a minute!"

"What's up?"

"I've just remembered that we unplugged the left hand speaker just now. There can't be any voltage at TR1 collector with the speaker out of circuit."

Quickly, Dick switched off the record player, plugged in the left hand channel speaker and switched on again. Once more he checked the voltage at TR1 collector.

"That's queer," he said, puzzled. "There's still no voltage on this collector."

A look of consternation suddenly passed over Smithy's face.

"Oh no," he muttered. "It can't be!"

Alarmed, Dick turned round to look at the Serviceman.

"Blimey, Smithy, what's eating you? You look as though you've had a visitation or something."

"I have just," said Smithy with a stricken voice, "had a truly dreadful thought. Here I've been holding forth in great detail on the inner workings of this record player amplifier when it's more than possible that we needn't even have bothered to get the darned printed circuit board out at all!"

With trembling fingers, Smithy switched off the record player and removed the left hand channel speaker plug. He switched Dick's testmeter to a low ohms range and applied it to the pins of the speaker plug. The meter needle did not even move.

"Ye gods," wailed Smithy. "All that's wrong with this left hand channel is that the flaming speaker or its lead is open-circuit! That's what prevented any voltage getting to R9 in the amplifier. TR1 was cut off and so, in consequence, was

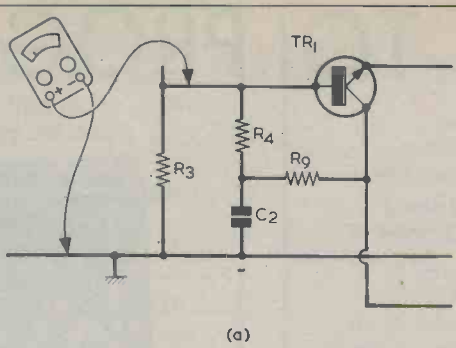
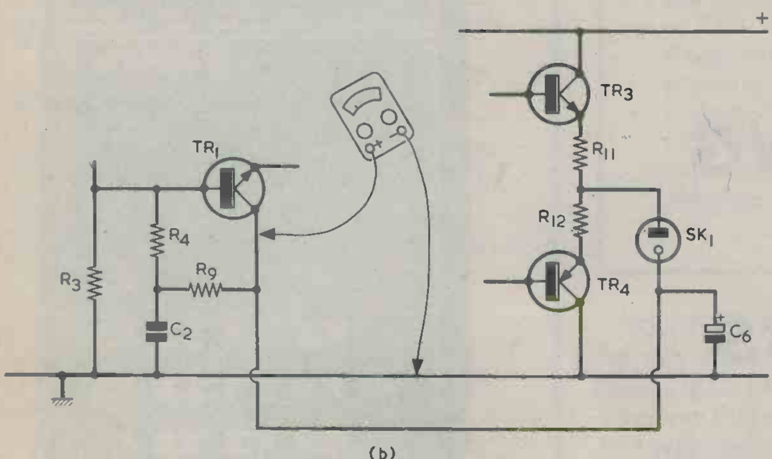



*Fig. 7(a). In a further attempt to trace the fault in the record player left hand channel, Dick checked the voltage between the base of TR1 and chassis (b). He finally measured the voltage on the collector of TR1*




TR2, allowing the output emitters to go high. Dear, oh dear, why on earth didn't I do the obvious thing of checking the speaker before I started looking into the amplifier itself?"

"Here, take it easy," chuckled Dick. "We all of us make mistakes now and again."

But Smithy was not to be comforted. Feverishly, he removed the cover of the DIN speaker plug to reveal that one of the speaker wires had broken away from its tag in the plug. Gently, Dick took the speaker lead and plug away from Smithy's shaking hands and resoldered the wire to its tag. He next plugged the speaker into the amplifier and quickly checked that the left hand output emitters now had their proper voltage of 10.5 volts positive of chassis. It was not long before he had the printed board refitted inside the stereo player case, and was able to put the player through its paces.

