MAY 1989 £1.95

# Amateur RADIO

For all two-way radio enthusiasts

## Amateur Radio in the Pacific: A DX Stop-over in Tarawa


## Construction: A Compact 13.8V 20 amp Power Supply

## Data Communications: The Wavecom W-4010 Decoder/Analyser

# Amateur RADIO

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## SERVICES

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# P. M. COMPONENTS LTD

SELECTRON HOUSE, SPRINGHEAD ENTERPRISE PARK
SPRINGHEAD RD, GRAVESEND, KENT DA11 8HD

TELEX 966371 TOS—PM

## Semiconductors

| | |
|---|---|
| AC125 | 0.30 |
| AC126 | 0.45 |
| AC127 | 0.20 |
| AC128 | 0.28 |
| AC128K | 0.32 |
| AC141 | 0.28 |
| AC141K | 0.34 |
| AC142K | 0.45 |
| AC176 | 0.22 |
| AC176K | 0.31 |
| AC187 | 0.25 |
| AC187K | 0.28 |
| AC188 | 0.25 |
| AC188K | 0.37 |
| ACY17 | 1.15 |
| AD142 | 2.50 |
| AD149 | 1.50 |
| AD161 | 0.50 |
| AD162 | 0.50 |
| AF106 | 0.50 |
| AF114 | 2.50 |
| AF115 | 1.95 |
| AF116 | 2.50 |
| AF117 | 2.50 |
| AF118 | 3.50 |
| AF121 | 0.60 |
| AF124 | 0.65 |
| AF125 | 0.65 |
| AF126 | 0.45 |
| AF127 | 0.65 |
| AF139 | 0.40 |
| AF150 | 0.60 |
| AF178 | 1.95 |
| AF239 | 0.42 |
| ASY27 | 0.85 |
| ASY77 | 1.50 |
| AU106 | 6.95 |
| AY102 | 2.95 |
| BC107A | 0.11 |
| BC107B | 0.11 |
| BC108 | 0.10 |
| BC108B | 0.12 |
| BC109 | 0.10 |
| BC109B | 0.12 |
| BC114A | 0.09 |
| BC115 | 0.55 |
| BC116A | 0.50 |
| BC117 | 0.19 |
| BC119 | 0.24 |
| BC125 | 0.25 |
| BC140 | 0.31 |
| BC141 | 0.25 |
| BC142 | 0.21 |
| BC143 | 0.24 |
| BC147B | 0.12 |
| BC148A | 0.09 |
| BC149 | 0.09 |
| BC153 | 0.30 |
| BC157 | 0.12 |
| BC159 | 0.09 |
| BC161 | 0.55 |
| BC170B | 0.15 |
| BC171 | 0.09 |
| BC172B | 0.10 |
| BC173B | 0.10 |
| BC174 | 0.09 |
| BC177 | 0.15 |
| BC178 | 0.15 |
| BC182 | 0.10 |
| BC182LB | 0.10 |
| BC183 | 0.10 |
| BC183L | 0.09 |
| BC184LB | 0.09 |
| BC204 | [illegible] |
| BC207B | 0.25 |
| BC208B | 0.20 |
| BC212 | 0.09 |
| BC212L | 0.09 |
| BC213 | 0.09 |
| BC213L | 0.09 |
| BC214 | 0.09 |
| BC214C | 0.09 |
| BC214L | 0.09 |
| BC237B | 0.15 |
| BC238 | 0.15 |
| BC239 | 0.15 |
| BC251A | 0.15 |
| BC252A | 0.15 |
| BC258 | 0.25 |
| BC258A | 0.39 |
| BC284 | 0.30 |
| BC300 | 0.30 |
| BC301 | 0.30 |
| BC303 | 0.26 |
| BC307B | 0.09 |
| BC327 | 0.10 |
| BC328 | 0.10 |
| BC337 | 0.10 |
| BC338 | 0.09 |
| BC347A | 0.13 |
| BC461 | 0.35 |
| BC478 | 0.20 |
| BC527 | 0.20 |
| BC547 | 0.10 |
| BC548 | 0.10 |
| BC549A | 0.10 |
| BC550 | 0.14 |
| BC557 | 0.08 |
| BC558 | 0.10 |
| BC639/10 | 0.30 |
| BCY33A | 19.50 |
| BD115 | 0.30 |
| BD124P | 0.59 |
| BD131 | 0.42 |
| BD132 | 0.42 |
| BD133 | 0.50 |
| BD135 | 0.30 |
| BD136 | 0.30 |
| BD137 | 0.32 |
| BD138 | 0.30 |
| BD139 | 0.32 |
| BD140 | 0.30 |
| BD144 | 1.10 |
| BD150C | 0.29 |
| BD159 | 0.65 |
| BD160 | 1.50 |
| BD166 | 0.50 |
| BD179 | 0.72 |
| BD182 | 0.70 |
| BD201 | 0.50 |
| BD202 | 0.50 |
| BD203 | 0.50 |
| BD204 | 0.70 |
| BD222 | 0.46 |
| BD223 | 0.59 |
| BD225 | 0.48 |
| BD232 | 0.35 |
| BD233 | 0.35 |
| BD236 | 0.49 |
| BD237 | 0.40 |
| BD242 | 0.65 |
| BD246 | 0.75 |
| BD376 | 0.32 |
| BD379 | 0.45 |
| BD410 | 0.65 |
| BD434 | 0.65 |
| BD436 | 0.60 |
| BD437 | 0.60 |
| BD438 | 0.75 |
| BD510 | 0.95 |
| BD518 | 0.75 |
| BD520 | 0.65 |
| BD534 | 0.45 |
| BD535 | 0.45 |
| BD575 | 0.95 |
| BD587 | 0.95 |
| BD588 | 0.95 |
| BD698 | 1.50 |
| BD701 | 1.25 |
| BD702 | 1.25 |
| BD707 | 0.90 |
| BDX32 | 1.50 |
| BDX53B | 1.65 |
| BF115 | 0.35 |
| BF119 | 0.65 |
| BF127 | 0.39 |
| BF154 | 0.20 |
| BF158 | 0.22 |
| BF160 | 0.27 |
| BF173 | 0.22 |
| BF177 | 0.38 |
| BF178 | 0.26 |
| BF179 | 0.34 |
| BF180 | 0.29 |
| BF181 | 0.29 |
| BF182 | 0.29 |
| BF183 | 0.29 |
| BF184 | 0.35 |
| BF185 | 0.28 |
| BF195 | 0.11 |
| BF197 | 0.11 |
| BF198 | 0.16 |
| BF199 | 0.14 |
| BF200 | 0.40 |
| BF240 | 0.20 |
| BF241 | 0.15 |
| BF245 | 0.30 |
| BF256LC | 0.35 |
| BF257 | 0.28 |
| BF259 | 0.28 |
| BF271 | 0.28 |
| BF271 | 0.26 |
| BF273 | 0.18 |
| BF335 | 0.35 |
| BF336 | 0.34 |
| BF337 | 0.29 |
| BF338 | 0.32 |
| BF355 | 0.37 |
| BF362 | 0.38 |
| BF363 | 0.65 |
| BF371 | 0.25 |
| BF394 | 0.19 |
| BF422 | 0.32 |
| BF423 | 0.25 |
| BF457 | 0.32 |
| BF458 | 0.36 |
| BF467 | 0.68 |
| BF493 | 0.35 |
| BF4995 | 0.23 |
| BF4997 | 0.25 |
| BFR39 | 0.23 |
| BFR40 | 0.23 |
| BFR81 | 0.25 |
| BFR88 | 0.30 |
| BFR90 | 1.50 |
| BFR91 | 1.75 |
| BFT42 | 0.35 |
| BFT43 | 0.35 |
| BFW10 | 0.55 |
| BFW11 | 0.75 |
| BFW16A | 1.15 |
| BFW61 | 0.60 |
| BFW92 | 0.85 |
| BFX29 | 0.30 |
| BFX84 | 0.26 |
| BFX85 | 0.32 |
| BFX86 | 0.25 |
| BFY18 | 1.35 |
| BFY50 | 0.32 |
| BFY51 | [illegible] |
| BFY90 | 0.77 |
| BLY48 | 1.75 |
| BR100 | 0.45 |
| BR101 | 0.49 |
| BR103 | 0.55 |
| BR303 | 0.95 |
| BRC4443 | 1.15 |
| BRY39 | 0.45 |
| BSW64 | 0.95 |
| BSX60 | 1.25 |
| BT100A/02 | 0.85 |
| BT106 | 1.49 |
| BT116 | 1.20 |
| BT119 | 3.15 |
| BT120 | 1.65 |
| BU105 | 1.95 |
| NU108 | 1.69 |
| BU124 | 1.25 |
| BU125 | 1.25 |
| BU126 | 1.60 |
| BU204 | 1.55 |
| BU205 | 1.30 |
| BU208 | 0.95 |
| BU208A | 1.15 |
| BU208D | 1.35 |
| BU326 | 1.20 |
| BU326S | 1.50 |
| BU407 | 1.24 |
| BU408 | 1.50 |
| BU426A | 0.75 |
| BU500 | 2.25 |
| BU508A | 1.95 |
| BU526 | 1.90 |
| BU807 | 2.25 |
| BUY20 | 2.15 |
| BUV41 | 2.50 |
| GET[illegible] | 2.50 |
| GEX542 | 9.50 |
| MJ3000 | 1.98 |
| MJE340 | 0.40 |
| MJE350 | 0.75 |
| MJE520 | 0.48 |
| MJE2955 | 0.95 |
| MPSA13 | 0.29 |
| MPSA92 | 0.30 |
| MRF237 | 4.95 |
| MRF450A | 15.95 |
| MRF453 | 17.50 |
| MRF454 | 26.50 |
| MRF455 | 17.50 |
| MRF475 | 2.95 |
| MRF477 | 14.95 |
| MRF479 | 5.50 |
| OC16W | 2.50 |
| OC23 | 9.50 |
| OC25 | 1.50 |
| OC26 | 1.50 |
| OC28 | 5.50 |
| OC29 | 4.50 |
| OC32 | 5.50 |
| OC42 | 1.50 |
| OC44 | 1.25 |
| OC45 | 1.00 |
| OC70 | 1.00 |
| OC71 | 0.75 |
| OC72 | 2.50 |
| OC75 | 1.50 |
| OC81 | 1.00 |
| OC84 | 1.50 |
| OC139 | 12.50 |
| OC171 | 4.50 |
| OC200 | 4.50 |
| OC201 | 5.50 |
| OC205 | 10.00 |
| R2008B | 1.45 |
| R2009 | 2.50 |
| R2010B | 1.45 |
| R2322 | 0.58 |
| R323 | 0.66 |
| R2540 | 2.48 |
| RCA16029 | 0.85 |
| RCA16039 | 0.85 |
| RCA16181 | 0.85 |
| RCA16334 | 0.90 |
| RCA16335 | 0.85 |
| RCA16572 | 0.85 |
| S20600 | 0.95 |
| SKE5F | 1.45 |
| T6021V | 0.45 |
| T6027V | 0.45 |
| T6029V | 0.45 |
| T6036V | 0.55 |
| T9002V | 0.55 |
| T9011V | 0.75 |
| T9015V | 2.15 |
| T9034V | 2.15 |
| T9038V | 3.95 |
| THY15/80 | 2.25 |
| THY15/85 | 2.25 |
| TIP29 | 0.40 |
| TIP29C | 0.42 |
| TIP30C | 0.43 |
| TIP31C | 0.55 |
| TIP32C | 0.42 |
| TIP33C | 0.95 |
| TIP34B | 0.95 |
| TIP41A | 0.45 |
| TIP41C | 0.45 |
| TIP42C | 0.47 |
| TIP47 | 0.65 |
| TIP48 | 0.65 |
| TIP50 | 0.65 |
| TIP120 | 0.60 |
| TIP125 | 0.65 |
| TIO142 | 1.75 |
| TIP146 | 2.75 |
| TIP161 | 2.95 |
| TIP2955 | 0.80 |
| TIP3055 | 0.55 |
| TIS91 | 0.20 |
| TV106 | 1.50 |
| TV106/2 | 1.50 |
| ZRF0112 | 16.50 |
| 2N1100 | 6.50 |
| 2N1308 | 1.35 |
| 2N1711 | 0.30 |
| 2N2219 | 0.28 |
| 2N2626 | 0.55 |
| 2N2905 | 0.40 |
| 2N3053 | 0.40 |
| 2N3054 | 0.59 |
| 2N3055 | 0.52 |
| 2N3702 | 0.12 |
| 2N3703 | 0.12 |
| 2N3704 | 0.12 |
| 2N3705 | 0.20 |
| 2N3706 | 0.12 |
| 2N3708 | 0.12 |
| 2N3733 | 9.50 |
| 2N3773 | 2.75 |
| 2N3792 | 1.35 |
| 2N4280 | 3.50 |
| 2N4427 | 1.95 |
| 2N4444 | 1.15 |
| 2N5294 | 0.42 |
| 2N5296 | 0.48 |
| 2N5298 | 0.60 |
| 2N5485 | 0.45 |
| 2N5496 | 0.95 |
| 2N5641 | 16.50 |
| 2N5643 | 16.50 |
| 2SA329 | 0.95 |
| 2SA715 | 0.55 |
| 2SC495 | 0.80 |
| 2SC496 | 0.80 |
| 2SC784 | 0.75 |
| 2SC785 | 0.75 |
| 2SC789 | 0.55 |
| 2SC931D | 0.95 |
| 2SC937 | 1.95 |
| 2SC1034 | 4.50 |
| 2SC1096 | 0.80 |
| 2SC1106 | 2.50 |
| 2SC1124 | 0.95 |
| 2SC1162 | 0.95 |
| 2SC1172Y | 2.20 |
| 2SC1173 | 1.15 |
| 2SC1306 | 1.75 |
| 2SC1364 | 0.50 |
| 2SC1413A | 2.50 |
| 2SC1449 | 0.50 |
| 2SC162B | 0.75 |
| 2SC167B | 1.50 |
| 2SC1945 | 3.75 |
| 2SC1953 | 0.95 |
| 2SC1957 | 0.80 |
| 2SC1969 | 2.95 |
| 2SC1985 | 1.50 |
| 2SC2028 | 1.15 |
| 2SC2029 | 1.95 |
| 2SC2078 | 1.45 |
| 2SC2091 | 0.85 |
| 2SC2098 | 2.95 |
| 2SC2166 | 1.95 |
| 2SC2314 | 0.80 |
| 2SC2371 | 0.36 |
| 2SC931D | 0.95 |
| 2SK19 | 0.55 |
| 2SK33 | 0.55 |
| 3SK88 | 0.95 |

## Integrated Circuits

| | |
|---|---|
| AN103 | 2.50 |
| AN124 | 2.50 |
| AN214 | 2.50 |
| AN214Q | 2.50 |
| AN236 | 1.95 |
| AN239 | 2.50 |
| AN240P | 2.80 |
| AN247 | 2.50 |
| AN260 | 2.95 |
| AN262 | 1.95 |
| AN264 | 2.50 |
| AN271 | 3.50 |
| AN301 | 2.95 |
| AN303 | 3.50 |
| AN313 | 2.95 |
| AN315 | 2.95 |
| AN316 | 3.95 |
| AN331 | 3.95 |
| AN342 | 2.95 |
| AN362L | 2.50 |
| AN612 | 2.15 |
| AN6362 | 3.95 |
| AN7140 | 3.50 |
| AN7145 | 3.50 |
| AN7145M | 3.95 |
| AN7150 | 2.95 |
| AN7151 | 2.50 |
| BA521 | 1.50 |
| CA1352E | 1.75 |
| CA3086 | 0.46 |
| CA3123E | 1.95 |
| CA313EM | 2.50 |
| CA3140S | 2.50 |
| CA3140T | 1.15 |
| ETT6016 | 2.50 |
| HA1137W | 1.95 |
| HA1156W | 1.50 |
| HA1306 | 1.50 |
| HA1322 | 1.95 |
| HA1339A | 2.95 |
| HA1366W | 2.75 |
| HA1406 | 1.95 |
| HA1551 | 2.95 |
| LA1201 | 0.95 |
| LA1230 | 1.95 |
| LA3201 | 0.95 |
| LA4101 | 0.95 |
| LA4102 | 1.50 |
| LA4140 | 2.95 |
| LA4031P | 1.95 |
| LA4400 | 3.50 |
| LA4420 | 3.50 |
| LA4422 | 1.50 |
| LA4430 | 2.50 |
| LA4461 | 3.95 |
| LC7120 | 3.25 |
| LC7130 | 3.50 |
| LC7131 | 5.50 |
| LC7137 | 5.50 |
| LM323K | 4.95 |
| LM324N | 0.45 |
| LM380N | 1.50 |
| LM380N8 | 2.95 |
| LM383T | 2.95 |
| LM390N | 3.50 |
| LM1011 | 3.15 |
| M5155L | 2.95 |
| M51513L | 2.30 |
| M51521L | 1.50 |
| MB3705 | 1.50 |
| MB3712 | 2.00 |
| MB3756 | 2.50 |
| MC1307P | 1.00 |
| MC1310P | 1.95 |
| MC1327 | 1.70 |
| MC1327Q | 0.95 |
| MC1351P | 1.75 |
| MC1352P | 1.00 |
| MC1357 | 2.35 |
| MC1358 | 1.58 |
| MC1496 | 1.75 |
| MC1723 | 0.50 |
| MC3357 | 2.75 |
| MC3401L | 2.50 |
| MC14106P | 2.95 |
| MC14518CP | 7.50 |
| ML231B | 1.75 |
| ML232B | 2.50 |
| ML239 | 2.95 |
| MSM5807 | 8.75 |
| SAA500A | 3.50 |
| SAA1025 | 7.25 |
| SAA1251 | 4.95 |
| SAA5010 | 5.35 |
| SAA5020 | 5.75 |
| SAB3210 | 3.50 |
| SAS560S | 1.75 |
| SAS570S | 1.75 |
| SAS580 | 2.85 |
| SAS590 | 2.75 |
| SL901B | 7.95 |
| SL917B | 6.65 |
| SL1310 | 1.80 |
| SL1327 | 1.10 |
| SL1327Q | 1.10 |
| SN7414 | 1.50 |
| SN7421 | 0.85 |
| SN76110N | 0.89 |
| SN76115N | 1.25 |
| SN76131N | 1.30 |
| SN76226DN | 2.95 |
| SN76227N | 1.05 |
| SN7622BN | 2.95 |
| SN76533N | 1.65 |
| SN76650N | 1.15 |
| SN76660N | 0.90 |
| STK011 | 7.95 |
| STK014 | 7.95 |
| STK015 | 5.95 |
| STK018 | 7.95 |
| STK025 | 11.95 |
| STK032 | 7.95 |
| STK07B | 11.95 |
| STK085 | 8.95 |
| STK415 | 7.95 |
| STK435 | 7.95 |
| STK437 | 7.95 |
| STK439 | 7.95 |
| STK461 | 11.50 |
| STK463 | 11.50 |
| STK0015 | 7.95 |
| STK0029 | 7.95 |
| STK0039 | 7.95 |
| TA7061AP | 1.50 |
| TA7072 | 2.65 |
| TA7073 | 3.50 |
| TA7108P | 1.50 |
| TA7120P | 1.65 |
| TA7129P | 2.50 |
| TA7130P | 1.50 |
| TA7137P | 1.00 |
| TA7146P | 1.50 |
| TA7176AP | 2.95 |
| TA7193P | 3.95 |
| TA7203 | 2.95 |
| TA7204P | 2.15 |
| TA7205AP | 1.15 |
| TA7208 | 1.95 |
| TA7222AP | 1.80 |
| TA7227P | 4.25 |
| TA722BP | 1.95 |
| TA7310P | 1.80 |
| TA7314P | 2.95 |
| TA7321P | 2.25 |
| TA7609P | 3.95 |
| TA7611AP | 2.95 |
| TA7629 | 2.50 |
| TAA310A | 3.50 |
| TAA320A | 3.95 |
| TAA350A | 1.95 |
| TAA550B | 0.95 |
| TAA570 | 1.95 |
| TAA621 | 3.95 |
| TAA630S | 2.95 |
| TAA661B | 1.95 |
| TAA700 | 1.70 |
| TAA930 | 3.95 |
| TBA120AS/B/C SA/SB/T/U | 1.00 |
| TBA395 | 1.50 |
| TBA396 | 0.75 |
| TBA440N | 2.55 |
| TBA480Q | 1.95 |
| TBA510 | 2.50 |
| TBA510Q | 2.50 |
| TBA520 | 1.10 |
| TBA520Q | 1.10 |
| TBA530 | 1.10 |
| TBA530Q | 1.10 |
| TBA540 | 1.25 |
| TBA540Q | 1.35 |
| TBA550Q | 1.95 |
| TBA560C | 1.45 |
| TBA560Q | 1.45 |
| TBA570 | 1.00 |
| TBA651R | 2.50 |
| TBA673 | 1.95 |
| TBA750 | 1.95 |
| TBA750Q | 2.65 |
| TBA800 | 0.89 |
| TBA810AS | 1.65 |
| TBA810P | 1.65 |
| TBA820M | 0.75 |
| TBA820Q | 1.45 |
| TBA890 | 2.50 |
| TBA920 | 1.65 |
| TBA950/2X | 1.50 |
| TBA990 | 1.49 |
| TBA990Q | 1.49 |
| TCA270 | 2.50 |
| TCA270SQ | 2.50 |
| TCA650 | 2.50 |
| TCA760 | 2.50 |
| TCA800 | 6.95 |
| TCA830S | 1.95 |
| TCA900 | 2.50 |
| TCA940 | 1.65 |
| TDA440 | 2.20 |
| TDA1001 | 2.95 |
| TDA1003A | 3.95 |
| TDA1006A | 2.50 |
| TDA1010 | 2.15 |
| TDA1005 | 2.25 |
| TDA1035 | 2.50 |
| TDA1037 | 1.95 |
| TDA1044 | 2.15 |
| TDA1170 | 1.95 |
| TDA1180 | 2.15 |
| TDA1270Q | 3.95 |
| TDA1327 | 1.70 |
| TDA2002 | 0.95 |
| TDA2003 | 1.95 |
| TDA2010 | 1.95 |
| TDA2020 | 2.95 |
| TDA2030 | 2.80 |
| TDA2140 | 3.95 |
| TDA2150 | 2.50 |
| TDA2151 | 1.95 |
| TDA2160 | 2.50 |
| TDA2524 | 1.95 |
| TDA2530 | 1.95 |
| TDA2532 | 1.95 |
| TDA2540 | 1.95 |
| TDA2541 | 2.15 |
| TDA2560 | 1.15 |
| TDA2576 | 4.50 |
| TDA2581 | 2.95 |
| TDA2582 | 2.95 |
| TDA2593 | 2.95 |
| TDA2600 | 6.50 |
| TDA2610 | 2.50 |
| TDA2611A | 1.95 |
| TDA2640 | 3.50 |
| TDA2655 | 4.50 |
| TDA2680A | 2.75 |
| TDA2690 | 2.45 |
| TDA3310 | 2.95 |
| TDA3510 | 3.50 |
| TDA3560 | 3.95 |
| TDA4050 | 2.95 |
| TDA4600 | 2.50 |
| TDA9503 | 3.15 |
| TEA1009 | 1.35 |
| UPC41C | 3.50 |
| UPC566H | 2.95 |
| UPC575C2 | 1.50 |
| UPC1001H | 1.95 |
| UPC1020H | 2.95 |
| UPC1024H | 1.50 |
| UPC1025H | 1.95 |
| UPC1028H | 1.95 |
| UPC1032H | 0.95 |
| UPC1158H | 0.75 |
| UPC1167C2 | 1.95 |
| UPC1181H | 1.25 |
| UPC1182H | 1.50 |
| UPC1185H | 3.95 |
| UPC1191V | 1.50 |
| UPC1350C | 2.95 |
| UPC1353C | 2.45 |
| UPC1360 | 2.95 |
| UPC1365C | 3.95 |
| UPC2002H | 1.95 |
| UPC2114LC | 2.50 |
| 555 | 0.35 |
| 556 | 0.60 |
| 723 | 0.50 |
| 741 | 0.35 |
| 747 | 0.50 |
| 748 | 0.35 |
| 7808 | 0.50 |
| 7805 | 0.50 |
| 7812 | 0.50 |
| 7815 | 0.50 |

### VIDEO SPARES & HEADS

Please phone with your recorder model no for our quotation

| | |
|---|---|
| 3HSSV for Ferguson/JVC | 27.50 |
| 3HSSUIN for National Panasonic/Philips | 29.50 |
| 3HSS3N for National Panasonic NV777/330 | 39.50 |
| 3HSSN/4HSS for National Panasonic | 29.50 |
| 3HSSH for Hitachi | 35.00 |
| 3HSSU3N for National Panasonic | 35.00 |
| 3HSSP for Sharp | 35.00 |
| 3HSS6NA for National Panasonic Industrial | 75.00 |
| 3HSSU2N for National Panasonic | 39.50 |
| 3HSSSF for Fisher/Fidelity | 35.00 |
| 3HSSR for Amstrad/Saisho/Triumph | 35.00 |
| PS38S for Sony SLC5 6 7 etc | 35.00 |
| PS3BT for Toshiba | 39.50 |
| PS4B2S for Sony SLC20/30 etc | 39.50 |
| PS5B3S for Sony SLCB/C9 etc | 49.50 |
| Philips V2000 | 65.00 |

### VIDEO BELT KITS

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|---|---|
| Akai VS9300/9500/9800 | 2.75 |
| Amstrad 7000/Saisho/Triumph | 1.50 |
| Ferguson 3V16 | 2.75 |
| Ferguson 3V22/JVC HR3360/3660 | 2.95 |
| Ferguson 3V23/JVC HR7700 | 1.50 |
| Ferguson 3V29/JVC HR7200 | 2.75 |
| Ferguson 3V31/JVC HR7650 | 2.75 |
| JVC HR3330/3600 | 2.75 |
| Hitachi VT11/33 | 2.75 |
| Hitachi VT5000 | 2.95 |
| Hitachi VT8000 | 1.25 |
| National Panasonic NV300/333/340 | 2.95 |
| National Panasonic NV2000B | 3.75 |
| National Panasonic NV777 | 2.75 |
| National Panasonic NV3000B | 3.75 |
| National Panasonic NV7000 | 2.75 |
| National Panasonic NV8600/8610/8620 | 3.75 |
| Sanyo VTC5000 | 1.50 |
| Sanyo VTC5300 | 1.75 |
| Sanyo VTC5500 | 2.75 |
| Sanyo VTC9300 | 3.75 |
| Sanyo VTC9300P | 3.90 |
| Sharp 6300 | 3.50 |
| Sharp 7300 | 3.50 |
| Sharp 8300 | 3.50 |
| Sharp 9300 | 3.50 |
| Sony C6 | 2.75 |
| Sony C7 | 3.50 |
| Sony T9 | 2.95 |
| Sony SL30008 | 3.75 |
| Sony SL8000/8080 | 4.50 |
| Toshiba 7540 | 3.50 |
| Toshiba 9600 | 1.50 |

### E H T MULTIPLIERS

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|---|---|
| UNIVERSAL TRIPLER | 5.45 |
| DECCA 30 | 6.35 |
| DECCA 80 | 6.95 |
| DECCA 100 | 6.95 |
| DECCA 120 | 6.95 |
| DECCA 1730 | 6.35 |
| GEC 2040 | 5.45 |
| GEC 2110 | 6.95 |
| ITT CVC1-9 | 6.35 |
| ITT CVC20/25/30 | 6.35 |
| ITT CVC45 | 6.95 |
| PHILIPS G8 (550) | 6.95 |
| PHILIPS G9 | 6.00 |
| PYE 697 | 6.50 |
| PYE 713 4 LEAD | 8.50 |
| PYE 713 5 LEAD | 8.50 |
| PYE 731/25 | 8.50 |
| RANK A774 | 6.35 |
| RANK A823 | 6.95 |
| RANK T20A | 6.95 |
| SIEMENS TVK76/1 | 6.95 |
| SIEMENS EUROPA | 7.50 |
| THORN 1500 | 5.45 |
| THORN 1600 | 5.45 |
| THORN 3500 | 7.95 |
| THORN 8000 | 6.95 |
| THORN 8500 | 7.15 |
| THORN 9000 | 8.50 |
| THORN 9600 | 8.50 |
| TV11 STICK | 0.90 |
| TV13 STICK | 1.25 |
| TV18 STICK | 1.10 |
| TV20 STICK | 1.40 |

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2MM Q/QB @ 0.06 each **£4.50**
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500MA 800MA 1 25Amp
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10Amp

1.25 inch A/S @ 0 15 each **£10.00**
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We have recently introduced a special in house selection facility and can offer the following service for audio, hi fi etc

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| Special Selection of pre amp valves for low microphony etc | £1.00 per valve |
| Supply and fitting of pre amp dumping rings | £1.00 per ring |
| Special selection and matching of power valves | £1.00 per valve |

## Valve Hardware List

**SOCKETS**

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| A12 | 1.75 |
| B4 CHASSIS | 2.50 |
| B5 CHASSIS | 2.50 |
| B5 FLOATING | 2.50 |
| B7 CHASSIS | 1.75 |
| B7A CHASSIS | 8.50 |
| B7G PCB | 0.65 |
| B7G PCB CERAMIC | 0.95 |
| B7G CHASSIS | 0.65 |
| B7G CHASSIS SHOCKPROOF | 0.65 |
| B7G SKIRTED CHASSIS | 0.65 |
| B7G SKIRTED PCB | 0.95 |
| B7G SKIRTED PTFE CHASSIS | 0.95 |
| B8A CHASSIS | 0.85 |
| B8G CHASSIS | 0.85 |
| B8H CRT | 0.45 |
| B9A PCB | 0.45 |
| B9A OCB THIN | 0.95 |
| B9A CHASSIS | 0.95 |
| B9A CHASSIS SHOCKPROOF | 0.50 |
| B9A SKIRTED CHASSIS | 1.25 |
| B9A SKIRTED CHASSIS CERAMIC PINCH | 0.65 |
| B9A SKIRTED PCB | 1.25 |
| B9D CERAMIC PCB | 0.95 |
| B9D CERAMIC CHASSIS | 0.95 |
| B9G CERAMIC CHASSIS | 2.50 |
| B10B CHASSIS | 0.50 |
| B13B CHASSIS | 0.50 |
| B14A CRT (3BPI) | 1.95 |
| OCATAL VINTAGE CHASSIS | 0.35 |
| OCTAL CHASSIS | 0.65 |
| OCTAL PCB | 0.95 |
| GIANT 7 PIN (B13) SOCKET | 8.50 |
| JUMBO 4 PIN | 13.95 |
| GIANT 4 PIN (4212H) | 25.00 |
| NUVISTOR | 4.50 |
| SK406 | 9.50 |
| SK410 | 35.00 |
| SK410S | 25.00 |
| SK610A | 35.00 |
| CHIMNEY (SK410(S) SK610A) | 3.50 |
| UX4 CHASSIS | 1.95 |
| UX5 CHASSIS | 1.95 |
| UX7 CHASSIS | 2.95 |
| X9V CHASSIS | 0.50 |
| 11PGF CHASSIS | 0.50 |

**PLUGS**

| | |
|---|---|
| OCTAL | 0.85 |
| B7G | 0.35 |
| B9A | 0.65 |

**CANS**

| | |
|---|---|
| B7G | 0.35 |
| B9A | 0.65 |

**TOP CAPS**

| | |
|---|---|
| NOVAL | 0.75 |
| OTHERS ON APPLICATION | |

**EX-EQUIPMENT**

| | |
|---|---|
| 4CX250B AEI BASE | 15.00 |
| 4CX250B MILITARY SOCKET | 10.00 |
| 4CX300A CLAMPS | 5.00 |

### DIODES

| | |
|---|---|
| AA119 | 0.10 |
| BA115 | 0.13 |
| BA145 | 0.16 |
| BA148 | 0.17 |
| BA154 | 0.06 |
| BA156 | 0.15 |
| BA157 | 0.30 |
| BA244 | 0.75 |
| BA301 | 0.75 |
| BA302 | 0.85 |
| BA313 | 0.75 |
| BA318 | 2.95 |
| BA328 | 2.95 |
| BA521 | 1.75 |
| BAV21 | 0.30 |
| BAW62 | 0.19 |
| BAX13 | 0.04 |
| BAX16 | 0.12 |
| BB105B | 0.30 |
| BT151 | 0.79 |
| BY126 | 0.10 |
| BY127 | 0.11 |
| BY133 | 0.15 |
| BY164 | 0.45 |
| BY176 | 1.20 |
| BY179 | 0.63 |
| BT182 | 0.55 |
| BY184 | 0.35 |
| BY187 | 0.45 |
| BY199 | 0.40 |
| BY206 | 0.14 |
| BY208 800 | 0.33 |
| BY210-800 | 0.33 |
| BY223 | 0.90 |
| BY298 400 | 0.22 |
| BY299 800 | 0.22 |
| BYX10 | 0.50 |
| BYX25-600 | 1.25 |
| BYX36 150R | 0.20 |
| BYX38 600R | 0.60 |
| BYX55 600 | 0.30 |
| BYX71 600 | 1.75 |
| BZX61 | 0.15 |
| BZX88 | 0.10 |
| BZY95C30 | 0.35 |
| CS4B | 8.00 |
| CS10B | 18.50 |
| MR510 | 0.65 |
| MR512 | 0.65 |
| OA47 | 0.15 |
| OA90 | 0.10 |
| OA91 | 0.15 |
| OA95 | 0.10 |
| OA202 | 0.40 |
| IN210R | 5.00 |
| IN23B | 2.95 |
| IN23C | 4.95 |
| IN23ER | 4.95 |
| IN23WE | 2.95 |
| IN4001 | 0.04 |
| IN4003 | 0.04 |
| IN4004 | 0.05 |
| IN4007 | 0.06 |
| IN4148 | 0.02 |
| IN4448 | 0.10 |
| IN5401 | 0.12 |
| IN5402 | 0.14 |
| IN5403 | 0.12 |
| IN5406 | 0.13 |
| IN5407 | 0.16 |
| IN5408 | 0.16 |
| ITT44 | 0.10 |
| ITT923 | 0.15 |
| ITT2002 | 0.10 |

### ZENER DIODES

| | |
|---|---|
| BZX61 Series | 0.15 |
| BZY88 Series | 0.20 |

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| CME1523W | 9.50 |
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| D10 210GH | 45.00 |
| D10 230GM | 45.00 |
| D13 611GH | 59.00 |
| D13 630GH | 59.00 |
| D14 200GM | 75.00 |
| D16 100GH97 | 65.00 |
| DH3 91 | 55.00 |
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| F31 12LD | 75.00 |
| LF708 | 75.00 |
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| M23 112GV | 45.00 |
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| M31 190GR | 45.00 |
| M31 191W | 55.00 |
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| SE5FP31 | 45.00 |
| T9750 | 75.00 |

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| A3283 | 24.00 |
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| AC/S2PEN | 8.50 |
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| AH221 | 39.00 |
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| ARP34 | 1.25 |
| ARP35 | 2.00 |
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| BS894 | 250.00 |
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| BT17 | 25.00 |
| BT113 | 35.00 |
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| C3M | 17.95 |
| C1134 | 32.00 |
| C1149/1 | 195.00 |
| C1150/1 | 135.00 |
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| CCA | 3.50 |
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| DA41 | 22.50 |
| DA42 | 17.50 |
| DA90 | 4.50 |
| DAF91 | 0.95 |
| DAF96 | 0.95 |
| DC70 | 1.75 |
| DC90 | 3.50 |
| DCX 4 5000 | 25.00 |
| DET16 | 28.50 |
| DET18 | 28.50 |
| DET20 | 2.50 |
| DET22 | 35.00 |
| DET23 | 35.00 |
| DET24 | 27.50 |
| DET25 | 22.00 |
| DET29 | 32.00 |
| DF91 | 1.50 |
| DF92 | 1.50 |
| DF96 | 1.25 |
| DF97 | 1.25 |
| DG10A | 8.50 |
| DH63 | 1.50 |
| DH77 | 0.90 |
| DK91 | 1.20 |
| DK92 | 1.50 |
| DL35 | 2.50 |
| DL63 | 1.00 |
| DL70 | 2.50 |
| DL73 | 2.50 |
| DL91 | 3.95 |
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| DLS16 | 10.00 |
| DM70 | 5.25 |
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| DOD 006 | 79.50 |
| DY51 | 1.50 |
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| E81CC | 5.50 |
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| E83CC | 4.50 |
| E83F | 5.50 |
| E86C | 9.50 |
| E88C | 7.95 |
| E88CC | 3.50 |
| E88CC-01 | 6.95 |
| E88CC MULLARD | 4.95 |
| E90CC | 7.95 |
| E90F | 7.95 |
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| E92CC | 3.95 |
| E99F | 6.95 |
| E130L | 18.50 |
| E180CC | 10.50 |
| E180F | 6.50 |
| E182CC | 9.00 |
| E186F | 8.50 |
| E188CC | 7.50 |
| E235L | 12.50 |
| E280F | 19.50 |
| E283CC | 12.00 |
| E288CC | 17.50 |
| E810F | 25.00 |
| E1148 | 1.00 |
| EA50 | 1.00 |
| EA52 | 55.00 |
| EA76 | 1.95 |