## AFTERNOON OFF

Smithy looked at his assistant with glazed eyes as the latter carried the now fully serviceable record player over to the "Repaired" rack.

"It's no good," he moaned as Dick returned. "I'm simply getting past it. From now on I'm joining the line for the old stick and shawl!"

"Nonsense," retorted Dick. "We've got the record player fixed even if we did go a roundabout way of doing it. Hey, how about the two of us packing it in for the rest of the afternoon? After all, we ***are*** due for a day out and there's nothing left to do in here."

"It's too late to go anywhere," complained Smithy. "Nearly half the afternoon's gone."

Dick decided that a little distraction would be in order.

"I know a place," he said slowly and distinctly," where you can get really saturated yellowy chips."

The troubled look left Smithy's eyes, to be replaced by an avid gleam.

"And where they've got lukewarm pies which are all full of viscous soggy meat mixture."

"Go on," whispered Smithy.

"And where they don't allow mustard on the tables, and if you don't want sugar in your tea you've got to ask especially."

Smithy licked his lips.

"And where," went on Dick, "when the metal sauce bottle caps corrode away the proprietor simply screws new caps onto the corroded bits."

"Joe's Caff," breathed Smithy.

"Joe's Caff," confirmed Dick.

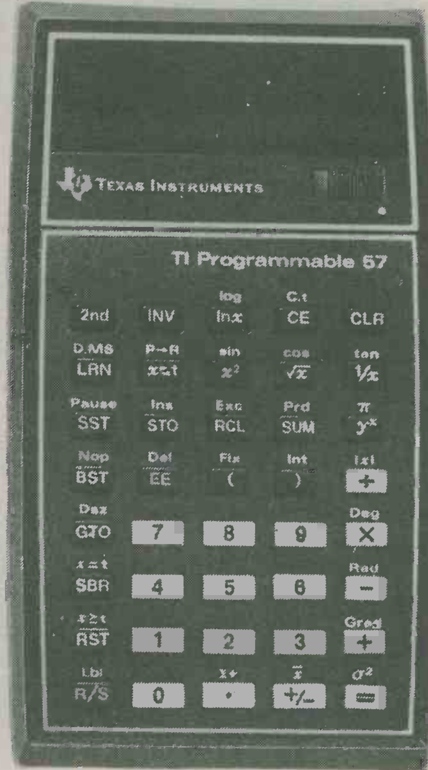
With one accord the pair rose. Smithy turned off the main switch and they sallied forth to savour the delights offered by the redoubtable Joe at his equally indestructible (to use the exquisitely explicit American phrase) greasy spoon. ■

# TUNE-IN TO PROGRAMS

## *PART 8*

### By
### Ian Sinclair

## *RECORDING YOUR PROGRESS*




*The keyboard of the Texas Instruments TI-57 programmable calculator. Most keys have a second function, whereupon facilities are nearly double the number of keys provided*

One big disadvantage of a key programmable calculator is that your precious program is lost when the power is switched off. At the time of writing, programmable calculators which store programs on magnetic cards are pricey and likely to remain so because of the electromagnetic bits and pieces. The most promising development is to couple the calculator to a casette recorder so that the program can be recorded on a casette, but the present generation of programmables do not include the interface circuits that are needed for this operation. My requests to manufacturers for information on the possibility of adding such circuits have not been answered. Keep an eye open though — with the extensive home-computer use of casettes, a similar use with programmables is perfectly feasible and would greatly extend the usefulness of a programmable.

### RECORDING ON PAPER

We key-programmable users, then, are stuck with recording our programs on paper. Texas users are fortunate because each TI-57 comes with a set of record sheets which are ideal for such notes.

Briefly, what we have to note are the following:

1. Each step of the program, along with the key codes which appear when the program is "replayed" using the [SST] key in [LRN] mode.
2. What each memory is used for and the start-up procedure.
3. What each label and subroutine is used for.
4. What, in general, each program is doing. This can be done formally in the form of a flow chart (see later) or less formally as a set of notes.
5. A test set of numbers so that the program can be checked before using it on fresh data.