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|---|---|
| EA79 | 1.95 |
| EABC80 | 1.50 |
| EAC91 | 2.50 |
| EAF42 | 1.20 |
| EB34 | 1.50 |
| EB41 | 3.95 |
| EB91 | 0.85 |
| EBC33 | 2.50 |
| EBC41 | 1.95 |
| EBC81 | 1.50 |
| EBC90 | 1.95 |
| EBC91 | 1.95 |
| EBF80 | 0.95 |
| EBF83 | 0.95 |
| EBF89 | 0.95 |
| EBF93 | 0.95 |
| EBL1 | 4.50 |
| EBL21 | 4.50 |
| EC52 | 0.75 |
| EC70 | 1.75 |
| EC81 | 7.95 |
| EC86 | 1.95 |
| EC88 | 1.95 |
| EC90 | 1.95 |
| EC91 | 5.50 |
| EC93 | 1.50 |
| EC95 | 7.00 |
| EC97 | 1.10 |
| EC8010 | 12.00 |
| ECC32 | 3.50 |
| ECC33 | 3.50 |
| ECC35 | 3.50 |
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| ECC81 SPECIAL QUALITY | 2.25 |
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| ECC83 BRIMAR | 2.15 |
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| ECC86 | 2.75 |
| ECC88 | 1.35 |
| ECC89 | 1.50 |
| ECC91 | 2.00 |
| ECC189 | 2.50 |
| ECC801S | 6.95 |
| ECC803S | 6.95 |
| ECC804 | 0.60 |
| ECC2000 | 7.95 |
| ECF80 | 1.15 |
| ECF82 | 1.50 |
| ECF86 | 1.70 |
| ECF200 | 1.85 |
| ECF202 | 1.85 |
| ECF801 | 0.85 |
| ECF804 | 6.50 |
| ECF805 | 2.50 |
| ECF806 | 10.25 |
| ECH3 | 4.50 |
| ECH4 | 4.50 |
| ECH35 | 3.50 |
| ECH42 | 1.50 |
| ECH81 | 1.75 |
| ECH83 | 1.50 |
| ECH84 | 1.00 |
| ECH200 | 1.50 |
| ECL80 | 0.60 |
| ECL82 | 1.00 |
| ECL83 | 2.50 |
| ECL84 | 1.00 |
| ECL85 | 0.95 |
| ECL86 | 1.50 |
| ECL805 | 0.95 |
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| EF22 | 3.50 |
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| EF40 | 4.50 |
| EF42 | 3.50 |
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| EF54 | 4.50 |
| EF55 | 4.95 |
| EF70 | 1.20 |
| EF72 | 3.50 |
| EF73 | 3.50 |
| EF80 | 0.55 |
| EF83 | 3.95 |
| EF85 | 0.85 |
| EF86 | 2.50 |
| EF86 MULLARD | 4.50 |
| EF86/CV4085 | 5.00 |
| EF89 | 1.50 |
| EF91 | 1.95 |
| EF92 | 2.15 |
| EF93 | 1.50 |
| EF94 | 1.50 |
| EF95 | 1.95 |
| EF97 | 0.90 |

| | |
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| EF98 | 0.90 |
| EF183 | 0.75 |
| EF184 | 0.85 |
| EF731 | 4.50 |
| EF732 | 4.50 |
| EF800 | 11.00 |
| EF804S | 19.50 |
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| EF806S | 25.00 |
| EF812 | 0.65 |
| EFL200 | 1.50 |
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| EL34 SIEMENS | 4.50 |
| EL36 | 2.50 |
| EL36 MULLARD | 3.95 |
| EL38 | 9.00 |
| EL41 | 3.50 |
| EL42 | 2.00 |
| EL71 | 4.50 |
| EL81 | 6.95 |
| EL83 | 7.50 |
| EL84 | 0.95 |
| EL84 MULLARD | 4.50 |
| EL84 SIEMENS | 2.50 |
| EL85 | 4.50 |
| EL86 | 1.75 |
| EL90 | 1.75 |
| EL91 | 6.00 |
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| EL152 | 15.00 |
| EL360 | 6.75 |
| EL500 | 1.95 |
| EL504 | 1.95 |
| EL506 | 5.95 |
| EL509 | 5.25 |
| EL509 MULLARD | 7.50 |
| EL519 | 6.95 |
| EL802 | 3.65 |
| EL821 | 6.95 |
| EL822 | 12.95 |
| ELL80 | 22.50 |
| EM34 | 12.50 |
| EM80 | 1.65 |
| EM84 | 1.65 |
| EM85 | 3.95 |
| EM87 | 2.50 |
| EN32 | 15.00 |
| EN91 | 2.25 |
| EN92 | 4.50 |
| EY51 | 0.80 |
| EY70 | 7.50 |
| EY81 | 2.35 |
| EY82 | 1.15 |
| EY83 | 1.50 |
| EY84 | 5.95 |
| EY86/87 | 0.65 |
| EY88 | 0.95 |
| EY91 | 5.50 |
| EY500A | 1.95 |
| EY802 | 0.70 |
| EZ35 | 1.00 |
| EZ40 | 3.50 |
| EZ41 | 3.50 |
| EZ80 | 0.75 |
| EZ81 | 0.75 |
| EZ90 | 1.50 |
| FW4 800 | 4.50 |
| G55/1K | 9.00 |
| G180/2M | 6.95 |
| G240/2D | 9.00 |
| GC10B | 17.50 |
| GC10D | 17.50 |
| GC10/4B | 17.50 |
| GC10/4E | 17.50 |
| GC12/4B | 17.50 |
| GD86W | 6.00 |
| GDT120M | 5.00 |
| GN4 | 6.00 |
| GN10 | 15.00 |
| GR10G | 4.00 |
| GS10C | 16.50 |
| GS10H | 12.00 |
| GS12D | 12.00 |
| GT1C | 14.00 |
| GU20 | 35.00 |
| GU50 | 17.50 |
| GXU1 | 13.50 |
| GXU3 | 24.00 |
| GXU50SS | 14.50 |
| GY501 | 1.50 |
| GY802 | 1.50 |
| GZ32 | 2.50 |
| GZ33 | 4.50 |
| GZ34 | 2.50 |
| GZ37 | 4.50 |
| HBC90 | 1.95 |
| HL41 | 3.50 |
| HL90 | 3.50 |
| KT8C | 7.00 |
| KT33C | 3.50 |
| KT36 | 2.95 |
| KT44 | 5.95 |
| KT45 | 5.95 |
| KT61 | 5.00 |

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|---|---|
| KT63 | 2.00 |
| KT66 USA | 11.95 |
| KT66 GEC | 25.00 |
| KT66 TEONEX | 5.00 |
| KT67 | 9.00 |
| KT77 GEC | 11.95 |
| KT81 | 7.00 |
| KT88 USA | 12.95 |
| KT88 Selectron | 15.00 |
| KTW61 | 2.50 |
| KTW62 | 2.50 |
| KTW63 | 2.00 |
| KTZ63 | 2.50 |
| LB7 20 | 95.00 |
| LS9B | 6.95 |
| M508 | 195.00 |
| M5143 | 155.00 |
| M5199 | 295.00 |
| M8079 | 6.00 |
| M8082 | 7.50 |
| M8083 | 3.25 |
| M8091 | 7.50 |
| M8096 | 3.00 |
| M8098 | 5.50 |
| M8099 | 5.00 |
| M8100 | 5.50 |
| M8136 | 7.00 |
| M8137 | 7.95 |
| M8161 | 6.50 |
| M8162 | 5.50 |
| M8163 | 5.50 |
| M8190 | 4.50 |
| M8195 | 6.50 |
| M8196 | 5.50 |
| M8204 | 5.50 |
| M8223 | 4.50 |
| M8224 | 2.00 |
| M8225 | 3.95 |
| ME1400 | 3.50 |
| ME1401 | 29.50 |
| ME1402 | 29.50 |
| MHLD6 | 4.00 |
| MP25 | 195.00 |
| MS4B | 5.50 |
| MU14 | 3.50 |
| N37 | 12.50 |
| N78 | 9.85 |
| OA2 | 1.50 |
| OA2WA | 2.50 |
| OA3 | 2.50 |
| OB2 | 1.50 |
| OB2WA | 2.50 |
| OC3 | 2.50 |
| OD3 | 2.50 |
| OM4 | 2.50 |
| OM5B | 3.00 |
| OM6 | 1.75 |
| ORP43 | 2.50 |
| ORP50 | 3.95 |
| P61 | 2.50 |
| P41 | 2.50 |
| PABC80 | 0.95 |
| PC86 | 0.75 |
| PC88 | 0.75 |
| PC97 | 1.10 |
| PC900 | 1.25 |
| PCC84 | 0.40 |
| PCC85 | 0.55 |
| PCC88 | 0.70 |
| PCC89 | 0.70 |
| PCC189 | 0.70 |
| PCC805 | 0.70 |
| PCC806 | 0.80 |
| PCE82 | 0.80 |
| PCF80 | 0.65 |
| PCF82 | 0.60 |
| PCF84 | 0.65 |
| PCF86 | 1.20 |
| PCF87 | 1.25 |
| PCF200 | 1.80 |
| PCF201 | 1.80 |
| PCF801 | 1.35 |
| PCF802 | 0.85 |
| PCF805 | 1.25 |
| PCF806 | 1.50 |
| PCF808 | 1.25 |
| PCH200 | 1.50 |
| PCL82 | 0.85 |
| PCL83 | 2.50 |
| PCL84 | 0.75 |
| PCL85 | 0.80 |
| PCL86 | 0.85 |
| PCL805 | 0.90 |
| PD500 | 5.95 |
| PE1 100 | 69.00 |
| PEN25 | 2.00 |
| PEN40D | 3.00 |
| PEN45 | 3.00 |
| PEN45DD | 3.00 |
| PEN46 | 2.00 |
| PFL200 | 0.95 |
| PL36 | 1.75 |
| PL38 | 1.50 |
| PL81 | 1.25 |
| PL82 | 0.60 |
| PL83 | 0.52 |
| PL84 | 0.78 |
| PL500 | 1.25 |
| PL504 | 1.25 |
| PL508 | 1.50 |
| PL509 | 4.85 |
| PL519 | 4.95 |
| PL802 | 6.00 |
| PL802T | 3.50 |
| PL820 | 2.95 |
| PY32 | 0.60 |
| PY33 | 0.50 |
| PY81 | 0.70 |
| PY82 | 0.70 |
| PY83 | 0.70 |

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|---|---|
| PY88 | 0.65 |
| PY500A | .95 |
| PY800 | 0.85 |
| PY801 | 0.85 |
| QB3 300 | 72.00 |
| QB3-1750 | 139.00 |
| QB5-3500 | 595.00 |
| QQE02-5 | 19.50 |
| QQE03-12 | 7.95 |
| QQE03-20 | 35.00 |
| QQE06-40 | 45.00 |
| QQV02-6 | 19.50 |
| QQV03-10 | 5.50 |
| QQV03-10 MULLARD | 15.00 |
| QQV03 20 | 25.00 |
| QQV06 40A | 27.50 |
| QQV06 40A MULLARD | 39.50 |
| QQV07 50 | 55.00 |
| QQZ03-20 | 42.50 |
| QQZ06 40 | 45.00 |
| QS75/20 | 1.50 |
| QS95/10 | 4.85 |
| QS108/45 | 4.00 |
| QS150/15 | 6.95 |
| QS150/30 | 1.15 |
| QS150/40 | 7.00 |
| QS1205 | 3.95 |
| QS1213 | 5.00 |
| QU37 | 9.50 |
| QV03 12 | 6.50 |
| QV05 25 | 2.50 |
| QV06-20 | 29.50 |
| QV08 100B | 145.00 |
| QY3 125 | 85.00 |
| QY4 250 | 85.00 |
| QY4 400 | 95.00 |
| R10 | 4.00 |
| R18 | 2.50 |
| RG1 240A | 14.50 |
| RG3 250A | 6.50 |
| RG3 1250A | 35.00 |
| RR3 250 | 15.00 |
| RR3-1250 | 35.00 |
| S11E12 | 38.00 |
| S104 2K | 10.00 |
| SC1 1300 | 6.00 |
| SP61 | 3.50 |
| STV280/40 | 11.95 |
| TB2 5/300 | 95.00 |
| TB2 300 | 195.00 |
| TB3-750 | 115.00 |
| TB3 2000 | 450.00 |
| TBL2 300 | 395.00 |
| TBL2 500 | 495.00 |
| TD03 10/D/F | 35.00 |
| TT15 | 45.00 |
| TT21 | 45.00 |
| TT22 | 39.50 |
| TT100 | 69.00 |
| TY2 125A | 85.00 |
| TY4 400 | 85.00 |
| TY7 6000A | 600.00 |
| TY8 600W | 365.00 |
| U19 | 9.50 |
| U26 | 0.90 |
| U35 | 3.50 |
| U37 | 9.00 |
| U41 | 6.95 |
| U50 | 2.00 |
| U82 | 3.00 |
| U191 | 0.70 |
| U192 | 1.00 |
| U193 | 1.00 |
| U251 | 2.50 |
| U801 | 3.50 |
| UABC80 | 1.00 |
| UAF42 | 1.95 |
| UBC41 | 3.95 |
| UBC81 | 1.50 |
| UBF80 | 0.95 |
| UBF89 | 1.00 |
| UBL21 | 1.75 |
| UC92 | 1.20 |
| UCC84 | 0.70 |
| UCC85 | 0.60 |
| UCF80 | 1.00 |
| UCH21 | 2.50 |
| UCH41 | 2.50 |
| UCH42 | 3.95 |
| UCH81 | 1.00 |
| UCL82 | 1.75 |
| UCL83 | 2.50 |
| UF41 | 2.25 |
| UF42 | 2.25 |
| UF80 | 1.75 |
| UF85 | 1.20 |
| UF89 | 2.00 |
| UL41 | 10.00 |
| UL44 | 3.50 |
| UL84 | 1.50 |
| UL85 | 0.85 |
| UU5 | 3.50 |
| UU6 | 6.00 |
| UU7 | 8.00 |
| UU8 | 9.00 |
| UY41 | 3.50 |
| UY85 | 0.70 |
| V235A 1K | 250.00 |
| V238A 1K | 295.00 |
| V246A 1K | 250.00 |
| V246A/2K | 315.00 |

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|---|---|
| V241 1K | 195.00 |
| V453 | 12.00 |
| VLS631 | 10.95 |
| VP4B | 9.50 |
| VP41 | 4.95 |
| VR101 | 2.50 |
| VR105/30 | 2.50 |
| VR150/30 | 2.50 |
| VU39 | 2.50 |
| W21 | 4.50 |
| W61 | 4.50 |
| W77 | 5.00 |
| W81M | 4.50 |
| W739 | 1.50 |
| X24 | 4.50 |
| X41 | 4.50 |
| X66/X65 | 4.95 |
| X76M | 1.95 |
| XC24 | 1.50 |
| XC25 | 0.50 |
| XFW47 | 1.50 |
| XFW50 | 1.50 |
| XG1 2500 | 75.00 |
| XL62BFT | 7.50 |
| XNP12 | 2.50 |
| XR1 1600A | 49.50 |
| XR1 3200A | 79.50 |
| XR1 6400A | 149.50 |
| Y65 | 6.95 |
| YD1100 | 75.00 |
| YJ1060 | 265.00 |
| YL1020 | 42.50 |
| YL1060 | 195.00 |
| YL1070 | 195.00 |
| YL1071 | 195.00 |
| YL1290 | 65.00 |
| Z77 | 1.20 |
| Z300T | 6.00 |
| Z302C | 12.00 |
| Z359 | 9.00 |
| Z520M | 4.00 |
| Z700U | 9.50 |
| Z759 | 19.85 |
| Z803U | 18.95 |
| ZA1000 | 12.50 |
| ZA1001 | 1.50 |
| ZM1001 | 12.00 |
| ZM1005 | 8.00 |
| ZM1020 | 6.00 |
| ZM1021 | 8.00 |
| ZM1023 | 7.95 |
| ZM1041 | 14.00 |
| ZM1082 | 9.00 |
| ZM1084 | 10.00 |
| ZM1175 | 6.50 |
| ZM1177 | 9.00 |
| ZM1202 | 55.00 |
| ZM1263 | 4.00 |
| 1A3 | 4.50 |
| 1AE4 | 3.50 |
| 1AX2 | 3.50 |
| 1B22 | 10.00 |
| 1B27 | 55.00 |
| 1B3GT | 1.95 |
| 1B35A | 45.00 |
| 1B63A | 75.00 |
| 1K3 | 2.50 |
| 1N5GT | 2.50 |
| 1P28 | 25.00 |
| 1R5 | 1.50 |
| 1S5 | 1.50 |
| 1T4 | 1.50 |
| 1U4 | 1.75 |
| 1U5 | 1.50 |
| 1X25 | 2.50 |
| 2A3 | 16.50 |
| 2AS15A | 11.50 |
| 2B7 | 4.50 |
| 2B22 | 69.50 |
| 2C36 | 70.00 |
| 2C39A | 32.50 |
| 2C39BA | 39.50 |
| 2C40 | 37.00 |
| 2C42 | 29.50 |
| 2C43 | 60.00 |
| 2C51 | 2.50 |
| 2CY5 | 1.50 |
| 2D21 | 2.25 |
| 2D21W | 3.15 |
| 2E22 | 49.00 |
| 2E26 | 7.95 |
| 2J55 | 295.00 |
| 2K25 | 49.50 |
| 2K26 | 95.00 |
| 2K29 | 250.00 |
| 2K48 | 140.00 |
| 2K56 | 250.00 |
| 2X2A | 5.00 |
| 3A/107B | 12.00 |
| 3A/108A | 9.00 |
| 3A/109B | 11.00 |
| 3A/110B | 12.00 |
| 3A/141K | 11.50 |
| 3A/146J | 7.50 |
| 3A/147J | 7.50 |
| 3A/167M | 10.00 |
| 3A3A | 3.95 |
| 3A4 | 1.50 |
| 3A5 | 4.50 |
| 3AT2 | 3.35 |
| 3B22 | 25.00 |
| 3B26 | 24.00 |
| 3B28 | 15.00 |
| 3BZ6 | 1.50 |
| 3C45 | 39.50 |
| 3CX3000A7 | 650.00 |
| 3CY5 | 1.50 |
| 3D21A | 29.50 |

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|---|---|
| 3E22 | 49.50 |
| 3E29 | 39.50 |
| 3EJ7 | 1.95 |
| 3H | 0.40 |
| 3J 170E | 1450.00 |
| 3L | 0.40 |
| 3Q4 | 2.50 |
| 4-65A | 75.00 |
| 4-250A | 85.50 |
| 4-400C | 87.50 |
| 4-1000A | 425.00 |
| 4B32 | 35.00 |
| 4BQ7A | 1.75 |
| 4BZ6 | 1.95 |
| 4C28 | 25.00 |
| 4C35 | 145.00 |
| 4CS250R | 285.00 |
| 4XC125C EIMAC | 150.00 |
| 4CX250B | 45.00 |
| 4CX250BM | 65.00 |
| 4CX250K EIMAC | 115.00 |
| 4CX250R AMPEREX | 125.00 |
| 4CX350A | 100.00 |
| 4CX1000A | 425.00 |
| 4CX1500B | 475.00 |
| 4CX5000A | 1000.00 |
| 4D21/4 125A | 85.00 |
| 4D32 | 125.00 |
| 4E27A | 125.00 |
| 4GS7 | 2.25 |
| 4GV7 | 2.25 |
| 4J6A | 2.95 |
| 4KT6 | 1.50 |
| 4T85P | 150.00 |
| 4X150A | 35.00 |
| 4X150D | 55.00 |
| 4X500A | 350.00 |
| 5A/102D | 9.50 |
| 5A152M | 9.00 |
| 5A163K | 10.00 |
| 5A170K | 6.25 |
| 5A 180M | 9.00 |
| 5A-206K | 10.00 |
| 5B-110M | 10.00 |
| 5B-254M | 14.50 |
| 5B 255M | 14.50 |
| 5B 256M | 15.00 |
| 5B-257M | 15.00 |
| 5B258M | 14.50 |
| 5C22 | 125.00 |
| 5CL8A | 2.50 |
| 5J180E | 1950.00 |
| 5JL8 | 2.95 |
| 5R4GB | 5.50 |
| 5R4GY | 4.95 |
| 5R4WGY | 5.95 |
| 5T4 | 5.95 |
| 5T8A | 1.95 |
| 5U4G | 4.50 |
| 5U4GB | 4.50 |
| 5V4G | 2.50 |
| 5W4 | 4.95 |
| 5X4 | 4.95 |
| 5Y3GT | 2.50 |
| 5Z3 | 4.50 |
| 5Z4G | 2.50 |
| 6/30L2 | 0.70 |
| 6A/203K | 9.00 |
| 6A7 | 4.95 |
| 6A8 | 2.50 |
| 6AB7 | 4.50 |
| 6AC7WA | 2.00 |
| 6AG5 | 2.50 |
| 6AG7 | 2.50 |
| 6AH6 | 3.50 |
| 6AJ4 | 3.50 |
| 6AJ7 | 2.00 |
| 6AK5 | 1.95 |
| 6AK6 | 2.50 |
| 6AL5 | 0.85 |
| 6AM4 | 3.25 |
| 6AM5 | 6.00 |
| 6AM6 | 1.95 |
| 6AN5 | 4.50 |
| 6AN8A | 4.50 |
| 6AQ5 | 1.75 |
| 6AQ8 | 1.50 |
| 6AR5 | 8.95 |
| 6AS5 | 1.50 |
| 6AS6 | 2.50 |
| 6AS7G | 4.50 |
| 6AT6 | 1.95 |
| 6AT8 | 1.75 |
| 6AU4GT | 2.95 |
| 6AU5GT | 4.50 |
| 6AU6 | 0.95 |
| 6AV6 | 1.95 |
| 6AW8A | 3.50 |
| 6AX4GT | 1.95 |
| 6AY3B | 1.95 |
| 6AZ8 | 4.50 |
| 6B8G | 2.50 |
| 6B10 | 1.95 |
| 6BA6 | 1.50 |
| 6BA7 | 4.50 |
| 6BA8A | 3.50 |
| 6BC8 | 1.50 |
| 6BR3 | 2.95 |
| 6BE6 | 1.50 |
| 6BG6G | 3.00 |
| 6BH6 | 1.95 |
| 6BH8 | 1.50 |
| 6BJ6 | 1.50 |

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|---|---|
| 6BK4 | 6.50 |
| 6BL6 | 85.00 |
| 6BL8 | 1.15 |
| 6BM6 | 115.00 |
| 6BN6 | 1.65 |
| 6BN8 | 3.95 |
| 6BQ5 | 1.35 |
| 6BQ7A | 1.50 |
| 6BR7 | 4.95 |
| 6BS7 | 5.50 |
| 6BW6 | 5.35 |
| 6BW7 | 1.50 |
| 6BZ6 | 2.50 |
| 6BZ7 | 2.95 |
| 6C4 | 1.95 |
| 6C5 | 2.50 |
| 6C6 | 3.50 |
| 6C8G | 2.50 |
| 6C9 | 4.95 |
| 6CA4 | 4.95 |
| 6CA7 | 3.50 |
| 6CB5 | 3.95 |
| 6CB6 | 2.35 |
| 6CD6GA | 4.50 |
| 6CF6 | 1.95 |
| 6CG7 | 4.50 |
| 6CH6 | 6.95 |
| 6CL6 | 3.25 |
| 6CL8A | 2.95 |
| 6CM7 | 2.95 |
| 6CS6 | 0.75 |
| 6CS7 | 0.95 |
| 6CW4 | 8.00 |
| 6CX8 | 3.95 |
| 6DC6 | 2.35 |
| 6DJ8 | 1.35 |
| 6DJ8 SPECIAL | 3.50 |
| 6DK6 | 1.50 |
| 6DQ5 | 8.50 |
| 6DQ6B | 2.50 |
| 6DT6A | 1.50 |
| 6DW4B | 3.50 |
| 6E5 | 3.95 |
| 6EA7 | 2.50 |
| 6EA8 | 2.50 |
| 6EB8 | 3.50 |
| 6EJ7 | 0.85 |
| 6EM5 | 2.50 |
| 6EM7 | 2.50 |
| 6EU8 | 1.75 |
| 6EV7 | 2.95 |
| 6EW6 | 1.50 |
| 6F1 | 2.00 |
| 6F5 | 5.50 |
| 6F7 | 5.50 |
| 6F13 | 3.00 |
| 6F14 | 1.00 |
| 6F17 | 2.75 |
| 6F23 | 0.60 |
| 6F24 | 1.25 |
| 6F25 | 1.25 |
| 6F28 | 1.25 |
| 6F32 | 1.25 |
| 6F33 | 10.50 |
| 6FH5 | 8.50 |
| 6FH6 | 15.00 |
| 6FL2 | 4.50 |
| 6FQ7 | 4.50 |
| 6GE5 | 3.95 |
| 6GH8A | 2.50 |
| 6GJ7 | 0.85 |
| 6GK6 | 3.95 |
| 6GM6 | 2.65 |
| 6GS7 | 21.5 |
| 6GV8 | 0.95 |
| 6GW8 | 2.50 |
| 6GY5 | 4.95 |
| 6GY6 | 2.50 |
| 6H1 | 9.50 |
| 6H6GT | 2.50 |
| 6HB7 | 1.95 |
| 6HF8 | 3.50 |
| 6HM5 | 2.50 |
| 6HQ5 | 3.50 |
| 6HS6 | 4.95 |
| 6HS8 | 2.95 |
| 6HZ6 | 3.50 |
| 6J4 | 2.15 |
| 6J5GT | 2.50 |
| 6J6 | 2.00 |
| 6J7 | 4.15 |
| 6J7G | 4.15 |
| 6JB6A | 9.50 |
| 6JE6C | 9.50 |
| 6JM6 | 9.50 |
| 6JU8A | 2.50 |
| 6JS6C | 9.50 |
| 6K7G | 2.00 |
| 6K8G | 3.00 |
| 6KD6 | 9.50 |
| 6KG6A | 6.95 |
| 6L1 | 2.50 |
| 6L6GC | 3.50 |
| 6L6GC USA | 9.50 |
| 6L6GT | 3.50 |
| 6L7 | 3.50 |
| 6L15 | 3.15 |
| 6L19 | 3.95 |
| 6LJ8 | 2.50 |
| 6LD20 | 1.15 |
| 6LF6 | 11.50 |
| 6LQ6 | 9.50 |
| 6P28 | 2.00 |
| 6Q7GT | 1.50 |
| 6R7 | 3.15 |
| 6RHH8 | 10.00 |
| 6S4A | 1.95 |
| 6SA7 | 1.95 |
| 6SC7 | 1.95 |
| 6SH7 | 1.95 |
| 6SJ7GT | 1.95 |

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|---|---|
| 6SK7 | 1.95 |
| 6SL7GT | 1.95 |
| 6SN7GT | 1.95 |
| 6SQ7GT | 1.50 |
| 6SS7 | 1.95 |
| 6T8 | 1.50 |
| 6U6GT | 3.50 |
| 6U7G | 3.50 |
| 6U8A | 1.50 |
| 6V6G | 1.25 |
| 6V6GT | 1.95 |
| 6W4GT | 1.95 |
| 6Y6G | 3.95 |
| 6X2N | 1.00 |
| 6X4 | 1.50 |
| 6X5GT | 1.00 |
| 6X8A | 2.25 |
| 7A6 | 4.50 |
| 7AU7 | 1.50 |
| 7B6 | 3.50 |
| 7B7 | 2.50 |
| 7D8 | 4.50 |
| 7J7 | 5.50 |
| 7K7 | 7.50 |
| 7L | 1.50 |
| 7Q7 | 4.50 |
| 7Y4 | 2.50 |
| 8B8 | 2.50 |
| 8B10 | 2.50 |
| 8BQ5 | 1.95 |
| 8CW5 | 1.50 |
| 8E88B | 1.50 |
| 8FQ7 | 1.95 |
| 10D2 | 1.25 |
| 10DE7 | 2.50 |
| 10DX8 | 2.50 |
| 10EB8 | 1.95 |
| 10EW7 | 2.95 |
| 10F1 | 0.75 |
| 10GK6 | 1.95 |
| 10P14 | 2.50 |
| 11E3 | 55.00 |
| 11R3 | 5.50 |
| 12A6 | 3.95 |
| 12AD6 | 2.50 |
| 12AE6 | 5.50 |
| 12AH7GT | 4.95 |
| 12AL5 | 1.00 |
| 12AT6 | 1.75 |
| 12AT7 | 1.50 |
| 12AT7WA | 2.50 |
| 12AU6 | 1.50 |
| 12AU7 | 0.85 |
| 12AV6 | 1.95 |
| 12AV7 | 2.50 |
| 12AX4GTB | 2.50 |
| 12AX7 | 0.95 |
| 12AX7WA | 2.50 |
| 12AX7S | 7.95 |
| 12AY7 | 3.95 |
| 12B4A | 4.50 |
| 12BA6 | 2.50 |
| 12BE6 | 1.95 |
| 12BH7A | 3.95 |
| 12BL6 | 1.75 |
| 12BR3 | 1.95 |
| 12BY7A | 3.50 |
| 12C8 | 2.50 |
| 12CA5 | 1.95 |
| 12CX6 | 1.95 |
| 12DQ6B | 3.50 |
| 12DW4A | 3.50 |
| 12DZ6 | 3.95 |
| 12E1 | 19.50 |
| 12E14 | 38.00 |
| 12FX5 | 1.95 |
| 12GN7 | 3.95 |
| 12GH7 | 3.95 |
| 12J5GT | 3.95 |
| 12J7GT | 3.50 |
| 12JZ8 | 2.95 |
| 12KGT | 1.50 |
| 12K8Y | 1.95 |
| 12KU7 | 1.95 |
| 12S7GT | 1.50 |
| 12SA7GT | 1.95 |
| 12SG7 | 4.75 |
| 12SK7 | 1.95 |
| 12SJ7 | 1.50 |
| 12SN7GT | 1.85 |
| 12SW7 | 3.50 |
| 12SY7 | 4.50 |
| 12X4 | 1.95 |
| 13D7 | 3.20 |
| 13DE7 | 2.50 |
| 13DR7 | 2.95 |
| 13E1 | 145.00 |
| 13EM7 | 3.50 |
| 14B6 | 4.50 |
| 14R7 | 3.50 |
| 15E | 5.50 |
| 16AQ3 | 1.95 |
| 16GY5 | 2.95 |
| 16H | 0.40 |
| 16L | 0.40 |
| 17A8 | 3.50 |
| 17AX4GTA | 1.95 |
| 17BE3 | 2.50 |
| 17DW4A | 2.95 |
| 17EW8 | 1.50 |
| 17JZ8 | 4.50 |
| 18D3 | 6.00 |
| 18GB5 | 3.50 |
| 19AQ5 | 3.50 |
| 19AU4GT | 2.50 |
| 19BG6 | 3.50 |
| 19G3 | 19.50 |
| 19G6 | 9.00 |
| 19H4 | 35.00 |
| 19H5 | 33.50 |
| 20CV | 9.50 |
| 20D1 | 1.50 |

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|---|---|
| 20LF6 | 7.95 |
| 20L1 | 0.95 |
| 20P1 | 0.55 |
| 20P4 | 1.95 |
| 20P5 | 1.15 |
| 21JZ6 | 4.95 |
| 21KQ6 | 4.95 |
| 21LU8 | 3.75 |
| 24B1 | 39.50 |
| 24B9 | 39.50 |
| 25BQ6 | 1.75 |
| 25DQ6B | 2.95 |
| 25L6GT | 1.75 |
| 29C1 | 19.50 |
| 29KQ6 | 6.50 |
| 30C15 | 0.50 |
| 30C17 | 0.40 |
| 30C18 | 1.48 |
| 30FL2 | 1.35 |
| 30FL12 | 0.95 |
| 30FL13 | 1.10 |
| 30FL14 | 1.25 |
| 30L1 | 0.45 |
| 30L15 | 0.60 |
| 30L17 | 0.60 |
| 30P4MR | 1.00 |
| 30P12 | 1.00 |
| 30P18 | 0.60 |
| 30P19 | 1.00 |
| 30P1 | 2.50 |
| 30PL13 | 0.60 |
| 30PL14 | 1.75 |
| 31JS6C | 5.50 |
| 33A 158M | 19.50 |
| 35A3 | 3.95 |
| 35A5 | 4.50 |
| 35C5 | 4.50 |
| 35L6GT | 2.00 |
| 35Z3 | 1.95 |
| 35Z5GT | 3.50 |
| 38HE7 | 5.95 |
| 40KD6 | 5.50 |
| 42 | 6.95 |
| 47 | 6.00 |
| 50A5 | 1.50 |
| 50B5 | 1.95 |
| 50C5 | 0.95 |
| 50CD6G | 1.95 |
| 50EH5 | 1.50 |
| 50JY6 | 2.95 |
| 53KU | 4.50 |
| 75B1 | 3.50 |
| 75C1 | 4.50 |
| 80 | 4.50 |
| 83 | 8.50 |
| 83A1 | 7.50 |
| 85A1 | 6.50 |
| 85A2 | 2.95 |
| 90AV | 17.50 |
| 90C1 | 3.50 |
| 90CG | 17.50 |
| 90CV | 17.50 |
| 91AG | 9.00 |
| 92AG | 19.50 |
| 92AV | 19.50 |
| 95A1 | 6.50 |
| 100E1 | 10.00 |
| 108C1 | 2.50 |
| 150B2 | 6.50 |
| 150C1K | 9.00 |
| 150D2 | 2.50 |
| 150C4 | 2.50 |
| 185BT | 1.50 |
| 211 | 25.00 |
| 230D | 15.00 |
| 231D | 15.00 |
| 250TH | 150.00 |
| 307 | 5.00 |
| 328A | 15.00 |
| 572B | 59.00 |
| 705A | 12.50 |
| 713A | 25.00 |
| 723A/B | 75.00 |
| 724A | 275.00 |
| 725A | 275.00 |
| 726A | 75.00 |
| 801A | 15.00 |
| 802 | 25.00 |
| 803 | 14.95 |
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| 807 | 3.50 |
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| 812A | 35.00 |
| 813 Philips | 35.00 |
| 813 | 27.50 |
| 829B | 14.50 |
| 833A | 95.00 |

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|---|---|
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| 866A | 8.50 |
| 872A | 20.00 |
| 873 | 60.00 |
| 954 | 1.00 |
| 955 | 1.00 |
| 1849 | 315.00 |
| 1927 | 25.00 |
| 2040 | 25.00 |
| 2050A | 5.95 |
| 2050W | 6.50 |
| 4212H | 250.00 |
| 4471 | 35.00 |
| 4687A | 9.50 |
| 5544 | 79.50 |
| 5559 | 55.00 |
| 5636 | 5.50 |
| 5642 | 9.50 |
| 5643 | 9.50 |
| 5651 | 2.50 |
| 5654 | 1.95 |
| 5670 | 3.25 |
| 5672 | 4.50 |
| 5675 | 28.00 |
| 5678 | 7.50 |
| 5687 | 4.50 |
| 5696 | 4.50 |
| 5702 | 3.50 |
| 5704 | 3.50 |
| 5718 | 6.15 |
| 5725 | 2.50 |
| 5726 | 2.50 |
| 5727 | 2.50 |
| 5749 | 2.50 |
| 5750 | 1.85 |
| 5751 | 2.95 |
| 5763 | 6.50 |
| 5814A | 3.25 |
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| 5829WA | 6.50 |
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| 5863 | 95.00 |
| 5879 | 9.50 |
| 5886 | 13.95 |
| 5894 | 39.50 |
| 5899 | 4.50 |
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| 5965 | 2.15 |
| 6057 | 3.75 |
| 6058 | 2.50 |
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| 6132 | 10.50 |
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| 6146B | 9.50 |
| 6146W | 12.50 |
| 6155 | 72.00 |
| 6156 | 72.00 |
| 6157 | 2.50 |
| 6158 | 3.20 |
| 6189 | 4.50 |
| 6201 | 6.45 |
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| 6386 | 14.50 |
| 6442 | 75.00 |
| 6463 | 7.50 |
| 6550 | 8.95 |
| 6550A GE | 13.95 |
| 6870 | 11.50 |
| 6883B | 9.95 |
| 6973 | 7.95 |
| 7025 | 2.50 |
| 7025S | 6.95 |
| 7027A | 8.50 |
| 7119 | 9.00 |
| 7189 | 5.50 |
| 7199 | 7.50 |
| 7247 | 4.95 |
| 7475 | 5.00 |
| 7486 | 155.00 |
| 7527 | 95.00 |
| 7551 | 8.50 |
| 7581A | 11.95 |
| 7586 | 15.00 |
| 7587 | 19.50 |
| 7591A | 8.95 |
| 7815 | 59.50 |
| 7868 | 8.50 |
| 7895 | 17.50 |
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# STRAIGHT & LEVEL

## THE ICOM 725

The Icom 725, which is pictured on this month's front cover, is something new in the realm of amateur radio.

This general-coverage transceiver is a new addition to Icom's comprehensive range of amateur radio equipment.

The rig has a sensitivity of 0.15µV for 10dB S/N and has up to 100W of variable output on SSB. The transceiver uses the latest Direct Digital Synthesiser system (DDS) for maximum performance.

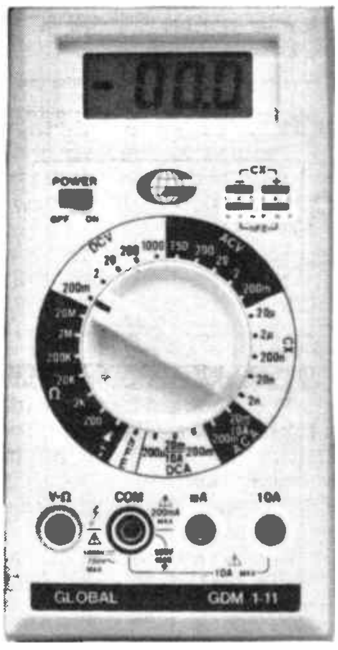
Other features include a triple IF system, multiple memory scan and twenty-six memories for storing mode information.

The Icom 725 is priced at £759.00 and is available from Raycom Communications Systems Ltd, International House, 963 Wolverhampton Road, Oldbury, West Midlands BG9 4RJ. Tel: 021-544 6767.

## HAND-HELD MULTIMETER

Global Specialties have introduced a 3.5 digit hand-held multimeter, the GDM 1.11, which includes capacitance measurement as one of its eight functions.

The multimeter also includes facilities for diode testing and semiconductor $h_{FE}$ measurements. It has a basic dc accuracy of 0.5%.




*The GDM 1-11 multimeter*

The multimeter has a total of twenty-nine ranges, incorporating dc voltage up to 1kV and dc/ac current up to 10 amps, which are selected by a single rotary control. Probes are included, and the multimeter is priced at £49.95. An optional carrying case is also available.

For further information contact Global Specialties, 2nd Floor, 2-10 St John's Street, Bedford MK42 0DH.

## FLEXIBLE SC CONNECTOR

A B Stratos have recently introduced an alternative to the FC/PC connector in the form of the SC connector.

The SC connector features a rectangular mating face to eliminate rotational loss; an axial push-fit locking mechanism, and adapter springs for panel-mounting applications. High density, multiway adapters allow five connections within a 15mm × 35mm face.