With this sort of record-keeping, which is not nearly so tedious as it sounds, you can be sure of being able to use a good program again. There is nothing more infuriating than having to design a program from scratch only a few months after having used it, just because no record was kept at the time. In addition, keeping complete records makes it easy to change a successful short program into a subroutine to use within another new program. Let's look at each of these points in detail.

Fig. 1 shows a program which is written as it would be noted down at first, and then with each step recorded as it would be on the re-run, using the [SST] key. The re-run enables us to check through a program quickly because we don't have to match each code number to a kev, just to the code number on the list. In addition, we can check quickly that we have programmed the correct number of steps. If that number is wrong, you can be sure the program won't run correctly.

The program is to find the impedance of a damped parallel resonant circuit, starting at the resonant frequency and then raising the frequency by 1kHz on each run.

The first record of the program would be:

LRN RCL 1 X RCL 2 = 1/x$\sqrt{x}$ STO 3 Lbl σ RCL 3 X RCL 2 - (RCL 3 X RCL 1) 1/x = STO 4 x² + RCL 0 1/x x² = STO 5 RCL 0 1/x ÷ RCL 5 = STO 7 RCL 4 ÷ RCL 5 = +/- INV p→R.x⇌t R/S 6283 SUM 3 GTO 0 LRN

The re-run of that program to show the code listing would be:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 00 | 33 | 1 | 16 | 44 | | 32 | 32 | 7 |
| 01 | 55 | | 17 | 25 | | 33 | 33 | 4 |
| 02 | 33 | 2 | 18 | 85 | | 34 | 45 | |
| 03 | 85 | | 19 | 32 | 4 | 35 | 33 | 5 |
| 04 | 25 | | 20 | 23 | | 36 | 85 | |
| 05 | 24 | | 21 | 75 | | 37 | 84 | |
| 06 | 32 | 3 | 22 | 33 | 0 | 38 | –27 | |
| 07 | 86 | 0 | 23 | 25 | | 39 | 22 | |
| 08 | 33 | 3 | 24 | 23 | | 40 | 81 | |
| 09 | 55 | | 25 | 85 | | 41 | 06 | |
| 10 | 33 | 2 | 26 | 32 | 5 | 42 | 02 | |
| 11 | 65 | | 27 | 33 | 0 | 43 | 08 | |
| 12 | 43 | | 28 | 25 | | 44 | 03 | |
| 13 | 33 | 3 | 29 | 45 | | 45 | 34 | 3 |
| 14 | 55 | | 30 | 33 | 5 | 46 | 51 | 0 |
| 15 | 33 | 1 | 31 | 85 | | 27 | 00 | |

end of program

*Fig. 1*

Fig. 2 shows the method which should be used to remind yourself of how each memory is used. The Texas record-form prints in the other uses of the memories, such as the use of memory 0 for counting down, using [Dsz], and the use of memory 7 for comparison checks [x = t] and so on. In particular, any quantity which has to be dug out of a memory at the end of a program should be written down. Most important, the start-up procedure for a program should be noted.

**MEMORY LISTING**

| Memory Use | Number | |
|---|---|---|
| 0 | Value of damping resistance in ohms | ENTERED |
| 1 | Value of L in henrys | ENTERED |
| 2 | Value of C in farads | ENTERED |
| 3 | Value of $2\pi f$ for resonance (calculated) | |
| 4, 5, 7 | Intermediate values | |

*Fig. 2*

**Starting Procedure for Program of Fig. 1**

Load store 0 with value of damping resistance in ohms.

Load store 1 with value of inductance in henrys, using EE6 +/- if units of μH are entered.

Load store 2 with value of capacitance in farads, using EE12 +/- if units of pF are entered.

CLR RST then R/S for resonance. Resonant frequency can now be found by pressing RCL 3 ÷ 2 ÷ π =.

Press R/S again to obtain impedance at 1kHz above resonant frequency. Each subsequent press of R/S gives the impedance at 1kHz higher.

*Fig. 3*

The Texas record-sheets do not provide speciali, for this, but there is plenty of room for keeping a note, Fig. 3 shows the kind of thing that is needed, ensuring that each program is correctly started. In this way, we don't waste time checking a program when all that is at fault is a start-up error, such as forgetting to press [RST] for example.

A record of all the labels and subroutines that are used is also extremely helpful for at least two reasons. One reason is that a subroutine may have to be used by itself for some minor calculations. If, for example, we have a subroutine which calculates the reactance of a capacitor and which is part of a program for calculating impedance, we can use this subroutine separately while the program is in store. If the subroutine follows [Lbl] [O], then to make use of this subroutine we make sure that the memories are correctly loaded (with C and f in this example), press [GTO] [0] and [R/S], and so run the subroutine by itself. The display will show the number which has been calculated at the end of the subroutine. This is possible only when the subroutine ends with the instruction [INV] [SBR], because when a subroutine is used by itself this instruction takes the place of [R/S] to stop the subroutine. If the subroutine ends in a [GTO] instruction the result will not be displayed, and the rest of the program will be worked.

Listing labels also helps to ensure that the same label is not used twice, and listing subroutines allows us to pick out useful subroutines for use in other programs. A useful additional note is the number of steps in a subroutine because this lets us know at once if there is room for it in another program.

The most important part of record-keeping is the one which is often neglected — keeping a record of how a program is constructed. Programming is a way of thinking about problems, a way of breaking them down into easily-solved pieces, and if we record how we have tackled each problem we can very often use a similar method again.

## FLOW CHART

There are many ways of noting how a program goes about its work. A record of the method can be as simple as a note of the formula used, or a summary of the calculations and the loops; alternatively we can go to the "professional" method of a flow chart. A flow chart is a diagramatic method of setting out what a program does, and is a very useful method of designing programs. Fig. 4 shows the standard flow-chart symbols, and Fig. 5 shows a flow-chart for a program.

When a program is designed by the use of a flow-chart, the work of preparing the program can be greatly speeded up because the flow-chart shows where subroutines can be used (the box symbol with double lines), where decision steps like [Dsz] or [x = t] are needed (the first symbol in Fig. 4) and where loops exist. Preparing flow-charts is something you learn by practice, but we can run quickly over one just to see what is involved.

Fig. 5 shows a flow-chart for calculating reactances, with the frequency increased by 1 kHz on each loop. When the program is started, the calculation of capacitive reactance is shown as a subroutine, and the result is shown stored. The next step is calculation of inductive reactance, another subroutine, with the value placed in another store. The next step uses the stored values of reactance to calculate the total reactance which is then displayed. The READOUT step could be a pause or an [R/S] step. Following this is the decision "is f = 20kHz?", assuming that this is a program for finding reactance values up to 20kHz. If the answer at the decision step is NO the loop is traced, and frequency is incremented by 1kHz (not a subroutine, just a [1] [SUM] [0] type of step) and so back to the first reactance calculation. If the answer to the decision question is YES, the program stops.