The mean insertion loss at a 1,300mm wavelength is 0.06dB, and the connector has a standard deviation of 0.03 with a return loss of 27dB and SD of 0.6.

For further information about this flexible SC connector and other products from AB Stratos Ltd contact Alistair Gooch, AB Stratos Ltd, Haverhill, Suffolk. Tel: (0440) 706441.

## NEW IC DRIVER

Celdis have designed a new IC to drive a variety of switched-mode power supply circuits for televisions and data graphic monitors, etc.

The TDA8380 will, for example, drive forward or flyback converters in continuous or discontinuous current mode. Power control and regulation is achieved via pulse-width modulation at a fixed frequency to give the power required.

The IC is supplied with a standard 16 pin DIL and features an internally-stabilised voltage, while reference currents are externally programmed. It offers both high and low IC supply-voltage protection, and its internal error amplifier is frequency compensated externally. In addition, access is provided to PWM to provide an alternative external error amplifier.

Other features include: a synchronisable operating frequency of 10 to 100kHz; low starting current initialisation for mains operation; direct initialisation for battery source; slow or soft-start options; a fail-safe control loop; overload voltage fold-back; and a remote on/off switching capability.

For further information contact Celdis, 37 Loverock Road, Reading, Berkshire RG3 1ED. Tel: (0734) 585171.

## LOWPASS AND BANDPASS FILTERS

Cirkit have recently introduced a new range of lowpass and bandpass filters for radiophones, amateur radio equipment and data communications. MCA and related communicators have been added to the range of Toko products, available through Cirkit Distribution Ltd.

The THB127B and THB128A are hybrid ICs, consisting of a lowpass filter with cut-off at 20kHz and an operational amplifier.

Both filters measure 15.5mm × 6mm × 10mm and the modules have an operating temperature range of −30°C to +70°C and a storage temperature range of −40°C to +85°C. The Attenuation ratings are 3dB at 3kHz and 36dB at 5.9kHz, with a current consumption of 1.4mA. The THB128A's attenuation is rated at 3dB at 22kHz and 36dB at 60kHz; its current consumption is 3.0mA. The greatest distortion from each filter is only 0.5% at 1kHz.

The filters come into their own wherever a single power supply and low current consumption are the prime requirements. For example, hand-held radio, radiophone, data communications or MCA

# All the latest news, views, comment and developments on the amateur radio scene

equipment. Each filter is a hybrid-integrated circuit consisting of a 300Hz to 3kHz bandpass filter and an operation amplifier; originally developed for cellular telephone systems.

Both units have an operating temperature range of −30°C to +70°C and may be stored at temperatures from −40°C to +85°C. The THB111A has an attenuation rating of 30dB at 100Hz and 7.9Hz, and has a maximum current consumption of 2.2mA; while the THB112A exhibits attenuation of 18dB at 100Hz and 24dB at 6.8kHz. The modules create a distortion factor of only 0.2% at 1kHz.

For further information and prices contact Cirkit Distribution Ltd, Park Lane, Broxbourne, Hertfordshire EN10 7NQ. Tel: (0992) 444111.

## EMI/RFI FILTERS

STC Mercator have introduced the new Murata Erie (type 1214) feed-through range of EMI/RFI filters. The devices have an effective temperature/voltage performance, which is achieved by using sophisticated potting techniques. High temperature solder prevents solder reflow during installation, whilst a silver-plated eyelet ensures perpendicular mounting.

Other features include: a low dielectric ceramic to increase attenuation performance; a solder-free bushing, and a minimum insertion loss at 25°C (MIL-STD-220) of 5dB at 10MHz, 50dB at 100MHz, 60dB at 1GHz and 60dB at 10GHz.

For further details contact Ted Phillips at STC Mercator. Tel: (0493) 844911.

## YOUNG RADIO AMATEUR OF 1989

The Department of Trade and Industry have announced its sponsorship of the Young Amateur of the Year Award, for outstanding achievement by a young amateur radio enthusiast in 1989.

To qualify, the applicants must satisfy the following conditions.

**1** The applicant must be under eighteen before 31 July 1989.

**2** Keen on DIY radio construction.

**3** Interested in using radio and gaining operating skills.

**4** Use radio for a community service, such as helping the disabled or in emergency communication networks.

**5** Encourage interest in amateur radio.

**6** Must be involved in amateur radio, such as in a school scientific project.

**7** Eligible for the 1989 award and its £250.00 cash prize.

The prize, for the most outstanding achievement between 1 April 1988 and 31 July 1989, will be awarded by the DTI and presented at the RSGB's HF convention in October.

The DTI will provide every genuine entrant with a copy of its coloured chart of radio frequency allocations in the UK. The winner will also visit the DTI's Radio Monitoring Station, at Baldock, Hertfordshire.

The 1988 award went to fifteen-year-old Andrew Keeble, from Norwich, for his enthusiasm in encouraging others' interests in radio, his radio construction skills and voluntary activities.

The closing date for all applications is 31 July 1989. Entrants do not need to be a radio licence holder to enter. The competition is open to anyone in the UK, the Channel Islands, or the Isle of Man.

Applications or nominations for the award must be sent to the secretary, RSGB, Lambda House, Cranborne Road, Potters Bar, Hertfordshire EN6 3JE. Tel: (0707) 59015.

## THE G-MEX EXHIBITION RALLY

Approximately 3,000 radio and electronics enthusiasts attended the first amateur radio and electronics rally to be held at a city centre railway station. The rally, organised by the Trafford Amateur Radio Club, was held at the G-MEX Exhibition Centre, Manchester.

For further details about the Trafford Amateur Radio Club, contact Eric Graham G0CTM, 64 Stretford Road, Urmston, Manchester M31 1LD. Tel: 061-748 0251.

## MORSE TEST FEE INCREASED

The fee for amateur radio Morse tests was increased from £7.00 to £10.00 on 1 April 1989.

For further information contact the DTI. Tel: 01-215 4751/6.

## RALLIES

The Southend and District Radio Society Rally and Boot Sale will be held at the Roachway Youth Centre, Roachway, Rochford, Essex, on Sunday 7 May.

For further details contact Ted G4TUO. Tel: (0702) 202129.

The Plymouth Radio Club Mobile Rally takes place on 28 May at Plymstock School, Church Road, Plymstock, Plymouth, starting at 10.00am.

There is free parking, and there will be refreshments available. Other attractions will include a raffle, trade stands, demonstrations and a talk-in on S22.

For further information contact Joe G1RXR. Tel: (0752) 509855.

## CLUB NEWS

The Huntingdonshire Amateur Radio Society meets on the first and third Thursday of every month at the Medway Centre, Coneygeare Road, Huntingdon, Cambridgeshire at 7.30pm.

The Society arranges lectures, 'natter nights', Special Event Stations and even the occasional social event. Members and non-members are welcome.

There is a club net on 2m on Sunday evenings from 8.00pm on 145.525, .550 or .575. In addition, packet messages which are sent c/o GB7HXA will reach the club's chairman or secretary.

Forthcoming events will include a junk sale and auction at the Medway Centre on August Bank Holiday from 10.30am to 5.00pm. There will be a talk-in on S22, and 'OV' (RB5) on the day.

The club will also be participating in JOTA this year, following the successful weekend spent last year supporting the Godmanchester Scout Pack.

For further details contact the secretary. Tel: (0480) 56772.

The recently formed Kirkby Amateur Radio Club is currently organising various activities, including Morse code tuition, electronic construction, talks on computers and 'on air' nights.

The club meets every Wednesday evening from 7.30pm to 11.00pm, at the Kirkby Sports Centre, 17 Valley Road, Westvale, Kirkby, Liverpool.

# A COMPACT 13.8V 20AMP POWER SUPPLY

## by Steven Goodier G4KUB and John Goodier G4KUC

In the September 1987 issue of ***Amateur Radio***, we described the construction of a 13.8V power supply unit which was capable of supplying some 25 to 35 amps continuously. We have always been interested in the design and construction of such units, and over the years we have built and tried many different designs with varying degrees of success. We collected the best of the designs and ideas and added quite a few of our own, and ended up with what we consider to be a versatile and reliable power supply control board. Of course, some high current power supplies tend to be on the large size, and we would like to think that our design was one of the smaller ones published, with a case size of 350mm × 230mm × 160mm.

The main reason for such a large size was due to the heatsinks, smoothing capacitors and the transformer, but it must be said that the transformer was not oversized, considering it could supply 16V at 42 amps. We have, for some time, wanted to see if it was possible to produce a compact version of the supply, yet still keep it simple enough for most people to construct at home on the kitchen table using simple tools. Of course, the minimum requirements for such a supply were that it should be capable of supplying a fair amount of current and should be capable of easily powering the new generation of 45W VHF rigs which are now beginning to appear. With these considerations in mind we spent over four months designing and building the power supply unit described in this article.

### Design considerations

Let's start by looking at the type of specifications we want our PSU to have. First, it should be capable of producing about 15 amps output at 13.8V. A number of safety features should be built in as standard and these should include under- and over-voltage protection, short circuit proof and a current limit. We didn't want any external metalwork showing, so a single heavy-duty heatsink is mounted inside the box and cooled by an 80mm or 120mm fan. A heat sensor connected to the heatsink automatically turns on and off a cooling fan when the power supply starts to run hot. Most of the components should be mounted in a single printed circuit board including the smoothing capacitors, soft start and relay protection; this then makes the construction of both the main control board and the rest of the supply very simple indeed.

The mains transformer is an important consideration, but it tends to be quite large at this power rating, making a small compact power supply difficult to build. To overcome this problem we used a toroidal mains transformer which is rated at 16.5 amps RMS maximum with an 18V secondary. Toroidal transformers have the advantage of being much smaller in both size and weight, but at the same time they offer a high efficiency output. Because we are only using one heatsink the number of pass transistors used to supply the required output had to be limited to only two. This can be a disadvantage because of the amount of voltage each transistor will have to drop, this is offset by using high current, high temperature semiconductors bolted to a large heatsink and cooled by a fan when necessary.

### Circuit description

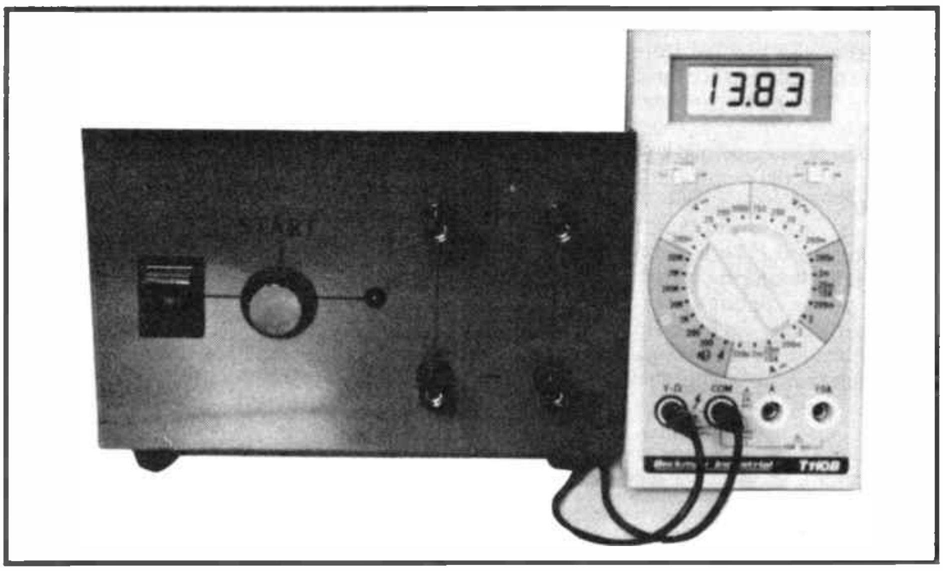
**Fig 1** shows the block diagram of the complete power supply unit, and **Figs 2** and **3** show the complete circuit diagram. Mains voltage enters the supply via a double pole 'on/off' switch which also carries LP1 – the neon indicator. The neutral side is taken straight to one side of the mains transformer T1. The live side is then taken via a 5 amp fuse to SW2 and one side of RL1. Looking carefully at the circuit diagram shows that there is an open circuit between the mains input and T1. To start the supply SW2 must be pressed, this allows mains voltage to flow to the transformer via R17 which limits the inrush of current at switch on. The inrush of current occurs because the smoothing capacitors are empty of charge. R17 allows charging to take place slowly, thus protecting the transformer T1 and the bridge rectifier BR1. Once the supply has reached its normal operating voltage RL1 will energise, thereby keeping the mains voltage supplied to the transformer permanently. SW2 can then be released. All this happens very quickly and is known as 'soft start'. RL1 forms an important part of the power supply's protection circuit which will be described later.

The mains transformer has two 18V windings and each supplies a maximum current of 8.33 amps RMS, these two windings must be wired in parallel to form a single 18V, 16.5 amp winding. The output of T1 is fed into the bridge rectifier BR1; this device is rated at 25 amps and is bolted to the chassis to keep it cool. After rectification we should have a voltage of about 25V dc which requires considerable smoothing before we can make use of it. C1 and C2 form the smoothing capacitors and are made up from 4 × 10,000$\mu$F, giving a total smoothing capacitance of 40,000$\mu$F. This should be ample for a 15 amp supply, working on the rule of 2000$\mu$F per amp. After smoothing you should now have an unregulated supply of 25V ready for regulating down to the required 13.8V output.

### Voltage regulation

Regulation is provided by an LM723 voltage regulator IC. This IC is mounted in a 14 pin package, and very few external components are needed to produce a stable, regulated output. The output voltage is set by the resistor combination R3, R4 and VR2. R3 is connected to the output to sense any voltage drop when supplying high currents; if any voltage drop does occur, then the 723 will slightly increase the output voltage to maintain regulation. If wished, R3 may be extended and used as a remote sensor, this can be connected directly to the supplied equipment and can be used to sense any voltage drop in the equipment. VR2 is used to set the output voltage, and the swing should be in the region of 12 to 15V. Since the 723 can only supply about

*Front panel view of the power supply and voltmeter*



150mA, a predriver transistor TR1 is needed to ensure that there is enough current gain to drive the pass transistors. The transistor chosen is a TIP3055 which is mounted on the main PCB and will need a small heatsink.

TR2 and TR3 are the pass transistors and handle all the current provided by the power supply unit. Since only two transistors are used in this design, they must be chosen carefully to ensure they work over long periods at high currents. The types used are two 2N3771s which can handle 30 amps each at a rated maximum junction temperature of 200°C and have a maximum device power dissipation of 150W. These transistors are ideal and are bolted to a single heatsink. To ensure power sharing, the emitters of each transistor are wired together via the 0.1 ohm, 3W resistors R15 and R16. These resistors are made up from two 0.22 ohms, 3W wire-wound resistors wired in parallel. The positive output of the power supply is taken directly from the resistors R15 and R16.

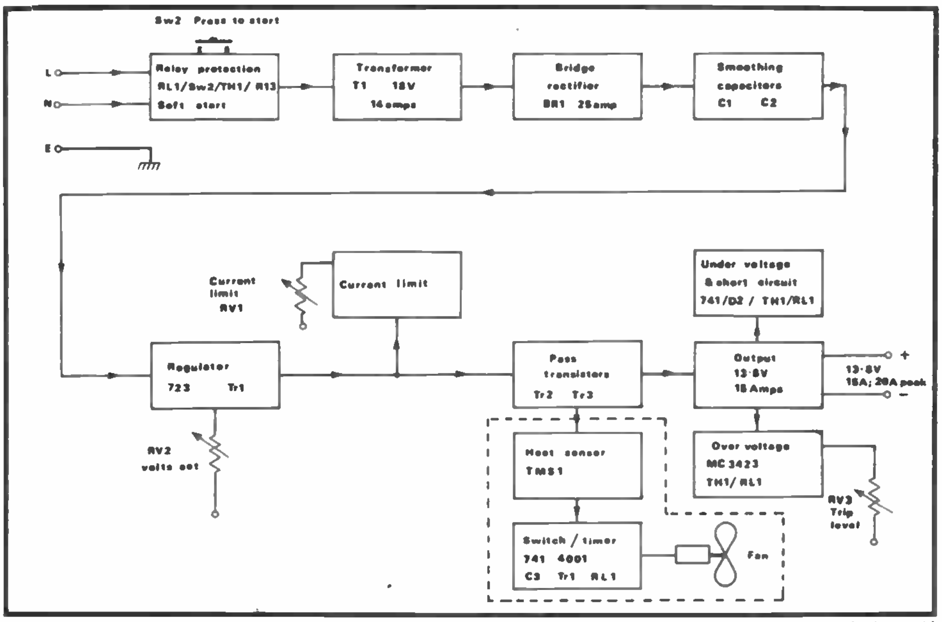



***Fig 1:*** *Block diagram of the power supply. The dotted area indicates the temperature switch and is not part of the main PCB*

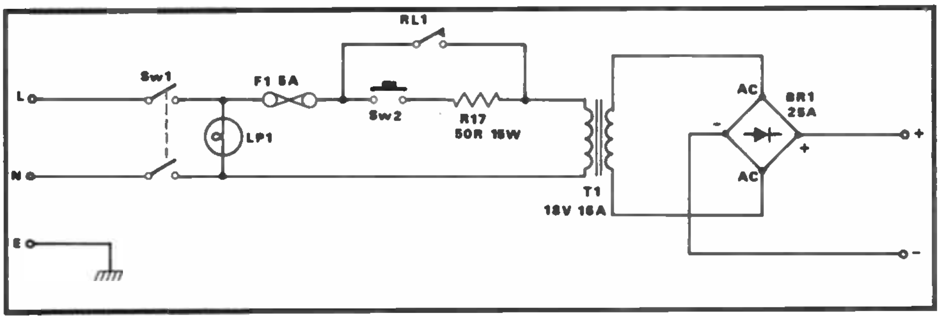



***Fig 2:*** *Circuit diagram of the first half of the power supply. T1 is rated at 13V 16.5 amps RMS and RL1 forms part of the protection circuits*

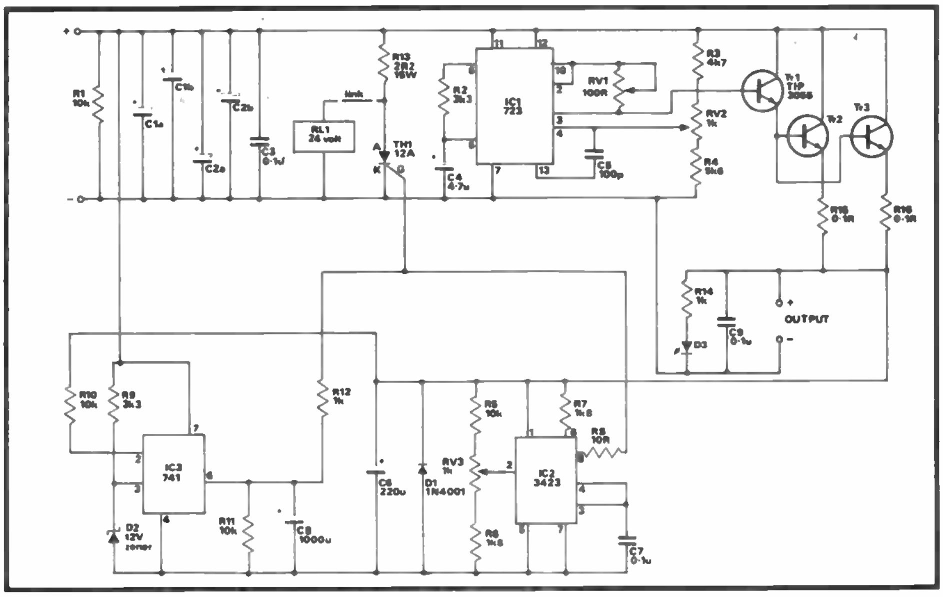



***Fig 3:*** *Circuit diagram of the main control board. Most of the components are mounted on a single PCB*

## Protection circuits

Any power supply that provides power to an expensive piece of equipment should have a certain amount of protection built in, and this design is no exception. In our opinion, the best way to protect equipment in the event of a fault occurring is to shut the supply down and remove the mains; this power supply design incorporates such a system. The first of the protection circuits is an over-voltage sensor which is based around the MC3423 over-voltage crowbar protector. If you consider what happens when a short circuit develops between the emitter and collector of any of the pass transistors, then you will understand why such a circuit is necessary. If this fault does develop, then all of the unregulated supply (in our case this would be about 25V) will appear on the output terminals.

Voltage is fed back from the output to pin 2 of IC2 via the resistor network R5, R6 and VR3. VR3 is used to set the trip level which is usually 15V for a 13.8V power supply. Once the preset level has been reached pin 8 goes high, this in turn fires the thyristor TH1. If you look at the circuit diagram you will notice that TH1 is wired in series with R13 and that both are wired directly across the unregulated supply line. When a fault occurs TH1 grounds the relay coil of RL1, thus opening the relay contacts and disconnecting the mains supply. The smoothing capacitors are then rapidly discharged through R13 and TH1. This results in the power supply being closed down and the mains being disconnected. False tripping can occur, so to help prevent this happening the MC3423 has a programmable feature. C7 determines the minimum duration of the over-voltage condition which will trip the over-voltage protector. If C7 has a value of 0.1µF, the delay will be about 1mS; a value of 0.01µF will give a delay of about 0.1mS.

Under-voltage is also fitted to the supply which will trip the unit if the output voltage falls below 12V. The under-voltage sensor is based around a 741 op-amp which is a reference voltage generated by R9 and D2 and applied to pin 3. The output voltage is sampled by R10 and is applied to pin 2. If this value falls below the reference value set by D2, then pin 6 goes high and fires the thyristor TH1. If a short circuit occurs on the output of the supply, then the regulated output will drop well below 12V. This will trigger the under-voltage detector, closing the supply down. Hence, this simple circuit acts as both an under-voltage detector and gives short circuit protection. C8 is included across the output of the 741 to hold it low when the supply is switched on. This is needed to stop the detector tripping before the supply reaches 13.8V at switch on.

### Temperature switch

As there is only a single heatsink it is inevitable that the power supply will become hot due to the heat generated by the pass transistors. To help with cooling it a temperature-controlled switch is included in the design which will automatically switch a fan on when the heatsinks become hot and switch it off again when the heatsinks cool down.

The switch is based around a 741 op-amp and **Fig 4** shows the circuit diagram. TMS1 is a rod thermistor and is wired in series with VR1, which is used to adjust the sensitivity of the circuit. The output of the 741 passes through a potential divider and drives TR1 which operates RL1 to drive the fan. In the prototype circuit, as the heatsinks gradually cooled then warmed again, the fan was continually switching on and off for very short periods. To overcome this problem, the circuitry based around IC2 was added.

IC2 forms a simple latching circuit which is based around a 4001B quad 2 input NOR gate. The circuit is wired to start a timer (its duration is determined by the value of C3), and the timing period starts as soon as pin 2 of IC2 goes momentarily high. This is achieved by sampling the op-amp output at pin 6 via R5. Because IC2 is wired as a latch the output at pin 4 will remain high, regardless of the state of pin 6 at IC1. This ensures that once the fan is switched on it will run for a fixed amount of time, even though the heatsinks may have cooled below the thermistor's switch on temperature. Adding IC2 eliminates the continual on/off switching that happens as the heatsinks warm and cool.

As already stated, the fan remains on for a duration determined by C3. We used a 220μF which gave a running time of approximately one minute, thirty seconds. This time can be varied by changing the value of C3, eg, 100μF gave thirty-five seconds and 47μF gave fifteen seconds.

### Construction

Construction is fairly straightforward and can be split into a number of different stages. Mounting the smoothing capacitors and soft start on to the main PCB has considerably reduced the amount of inter-wiring, so most of the construction is down to the hardware and the two remaining PCBs.

The first things to build are the two PCBs and as each is completed, it can be tested. This will leave you with the wiring of the transformer and the metal-work needed for the case to finish the power supply.

### The main control board

A major part of construction is the

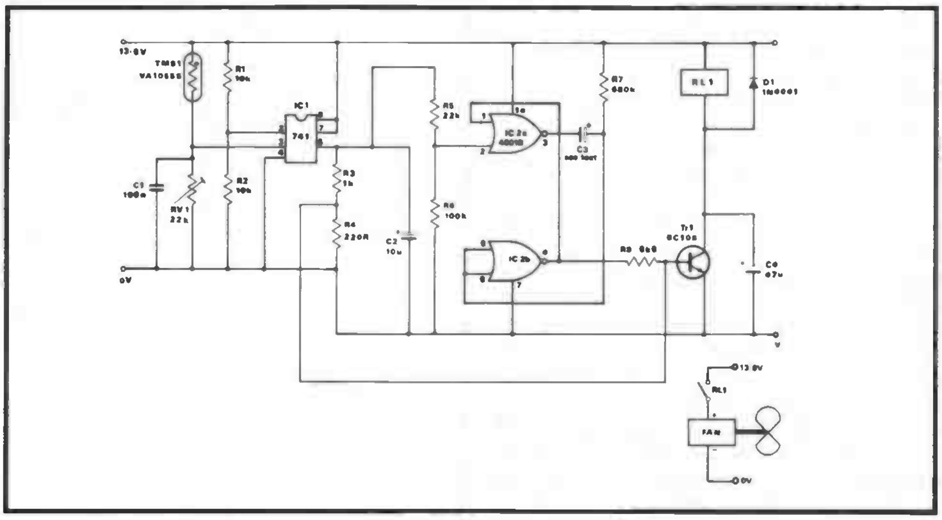


**Fig 4:** *Circuit diagram of the temperature switch. TMS1 is on a remote board mounted on the heatsink of the PSU*

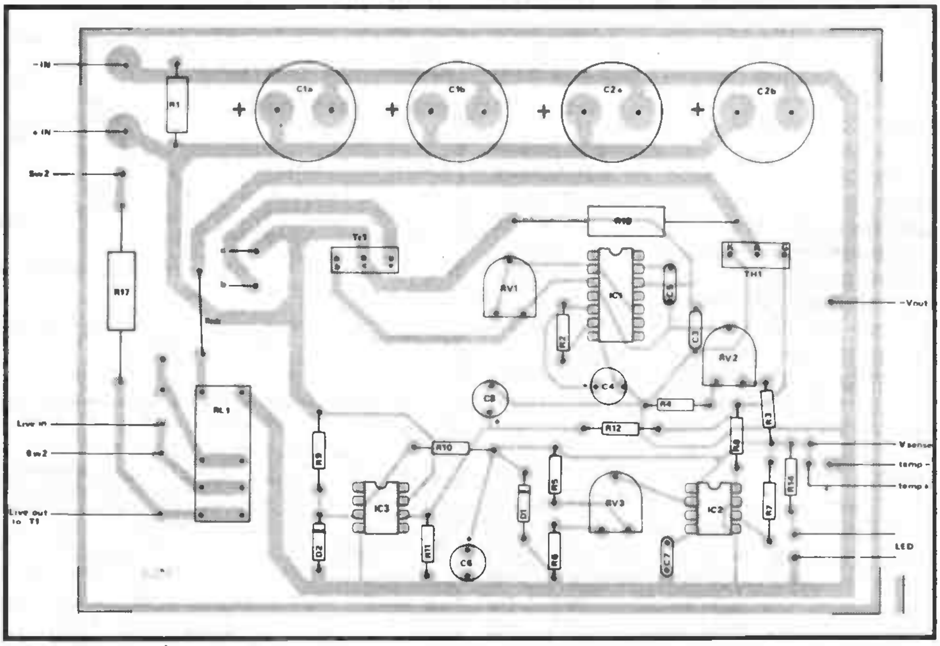


**Fig 5:** *Component overlay of the main PCB. R13 and R17 are mounted off the board using 16swg tinned copper wire*

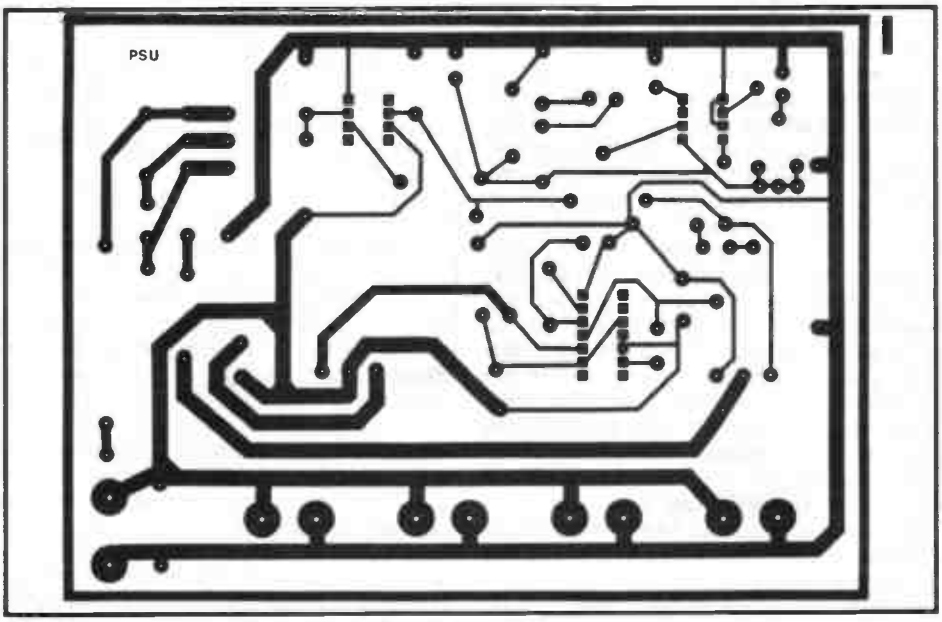



**Fig 6:** *The foil pattern of the main PCB*

control board which carries most of the components for the power supply unit. **Fig 5** shows the component side, and **Fig 6** shows the foil pattern. The first job is to make the PCB. To do this you will need the usual PCB pen and acid, etc. After the board has been etched and drilled, start soldering into position all of the resistors including the three preset resistors, but leave R13 and R17 for the moment. Next, solder in the capacitors (except C1 and C2), followed by the diodes and IC holders; take care to mount the diodes and the electrolytic capacitors the correct way round.

R13 and R17 are aluminium-clad resistors and are mounted off the board using 16swg tinned copper wire. Start by mounting R13, this is quite close to IC1 so it needs to stand off the board by about 15mm. R17 can now be soldered into place. This carries 240V ac, so insulate the copper legs and the solder joint. The best way to insulate the legs is to slide insulated sleeving over them before soldering.

Next mount TH1 and TR1. TR1 is attached to a small heatsink and is best mounted with the heatsink already attached. Make sure to mount both of these components the correct way round; as a guide their metal backs face the smoothing capacitors.

Finally, mount the relay RL1 and the four smoothing capacitors. You may have to enlarge the mounting holes to take RL1, and again be careful to solder the electrolytic capacitors the right way round. That completes the construction of the main PCB.

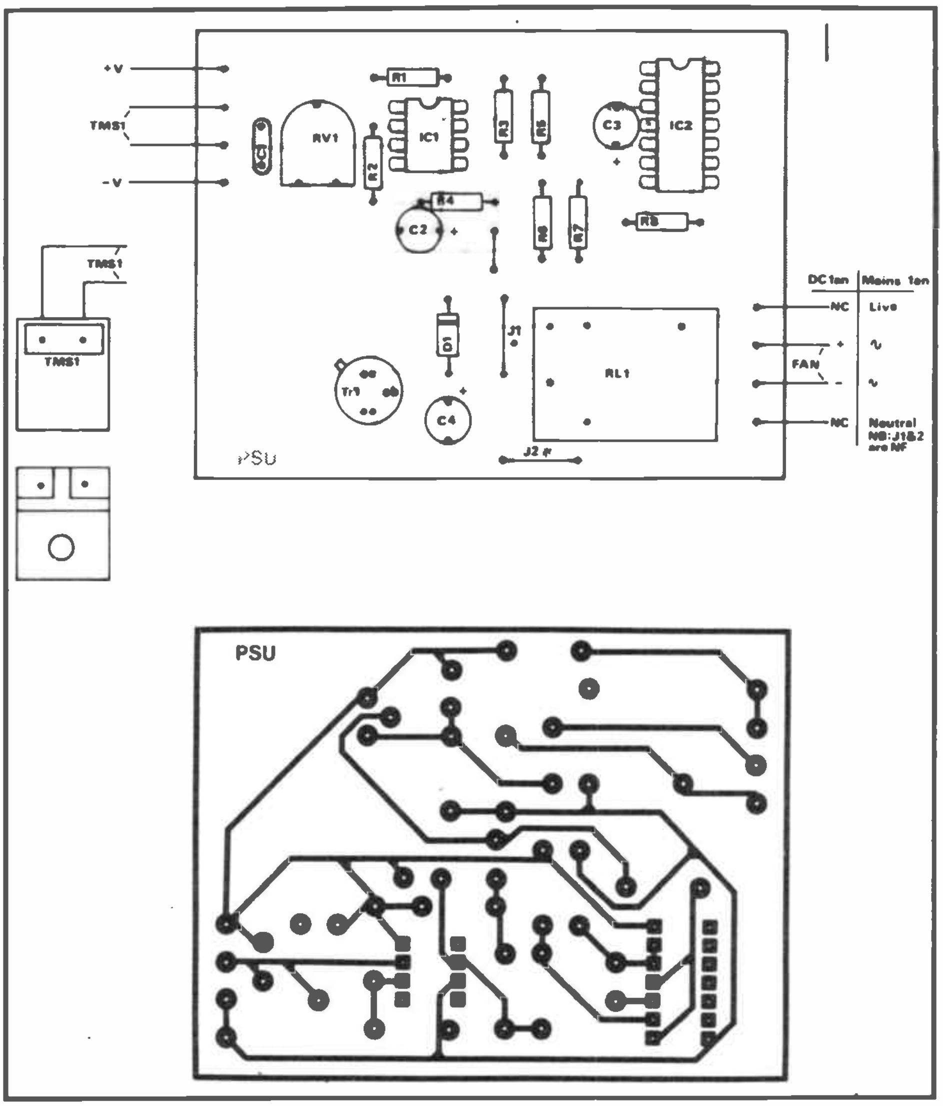



*Fig 7:* **(top)** *component overlay of the temperature switch.* *Fig 8: Temperature switch PCB foil pattern*

### Testing

To test the control board before mounting it in the box, you will have to supply the board with about 21 to 25V dc. Because we are going to simulate fault conditions, the supply used must be short circuit proof. We used a simple 0 to 25V PSU based around an LM317K voltage regulator to do this job.

First, set the preset resistors to the following positions: VR1 centre, VR2 centre and VR3 fully anticlockwise. Solder a piece of wire between the sense output and the emitter of TR1, now connect your external supply to the dc volts input near to R1. Turn your supply voltage on and adjust its output for about 21V. As soon as your external supply is switched on the onboard relay should 'pull-in' and the output voltage at the emitter of TR1 should be 13 to 14V. Turning VR2 should produce a voltage swing of between 12 and 14.6V.

To test the under-voltage stage, monitor the output voltage and adjust VR2; when the output voltage reaches 12V the relay should drop out. It is advisable to turn off your external power supply as soon as RL1 drops out. This is because your supply will almost be shorted to earth via R13 and TH1 and if it is left in this condition, damage could result to both your power supply and the control board. After finishing this test, reset VR2 to its centre position and switch the supply back on. If, for any reason, the swing on VR2 does not drop below 12V, then the under-voltage stage can be tested by monitoring the output on a voltmeter, then switching off your external power source. After a few seconds the smoothing capacitors will start to discharge and the output voltage will begin to fall. As soon as it reaches 12V the under-voltage protection circuit will operate and there will be a very rapid fall in voltage.

### Testing the over-voltage

To test the over-voltage stage, adjust the output voltage to 14.5V and slowly adjust VR3 until the over-voltage stage triggers and the relay drops out. Switch off your supply and readjust VR2 to its centre position. Switch back on and monitor the output voltage. Start to increase the output via VR2, and when it reaches about 14.5V the relay should drop out. Be ready to turn your power supply off, since its output will almost be shorted to earth each time the relay drops out. If your control board has passed these tests it is almost certainly working correctly. Finally, readjust VR2 so that it reads 13.8V and remove the link between the sense and TR1 emitter.

### Temperature switch construction

**Figs 7** and **8** show the PCB component overlay and pattern of the switch which is built on a small PCB, measuring 85mm × 60mm. The sensor board is approximately 20mm × 25mm and is mounted on the heatsink by using a 6BA nut and bolt. You should encounter no problems building this board, but ensure that the electrolytic capacitors D1 and TR1 are mounted the correct way round, and remember to use IC holders for both integrated circuits. In the prototype we used a 240V fan, but it is much better to use a 12V dc operated fan for safety reasons – it also makes wiring up a lot easier. When using a 12V fan you must include the two wire links which are placed on either side of the relay (both links are marked with a '*' on the PCB overlay). If you decide to use a mains driven fan, then under *no* circumstances must you include these links. The extra wiring for a mains driven fan is shown in **Fig 7**; the live and neutral wires can be tapped off the terminal block on the back panel which supplies the transformer with mains.

Once your switch is wired up and running, you may find that the power supply's over-voltage protection has tripped owing to interference from the relay/fan motor starting. To overcome this problem, we wired a 0.1$\mu$F interference suppression capacitor across the live and neutral wires (mains driven fan only) and a contact suppressor across the relay contacts. Both of these components are soldered underneath the temperature board.

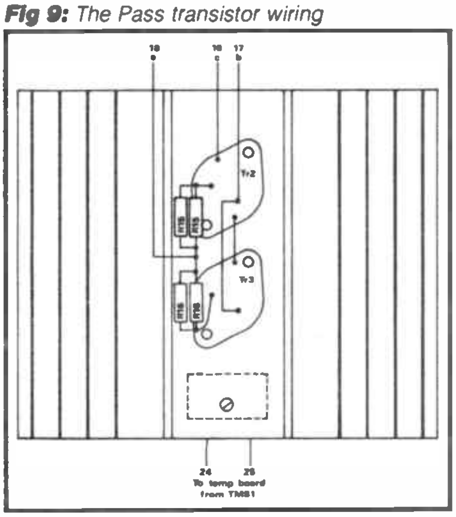
When you are satisfied with your work you can test the switch. Wire the circuit (see **Fig 7**) and apply about 13.8V. By adjusting VR1 you should be able to get the relay to switch on at a variety of temperatures and to test this, apply a hot hairdryer to the thermistor. As the sensor heats up and then cools down the fan should switch on and off, depending on the position of VR1. You must remember that once the fan has switched on, it will remain on for a period depending on the value of C3.

### Pass transistors

Two 2N3771 transistors are used to handle the current output and are mounted on a large heatsink, which is fixed into position beneath the main control board. Start by marking the position of each transistor on the heatsink as shown in **Fig 9**; you can use the mounting kit insulator as a template. Also mark and drill the position of the thermostat sensor, this is best located to one end of the heatsink away from the fan. Both transistors must be mounted using TO3 insulating kits. Use plenty of heatsink compound between the transistors and the heatsink. When you have mounted the transistors, use an ohms meter to check that there are no short circuits between the case of each transistor and the heatsink.

The next job is to solder into place the current-sharing resistors R15 and R16. Each resistor is made up from two 0.22 ohm 3W wire-wound resistors wired in parallel. When these have been made, solder them to the emitters of both transistors (as shown in **Fig 9**), now wire the base and collectors together. Solder the out-going wires as shown, both the emitter and collector wires must be made of high current 20 amp cable. Do not forget to colour code the wiring, because you will need to know where the individual wires lead to. Finally, fit the heat sensor board holding the thermistor into position.

***Fig 9:*** *The Pass transistor wiring*



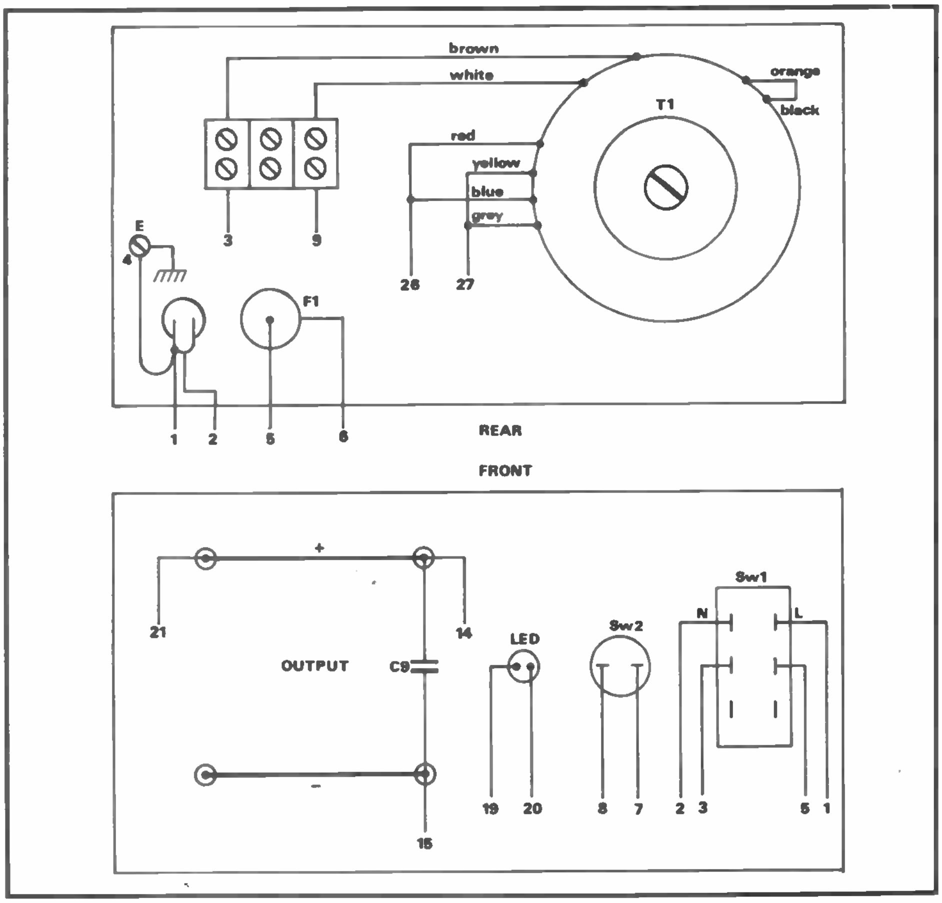




***Fig 10:*** *Front and back view of the case. The wiring has been numbered and can be checked with Table 1 below*

| Wire number | DESCRIPTION |
|---|---|
| 1 | Mains input to on/off switch SW1 (live) |
| 2 | Mains input to on/off switch SW1 (neutral) |
| 3 | Neutral from SW1 to terminal block on back panel |
| 4 | Mains earth bolted to back panel |
| 5 | Live from SW1 to fuse holder on back panel |
| 6 | From fuse holder to main PCB |
| 7 | From main PCB to push-switch SW2 |
| 8 | From push-switch SW2 to main PCB |
| 9 | From main PCB to terminal block on back panel |
| 10 | + volts from bridge rectifier BR1 to PCB. Use 20 amp cable |
| 11 | − volts from bridge rectifier BR1 to PCB. Use 20 amp cable |
| 12 | From main PCB to 30 amp terminal block. Use 20 amp cable |
| 13 | From main PCB to 30 amp terminal block |
| 14 | To positive output terminal. Use 20 amp cable |
| 15 | To negative output terminal. Use 20 amp cable |
| 16 | From pass transistors TR2/3 collectors. Use 20 amp cable |
| 17 | From pass transistors TR2/3 base |
| 18 | From pass transistors TR2/3 emitters. Use 20 amp cable |
| 19 | To front panel 'ON' LED positive |
| 20 | To front panel 'ON' LED negative |
| 21 | Volts sense to positive output terminal |
| 22 | Positive supply to temperature switch |
| 23 | Negative supply to temperature switch |
| 24 | To heat sensor mounted on heatsink |
| 25 | To heat sensor mounted on heatsink |
| 26 | To secondary of mains transformer T1 (18V ac) |
| 27 | To secondary of mains transformer T1 (18V ac) |

### Metal-work

The heatsink, fan and the rest of the

circuitry are mounted in an aluminium case, measuring 280mm × 204mm × 127mm. **Fig 10** shows the front and back view of the box. The transformer is mounted on the back panel, but because of its weight you should ensure that it sits on the base of the case. Also on the back panel are a 5 amp terminal block, a 20mm panel-mounted fuse holder and the mains input. Now turning to the front panel, mark and cut out the holes for the following components: SW1, SW2, LED and the output terminals. It is possible to mount the output terminals on the back panel, but you may have to alter the wiring.

The base holds most of the major components for the power supply, and the layout for this is shown in **Fig 11**. The heatsink is mounted off the base by using 20mm insulated spacers. The PCB is also mounted off the heatsink using the same type of spacers, because this allows cool air to flow over the heatsink. The spacers are held in place between the grooves of the heatsink by a large washer above and below the grooves. Once the PCB is mounted on to the heatsink, the total height from the base to the top should be about 120mm. The fan has four mounting holes but we are only going to use two of them. I used two 'L' shaped aluminium brackets and attached them to the bottom corners of the fan, which can then be bolted securely into place. Once the fan and heatsink are fixed into place there is very little room on either side of the box, so take care to mount these components accurately.

The rectifier is mounted towards one corner and fixed into position with a single bolt, then you should apply some thermal grease between the rectifier and the base before finally bolting this component into place. There is now only a 30 amp terminal block and the temperature-controlled switch that remain to be mounted close to the front panel. There is no easy way to describe metal-work construction, so it is best to take your time and check all your measurements before you begin drilling any holes. Once all the holes have been cut and drilled, the box can be painted and labelled.

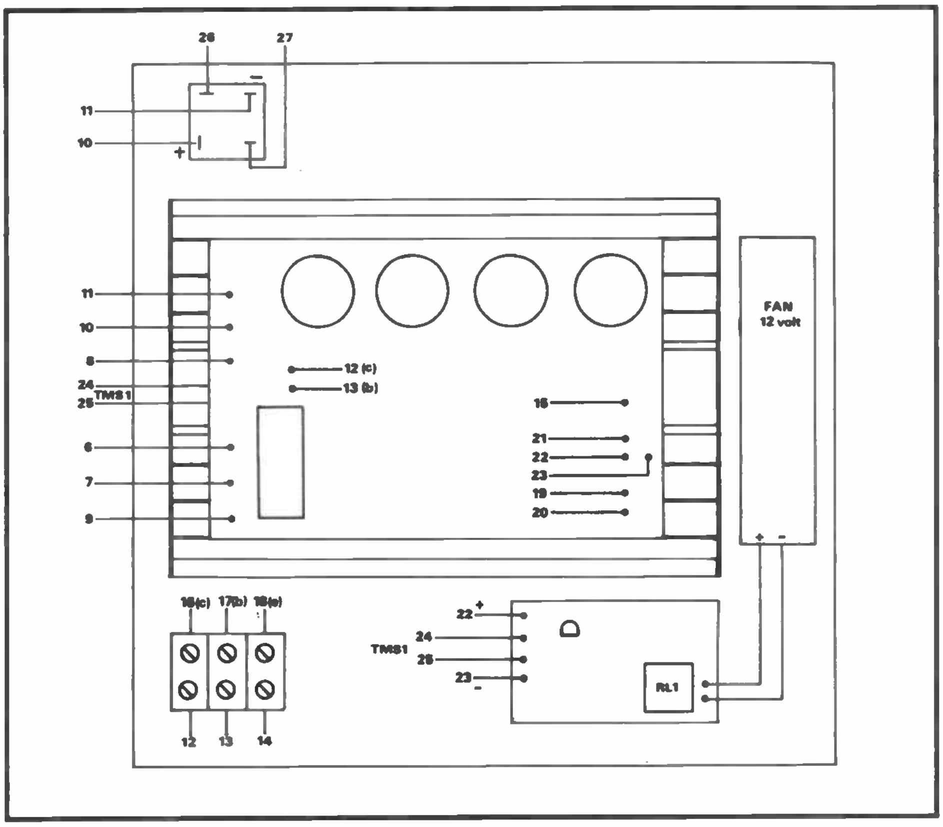



**Fig 11:** *The base of the box. The main PCB is fitted over the heatsink to save space*

### Final wiring

Start the final wiring by placing all the wires on to the main control board. Once this is done, put some insulating material under the board around RL1, R17 and its associated inputs and output wiring. This will prevent any accidental electric shocks from the mains voltage on this part of the board. The board can now be bolted on to the heatsink and the whole lot can then be fixed into the case.

If you study **Figs 10** and **11** you will see that we have numbered all the wiring, and this can be double-checked by referring to Table 1. As well as providing wiring information, Table 1 shows the type of wire to use and other relevant details. Using both diagrams and the information from Table 1, you should have no problems with the wiring of the supply, however it is a good idea to double-check all wiring before switching on the supply.

The mains transformer has two tappings which must be wired together to provide a single 18V output. To do this, wire the yellow, grey, red and blue wires together (follow the manufacturer's recommended guidelines). You must also wire the primary up to give a 240V mains input, which is done by wiring together the orange and black wires.

We wired the secondaries into 'push on' connectors which enabled both wires to be pushed directly on to the bridge rectifier. We then checked that the supply was working before fitting the temperature switch. This is a very simple matter as there are very few connections to it. Once you have double-checked your wiring, you can then test the power supply unit.

### Testing and setting up

If you have already tested your control board then the only thing to set up is the current limit and temperature switch, but it is advisable to run through the setting up procedure again. First, switch on the power supply with SW1; if you have used a switch with a built-in neon then this should light. Pressing SW2 should start the supply, causing the relay to pull in and the front panel LED to light. Placing a voltmeter across the output should produce a reading close to 13.8V, assuming you have already set up this voltage when testing the board.

If you have not already tested the control board, then set VR1 centre, VR2 centre and VR3 fully anticlockwise and connect a voltmeter to the output. Switch the supply on and press SW2. If the supply refuses to start, for example the relay pulls in and suddenly drops out, then this could be because the output voltage is below 12V and the under-voltage circuit is closing the supply down. If this happens, turn VR2 up slightly and restart the supply using SW2. When all is well the output voltage should read between 12.5 and 14V; adjust VR2 until the output reads 13.8V. We will now test each stage in turn.

### Under-voltage

The under-voltage protection can be tested by turning the supply off and monitoring the output. When it reaches 12V the relay should trip and the voltage should quickly drop to zero. Alternatively, the output may be adjusted slowly down to 12V using VR2; the power supply should trip at this voltage. When satisfied, readjust VR2 to its previous position and restart the supply with SW2.

### Over-voltage

To test the over-voltage protection you will first need to adjust the output to 14.5V, or to the level you wish the supply to trip at. Adjust VR3 until the supply trips and is switched off. Readjust VR2 to its normal position and restart the supply. Again, start to increase the output voltage, and at about 14.5V the supply should trip. Now readjust the output back to 13.8V.

It is now possible to test the power supply with a load by using a resistor, rather than connecting an expensive piece of equipment across the output. Any high wattage/low value resistor will do, although we suggest you use two different values to test the supply. The first is a 50W 1R resistor (Verospeed, stock No 90-36656B) and will draw about 14 amps. The other is a 50W 0.68R resistor (Verospeed, stock No 90-36654K) and will draw approximately 20 amps. It is important to cool the resistor while it is connected to the supply, by submerging it in a bowl of cold water for example.

Start by turning VR1 (current limit) fully clockwise. While monitoring the output with a voltmeter connect the 1R resistor across the output; you will probably find there is a slight voltage drop when the resistor is connected. Leave the load on for about thirty seconds to check all is working well. You must not leave the load connected for too long because the temperature switch is not yet set up and the heatsink will start running hot; if wished, the temperature board can be adjusted to allow the fan to run continuously while this test is being carried out. This is done by adjusting VR1 on the temperature board until the fan switches on. If all seems well, it should be possible to set the current limit.

### Current limit

It is difficult to set this control without the use of a current meter capable of measuring about 20 amps. We found the following method suitable and encountered no problems once it was set. We tested this supply up to 20 amps and it continuously provided this current for over five minutes.

To set the current limit to 20 amps, connect a voltmeter and the 0.68R load across the output and adjust VR1 until the output voltage starts to fall off slightly. You will notice that by adjusting VR1 you can get the output voltage to fall by a number of volts, and if you adjust it to below 12V the supply will trip out due to the under-voltage protection circuits. The best position to leave VR1 is at the point where the output just starts to drop at the point of maximum current.

### Short circuit

Test the short circuit protection by placing a short on the output terminals; this is not something you should do on a regular basis. Once the output has been shorted, there is a half-second delay before the power supply closes down. Remove the short and restart it by pressing SW2, and then check that the output voltage is correct.

If you are happy with the performance of the unit so far, then the supply is probably working properly. Leave it switched on for about two hours and every so often draw 14 amps; this will help to show up any faults or weaknesses in the construction. When you are completely happy you can begin setting up the temperature switch.

### Temperature switch

Before making the final adjustment to the temperature switch it is best to allow the heatsink to come up to its normal working temperature.

We did this by leaving our HF rig, which

## COMPONENTS LIST FOR THE POWER SUPPLY

**Resistors**

| | | | |
|---|---|---|---|
| R1 | 10k | R10 | 10k |
| R2 | 3k3 | R11 | 10k |
| R3 | 4k7 | R12 | 1k |
| R4 | 5k6 | R13 | 2R2 15W |
| R5 | 10k | R14 | 1k |
| R6 | 1k8 | R15 | 0.1R |
| R7 | 1k8 | R16 | 0.1R |
| R8 | 10R | R17 | 50R 15W |
| R9 | 3k3 | | |
| VR1 | 100R | VR3 | 1k |
| VR2 | 1k | | |

**Capacitors**

| | | |
|---|---|---|
| C1 | 2 × 10,000μF | Verospeed 92 50986k |
| C2 | 2 × 10,000μF | Verospeed 92 50986k |
| C3 | 0.1μF disc 40V | |
| C4 | 4.7μF tant 35V | |
| C5 | 100pF ceramic | |
| C6 | 220μF single-ended elec 35V | |
| C7 | 0.1μF disc 40V | |
| C8 | 1000μF single-ended elec 35V | |
| C9 | 0.1μF disc 40V | |

**Semiconductors**

| | | |
|---|---|---|
| IC1 | LM723 voltage-regulator 14 pin DIL | |
| IC2 | MC3423 over-voltage crow-bar protector | RS 307-890 |
| IC3 | 741 op-amp | |
| TR1 | TIP3055 | |
| TR2 | 2N3771 | |
| TR3 | 2N3771 | |
| D1 | 1N4001 | |
| D2 | 12V zener 400mW | |
| LED | red (plus holder) | |
| BR1 | 25 amp bridge rectifier | Maplin BH48C |
| TH1 | 12 amp thyristor C126D or BT152 | Maplin WQ23A |

**Miscellaneous**

| | | |
|---|---|---|
| SW1 | dual-rocker with neon | Maplin YR70M |
| SW2 | large push-to-make switch | Maplin RK82D |
| RL1 | 24V single pole c/o 16 amp | Verospeed 258-51195F |
| T1 | 18V mains transformer | Jaytee 73014 |

| | |
|---|---|
| Panel mounting fuse holder and 5 amp fuse | |
| IC holders 2 × 8 pin and 1 × 14 pin | |
| Heatsink 1.1° CW type 6W-1 | Maplin FL77J |
| Heatsink to suit TIP2055 | Maplin FG55K |
| Semiconductor mounting kits to suit TO3 | Maplin WR24B |
| Terminal post (red) | Maplin HF07H |
| Terminal post (black) | Maplin HF02C |
| Terminal block 5 amp | Maplin HF01B |
| Terminal block 30 amp | Maplin HL55K |
| Push-on solder tags | Maplin HF10L |
| High current wire 20 amp | Maplin XR59P |
| Insulated stand-offs 20mm | Maplin FS38R |
| 6 amp mains cable | |
| Printed circuit board | |
| Case type: J44 204mm × 280mm × 127mm | Minffordd Engineering |
| Nuts, bolts, hardware, etc | |

**Notes**

The high wattage resistors R13 and R17 are of the aluminium clad-type, available from Verospeed, Boyatt Wood, Eastleigh, Hants SO5 4ZY. Their catalogue is free on request.

R15 and R16 are made up from two 0.22R 2.5W or 3W wire-wound resistors and wired in parallel to form a single 0.1R resistor. Available from Verospeed or Maplin Electronics.

draws about 1.5 amps on receive, switched on for about thirty minutes. Afterwards the heatsinks on our rig were just warm to the touch and now is the time to make the final adjustment of the temperature switch.

You will have to draw a continuous amount of current from the supply to allow the pass transistors to become hot. First, make sure that VR1 on the temperature board is fully clockwise and then place a load across the output of the supply; the resistor which is used for setting up the current limit will do for this job. Wait until the heatsink becomes fairly warm and then adjust VR1 until the fan switches on. You may have to experiment with various settings of VR1 to obtain the best results. Once the fan has started, it will run for the preset time already set by C3 on the temperature board. Leave the load on for a short time before removing it. You will notice that the fan has greatly reduced the temperature of the heatsink. You may have to experiment with the final setting of VR1 which may take a few days.

## COMPONENTS LIST FOR THE TEMPERATURE BOARD

**Resistors**

| | | | |
|---|---|---|---|
| R1 | 10k | R5 | 22k |
| R2 | 10k | R6 | 100k |
| R3 | 1k | R7 | 680k |
| R4 | 220R | R8 | 5k6 |

VR1 22k

TMS1 thermistor VA1055S (green) Maplin FX21X

**Capacitors**

| | | | |
|---|---|---|---|
| C1 | 0.1μF disc | C3 | 220μF |
| C2 | 10μF min elec 16V | C4 | 47μF min elec 16V |

all electrolytic capacitors are single-ended

**Semiconductors**

| | |
|---|---|
| IC1 | 741 op-amp and 8 pin IC holder |
| IC2 | 4001B quad 2 input NOR gate + 14 pin IC holder |
| TR1 | BC108 |
| D1 | 1N4001 |

**Miscellaneous**

| | |
|---|---|
| RL1 (miniature mains relay 12V) | Maplin YX97F |
| 12V 80mm or 120mm fan | Maplin YP40T |
| Suppression capacitor 0.1μF | Maplin FF56L |
| Contact suppressor | Maplin YR90X |
| Printed circuit board materials, connectors, etc | |

### Conclusion

This power supply was primarily intended to be a second PSU for the shack with a minimum requirement of 10 amps output, which it provides comfortably. It also gave us the opportunity to include the smoothing capacitors and soft start in a single PCB design. On test, it delivered up to 20 amps continuously for a short amount of time, and was capable of powering our TS-440S running 100W output on FM. We know that the TS-440S requires approximately 18 amps for maximum output on FM, and stations worked reported no signs of ripple or hum on the carrier. The power supply performed well, and should be able to run an SSB transmitter all day.

One major advantage of this design in our opinion is the fan which was used to cool the heatsinks. We were amazed by its overall efficiency and the excellent job it did in keeping the power transistors cool. After running the power supply for long periods at high currents, it only took a matter of minutes to completely cool the heatsinks. As the power supply was remotely sensed and switched, it was found that there was no need to run the fan continuously.

Some additions have been included, such as the temperature-controlled fan and the built-in heatsinks which contribute to a small, and neat design.

Of course, with a small design there are penalties to pay and these are mainly with the smoothing capacitors. Even though there is a total of 40,000μF of smoothing on the board, small electrolytic capacitors, unlike their bigger brothers, are unable to supply a vast amount of current without some ripple appearing on the output. However, the supply operates well up to 20 amps output, therefore you should not place too much emphasis on this minor design consideration.

I would like to thank the following people for their help and advice: Mr P Godfrey, Jaytee Electronic Services, 143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL. Tel: (0227) 375254. Mr P Hunter, Minffordd Engineering, Sun Street, Ffestiniog, Gwynedd, Wales LL41 4NE. Tel: (0766) 762572. Please enclose an SAE with any enquiries.

### References

A Complete 13.8V 20 Amp PSU, *Amateur Radio*, September 1987; ILP Transformer Data Sheet; RS Data Sheet 3396, MC3423 Over-voltage Crowbar Protector.

# The World of D | A | T | A

## BY DON FIELD G3XTT

Last month I looked at the selection of a TNC for your datacomms station. This month I want to look at other aspects of the station starting, not surprisingly, with the radio gear.

**The radio station**

Obviously you must have transmit and receive capability on the bands you are interested in, and this includes a suitable antenna. Let's have a look at this in more detail.

Packet radio on VHF is an interesting example of how little you can get away with by way of equipment. In many parts of the country you will be within range of a mailbox operator or a well-sited station through which you can digipeat to a mailbox. Consequently, you will require no more than about 25W of power and a simple antenna, such as a vertical, or a fixed vertically-polarised beam. There is also no need for a big tower and rotator and, yet, hey presto, you have national and even international coverage via the VHF, HF and satellite mailbox networks. Since packet takes place on only a handful of defined frequencies, you don't need an all-singing, all-dancing, synthesised transceiver. An old Pye FM set or one of the early crystal-controlled Japanese black boxes will be more than adequate; these can be bought for just a few tens of pounds. On 2m, for example, only three frequencies will be sufficient for all packet activities in the foreseeable future. Sooner or later 12.5kHz channel spacing will arrive on VHF, but other changes are also likely on the data front, such as higher data rates, purpose-built data transceivers, and much more, so it's probably not worth worrying about all this when selecting a rig.

The requirements change for modes other than packet on VHF. If you are interested in RTTY, particularly for DXing or contest working, then you will probably want a good multimode transceiver which has the ability to run plenty of power and with a high-gain antenna system. This is because very little direct point-to-point operation takes place on packet, although most activity is via intermediate stations or to mailboxes. The opposite is true with RTTY, since most RTTY operation is via direct point-to-point QSOs.

For HF operation, whether RTTY, AMTOR or packet, you will need something rather more sophisticated. Good frequency stability is important, which rules out many of the older rigs, and adjustable bandwidth is helpful to minimise QRM. It is important to be able to take a separate output to the TNC to keep the loudspeaker live so that you can hear what is happening on the frequency. This can also be useful on VHF, and it's absolutely essential on HF. AMTOR places particular constraints on transmit/receive changeover times (the table shows which rigs can work on AMTOR).

The issue of bandwidth is an interesting one. Although many transceivers allow the fitting of a narrow filter, this is usually only available (without modifying the set) in the CW mode. Fortunately, many rigs have some sort of variable bandwidth in the SSB mode. The popular HF packet frequencies are 2kHz apart, but if everyone were to use narrow filters, then there would be no reason why the number of channels should not double.

Again, the antenna's requirements for HF are more demanding than for VHF. You will normally want to transmit a strong signal to overcome QRM, although this is less true with AMTOR which, by its very nature, is well-suited to poor signal paths.

The input to your transceiver, for both HF and VHF operation, will normally be by way of an audio signal which can go in via the microphone jack. You will also need to connect to the PTT line so that the TNC can activate the transmitter. Also, the receive audio can come from the external speaker socket or some other suitable source. For RTTY operation, some HF rigs permit direct dc keying of the transmitter; the audio tones are generated in the rig.

My TS940S offers a range of choices for interconnection with a TNC. Audio in can be connected via the microphone socket, the phone-patch input, or the accessory socket. Audio out can be taken from the external speaker socket, phone-patch output, or the accessory socket. Finally, there is also a RTTY socket for direct dc keying. However, even if your rig doesn't offer such a wide choice, there is bound to be some way of getting the data signals in or out. If you decide to use a phone-patch input, the microphone will remain live when you are transmitting tones, so remember to unplug it when you go to data operation.

**The computer**

Radio amateurs often begin using packet radio because they already have a computer. Providing your computer has a standard TTL or RS232 interface, it should be able to drive the TNC. Even the PSION organiser has been used as a driver. MSX computers can be a problem without the proper communications cartridge, and CP/M machines are also difficult to work with. Apricot computers, I'm told, can also be a problem from a communications point of view.

If you are going to buy a computer, you may want to consider the following points:

**1** What sort of emulator software would you like to run? There are many shareware programs available for the IBM and its clones, for example, but in the UK most software aimed specifically at the radio amateur (including RTTY and CW programs) is written for the BBC micro. Your TNC supplier will be able to recommend a suitable software package. Some software is designed to take full advantage of a colour screen, so you may also want to bear this in mind. An eighty-column display is also essential. Of course, there may also be other types of non-amateur radio software that you want to run as well.

**2** You will need some sort of storage medium; either a floppy or hard disc is best for saving bulletins and QSOs, etc. The alternative is to print everything, but this is tedious and a waste of paper. You will almost certainly need a printer to obtain hard copy from time to time.

**3** The memory requirements are not likely to be a problem, though you can quickly fill 64K bytes of memory in a relatively long session on your local bulletin board.

**4** Finally, your computer will have to work simultaneously with your radio, therefore the scope for mutual interference is vast. A computer which is well-screened (and this includes the keyboard and monitor) will make all the difference to your enjoyment. Even though my computer is right next to my radio gear, there is no discernible 'hash' present on HF or VHF, and neither is there any disruption to the performance of the computer when I am on transmit. Not all models are as well-behaved as this, although there are methods of minimising the problem using filters, careful routing of cables and good earthing, etc.

This column, together with what I said about TNCs last month, should cover all the elements of the datacomms station. The Table shows some further information about TNCs. Setting up all this gear requires careful reading of the manuals and lots of patience. I cannot cover everything in detail because each type of equipment operates in a different way, although next month I will discuss setting up the TNC parameters. Provided you follow all the steps logically you should have no major problems, and the default settings in the TNC should at least enable you to get started.

Next month I will turn to the basics of packet operation.

### Sources of information

I often receive requests for advice on which books cover data-communications, and packet radio in particular. I can highly recommend two US publications: **The Packet Radio Handbook**, by Jonathon Mayo KR3T, published by Tab Books and **Your Gateway to Packet Radio**, by Stan Horzepa WA1LOU, published by the ARRL. Both authors are closely involved with packet radio in the USA. Of course, references to frequencies and networking, etc, are directly related to the US, but the rest of the material is just as applicable here. The major London bookshops stock these publications, and they are also available by mail order (unfortunately at a higher price) from the RSGB and elsewhere.

It is also worth mentioning some regular newsletters. The RSGB publishes 'Connect International' on a monthly basis (non-members are welcome to subscribe). Unfortunately, CI does not have an editor at the time of writing, but hopefully this will be sorted out soon. The ARRL's newsletter, 'Gateway', is published bi-weekly and is highly regarded. The subscription from the UK costs US $14.00 per year for ARRL members and US $17.00 for non-members. 'QEX', the ARRL Experimenter's Exchange, also devotes a lot of its content to computer and datacomms topics, and is published monthly. The annual subscription costs US $38.00 for ARRL members and US $48.00 for non-members. You can also use your credit card to order ARRL publications.

### Operating

I enjoyed taking part in the BARTG RTTY Contest, and was particularly pleased to work VU7JX in the Laccadive Islands on both 10 and 20m. In fact, during thirteen hours of operation I worked forty countries and copied a total of forty-eight, including rare ones like A22BW, 4U1UN and HP1AC. Some stations had very high serial numbers (well over 500) by the time the contest ended. So, clearly, RTTY activity is at a high level.

From the messages flying about on 2m packet, I note that a packet digipeater, G4XGN-7 or G4XGN-3 is now operational on 29.250MHz, using standard 1200 baud FM, as on VHF. It will be interesting to see if packet operation on 29MHz FM really takes off over the next few years. My guess is that it will.

Following my note regarding the US to Israel packet link last month, I was interested to see that at least some US to Europe packet mail finds its way to the UK by a very different route. Apparently, it is 'dumped' in bulk on to disc and then sent over public data networks to Europe, where it is reintroduced into the amateur packet network! This takes the edge off our claims of sophisticated networking capabilities within the amateur environment, but I suppose it does at least work! I heard a similar tale on one occasion about networking between two UK bulletin boards; this was proving difficult. On at least one occasion the two SYSOPS met at a motorway service station halfway between their respective QTHs and exchanged discs!

### RSGB Data Symposium

If you are serious about datacomms you may well want to attend this year's RSGB Data Symposium. The date and venue have changed from those originally publicised. The event will now be held concurrently with the AMSAT-UK Colloquium between 28 and 30 July, at the University of Surrey in Guildford. Most of the data-related topics will be covered during the first two days. The event will be mainly satellite-oriented on the third day. Further details will be available from the RSGB nearer the time.

That's it for this month. Do please let me know what you want me to cover. Next month the main topic will be how to make your first faltering steps on packet. Bye for now.

## THE WORLD OF DATA
## UPDATED COMPARISON OF TNCs CURRENTLY AVAILABLE

| Model | Tuning indicator | Modem(s) | RAM | Computer interface | Other modes | KISS | Terminal S/W for: | NET/ROM support |
|---|---|---|---|---|---|---|---|---|
| Pac-Comm Tiny 2 | No | VHF | 2kB | TTL/RS232 | | Can be blown on ROM | BBC, PC, Atari ST, Dragon, Amiga, QL Spectrum, Einstein Colour Genie, Vic 20, CBM 64/128, Atari 8 bit | Yes |
| Pac-Comm Micropower 2 | No | VHF | 32kB | TTL/RS232 | | Can be blown on ROM | As for Tiny 2 | Yes |
| Pac-Comm TNC-220 | Yes (optional) | HF/VHF | 32kB | TTL/RS232 | | Yes | As for Tiny 2 | No |
| Pac-Comm PC-120 | No | HF/VHF | 32kB | - | | Yes | | No |
| Pac-Comm DR200 | No | VHF/VHF | 32kB | TTL/RS232 | Level 2 and 3 gateways | No | As for Tiny 2 | No |
| Kantronics KAM | Yes | HF/VHF | 32kB | TTL/RS232 | CW, RTTY, ASCII, AMTOR Weather fax (with suitable computer program) | Yes | BBC, IBM | No |
| Kantronics KPC-2 | No | HF/VHF | 32kB | TTL/RS232 | Weather fax (Rx only) | Yes | | No |
| Kantronics KPC-4 | No | HF/VHF | 32kB | TTL/RS232 | Weather fax (Rx only) | Yes | | No |
| AEA PK232 | Yes | HF/VHF | 16kB | RS232 | CW, RTTY, ASCII, AMTOR Weather fax, NAVTEX | Yes | IBM, BBC, CBM 64 and 128 | No |
| PK88 | No | VHF (speed under S/W control) | 32kB | RS232 | | Yes | BBC, CBM 64 and 128 | Yes |
| MFJ multimode data controller | Yes | HF/VHF | 32kB | TTL/RS232 | RTTY, ASCII, CW Weather fax SSTV, Contest Memory Keyer | | | Yes |
| G0BSX | No | HF/VHF | 32kB | RS232 | | Yes, with appropriate firmware | | Yes |

Note: TTL means direct connection to CBM 64, VIC 20 and Atari 8 bit computers. No RS232 is required.

# SECOND-HAND

by HUGH ALLISON G3XSE

**Driving home screws**

No, not getting prison wardens home after a party, but getting tiny screws into their place when you haven't got easy access to the hole. It all started with an outburst of bad language which would have made a sailor blush. An engineer had repaired a video but had inadvertently left out a motor mounting screw. Now, this screw is fairly vital; without it the sound tends to warble. The trouble is you virtually have to strip the machine down to individual components to get it back in, half an hour's work if you're lucky. There is also the pure joy of dealing with several springs that are only interested in jumping clean out of the chassis given the slightest provocation. The said engineer had tried to position the screw with a pair of tweezers without disassembling the set; needless to say, he'd dropped it and the screw had disappeared in the gubbins.

Now comes the interesting bit. The engineer has to up-end the set and shake it in an attempt to dislodge the lost screw. This is fast becoming a popular spectator sport. Several other engineers gather round in anticipation, for not only is there the outside chance that the video will be dropped, but it's well worth a bet on what else will come out. I've seen bunches of keys, paper clips, shopping bills and no end of video club membership cards fall out of up-ended machines. Unfortunately, in this case there was only a gentle 'plop' as the screw fell out on to the carpet. Boring, though it still had to be refitted, so there was a chance of further entertainment.

'What about a magnetic screwdriver?' I innocently suggest. It is not well received. We have a brass screw, and using a magnetic screwdriver near the heads didn't seem a good idea.

'Blue Tack then', I said. 'Eh?' they said. The trick is a tiny ball of 'Blue Tack', the non-sticky sticky stuff you use to hold posters on the wall, etc. Put the ball on the end of the screwdriver and push it hard on to the blade. Then gently push the screw into the ball (note, hard on to the blade, screw gently on to Blue Tack). The idea is that the Blue Tack holds the screw but, once in place, the Blue Tack comes out on the screwdriver. It isn't a brilliant idea to leave Blue Tack inside units in case it goes into the works.

We try. . .and fail. Although we can see the hole, it's below half a dozen springs and these kept flicking the screw off the blade.

'Thin solder then'. Here the game is to make a small loop on the end of a foot or so of narrow-gauge solder 'wire'. You put the screw in the loop then lower away into the hole and do it up. The idea behind thin solder (22sg is best) is that, should you inadvertently hit something on the way down, the solder bends, thus absorbing the impact, rather than jar the screw out of the loop. Success first go. Brilliant.

What, you may ask, has this to do with amateur radio? Well, many rigs, old and new, have screws that are difficult to insert. I particularly remember an ancient valve transceiver that had a preselector capacitor mounting screw, not only difficult to align, but stiff to turn. In desperation I soldered the screw to the screwdriver, did it up, then broke the joint by jiggling the screwdriver around. It can be a problem.

**Codar AT5. . .again and again**

Following my piece on AT5s working but coming up on the medium wave (1 to 1.5MHz) rather than 1.8 to 2.0MHz top band, I've had an interesting letter on them being modified for other frequencies. Apparently there are quite a few about on the very, very, mega-naughty 6 to 6.6MHz band. This involves fairly major modification to the internals, consequently re-engineering it back to 160m is not a simple job. Beware.

One more point: drift. The advertising photos of the rigs showed them standing on top of their power supplies. The heat from the PSU causes drift. Stand them side by side, no drift.

**Kits 'n stuff**

There has been a welcome increase in the sale of second-hand kits. You know the sort of thing, 80m QRP rigs and the like. These rigs have been built to the highest standard that the original constructor could manage, and that might not be much. It's also worth bearing in mind that some kits don't include the hardware – case, screws, etc. An inexperienced constructor may well have scrimped here with resulting instability. When contemplating buying a second-hand kit, it is very much a case of let the buyer beware. Have a good look at it first. Mechanically speaking, if it looks right it might just be right.

As a general rule, the constructor has halved the value of the thing by building it, though the addition of any accessories or bits not supplied in the original kit, such as variable capacitors, can help push the price back up. If the kit ain't built, and is complete, then three-quarters of the list price might just be reasonable. Complete, by the way, includes the all-important instructions and circuits. Some of these kits are surprisingly technically advanced or use unusual circuitry, and even I have been caught using the odd diagram!

With direct conversion receivers, stability is directly proportional to overall structural rigidity. For example, there should definitely not be any flex when trying to twist the case by hand. Similarly, a good shaking shouldn't move anything. I once bought a Howes kit – 80m transmitter and direct conversion receiver combined to make a transceiver – that looked really stylish from the outside. I smelled a rat when I noticed that there weren't any screw holes on the bottom to hold the boards, but I bought it anyway (at a fiver it was irresistible)! Appalling wasn't in it, it drifted all over the place. Off with the lid and to my total disbelief the boards were held in with masses of Blue Tack! A handful of 6BA screws, washers, stand-off pillars and nuts transformed it into a super little set. Arrgh.

The ultimate bad buy has got to be a non-working, badly built kit that's never, ever worked. If it's cheap enough and you are confident enough then it might be worth a whirl. Best bet on the repair front is to check it out stage by stage. Oscillators (the VFO probably) are often not working and could be a good place to start. The audio circuitry shouldn't be too hard to tackle, then there is only the mixer left! If all else fails, haul out the transistors – one at a time if you have no circuit, to save mixing them up – and check them on an AVO. If the thing has never worked, don't take anything for granted. I once thought it strange to use a MOSFET in the audio stage and a high power audio transistor as the mixer until the penny dropped – the original constructor had mixed them up!

Fixed value capacitors are often confusing. A thousand pFs might appear on the circuit diagram as '1000pF'. The actual device might have .001$\mu$F stamped on it, or even better, 102. There really is tremendous scope here for a disaster. If it has never worked it's just as easy for you to remake (ie, overlook) the error the original constructor made.