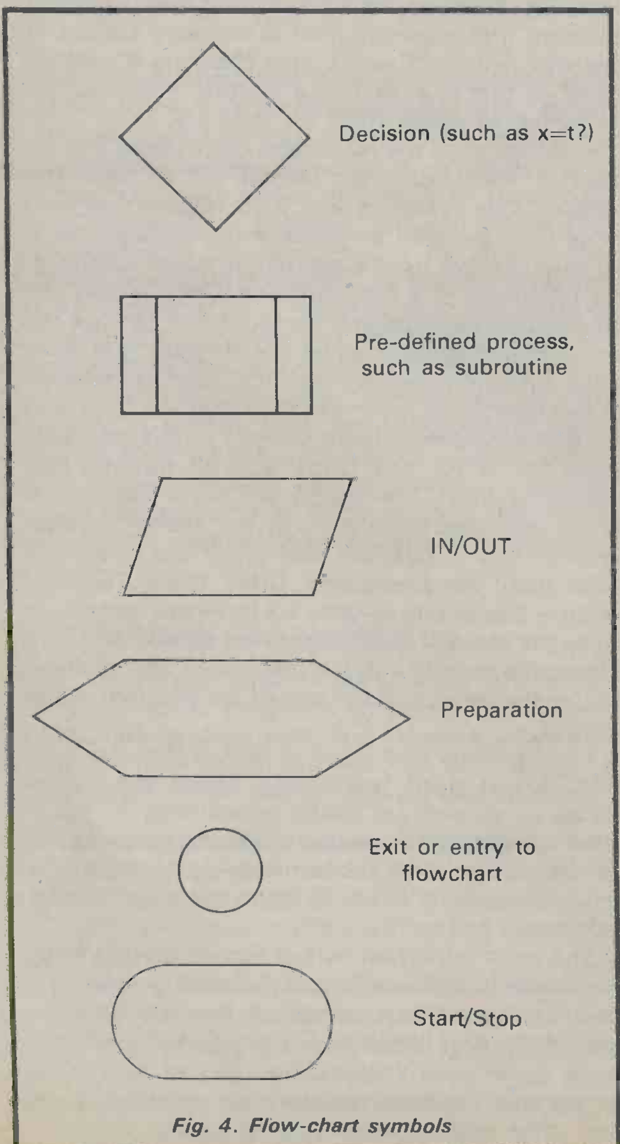


*Fig. 4. Flow-chart symbols*

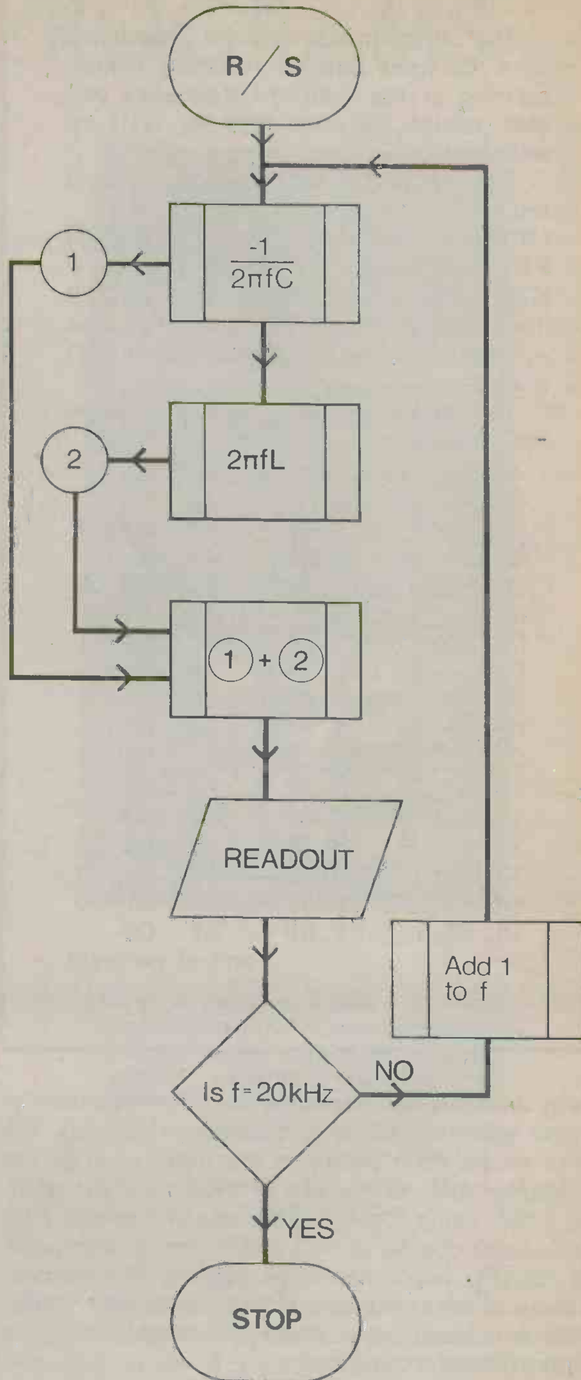


*Fig. 5. Flow-chart for reactances*

This sort of chart does not need to show much detail, but it does show what the outline of a program has to be, and it makes for much easier understanding of programs. Quite a lot of experience is needed before you can look at a set of program steps and decide how the program works, even when you are familar with the calculator, but with a flow-chart for the program you know exactly what to look for, and the whole process. In addition, if you have a program written for a very different machine, such as the Casio FX201P, the inclusion of a flow-chart helps greatly in translating the program for the TI-57. The Texas record sheets leave ample room for a small flow-chart.

Finally, a set of test data is most useful. Sometimes a program can be quite complex (see next month!) and, if we key in the program wrongly, the answers will be wrong but we don't realise it. Gibberish answers are, of course, easily spotted, but answers that look reasonable simply have to be accepted unless you can