I'm not saying that there aren't tremendous bargains to be had from second-hand home-brew equipment, far from it. Apart from the Howes kit above (now a permanent part of the shack), I had a lot of pleasure in my youth from a G2DAF receiver that had started life as a kit and had been built by a perfectionist. The list goes on and on: ATUs, speech processors, audio filters, etc, have all been bought at a fraction of the cost of a 'proper' kit. All I'm trying to do here is to emphasise that this sort of stuff requires very careful examination before buying, and maybe some skill after.

**A little knowledge. . .**

I've had two letters since Christmas about the following 'idea'. What makes me smile is that I thought the same thing when I was learning the mysterious ways of radio, many years ago.

The average short wave general coverage receiver goes up to 30MHz. Your up-and-coming enthusiast, bursting with misplaced curiosity, opens the machine up and spots, say, 50MHz devices in the front end. (We could be talking of either valves or transistors here). So, if 50MHz devices equals a 30MHz receiver, and if he bungs in 200MHz devices it should work to 120MHz. Wrong.

What determines the upper working frequency is your coils and capacitors. Sure, if you only had 20MHz devices in there then there isn't going to be much action at 30MHz, but the reverse is not true. I'm afraid it's a case of a little knowledge being a dangerous thing. After I had had my 'idea' along these lines and a kindly club member had explained the problems to me, I tried reducing the inductance of the coils in a long/medium/short wave valve receiver. The set was designed to tune up to 18MHz but careful tweaking resulted in mediocre performance at 50MHz. In those days BBC 1 was still transmitting on 48MHz and sound from it could be received. The limiting factors of ultimate frequency extension are layout, switch capacitance, minimum capacitance of tuning capacitor, etc.

It isn't often I recommend leaving things well alone, but radically extending the frequency coverage of a receiver is fraught with trouble. Far better to either play with converters or buy a dedicated VHF receiver.

On the subject of range extension, I was very impressed with the ingenuity of a local CBer. He wanted to listen to the Russian space station which transmits just below the 2m band (I am talking about the 'proper' space station comms, not the amateurs within). He plumbed his 2m amateur band converter (28 to 30MHz) into his old, legal, 27MHz FM CB set. Works a treat.

*The Unica UNR-30 receiver*

## Unica UNR-30

I understand that these receivers were sold in fairly large numbers through CB shops when CB first became legal. They are mains-powered and valve. First warning, watch the fuse on the back. The plastic cover is often missing over the fuse and, since the fuse is at mains potential, there is a good chance of electrocuting yourself.

Second point, beware the phone sockets. For some reason they have a tendency to short themselves out. The output valve works its little heart out developing bags of audio, which the built-in speaker doesn't get to see 'cos the socket shorts it all out. Definitely prime suspect with low (or no) audio.

One letter I received from a reader on the subject of this box concerned the HT. He was concerned that the rail was only 175V and the performance of his receiver was poor. It was my unpleasant duty to inform him that both the volts and the sensitivity were normal. They certainly aren't going to set any new standards for receiver sensitivity – 10μV or so is needed for a faint squark at 25MHz. The second channel is a bit grim too. Any strong CB signal will come up twice.

The circuit is a superhet, with no RF stage, and the valve line-up is 6BE6, 6AU6, 6AV6 and 6AR5. The rectifier is a miniature solid-state diode. Take care when working on these receivers, the valves stick up proud of everything else and will break if the set is up-ended with the covers off. Best bet when working on one is to stand it on its side, with the mains transformer down.

There is a BFO (of sorts) and the thing is quite stable. It is small and compact, but lousy performance and poor frequency accuracy (and marking) would make me tempted to wait and see what else came along. I've seen them sell at £20.00 to £25.00 second-hand, if you really want to buy one.

# THE WAVECOM W-4010
## DATA COMMUNICATIONS DECODER/ANALYSER

by Ken Michaelson G3RDG

I have always been interested in receiving weather messages and similar types of transmission, so I much appreciated having the opportunity to try out a new decoder which must be the top of the range of this sort of equipment. The unit is manufactured by Wavecom Elektronik GmbH of Hohentengen, West Germany. It is able to decode Morse, standard baudot, bit inversion, ARQ, FEC, ASCII packet radio and variable speed baudot and ASCII. Because all four software modules were installed in the review unit, it was able to decode fourteen additional commercial data modes, such as MODULE B – 'ARQ-E'; 'ARQ-E3'; 'ARQ-M3'; 'ARQ-M4'; MODULE 'C' – 'FEC-A'; 'SI-ARQ'; 'SI-FEC'; 'SWED-ARQ'; 'AUTOSPEC', and MODULE D – the 300 and 200 baud press transmissions, as well as some at 75 and 50 bauds.

The interior of the decoder shows the quality of manufacture one has come to expect from West Germany. The unit is housed in a steel case covered in dark green rexine, with the front panel finished in silver and surrounded by a metallic band in dark grey.

### Front panel

The front panel of the W-4010 is where all the information is shown. On the left are two rotary controls. The left-hand one operates the filter, which is of the continuously variable bandpass type. Quoting the Owner's Manual, the filter had 'an attenuation of over 27dB when the input frequency exceeded the filter corner frequencies by more than 200Hz'. As far as I was concerned this was a user review and I did not check the attenuation figure, but I found the filtering excellent. The right-hand knob, labelled 'Level', is in fact a type of squelch circuit, but more of that later.

Above these two controls is the 16-segment LED bar tuning indicator. I have come across this type of tuning indicator before and it is very convenient. The centre of the panel is taken up with ten LED indicators in two vertical columns of five. The left-hand column shows from the top: 'Synch'; 'Phasing'; 'Traffic'; 'B', and 'Y' (signal in). The right-hand column covers from the top: 'Error'; 'RQ'; 'Idle'; 'A', and 'Z' (signal out).

On the right-hand side of the panel are two columns of four keys. The left-hand column is labelled from the top: 'F1'; 'F2'; 'F3', and 'F4', all of which are coloured grey. The right-hand column is labelled: 'MODUL' (white key); 'BU-ZI', and 'PRINT' (grey keys), and 'POWER' (red key).

The rear panel, finished in brushed aluminium, has six sockets on it. On the top row, left to right, are: the power input, a 2.1mm socket with the positive on the inner conductor; a 5 pin DIN socket catering for serial TTL out, serial RS232 out, DTR (data terminal ready), external demodulator out and ground, and the Centronics printer output, taking the usual Amphenol plug. On the bottom row are three phono sockets, from left to right: VHF in; HF in, and Video out.

### Preparation

Before using the decoder I had to arrange for a monitor screen. I had intended to use the colour monitor I have for the BBC computer, but I discovered that it had no 'composite' input. Fortunately, however, I had a small colour TV in the shack which had video input and video output sockets, and it happily accepted the composite signal from the unit. The manual states that 'a modulated TV output is deliberately not available, since television receivers do not have the necessary bandwidth to give sharp and clear text'. Well, this was not a modulated signal, but I must admit that the display of the eighty column option was not all that good. However, I used the forty column × eighteen lines selection with perfect satisfaction. My receiver, an Icom IC751, was then connected by its phone socket to the 'HF in' socket on the unit with the lead supplied, and the dc power input, also with the lead supplied, was plugged into its socket on the rear panel. I was now ready to operate.

### Modes

The W-4010 has four software EPROMs inserted into the top circuit board, labelled 'A', 'B', 'C' and 'D', which cater for a multitude of different code transmissions. To give you some idea of what can be decoded, I will describe my operation of the W-4010 starting with Module 'A'. On switch-on the screen displayed 'WAVECOM W-4010 MODULE A V2.0' and showed the six modes available which I have listed above. The bottom line read 'F4 TO CONTINUE'. Pressing the F4 key gave me the first secondary menu showing three fresh commands for the keys F1 to F3.

Pressing the F1 key brought the video selection command on the screen giving a choice of eighty characters by twenty-four lines or forty characters. F2 gave the choice of four variations of cursor, 'OFF', 'ON' no blinking, 'ON' slow blinking and 'ON' rapid blinking. The Synch frequency could be altered to either 50Hz or 60Hz by pressing F3. The usual command available at the bottom line, 'F4 TO CONTINUE', brought me back to the main menu.

Pressing F2 in this menu put me into the RS232/V24 command menu, giving the choice of Baud rate (F1), Data and Stop bits (F2) and Parity functions (F3). F4 again returned me to the main menu where sequential pressures on F4 took


*The Wavecom W-4010*

me through the six modes available. Each mode menu gave a fresh list with nine options to play with. I shall not catalogue them all, but F2 gave me either ARQ or FEC and F3 altered the alphabet between 'ITA-2', 'Cyrillic' and 'Greek'. The key BU-ZI, when pressed with one of the F keys, gave four out of the nine options mentioned, one of which was UOS (Unshift On Space), on or off, and another was MSI (Multiple Scroll Inhibit). Pressure on F4 and F3 reversed the sequence, so it went back to Sitor from Morse, and so on.

I shall not list all the options available in this unit, because it would take too long; the descriptions of operation of the six modes in Module 'A' take four and a half pages in the manual! However, you can see from the schedule I have given above that the Wavecom-4010 will decode practically anything. Each time a fresh module is called up, the sequence of events is as I have described it for Module A, pressing F4 to continue. The baud rates can be called up for fixed known speeds, but if you think that the transmission is an unusual speed, then a 'Speedcheck' command is available to give you the exact speed. When in the reception mode, the bottom line of the monitor gives the Mode, Speed, Alphabet, and Error, Traffic or Phasing. On occasions, according to the mode, the number of characters is indicated instead of Alphabet.

### Squelch level

I mentioned the squelch circuit before. This is called 'Variable Minimum-Amplitude Squelch' and works in the following way. It acts on the signal amplitude, so that when a signal is below a certain level it is squelched out completely. Above this preset level, according to the position of the knob, it passes through with no attenuation. The manufacturers say, and I agree with them, that this is especially important for the reception of CW, because the squelch level can be adjusted according to the interference level. In fact, the squelch is there to prevent interference from reaching the decoder during CW pauses, which would, of course, cause characters to be wrongly decoded. The squelch works only in the CW, ARQ and packet radio modes. Turning the knob clockwise increases the squelch effect, and turning it anticlockwise cuts it out. When the squelch is used in either the ARQ or packet radio modes it makes the LED display centre itself during pauses and makes the tuning of these narrow shift modes much easier. I found it a great help particularly with packet radio of the HF bands.

### Using the W-4010

The operation of the unit is straightforward, provided that care is taken to press the right keys! Complete instructions are given in the Owner's Manual. I am impressed by the fact that you are able to tune into a baudot signal, put the unit on baudot auto and in about five seconds the W-4010 has decided on the speed and whether the signal is normal or inverted and comes up with the readout. In addition, the unit is capable of making synchronous and asynchronous bit analysis which means that the bit length can be displayed. This result can be sent to the printer for closer inspection and enables the block lengths to be set.

### Conclusion

I had a great deal of pleasure using the W-4010, and for anyone wanting to venture into a completely new facet of amateur radio, I would thoroughly recommend it. The facilities which are available are truly staggering. However, there is one proviso; the unit can only be used with a stable receiver. The price of the W-4010 commences at £895.00, including VAT.

My thanks to Dewsbury Electronics, 176 Lower High Street, Stourbridge, West Midlands DY8 1TG, tel: (0384) 390063, for the loan of the W-4010 for this review.

## Technical Specifications

| | |
|---|---|
| **Case:** | 200mm (w) × 250mm (d) × 80mm (h) |
| **Front panel:** | LEDs for Traffic, Sync, Phasing, Error, Idle, Rq, Input B-Y, Output A-Z and Print On |
| Keys: | F2, F3, F4, On/Off, Printer on/off, BU-ZI and Menus |
| Tuning LED: | 16-element bar graph |
| Rotary control for | variable filter |
| Rotary control for | minimum amplitude squelch |
| **Rear panel** | |
| Coaxial low voltage jack: | 2.1mm pin 12/14V dc input |
| Five pole DIN socket for | RS232-C interface (including DTR), serial TTL output, TTL external input either TTL or RS232 |
| Phono socket for | short wave audio input |
| Phono socket for | VHF/UHF audio input |
| Printer output jack: | Centronics type |
| Phono socket for | video output, 75 ohms, Composite/BAS |
| **Processing** | |
| CPU: | 8 bit CMOS, clocked at 4MHz, 2 or 8 KB NOVRAM, 5 EPROMs 27128 or 27256, 5 programmable 16 bit timers |
| **Video:** | 80 characters × 24 lines or 40 characters × 18 lines |
| CPU: | 8 bit, 12MHz, 4 character sets ASCII, upper and lower sets CCITT-2, TASS-Cyrillic, Third shift Cyrillic, Third shift Greek |
| **Interface:** | RS-232 serial computer or printer interface with data terminal, Ready (DTR) and 255 byte buffer |
| Baud rates: | 300, 600, 1200, 2400, 4800 or 9600 baud |
| Data format: | 7 or 8 bits/Parity Odd, Even or None/1 or 2 stop bits |
| | Jumper for shift inversion |
| | Centronics printer interface with 255 byte buffer |
| | Input for external demodulator either TTL or RS-232 |
| **Demodulator:** | Quadrature demodulator with 1750Hz centre frequency, automatically switching to 800Hz for CW |
| | Microprocessor-controlled switched capacitor 6 pole digital low-pass filter |
| | F7-B (F6) demodulator for 100Hz shift |
| | 1200 baud PLL packet radio demodulator |
| **Filter:** | Variable bandwidth filter composed of elliptic high-pass and low-pass filters, each with 4 poles |
| RTTY bandwidth: | 10-2300Hz, limits 600 and 2900Hz |
| CW bandwidth: | 10-800Hz, limits 400 and 1200Hz |
| Level pot: | Variable minimum amplitude audio squelch for CW, ARQ and packet radio |
| Audio input level: | Between 0.1 and 5 volts p-p maximum |

# USING YOUR OSCILLOSCOPE PART FIVE

## In the last part of this series Joe Pritchard looks at component testing and advanced applications

Component testing with a 'scope falls into two broad categories. The first is where we use the 'scope in one of the modes of operation already discussed, ie, as a voltmeter, timer, etc. For example, we could use the 'scope to measure capacitance by building a simple RC oscillator and then plugging in the capacitor, with a known value of R in the frequency determining part of the circuit, and then measuring the frequency generated by the circuit (**Fig 1** shows the boring old 555). The second method involves using the 'scope, with a few other components, as a more sophisticated component checker, which can also check semiconductors. This method uses the 'Y' and 'X' plates of the 'scope, along with a circuit to provide two sine-waves. The 'scope's display then gives a simple indication of whether the component is working or not.

One point to note is that this type of component measurement is very much a 'go/no-go' type of indication, and it is difficult to obtain quantitative results from using a 'scope-based component tester. However, this does not detract from the usefulness of such a circuit, and **Fig 2** shows the block diagram of a basic component tester. The system works by feeding ac signals to the device under test; the phase difference being set up by an RC network. The most convenient source of ac signals is to use a step-down transformer to convert the 50Hz mains into a low voltage (often between 5 and 20V), which is then fed into an RC network to provide the two ac signals. The combination of the RC network and the component under test provides a phase difference between the signals fed to the X and Y plates of the 'scope, thus giving a display which is dependent upon the component.

Before we continue let's make a few points about 'scope-based component testers. Essentially, they are comparative instruments, ie, to obtain the best results you require a working version of the component under test, so that you can get a 'scope display (representing the working component) to compare with the component you are testing. This allows you to examine components in circuits, provided that you can get a working circuit to compare. In this case, the probes of the component tester would be connected to a non-powered circuit around the component. The exact positioning of the probes is determined by the component being tested. Note that when used in this way, the component tester is actually testing a network of components, as all of the components

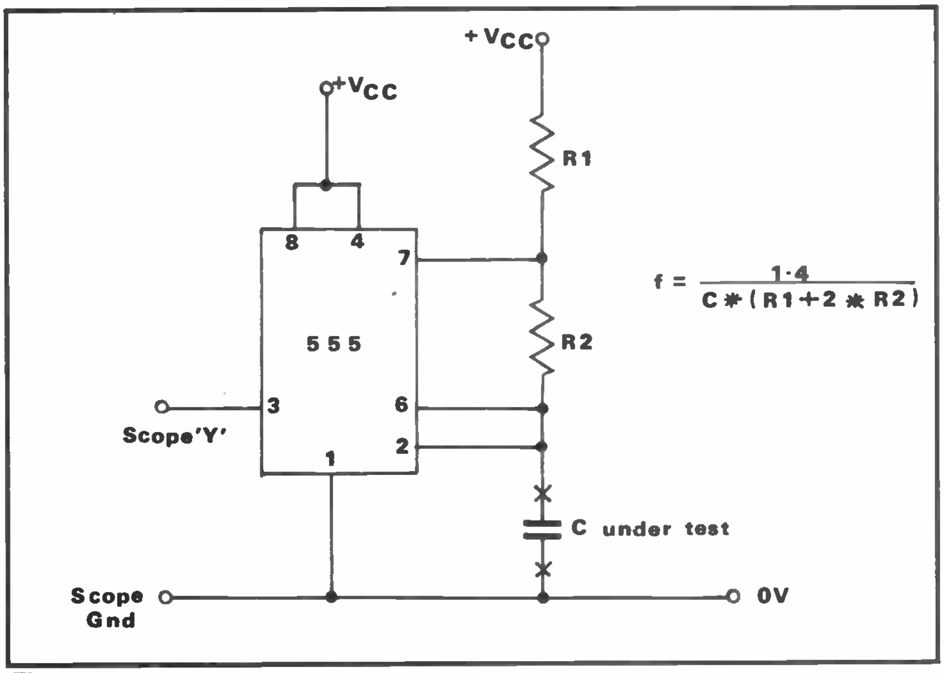



*Fig 1*

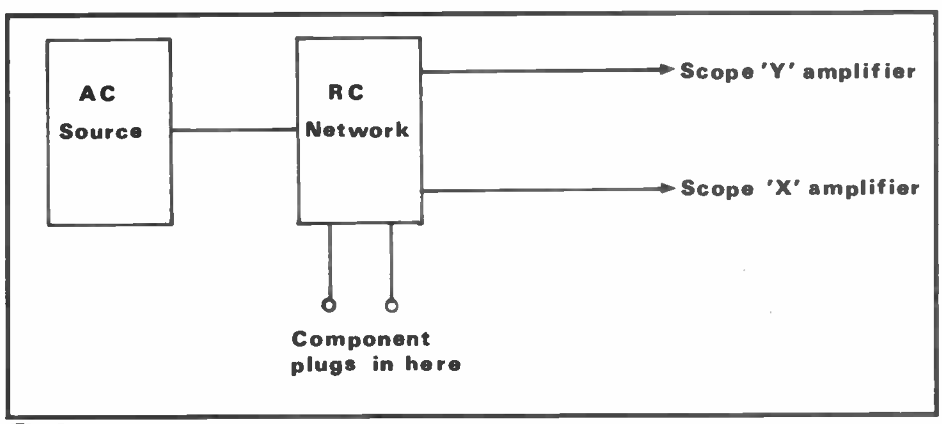



*Fig 2*

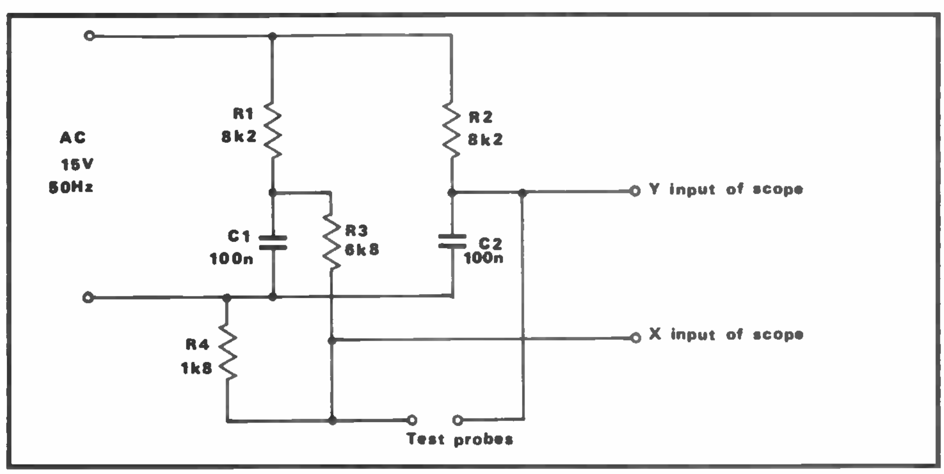



*Fig 3*

in the vicinity of the component under test will have some effect on the signals sent to the X and Y plates of the 'scope. This comparative way of working allows the testing of components which you would not normally think of testing with a 'scope, such as thyristors and diodes, etc.

Secondly, it is important that the test voltage used does not exceed any of the ratings of the component under test, especially if you are examining small signal devices.

It is also necessary to consider your 'scope; in a perfect world you must be able to adjust the X and Y amplifier gains to ensure that the display 'fits on' to the 'scope's screen. This is not always the case, however, and we occasionally need to 'tweak' the voltage levels which are fed to the 'scope's X input if the 'scope cannot adjust the X gain. If this is not done, then it will be difficult to observe the whole display, and the tester becomes rather useless!

Finally, this whole area of the 'scope's use is well-suited to further experimentation, so you might like to try using, for example, triangle or square-waves as a signal source. Also, due to the essential go/no-go nature of the testing, the frequency used is not too important; it is simply that low frequencies are easier to generate, and all 'scopes have the ability to display the patterns produced.

**Fig 3** shows the RC network for a simple component tester. The construction is not critical and will hang together on a piece of tagstrip. The ac signal used is a 15V peak-to-peak output from a low power mains transformer. When wiring up the mains part of this circuit, take the usual precautions with regard to fusing and earthing. *Do not work on a live circuit.*

The tester should be built into an earthed metal box, and the connections for the test probes and the 'scope's outputs should be insulated from the metal box. To achieve this, I used 4mm terminals with plastic shafts which were secured to the box by a nut and washer.

Components R3 and R4 will need to be developed through experimentation, as these form a potential divider to limit the signal which is applied to the X plates of the 'scope. The relative values of these components depend upon the X gain of the 'scope, whether this gain is adjustable or not, together with the voltage used as an ac source. I used ¼W resistors, and the capacitors were polyester devices of 63V working. To reduce the current fed to the devices under test, you can insert a resistor into the probe output leads; this will be useful for testing small signal devices.

**Fig 4** shows typical displays that can be expected for good devices, as well as some bad displays you may encounter. Do not forget that the easiest way to check the condition of a device is to check it against a device of a similar type which is known to be in good working order.

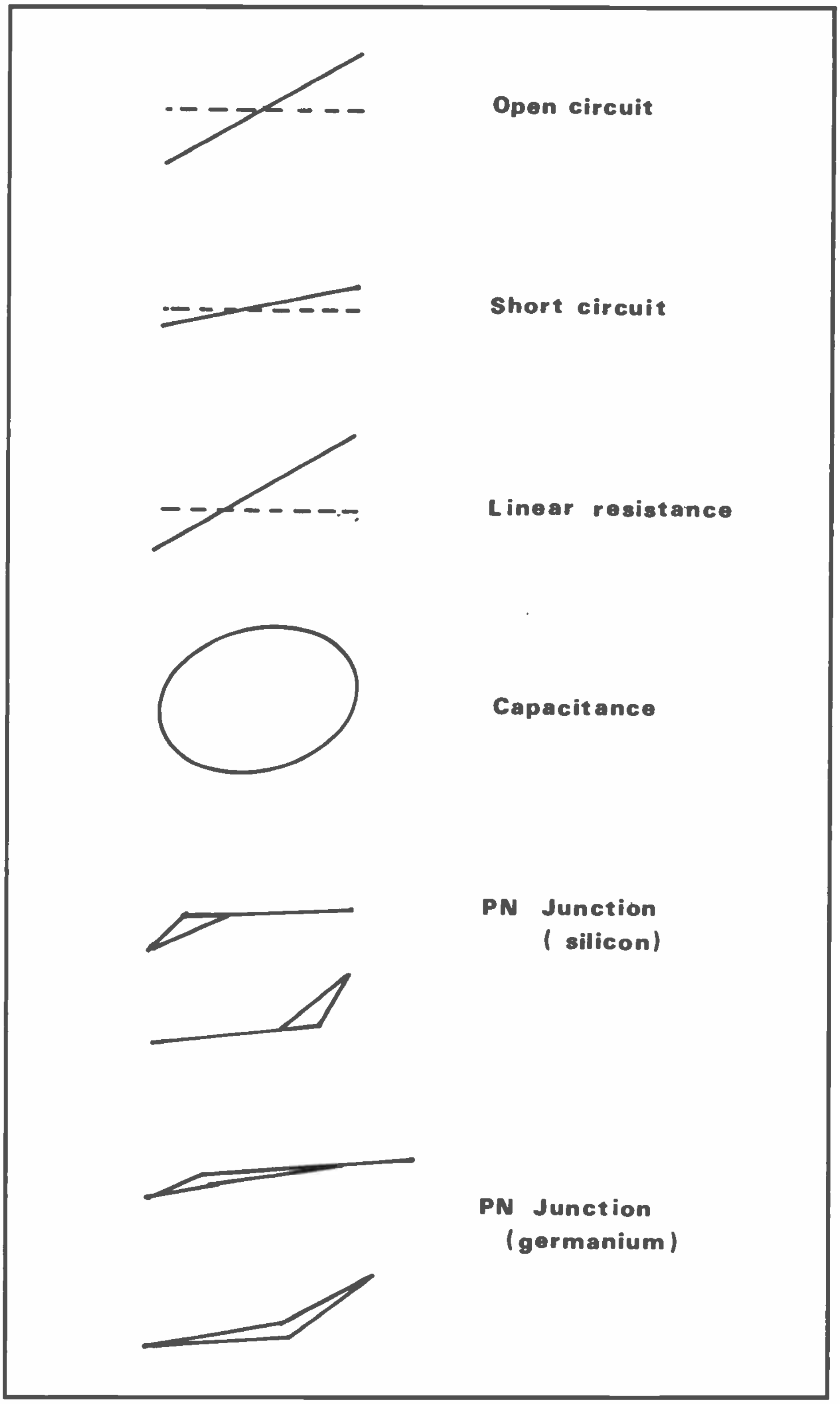


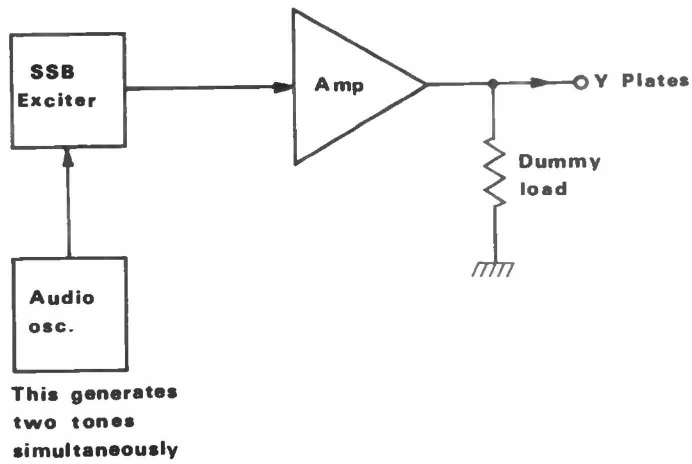

**Fig 4**

## Advanced applications

To complete this series of articles, I thought I would take a brief look at a couple of more advanced techniques using 'scopes. The first is well-known to radio amateurs; monitoring transmitter output when setting up an SSB linear amplifier.

The two-tone test indicates whether a linear amplifier is actually linear; if it is not, then the output signal may contain harmonics which could lead to interference to other users of the RF spectrum. **Fig 5** shows a typical arrangement for this test and the types of output signal you might expect.

A 'scope can also monitor the output of a CW transmitter in order to examine the keying waveforms; again, key clicks (as shown in **Fig 6**) can cause interference to other radio users. One problem here is that the bandwidth of the 'scope may not be wide enough for all transmitter frequencies. One possible solution to



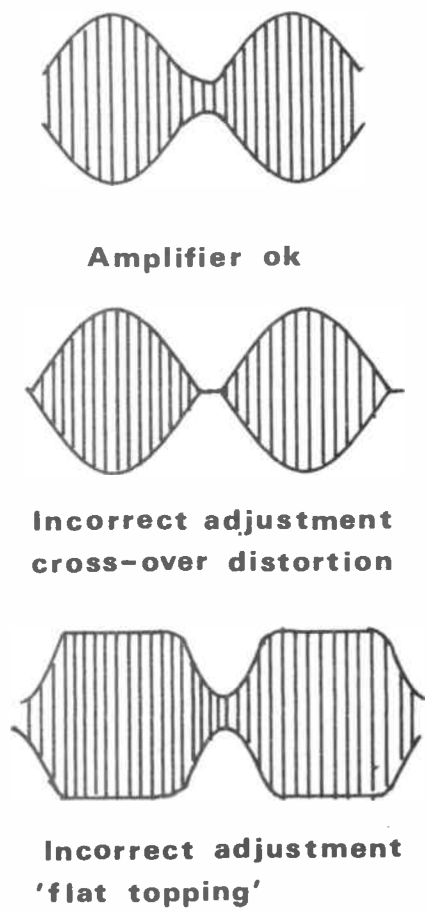




*Fig 5*

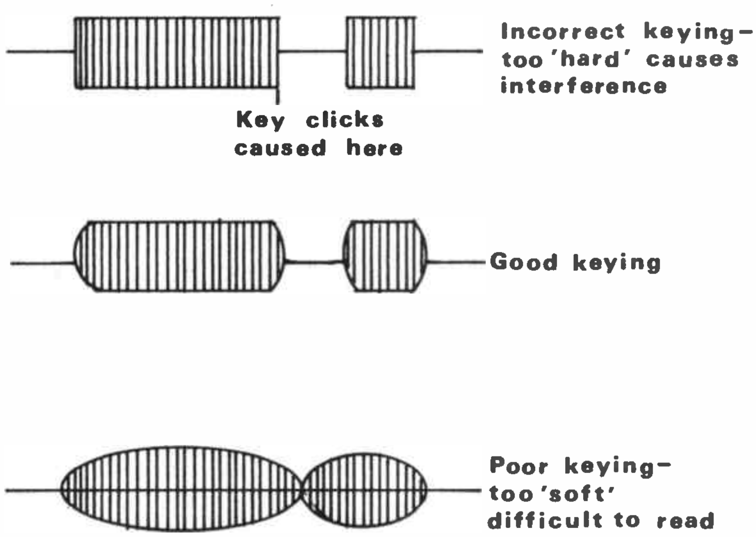



*Fig 6*

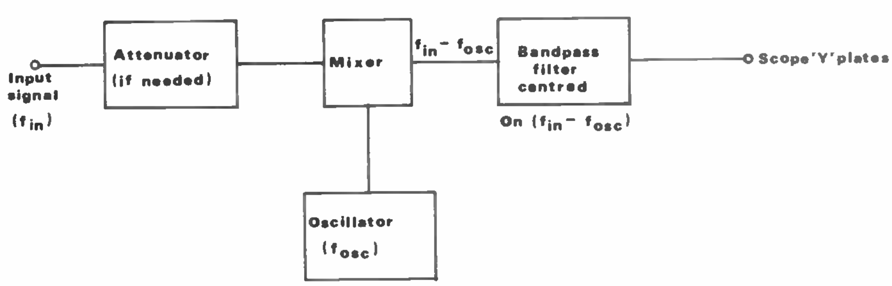



*Fig 7*

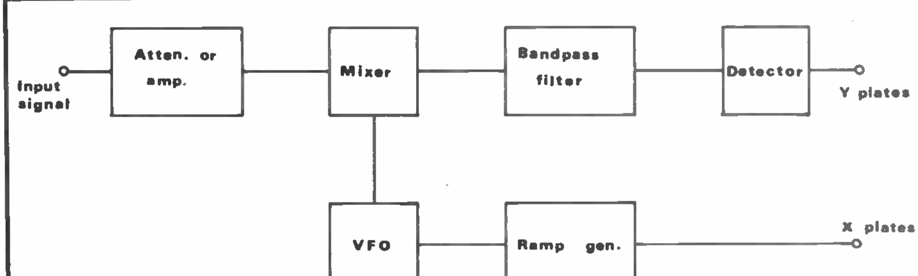



*Fig 8*

this problem is to mix the signal under examination with a signal of a fixed frequency, so that the difference signal of the mixing process is within the bandwidth of the 'scope. For example, we could mix a 14MHz signal with a fixed 11MHz signal to give a difference signal of 3MHz – well within the bandwidth of many 'scopes. This can be filtered off and applied to the Y plates of the 'scope, as shown in **Fig 7**. Clearly, the fixed signal used to produce the difference signal must be a good quality sine-wave with a peak-to-peak size roughly the same as the signal under test.

Another use for 'scopes is in frequency analysis, although this area is rather complex and is ripe for experimentation. Here, a display is produced where the X axis of the 'scope display represents the frequency, and the Y axis represents the size of signals found on different frequencies. A block diagram for a simple frequency analyser is shown in **Fig 8**. A ramp voltage provides a signal to the X plates of the 'scope, and a control-voltage to a VCO is used to generate a signal which mixes with the input signal to give an intermediate frequency; the magnitude of this signal is fed to the Y plates of the 'scope.

I hope this series has provided you with some food for thought about using your 'scope.

# DX STOP-OVER IN TARAWA

## by Kirsti Jenkins-Smith VK9NL

When the operators of the HIDXA DXpedition to Howland Island (KH1) first came together in Tarawa, West Kiribati (T30), in late March 1988, there was an instant upsurge of activity from T30. Normally, as in many small Pacific islands, only a handful of operators is available to fill the need. T30 was mainly represented by Willy T30AC, Ali T30AY and Retite T30BY.

Jim Smith VK9NS, who was leading the DXpedition, arrived at T30 in early March 1988 to organise the final details of the Howland Island trip. He was followed a week later by Jean-Louis TR8JLD. I and the rest of the operators, Mac KV4AM, Chris NO1Z, Ron 7J3AAB, arrived over the following few days.

**Three stations**

Staying at the Otintai Hotel, there were three stations shared by the DXpedition's members, signing T30JS, T30JL, T30MA, T30.. and T30NL. The hotel's management was very co-operative, and the staff helped to erect our antennas in the hotel grounds.

Jim and Jean-Louis also met with considerable goodwill from the Kiribati Telecommunications authorities. Mote, an ex-ship's radio officer who is now the radio licensing officer for Kiribati, was most helpful to the HIDXA operators, enabling us to have our calls and licences for Kiribati issued on arrival. Mote had always been interested in amateur radio, but found the cost of equipment prohibitive.

Jim and Jean-Louis were allowed to use a lowband commercial antenna for two nights of intensive 160m work. Many QSOs were made during a few short hours on this band, reaching as far as the east coast of the USA, South America and Japan.

Mac withdrew from the DXpedition to Howland Island. He stayed on in Tarawa, where he was still signing T30MA when the rest of us returned from Howland Island two weeks later.

Since we had missed the weekly flight to Nauru, we had almost a week to operate T30 while winding up the DXpedition. We also had to make arrangements for sending our equipment home and disposing of the things we no longer needed. Other items, such as a beam antenna, guy-ropes, operating tables, etc, were stored for Jim's planned DXpedition later in the year to Canton Island, Central Kiribati.

**Kiribati**

Kiribati gained its name when it became independent in 1979. This archipelago consists of thirty-three islands throughout the Pacific ocean. Since it is such a widely dispersed country, it has been divided into three DXCC countries. Tarawa, in West Kiribati, is a scythe-shaped string of atolls and small islands, some of which are bound together by man-made causeways.

Formerly part of the British Gilbert Islands, Tarawa offers everything one usually expects to find in the South Sea islands; friendly people and swaying coconut palms. Since the power lines are underground, there is nothing to disturb the sight of idyllic narrow roads winding their way between the traditional native villages.

**Betio**

Betio, with its port facilities and busy residential area was, until recently, separated from the rest of Tarawa by a wide stretch of water. Therefore, a ferry had to be used between the two islands. However, thanks to a grant from Japan, a 2km causeway was built, thus eliminating a major inconvenience for the residents of both islands.

Betio has some interesting sightseeing to offer. One of the most fierce battles of the Second World War took place on the island. Today, children play on abandoned Japanese guns along a stretch of beach dotted with 'pill-boxes' and bunkers. In the centre of the island stands Rear Admiral Shibasaki's command post, a 25ft high reinforced concrete blockhouse. Now partly hidden behind a large breadfruit tree, it still looks as solid and impregnable as it must have been over forty years ago.

Once the travel and shipping arrangements had been completed, we all spent some time counting QSOs and analysing the logs from Howland Island.

One more thing had to be done before we could leave Tarawa. Kan JA1BK had loaned us two rigs for the HIDXA DXpedition to Howland Island. One was to be retained by HIDXA for future DXpeditions, and the other was to be returned to Kan. Now, keeping in mind Mote's kind help during our stay in Tarawa, we wished to show our appreciation in some way. We decided to help him get on the air with his own call (T30MT). Jim made a quick telephone call to Kan, who immediately donated the rig that was to be returned to him to Mote. On the morning of our departure Mote came to the hotel where the rig was presented to him with our best wishes. Mote expressed his sincere thanks to Kan for his generosity; something which has resulted in one more operator to handle the demand for T30 among the world's DXers.

At the time of writing, Mote has been reported active on CW – and will give many operators that much sought after CW country.

Jim VK9NS returned to Tarawa later in the year to pick up the stored equipment for his operation as T31JS from Canton Island in July.

All in all, our stop-over in Tarawa was a valuable spin-off for DXers from something that started off as a DXpedition to Howland Island!

***Left to right:*** *Jim VK9NS, Jean-Louis TR8JLD and Chris NO1Z*

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# DX DIARY

**News for HF operators compiled by Don Field G3XTT**

Looking back through the log for March, I see that there were some excellent conditions at times, with Pacific stations being worked at good strength on 10m. However, as readers will no doubt be aware, we also had the biggest solar storm for some years, with a visible aurora over much of Europe, which left the bands in very poor shape indeed for several days. Nevertheless, at one stage or another there was plenty of DX to be worked. The Desecheo operation was particularly good, as was the effort by G3SXW and G3TXF from the Gambia. The Laccadive Islands operation was not quite so easy to find, but most people eventually made a QSO.

## QSLs

Although I have given the topic of QSLs quite a thrashing in recent months, I want to return to it briefly, mainly because I have received a letter on the subject from Bob O'Hara ZD8BOB on Ascension Island. This column certainly seems to reach some distant spots! Bob believes that DXers are essentially honest, but suggests that most QSLs are as much for the operator's own satisfaction as for awards. Bob likens the DXer to the philatelist who not only wants to see a Penny Black, but likes to remind himself from time to time that he still has it. Bob deprecates demands for 'payment' as such, but points out that an active DX operator like himself incurs quite considerable legitimate expenses. Bob made 3,500 QSOs within three months of starting operations from ZD8 and, as he says, if each one asked for a direct card, he would have to sell his gear to meet the cost of cards and postage. Fortunately, most DXers realise this and include postage or accept that the return card will come via the bureau. Nevertheless, Bob's pet hate is the minority who enclose a return envelope but nothing towards the postage.

Apparently the ethics of QSL manager F6FNU have given sufficient cause for concern to the French national society that it will no longer accept cards issued by F6FNU for credit for REF sponsored awards. This applies to QSLs dated 1 March 1989 or later. Personally I have had no difficulties in getting cards from F6FNU, but I have certainly heard some horror stories. Meanwhile, the RSGB HF Committee is looking at encouraging DX foundations and others who sponsor QSL cards to endorse a 'code of practice' to discourage some of the less savoury aspects of QSLing behaviour.

## Contests

While I try to include in these pages information about forthcoming HF band contests, I can't help wondering whether there are now far too many contests on the bands. During March it seemed that every weekend the band was full of contests, making ordinary ragchewing or DXing almost impossible. On one weekend there was the Bermuda Contest on SSB and the BARTG Contest on RTTY, while the previous weekend had seen the RSGB Commonwealth Contest on CW and a Russian event on SSB.

Readers of DX Diary will know that I am very keen on the major international contests such as the CQWW events and the ARRL contests, but the number of 'local' events seems to have got out of hand. Perhaps, like the RSGB 7 and 21MHz contests, such events should be confined to a single band? Certainly I would have thought that multi-mode events such as the IARU Contest in July and the OK-DX Contest in November should be banned or their rules completely revised, because right now they leave no escape for the non-contester other than to the WARC bands. Comments from readers would be welcome.

It won't be easy to persuade contest organisers around the world to cut out their own particular events as contests seem sometimes to be an indication of national virility in the amateur radio sense, but it may be that some pressure can be brought to bear via the RSGB's HF Contests Committee.

Meanwhile, life goes on, so here is a preview of the contests which will take place during May, whether we like it or not. The Russian CQ-M Contest is on 14/15 May, starting at 2100GMT on the Saturday. This is one of those unfortunate two-mode events which I referred to above. The Ibero-American Phone Contest is on 27/28May and if you QSY to CW to avoid this you will find the CQ WPX CW Contest in full swing. The latter is a major world-wide event, running for forty-eight hours, although single operators are limited to thirty-six hours of operation. The WAB LF Phone Contest is on 21 May; a good opportunity to work some new squares, book numbers, etc. And no doubt there will be the usual clutch of US QSO parties, and so on.

The results of last year's CQ WPX SSB Contest have appeared recently. GB2FXB, operated by G3FXB, was second in Europe in the single-operator all-band category, with a higher score than I and others managed in a multi-operator effort as GB4CDX (in which we came tenth in Europe). Many congratulations, Al! Steve GW4BLE came seventh in Europe on 21MHz. There was also a commendable number of other entries from the UK, especially in the multi-operator category. Contests are often more fun when entered in this way, and also take less toll on the individual operators!

There is a rather different kind of contest between 31 May and 4 June. This is the 'Sailor of the Year Award Contest', dedicated to the memory of Italian sailors and sponsored by the Brindisi section of the ARI. Work I7 and IK7 stations on any mode. Contacts on 40 and 80m count one point and on 20 and 15m two points. Each station can be worked once per day and per band, though there must be at least ten minutes between QSOs with the same station. Score fifteen points and you will be eligible for an award. The charge is 10,000 lire or equivalent, and applications should be sent to Francesco Perla I7QHE, Via Martini 76, 72100 Brindisi S, Elia, Italy, postmarked no later than 30 June 1989.

## DXNS CQ and ITU Zones Guide

Geoff Watts, founder of DX News Sheet, has recently brought out another of his invaluable DX aids. This one, 'CQ and ITU Zones Guide', lists all DXCC countries in each CQ and ITU zone in prefix order. This latest operating aid complements the other three which Geoff still publishes, namely the Prefix-Country-Zone List, the DXCC Countries Guide and the USSR Oblast Guide (with maps). In each case the price is £1.00 for a double-sided version, and £1.25 for a single-sided version. Write to Geoff Watts, 62 Belmore Road, Norwich NR7 0PU.

While talking about operating aids, I recently received details of the WB2DND logging and QSL program for MS-DOS computers. This was developed for N4NW's operations as 9Q5NW and TN4NW, and is now available from WB2DND for $25.00, which includes both software and manual. Log data is stored in a format which is compatible with the popular dBase III database program.

## DX news

The sad news is that 4W0PA was closed down by the Yemeni authorities and his work permit cancelled. Details of why this happened are rather sparse at the time of writing, but it seems that whatever lay behind this may make it difficult for other amateurs to get permission to operate from the Yemen for quite some time. There is no evidence that Hans himself did anything untoward, and it is still possible that the ARRL may decide to accept for DXCC credit those few QSOs he was able to make during the time that he was operational. I certainly hope so as I was one of the lucky few!

LA7DFA will be active from Jan Mayen Island until 10 October, mainly on CW. According to DX News Sheet, Per is aiming for 10,000 QSOs during his stay, so he should be relatively easy to find on the bands.

Clive G3NKQ is currently active as VP8BWL from the Falklands. He will take care of the QSLing when he returns to the UK in mid-June. VP8BUB has been active again from South Georgia, though only sporadically.

A group of Guernsey amateurs is planning to operate from Jersey from 6-8 May. I guess this may give the Jersey amateurs pause for thought as there is always plenty of rivalry between the two islands!

While on the subject, the Guernsey Bailiwick Award is available for contacting the various islands and parishes which go to make up the Bailiwick of Guernsey. For the Bronze award, work stations in six of the Guernsey parishes, plus GU3HFN or GU8NIS (the Club stations). For the Silver award, work eight of the Guernsey parishes, one of the club stations, and either Alderney or Sark. For the Gold award, work all ten Guernsey parishes, one of the club stations, and both Alderney and Sark. If you can claim the Gold award on each of five separate bands you can apply for the Five-Band award and, at extra cost, claim a special engraved copper Guernsey can.

All contacts with Guernsey stations for the various awards must be with members of the GARS. In each case, endorsements are available for single-band and/or single-mode. Each award costs £2.00, and applications consisting of a list of QSLs held (QSOs alone are not enough), certified by two amateurs or a national awards manager, should be sent to Phil Horsepool GU0JCI, PO Box 100, Guernsey.

TK/HB9CJC will operate from Corsica from 4 June until 2 July. ZL7TZ is back on Chatham Island and promising lots of activity. 5W1GP was due to start operations from Tokelau as ZK3YY on 15 April for an unspecified period, so it's possible he may still be active when you read this.

Yannick F6FYD has finally received his Somali licence and will be active as T5YD until about September. T5GG has also been extremely active recently, and has done a couple of spells as 6O1GG from the island of Juba, so Somalia may become less rare than it has been. GW4KYN should be out there by the time you read this. He plans to stay for eighteen months, so let's hope that he is able to get a licence.

Activity from China continues to increase, and there are reports that about forty club operators have recently taken their personal licence exams and may soon appear on the bands with callsigns starting with the BZ prefix.

For prefix hunters, the special call IY0ONU will be aired from Trasimeno Lake in central Italy on 19-28 May and 21-30 July, to celebrate the tenth anniversary of UNICEF's Children's Year. The Swedish SK3HK club will use the special callsign 7S3HK in the WPX CW contest at the end of the month.

**Council of Europe**

The Council of Europe station in Strasbourg will air the special callsign TP40CE on 5-7 May and 20-22 October, to celebrate forty years of the Council. Two Council of Europe Awards are available. The second class award requires contacts with stations in each of the twenty-three member states plus TP2CE itself (or any other special TP call, such as TP40CE), on any of the bands 80-10m. The first class award requires this feat to be achieved on each of the five bands, making 120 contacts in all. The latter award will be signed personally by the Council's Secretary General. To apply, send a certified log extract with the fee of $6.00 or sixteen IRCs to F Kremer F6FQK, 31 rue Louis Pasteur, F-67490 France.

**Banaba Island**

Banaba Island, or Ocean Island as it used to be known, is one of the remoter islands of Kiribati, and is almost certain to count for DXCC in its own right under the new interpretation of the rules. Jim Smith VK9NS, well-known for his DXpedition activities, has been looking in to putting Banaba on the air, probably with a T33 callsign. At the time of writing there are conflicting reports about when such an operation might take place, but if you hear T33 on the bands get in there and work it!

There were some operations from Ocean Island under the old VR1 prefix back in the '60s and '70s, but there has been nothing for many years now.

**IOTA**

Early notice of an Islands on the Air operation. I will be joining a group of Cambridge University Wireless Society members who plan to operate from the Flannan Islands (off the Outer Hebrides) sometime between 8 and 15 July (depending upon the weather). The callsign will be GM6UW/P, and it is possible we may also get to St Kilda. I look forward to working DX Diary readers from there.

**New bands**

Congratulations to Tom GW3AHN, who completed Worked All States on 18MHz on 25 February. Remember that US amateurs only gained access to the band on 1 February.

**The DX Magazine** is sponsoring a new award to encourage activity on the 10MHz band. To qualify, work 100 countries on the band since 1 January 1988. No QSLs are required, and applications should be made on the ARRL's DXCC application form. Send this, with the fee of $2.00 or four IRCs to **The DX Magazine**, PO box 50, Fulton, CA 95439, USA. Apparently the certificate is a particularly attractive one and well worth the effort.

**YASME news**

DX News Sheet reports that Lloyd and Iris Colvin made 3,000 contacts with 124 countries during their operation as W6QL/5N0 from Nigeria. They operated from the QTH of Cal KH6HSS/5N0. They had previously tried to operate from neighbouring Niger, but when they arrived there with their 400lb of gear and belongings after a long overland trip from Nigeria, they found that they were not to be issued with a licence. Nevertheless, their travels last winter and spring included successful operations as 5B4KG, ZC4ZR and 9H1JN as well as the Nigerian operation. Later in the year they hope to head off to Russia to activate each of the fifteen republics of the USSR. There really is no stopping these two!

**An early WARC?**

There are indications via the IARU that there may be a World Administrative Radio Conference (WARC) in the early '90s, earlier than previously expected. At the last WARC in 1979 amateurs gained three new bands, but WARCs aren't always good news. For example, once upon a time the 20m band extended to 14400kHz, but the top 50kHz was lost to other services.

We rely on our national societies and the IARU itself to lobby on behalf of radio amateurs at these events and to put in a lot of preparatory effort to justify our use of previous frequency space. Some years back the professionals seemed to feel that, with the advent of satellites, the HF bands were becoming less important. However, in recent years that trend has reversed completely. The military has realised that satellites are vulnerable, and short wave broadcasting has increased significantly. All in all, it behoves those of us who enjoy the HF bands to make good use of them and to support the RSGB and the IARU in the work they do on our behalf.

Finally, if your German is up to it, there is a DX information net on 3677kHz at 1800GMT on Thursdays. Via a rather different medium, G4DYO, editor of DX News Sheet, is now putting out HF DX information via the 2m packet network on a regular basis.

# PROJECT BOOK

by Martin Williams

A useful accessory to have around the shack is a dummy load. They are not used very often, but how can you do even simple jobs such as checking your power output without one? If you use an SWR bridge to measure output, then you must have a good 50 ohm load for the bridge to obtain accurate results. The loads that are available commercially tend to be on the expensive side. Fortunately, a reliable load can be made cheaply and by someone with little electronic ability.

**Criteria**

Three major points must be considered. First, the load must be matched to the impedance you require, which will normally be 50 ohms. Second, it must be capable of taking enough power to do the job. Third, it must be able to perform the previous two points at the frequencies you are interested in.

The load is built using readily available resistors in suitable numbers to handle the power generated. For instance, a load to handle 10W could be made using ten 470 ohm 1W resistors or two 100 ohm 5W types. When selecting suitable resistors for your load, remember that the combined resistance of a number of *equal* value resistors in parallel is simply the value of one resistor divided by the number of resistors used.

**Construction**

The simplest load to build is suitable for rigs such as hand-helds and the ubiquitous FT-290. You need an SO-type plug and a 3W 47 ohm resistor. Push the resistor into the body of the plug so that it is firmly seated with one wire appearing through the pin. Solder this wire and the other wire to the body of the plug, using the shortest lead length possible. You now have a 3W load with virtually 1:1 SWR at 2m or below.

**More power**

A 30W load can be made using ten 470 3W resistors. Keep the lead lengths as short as possible so that the load will function well into the UHF range. Cut two 2in diameter discs from some thin brass or copper sheet, being careful to remove all burrs and sharp edges. In one piece cut a central hole so that it will be a tight push-fit over an SO-type of plug, or whatever type you are using. Next, fit a short length of tinned copper wire to the centre pin of the plug. Now clamp the two pieces together in a vice and drill the required number of holes, then mount the resistors by pushing the leads through the holes. Keep the holes well-spaced and symmetrical.

**Fitting**

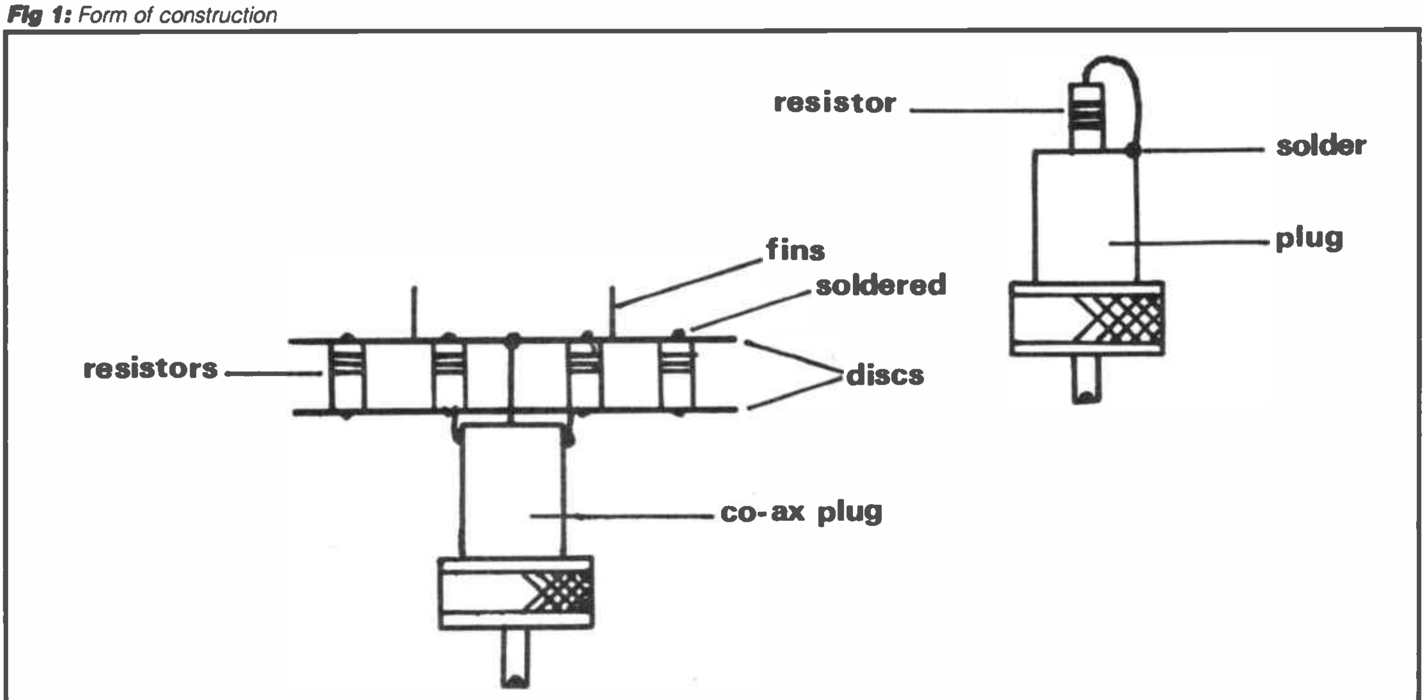
Take the disc with the large central hole and solder it to the body of the plug. Fit and solder one end of the resistors to the plate. Take the other disc and drill a central hole to take the piece of stiff tinned copper wire. Insert the free ends of the resistors and solder them to the disc. The bodies of the resistors should touch both discs. To finish the job, solder the wire from the centre pin of the plug to the top disc. If you wish, you can add some small fins to act as heatsinks, as shown in **Fig 1.**

**In use**

The author's version of the larger unit shows an SWR of less than 1.2:1 at 500MHz. Since it is normally used for short periods only, it is capable of handling up to 40W. For long term testing, do not exceed 30W.

Remember that if you run the unit at this level for long, it will become *very* hot. Think of trying to remove a hot 25W electric light bulb – handle it with great care!

**Fig 1:** *Form of construction*




**News and comment from Glen Ross G8MWR**

This month we start with news of two important 'firsts'. These fall neatly at the extremes of our sphere of interest, one on 6m and the other on 24GHz. Let us start with the higher band. Dave GM3WIL, having already made what is probably the first GM to GI contact on 10GHz, was keen to make the first contact over the same path on 24GHz. He and some of the Northern Ireland stations have been attempting this for some time and have, on occasions, managed to get some tone over the path but no completed contact. All this work culminated on 11 March when a contact was completed with GI4SQL, and a little later with GI8GGX.

### The details

For the tests GM4WIL was located at Port Patrick NW-475-567 and, instead of the usual high spot, was only 10ft above sea level (ASL). The GI stations were located at Agnew Hill NW-998-539 and this gave a path length of 52km. Initial contact was made on 10GHz where the signals were so strong as to overload the receivers. A move was then made to 24GHz where signals started at around 5/5 rising during the test to 5/9+. Dave noticed heavy QSB and possibly Doppler shift which he feels may have been caused by wave-action.

### The gear

His gear ran about 7mW to a 16in dish. The receiver's intermediate frequency was the usual 10.7MHz, but using a filter of only 50kHz bandwidth. Dave said he found little difficulty in keeping the free-running 24GHz oscillator inside this bandwidth. When one considers the high attentuation due to water vapour at this frequency and that they were operating over 52km of very wet air, this is indeed an achievement and as such we are issuing one of our Special Class awards.

### G/VK on 6m

News has also arrived of the first England to Australia contact on 6m. This happened at 0830hrs GMT on 20 March. The stations involved were G4FJK, located at Clevedon, and VK6KXW. The contact took place on 50.110MHz and signal strengths were running at up to S7. If you think you need QRO to get results on this band, you may change your mind when you hear that G4FJK was running an Icom IC551 at IOW into a five-element beam. This, of course, would give him around the legal limit as far as ERP is concerned. My computer propagation simulation program suggests that the best times for a short path opening to VK would be from around 0700hrs to 0900hrs GMT. Worth a look around before you leave for work.

### Six plus

As well as the usual beacons that you can check for good propagation, there are also a lot of TV stations around our band which also provide information about possible openings. Another, and previously unsuspected system, is the car phone transmissions. I have heard various ringing noises and what sound like Arabic voices on a couple of occasions when tuning close to 50.2MHz. The signals were particularly strong at around lunch-time. There are also reports of some contacts between England and South Africa at similar times. ZS6CE has asked me to mention the fact that he monitors 50.11MHz most of the day, and alerts European stations via packet when openings are in progress.

### News

From the excellent 'Daily Six News' which is produced by the UK Six Metre Group, we hear that on 16 March the South African beacon ZS3VHF was heard here from 1250hrs to 1350hrs GMT, with signals running at 559. At 1300hrs GMT ZS3E worked G3JVL and G4JCC. On 18 March at 1025hrs ZS6BMS worked into England, and ZS3VHF was running up to 559 from 1030hrs until 1540hrs GMT. At around 1130hrs ZS6PW and ZS6XJ were both working into G-land. A little later at 1515hrs ZS11S was workable for about fifteen minutes and later still, at 1730hrs, ZS3E was working into England and France. It seems like a good day on the band.

### Beacons

News arrives of a new, possibly the first, 10GHz beacon in Scotland. The beacon has been installed by GM41SM and at the moment uses his call, although a formal licence is due to be issued. The beacon is located at Blackhill, in Central Scotland, and the references are NGR NS-828-647 or Maidenhead IO85BU. The beacon runs wideband FM on 10.415GHz with a transmitter power of 25mW to a slotted waveguide aerial with a gain of 10dBi and omnidirectional coverage which is 35ft above ground. The site itself is at 750ft ASL with an excellent take off; it should have, it sounds like a TV transmitter site to me! Any reports would be welcome and should be sent to GM41SM who is QTHR or on packet at GB7MAC. The next project to be undertaken up there is the provision of a narrowband beacon on 5.7GHz. Watch this space.

### Repeaters

Someone else looking for reports is the Wakefield Repeater Group, and their new 1296MHz repeater came on air on 20 March. The frequency of this one is 1297.375, and it uses a pair of Alford slot aerials at 30ft above ground, the actual location being at North Wakefield. Do not forget that when 23cm repeaters are not repeating, they operate in beacon mode and give a good indication of band conditions. Your reports on this one should be sent to G0CDA or G3SPX, both QTHR, or via packet on GB7YAX.

### Awards

In the past I have asked for your ideas on awards for both 4 and 6m which we could add to our already well-established ideas for the other bands. There is still nothing formulated for 6m but we are proposing the following, based on ideas from G4VOZ for the 4m award. First for the countries. As well as the usual G, GM, etc, it is proposed that the following shall also count as separate countries: Lundy, Steepholme, Flat Holme, Anglesey, Sark, Alderney and Shetland plus EI and ZB2. This would make a total of fifteen countries available, each would count as one point.

### More points

All of the counties would also get you one point, except for the Highlands and Grampian for which you could claim three and two points respectively. To get these additional points you would have to work stations in different locator square suffixes; this would stop expedition stations changing callsigns to give extra points. This system would allow for a maximum of around eighty points. The awards would be based on twenty points for a Bronze award, forty points to get a Silver award, and sixty points to claim the Gold award. The points can be made up in any combination of countries and counties. Would you let me have your comments on these proposals? If they meet with general agreement, the awards will be issued counting from a starting date of 1 January 1989 so as to give everyone a clean start.

### The aurora

Reports are pouring in about the superb aurora that occurred on 13 March. There is far too much to report individually, so I intend to quote from a letter from GW0HOL which gives a fair flavour of what happened. He caught up with the opening at about 1400hrs GMT when he worked PA3BLS; this was then followed by a further twenty or so contacts into ON, EI, D1 and F. His best DX on 2m was to OE3JPC in JN88 square and OK1OA in JN70. He then moved to 70cm which is not a band noted for auroral activity and worked PA3DZL. Contacts then followed with DK5AI in JO50 square, PA0WWM and F6CAS, as well as several G stations.

### Heavy QSB

All of the signals were observed to have very strong auroral flutter, so much so that at one time he was measuring Doppler shift of up to 2.7kHz. On 2m he ran 70W to an eight-element quad, and on 70cm he had 50W to a seventeen-element Yagi array. GW0HOL says that the aurora was visible from Cardiff as a pale blue and pink band. At 2150hrs it covered the sky from north to south and was at its most intense phase so strong that ray features were easily seen. The visible aurora finished at around 2230hrs GMT, although the radio event actually continued for some time.

### CEPT

For those of you going abroad, the new CEPT licence arrangement, whereby you do not need a reciprocal licence, is a great advantage. To add to the list of participating countries that we gave a few issues ago, you may now like to add Spain. Arrangements are being negotiated with other countries and we will keep you informed.

### The mole

Patience has its rewards, and the latest mole report can be published. This concerns the abuse of repeaters in various ways. It has always been thought that the group operating the repeater was only responsible for technical matters. This assumption has now been blown wide apart. The dispute revolves around the misuse of GB3NA. A letter of complaint, signed by more than twenty people, was sent by the Sheffield Amateur Radio Club and another, with over fifty signatures from the Barnsley Club, demanded some action over the abuse they were having to put up with.

### The answer

The answer comes in a letter from G4AFJ, who is the chairman of the RSGB's Repeater Management Group, which was sent to the group responsible for running GB3NA. The gist of the letter is as follows:

'I believe that you are well aware of the situation, but you believe that you are only responsible for the technical side of the repeater and not for the content of the traffic that passes through it. Unfortunately this is not the view of the DTI and, in a similar case, the RIS requested that a repeater be shut down. The official view is that the licensee is responsible for the content of traffic passing through the repeater. Your group holds the franchise for GB3NA and you therefore have a responsibility to ensure that the repeater conforms to the specification laid down by the RMG, and that your members are educated in the correct techniques of operating through it.'

### On the line

This sorts out the responsibility once and for all; your local repeater group is responsible and must do something to stop the problems of obscene language, etc. Perhaps we will have to move to the American system where all traffic through a repeater is tape-recorded with date and time stamping; much as is done by local broadcast stations over here. Do not be put off if your local group says that it is not their problem. It is! Although all this took place last November, the RSGB has not mentioned it in **RadCom**; why?

### Close-down

Well, a lot of good news this month. Send all your news and comment to: 81 Ringwood Highway, Coventry CV2 2GT. Alternatively, you can contact me via packet, which I have just about conquered, at GB7NUN. Have fun on the bands.

# Surface Mount Technology

## by Ian Poole G3YWX

Surface mount technology, or SMT for short, is a new revolution which is sweeping through the electronics industry, affecting virtually every equipment manufacturer, including makers of amateur radio equipment. What does this new technology mean to the radio amateur and what effect does it have on radio equipment?

Surface mount technology can be traced back to the 1950s, when valves reigned supreme and wire-ended components were used together with tag strips. This method of construction was lengthy and labour intensive, making equipment very costly.

To reduce production costs many ideas were tried and the one which caught on was the printed circuit. Initially it was thought to be impracticable, but it was later proved to be a winner. One of the major reasons for its success was the growing popularity of the transistor, since it lent itself particularly well to the use of printed circuits.

As time passed, automation increased and components were soon being inserted automatically into boards. However, components with wires were unsuited to being inserted into boards like this. Component wires had to be preformed or bent to shape and then cut to length, adding unnecessary operations into the production cycle.

It was not long before someone asked why leads were needed at all. The problems could be solved by mounting the components directly on to the board. Again, the idea took a while to catch on. This was mainly because of the financial investment which was required to develop a new range of components. New resistors, capacitors, ICs, transistors, etc, were all needed. After a slow start, most forward-looking companies introduced SMT into their new designs.

Today, many manufacturers are using large quantities of SMT devices. This has meant that the cost of SMT devices has fallen and that the range has increased dramatically. Many everyday products, as well as amateur radio equipment, use them. One of the first was the Mark 2 version of the popular FT-290R.

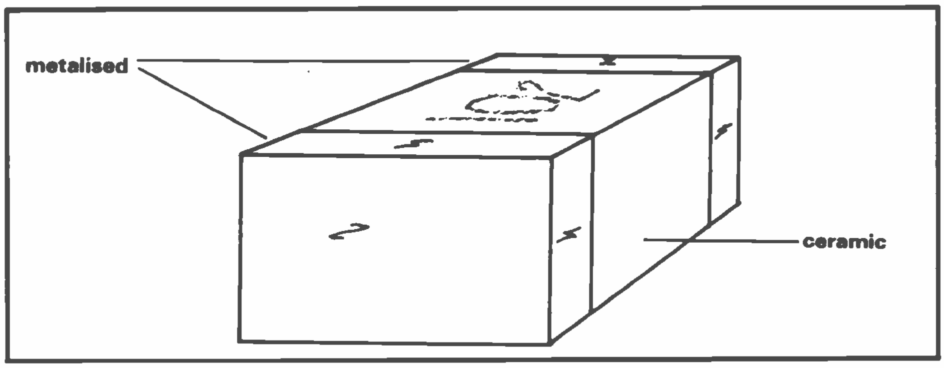



***Fig 1:*** *A chip capacitor*

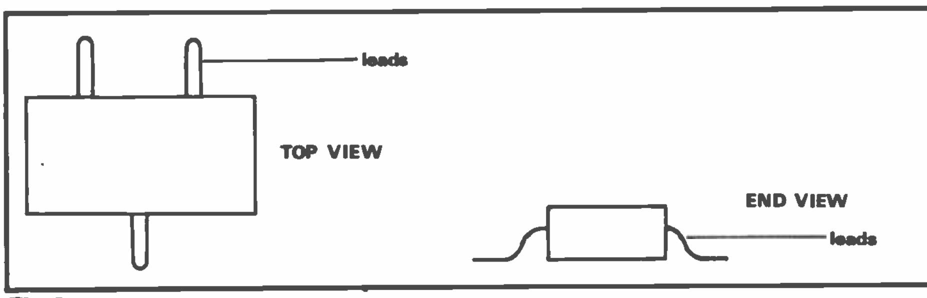



***Fig 2:*** *A surface mount transistor*

### What is SMT?

Surface mount technology amounts to more than just capacitors and resistors without leads. Along with the new range of devices, new methods of soldering have been devised and smaller PCBs have been developed. The overall result has been to enable smaller, more compact and sophisticated products to be made. But what are the new devices like?

As the name implies, the devices sit on the surface of the board. The resistors and capacitors are made in the form of a chip; hence, chip capacitors and chip resistors. Essentially they are small, measuring only 0.5mm × 3mm × 3mm and have an area of metallisation at either end for the connection, as shown in **Fig 1**.

Transistors and diodes have also changed. The most common package is black and slightly smaller than the resistor or capacitor. It has three leads, two along one side and the third on the other. Diodes only use two of the leads, but still have the third lead to show the orientation of the device. The pins on the devices have been designed to sit on the boards (see **Fig 2**).

The modifications to ICs have been the most advantageous. Although there are several different styles, the larger ones are square with the leads on a 0.15in pitch instead of the standard 0.1in pitch (see **Fig 3**). The combination of these two modifications means that you can have many more pins on an IC without the package becoming too large. The smaller ICs do not require large numbers of pins and are like smaller versions of their conventional counterparts.

The pins for ICs have a number of different standards. But the most common style is similar to those found on transistors and diodes.

PCBs have also changed. Instead of having holes for each lead, they have a pad instead. This is designed to be the correct size for the metallised end of a capacitor resistor, or the pin of an IC or transistor. By doing this there are far fewer holes needed on boards, and this can greatly reduce production costs.

Finally, new techniques for soldering have been devised. Terms such as 'vapour phase' and 'solder-wave' have become commonplace. The former technique involves placing the components on to the board using solder paste where connections are required. The board is then lowered into the vapour of a boiling liquid which melts the solder to make the joints.

The solder-wave technique involves passing a wave of molten solder over a board with these devices attached. In order to prevent the components from moving, they are temporarily fixed in place with an adhesive such as epoxy resin.

### Why surface mount?

This new technology offers a number of advantages. Most of them are associated with the manufacturer's equipment, but the radio amateur can benefit from them as well.

As far as the manufacturer is concerned, the main advantage is that these devices lend themselves very well to automatic insertion into the boards. As they do not have leads to be preformed before insertion or have their excess leads cropped, 'pick and place' machines can be used to great advantage.

Pick and place machines mechanically pick up components from specially prepared tubes or 'hoppers' and place the components on to the board before soldering. Components are placed on to boards at a rate of a few thousand per hour; a rate which is hundreds of times faster than if they were done manually, and several times faster if mechanically placed conventional devices were used.

Apart from automation, the manufacturer benefits from a reduction in size. With surface mount components being so much smaller, space on the board is utilised in a much better way. This can reduce costs, particularly if cabinet sizes are reduced.

There are benefits for the radio amateur as well. Since these devices are small and have no leads, the risks of stray inductance and capacitance are very much smaller. Consequently, standard resistors and capacitors can be used at frequencies up to 1000MHz or more.

For the enthusiast who wants to use even higher frequencies there are special microwave components available. The main drawback of these components is their cost. It is easy to spend £10.00 on a single microwave capacitor, against a few pence for ordinary chip components.

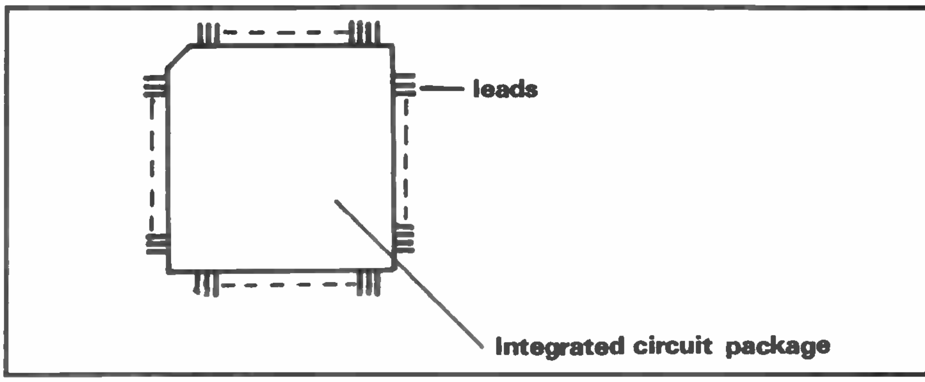



***Fig 3:*** *A typical surface mount IC*

### The problems

Surface mount technology does have some drawbacks. The obvious problem for the radio amateur is the size and serviceability. In the old days, when valves were around, components were easy to handle and equipment could be 'got at' or modified. Alas, now with surface mount devices, the components are so small that they are difficult to hold and can be dropped quite easily on to the floor.

In addition to this, most of the components are not marked. The performance of capacitors is reputed to be impaired by markings, and most resistors are not marked either. So once components are out of their packets or tubes they must not be mixed up! Transistors and diodes do not have their full type number because of their small size. Instead, they have another type code consisting of two letters.

The final difficulty arises during the manufacturing process. The adhesive which holds components in place during soldering can cause problems. Often a glue which degrades on heating is used, but not all manufacturers use this type of adhesive. This makes replacing faulty components difficult. You can only hope that the manufacturer of your equipment has not used a permanent type of adhesive.

### Future developments

While these problems may make SMT seem like a retrograde step for the user, the same was once said about PCBs and they are now used by everyone. The way to live with them is to ensure that manufacturers use them properly. Well-marked or identified PCBs can overcome the problem of poorly marked components. Adhesive which is destroyed during soldering is another requirement.

Once the problems are overcome, SMT should become as much an everyday part of amateur radio as PCBs are today.

# SHORT WAVE LISTENER

## TREVOR MORGAN GW4OXB

Tom McElvey, a member of the old Dominion DX Club in the USA, wrote to me a short while ago and mentioned that in the States listeners are often classified as 'failed amateurs' or, as he puts it, 'second class citizens' in the radio fraternity. As you may know, I do not subscribe to this feeling and believe that the radio listener, regardless of his affiliations, is often as knowledgeable as the licensed amateur but has no desire to transmit. Furthermore, there are many licensees who not only began in the hobby as listeners, but continue listening to and logging amateur and broadcast stations regularly.

There is another old comment that gets up my nose in that all Citizen Band enthusiasts are tarred with the same brush and will never make good amateurs. Well, perhaps some of them will not pass the RAE for one reason or another, but there are those who not only pass with credits, but go on to be first class operators, both on sideband and the key. And what of those who do not take up the RAE? There are many radio clubs that boast a good proportion of their membership as being either ex or current CB enthusiasts who are also keen listeners. I personally know a bunch of lads who could competently lecture on propagation, slow scan television and the broadcast bands, etc, yet have no desire to become licensed.

We all had to start somewhere. In my case, it was through being intrigued by ex-WD radios in Lisle Street, London, at the age of fourteen. The youngster today has a world full of electronics and computers to master and reasonably cheap equipment to buy, so why shouldn't he take advantage of it?

The radio hobby is there to be enjoyed, not by an elite few, but by anyone who has an interest in it. So let's welcome them all as fellow enthusiasts.

Many of the listeners I know personally and many that I hear of, started the hobby via the broadcast bands. Some remain broadcast enthusiasts, finding the programmed material easier and more enjoyable to listen to than the often overcrowded and noisy amateur bands. Also, it doesn't need to cost a lot of money, nor a shack full of equipment, to enjoy this side of the hobby. Some of us, who are fortunate, accumulate quite an array of equipment, such as various types of receivers, computers and their accessories, filters and aerials to cater for our interests. Despite this wealth of equipment, the most important piece of superb engineering is the human ear and its matching computer, the brain.

Just take your average computer and load it with a Morse program. I bet that, as soon as there is a bit of noise around, or the signal fades or mixes with another, it will show garbage on the screen! Now compare that with a keen short wave listener who has learned to read Morse. He will pick out the tones through very bad noise, from among many other Morse signals and, not only read it, but probably tell you if the operator is using a straight key or an electronic one!

The whole meaning of the argument is that, with a little practice, most listeners can discriminate between signals – not only Morse, but speech too.

The ability to do this is essential for successful listening and it doesn't matter how good your receiver is, it is this that will help you dig out that rare station from the noise.

The broadcast bands are overcrowded, and DX stations are often overcome by more powerful local stations. Luckily, we do not suffer the amount of jamming that used to be present, but there are still plenty of interfering noises to contend with.

Radio waves at different frequencies behave differently, so they are more suitable for different uses by broadcasters. The long and medium waves are used mainly for local transmissions for home consumption, although some external services can be found. Distances covered can be up to several hundred miles. At night, medium wave signals are reflected by the ionosphere and some long distance signals can also be received.

The short wave bands are used for long distance traffic. Propagation is mainly by skywave but signals can be affected by ionospheric conditions, especially during low sunspot activity. The main propagation is via the F layers, but these signals can be subject to severe fading and distortion at times.

Because of the variable conditions on the bands, broadcast stations have a set of frequencies that is used to transmit the same programme. This enables the listener to tune to each of the scheduled frequencies and find the best one for reception at any given time. For example, let's take the transmission by Radio Prague, Czechoslovakia, on 16 March 1989. On 5.930 there was fast shallow fading and a high noise level. On 6.055 there was a little fading but good signal level (does anyone know what the 'electronic cow' interference is on this frequency?). On 7.055 there was very little problem and excellent reception. 9.540 was affected by adjacent channel interference and fading, and 11.990 was subject to RTTY signals. So, there were two reasonable frequencies out of the five that were received. The following day showed further changes.