be bothered to work them out without using the program. A set of test data, using simple numbers, and a note of the answer, solves this problem. Key in your program, enter the test data, run the program, and check the answer. If the answer agrees with the recorded value for the same test data, the program is working and you can go ahead with the real data. If the answer is wrong — aren't you glad you didn't use the program?

(To be continued)

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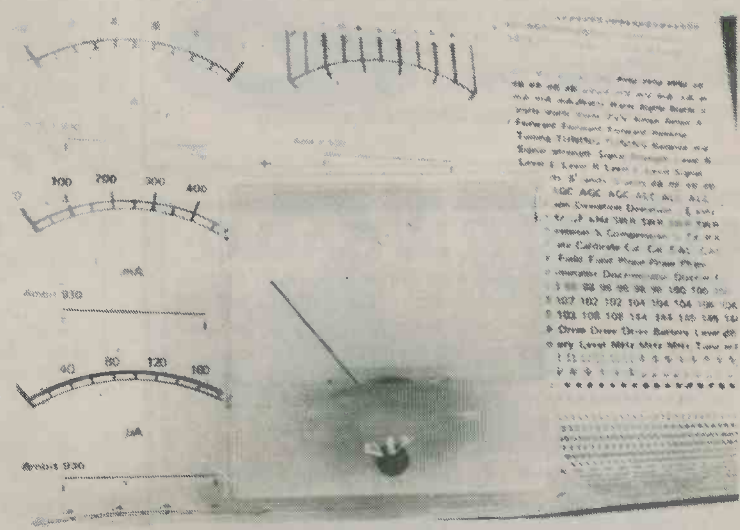

*Illustrating the "Meter Made" system introduced by Ambit International. Employing a range of different movements and rub-down scale transfers, almost any type of meter can be made up for any application*

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(Continued on page 61)

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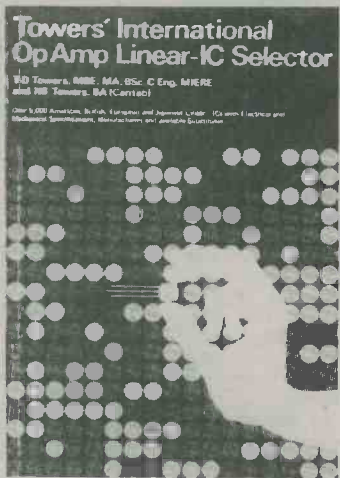


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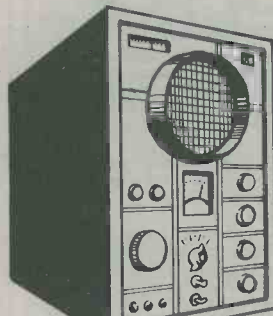

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(Continued from page 61)

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