Let us assume that we have our receiver and want to tune in to a particular station. Unfortunately, our cheap receiver only has the metre bands marked on the dial (quite common in domestic-type receivers). Table 1 shows where you will find the frequency.

Identifying various stations comes with practice. Once you are a regular listener, you will find that most stations have an 'interval signal'. This may be a specific tune: church bells or another device that will help you recognise the station when you hear it. Some listeners make recordings of these interval signals for reference. Sometimes you can identify the origin of a programme by the language it uses, but with major stations broadcasting in several languages, this is not so reliable. It is, however, possible to identify stations by their regular programme layout or even by personalities and their expressions (I doubt if any regular listener would fail to recognise Vladimir Posner of Radio Moscow if he spoke Swahili!). Once again, these things come with experience.

Most portable or domestic receivers have in-built ferrite aerials which are suitable for local and strong distant stations that transmit on the long and medium waves, but these are somewhat directional and you may have to turn the receiver to get the best reception. For the short wave bands, a telescopic aerial is usually provided.

Using an extended wire aerial, preferably outside the house, is always advisable. Failing this, an 'active aerial' can be employed to good effect, but make sure it is away from any source of electrical interference. Aerials are not only a study in themselves but an experimenter's joy and, as a listener, you can try virtually any material in any configuration that takes your fancy. The motto I stand by is, 'If it works. . .use it'.

Always keep a log of the stations you hear. You may wish to refer to it later to compare reception conditions. Sending reception reports to broadcast stations is slightly different to amateur reporting, but the basics are the same.

Make your report as useful

## BROADCAST FREQUENCY ALLOCATIONS

| | | | |
|---|---|---|---|
| Long wave | 148.5-283.5kHz | 2020-1080m | Region 1 |
| Medium wave | 526.5-1606.5kHz | 570-187m | Region 2 |
| 120m band | 2300-2495kHz | 130-120m | Tropical band |
| 90m band | 3200-3400kHz | 93.7-88.2m | Tropical band |
| 75m band | 3950-4000kHz | 76-75m | Regions 1 and 3 only |
| 60m band | 4750-5060kHz | 63.2-59.3m | Tropical band |
| 49m band | 5950-6200kHz | 50.4-48.4m | All regions |
| 41m band | 7100-7300kHz | 42.3-41.1m | Regions 1 and 3 only |
| 31m band | 9500-9900kHz | 31.6-31.3m | All regions |
| 25m band | 11650-12050kHz | 25.8-25.9m | All regions |
| 22m band | 13600-13800kHz | 22.1-21.7m | All regions |
| 19m band | 15100-15600kHz | 19.9-19.2m | All regions |
| 16m band | 17550-17900kHz | 17.1-16.8m | All regions |
| 14m band | 21450-21850kHz | 14-13.7m | All regions |
| 11m band | 25650-26100kHz | 11.7-11.5m | All regions |
| VHF/FM band | 88-108MHz | 3.2-2.8m | All regions |

Region 1: Europe, Africa, USSR and Turkey
Region 2: North and South America, Greenland and the Pacific (FCC regulated)
Region 3: Oceania, Australasia and Asia, except areas in regions 1 and 2

▲ *Table 1*

## BROADCAST REPORTING CODE

| S-signal strength | I-interference (man-made) | N-Natural (atmospheric) | P-Propagation (fading) | O-Overall merit |
|---|---|---|---|---|
| 5=excellent | nil | nil | nil | excellent |
| 4=good | slight | slight | slight | good |
| 3=fair | moderate | moderate | moderate | fair |
| 2=poor | severe | severe | severe | poor |
| 1=bad (barely audible) | extremely strong | extreme | extreme | unusable |

Some stations will accept a report based on the SIO ratings only, but remember to give some explanation of what you mean, such as 'fading was slow but deep, badly affecting reception'. Try to make a comparative report with the same station on another frequency, or another station from a similar distance and direction on a close frequency.

◄ *Table 2*

to the station as possible. Tell them what you thought of the programme and let them know of any difficulties you may have had in receiving it. A series of reports is more useful than a single one, and reports of the same programme on different frequencies are also a good idea (see Table 2).

Remember, broadcast stations are interested in what their listeners have to say and will respond to good, regular reporting.

Some stations offer awards and other inducements to regular listeners, so listen carefully to the programmes. Record them so that you do not miss an important announcement.

### Awards

One of our regular readers, Peter Cain RS36554, has been logging hard to get the Broadcast Listeners Award for logging over 100 stations. Among the usual major stations were quite a few less well-known stations, such as KNLS Alaska (11.930), KUSW Utah (15.225), Bangladesh (11.510), Voz del Cid (clandestine 6.305), KFBS Saipan (12.025 and KYOI (9.465). Peter uses the Trio R1000 receiver. . .obviously to good effect. Well done!

It was nice to hear from Tony Blackburn of Stratford-upon-Avon again after his jaunts to foreign parts (H44, VK4 and VS6), and his reports on the bands. Some lovely stuff has been logged and I can only give a small sample here: 3A/F9UW, 4S7PVR, 8Q7CS, S6AVU, A71BK, J73LC, S79D, UJ8JMM, V44KAA, XF3RGS, 3B8FP, 6W7OG, KC6NW, V29C, 3W0A, JX1UG, FX6XL, P43FM, ZD9BV, plus top band catches of JW7FD, RF6FIL, VP9AD, OY9JD and A92BE!

Amateur band award claims are still coming in thick and fast. We have a Bronze Prefix award claim from Mick Brown RS91342 of Dunstable, which included 5L2RL, YZ7DX, YT7KF, KC8C/P3, AB5A, HZ1AB, SJ9WL, TP2CE and 5N9GM. Nice to get the first 250 in the book, Mike!

Ewald Bartunek of Vienna claimed the Asian and North American Continental awards for 100 stations logged in each continent. Nice awards, these, as they get the newcomer off to a start. (All you need is 100 different stations in one continent). You can go on to get them on one band or in different modes, or even claim for 100 broadcast stations.

Gordon Garraway of Bristol claimed the Silver Prefix award for over 500 amateur prefixes, all on CW mode! They included 5A7, JG6, RV9, ZS5, YD4, XM3, 7J6, XE2, EW1, 5B4, 8P9, 4N7 and a good selection of regulars. Gordon mentioned that he had been experiencing interference which was traced to one neighbour having a thermostat permanently arcing, and another with a loose wire under the floor!

Herbert Yeldham of Burnham-on-Crouch claimed a Continental award for 300 North American stations, *all* found on 10m since 1 January. Just shows how the bands are picking up at the top end.

Another broadcast award claim, this time for the Medium Wave DX award, comes from Oldrich Liska of Prague, Czechoslovakia. Oldrich uses a Telefunken E108 receiver with an endfed 40m wire. Well done, Oldrich!

Our old mate Geoff Watts has been busy again and can now offer the 'DXNS CQ and ITU Zones Guide'. This is a companion to the 'Prefix List' and gives a list of the DXCC countries in each ITU zone and each CQ zone in alphabetical order. It costs just £1.00 and is available from Geoff Watts, 62 Belmore Road, Norwich NR7 0PU.

Well, that's it for this month. Cheers for now and good listening!

You can send any comments, reports or claims for awards direct to me at 1 Jersey Street, Hafod, Swansea SA1 2HF.

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## BUILD A RECEIVER!

Building your own receiver is one of the most satisfying aspects of amateur radio. Nothing quite beats the thrill of hearing stations from far away on a set you constructed yourself. The first contact on a homebrew transmitter comes a close second though! Fortunately we offer kits for both, but it's the receivers' turn to be featured this month:-

**DcRx DIRECT CONVERSION COMMUNICATIONS RECEIVER**
The **HOWES DcRx** series of receiver kits offer amazingly good performance for simple, easy to build equipment. These receiver kits have made an excellent introduction to amateur radio for many newcomers, as well as providing the basis of a QRP station for thousands of licenced operators around the World. These are single band receivers, and as such avoid complexity and expenses, whilst offering very pleasing results for both SSB and reception. Versions are available to cover the 20, 30, 40, 80 and 160M amateur bands, plus a 5.45MHz HF airband variant. A case and a couple of tuning capacitors are the only major parts you need to add. We can supply suitable capacitors at £1.50 each for all but the 160M version. The DcRx receivers can form part of a transceiver in conjunction with one of our transmitters, and there are many other interlinking modules that can be added as you build up your station.
**DcRx Kit: £15.60** **Assembled PCB: £21.50**

**MBRX H.F. MARINE BAND COMMUNICATIONS RECEIVER**
The **HOWES MBRX** is a more sophisticated Direct Conversion receiver offering full coverage of the HF marine band from 1.6 to 3.95MHz, including the 80 and 160M amateur bands, international distress frequency, coastal stations etc. Additional features include a switched RF attenuator, RF amplifier stage, two stage active filtering, fine tune control, and an AGC system. As with the DcRx kits, up to 1W audio output is available for loudspeaker or headphones. Two 365pF (or 500pF) tuning capacitors are required. This kit will enable you to build an SSB and CW receiver with good facilities and performance at a sensible price.
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**TRF3 SHORTWAVE BROADCAST RECEIVER**
This little set is designed principly for AM Broadcast reception, but SSB and CW signals can also be resolved with a little careful tuning. Frequency coverage is 5.7 to 12.8MHz in three switched bands. This gives reception of the busiest part of the shortwave broadcast spectrum, plus 30 and 40M amateur bands. The set features a switchable input stage that enables very short antennas to be used as well as full size ones. This kit is a very popular present for the "junior op", and has good educational value as well as being great fun to build and use. A suitable 50pF tuning capacitor is available at £1.50.
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## NEW ACTIVE ANTENNA

**AA2 ACTIVE ANTENNA KIT**
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If you would like more information on any item, or the rest of our range, simply drop us a line enclosing an SAE. We have an information sheet on each kit, plus a catalogue showing the full range.
All **HOWES KITS** come with full, clear instructions, good quality PCB, and all board mounted components. Delivery is normally within 7 days.
**Please add £1.00 P&P** to your total order value.

**73 from Dave G4KQH, Technical Manager**

# SURVEILLANCE
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# MORSE REPORT

## Tony Smith G4FAI takes his bimonthly look at the world of dots and dashes

**EUCW Straight Key Day**

The European CW Association's Straight Key Day, organised by the Scandinavian CW Activity Group (SCAG), will be held on Saturday, 24 June 1989. The idea is to put aside your electronic keyer for the day and use a hand-key for relaxed and enjoyable QSOs on frequencies between 3540 and 3570; 7020 and 7040; 14050 and 14070kHz, or anywhere in the 10MHz band.

Participants making at least five QSOs in this event may vote for the best hand-style or 'fist' worked, one vote for each of the three considered best. A Straight Key Award will be sent free to every operator who receives at least two votes.

EUCW is an association of independent CW clubs across Europe which promotes and encourages amateur CW operating at all levels of proficiency. The EUCW SKD is open to *all* amateur CW operators whether they are members of EUCW clubs or not. Logs and votes should be sent to the SKD Manager, Daniel Klintman SM7RXD, Adjunktsgatan 3D, S-214 56 Malmoe, Sweden, before 18 July 1989.

**CW Novice Award**

If you are just beginning to use CW you might consider working for the CW Novice Award, administered by the G-QRP Club on behalf of EUCW and the World QRP Federation. This award provides you with a valued reminder of your first experiences using CW on the air.

During the first twelve months of holding an amateur licence an applicant must work fifty different stations using CW, with two classes to choose from. In class A, the maximum output power to be used when making the fifty contacts is 5W (increased from 3W as from 1 January 1989). In class B, any licensed power can be used.

Applications should include a log extract giving details of the contacts made, certified by the applicant and one other licensed amateur. They should be sent to A D Taylor G8PG, 37 Pickerill Road, Greasby, Merseyside L49 3ND. Enclose three first class stamps (overseas, three IRCs).

**World QRP Day**

QRP operating has come a long way in recent years, mainly due to the efforts of the G-QRP Club and the American QRP Amateur Radio Club International (QRP ARCI). QRPing is now a highly respected aspect of amateur radio activity.

The International Amateur Radio Union recognises this by designating 17 June each year as 'World QRP Day'. This is when all amateurs are asked to try working with low power. For those people who are trying it for the first time the best approach is to use the lowest power possible, consistent with achieving satisfactory communication. Having said that, you might well end up using a power level that is considerably lower than the 'regulation' 5W! Why not give it a try on 17 June?

**Feedback**

Bob Bagwell G4HZV was interested in my comments in the January issue of ***Amateur Radio***, about the lack of specific CW representation in the hierarchy of national societies. He says, 'The RSGB clearly regards CW as merely a qualification for the full licence, and not as the excellent mode of communication which we know and love'. He is also concerned about encroachments into the CW sections by non-authorised intruders. 'One thing we could all do', he says, 'is to populate our sub-bands above 50kHz from the bandedge, to discourage the downward progress of all the "squeaks and bumps" from these new datacomms systems'.

Another reader, who prefers to remain anonymous, is unhappy about the pressurised 'get through the RAE and Morse test' approach in some classes which does not provide satisfactory practical experience. He feels that there is a lot of help for newcomers to get to 12wpm but precious little to turn them into good CW operators.

He would like to see training classes established (or special on-the-air sessions) starting at the 12wpm level to provide instruction in abbreviations, procedures and general operating skills. The reader concludes, 'Perhaps a local club would be the obvious way. Or perhaps a national club like FISTS could introduce area club nights/meetings which would include this sort of activity'.

**World champion**

You may already know that the BBC **Record Breakers** programme has issued a challenge for someone to try to beat the 35wpm world record for Morse hand-key sending set up by Harry Turner in 1942. Details of the challenge appear in the spring issue of **Morsum Magnificat**, in an article which is appearing at the same time in **Dots & Dashes**, journal of the Morse Telegraph Club.

**Still active**

Harry Turner W9YZE is now eighty-two years old, and I wrote to him recently on behalf of **Morsum Magnificat** to ask about the world record he achieved in the presence of General Ben Lear at the Signal Corps School, Camp Crowder, Missouri.

He replied, 'I really did not try for a record. I was just giving a demonstration for the General. It made him feel good to think that the school was turning out such fast operators, but the top speed of the operators that the school really did turn out was not over 20wpm sending and receiving...'

Harry obtained his call in 1936. At one time, he was editor/secretary/treasurer of the QRP ARCI. Today he is secretary and treasurer of his local chapter of the Morse Telegraph Club. He still uses CW on the amateur bands, but he has not forgotten the American Morse he originally used on the railroads.

He is controller on 7144kHz of an American Morse net (mainly for novices learning this code) on Mondays, Wednesdays and Fridays. Like many other MTC members who still use the 'mother tongue' he uses a sounder for reception, activated by a home-built converter. The story of Harry's record will appear in the summer issue of **Morsum Magnificat**, published at the end of May 1989.

**Antique Field Day**

The Norwegian Radio Historical Association's Antique Field Day this year will be held on Saturday, 3 June. The schedule is 0700-0900hrs UTC on 3.513MHz and 1000-1200hrs UTC on 14.055MHz, both frequencies are crystal controlled. As previously, the main station will be a B2 set, used by Norwegian resistance forces in World War Two.

The Norwegians want to contact British stations 'to relive the atmosphere and the excitement of the old days'. They are also interested in setting up a weekly antique net on 14.055 between England and Norway. Anyone wanting to get involved in this should write to Arnfinn Manders LA2ID, Magnus Bergsgt 2, 0266 Oslo 2, Norway.

# 50MHz

by Ken Ellis G5KW

Last month we reported that F9LT heard two VK6s and that WAC was just around the corner.

On 20 March from 0833hrs to 0836hrs, a QSO occurred between VK6KEX and Tim G4FJK, of Clevedon, near Bristol. This was an all-time first two-way contact on 50MHz between Australasia and the UK and a stepping-stone to that elusive WAC. Tim is no stranger to 50MHz DX, as many of us have worked him crossband during cycle 21 when he was operating as VP2VGR.

The excellent conditions reported during January and February continued in March, but solar reconstruction has disrupted HF communications and caused some absorption of amateur band frequencies. However, F2 propagation has been enhanced and there is evidence of TEP on the north/south path to South Africa during the spring equinox period.

### Smithy G8KG reviews cycle 22

Smithy G8KG, writes: 'Having ended 1988 on a high note, cycle 22 continued to rise during the first quarter of 1989. In January the monthly solar flux average of just under 236sfu (higher than in any month during cycle 21) was the highest monthly value for thirty years. The final figures, which differ slightly from the provisional ones broadcast by WWV, show that the daily value topped the 300 mark on 13 January and again on the 16th.

'Solar activity continued to be very high in February, although the daily values and the monthly average were slightly lower than the January average. On the other hand, the provisional monthly sunspot count has risen from 161.6 to 164.5 and the geomagnetic field, which was disturbed by a number of major solar flares during most of January, began to settle down. This, together with the cumulative effect of high solar activity, produced excellent F2 propagation conditions during the latter half of the month with very high MUFs on a number of days.

'These excellent conditions extended into the first week of March but from 6 to 18 March, a succession of major flares occurred. The solar flare on the 6th was the largest since the great flare of August 1974; fortunately, due to its location, the effect on the ionosphere was limited. While the solar flux was above 200 and still rising, the recent flare activity caused a severe magnetic storm, as well as a major visual and radio aurora on the 13th. The storm caused forty-eight hours of near blackout conditions on the HF bands, except at low latitudes, and prevented what might otherwise have been good F2 conditions on 6m.

'At the time of writing, it is likely that the monthly average flux for March will fall to around 210sfu. It is not unusual for the average to fall after a major rise, although the three-month mean still puts cycle 22 clear of cycle 21's peak. With cycle 22's peak anything up to a year away, the present cycle is still ahead of cycle 19 at the same age.

The NGDC, from Boulder, Colorado, has issued a bulletin predicting a probable peak smoothed sunspot number of 195 (smoothed monthly flux of about 240sfu) in early 1990, which is just below the peak of cycle 19'.

### 50MHz contests

The viability of holding contests in the UK under the Government's present restrictions is debatable. We must use all means possible to increase activity and stimulate interest in 50MHz, but the desire to 'win at all costs' has led to rules being broken on other bands. Until 50MHz is given a Region 1 general allocation, we will continue to operate on a 'grace and favour' basis, and could lose the 50MHz band if interference from high power stations is reported to the licensing authorities.

The RSGB 50MHz Contest, which was held on 23 October 1988, was well-supported in both sections, and the recent increase in activity was reflected by a trebling of QSOs compared with 1988.

A total of 585 different callsigns appeared in the logs, including: G-499, GB-1, GD-3, GI-2, GJ-5, GM-17, GU-2, GW23 (Class A licensees, 263; Class B licensees, 289) EI-1, F-5, PA-24, ZS-2 and 5N-1. Conditions were described as 'average' to 'better than average' over the mainland, but 'very poor' in the Channel Islands due to QRM from a local car rally.

Some contestants had an opening to South Africa and Nigeria. G3GJQ/5N28 worked twenty-eight stations in the UK, France and Portugal between 1348hrs and 1423hrs. Contacts from the UK were into squares IN89, IO90, IO91 and J001; a fact which encouraged many contestants to voice their approval of the twenty-five point maximum rule! Such privileged contacts might have distorted the results if normal scoring had been used. GJ4ICD claimed a GJ-5N first on 50MHz.

The log from G3GJQ/5N28 was very interesting, although some contestants may find that their QSOs are invalid when the log has been cross-checked. Certificates will be awarded to G4KUX and GJ4ICD in the single-operator fixed section, and to G4THB/P (the operators were G4UJS and G4XUM) and GW4MGR/P (the operators were G0JSB and G3UVR) in the open section. Subject to council approval, the Telford Trophy will be presented to G4THB/P.

### The UK Six Metre Group

The UK Six Metre Group is organising a cumulative contest for its members on the first Sunday of each month from 0600hrs to 1800hrs, January to December. Three trophies will be awarded. The first trophy is the Championship Cup which will be presented by G5KW to the overall winner; the second trophy will be presented by G4JCC to the operator with the most meritorious QSO, and the third will be presented by G4IIL to the most successful SWL.

### SMIRK and ARRL contests

June is normally a month when Sporadic E and F2 propagation provide several opportunities for operating DX. DXpeditions and the SMIRK and ARRL contests also take place in June, so it is a good time to increase your country and square totals.

### Ray Cracknell G2AHU

The following report for February was recently sent in by Ray Cracknell G2AHU.

'Folke SM5AGM, the IARU Region 1 VHF record co-ordinator, confirms that official records do not take account of long path distances, and that only the shortest distance between two stations can be recognised.

'An Australian television channel from Toowoomba, near Brisbane, on 46.172, was received by G4GLT on 11 February from 0803hrs to 0849hrs and by G3UKV at 1130hrs.

'Amateur reports for February are as follows: 1st, 1655hrs to 1720hrs, G, GW and GJ worked ZD8MB; 3rd, 1215hrs to 1340hrs, G worked J52US, KP2A and FY5DG; 13th, 1335hrs to 1435hrs, G3UKV worked KP2A and 9Y4VU; 16th, 1215hrs to 1533hrs, G worked 5N, TU2MA, ZS3JO and J52US; 24th, 1203hrs to 1231hrs, G4IGO (and others) worked TR8CA, 9Y4VU, J52US and HC5K.

'On the 25th at 0858hrs a major opening to the Far East occurred and G4UPS worked VS6UP. From 0905hrs to 1000hrs, JH41VO and JA4MBM were heard in G and GM. LA3EQ worked six VK6s. PA3CI worked five VS6s. CT1LN worked JA. T77C worked ZS3JO and J52US and 5N worked many Gs.

'On the 26th, from 0915hrs to 1715hrs, a major opening occurred to Japan, Africa and America.

'At 0914hrs, GJ4ICD worked JA410V; at 0951hrs, G3UKV worked JR6JYL; at 1010hrs, G3SED worked JA4MBM and others, followed with many JAs heard. Signals peaked at 70-80° and faded out at 1130hrs. From 1145hrs to 1515hrs, ZS3, 4 and 6 worked all of G and GM. From 1535hrs to 1645hrs, W1, 2, 3, 5, 8 and VE1, 2 and 3 were also worked by many operators. At 1709hrs, ZS3E was heard working into the USA. On the 27th, at 1237hrs, GW and OH worked ZS3AT and at 1250hrs, worked VE1YX. From 1330hrs to 1500hrs, they worked W1 and VE1'.

A very interesting month!

## From the mailbag

John GW3MHW, near Aberystwyth, recently sent in this report.

'Since 31 December, MUF has reached the low end of the band on most days, and I worked most of what was around. During March I QSO'd HC, KP4, P43, PZ1, J52, 5N0, TR8 and SM7RAE. My country score now stands at thirty-seven. I am the only 6m amateur in square 1072. While listening at my other site (IO82IP), the 6m band is often over-populated, causing difficult operating conditions. This problem is due to stations not waiting for favourable propagation to occur and calling CQ while others are attempting to work DX'.

Geoff GJ4ICD, Jersey, sent a long, interesting log covering February and the first three weeks of March which included some rare DX.

'I still find propagation on 50MHz confusing. For instance, the solar flux has been very high with low 'A' and 'K' figures and no activity! However, on 1 March the flux levels were at their lowest for some time, and yet still produced TR8CA which is becoming an everyday affair.

'On 26 February I attended a Star Day and heard JH4IUD – QSO'd at 0914hrs, 579. I also QSO'd JA4MBM at 0951hrs. Heard: JA6TEW – no QSO; at 1045hrs, QSO, SSB with JA6IML, 53ew; at 1121hrs, TR8CA, 59++ew; at 1129hrs, ZS4S, 59+ew and ZS6CE, 59+ew; at 1200hrs, J52US, 59+ew and ZR6KE, 50.200, 59ew, SSB.

From 1537hrs, I QSO'd K8MMM, W8ERD, K8MFO, WB2CMI, K8NXI, WA2BPE and W2CNS'.

During the ZS contest on 18-19 March, Geoff worked over thirty ZS6s; this was the only area in the UK to report such activity from ZS.

Geoff also reported several UK 'firsts' which are as follows: 19/1/89, at 1326hrs, HH7PV; 14/2/89, at 1251hrs, 9Y4VU; 16/2/89, at 1234hrs, TU2MA and 21/2/89, at 1311hrs, TR8CA.

Ted Collins G4UPS, Hemyock, Devon, reports: 'A new KH6 beacon is now on the air, KH6HI on 50.063, the power is 15W using a turnstile antenna.

'Some operators have been sending QSL cards to ZS3DM using old callbooks; the cards have been returned with "deceased" printed on the returned envelopes. ZS3DM was a previously issued callsign, so please now QSL via POB 22951, Windhoek 9000, Namibia, South West Africa.

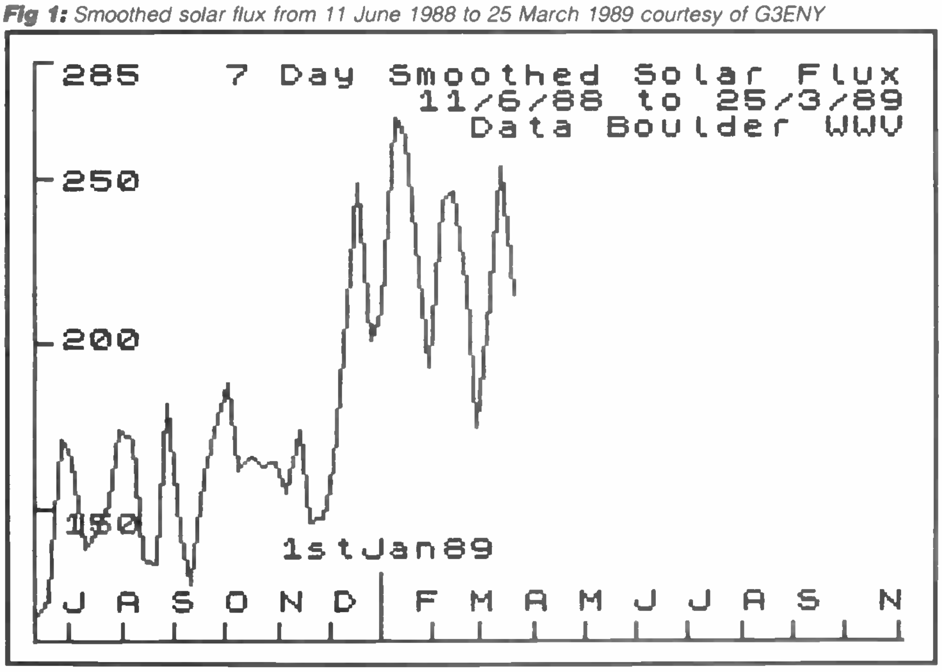
'Tanzania 5H1HK, QSL via JH4RHF. Kenya 5Z4RT does not have a permit yet, although it can be worked crossband.

'In Sweden, 6 March was a red-letter day for 6m operators. SM6PU and SM7BAE, among others, received their permits on that day. (There will be twenty-five permit holders soon.) Operation is allowed outside TV hours only, and it is illegal for SMs to operate during the day. TV closes at approximately 2235hrs.

'In Gabon, West Africa, TR8CA informed me that two further permits have been issued to TR8BL and TR8RLA.

'Members of the Ward Island VE8 expedition arrived safely, albeit a few days late, on 7 March. The recent Polar absorption factor has prevented anything being heard from them on 28885. However, on 21 March GM4DMA/VE8 asked me to QSP the information that they would continue operating for about two months, so you can ignore press reports about their imminent return home! They call CQ on 50.110 on the hour, every hour'.

***Fig 1:*** *Smoothed solar flux from 11 June 1988 to 25 March 1989 courtesy of G3ENY*




## First G/JA QSO on 6m

I have received a QSL card acknowledging my QSO with Yoshi JH41UO on 25 February at 0900hrs. The card confirmes that this was the first 9/JA QSO on 6m.

Old records confirm that my QSO with VS6UP on 25 February was the first two-way contact on 6m between VS6 and G. The QSL card was received on 15 March and endorsed, 'First VS6/G 6m QSO'.

In Zambia, 9J2KF was recently worked on 6m by 9H1 station. His name is Kiyo. QSL him via POB 30027, Lusaka, Zambia.

In Argentina, during the opening to Europe on 20 March, LU8MBL worked nineteen G stations: 5GW, 2GI, 5GW, 2PA, 9H1CG, and a DJ crossband. His locator is FF57. QSL information to Gerado Salvador Ruiz, Colon 1081 Godoy Cruz, Mendoza, Argentina.

On 20 March at 0833hrs, G4FJK had the first G/VK QSO on 6m. Tim heard Peter VK6KXW call CQ on CW and replied to him on CW. VK6KXW responded on SSB, giving 45, and Tim replied on 57. G4FJK operates an Icom 551 using 10W to a five-element Tonna. Tim will be better known under his old callsign of VP2VGR; a well-known callsign during the last solar cycle.

## New UK beacon

The GB3BUX beacon became active on 50.000 on 21 March and on the 22nd it was copied by ZS6CE. The VK8VF beacon is being moved on to 50.056; this will be helpful when all the important beacons are within the beacon band.

That concludes one of the best periods I have ever reported. Many thanks to all those who have sent me so much useful information, and good luck to those who are taking part in this outstanding cycle.

Please send your reports to Ken Ellis G5KW, 18 Joyes Road, Folkestone, Kent CT19 6NX.

# JOIN THE QRP FUN ON 80 METRES

by George Dobbs G3RJV

### QRP operation

Almost anyone who has used CW on the 80m band (3.5 to 3.6MHz) will have noticed the large number of QRP (low powered) stations which operate on that band. Most of them are members of the G QRP Club and enjoy taking a few watts of RF power on to the band, especially if they can work fellow QRP operators. Many of these stations use home-built, and often very simple, equipment.

What is QRP? Well, the international definition is a transmission which does not exceed 5W of RF output.

Why use such low levels of power? Some people enjoy QRPing just for the fun of it and to pit their wits and skills against others on the bands using more conventional powers. Naturally, the station's chances of causing TVI are reduced when running lower levels of power. Some people enjoy building simple equipment which can be used to put a few watts on to the band. Behind all of this is the ethic that it is folly to use more power than is required to make communication possible.

What can be achieved with lower powers? The answer to that depends on the type of antenna you use, but many stations have results similar to those achieved with conventional levels of power. After all, remember that one 'S unit' is a 3dB change, which is a four-fold power change. Therefore, in theory, reducing the power of a station by four times only makes it a single S point down.

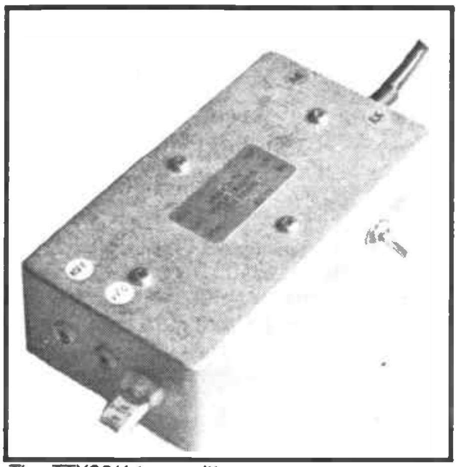
Many operators have found a new lease of life for their hobby by using QRP on the bands. Several of them work on 80m around the international QRP calling frequency of 3560kHz.

There are many circuits and kits available for building QRP transmitters. Not all radio amateurs are constructors and some may prefer buying a small transmitter to work QRP on 80m. Until recently, apart from expensive multiband QRP transceivers, there has been little choice other than building one's own QRP transmitter.

A new company, Signal Designs, have produced a compact transmitter module for QRP working on the 80m band. Their TTX80/4 transmitter can be used with an 80m receiver (or the receive portion of a transceiver) to put a genuine QRP CW signal on 80m. There is nothing to build because the module is complete and ready to use and could be an easy way of trying QRP. It could also be a simple way for a beginner, who already has a receiver, to become active on the band at a modest cost.

### The TTX80/4 transmitter

The TTX80/4 is a small solid-state transmitter which is housed in a die-cast aluminium box. The basic transmitter is crystal-controlled, but an optional VFO is available. The transmitter works from 12 to 14V dc and has a nominal output of 4W.



*The TTX80/4 transmitter*

The power line has reverse polarity protection, therefore the user cannot damage the unit by connecting the supply the wrong way round. The output stage has built-in protection and is terminated with a low pass filter to give a clean output signal at 50 ohms impedance. The only control is a simple transmit/receive switch which also changes over the antenna from the transmitter to the receiver.

When I received a prototype TTX80/4 to test, I gave into my usual temptation and reached for the screwdriver. When I removed the cover I was surprised to find that there was no PCB. The transmitter is built on a system of point-to-point wiring. This is not as odd as some may think. Recently I had the pleasure of entertaining Roy Lewallen W7EL, a well-known authority on QRP equipment, design and construction. His design, 'The Optimised QRP Transceiver', published in **QST**, has become a world-wide classic. Roy only uses point-to-point construction techniques in his equipment and swears by its reliability in RF equipment. The inside of the TTX80/4 transmitter is rugged, robust and neat – all indications of good construction.

### Using the TTX80/4

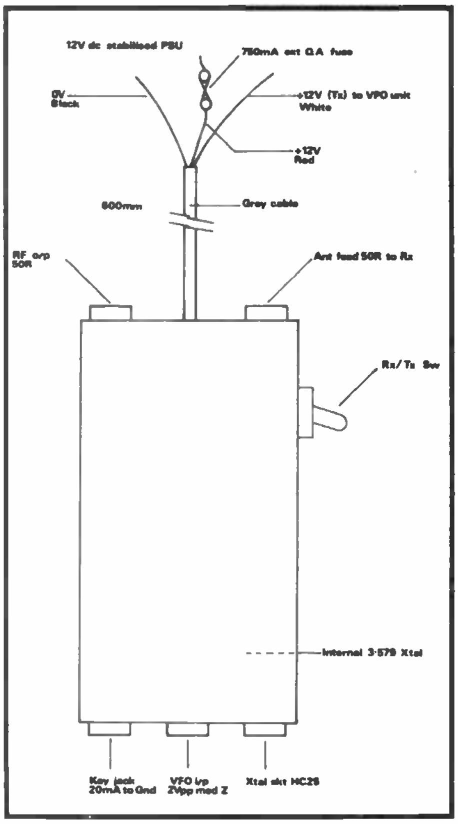
**Fig 1** shows the control and termination layout of the transmitter. Using the TTX80/4 is very simple. The transmitter is connected to a 12V stabilised dc supply with two fly leads; a 750mA in-line fuse is advised. The antenna and receiver are connected. The key jack (3.5mm) keys to ground in the usual way. The transmitter needs a fundamental crystal with an HC25 housing.

A crystal on 3.579 is supplied with the transmitter. Although 3.579 is not the ideal frequency, many QRP stations use it as a second choice if they are crystal-controlled, because these crystals are so readily available. Alternative crystals for the band are easily obtained from the source in Table 1.

A few precautions are necessary when air testing the transmitter. The receiver *must* be connected to the Rx socket, and the transmitter should be fed into a 50 ohm load. Although the output stage is designed to cope with mismatches, long key-down periods with a mismatch are to be avoided. If you are not using an 80m dipole or some other 50 ohm terminated antenna, an ATU will be required to bring the SWR down to 2:1, or better.

The crystal oscillator's load capacity is greater than 30pF, so the oscillator frequency will be slightly lower than the stated crystal frequency. This gives the user more scope for external crystal pulling in a VXO (variable crystal oscillator) circuit. The simplest method is to add a series variable capacitor (less than 100pF) to the crystal. There is an input socket for an external VFO (variable frequency oscillator) which can be home-built or the VFO80 can be supplied by Signal Designs. The VFO jack disconnects the crystal. The required VFO signal is in the order of 2V peak-to-peak at medium impedance (about 300 to 600

***Fig 1:*** *The control and termination layout of the TTX80/4*



ohms). The fly lead also has a 12V (transmit) lead to feed the VFO.

### On the air

I soon had the TTX80/4 working on the air and, by chance, as soon as I had the transmitter set up to my trusty old Drake 2B receiver and G5RV antenna, I heard an HA calling CQ. I gave him a quick 'two-by-two' call and he came back with a report of 569. I have a number of 80m crystals, and enjoyed several sessions on the band with the TTX80/4 and Drake 2B combination. I worked a good selection of G stations, including some two-way QRP contacts and several European countries. The signal sounded clean and stable. It may seem crude to some 'whizz rig' operators to be crystal-controlled with a manual changeover, but this is *real* amateur radio.

### The verdict

I liked the TTX80/4. It will never set the amateur radio world on fire but it is a simple, well-built transmitter which certainly does all the makers claim of it. For an individually hand-built unit using good quality components, the price is fair. I hope that the appearance of this transmitter on the market will encourage more radio amateurs to try QRP on 80m, and enjoy this satisfying facet of our hobby. It could also provide the radio amateur with a limited budget with a convenient way of getting on to an HF band.

## SPECIFICATIONS

| | |
|---|---|
| Construction | Integral die-cast case, measuring 120mm × 65mm × 40mm |
| Weight | 300gm |
| Connectors | Receiver and antenna, coax sockets, Morse key and external VFO, 3.5mm jack sockets, xtal socket, HC25, dc connections and flying-lead |
| Power supply | 13.2V nominal, 14V dc maximum, 750mA maximum |
| Frequency | 3.5 to 3.6MHz, xtal-controlled or external VFO |
| Power output | 4W nominal, 3.5W minimum in 50 ohms at 13.2V dc |
| RF filtering | Multisection LPF, harmonics −40dB minimum in 50 ohms |
| Protection | Reverse polarity and current control |
| Keying | 20mA contact to ground, envelope-shaped |
| Antenna | Integral miniswitch, 'Net' signal, receiver isolation 40dB minimum at 50 ohms |

The TTX80/4 is supplied with a 3.579kHz crystal and all mating connectors. The price is £40.50 plus £1.75 p&p. Cheques/PO are payable to C Plimmer. For more information about the TTX80/4, the VFO80 and VFO contact Signal Designs, 112 Drift Road, Clanfield, Hants PO8 0PE.

**80m fundamental crystals**

Crystals for the TTX80/4 are available at 3540, 3550 and 3560kHz (QRP calling frequency), and retail for £4.00 each, including VAT and postage (£3.50 to G QRP Club members).

Further details are available from Golledge Electronics, Merriott, Somerset TA16 5NS

**The G QRP Club**

Details about the club and a sample copy of their journal SPRAT can be obtained from David Jackson G4HYY, Castle Lodge West, Halifax Road, Todmorden, Lancs OL14 5SQ

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■ GEC BRT400 Rx, £100.00, or exchange for Trio RS99 Rx. Lafayette general coverage Rx, fifteen valves, calibrator and Q multiplier. Offers or exchange for Trio RS99 Rx or similar. J Wright, 54 Queen Mary Avenue, Basingstoke, Hants RG21 2PG. Tel: (0256) 468649

■ Bearcat BC950 XLT scanner, one month old, unwanted present. Base/mobile 29-54, 118-136, 144-174, 406-512, 806-956MHz, £200.00. Tel: (0272) 248679 days, 685767 evenings. Ask for Keith

■ Solartron double beam oscilloscope, type CD711, S2. Offers. Buyer collects. Mrs Lawton, 26 Church Lane, Wadworth, Doncaster, S Yorks

■ 1920 (approx) Burndet horn speaker; 1933 AC74 EKCO radio (not working); 1935 AC85 EKCO radio (working); 3-speed Brennar tape recorder (not working). Offers invited. Mr Elmes, 261 Preston Drive, Brighton BN1 6FL. Tel: Brighton 502159

■ NRD525 comms receiver, comes with NRD, NVA 88 ext spkr, £700.00. Pocom all mode RTTY CW converter, £500.00. ICS PK232 RTTY CW converter, comes with IBM disc, not used, £200.00. Dressler ARA active antenna, £60.00. ERA 30, BP 34, SSB, CW audio filter, £60.00. Racal RA17 comms receiver, comes with very rare seven digit LED readout unit, superb condition, £450.00. 2 Beare Green Cottages, Beare Green, Nr Dorking, Surrey RH5 4PE. Tel: (0306) 712878

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■ Icom IC3210E dual bander, 2m/70cm. Three months old, as new, nine months warranty left (ARE). Bargain at £400.00 cash, incl dual band mobile aerial. Kevin. Tel: 01-491 0040 days, (0532) 646342 weekends

■ Antenna tuning unit, military type No 9. Excellent condition, as new, olive green colour. Sold at radio rallies for around £30.00, my price, £25.00, and I will pay for the carriage by Securicor. George Jacob, 23 Waterloo Gardens, Penylan, Cardiff CF2 5AA. Tel: (0222) 487299

■ Icom IC-735 HF transceiver, with matched PSU and base mic. Unused and boxed. Cash offers. Write to Mr C Taylor, 2 Picton Place, Carmarthen, Dyfed SA31 3BY

■ Breaking a BBC-B issue 7 computer. Most parts available. Also Z80 second processor outfit, £95.00, and Acorn speech system, £10.00. Both complete with manuals, etc. Consider exchange for anything BBC/Airband. Tim Hargreaves, 23 Clandon Avenue, Tunstall, Stoke-on-Trent ST6 5UX. Tel: (0782) 838554

■ Collins 51J4 G/C receiver, similar to amateur version 75A4, with three mech filters. B40 needs repair. WS38, WS58, WS19. OZ8RO, Rag Otterstad, Vejdammen 5, DK-2840, Holte. Tel: 010-452 801875

■ Ham International multimode 11, £60.00 ONO. Tel: (0244) 570738 after 4.30pm

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■ Advance DB 'scope, type OS1000A, perfect, £175.00. Copper laminate boards 100 4¼in x 16¼in, 50p each or £40.00 the lot. 340 radio mags **PW, PE, RC**, 1954-1973, 10p each or £30.00 the lot. Yaesu FDRX 400, 11 band Rx with matching spkr and Joymatch III aerial tuner, £120.00. AR2001 scanner, 25MHz to 550MHz, £125.00. Will swap all or part for best keyboard or organ. J Knowles, 41 Legh Road, Haydock, Nr St Helens, Lancs SA11 0EH. Tel: (0744) 27067

■ Icom ICR71E, FM fitted, boxed, as new, £560.00. Icom ICR7000, boxed, as new, £650.00. Wrasse SC1 SSTV transmit/receive, fax/receive, £600.00. Tel: (0634) 828952 (Medway)

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■ Racal RA98 SSB adapter, in good condition but has two valves missing, £25.00. Pye Vanguard AM25T Tx/Rx with manual, Pye mic and control box for spares, £10.00. Heathkit valve audio signal generator, £8.00. Levers-Rich EM242P studio mastering tape deck, 30-60IPS, in steel case with some electronics, £30.00. Buyer collects. Tel: (0425) 622306 (New Milton, Hants)

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■ Marconi TF995A 3/S signal generator. As new, with all accessories, in case, with manual. 1.5 to 220MHz, AM, FM. With internal meter to monitor, RF/mod/dev, and xtal calibrator, £55.00. Martin. Tel: (0742) 746550

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■ 12-element ZL for 2m, £15.00. SEM 2m preamp BF981 var gain, £10.00. JEP terminal unit, RTTY, CW, etc, £5.00. Tel: (0483) 233991 (Guildford)

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■ FT290R Mk1, Ni-Cads, ⅝ x 3 Sandpiper collinear, 10m Pope 100 coax, £275.00, or part exchange for 2m multimode capable of voice readout. GW1XUK. Tel: Penmaenmawr 623672

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■ Circuit board etching tweezers, 20p per pair. Money or stamps accepted plus SAE. Tweezers are all new, made by Rolon, and are suitable for photographic developing, stamp mounting etc. By post only from Mr Lawrence, 7 Griffin Crescent, Littlehampton, Surrey BN17 7LH

## WANTED

■ Datapoint 1500 computer, model 96-1501-002(1), serial 130669, Ventec type 3000, serial D877. Ventec Diskette 1500, model 98-1542-002(5), serial 149951. Made approx 1979. Any information, circuit diagrams, user guide, spares, etc. Will pay costs of copying and postage. Tel: (0946) 832883 evenings

■ 680X for spares. Also Wobulator up to 10MHz range. J Wright, 54 Queen Mary Avenue, Basingstoke, Hants RG21 2PG. Tel: (0256) 468649

■ BBC enthusiasts for pen-pals and to exchange ideas and information. Tim Hargreaves, 23 Clandon Avenue, Tunstall, Stoke-on-Trent ST6 5UX. Tel: (0782) 838554

■ German WW2 ex-service equipment. Will collect. OZ8RO. Rag Otterstad, Vejdammen 5, DK-2840, Holt. Tel: 010-452 801875

■ Variable PSU in good condition, 0-30V. Tel: (0634) 828952 (Medway)

■ Information wanted on Diablo Hi-Type II printer, PerSci dual 8in disc drives, Kalamazoo K2000C computer. Borrow or buy useful data. F Burlingham, Ground Floor Flat, 5 Marine Parade, Peel, Isle of Man

■ AOR AR2001 or AR2002. Will collect. Tel: (0235) 33030

■ Will exchange Admiralty handbooks, volumes 1 and 2, in good condition, for a set of high resistance headphones in good condition. G E Glover, 8 Queensway, Kearsley, Bolton BL4 8LP. Tel: (0204) 75345

■ Sony CRF320 or 330 world zone short wave receiver. Condition not important. Good cash price paid and collection arranged anywhere in UK or N Ireland. V Ambrose, 20 Cambridge Street, Wymington, Rushden, Northants NN10 9LK. Tel: (0933) 56087

■ **Radio Constructor** magazines, 1965-80. Old din meter. Old Sinclair miniature TVs. Spares, servicing information and other data for the Sinclair miniature TV. Valve data books. D E Jones. Tel: 01-249 4829

■ GW brass Morse key on slate base. Must be in VGC. Tel: (0228) 41309 after 5pm

■ Copy of H Gibson's **Test Equipment for the Radio Amateur**. Tel: (0626) 864486

■ SEM Transmatch. Prefer with Esitune and dummy load fitted, but will take one without. Tel: (0626) 864486

■ BBC test card music from the 1950s and 1960s and Music Reporting forms/play lists from any year. Also any photographs or videos of (or information about) BBC identification captions and test cards, in particular the BBC Test Card 'B' used in the 1940s. Does anyone have a copy of the BBC/BREMA 'Colour Receiver Installation Film'? This was shown many times on BBC-2 during 'Service Information' from 1967 when colour television began. Keith Hamer, 7 Epping Close, Derby DE3 4HR. Tel: (0332) 513399

■ Retired collector requires old ships' radios, Omega receiver, VLF receiver, Eddystone 770, TV camera with manual, T1154, R1155, 3cm (10GHz) dish waveguide and diode. Write to Woodhouse, 'Trenoweth', Porthpean, St Austell, Cornwall PL26 6AU

■ Wanted for experimental work, ac power unit 250/S, as used with Codar AT5 Tx. Price required and condition to Marris, 35 Kingswood House, Farnham Road, Slough, Berks SL2 1DA

■ FRG-9600 basic Mk1, Mk2 or Mk5. Cash waiting. S P Martin, 24 Collingwood Close, Worle, Weston-super-Mare, Avon BS22 9PQ

■ 934MHz Delta-One transceiver. Tel: (0702) 512814

■ VHF/UHF TV, minimum 5in screen. Must have Secam L + PAL, 5.0/6.0 6.5MHz sound, ac/dc. Would forgo Secam L for a JVC CX 610GB which must be in full working order. Tel: 01-505 6303

■ Blind radio operator seeks some assistance in putting up antennas. Tel: (0277) 823434 (Brentwood, Essex area)

■ Eddystone 990R receiver, also Hallicrafter S21 5/10 receiver, urgently required for OAP. Good price paid. Must be in good working order. R Hastie, 41 Elm Grove Drive, Dawlish, Devon EX7 0EY. Tel: Dawlish 862918

■ Belcom LS102 with conversion to 11m (26-30MHz). Will pay any reasonable price. Shaun. Tel: 051-928 7953 (Merseyside)

■ 1964 Hallicrafter SR-150 amateur band, fixed-mobile transceiver, 80-10m. Collins s/line KWM-2, SSB transceiver, 80-10m, circa 1964. Tel: (0734) 882899

# Amateur RADIO SMALL ADS



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Amateur RADIO SMALL ADS

This method of advertising is available in multiples of a single column centimetres—(minimum 2cms). Copy can be changed every month.

**RATES**
per single column centimetre:
1 insertion £7.00, 3 — £6.60, 6 — £6.30, 12 — £5.60.

## AMATEUR RADIO SMALL AD ORDER FORM

**TO:** **Amateur Radio · Sovereign House**
**Brentwood · Essex CM14 4SE · England · (0277) 219876**

**PLEASE RESERVE**..............centimetres by..............columns

**FOR A PERIOD OF** 1 issue........☐ 3 issues........☐ 6 issues.......☐ 12 issues........☐

**COPY** enclosed........☐ to follow........☐

**PAYMENT ENCLOSED:** (Add 15%VAT).... £ —

Cheques should be made payable to Amateur Radio. Overseas payments by International Money Order and Credit Card

**CHARGE TO MY ACCOUNT**........☐ CREDIT CARD EXPIRY DATE ☐☐ / ☐☐

COMPANY ..........................................................

ADDRESS ..........................................................

SIGNATURE .................................... TELEPHONE ....................

..........................................................

C P I

## WHOLESALE

Scanners and some amateur accessories delivered to your shop. Contact for a price list

**Parma House, 433 Wilmslow Road, Manchester M20 9AF**
**only 3 minutes from the M56**

# Pama & Co

**NATIONWIDE DELIVERY**

**DEALERS contact us today for very fast, Friendly Service, Competitive Prices, Widest Range & Latest CB Products**

**Order Line: 0800 262963**
**Tel: 061-445-8918 061-434-5701**
**Fax: 061-445-0978 Tlx: 666762 PAMACO G**

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## 2 METRE COLLINEAR UVRAL X2⁵/8over ⁵/8

An omni directional antenna giving low angle radiation. The ideal base station vertical. Ruggedly constructed for long life

**Technical Specification**

| | |
|---|---|
| Gain | :- 6 dB |
| Impedance | :- 50 Ohms |
| Max Power | :- 100 Watts |
| Length | :- 3.14 metres |
| SWR 144 to 146Mhz | :- Less than 1.5 |
| Wind Loading | :- 4.6 Kgf at 100mph |
| Weight | :- 1.2 Kgs |
| Mounting Diameter | :- 25mm |
| Termination | :- Free 'N' Socket |

N Plug extra, costs **£4.52 inc VAT**

Send cheque or postal order for **£33.96** inc VAT plus **£2.60** postage to:

**BUCKLEYS (UVRAL) LTD**
Beta Works, Range Road
Hythe, Kent CT21 6HG
Tel: (0303) 60127/60128

Various Frequencies Available

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## JAYCEE ELECTRONICS LTD

**20 Woodside Way, Glenrothes**
**Fife KY7 5DF**
**Tel: 0592 756962** (Day or Night)

Open: Tues-Fri 9-5; Sat 9-4; Sunday by appointment
Good range **Kenwood & Yaesu etc,** plus
Quality Secondhand Equipment

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## PSSS....

## ALL THE SUPER BARGAINS ARE ON THE INSIDE FRONT COVER

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## QUARTZ CRYSTALS and FILTERS

Large numbers of standard frequencies in stock for amateur, CB, professional and industrial applications. Stock crystals **£5.00** each (inc VAT and UK post). Any frequency or type made-to-order from **£6.50.** Phone or SAE for lists.

**GOLLEDGE ELECTRONICS**
**Merriott, Somerset TA16 5NS**
**Tel: (0460) 73718**

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## IAN FISHER COMMUNICATIONS OF STANHOPE

**CB Works, The Market Shop, Market Place, Stanhope, County Durham**
**☎ (0388) 528464**

Main Distributors of 27MHz CB radios and the NEW CEPT models including UNIDEN and DNT.
Including U.K. and CEPT walkie talkies.
Rather good ½ mile radius 2 channel walkie talkies £22.50 each
Large stocks of coaxial cable, plugs, sockets and adaptors.
Stockists of the new CT1600 Hand-Set. 800 channels covering 2mtrs. Price on request

**AIRBAND RADIO**

Very latest sonic 4=8342 multiband radio receiver airband +PMR from 54MHz to 176MHz two aerials £21.00
All available via mail order. Retail/Wholesale

OPEN: MON-SAT 10.30am-6.00pm SUN 2.30 - 4.30
RING FOR DETAILS (0388) 528464

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## AMIGA ACS SYSTEMS ATARI
## AMATEUR RADIO: COMPUTERS: SOFTWARE

| | |
|---|---|
| Atari Compack 1 RRP | Atari Compack 2 ........ RRP |
| Atari 520STM | Atari 520STFM |
| with ½MB ext drive .. £269.95 | with internal IMB drive ........ £299.95 |
| PK88 VHF/HF Packet TNC........ £109.95 | Pk232 7 mode TNC...... £279.95 |
| Packed Software + Cables....... £14.95 | Packet Software + Cable ........ £14.95 |
| TOTAL RRP ............ £394.85 | TOTAL RRP ............ £594.85 |
| Amsat/Rig Members . £374.90 | Amsat/Rig Members.. £544.90 |
| Amiga Fax Pack 1 ............ RRP | Commodore Compack 2.... RRP |
| Amiga A500............ £399.99 | New Type 64C (H/Pack) ........ £149.95 |
| Amiga Modulator ......... £24.95 | PK232 7 Mode TNC..... £279.95 |
| Amiga Fax (new version)........ £109.95 | Comm-Packratt ............ £59.90 |
| (few 1st issue Amiga Fax left @ £99.95) ............ £534.89 | TOTAL RRP ............ £489.85 |
| Amsat UK/Rig Member Rig Members only...... £459.94 | Amsat UK/Rig Members............ £463.90 |

All TNC's come with new CW ident update eproms: PK232 £15 set: PK88 £8 postage: Software 2.50: Printers/Computers 5.00: Terminals 4.00
All enquiries must include a large SAE or 2 IRC or 75p in stamps

**ACS Systems, 19 Cilhaul Terrace, Mountain Ash, Mid Glamorgan, South Wales CF45 3ND. Tel: 0443 476040**
**24 Hour Answer Service**

*Cheques payable to ACS Systems please*

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## MRZ COMMUNICATIONS LTD

NEWCASTLE UNDER LYME

# ICOM

RADIO EQUIPMENT

| | |
|---|---|
| **BUSINESS** | **AIR** |
| **MARINE** | **AMATEUR** |

**TEL: (0782) 619658**
**7 DAY SERVICE**

VISA

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## AGRIMOTORS

**MERTON CB AND RADIO CENTRE**
**MERTON GARAGE AND POST OFFICE, MERTON.**
**Nr OAKHAMPTON, DEVON EX20 3DZ**
OPEN 6 DAYS 9.30-5.30 LUNCH 1-2pm
EARLY CLOSING THURSDAY 1.00pm
(SUNDAYS BY APPOINTMENT)
SPECIALIST IN 934 MHz
SUPPLIERS OF ALL 27MHz AND 934 MHz EQUIPMENT
AMATEUR ACCESSORIES CATERED FOR
08053 200

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## SOUTH WALES ELECTROMART

Equipment, Components, Howes Kits, Eldy Kits, A.R. Gear & much more.

**Taillwyd Road (off Main Road)**
**Neath Abbey, Neath**
**Tel: (0639) 644111**

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## *ETESON ELECTRONICS*

E.E.

***158 Lower Green, Poulton-le-Fylde, Blackpool***
***Tel: (0253) 885107***

*Open: 9.30am - 12.30, 1.30 - 5.30. Closed Wed & Sun.*
*Electronic Component Specialists.*

*A wide range of electronic components, IC's, capacitors, transistors, resistors, plugs and sockets etc.*

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## Selectronic

Radio communications and scanning receiver specialist

**203 High Street**
**Canvey Island, Essex,**
**Tel: 0268 691481**
(Open Mon-Sat 9-5.30)

Amateur radio equipment also in stock

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## JAPANESE Ic's (PART OF OUR RANGE)

AN7178 £2.95, BA5406 £2.20, HA1377 £2.20, HA1392 £2.50, HA1394 £2.95, HA1397 £2.75, HA1398 £2.75, HA13001 £2.95, LA4460 £1.80, LA4461 £1.80, LA4507 £4.25, LC7137 £4.50, M51517 £2.80, MB3705 £1.80, MB3712 £1.50, MB3722 £3.50, MB3730 £2.90, MB3731 £3.50, STK461 £7.50, STK463 £8.40, TA7205AP £1.00, TA7222AP £1.30, TA7240 £2.95, TA7241 £2.95, TA7270 £2.75, TA7271 £2.75, TA7274 £2.95, TA7280 £3.50, TA7281 £2.95, TA7282 £2.95, TA7283 £2.95, TA7288 £2.95, TA7611 £3.20, UPC575 £1.00, UPC1156 £2.95, UPC1181 £1.18, UPC1182 £1.10, UPC1185 £2.50, UPC1188 £2.75, UPC1230 £2.50, UPC1263 £2.50, UP1277 £2.75, UPC1278 £2.75, UPC1385 £3.60, UPC1394 £1.95.

ADD 60p POST AND PACKING AND THEN ADD 15% VAT TO TOTAL

**T POWELL 16 PADDINGTON GREEN LONDON W2 1LG**
**OPEN MON-FRI 10AM-5PM, SAT 9AM-12 NOON.**
**TELEPHONE: 01 723 9246**
**ACCESS/VISA. TELEPHONE ORDERS ACCEPTED OVER £5.00**

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## TURN YOUR SURPLUS

IC's TRANSISTORS etc, into cash, immediate settlement. We also welcome the opportunity to quote for complete factory clearance.

**CONTACT:**

**COLES-HARDING & CO**
**103 South Brink, Wisbech, Cambs**
**TEL: 0945 584188/Fax. No. 0945-588844**
Est Over 10 years

# ADVERTISERS INDEX



Amateur RADIO

## ADVERTISING RATES & INFORMATION

### DISPLAY AD RATES

| depth mm x width mm | ad space | 1 issue | 3 issues | 6 issues | 12 issues |
|---|---|---|---|---|---|
| | | | series rates for consecutive insertions | | |
| 61 x 90 | ⅛ page | £86.00 | £82.00 | £59.00 | £53.00 |
| 128 x 90 or 61 x 186 | ¼ page | £115.00 | £110.00 | £105.00 | £92.00 |
| 128 x 186 or 263 x 90 | ½ page | £225.00 | £210.00 | £200.00 | £180.00 |
| 263 x 186 | 1 page | £430.00 | £405.00 | £385.00 | £345.i0 |
| 263 x 394 | double page | £830.00 | £780.00 | £740.00 | £660.00 |

### COLOUR AD RATES

| depth mm x width mm | ad space | 1 issue | 3 issues | 6 issues | 12 issues |
|---|---|---|---|---|---|
| | | colour rates exclude cost of separations | series rates for consecutive insertions | | |
| 128 x 186 or 263 x 90 | ½ page | £305.00 | £290.00 | £275.00 | £245.00 |
| 263 x 186 | 1 page | £590.00 | £550.00 | £530.00 | £470.00 |
| 263 x 394 | double page | £1,130.00 | £1,070.00 | £1,010.00 | £900.00 |

### SPECIAL POSITIONS

Covers: Outside back cover 20% extra, inside covers 10% extra
Bleed: 10% extra (Bleed area = 307 x 220)
Facing Matter: 15% extra

### DEADLINES

*Dates affected by public holidays

| issue | colour ad | mono proof ad | mono no proof & small ad | mono artwork | on sale thurs |
|---|---|---|---|---|---|
| May 89 | 29 Mar 89 | 30 Mar 89 | 5 Apr 89 | 7 Apr 89 | 27 Apr 89 |
| June 89 | 26 Apr 89 | 27 Apr 89 | 3 May 89 | 5 May 89 | 25 May 89 |
| July 89 | 31 May 89 | 1 Jun 89 | 7 Jun 89 | 9 Jun 89 | 29 Jun 89 |
| Aug 89 | 28 Jun 89 | 29 Jun 89 | 5 Jul 89 | 7 Jul 89 | 27 Jul 89 |

### CONDITIONS & INFORMATION

**SERIES RATES**
Series rates also apply when larger or additional space to that initially booked is taken.

An ad of at least the minimum space must appear in consecutive issues to qualify for series rates.

Previous copy will automatically be repeated if no further copy is received.

A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received.

Display Ad and Small Ad series rate contracts are not interchangeable.

If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

**COPY**
Except for County Guides copy may be changed monthly.

No additional charges for typesetting or illustrations (except for colour separations).

For illustrations just send photograph or artwork.

Colour Ad rates do not include the cost of separations. Printed – web offset.

**PAYMENT**
Above rates exclude VAT.
All single insertion ads are accepted on a pre-payment basis only, unless an account is held.
Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by the publication date.
Overseas payments by International Money Order or credit card.

**FOR FURTHER INFORMATION CONTACT**
Amateur Radio, Sovereign House, Brentwood, Essex CM14 4SE
(0277) 219876

Commission to approved advertising agencies is 10%.

**CONDITIONS**
10% discount if advertising in both Amateur Radio and Radio & Electronics World.
A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

## No. 1 LIST BAKERS DOZEN PACKS

All packs are £1 each, if you order 12 then you are entitled to another free. Please state which one you want. Note the figure on the extreme left of the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

BD2 5 13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
BD7 4 In flex switches with neon on/off lights, saves leaving things switched on.
BD9 2 6V 1A mains transformers upright mounting with fixed clamps.
BD11 1 6½in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
BD13 12 30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
BD22 2 25 watt loudspeaker two unit crossovers.
BD29 1 B.O.A.C. stereo unit is wonderful value.
BD30 2 Nicad constant current chargers adapt to charge almost any nicad battery.
BD32 2 Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
BD42 5 13A rocker switch three tags so on/off, or change over with centre off.
BD45 1 24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day, original cost £40 each.
BD49 10 Neon valves, with series resistor, these make good night lights.
BD56 1 Mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
BD59 2 Flat solenoids—you could make your multi-tester read AC amps with this.
BD67 1 Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
BD91 1 Mains operated motors with gearbox. Final speed 16 rpm, 2 watt rated.
BD103A 1 6V 750mA power supply, nicely cased with mains input and 6V output leads.
BD120 2 Stripper boards, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc.
BD122 10m Twin screened flex with white pvc cover.
BD128 10 Very fine drills for pcb boards etc. Normal cost about 80p each.
BD132 2 Plastic boxes approx 3in cube with square hole through top so ideal for interrupted beam switch.
BD134 10 Motors for model aeroplanes, spin to start so needs no switch.
BD139 6 Microphone inserts—magnetic 400 ohm also act as speakers.
BD148 4 Reed relay kits, you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets.
BD149 6 Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
BD180 6 Neon indicators in panel mounting holders with lens.
BD193 6 5 amp 3 pin flush mounting sockets make a low cost disco panel.
BD196 1 in flex simmerstat—keeps your soldering iron etc. always at the ready.
BD199 1 Mains solenoid, very powerful, has 1in pull or could push if modified.
BD201 8 Keyboard switches—made for computers but have many other applications.
BD210 4 Transistors type 2N3055, probably the most useful power transistor.
BD211 1 Electric clock, mains operated, put this in a box and you need never be late.
BD221 5 12V alarms, make a noise about as loud as a car horn. Slightly soiled but OK.
BD242 2 6in x 4in speakers, 4 ohm made from Radiomobile so very good quality.
BD252 1 Panostat, controls output of boiling ring from simmer up boil.
BD259 50 Leads with push-on ¼in tags—a must for hook-ups—mains connections etc.
BD263 2 Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress.
BD268 1 Mini 1 watt amp for record player. Will also change speed of record player motor.
BD283 3 Mild steel boxes approx 3in x 3in x 1in deep—standard electrical.
BD293 50 Mixed silicon diodes.
BD305 1 Tubular dynamic mic with optional table rest.

**VERY POWERFUL 12 VOLT MOTORS—⅓rd HORSEPOWER.** Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £15.00 plus £2.00 postage. Our ref 15P8.

**WHITE CEILING SWITCH** 5 amp 2 way surface mounting with cord and tassle. Made by the famous Crabtree Company. Price £1 each. Our ref BD528.

**13A SWITCH SOCKETS** Top quality made by Crabtree, fitted in metal box with cutouts so ideal for garage, workshop, cellar, etc. Price £2 each. Our ref 2P37.

## POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, workroom etc. Makes you feel better and work harder—a complete mains operated kit, case included. £12.50+£2 P&P. Our ref 12P5/1.

**ULTRA SONIC INTRUDER ALARM.** Small, nicely cased, will detect movement in a room up to 10m×10m. Ingenious construction makes it independent of the mains; cannot be switched off, even with its on/off switch, until you know the secret, has delayed action enabling you to switch it on and leave the room; it has an inbuilt piezo sounder which is very penetrating and high pitched and would frighten away most intruders. Has internal switching and could be coupled to an outdoor alarm if required.
It is the basis of a very efficient burglar alarm, or has other uses. For instance: you could disconnect the internal sounder and using the internal switches you would know when somebody arrives without that person being aware that you know. Similarly, the unit could be used to operate other equipment ultra-sonically. It is brand new, guaranteed OK, complete but less battery (PP3 alkaline type). Price is £20 plus £3 insured delivery. Our ref 20P11.

**110 DECIBEL HORN.** For use with the ultra sonic intruder detector. Ideal for external positioning to attract the attention of neighbours should you have an intruder. This unit has its own mounting bracket and comes complete with good length of lead. Price £7. Our ref 7P9. Incidentally, this could also be used as a loudspeaker.

**THREE CAMERAS** All by famous makers, Kodak, etc. One disc and two different instant cameras. All in first class condition, believed to be in perfect working order but sold as untested. You can have them for £10 the three, including VAT, which must be a bargain—if only for the lenses, flash gear, etc. Our ref 10P58.

**ATARI 65XE COMPUTER** At 64K this is most powerful and suitable for home and business. Brand new, complete with PSU, TV lead, owner's manual and six games. Can be yours for only £45 plus £3 insured delivery.

**DATA RECORDERS** ACORN for Acorn Electron, etc., reference number ALF03, with TV lead, manual and PSU. Brand new. Price £10 plus £1.50 post. Order ref 10P44.

**ATARI XC12** for all their home computers. With leads and handbook. Brand new. Price £15 plus £2 post. Order ref 15P20.

**JOYSTICK FOR ATARI OR COMMODORE** for all Atari and Commodore 64 and Vic20. New. Price £5. Order ref 5P126.

**EXTRA SPECIAL OFFER** We will supply the Atari 65XE, data recorder XC12, joystick and six games for £57.50 plus £4 insured delivery.

**SUB-MIN TOGGLE SWITCH** Body size 8mm x 4mm x 7mm SBOT with chrome dolly fixing nuts. 4 for £1. Order Ref. BD649.

**SOUND TO LIGHT UNIT.** Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼in. sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form.

**WALKMAN TYPE PERSONAL STEREO CASSETTE PLAYERS.** These are not second hand but are slightly reject and may need some attention. All are complete with stereo headphones and are famous makes: Sanyo, Panasonic, Sony, etc. Stereo cassette type, no radio, £5 each. Our ref 5P132.

**SPECIAL OFFER** is ten of the cassette only version, our ref 5P132, for £40. This offer is our ref 40P3.

**RE-CHARGEABLE NICADS 'D' SIZE**
These are tagged for easy joining together but tags, being spot welded, are easy to remove. Virtually unused, tested and guaranteed. £2.00 ref 2P141 or 6 wired together for £10.00 ref 10P47.

## LASER TUBE

Made by Philips Electrical. New and unused. This is helium-neon and has a typical power rating of 1.6mW. It emits random polarised light and is completely safe provided you do not look directly into the beam when eye damage could result. DON'T MISS THIS SPECIAL BARGAIN! Price £29.95 plus £3 insured delivery.

POWER SUPPLY FOR PHILIPS LASER available in kit form, Price £15 plus £2 postage.

**PAPST AXIAL FAN—MANUFACTURERS REF NO. TYP4580N.**
This is mains operated. 15 watt rating and in a metal frame with metal blades so OK in high temperatures. Body size approx. 4¾" square x 1⅝" thick. £6.00 each, plus £1.00 postage. Our ref 6P6.

**VERY POWERFUL MAGNETS** Although only less than 1" long and not much thicker than a pencil these are very difficult to pull apart. Could be used to operate embedded reed switches, etc. Price 50p each, 2 for £1.00. Ref BD642.

**ORGAN MASTER** is a three octave musical keyboard. It is beautifully made, has gold plated contacts and is complete with ribbon cable and edge connector. Brand new, only £12 plus £3 postage. Order ref. 12P5.

**MUSIC FROM YOUR SPECTRUM 128** We offer the Organ Master three octave keyboard, complete with leads and the interface which plugs into your 128. You can then compose, play, record, store, etc., your own music. Price £19 plus £3 special packing and postage. Order ref. 19P1.

**20A DOUBLE POLE RELAY WITH 12V COIL** complete with mounting brackets. made by the Japanese Omron Company. Price £2 each. Our Ref. 2P173A.

**HAND-HELD VIDEO LAMP.** Mains operated and will enable you to take professional standard videos. Made by the famous Ferguson Company, this uses a 1000w halogen lamp in a fan cooled, hand-held and hand-switched metal housing. Comes complete with optional barn-door assembly and camera bar. Obviously intended to retail at over £60, we offer these at £30 each plus £3 insured delivery. Our ref 30P3.

**AN ALLADIN'S CAVE** We have opened another shop in Hove, the address is number 12 Boundary Road which is between Hove and Portslade fairly close to the seafront. When you want to see before you buy and when you want to browse around the special bargains available, this is where you should make for as the Portland Road shop in future will be just mail order. You can of course collect from Portland Road but you should bring in an order complete with reference numbers so that the stores can attend to it easily.

## J & N BULL ELECTRICAL

**Dept AR, 250 PORTLAND ROAD, HOVE**
**BRIGHTON, SUSSEX BN3 5QT**

**MAIL ORDER TERMS:** Cash, PO or cheque with order. Orders under £20 add £1.50 service charge. Monthly account orders accepted from schools and public companies. Access and B/card orders accepted. **Brighton (0273) 734648 or 203500**

### POPULAR ITEMS

**Some of the many items described in our current list which you will receive if you request it**

**DOUBLE MICRODRIVES.** We are pleased to advise you that the Double Microdrives which we were offering at about this time last year as being suitable for the 'QL', 'OPD' and several other computers are again available, same price as before namely £5. Our ref 5P113.

**SOFTWARE FOR REMAKING.** Just arrived. Large quantity of mainly games. All are on normal tape spool in cassette holders and should be suitable for wiping out and re-making into games or programmes of your own design. We offer 5 different for £2 or 100 assorted for £20. Important note: We cannot say which titles you will get nor accept orders for specified titles or 'so many, all different', etc., so only order if you can take them as they come. Order ref 5 for £2 is 2P224, 100 assorted is 20P10.

**VERY USEFUL MAGNETS.** Flat, about 1in long, ½in wide and ¼in thick. These are polarised on their faces which makes them ideal to operate reed switches in doors and windows or to hold papers or labels, etc., to metal cabinets, or even to keep cupboard doors firmly closed. Very powerful. 6 for £1. Our ref BD274(a).

**9in MONITOR** made for ICL, uses Phillips black and white tube. Brand new and complete but uncased. £16.00 plus £5.00 post.

**ACORN COMPUTER DATA RECORDER REF ALF03** Made for the Electron or BBC computers but suitable for most others. Complete with mains adaptor, leads and handbook. £10.00. Ref 10P44.

**FREE POWER!** Can be yours if you use our solar cells—sturdily made modules with new system bubble magnifiers to concentrate the light and so eliminate the need for actual sunshine—they work just as well in bright light. Voltage input is .45—you join in series to get desired voltage—and in parallel for more amps. **Module A** gives 100mA, Price £1, Our ref. BD631. **Module C** gives 400mA, Price £2, Our ref. 2P199. **Module D** gives 700mA, Price £3, Our ref. 3P42.

**SOLAR POWERED NI-CAD CHARGER** 4 Ni-Cad batteries AA (HP7) charged in eight hours or two in only 4 hours. It is a complete, boxed ready to use unit. Price £6. Our ref. 6P3.

**SWITCH AC LOADS WITH YOUR COMPUTER** This is easy and reliable if you use our solid state relay. This has no moving parts, has high input resistance and acts as a noise barrier and provides 4kW isolation between logic terminals. The turn-on voltage is not critical, anything between 3 and 30V, internal resistance is about 1K ohm. AC loads up to 10A can be switched. Price is £2 each. Ref. 2P183.

**METAL PROJECT BOX** Ideal size for battery charger, power supply, etc.; sprayed grey, size 8in x 4¼in x 4in high, ends are louvred for ventilation other sides are flat and undrilled. Price £2. Order ref. 2P191.

**BIG SMOOTHING CAPACITOR.** Sprague powerlytic 39,000uF at 50V. £3. Our ref. 3P41.

**4-CORE FLEX CABLE.** Cores separately insulated and grey PVC covered overall. Each copper core size 7/0.2mm. Ideal for long telephone runs or similar applications even at mains voltage. 20 metres £2. Our ref 2P196 or 100 metres coil £8. Order ref. 8P19.

**6-CORE FLEX CABLE.** Description same as the 4-core above. Price 15 metres for £2. Our ref. 2P197 or 100 metres £9. Our ref 9P1

**TWIN GANG TUNING CAPACITOR.** Each section is 0005μf with trimmers and good length ¼in spindle. £1 each. our ref BD630.

**13A PLUGS** Pins sleeved for extra safety, parcel of 5 for £2. Order ref. 2P185.

**13A ADAPTERS** Takes 2 13A plugs, packet of 3 for £2. Order ref. 2P187.

**20V-0-20V** Mains transformers 2½ amp (100 watt) loading, tapped primary. 200-245 upright mountings £4. Order ref. 4P24.

**BURGLAR ALARM BELL**—6" gong OK for outside use if protected from rain. 12V battery operated. Price £8. Ref. 8P2.

**VERY RELIABLE CAPACITOR** 4.7μ 400v not electrolytic so not polarised, potted in ali can, size 1¾x¾x1½in high. A top grade capacitor made for high class instrument work. Ideal for PCB mounting. 2 for £1. Our ref BD667.

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**CAPACITOR BARGAIN**—axial ended, 4700μF at 25V. Jap made, normally 50p each, you get 4 for £1. Our ref. 613.

**SINGLE SCREENED FLEX** 7.02 copper conductors, pvc insulated then with copper screen, finally outer insulation. In fact quite normal screened flex. 10m for £1. Our ref BD668. Ditto, but solid conductor. 10m for £1. our ref BD668a.

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**TELEPHONES.** We have just received a consignment of desk telephones, rotary dial type, in good working order and in new condition. We offer these at £5 each plus £2 special packing and postage. This model would have the connecting lead with four tags for going into the old type junction box. Our ref 5P134. Or for £6 you can have the same telephone but with the new flat BT type plug fitted. Our ref 6P10.

**3-CORE FLEX BARGAIN No. 1**—Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm for £2. ref. 2P189.

**3-CORE FLEX BARGAIN No. 2**—Core size 1.25mm so suitable for long extension leads carrying up to 13 amps, or short leads up to 25A. 10m for £2. Ref. 2P190.

**ALPHA-NUMERIC KEYBOARD**—This keyboard has 73 keys giving trouble free life and no contact bounce. The keys are arranged in two groups, the main area is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13" x 4"—brand new but offered at only a fraction of its cost, namely £3, plus £1 post. Ref. 3P27.

**WIRE BARGAIN**—500 metres 0.7mm solid copper tinned and p.v.c. covered. Only £3 plus £1 post. Ref. 3P31—that's well under 1p per metre, and this wire is ideal for push on connections.

**1/8th HORSEPOWER 12 VOLT MOTOR** Made by Smiths, the body length of this is approximately 3in, the diameter 3in and the spindle 5 16th of an inch diameter. It has a centre flange for fixing or can be fixed from the end by means of 2 nuts. A very powerful little motor which revs at 3,000rpm. We have a large quantity of them so if you have any projects in mind then you could rely on supplies for at least two years. Price £6. Our ref 6p1, discount for quantities of 10 or more.

**FDD BARGAIN.** 3½in made by Chinon of Japan. Single sided, 80 track, Shugart compatible interface, interchangeable with most other 3½in and 5¼in drives. Completely cased with 4 pin power lead and 34 pin computer lead. Price £40. Our ref 40P1.

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